

PEREGRINE FALCON MONITORING ON THE CALIFORNIA CHANNEL ISLANDS, CALIFORNIA, 2017

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EXECUTIVE SUMMARY

American Peregrine Falcons (*Falco peregrinus anatum*) historically were common residents on all the California Channel Islands, with an estimated 15-30 pairs. Peregrine numbers plummeted across much of the northern hemisphere starting in the late 1940s and the Peregrine population on the Channel Islands was drastically reduced or extirpated by 1955, likely as a result of the effects of DDE on egg hatchability.

The Santa Cruz Predatory Bird Research Group began Peregrine Falcon restoration on the Channel Islands in 1983, releasing 37 Peregrine Falcons on the islands through 1998. The first known successful hatching occurred on Anacapa Island in 1989. There were 9 occupied territories on the islands in 1992, 27 in 2007, 45 in 2013, 48 in 2014, 48 in 2015, and 46 in 2016.

In 2017, the Institute for Wildlife Studies surveyed 51 historic Peregrine territories on the Channel Islands using a combination of passive and call-broadcast surveys, of which 48 (94%) were occupied. We located 3 new territories (1 on Santa Cruz, 1 on Catalina, 1 on San Clemente) and there was at least 2 occupied territories on each island. There were 9 occupied territories on San Miguel Island, 10 on Santa Rosa Island, 17 on Santa Cruz Island, 4 on Anacapa Island, 2 on San Nicolas Island, 3 on Santa Barbara Island, 3 on Santa Catalina Island, and 3 on San Clemente Island. The northern Channel Islands continue to be the stronghold for Channel Island Peregrine Falcons, likely due to more suitable nesting habitat and a larger prey base as compared to the southern Channel Islands. In addition, the northern Channel Islands are closer together, allowing Peregrines to move more freely between the islands.

A minimum of 58 chicks are known to have hatched on the Channel Islands in 2017, of which 49 (84%) are known to have survived to ~28 days of age. The earliest and latest dates for the start of incubation of a first clutch were 14 March (MC76 Gnoma, Santa Rosa Island and MC64 West Point South, Santa Cruz Island) and 23 April (MC62 Punta Gorda, Santa Cruz Island), respectively. Nest success and productivity in occupied territories with known outcomes ($n = 30$) was 67% and 1.3 chicks/occupied territory.

We collected 99 prey items from 10 territories on 3 islands, of which 91 items (92%) were identified to species level, representing 34 different species. The most common species identified were Cook's Petrel ($n = 14$), House Finch ($n = 10$), Western Meadowlark ($n = 8$), and Eurasian Collared Dove ($n = 7$).

Measurements on eggshell fragments and/or addled eggs collected from 9 Peregrine territories on 3 islands had average thinning of 30% (range 23.4 – 44.8%), which is an increase from the 22.6% recorded in 2016.

The Peregrine Falcon population on the California Channel Islands has recovered to a level that is above predicted historic levels and current productivity appears sufficient to at least maintain the population. However, continued monitoring and banding of the population could lead to an understanding of basic population parameters, such as survival, emigration and immigration rates on the islands, as well as determine whether there are continuing effects of DDE contamination on eggshell thickness and hatching success.

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INTRODUCTION

American Peregrine Falcons (*Falco peregrinus anatum*; hereafter Peregrines) historically 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 (USFWS 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 was eventually 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 37 Peregrines on the Channel Islands (12 on San Miguel, 17 on Catalina, 4 on Santa Rosa, and 4 on Santa Cruz; Latta 2012). 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 Game 2011).

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 final consent decree for the Montrose case stated that “the Trustees will use the damages for restoration of injured natural resources, including bald eagles, Peregrines and other marine birds, fish and the habitats upon which they depend” (Montrose Settlements Restoration Program 2012). 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: the 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 current status of Peregrines on the Channel Islands and determine whether their recovery was still being affected by on-going contamination in the local

food web (Montrose Settlements Restoration Program 2005). The 2007 survey located 27 occupied territories on 5 of the 8 islands, 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 institute annual surveys through 2017 to gain more information on population demography and important population parameters, such as survival, immigration and emigration. As part of that effort, IWS located 45 occupied territories in 2013, 48 in 2014, 48 in 2015, and 46 in 2016, with at least 2 territories on each island (Sharpe 2014, 2015, 2016, 2017). This report summarizes the results of the 2017 field season, which represents the final year of funding through the MSRP.

STUDY AREA

The California Channel Islands are composed of eight islands located off the coast of southern California (Fig. 1). All of the Channel Islands are subject to a Mediterranean climate



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

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).

San Miguel Island (hereafter San Miguel) is owned by the U.S. Navy, but managed by the NPS (Fig. 1). It is approximately 13 x 6 km with a land area of approximately 37 km² and a maximum elevation of 253 m (Junak et al. 1995). The island is primarily a gently sloping plateau with long, sandy beaches that is fully exposed to the prevailing northwesterly winds (Coonan and Schwemm 2009).

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 km² 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 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 km² with a maximum elevation of 753 m (Junak et al. 1995).

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 km², spanning about 8 km from end to end and reaching a maximum elevation of 283 m (Junak et al. 1995).

San Nicolas Island (hereafter San Nicolas), owned by the U.S. Navy, 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 Island (Moody 2000; Fig. 1). It is approximately 13 x 5 km in size and has an area of about 58 km² and a maximum elevation of 277 m (Junak et al. 1995).

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 km² 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).

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 km², 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 U.S. Navy, is the southernmost of the Channel Islands, located approximately 92 km off the coast of California (Fig. 1). The island is 143 km², 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 Peregrine research activities were covered by multiple state and federal permits. IWS has a Memorandum of Understanding and Scientific Collecting Permits (Permit #s SC-2485 [Peter Sharpe] and SC-0932 [David Garcelon]) with the CDFW to conduct Peregrine research on the Channel Islands, a banding 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 research permits from the NPS (Permit # CHIS-2016-SCI-0012) and the Santa Catalina Island Conservancy (Permit 12-014) to allow us to conduct our research on Channel Islands National Park islands and Catalina. Authorization for Migratory Bird Treaty Act (MBTA) permits were delayed, so IWS was added to the Region 8 FWS MBTA permit (Permit# MB164274-0) to allow collection of feathers, failed eggs, and eggshells at nests.

Survey Method

We used a survey method similar to that used by the National Park Units in the Northern Colorado Plateau Network (NCPN), as described by Daw et al. (2006). The protocol involved monitoring 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 have typically 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. The 10-minute survey protocol begins with a 3-min passive observation period, followed by a 30-sec broadcast period, a 1-min observation period, a second 30-sec broadcast period, and a final 5-min passive observation period. We loaded recorded Peregrine vocalizations (Stokes Field Guide to Bird Songs: Western Region; Time Warner Trade Publishing, New York, NY), which were converted to mp3 format to be compatible with a digital game caller (FOXPRO NX4, FOXPRO Inc., Lewiston, PA). The vocalizations consisted of 5 sec of the ‘cack’ alarm call, immediately followed by 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 a surveyor rotated up to 360° (depending on terrain, habitat, and broadcast location) in order to evenly project the sound around the broadcast point and the broadcast was discontinued immediately when a responding Peregrine was detected.

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. The general protocol called for not conducting surveys or monitoring during periods of sustained high winds greater than 25 km/h (~15 miles/hour). However, the Channel Islands, especially San Miguel, Santa Rosa, San Nicolas, and Santa Barbara, 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 attempted to conduct most surveys/monitoring on leeward sides of the islands. If it was necessary to survey during high winds, we did not include the survey in the minimum of 3 surveys required to determine that a territory was unoccupied.

Surveying Historic Nesting Areas

IWS biologists began surveying territories for activity in February 2017. All territory locations on the Channel Islands that have been confirmed during our 2013-2016 surveys (Sharpe 2014, 2015, 2016, 2017) were uploaded into 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 historic 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 would return 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/Unknown Territories

We used the 10-min call-broadcast method to conduct ground-based and boat surveys for new or 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 Peregrines 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 used GPS units to record our daily survey routes, call-broadcast locations, and sightings of Peregrines. We revisited areas with potential Peregrine habitat at approximately monthly intervals to determine whether birds had gone undetected or had occupied an area after a previous survey.

Monitoring Active Territories

A primary goal of Peregrine monitoring under Phase 2 of the MSRP Restoration Plan 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 (Montrose Settlements Restoration Program 2012). We attempted to visit occupied territories at 10-14 day intervals to estimate the chronology of the breeding season. We refined estimates of lay and hatch dates by aging the chicks using photos and descriptions in Clum et al. (1996) and Moritsch (1983) with an assumed incubation period of 33 days (Linthicum 1996). We only used the 10-min call-broadcast about 1 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 a distance of 150-1500 m using 20-60x spotting scopes and binoculars. Distances to Peregrines or nest sites were estimated 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 and chicks. 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 active nests either 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 used a handheld radio to help direct the climbing team to the eyrie. Chicks were placed in a small duffle bag and carried to the top of the nest cliff for processing in most cases, although a few eyries were large enough for 2 climbers to enter and band chicks without removing them.

Peregrines exhibit reverse size dimorphism and we were able to determine the sex of each chick primarily 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 USFWS lock-on #6 band on the left leg and a black anodized aluminum band with silver alphanumeric characters (Acraft Sign & Nameplate Co., Edmonton, Alberta, Canada) on the right leg, and females were banded with a USFWS 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). We collected approximately 0.5 cc of heparinized whole blood from most chicks for future DNA and/or contaminants analyses.

During nest entries, we collected eggshell fragments and prey remains. Samples were labeled and delivered to the Western Foundation of Vertebrate Zoology (WFVZ; Camarillo, CA) for determination of shell thickness (addled eggs and fragments) and prey identification. We enhanced nest ledges, if necessary, by removing sharp stones or adding suitable substrate to reduce the chance of eggs breaking in the nest in the future.

Prey Remains

Prey remains delivered to the WFVZ were analyzed by N. John Schmitt (WFVZ) and Paul Collins, Santa Barbara Museum of Natural History. Prey items were keyed out using a reference collection and the minimum number of individuals (MNI) was determined based upon duplicate feathers or body parts (e.g., 2 left feet of a species would indicate a minimum of 2 individuals).

Eggshell Measurements

René Corado (WFVZ) measured the thickness of eggshells using 2 methods. Method 1, referred to as the René Corado “RC” method, used 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. For whole eggs, 10 shell measurements were taken around the equator of each egg (not at the poles because more calcium is deposited at the ends), where there is 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 an average membrane thickness was measured separately and provided. For samples that contain only eggshell fragments, usually only 1-2 measurements were taken on each fragment. To ensure that the egg fragments actually belong to the species in question, only those fragments that could be clearly identified as Peregrine eggshells were measured.

Method 2, referred to as the Sam Sumida “SS” method, used a Federal mechanical gauge (0.01 mm resolution; Mahr, Providence, Rhode Island, USA) attached to the same mounting bracket and pin used in Method 1, to allow for comparison with historical measurements taken by Sam Sumida and the WFVZ prior to 2003. Method 2 used the same procedure as described for Method 1, except for the change in the gauge, and a tapping of the raising and lowering arm of the mounting bracket.

Percent eggshell thinning was calculated by comparing measured eggshell thickness with the standard pre-DDT Peregrine eggshell thickness in California of 0.364 mm (Kiff 1994) using the equation $N\% = [1 - (\text{thickness}/0.364)] \times 100$ (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). We considered a territory occupied if there was evidence of occupancy on 2 or more visits to a territory.

Nest Success: The proportion of occupied territories on the Channel Islands in which 1 or more young ≥ 28 days old was observed, using the aging guidelines in Clum et al. (1996).

Productivity: The number of young observed at ≥ 28 days old per occupied territory, averaged across the Channel Islands.

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 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 in what appears to be feeding. 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, or none as described below.

Successful: A pair produced 1 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).

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

Data Management

Data were entered into island-specific Excel files that were shared via the cloud-based file storage program Dropbox. Dr. Sharpe combined the weekly data into a master database and the field notebooks were kept on each island as backup records. We downloaded data from our GPS units to the free Garmin Basecamp™ program weekly, which allowed us to evaluate which areas needed additional surveys and to share data among our biologists.

RESULTS

Surveying and Nest Monitoring

We surveyed 51 historic Peregrine territories on the Channel Islands and located 3 previously unknown territories (Table 1). We confirmed occupancy in 51 territories, with at least 2 occupied territories on each island (Figs. 2 and 3, Table 1). Survey summaries for each island and territory are provided below.

San Miguel Island

Surveys began on San Miguel on 1 March and continued every other week through 12 June. We surveyed 10 historic territories on San Miguel, of which 9 (90%) were confirmed occupied (Fig. 4, Table 1). We were unable to attempt banding at any nests on San Miguel in 2017 due to scheduling conflicts.

MC17 Hoffman Point: We confirmed a pair in the historic Hoffman Point territory (Fig. 4) during our first visit on 3 March. There were 3 adults (1 male, 2 females) present during 8 of the next 9 visits to the territory and they were categorized as being in the courtship stage on 16 March. They were incubating by 29 March and had at least 1 nestling on 14 May. Two nestlings were confirmed on 7 June and they were estimated to be about 28 days old on our last visit on 11 June.

MC28 Bat Rock: We confirmed a pair in the historic Bat Rock territory (Fig. 4) during our first visit on 2 March. The pair was first classified in the courtship stage on 19 March and was incubating by 15 April. We believed they had nestlings on 13 May and 1 chick was confirmed on 25 May. The chick was about 30 days old on our last visit on 12 June.

MC44 Cardwell Point: We were unable to confirm the presence of a pair in the historic Cardwell Point territory (Fig. 4) during 9 visits this season. There were 1-3 Peregrines present on 6 of the visits, but they could not be confirmed as exhibiting breeding behavior.

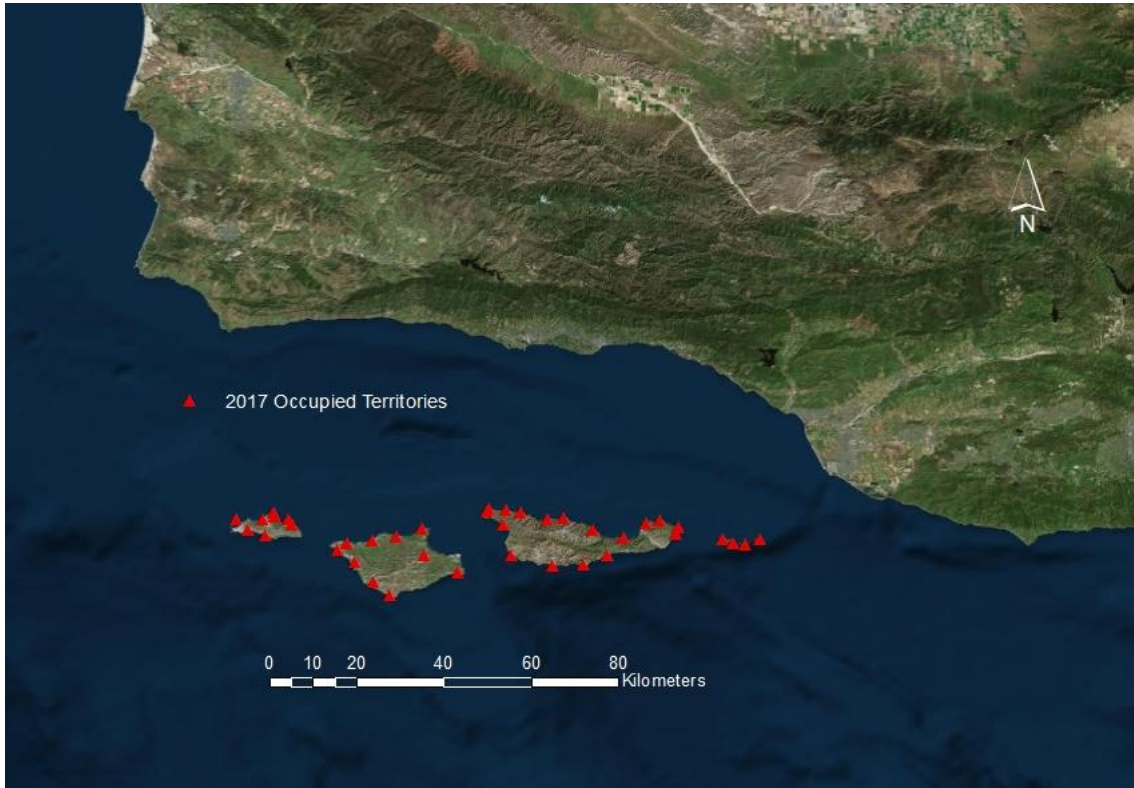


Figure 2. Occupied Peregrine Falcon territories on the northern Channel Islands in 2017.



Figure 3. Occupied Peregrine Falcon territories on the southern Channel Islands in 2017.

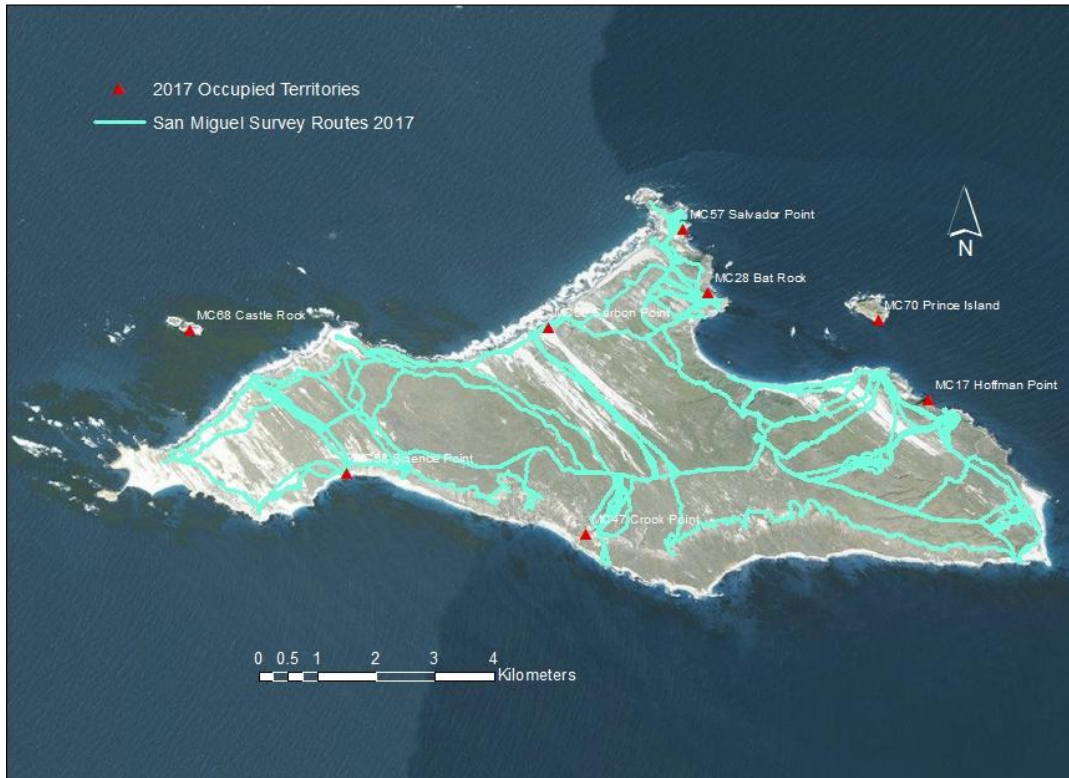


Figure 4. Peregrine Falcon survey routes and territories on San Miguel Island, CA, 2017.

MC47 Crook Point: We confirmed a pair in the historic Crook Point territory (Fig. 4) on 15 March, at which time they were in the courtship stage. They were confirmed incubating on 30 March and at least 1 chick had hatched by 28 April. Four chicks were confirmed on 24 May and 4 fledglings were present on 6 June (Table 1).

MC56 Carbon Point: We confirmed a pair in the historic Carbon Point territory (Fig. 4) on 4 March. They were confirmed to be incubating on 30 March and there were 2 nestlings about 10 days old present on 12 May. The nest had failed by 24 May.

MC57 Salvador Point: We confirmed a pair in the historic Salvador Point territory (Fig. 4) on 1 March. They were exhibiting courtship behavior between 19 March and 15 April, but there was no known nesting attempt.

Table 1. Status and breeding activity observed at Peregrine Falcon territories surveyed on the California Channel Islands in 2017.

Island/ Territory Name	State Code ^b	Territory Type	Occupancy Status	Breeding Activity	# Chicks Hatched	# of Fledglings	Notes (see report text for more details)
<u>San Miguel</u>							
Hoffman Point ^a	MC17	Historic	Occupied	Successful	2	2	Did not band chicks
Bat Rock ^a	MC28	Historic	Occupied	Successful	1	1	Did not band chicks
Cardwell Point	MC44	Historic	Unknown	Unknown	.	.	1-3 adults seen, but no known nesting
Crook Point ^a	MC47	Historic	Occupied	Successful	4	4	Chicks were not banded
Carbon Point ^a	MC56	Historic	Occupied	Unsuccessful	2	0	Failed during nestling stage
Salvador Point	MC57	Historic	Occupied	Unknown	.	.	No known nesting
Science Point ^a	MC58	Historic	Occupied	Unsuccessful	0	0	No known nesting
Castle Rock ^a	MC68	Historic	Occupied	Unsuccessful	0	0	No known nesting
Harris Point	MC69	Historic	Unknown	Unknown	.	.	Suspected to be Salvador Point birds
Prince Island ^a	MC70	Historic	Occupied	Successful	2	2	Did not band chicks
<u>Santa Rosa</u>							
Carrington Point	MC16	Historic	Occupied	Unknown	.	.	No known nesting
Lime Point ^a	MC27	Historic	Occupied	Unsuccessful	0	0	Failed during incubation
Water Canyon ^a	MC31	Historic	Occupied	Unsuccessful	1	0	Failed during nestling stage
Bee Rock Canyon ^a	MC34	Historic	Occupied	Successful	3	3	Banded chicks on 6/7
Orr's Camp	MC35	Historic	Occupied	Unknown	.	.	No known nesting
Trancion ^a	MC50	Historic	Occupied	Successful	2	2	Chicks banded on 5/15
Krumholtz ^a	MC51	Historic	Occupied	Successful	2	2	Chicks banded on 6/6
Soledad ^a	MC55	Historic	Occupied	Unsuccessful	0	0	Did not nest
Bonn Point	MC65	Historic	Unknown	Unknown	.	.	Unable to monitor regularly
Chickasaw Canyon	MC66	Historic	Unknown	Unknown	.	.	Did not monitor regularly
Sandy Point	MC67	Historic	Occupied	Successful	1	?	Banded chick on 6/7
Gnoma	MC76	Historic	Occupied	Successful	1	1	Did not band chick

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)
<u>Santa Cruz</u>							
Gherini Knife Edge ^a	MC18	Historic	Occupied	Successful	1	1	Banded chick on 5/23
Laguna ^a	MC19	Historic	Occupied	Successful	3	3	Banded chicks on 6/13
West End ^a	MC20	Historic	Occupied	Unsuccessful	0	0	Failed during incubation
Sea Lion ^a	MC30	Historic	Occupied	Successful	2	1	Banded single chick on 6/4
Black Point ^a	MC38	Historic	Occupied	Successful	2	2	Did not band chicks
Arch Rock ^a	MC45	Historic	Occupied	Successful	2	2	Did not band chicks
Valley Anchorage ^a	MC46	Historic	Occupied	Successful	1	1	Did not band chick
Cavern Point	MC52	Historic	Occupied	Unknown	.	.	Could not confirm nesting
Bowen Point ^a	MC53	Historic	Occupied	Successful	1	1	Did not band chick
Pelican Bay ^a	MC60	Historic	Occupied	Unsuccessful	0	0	Did not nest
Punta Diablo ^a	MC61	Historic	Occupied	Successful	2	2	Did not band chicks
Punta Gorda ^a	MC62	Historic	Occupied	Successful	2	2	Did not band chicks
San Pedro West	MC63	Historic	Occupied	Unsuccessful	0	0	Failed during incubation
West Point South ^a	MC64	Historic	Occupied	Successful	3	3	Banded chicks on 5/8
East Smuggler's	MC77	Historic	Occupied	Unknown	.	.	No known nesting
Del Norte ^a	MC81	Historic	Occupied	Unsuccessful	1	0	Failed during nestling stage
Pozo	MC90	New	Occupied	Unknown	.	.	No known nesting
<u>Anacapa</u>							
West Anacapa	MC21	Historic	Occupied	Unknown	.	.	Could not determine nesting status
Middle Anacapa ^a	MC43	Historic	Occupied	Successful	1	1	Did not band chick
Cathedral Cove	MC54	Historic	Occupied	Successful	2	2	Fledglings seen on 6/19
Camel Point	MC80	Historic	Occupied	Unknown	.	.	Could not determine nesting status
<u>San Nicolas</u>							
Harrington	MC73	Historic	Occupied	Unknown	2	.	Do not know outcome after hatch
Cattail Canyon	MC74	Historic	Occupied	Unsuccessful	0	.	Failed during incubation/early nestling
Midway	MC82	Historic	Unknown	Unknown	.	.	Did not monitor regularly

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)
<u>Santa Barbara</u>							
Signal Peak	MC33	Historic	Occupied	Unknown	.	.	No regular monitoring
North Peak ^a	MC71	Historic	Occupied	Successful	4	2	First known nesting in this territory
North Signal Peak	MC72	Historic	Occupied	Unknown	.	.	No known nesting
<u>Santa Catalina</u>							
Silver Peak	MC75	Historic	Occupied	Successful	1	1	Did not band chick
Lone Tree	MC78	Historic	Occupied	Unknown	.	.	Could not confirm nesting
Seal Point	MC88	New	Occupied	Unknown	.	.	No known nesting
<u>San Clemente</u>							
Cave Canyon ^a	MC59	Historic	Occupied	Successful	3	3	Banded chicks on 5/28
Seal Cove ^a	MC79	Historic	Occupied	Unsuccessful	0	0	Did not nest. Male was 2 nd year bird
Wilson Cove	MC89	New	Occupied	Successful	2	2	Did not band chicks

^aTerritory included in calculations of productivity

^b Designated by the California Department of Fish and Wildlife (CDFW)

^cMinimum number

MC58 Science Point: We did not confirm a pair in the historic Science Point territory (Fig. 4) until 1 April, at which time they were exhibiting courtship behavior. We observed them on 5 more days through 8 June and there was no known nesting attempt.

MC68 Castle Rock: We confirmed a pair in the historic Castle Rock territory (Fig. 4) on 2 March. A pair was present on the remaining 7 visits to the territory through 8 June, but there was no evidence of nesting.

MC69 Harris Point: We visited the historic Harris Point territory (Fig. 4) 10 times between 1 March and 9 June. At least 1 bird was seen on 6 visits, but the birds usually came from or returned to the Salvador Point territory, so we believe that the Salvador Point birds were using the Harris Point area for hunting and that there was not a separate territory this season. We came to the same conclusion in 2016.

MC70 Prince Island: We confirmed a pair was present in the historic Prince Island territory (Fig. 4) on 3 March. The pair was incubating by 13 April and we suspected chicks were present by 27 May. We confirmed 1 chick was present on 7 June and 2 chicks, approximately 30 days old, were seen on our last visit on 12 June.

Santa Rosa Island

Surveys began on Santa Rosa on 16 February and continued every other week through 12 June. We surveyed 12 previously known territories on Santa Rosa and confirmed occupancy in 10 (83%) of them (Fig. 5). We did not locate any new territories.

MC16 Carrington Point: We did not confirm the presence of a pair in the historic Carrington Point territory (Fig. 5) until our third visit on 29 March. Although at least 1 adult was present on each of the 9 visits we made through 10 June, there was no confirmed nesting attempt.

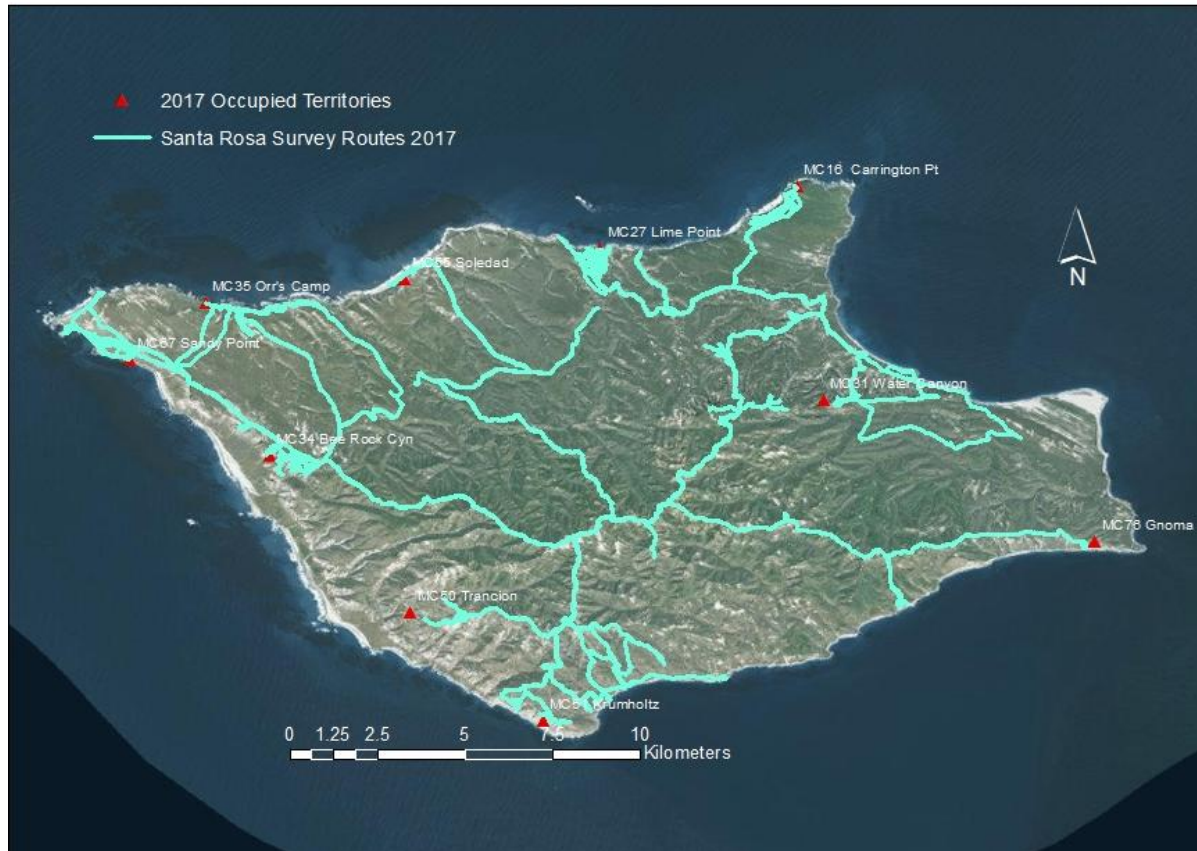


Figure 5. Peregrine Falcon survey routes and territories on Santa Rosa Island, CA, 2017.

MC27 Lime Point: We confirmed a pair in the historic Lime Point territory (Fig. 5) on 28 February. The birds were incubating by 29 March, but had failed by 28 April. We believe this pair made a second nesting attempt in Lobo Canyon and were found incubating on 14 May. They were still incubating on our last visit on 12 June.

MC31 Water Canyon: We confirmed a pair in the historic Water Canyon territory (Fig. 5) on 29 March, at which time they were exhibiting courtship behavior. They were incubating on 26 April and there was 1 nestling and 2 eggs present on 21 May. When we went to band on 8 June, we found that the nest had failed. We collected shell fragments for analyses.

MC34 Bee Rock Canyon: We confirmed a pair in the historic Bee Rock Canyon territory (Fig. 5) on 18 March. The birds were incubating on 13 April and there were 3 nestlings about 1 week old on 22 May. We entered the eyrie on 7 June, banded 3 chicks, and collected shell fragments for

analyses (Table 2, Appendix I). All 3 chicks were still present on 12 June and estimated to be between 27 and 30 days old.

Table 2. Summary of Peregrine Falcon banding on the California Channel Islands, CA in 2017.

Island/Territory Name	Sex	Age (days)	USGS Band #	Color Band	Wt. (g)
<u>Santa Rosa</u>					
MC34 Bee Rock Canyon	Male	23-24	1156-16874	30/AE	400
MC34 Bee Rock Canyon	Male	24	1156-16875	24/AE	425
MC34 Bee Rock Canyon	Male	21	1156-16876	26/AE	385
MC50 Trancion	Male	21-23	1156-16869	18/AE	560
MC50 Trancion	Female	21-23	1947-21683	91/AE	940
MC51 Krumholtz	Male	25-27	1156-16872	53/AE	775
MC51 Krumholtz	Male	25-27	1156-16873	17/AE	755
MC67 Sandy Point	Female	21	1947-21687	70/AE	865
<u>Santa Cruz</u>					
MC18 Gherini Knife Edge	Female	18-21	1947-21684	96/AE	735
MC19 Laguna	Male	23-25	1156-16877	14/AE	510
MC19 Laguna	Female	25-26	1947-21688	61/AE	670
MC19 Laguna	Female	25-26	1947-21689	89/AE	720
MC30 Sea Lion	Male	29-31	1156-16871	01/AE	670
MC64 West Point South	Male	21-23	1156-16867	43/AE	590
MC64 West Point South	Male	21-23	1156-16868	03/AE	555
MC64 West Point South	Female	21-23	1947-21682	84/AE	720
<u>San Clemente</u>					
MC59 Cave Canyon	Male	25-27	1156-16870	33/AE	610
MC59 Cave Canyon	Female	25-27	1947-21685	86/AE	885
MC59 Cave Canyon	Female	25-27	1947-21686	75/AE	930

MC35 Orr's Camp: We surveyed the historic Orr's Camp territory (Fig. 5) 6 times between 19 February and 22 May. At least 1 Peregrine was seen on each visit, but we could not confirm a pair until 13 May. We were unable to determine their nesting status.

MC50 Trancion: We confirmed a pair in the historic Trancion territory (Fig. 5) on 6 March. The birds were incubating on 30 March and there were 2 chicks present on 29 April. We entered the

eyrie on 15 May and banded 2 chicks (Table 2, Appendix I). Two fledglings were present on 9 June.

MC51 Krumholtz: We surveyed the historic Krumholtz territory (Fig. 5) 8 times between 17 March and 11 June. We confirmed a pair was present on 29 April, at which time they were incubating. There was at least 1 chick present on 12 May and we entered the eyrie on 6 June, banded 2 chicks, and collected shell fragments for analyses (Table 2, Appendix I). Both chicks were still present on our last visit on 11 June.

MC55 Soledad: We confirmed a pair in the historic Soledad territory (Fig. 5) on 3 April. The birds exhibited courtship behavior, but there was no evidence that they nested.

MC65 Bonn Point: We were only able to access the Bonn Point territory (Fig. 5) on 1 and 30 April due to road closures. An adult was seen on 1 April, but we were unable to confirm the presence of a pair.

MC66 Chickasaw Canyon: We surveyed the historic Chickasaw Canyon territory (Fig. 5) on 17 March and 16 April, but did not see any Peregrines.

MC67 Sandy Point: We confirmed a pair in the historic Sandy Point territory (Fig. 5) on 20 March. We were unable to locate their nest until 7 June, at which time they had 1 chick about 3 weeks old. The bird was banded on the same day and we collected shell fragments for analyses (Table 2, Appendix I).

MC76 Gnoma: We confirmed a pair incubating in the historic Gnoma territory (Fig. 5) on 2 April. They had 1 chick present on 30 April and it had fledged by 10 June.

Santa Cruz Island

Surveys began on Santa Cruz on 13 February and continued every other week through 10 July. We surveyed 16 historic territories all of which were occupied, and located 1 previously unknown territory (Fig. 6).

MC18 Gherini Knife Edge: We confirmed a pair was present in the historic Gherini Knife Edge territory (Fig. 6) on 18 March. The pair was incubating by 30 March and 1 chick was present on 13 May. We entered the eyrie on 23 May, banded 1 chick, and collected shell fragments for analyses (Table 2, Appendix I). The bird had fledged by our last visit on 23 June.

MC19 Laguna: We confirmed a pair exhibiting courtship behavior in the historic Laguna territory (Fig. 6) on 29 March. They were incubating by 15 April and there was at least 1 chick present on 12 May. We entered the eyrie on 13 June and banded 3 chicks (Table 2, Appendix I). All 3 nestlings were present on 25 June, at which time they were estimated to be 33-38 days old. No birds were seen in the territory on 9 July.



Figure 6. Peregrine Falcon survey routes and territories on Santa Cruz Island, CA, 2017.

MC20 West End: We confirmed a pair exhibiting courtship behavior in the historic West End territory (Fig. 6) on 20 March. They were incubating on 30 April and 27 May, but the nest had failed by 8 June.

MC30 Sea Lion: We confirmed a pair exhibiting courtship behavior in the historic Sea Lion territory (Fig. 6) on 20 March. They were incubating by 1 April, and there were at least 2 nestlings by 8 May. We entered the eyrie on 4 June, banded a single chick, and collected shell fragments for analyses (Table 2, Appendix I). The bird had fledged by our last visit on 21 June.

MC38 Black Point: We confirmed that a pair was present in the historic Black Point territory (Fig. 6) on 15 March. They were incubating by 30 April and there was at least 1 chick present on 27 May. We attempted to enter the eyrie on 4 June to band the 2 chicks present, but the adult female was too aggressive to safely conduct the banding. Both chicks had fledged by 23 June.

MC45 Arch Rock: We confirmed a pair in the historic Arch Rock territory (Fig. 6) on 19 March. They were incubating by 2 April, and at least 1 chick was present on 1 May. We attempted to band the chicks on 24 May, but ocean conditions would not allow a safe landing with our boat. We confirmed 2 nestlings on 9 June and they had both fledged by 23 June.

MC46 Valley Anchorage: We confirmed a pair in the historic Valley Anchorage territory (Fig. 6) on 13 February. They were exhibiting courtship behavior on 28 March and incubating by 29 April. We confirmed a single ~12-day-old chick in the nest on 25 May. We intended to band the chick on 12 June, but aborted the attempt because of unstable rocks above the eyrie. The chick was still present in the eyrie on 25 June, at which time it was about 37 days old.

MC52 Cavern Point: We confirmed a pair in the historic Cavern Point territory (Fig. 6) on 13 April and thought they might be incubating, but could not locate the eyrie. There was never an indication that they produced chicks.

MC53 Bowen Point: We confirmed a pair in the historic Bowen Point territory (Fig. 6) on 18 March. They were exhibiting courtship behavior on 29 March and incubating by 11 April. There was at least 1 chick present on 15 May and we confirmed a 5-week-old nestling on 24 June. No birds were seen on our last visit on 9 July.

MC60 Pelican Bay: We confirmed a pair in the historic Pelican Bay territory (Fig. 6) on 5 March. They were exhibiting courtship behavior on 3 April and were present through 10 May, but do not appear to have nested.

MC61 Punta Diablo: We confirmed a pair in the historic Punta Diablo territory (Fig. 6) on 16 February. They were exhibiting courtship behavior on 19 March and were incubating by 15 April. We did not confirm the presence of nestlings until 9 June, at which time there were 2 birds about 25-27 days old. Both had fledged by 22 June.

MC62 Punta Gorda: We confirmed a pair in the historic Punta Gorda territory (Fig. 6) on 19 March, at which time they were exhibiting courtship behavior. The pair was incubating by 30 April, and we confirmed the presence of 2 chicks about 1 week old on 27 May. Both nestlings were still present on 21 June, at which time they were about 28 days old. One fledgling was seen on 9 July, but both are believed to have fledged.

MC63 San Pedro West: We confirmed a pair in the historic San Pedro West territory (Fig. 6) on 18 March. We were unable to confirm their breeding status until 7 June, at which time they were incubating in a new eyrie. The nest had failed by 9 July.

MC64 West Point South: We confirmed a pair in the historic West Point South territory (Fig. 6) on 20 March. They were incubating by 14 April and had chicks by 30 April. We entered the eyrie on 8 May, banded 3 nestlings, and collected shell fragments for analyses (Table 2, Appendix I). All 3 had fledged by 8 June.

MC77 East Smuggler's: We confirmed a pair exhibiting courtship behavior in the historic East Smuggler's territory (Fig. 6) on 18 March. We were unable to confirm whether they nested.

MC81 Del Norte: We located a pair in the historic Del Norte territory (Fig. 6) on 16 February. The pair was exhibiting courtship behavior on 17 March and incubating by 12 April. There was 1 chick about 6 days old on 14 May, but the nest had failed by the time we entered to band on 25 May. We collected eggshell and prey remains from the eyrie (Appendix I).

MC90 Pozo: We located a pair of banded adults (could not read bands) in a new territory along Pozo Beach on 17 April. We were unable to confirm their breeding status over the next 3 surveys through 8 June.

Anacapa Island

We conducted four surveys of Anacapa from a charter boat (the *Retriever*) between 3 April and 12 July. We located pairs in each of the 4 historic territories (Fig. 7).

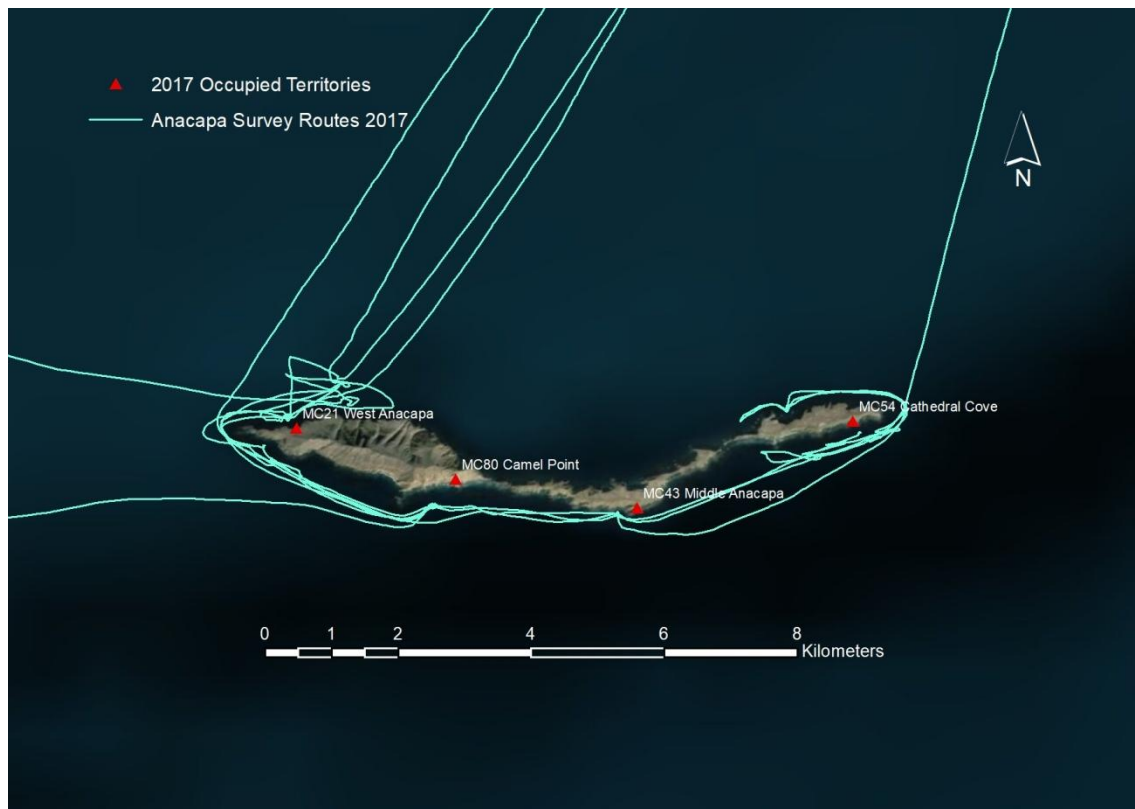


Figure 7. Peregrine falcon survey routes and territories on Anacapa Island, CA, 2017.

MC21 West Anacapa: We confirmed a pair in the historic West Anacapa territory (Fig. 7) on 3 April. They appeared to have chicks on 22 May, based upon behavior, but we could not confirm their status on 19 June or 12 July.

MC43 Middle Anacapa: We confirmed a pair exhibiting courtship behavior in the historic Middle Anacapa territory (Fig. 7) on 3 April. They had chicks by 22 May and we confirmed 1 fledgling on 19 June.

MC54 Cathedral Cove: We confirmed a pair in the historic Cathedral Cove territory (Fig. 7) on 3 April, although they were using the south side of the island instead of the Cathedral Cove area on the north shore. They were still on the south side of the island on 22 May and we could not determine their nesting status. On our last visit to the territory on 19 June, we observed 2 fledglings flying around the area.

MC80 Camel Point: We confirmed a pair exhibiting courtship behavior on our first visit to the historic Camel Point territory (Fig. 7) on 3 April. We could not confirm their nesting status on the remaining 3 surveys of the territory, but may have seen a fledgling chasing an adult on 19 June.

San Nicolas Island

We were unable to conduct intensive surveys on San Nicolas this season and only visited the island on 19-20 April and 15 May. We located pairs in 2 historic territories on the south side of the island (Fig. 8).

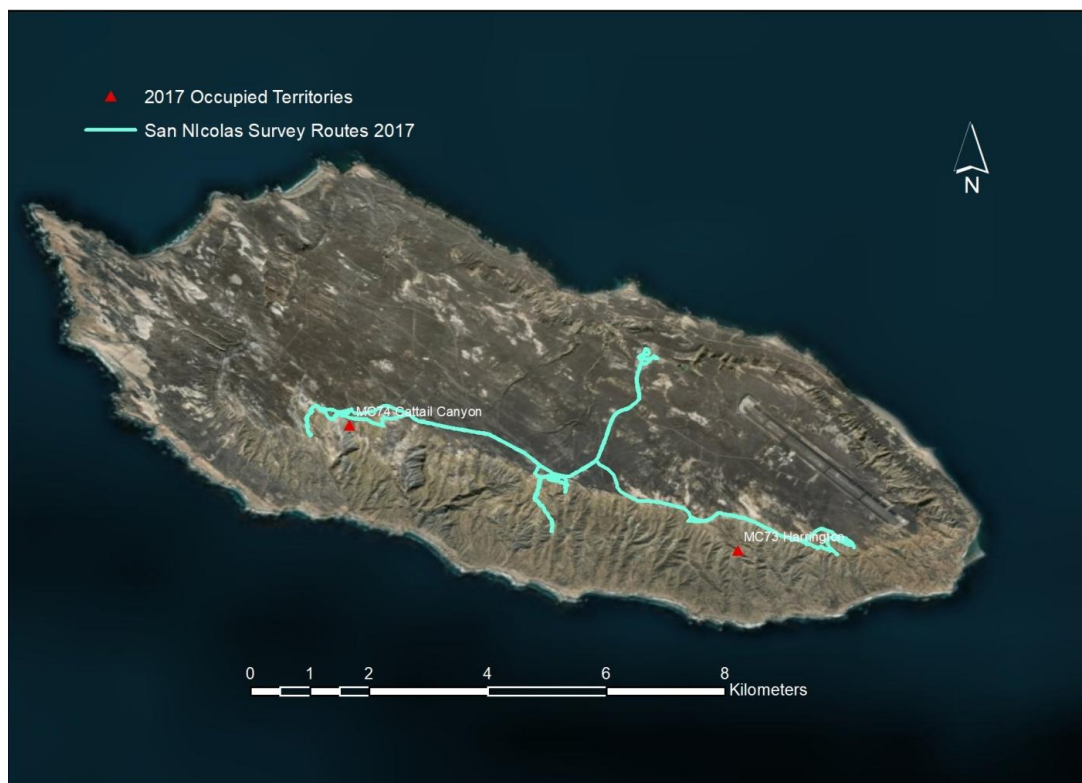


Figure 8. Peregrine Falcon survey routes and territories on San Nicolas Island, CA, 2017.

MC73 Harrington: The pair in the historic Harrington territory (Fig. 8) already had 2 young chicks when we located them in a new eyrie on 10 May. We were unable to return to the island to determine the outcome of nesting.

MC74 Cattail Canyon: The pair in the historic Cattail Canyon territory (Fig. 8) was incubating on 20 April, but there was no sign of any birds on 10 May, so we assume the nesting attempt failed.

Santa Barbara Island

Jim Howard and Peter Larramendy with the California Institute of Environmental Studies, conducted surveys of Santa Barbara for us this season because access to the island was limited by the destruction of the pier during winter storms in 2016. Pairs were located in each of the 3 historic territories and no new territories were discovered (Fig. 9).

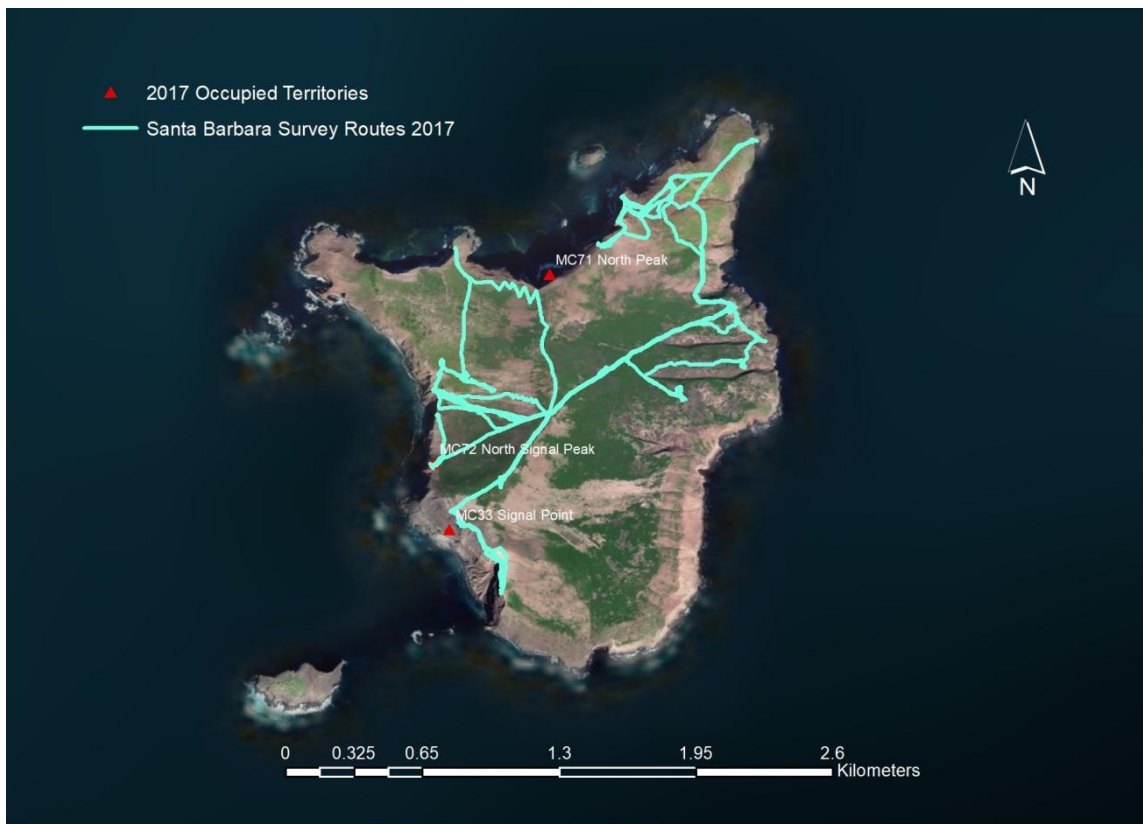


Figure 9. Peregrine Falcon survey routes and territories on Santa Barbara Island, CA, 2017.

MC33 Signal Peak: We confirmed a pair exhibiting courtship behavior in the historic Signal Peak territory (Fig. 9) on 25 February. They were still in courtship on 25 March and we were unable to determine their nesting status on 29 April and 29 May.

MC71 North Peak: We confirmed a pair in the historic North Peak territory (Fig. 9) on 24 February. They exhibited courtship behavior on 24 March and were incubating on 24 April. Four nestlings were present on 26 May, at which time they were approximately 21 days old. Two fledglings were seen on the next visit on 25 July.

MC72 North Signal Peak: We confirmed a pair in the historic North Signal Peak territory (Fig. 9) on 28 February. They exhibited courtship behavior on 22 April, but we could not determine whether they nested on the last 2 visits on 28 May and 1 August.

Santa Catalina Island

We surveyed two previously identified territories on the island, and located 1 new territory (Fig. 10).

MC75 Silver Peak: We confirmed a pair in the historic Silver Peak territory (Fig. 10) on 23 February. We could not determine their nesting status until 8 June, at which time they had a single chick (~28 days old). The bird had fledged by 4 July.

MC78 Lone Tree: We located a pair in the historic Lone Tree territory (Fig. 10) on 16 March. We could not confirm their nesting status until 18 May, at which time they appeared to be incubating in their historic eyrie. No birds were seen on our last visit on 12 June, so we could not determine the outcome of any nesting attempt.

MC88 Seal Point: We located a new pair on 23 March in a territory along the northern coast of the island (Fig. 10). They were still present on 18 April, but showed no signs of nesting. No birds were seen during our last survey on 1 June.

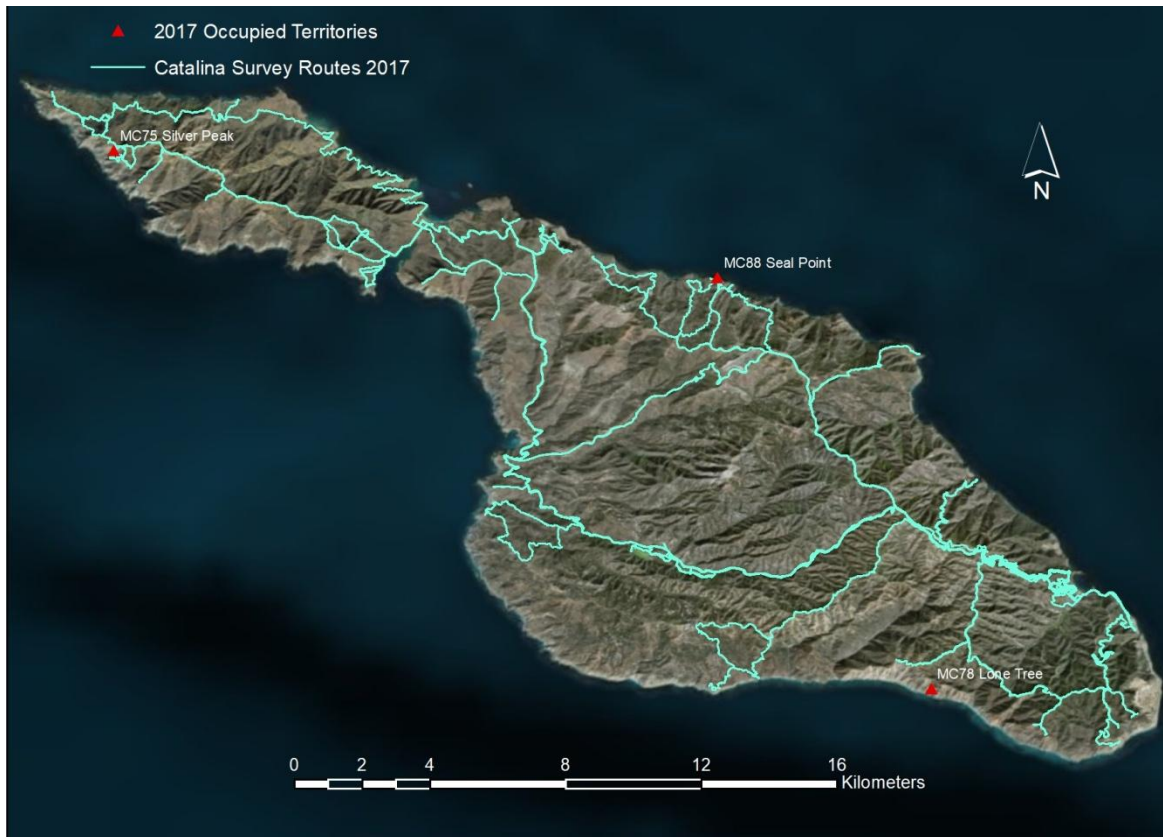


Figure 10. Peregrine Falcon survey routes and territories on Catalina Island, CA, 2017.

San Clemente Island

We surveyed the 2 historic territories on the island and located 1 new territory (Fig. 11).

MC59 Cave Canyon: We confirmed a pair exhibiting courtship behavior in the historic Cave Canyon territory (Fig. 11) on 12 April. They were incubating by 26 April and 3 chicks were present on 14 May. We entered the eyrie on 28 May and banded 3 nestlings that were 25-27 days old (Table 2, Appendix I). We collected shell fragments for analyses. One nestling was in the nest on 13 June, and we believe the other 2 birds had already fledged.

MC79 Seal Cove: We confirmed a pair exhibiting courtship behavior in the historic Seal Cove territory (Fig. 11) on 4 April (the male was a 2nd year bird). We surveyed the territory on 19 April, 2 May, and 29 May and there was no indication that the birds nested in 2017.



Figure 11. Peregrine falcon survey routes and territories on San Clemente Island, CA, 2017.

MC89 Wilson Cove: We located a potential new territory on 5 May when an adult was seen near Wilson Cove. We confirmed the presence of nestlings on 27 May and attempted to band them on 29 May, but could not reach the eyrie safely. On 2 June, we got a better view of the eyrie and confirmed 2 nestlings about 17 days old. We also confirmed that the male was banded (USGS Band 1156-16838) at the Cattail Canyon nest (MC74) on San Nicolas in 2014. Both nestlings were still at the nest on 22 June, at which time they were about 38 days old. On 19 December, the adult male was found with a wing injury near the airstrip. He was taken to Project Wildlife in San Diego, where he remained through the end of the year.

RESIGHTINGS

In 2017, we received sighting reports on the mainland for 2 Peregrines that we had banded as nestlings on the islands.

On 2 September and 25 November, a female banded in 2016 at the Punta Gorda territory on Santa Cruz (Band #1947-21675) was seen in La Jolla, CA.

On 29 December, a male banded in 2013 at the Cattail Canyon territory on San Nicolas (Band #1156-16812) was seen in Port Hueneme, CA.

PREY REMAINS

We collected prey remains from 10 territories on 3 islands, from which 99 individual prey items were identified. Ninety-one prey items (92%) were identified to the species level, representing 34 different species. Eight additional prey items could be identified only to the family level (Table 3). The most common species identified were Cook’s Petrel ($n=14$, all from MC59 Cave Canyon on San Clemente), House Finch ($n=10$), Western Meadowlark ($n=8$), and Eurasian Collared Dove ($n=7$).

EGGSHELL MEASUREMENTS

We collected eggshell fragments and/or an addled egg (2 total) from 9 territories on 3 islands in 2017 (Table 4, Appendix I). The eggshell measurements using the “SS” method were thicker, and thus had less eggshell thinning, than the “RC” method in all samples (Table 4). Percent eggshell thinning, compared to Peregrine eggs from pre-1947 in California, ranged from 23.4% to 44.8% using the SS method, and 25.5% to 47.3% using the “RC” method (Table 4).

Table 3. Prey remains ($n = 99$) collected from Peregrine Falcon eyries on the California Channel Islands in 2017 and identified to at least the Family level.

Family/ Scientific Name	Common Name	Island ^a			Total
		SCZ	SRI	SCL	
<u>Alaudidae</u>					
<i>Eremophila alpestris</i>	Horned Lark	.	2	.	2
<u>Alcedinidae</u>					
<i>Megasceryle alcyon</i>	Belted Kingfisher	.	1	.	1
<u>Alcidae</u>					
<i>Cephus columba</i>	Pigeon Guillemot	2	.	.	2
Unidentified Alcid		1	1	.	2
<u>Apodidae</u>					
<i>Aeronautes saxatalis</i>	White-throated Swift	1	.	.	1

Table 3. Continued

Family/ Scientific Name	Common Name	Island ^a			Total
		SCZ	SRI	SCL	
<u>Cardinalidae</u>					
<i>Pheucticus melanocephalus</i>	Black-headed Grosbeak	1	1	.	2
<i>Piranga ludoviciana</i>	Western Tanager	1	1	1	3
<u>Columbidae</u>					
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	2	4	1	7
<i>Zenaida macroura</i>	Mourning Dove	1	.	.	1
<u>Emberizidae</u>					
<i>Pipilo maculatus</i>	Spotted Towhee	2	1	.	3
<u>Falconidae</u>					
<i>Falco sparverius</i>	American Kestrel	3	.	.	3
<u>Fringillidae</u>					
<i>Carpodacus mexicanus</i>	House Finch	6	3	1	10
<u>Haematopodidae</u>					
<i>Haematopus bachmani</i>	Black Oystercatcher	1	.	.	1
<u>Hirundinidae</u>					
<i>Hirundo rustica</i>	Barn Swallow	1	.	.	1
<u>Icteridae</u>					
<i>Sturnella neglecta</i>	Western Meadowlark	2	6	.	8
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird	1	.	.	1
<u>Laniidae</u>					
<i>Lanius ludovicianus</i>	Loggerhead Shrike	1	2	.	3
<u>Laridae</u>					
<i>Larus californicus</i>	California Gull	4	.	.	4
<i>Larus occidentalis</i>	Western Gull	1	3	.	4
<i>Larus heermanni</i>	Heermann's Gull	1	.	.	1
<u>Mimidae</u>					
<i>Mimus polyglottos</i>	Northern Mockingbird	.	1	.	1
<u>Parulidae</u>					
Warbler spp.	Unidentified Warbler	2	1	.	3
<u>Picidae</u>					
<i>Colaptes auratus</i>	Northern Flicker	1	.	.	1
<u>Podicipedidae</u>					
<i>Podiceps nigricollis</i>	Eared Grebe	3	.	.	3
Grebe spp.	Unidentified Grebe	1	.	.	1
<u>Procellariidae</u>					
<i>Ardenna creatopus</i>	Pink-footed Shearwater	.	1	.	1
<i>Pterodroma cookii</i>	Cook's Petrel	.	.	14	14
<u>Scolopacidae</u>					
<i>Phalaropus fulicarius</i>	Red Phalarope	1	1	.	2
<i>Phalaropus lobatus</i>	Red-necked Phalarope	.	.	1	1
<i>Tringa semipalmata</i>	Willet	.	1	.	1

Table 3. Continued

Family/ Scientific Name	Common Name	Island ^a			Total
		SCZ	SRI	SCL	
<u>Sittidae</u>					
<i>Sitta carolinensis</i>	White-breasted Nuthatch	1	.	.	1
<u>Strigidae</u>					
<i>Athena cucularia</i>	Burrowing Owl	1	.	.	1
<u>Sturnidae</u>					
<i>Sturnus vulgaris</i>	European Starling	1	1	.	2
<u>Troglodytidae</u>					
<i>Catherpes mexicanus</i>	Canyon Wren	2	.	.	2
<i>Thryomanes bewickii</i>	Bewick's Wren	1	.	.	1
<u>Turdidae</u>					
<i>Catharus guttatus</i>	Hermit Thrush	.	.	1	1
Thrush spp.	Unidentified Thrush	.	1	.	1
<u>Tyrannidae</u>					
<i>Empidonax</i> spp.	Unidentified Flycatcher	1	.	.	1
<i>Sayornis nigricans</i>	Black Phoebe	.	.	1	1

^aSCZ=Santa Cruz Island, SRI=Santa Rosa Island, SCL=San Clemente Island

PRODUCTIVITY

At least 58 chicks are known to have hatched on the Channel Islands in 2017, of which 49 (84%) are known to have survived to ≥ 28 days of age. We calculated productivity based upon 30 pairs (see Table 1) that were monitored from early in the breeding season (i.e., courtship, incubation) and for which we know the outcome of the breeding season. Twenty-six pairs (87%) laid eggs, 24 pairs (80%) hatched at least 1 chick, and 20 pairs (67%) successfully produced at least 1 chick ≥ 28 days of age. Minimum productivity was 1.33 fledglings per occupied territory, and 2.0 fledglings per successful nesting attempt.

BREEDING CHRONOLOGY

We calculated the breeding chronology of pairs that produced chicks based upon estimated hatch dates and a 33-day incubation period (Linthicum 1996) and approximately 42 days of chick-rearing. The earliest start of incubation was 14 March at the Gnoma (MC76) and West Point South (MC64) territories (Fig. 12). The latest known incubation of a first clutch was at the Punta Gorda territory (MC62), where we estimate incubation began on 23 April (Fig. 12).

Table 4. Measurements of Peregrine Falcon eggs and eggshell fragments collected from nests on the California Channel Islands in 2017.

Island/Territory	Clutch Means (RC ^a)		Clutch Means (SS ^b)		Notes
	Eggshell Thickness (mm)	% Thinning	Eggshell Thickness (mm)	% Thinning	
<u>Santa Rosa Island</u>					
MC31 Water Canyon	0.228	37.4	0.236	35.2	Measured from 3 fragments with membrane
MC34 Bee Rock Canyon	0.192	47.3	0.201	44.8	Measured from 10 fragments without membrane
MC51 Krumholtz	0.271	25.5	0.279	23.4	Measured from 10 fragments without membrane
MC67 Sandy Point	0.242	33.5	0.252	30.8	Measured from 2 large fragments with membrane
Island Mean	0.233	35.9	0.242	33.6	
<u>Santa Cruz Island</u>					
MC18 Gherini	0.251	31.0	0.257	29.4	Measured from addled egg and 5 fragments with membrane
MC30 Sea Lion	0.244	33.0	0.251	31.0	Measured from 5 fragments without membrane
MC64 West Point South	0.252	30.8	0.261	28.3	Measured from 1 large fragment with membrane
MC81 Del Norte	0.26	28.6	0.266	26.9	Measured from 2 fragments with membrane
Island Mean	0.252	30.9	0.259	28.9	
<u>San Clemente Island</u>					
MC59 Cave Canyon	0.283	22.3	0.289	20.6	Measured from 10 fragments with membrane

^aRené Corado Method

^bSam Sumida Method

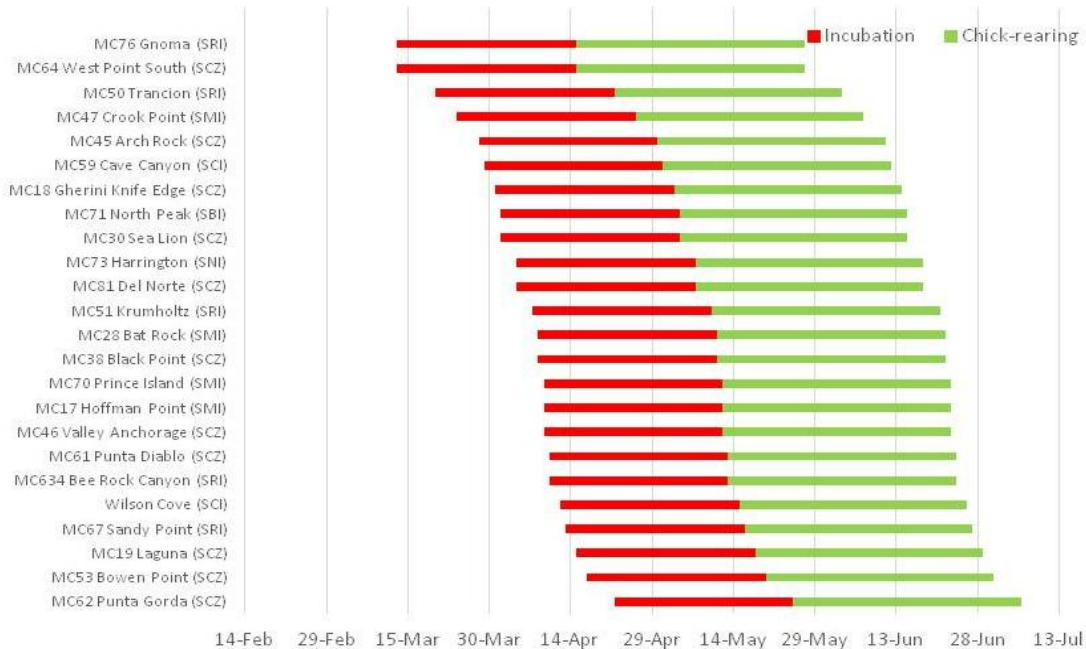


Figure 12. Breeding chronology of Peregrine Falcons on the California Channel Islands during 2017. Data are for nesting attempts that resulted in chicks that were aged at banding or when clearly visible in the eyrie so that we could estimate laying dates. The chick-rearing phase is based on 42 days from hatch to fledge.

The estimated mean and median date of the start of incubation was 5 April and 8 April, respectively. The estimated mean and median dates of chicks hatching (first chick of clutch) was 8 May and 11 May, respectively.

DISCUSSION

The Peregrine population on the Channel Islands has gone from being absent from the 1950s through 1983, to a population size that exceeds Hunt’s (1994) estimates for historical periods. The number of known occupied territories on the Channel Islands during the 2017 season increased to 51, exceeding the 45-48 territories located in 2013-2016 (Figure 13).

The northern Channel Islands continue to be the stronghold for Channel Island Peregrines. In other Peregrine populations, density of Peregrine territories appears to be 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 generally 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).

Nest success in occupied territories with known outcomes was higher than in 2016 (67% in 2017 vs. 58% (23 of 40 territories) [Sharpe 2017]), and productivity increased from 1.18 fledglings/occupied territory in 2016 (Sharpe 2017) to 1.33 fledglings/occupied territory in 2017. Over the 5 breeding seasons that IWS has monitored Peregrines on the Channel Islands (2013-2017), nest success has averaged 65% and productivity has been 1.4 chicks/occupied territory. Nest success and productivity on the Channel Islands is similar to that in the Pacific Region in 2003 (65% and 1.45 chicks/occupied territory), but slightly lower than the 2003 national average of 71% and 1.64 chicks/occupied territory (Green et al. 2003). More recent studies reported nest success of 77-78% and 1.8 chicks/occupied territory found in Colorado, Montana, Wyoming, and Idaho (Enderson et al. 2012, Moulton 2012). Nest success and productivity can vary greatly between years, so continued monitoring will allow us to better estimate long-term reproductive averages and trends in the Peregrine population on the Channel Islands.

The potential impact of DDE on the productivity of Peregrines on the Channel Islands is a continuing concern. 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), 12.4% in 2013 (Sharpe 2014), 14.4% in 2014 (Sharpe 2015), 10% in 2015 (Sharpe 2016), and 22.6% in 2016 (Sharpe 2017). Average eggshell thinning across the islands in 2017 was 30%. At this level of thinning, we would expect lower productivity, but this did not appear to be the case. Nevertheless, the increase in thinning during the past 2 seasons could be an indication of contaminate problems. Funding is available to analyze shell thickness in 2018, therefore we will attempt to make collections at a subsample of eyries.

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

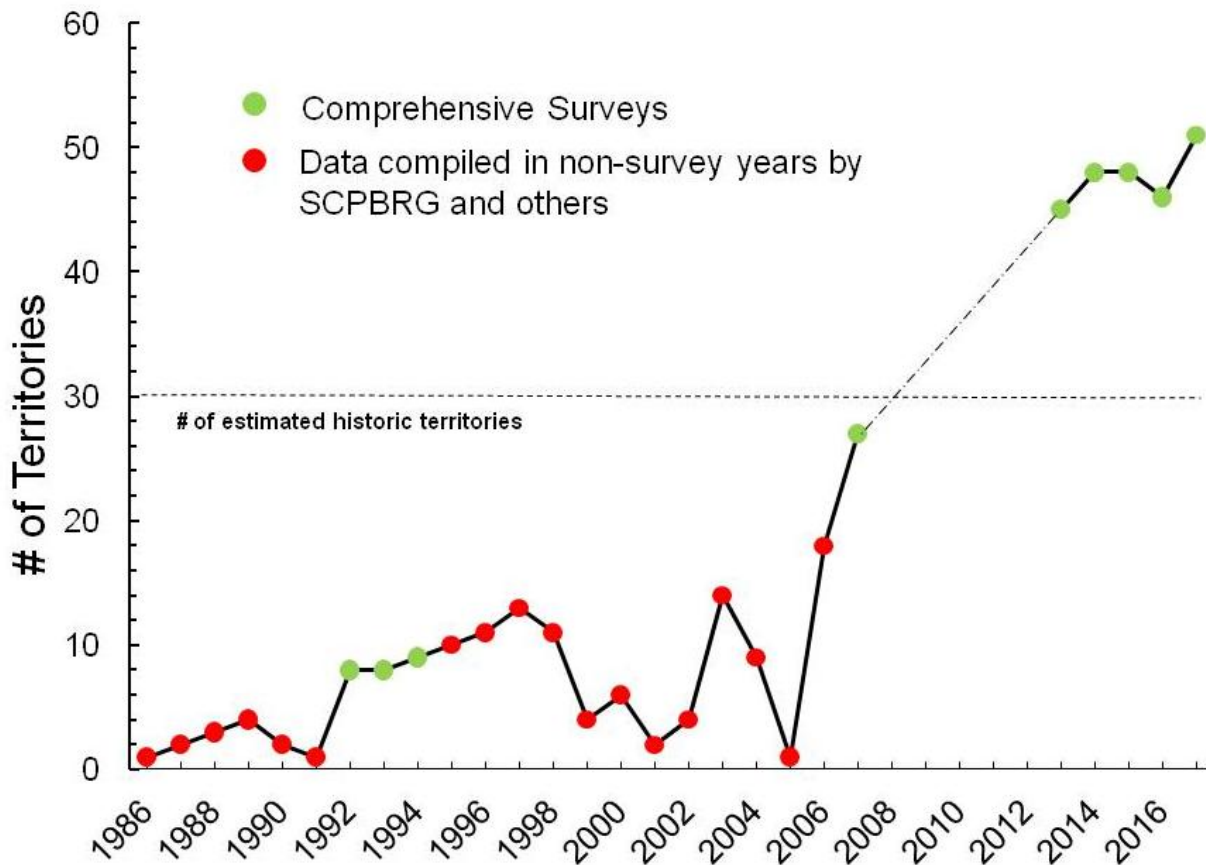


Figure 13. Number of known occupied Peregrine Falcon territories on the California Channel Islands from 1986 to 2017. Green points represent data from years when there were comprehensive surveys; red points are from years when there were no comprehensive surveys as reported in Appendix IV of Latta (2012).

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 2018 season, we will be eliminating monitoring on San Miguel and reducing effort on Santa Cruz, Santa Rosa, San Nicolas, and Anacapa due to the end of MSRP funding. We will rely primarily on the call-broadcast protocol for the rapid assessment of areas with suitable habitat outside of known territories, as has been done in other studies (Klinger and Tomlinson 2010), and we recommend its use in Peregrine population monitoring, especially when time and/or personnel are limited.

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Appendix I. Samples collected in 2017.

Sample ID	Island ^a	Territory	Sample Type	Collection Date	Notes
17-MC64-PR-1	Santa Cruz	West Point South	Prey Remains	5/8/2017	Collected from eyrie
17-MC64-SF-1	Santa Cruz	West Point South	Shell Fragments	5/8/2017	Collected from eyrie
17-MC50-PR-1	Santa Rosa	Trancion	Prey Remains	5/15/2017	Collected from eyrie
17-MC18-AE-1	Santa Cruz	Gherini	Addled Egg	5/23/2017	Collected from eyrie
17-MC18-PR-1	Santa Cruz	Gherini	Prey Remains	5/23/2017	Collected from eyrie
17-MC18-SF-1	Santa Cruz	Gherini	Shell Fragments	5/23/2017	Collected from eyrie
17-MC18-WB-1	Santa Cruz	Gherini	Whole Blood	5/23/2017	Collected from 1947-21684
17-MC81-PR-1	Santa Cruz	Del Norte	Prey Remains	5/25/2017	Collected from eyrie
17-MC81-SF-1	Santa Cruz	Del Norte	Shell Fragments	5/25/2017	Collected from eyrie
17-MC59-PR-1	San Clemente	Cave Canyon	Prey Remains	5/28/2017	Collected from eyrie
17-MC59-SF-1	San Clemente	Cave Canyon	Shell Fragments	5/28/2017	Collected from eyrie
17-MC59-WB-1	San Clemente	Cave Canyon	Whole Blood	5/28/2017	Collected from 1947-21685
17-MC59-WB-2	San Clemente	Cave Canyon	Whole Blood	5/28/2017	Collected from 1947-21686
17-MC59-WB-3	San Clemente	Cave Canyon	Whole Blood	5/28/2017	Collected from 1156-16870
17-MC30-PR-1	Santa Cruz	Sea Lion	Prey Remains	6/4/2017	Collected from eyrie
17-MC30-SF-1	Santa Cruz	Sea Lion	Shell Fragments	6/4/2017	Collected from eyrie
17-MC30-AE-1	Santa Cruz	Sea Lion	Addled Egg	6/4/2017	Collected from eyrie
17-MC30-WB-1	Santa Cruz	Sea Lion	Whole Blood	6/4/2017	Collected from 1156-16871
17-MC51-PR-1	Santa Rosa	Krumholtz	Prey Remains	6/6/2017	Collected from eyrie
17-MC51-SF-1	Santa Rosa	Krumholtz	Shell Fragments	6/6/2017	Collected from eyrie
17-MC51-WB-1	Santa Rosa	Krumholtz	Whole Blood	6/6/2017	Collected from 1156-16872
17-MC51-WB-1	Santa Rosa	Krumholtz	Whole Blood	6/6/2017	Collected from 1156-16873
17-MC34-PR-1	Santa Rosa	Bee Rock	Prey Remains	6/7/2017	Collected from eyrie
17-MC34-SF-1	Santa Rosa	Bee Rock	Shell Fragments	6/7/2017	Collected from eyrie
17-MC34-WB-1	Santa Rosa	Bee Rock	Whole Blood	6/7/2017	Collected from 1156-16874
17-MC67-PR-1	Santa Rosa	Sandy Point	Prey Remains	6/7/2017	Collected from eyrie
17-MC67-SF-1	Santa Rosa	Sandy Point	Shell Fragments	6/7/2017	Collected from eyrie
17-MC67-WB-1	Santa Rosa	Sandy Point	Whole Blood	6/7/2017	Collected from 1947-21687
17-MC34-WB-1	Santa Rosa	Bee Rock	Whole Blood	6/7/2017	Collected from 1156-16874
17-MC34-WB-2	Santa Rosa	Bee Rock	Whole Blood	6/7/2017	Collected from 1156-16875
17-MC34-WB-3	Santa Rosa	Bee Rock	Whole Blood	6/7/2017	Collected from 1156-16876
17-MC31-SF-1	Santa Rosa	Water Canyon	Shell Fragments	6/8/2017	Collected from eyrie
17-MC19-PR-1	Santa Cruz	Laguna	Prey Remains	6/13/2017	Collected from eyrie
17-MC19-WB-1	Santa Cruz	Laguna	Whole Blood	6/13/2017	Collected from 1156-16877