2023 Habitat Management Plan for Public Access for the Dana Point Preserve

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DRAFT March 14, 2023

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1. Preface

The Center for Natural Lands Management (CNLM) owns and manages the 29.4-acre Dana Point Preserve (Preserve), located in the City of Dana Point, Orange County, California. CNLM has prepared this habitat management plan (2023 Plan or Plan) for public access for the Preserve pursuant to Master CDP 04-23 for the City of Dana Point, specifically Condition No. 38.

CNLM submits the 2023 Plan focused on public access control at this time because of changing needs based on adaptive management, recent events regarding the management of public access for public health reasons, and the increased sensitivity of the natural resources on the Preserve. CNLM is in the process of preparing a comprehensive habitat management plan governing all aspects of the adaptive decision-making process for the management of the Preserve and long-term vision, continuity, and consistency for habitat management of the Preserve; the 2023 Plan will be incorporated as a component of that upcoming comprehensive habitat management plan.

CNLM acquired the Preserve in 2005 for the purpose of protecting the rare coastal sage scrub community and habitat for the threatened coastal California gnatcatcher (*Polioptila californica californica* or gnatcatcher) and endangered Pacific pocket mouse (*Perognathus longimembris pacificus* or PPM). CNLM's management of the Preserve is overseen by the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) through, in part, the Orange County Central and Coastal Subregions Natural Communities Conservation Plan/Habitat Conservation Plan (NCCP/HCP)[1]. The NCCP/HCP originally called for a temporary preserve for PPM on a portion of what is now the Preserve property; USFWS and CDFW approved the permanent protection of the Preserve through ownership and adaptive management by

[1] The previous owner of the Preserve property was a "Participating Landowner" under the NCCP/HCP, which commits the landowners to address impacts to and conservation of PPM, gnatcatcher, and other species on certain property, including the Preserve. The City of Dana Point is also a Participating Landowner.

CNLM, as part of the development of the Headlands area of Dana Point, as described below.

In 2004, the City adopted the Headlands Development and Conservation Plan (HDCP), which implements the Coastal Act for the Headlands area. The HDCP called for the creation of a conservation area to protect environmentally sensitive habitat areas (ESHA) within the project site, and specifically to balance protection of natural resources with public access on the Preserve. HDCP Policy 5.20 calls for "[r]egulat[ing] the time, manner and location of public access to parks and open space containing sensitive biological resources to maintain and protect those sensitive resources and to protect the privacy rights of property owners while honoring the public's constitutional right of access to navigable waters." Policy 3.7 provides that ESHA "shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas. . . .". The HDCP called for limited portions of the Preserve to "accommodate passive uses, such as the bluff top trails, security fencing, overlooks, seating and signage. . . ." (HDCP, Table 3.4.5).

The HDCP provides for establishment of the Preserve and designates it for Conservation Open Space, "the most restrictive land use within the [Headlands] project". Further, the HDCP requires long-term preservation and management of habitat for sensitive species, including the Pacific pocket mouse, provides for a non-profit trust to manage the Preserve in conjunction with USFWS and CDFW, and calls for recording a conservation easement to ensure the Preserve remains permanently conserved open space. Noting that the Preserve will "include[s] a limited bluff top trail . . . and limited visitor access to the coastline and natural environment," the HDCP provides that "[b]alancing the desire for limited public access and views along the perimeter, the [Preserve] is designed to protect a number of sensitive flora and fauna, including the Pacific pocket mouse" and "[a]s a result, and to protect this natural resource from overuse, only limited portions of the area will accommodate passive uses" and the "non-profit entity will establish hours of operation for the bluff top trail" (HDCP, Table 3.4.5).

Owing to its experience and expertise managing habitat for endangered species, CNLM was selected to be that non-profit entity.

The City authorized development of the Headlands Project, including the Preserve, under the California Coastal Act by issuing Coastal Development Permit 04-23 (Permit or CDP) on January 19, 2005 (City of Dana Point 2005). The CDP specifies that a "pedestrian trail of decomposed granite/gravel shall provide controlled access to the coastal bluff top" and requires all development to "be consistent with and comply with all requirements of the HDCP." It also calls for preparation of a habitat management plan before disturbance of any environmentally sensitive habitat area (ESHA)[2] and protection of Preserve ESHA by dedication of a conservation easement to the City or other appropriate entity.

On December 20, 2005, CNLM, the owner of the Preserve, granted a Conservation Easement (CE) over the Preserve to the City, which the City accepted as compliance with the CDP condition calling for a conservation easement (CNLM and City 2005). The purpose of the CE is "to ensure that biological values and resources in the [Preserve] continue to exist in perpetuity, and to prevent any use of the [Preserve] that will materially impair or interfere with such values and resources." The CE prohibits "[u]ncontrolled public access" and public access during non-daylight hours (with limited exceptions), and permits controlled public access to the nature trail and overlook areas for passive recreational uses.

A draft habitat monitoring and management plan for the Preserve and adjacent land now owned by the City of Dana Point was prepared by a consultant for Headlands Reserve, LLC in 2005, but appears to have never been finalized or approved by the City, the Coastal Commission, USFWS, or CDFW. Nevertheless, CNLM has submitted annual reports and work plans for management of the Preserve to the wildlife agencies

[2] HDCP Policy 3.1 describes the importance of areas designated as ESHA as "areas where plant or animal life of their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could easily be disturbed or degraded by human activities. . . ."

and the City since CNLM acquired the Preserve in 2005, which include comprehensive management and monitoring reporting and planning related to the Preserve. As mentioned above, CNLM is currently working on a comprehensive adaptive management plan for the Preserve, and this Plan covers adaptive management related specifically to public access to the blufftop trail on the Preserve.

The Preserve is small (relative to its intended conservation purpose), has distinct and hard edges on most boundaries (being bounded by the Pacific Ocean on its western boundary and by hardscaped City streets and residential development on most of the rest of its perimeter; Figure 1), and is occupied by two listed species within a fragile and rare suite of landscape features. In accordance with the CDP and HDCP, a trail was designed and created on the Preserve, and initially opened for public access in December 2009.

The Preserve is protected with a wildlife-friendly, six-foot-high iron fence (Figure 2) or concrete wall on all sides except the coastal bluff-tops and the border with Hilltop Park. CNLM's public access trail can be accessed by the visiting public from two locations with clearly marked gates—Scenic and Dana Strand (Figures 2 and 3). The trail is approximately 0.5 miles in length and includes five overlook areas (with benches and/or educational signs). Both the trail and overlook areas are well defined and enclosed by a post-and-cable trail fence. Any off-trail use would require intentionally climbing through or over the fence. Further, the trail meanders through the Preserve exposing the majority of the Preserve to potential public use impacts (i.e., within 100 meters of the trail). Gates are closed at all times except when individuals are entering and exiting the Preserve and are controlled by automatic devices powered by solar panels. The gates are locked when the trail is not open for public access. Signs and interpretive panels provide information about the Preserve, including allowable (e.g., hiking, running, and wildlife viewing) and prohibited (e.g., collecting materials, smoking, off-trail use, drone use, pets, bicycles, etc.) activities for trail use (Figures 2 and 3). Informational kiosks are also located at each gate with maps showing the trail and the list of trail use rules. The public also has access to informational brochures (available in the Nature

Interpretive Center), created by CNLM and the City, that provide allowed and prohibited activities on the trail, a map of the trail, information on the common plant and bird species seen from the trail, and a list of alternative nearby areas where dogs are allowed on trails.

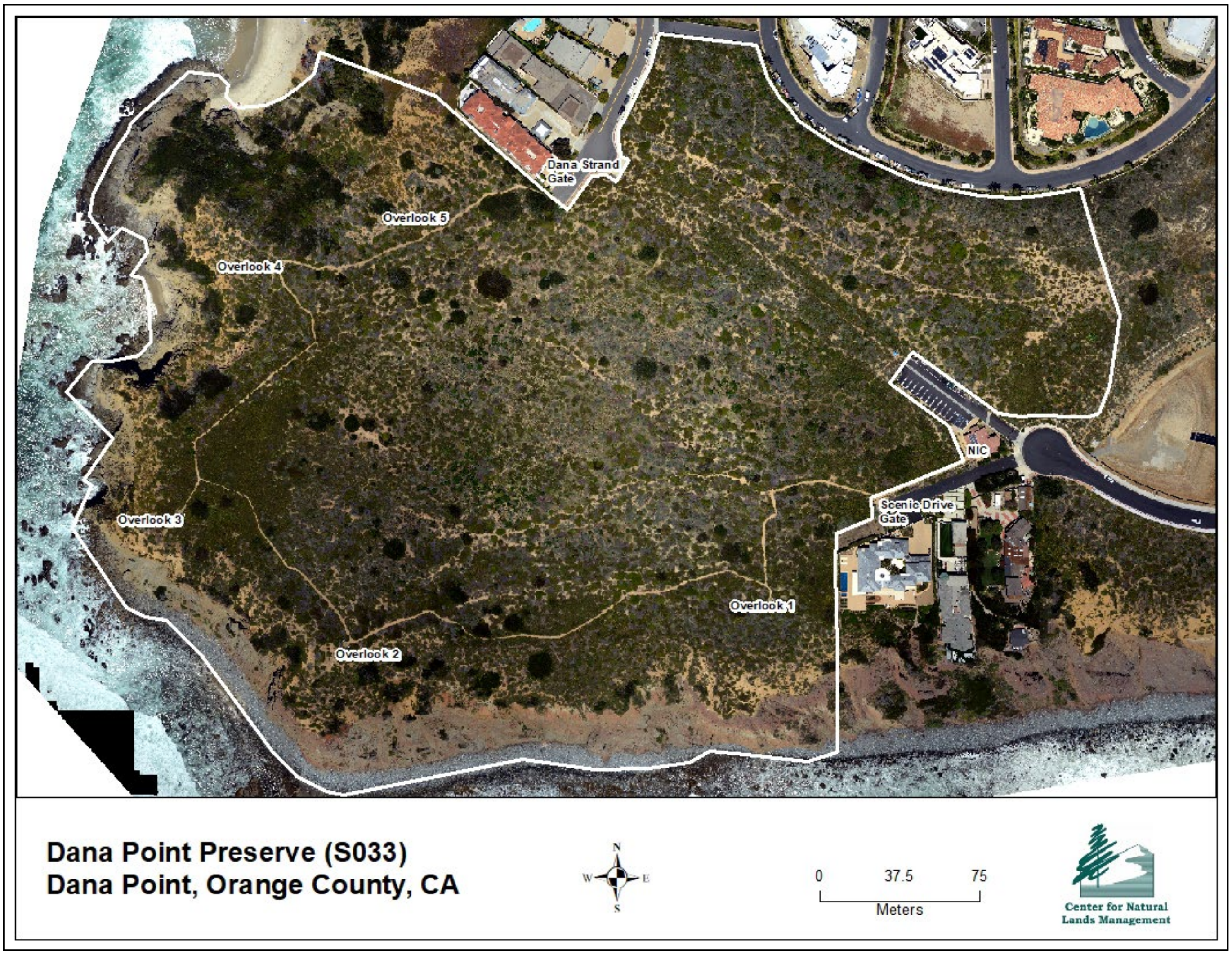

Figure 1. Overview of the CNLM Dana Point Preserve with boundary, trail, and gate features. The trail is the muted line within the Preserve area (bounded by a white line) and shows the overlook areas.

Since the trail was opened to the public in December 2009, it was generally open seven days per week, from approximately 7:00 a.m. to sunset. CNLM staff further controlled access to the trail by closing the trail, in part or in its entirety, from time to time for, among other reasons, protection of nesting locations of gnatcatchers near the trail (where trail use would risk nest abandonment and the death of nestlings), repair of the trail where storm events have made it unserviceable and/or unsafe, repair and maintenance of fences and other infrastructure, or other preserve management activities that would have been significantly affected by public presence or that may present a public safety risk.

CNLM is required to practice adaptive management with respect to the Preserve, which aims to improve management practices incrementally by designing, adjusting, and implementing plans in ways that facilitate learning from experience. Thus, when the Preserve was created and the trail was established, it was anticipated that changes in public access, among other things, could occur due to adaptive management. The U.S. Department of the Interior describes adaptive management as a decision process that:

> promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a “trial and error” process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders (Williams et al. 2009, National Research Council 2004).

CNLM stewardship practices reflect the principles and include the core elements of adaptive management (Rogers 2007). With this Plan, CNLM endeavors to make use of what it has learned since creation of the Preserve in 2005 and opening of the trail in 2009. As described in detail in the Plan, the intensity of public use of the Preserve has increased greatly since the trail was opened, and the Pacific pocket mouse has become more vulnerable to extinction. In addition, in the last 18 years, we have gained a much better understanding of the impacts of passive recreation on natural resources. As a result of these developments, CNLM is proposing hours of operation for public access to the Preserve trail that are more likely to be protective of the resident species.

2. Executive summary

The approximately 29-acre Dana Point Preserve (Preserve), located within the City of Dana Point in Orange County, California, has been owned and managed by the Center for Natural Lands Management (CNLM) since December 2005. The Preserve, in addition to supporting a rare coastal sage scrub community with considerable biodiversity, provides habitat for (and extant occurrences of) two listed species—the (federal) threatened coastal California gnatcatcher (*Polioptila californica californica*) and the (federal) endangered Pacific pocket mouse (*Perognathus longimembris pacificus*). A management plan for the Preserve was drafted in 2005 but provided little information regarding public access, although noting that excessive or uncontrolled access could result in habitat degradation. A conservation easement, granted to the City by CNLM in 2005, is intended to ensure that biological values and resources in the Preserve continue to exist in perpetuity, and to prevent any use that would materially impair or interfere with such values and resources. For much of the period between 2009—when the trail on the Preserve was first opened to the public—until the COVID-related substantial closure in 2020, the trail was open to the public generally seven days per week, typically 7:00 a.m. to sunset. CNLM staff closed the trail or modified public access as needed for trail maintenance, in particular, and for other reasons including protection of sensitive nesting locations. However, when the trail opened to public access in 2009, there was no underlying research or principles that supported this amount of public access in relation to the need to protect the sensitive onsite natural resources. This 2023 Plan provides evidence-based information pertaining to public use of the Preserve trail, relevant scientific literature, and a proposed schedule and rationale for public access. Although the Preserve contains a multitude of sensitive and rare species, the species of most management concern is the highly endangered Pacific pocket mouse (PPM) because there are only three populations left in the wild and the Dana Point population is highly important to the persistence of the species.

Hundreds of scientific studies—encompassing both individual research studies and literature syntheses—were reviewed in preparation for this 2023 Plan. The majority of studies concluded that public presence (“passive recreation”) in parks and preserves had negative impacts on wildlife. The sights, sounds, vibrations, movements, and smells of the public can elicit avoidance or stress responses. Other behaviors—bringing dogs on preserves, littering, walking off trail—further compounded the harmful impacts. Studies based on COVID-related park/preserve closures further confirmed that wildlife responded favorably in the absence of the visiting public. When neutral or positive impacts of the visiting public were noted, these were largely the result of financial support from the visiting public or benefits to generalist species (e.g., raccoons, foxes, coyotes) that adjusted to human presence and foraged on trash left behind.

Public visitation data collected on the Preserve shows dramatic increases in the number of visitors since 2011 when monitoring commenced. The number of visitors doubled between 2011 and 2017—from an average of 345 per day to 673 per day (approximately 250,000 visitors per year). In February 2023, the average daily visitation was 800 (~300,000 visitors per year).

Directly studying effects from the visiting public on PPM or other resources is difficult. The most likely effect is stress (with downstream impacts on reproduction, survival, and population persistence) but this is difficult to measure without causing impacts to the species. Data based on live-trapping events indicate that PPM decreased after the trail initially opened in 2009 and increased after the trail was closed to the public in 2020. However, there are many other variables that can affect PPM, including climate change and vegetation condition, and separating all the effects is difficult if not impossible. Some of those variables are more controllable than others and are additive in their impacts. PPM as a species has become more vulnerable over recent decades due to the loss of one of the previously four extant populations. Additional threats to PPM or other species on the Preserve that are more recent include two deadly viruses (affecting snakes and rabbits), Argentine ants, and the unpredictable and multiple impacts of climate change.

The preponderance of scientific literature pointing to the general negative impacts on wildlife from the visiting public, the increasing number of visitors to the Preserve, the incidents of trespass in the Preserve, and the other (largely uncontrollable) threats to PPM and other species, indicate a greater need to control public access. Without appropriate control, further impacts on PPM and other species seem likely and, at some point, would become irreversible, leading to extirpation. CNLM proposes a public access schedule of four days per week (including weekends, given their popularity with the public) with a summer (10 hours per day) and winter (8 hours per day) schedule. CNLM also proposes to set aside certain times for educational group visits on the trail—to facilitate public education, nature appreciation, and opportunities to engage disadvantaged and underserved communities. This schedule reflects the need to avoid public access during low-light times of the day when PPM is more likely to be active above-ground and engaging in critical activities including feeding, "bathing", and reproductive behavior. A schedule of four days per week should also serve to provide better control on overall visitation (and related impacts) and address the trends of ever-increasing numbers of visitors. Although the Preserve is a critical home environment for the resident species, particularly PPM, alternatives for public recreation, aesthetic enjoyment, and nature appreciation abound both within the City of Dana Point and Orange County more generally. Within the City limits alone, there are 28 parks (15 with coastal views) and 11 miles of trails. The Dana Point Preserve trail has no access to water or beaches. The proposed schedule of public access to the trail and associated adaptive management activities are consistent with the Coastal Act, the HDCP, the CDP, and the Conservation Easement.

The proposal for public access to the trail on the Dana Point Preserve is accompanied by continuing and additional monitoring of both public visitation and the natural resources to further the goals of adaptive management. The Preserve's natural resources will continue to be managed as well to lessen threats and impacts as much as possible. Information will continue to be sought from the visiting public, relevant scientific literature, onsite data and experience, and guidance from the research and regulatory communities. The practice of adaptive management will continue to be implemented to best effect to protect the natural resources and provide controlled public access, revisiting access schedules from time to time as appropriate.

Figure 2. Exterior sign on the Dana Point Preserve's Dana Strand Gate referring to prohibited uses. Some information is also provided on one of the two listed species on the Preserve—coastal California gnatcatcher. The type of fence that surrounds the Preserve can also be seen.

Figure 3. Exterior sign on the Dana Point Preserve's Scenic Gate referring to prohibited uses. Some information is also provided on one of the two listed species on the Preserve—the Pacific pocket mouse.

3. Sources of information regarding public access

Since 2005, when the Preserve was acquired, there has been considerable accumulation of information and experience that is relevant to this 2023 Plan, including:

- CNLM management experience on the Preserve relative to public access
- Changes in use of the Preserve by the public over time
- Changes in vulnerability of PPM at the species and population levels
- Information on PPM and gnatcatcher presence over time

- Changes in threats to the natural resources onsite
- A growing base of scientific literature regarding the relationship(s) between public use ("passive recreation") of nature preserves and wildlife response

Each of these topics has been explored and is described below.

3.1. CNLM management experience on the preserve relative to public access

During CNLM's more than 17 years of experience in managing the natural resources onsite and more than 13 years of experience in controlling public access of the Preserve, considerable insight has been gained into the relationship between these activities. Management activities related specifically to public access include monitoring, prevention of trespass and other prohibited behaviors, and remediation of some of the damage caused by trespass. The primary prohibited activities on the Preserve are using the trail outside of allowed hours, trespassing off the trail, littering, smoking, bringing pets onto the trail, and removing vegetation.

Monitoring of public access has included the use of trail counters to obtain information on the number and timing of visitors (see Section 3.2, below), as well as monitoring by CNLM staff on site. Since the trail opened to the public in 2009, CNLM has continued to hire additional staff to provide an onsite presence. CNLM currently has four staff members on site for an average of six days per week. CNLM staff at the Preserve patrol the trail, provide information and education to interested visitors, ensure that fencing, gates, and signage are intact, and interact with visitors who trespass off the trail or otherwise engage in prohibited activities. CNLM staff also document incidents of trespass and other prohibited behaviors. CNLM staff further plant vegetation or piles vegetation in areas that experience high frequencies of off-trail use (i.e., trespass) by the public to create additional barriers along the trail fence, and coordinate with CDFW Game Wardens and Orange County Sheriff's Department to help patrol and issue citations.

The most prevalent type of observed prohibited behavior (noted as an “incident”) documented on the Preserve is trespass by visitors off the trail. From June 2017 to February 2023, 374 incidents were documented, 59% (220) of those were off-trail incidents (Figure 4). Despite numerous signs, fencing, and the presence of CNLM staff, visitors continue to climb over the fence and go off the trail. The second most common incident at 22% (81) is pet dogs and cats on the trail. These incidents do not include incidents where staff intervened and prevented pets from entering the trail, only those observed on the trail. On average, these instances occurred approximately 15% of the days staff were on site. As an incident can only be recorded when staff is onsite to observe it, this is likely an underestimate as it does not include events that occurred when staff weren’t present. In the first two months of 2023, the number of dogs on the trail had already reached 10 incidents, which is double the observed number of incidents in 2020 and 2021 combined (K. Merrill pers. comm.).

Trespass on the trail after the trail is closed is also frequently observed. In 2022, wildlife cameras were installed at both the Selva and Scenic gates and have become useful tools in documenting trespass after hours and after sunset, in particular. In September and October 2022, when the trail access schedule was eight hours per day for three days per week, the average number of monthly trespass incidents after sunset was 2 (±1.1) and 1.6 (±0.5) per month, respectively. When the trail schedule was changed to open seven days per week, 7:00 a.m. to sunset, the average monthly trespass after sunset was 2.75 (±0.6) in November and 5 (±1.1) in December 2022 (Figure 5).

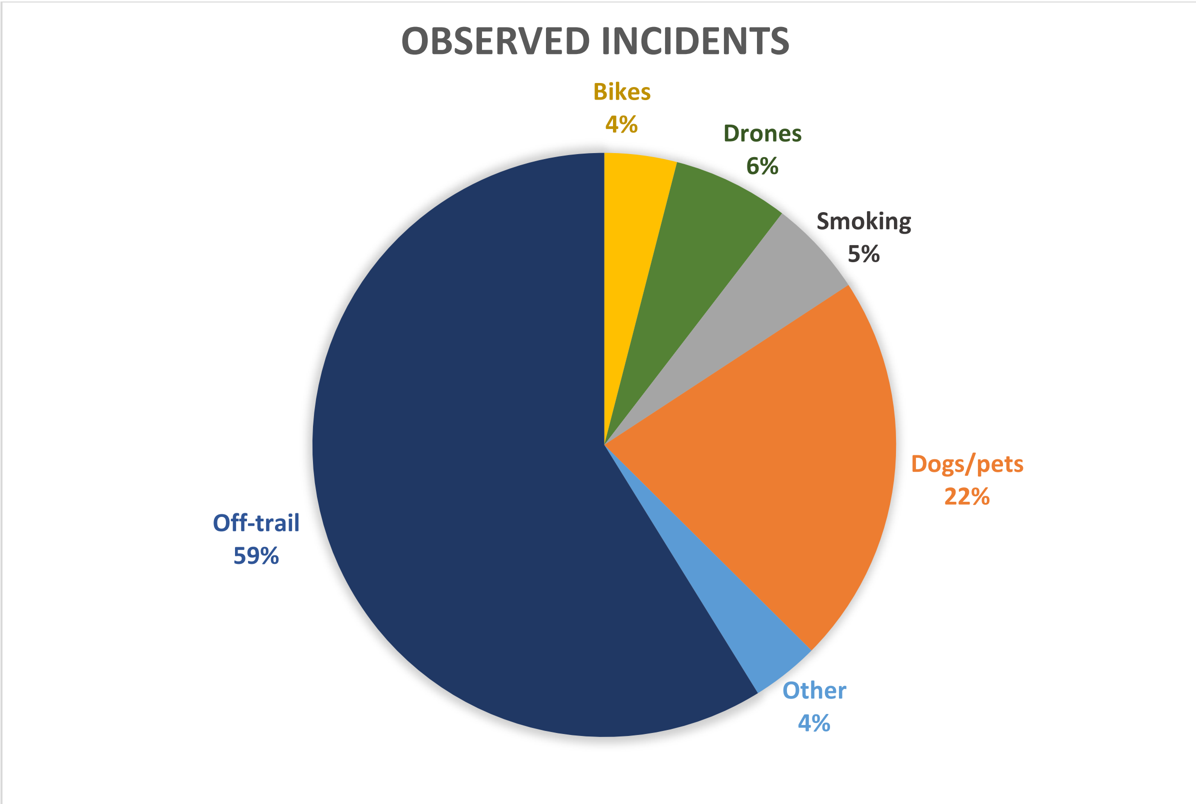

Figure 4. Observed incidents 2017-2023. Incidents observed only include active behaviors (these do not include evidence of trespass such as littering or footprints) observed by CNLM staff. Other includes spreading human remains, harassing wildlife, drinking alcohol, excavation, urination, and littering. Bikes include bicycles, e-bikes, and unicycles. Smoking incidents only include active smoking (does not include evidence of smoking such as cigarette butts). Drones only include drones flown from and over the Preserve (drones flown over the Preserve from the adjacent beach aren't included). Off-trail indicates people stepping off the trail. Dogs/pets only includes those observed on the trail.

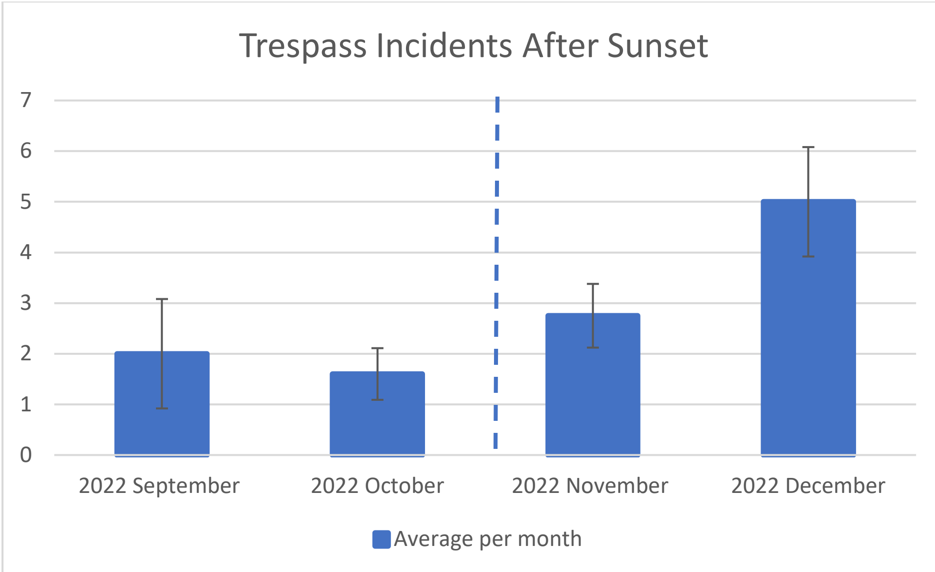

Figure 5. Trespass incidents after sunset. Average number of incidents caught on wildlife cameras at the Scenic and Selva gates for four months (mean, standard error). During September and October 2022 (to the left of the dashed line) the trail schedule was three days a week 8:00 a.m. to 4:00 p.m. and for November and December (right of the dashed line) the trail schedule was 7:00 a.m. to sunset, seven days per week.

Regardless of high levels of staff and volunteer effort, violation of trail rules by the visiting public is not decreasing. For the period November 5, 2022 to February 26, 2023, with a public access schedule of open daily from 7:00 a.m. to sunset, CNLM staff conducted patrols for 49 days and reported 38 incidents with a total of 165 visitors that refused to leave the trail at sunset. These incidents are in addition to those reported above in Figure 5. CNLM staff have called the Orange County Sheriff's Department's non-emergency phone line for a few of these incidents and, on one occasion, the Orange County Fire Authority responded. However, as far as reported by CNLM staff, no citations were given to individuals who trespassed after sunset (K. Merrill pers. comm.).

Other examples of destructive behavior by the public not abiding by trail rules include leaving food or trash onsite (may attract predators), bringing pets (usually dogs) onto the Preserve (sights and smells from domestic animals can have serious impacts on resident wildlife), making collections of plant materials for personal or commercial landscaping purposes (thereby potentially reducing the viability, amount, or reproductive potential of those plant species), and engaging in other activities that can threaten the Preserve or its component biota including geocaching, smoking, playing recorded bird calls/songs, conducting wedding ceremonies, establishing memorials, scattering human cremains, catching insects, and using drones. Even public use of the adjacent parking lot has the potential to cause impacts: in 2010 and 2017, vehicles were driven through the perimeter fence into the Preserve (CNLM 2011, 2018). All these behaviors have been observed by CNLM staff on the Preserve and documented in annual reports since 2010 (CNLM 2011-2021). CNLM staff frequently update signage and trail rules in response to new types of incidents. For example, in 2022 unicycle use was added to the list of prohibited activities because some visitors argued it wasn't a bicycle and therefore was allowed on the trail (K. Merrill pers. comm.).

Regardless of the effort and efficacy in detecting and stopping trail use violations, ultimately it is not feasible to detect and stop all such incidents. Most significantly, harm to the species may already have occurred by the time the activity is detected.

CNLM staff respond to the most immediate and visible signs of impact to the Preserve from off-trail trespass by removing debris and litter, restoring trampled or cleared vegetation, and monitoring for crushed or otherwise impacted gnatcatcher nests and PPM burrows. However, trespass can cause other less observable and difficult to redress cumulative impacts on the species and habitat, such as behavioral changes, including alteration of perceived threats or predator avoidance, especially during low light hours and after sunset.

Public access by visitors who observe trail rules also affects the species, through the sights, sounds, smells, movements, and vibrations of public presence, as discussed below in Section 3.4. Additionally, as further described in Section 3.5, introduction of serious viruses or other pathogens that could be harmful or catastrophic for resident species can often be vectored on footwear and clothing of the visiting public. Efforts to control those threats with trail entrance disinfecting stations are difficult to enforce as the public typically disregard informational signage at the trail entrances and thus probably have little effect, as experienced with such efforts to control the spread of the rabbit hemorrhagic disease virus serotype 2 (RHDV2) (K. Merrill pers. comm.).

3.2. Changes in use of the preserve by the public over time

Since 2011, when public trail use was first monitored, public visitation has steadily increased and, in fact doubled over just a seven-year period. There are no data for trail use for the first year the trail was open to public access. However, in 2011, because of growing scientific evidence, concern over impacts from public access, and apparent increases in public use of the Preserve trail in the past year, CNLM commenced monitoring public visitation. With financial support provided by USFWS, staff installed infrared trail counters at both gated entrances (Dana Strand and Scenic) to the Preserve's trail to collect objective and quantitative data on the amount of public visitation of the Preserve trail over time. For analysis, these data were inspected for any issues that may have resulted from power failures or failures in triggering counts upon entry of the public. For an initial analysis in 2020, all days with reliable data counts were included in the dataset for the year and the average number of visitors per day (i.e., per day of data collection) was calculated. During 2011-2017, there was a high degree of useable data. Data collection during 2018-2019 was affected by a high incidence of no data collected or trigger failures due to dead batteries, corrosion of the electronic plates, and frayed wires. Thus, the 2018-2019 data were very incomplete and considered unreliable as estimates of public use of the trail. Accordingly, a seven-year presentation of visitation is provided for the period 2011 through 2017 (Table 1, Figure 6) and 2020-2023 (Table 2). To be clear, references in this document to "number of visitors" that were recorded on the Preserve is more accurately defined as "number of counts by the infrared trail counters".

There is a significant upward trend over time in average daily visitation, almost doubling in that seven-year (2011-2017) period from 345 per day to 673. If these averages are represented as estimates of annual number of visitors (multiplying by 365 as the trail was open most days of the year for that period), that would indicate an increase in visitors from over 125,000 in 2011 to over 245,000 in 2017.

Table 1. Average daily trail use counts at the Dana Point Preserve, 2011-2017.

Year	Average Daily Visitation[1]					Annual Visitation Estimate[2]
	Mean	SE	N	Lower 95%CI	Upper 95%CI	
2011	344.5	10.3	185	324.3	364.7	125,740
2012	319.6	9.8	248	300.4	338.7	116,637
2013	361.1	8.5	344	344.3	377.8	131,793
2014	355.8	9.2	306	337.8	373.8	129,851
2015	444.6	16.0	239	413.3	475.9	162,281
2016	612.7	19.3	366	575.0	650.5	223,643
2017	672.5	20.4	302	632.6	712.4	245,465

[1] Average daily trail use counts, which represents average daily visitation and 95% confidence intervals (CI), were calculated as the total counts of reliable data / days of reliable data collection per year. For this representation, data from one gate only (Scenic gate) were used. Although this could lead to an over-representation of visitors (i.e., those who both entered and exited from the Scenic gate), that bias is reasonably assumed to be counter-balanced by the opposite—i.e., visitors exiting and entering from the other gate only. Further, the number of visitors recorded is probably an underestimate of the actual number because the counter counts people passing the sensor with a delay of 1.5 seconds rather than counting all individuals, and visitors not infrequently enter the gate in a group—and thus would be counted as only one visitor.

[2] Estimates of annual visitation were calculated as average daily trail use counts * 365 days although there were some days that the trail would have been closed to the public for trail maintenance, etc.

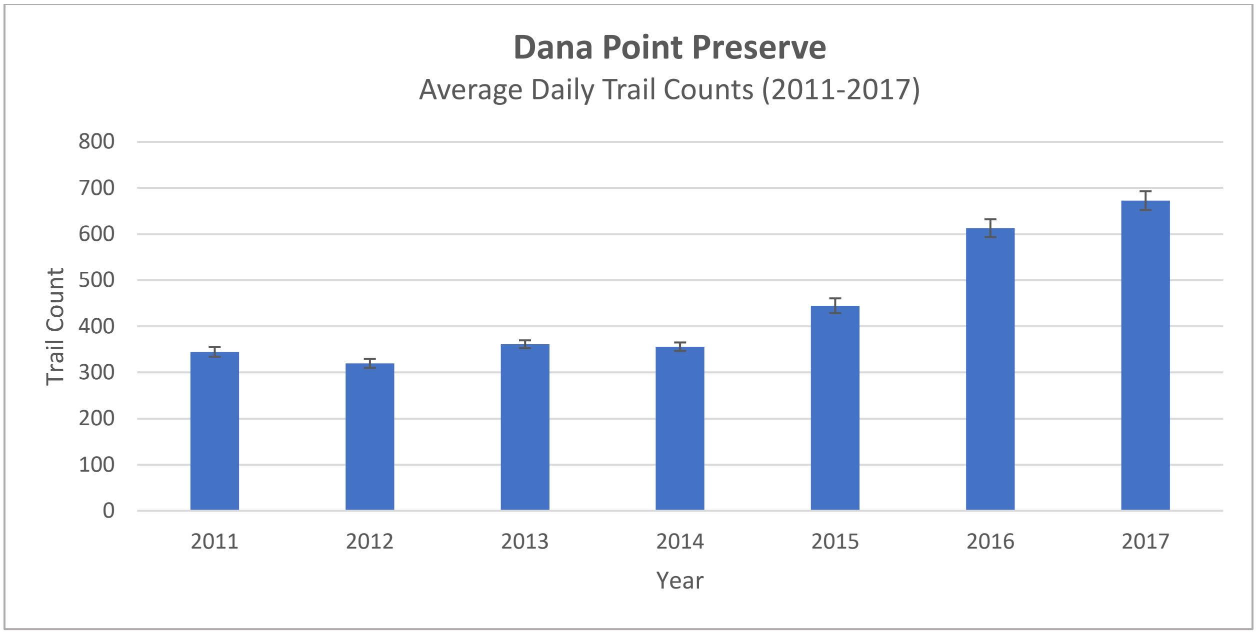

Figure 6. Average (mean, standard error) daily trail use counts (2011-2017) at the Dana Point Preserve.

Commencing in March 2020 to present, the public trail hours for the Preserve underwent intermittent changes, initially due to COVID-19 precautionary measures. As such, the data presented for this time period (2020-2023) have been characterized by schedule types as follows.

<u>January 2020 – March 2020, Pre-COVID public trail use:</u> In early 2020, the trail continued to be open for public use, for the most part, from 7:00 a.m. to sunset, seven days per week until mid-March 2020. Visitation data was collected for these three months.

<u>March 2020 – June 2021 public trail use:</u> The trail was closed in mid-March 2020 to the public—initially for trail maintenance and then longer because of public health directives regarding COVID-19. Although the narrowness of the trail could not accommodate the "social distancing" public directive in effect, the trail was re-opened gradually commencing in mid-October 2020 with a carefully implemented one-way access plan—initially for two days per week, three hours per day. Public compliance with COVID-19 safety rules for the trial was monitored, as were COVID-19 statistics and public health

directives, and, in response, the trail was temporarily closed mid-December 2020 to February 2021. By April 2021, the trail was opened for three days per week for four hours per day, and by mid-June 2021 it was open eight hours per day on those days. Given the multiple changes in the public access schedule, the data for the period of March 2020 to June 2021 are not presented.

<u>June 2021 – November 3, 2022 public trail use:</u> During this period, and with exceptions for trail closures related to weather and trail maintenance, etc., the trail was open to the public for three days per week (Tuesday, Thursday, and Saturday) for eight hours per day on those days (8:00 a.m. to 4:00 p.m.). During that approximately 16-month period, data were collected for 15 months (August 2021-November 2022).

<u>November 4, 2022 – February 27, 2023 public trail use:</u> Due to a preliminary injunction sought by the City of Dana Point and approved by the Orange County Superior Court, CNLM was required to open the trail for public access for 7:00 a.m. to sunset, seven days per week, commencing November 4, 2022 to present. During that 4-month period, trail counter data were collected for 3 months.

Public visitation rates as represented by trail counter data for the times periods described above are presented in Table 2.

Table 2. Average daily trail use counts at the Dana Point Preserve 2020-2023.

Period	Average daily visitation			Annual visitation estimate[4]	
	Access schedule	No. of months[3]	Mean	3 days/week schedule	7 days/week schedule
Jan – Mar 2020 (Pre-COVID)	7 days/week 7:00 a.m. to Sunset	3	713	-	260,245
[1]Aug 2021 – Nov 2022	3 days/week 8:00 a.m. to 4:00 p.m.	15	481	75,036	175,565
[2]Nov 2022 – Feb 2023	7 days/week 7:00 a.m. to Sunset	3	640	-	233,600

[1]The period March 2020 – June 2021 was not included due to the initial closure for seven months, followed by fluctuating public access hours. No trail counter data are available for June or July 2021.
[2] No trail counter data is available for December 2022.
[3] Number of months included in calculation (based on available data within period).
[4] Annual estimate based on access type, daily or three days per week (mean daily visitation * 3 [days] * 52 [weeks] or mean daily visitation * 365 [days]).

Data for January, February, and March 2020 (the period immediately preceding closure related to COVID-19) showed an average of 713±62.0 (SE) visitors per day. This suggests that the upward trend represented during 2011-2017 had continued, with an ever-increasing daily average of visitors on the public trail and had potentially reached over 260,000 visitors per year by March 2020. When the trail was open three days per week for 8 hours a day, the number of visitors per day was, on average, 481.1±18.1 (SE) somewhat higher than the average across 2011-2017 (444 per day), but much reduced from that in 2016 (613 per day), 2017 (673 per day), and the early 2020 observations of 713 per day. Extrapolating to annual visitation, based on three days per week, the estimate is 75,036. Further, if the eight hours per day visitation data are projected to a seven-day-per-week, 365-day schedule, annual visitation is estimated to be over 175,000, considerably higher than in 2011 (125,740).

In November 2022, when the trail was required to be open to the public seven days per week, 7:00 a.m. to sunset, visitation rates started to climb. Based on the three months of data available for this recent period, daily visitation rates had already increased by over 150 visitors per day, on average a 33% increase, with a projection of over 230,000 visitors per year. That number, however, is expected to be significantly exceeded, if that schedule remains in effect through 2023. Data shows that visitation at the beginning of that period was initially lower than expected for November and January, as the public was still accustomed to the previous schedule. The daily average for public visitation for February 2023, for the 20 days of data available, was 799.9 ±98.4 (SE)—an increase of approximately 12% over the pre-COVID 2020 daily average (713 per day).

The highest, and not just average, number of visitors per day could also be an important measure of impact on natural resources. At the very least, high daily visitor rates contribute disproportionately to annual visitor usage. Peak (one day) visitation can also be determined, although data are not available for every day that the Preserve's trail was open so the peak days for visitation (e.g., annually) cannot be confidently stated. Further, as previously explained, because several people can enter a gate at one time and only be counted as one, and if there are many visitors in a short period of time this is more likely to happen, that suggests that on busy days, the counts are likely to be underestimates of actual visitors. The greatest number of counts recorded on a single day within the period 2011-2017 was 2,896 and occurred on December 26, 2016. The highest daily count for early 2020 (January – March 2020) was 2,175 (February 16, 2020). Peak visitation days may be related to certain holidays and weather, thus there is no direct comparison available between 2016 and 2020 due to Covid-related closures on comparable dates/holidays. The highest daily count for the period August 2021 through November 2022, was 1,537 (January 1, 2022).

3.3. Information on Pacific pocket mouse and gnatcatcher presence over time

The two listed species on the Preserve have been monitored to provide information on their presence and changes in presence over time. For the coastal California gnatcatcher, surveys have been conducted annually by CNLM staff following USFWS protocols and permitted by CNLM's 10(a)(1)(A) permits. In addition to indicating presence, the surveys were generally able to detect numbers of individuals and reproductive groupings (pairs). Baseline data for the Preserve's population of gnatcatchers, collected in 2006, suggested a modest presence of perhaps three pairs or family groups (Table 3). Between 2006 and 2018, that number fluctuated between three and seven pairs—such fluctuations not being surprising for this (sub)species and variations in habitat conditions. There was an increase in 2019 to 14 pairs detected, and an even stronger increase in 2020 of 20 pairs. The results for the 2021 and 2022 monitoring events show a slight decline with 17 and 12 pairs detected, respectively (Table 3).

Table 3. Monitoring results for coastal California gnatcatcher on the preserve 2006-2022.

Reporting Year	Survey Results
2006	3 family groups
2007	3 pairs; 1 nest produced 3 fledglings
2008	4 pairs; all pairs produced 3-4 fledglings each
2009	5 pairs; all pairs produced 3-4 fledglings each
2010	4 pairs; all pairs produced at least 1 fledgling each
2011	5 pairs; 4 pairs produced at least 1 fledgling each
2012	7 pairs; all pairs produced at least 1 fledgling each
2013	7 pairs; 6 pairs produced at least 2 fledglings each
2014	6 pair; 3 pairs produced at least 1 fledgling each
2015	5 pairs; 3 pairs produced at least 1 fledgling each
2016	6 pairs (minimum)
2017	5 pairs (minimum)
2018[1]	7 pairs (minimum), one nest likely failed due to proximity to trail
2019	14 pairs; at least 8 pairs successful; multiple pairs attempted second nest.
2020	20 pairs; at least 9 pairs successful; multiple pairs attempted second nest
2021	17 pairs; at least 4 pairs successful; multiple pairs attempted second nest.
2022	12 pairs; at least 2 pairs successful; multiple pairs attempted second nest

[1]In 2018, one gnatcatcher nest was observed in a shrub immediately adjacent to the trail at Overlook 4. As a precaution to protect the nest, that small section of the trail was temporarily closed to public use (signs and temporary barriers were placed on both ends of the trail). However, visitors frequently ignored this closure and used that section of trail. Ultimately, that particular nest failed, and that pair did not produce a successful nest in 2018 (CNLM 2019).

For Pacific pocket mouse, detection is more challenging and less precise, given that they are nocturnal, dwell in underground burrows, and surface only for certain essential activities including foraging, mating, and sand baths. Currently, two methods for monitoring the PPM population are used at Dana Point Preserve, track-tube and live-trap.

Starting in 2011, CNLM used track tubes to monitor PPM using methods developed by experts in the field and following the USFWS survey protocols. Track-tube surveys have been used successfully for monitoring PPM (Brehme et al. 2014), providing information on presence/absence, areas occupied, and—depending on survey design—some phenological and demographic data. This information is valuable in guiding short-term management decisions, helping to reduce the risk of harassment or take of PPM, and determining any trends that may be important for the long-term management of the Preserve. Such surveys may also be an indirect indicator of habitat suitability for PPM. In 2020 a revised, more consistent and robust track tube monitoring design was implemented by CNLM on the Preserve. This updated monitoring design will provide spatial and temporal data for short-term and long-term management on the Preserve and has potential to be compared to and analyzed with species-level data from monitoring efforts of the other two wild PPM populations. However, due to the differences in track-tube monitoring efforts and survey design from 2011 to 2019 and the lack of data prior to the installation of the trail, only live-trap data are presented in this plan as a reference for changes in potential population size.

Live-trapping has been conducted from time-to-time on the Preserve and this can provide confirmation of the presence of the (sub)species and can provide some other indicators of population health (such as presence of both sexes, reproductive status, general health of individuals trapped). Although the number of animals trapped has an uncertain relationship to the actual number of mice on the Preserve, live-trapping provides a general indicator of high, medium, or low numbers overall on the Preserve.

Other reasons for trapping have been to provide individuals for the USFWS's captive breeding program and to allow for collection of samples for genetic testing. Fecal samples have also been collected during trapping with the objective of analyzing diet composition.

Preserve staff have kept live-trapping at a minimum given its highly invasive nature. Stress to the trapped animals is inevitable and accidental deaths are possible. Live-trapping has been conducted in six years since 2008, commencing the year prior to the trail opening (2008) and again in May 2009—with the trail being opened to the public later in the year (Table 4). In May 2009, 82 animals (unique individuals) were trapped—up from 30 trapped the year prior. The number of trapped individuals decreased dramatically over the next three trapping events from 2012 to 2019, with only two animals trapped in 2019. Trapping was most recently conducted in summer 2020, after the Preserve had been closed for over three months due to COVID-19, and the number of individuals trapped was dramatically higher: 77 unique individuals.

Although trapping success can also be associated with trapping "effort" (measured here as trap availability—e.g., one trap deployed for one night = one trap night), similar trapping efforts (e.g., 2009 vs 2012) resulted in very different numbers of mice caught, and high levels of trapping effort (e.g., >1200 trap nights) provided results that varied from 6 to 82 (Table 4). Although the trapping effort in 2019 was low relative to that in 2017, even tripling the outcome (i.e., as a rough estimate of effect of increasing the trapping effort to something similar to 2017) would have still resulted in a low number of mice trapped (hypothetically). The trapping effort in 2020 was lower than that in all the previous years but one since 2008 yet had the second highest number of mice trapped. In general, a high level of trapping will not result in significantly more captures if there is a low resident population; conversely, even a lower trapping effort can result in high trapping results if there is a more robust resident population of mice.

Table 4. Results from all live-trap Pacific pocket mouse monitoring events 2008-2020.

Month(s) and Year of Trapping Events	Level of Effort (trap nights)	Trapping Results (unique PPM)
May – June 2008	3280	30
May 2009[1]	3770	82
May 2012	3330	57
May 2017	2286	6
June 2019	792	2
June 2020[2]	1254	77

[1] The trail was opened to public access in December 2009.
[2] The trail was closed to public access in March 2020.

Many variables and conditions can affect both the number of Pacific pocket mice onsite and the number of trapped individuals including, but not limited to, food supply, vegetative cover and composition, sex ratio, demographics, and influences on above- and below-ground behavior. The latter could include the influence of the visiting public. For example, data collected in 2020 indicated a significant correlation between vegetation management (in this case, removal of some dead vegetation, primarily shrubs) and location of PPM (Brehme et al. 2020). It is not feasible to have an experimental design that allows changes in PPM (or other species) to be attributed to any single factor, as there are many moving parts in a natural landscape, as well as lag effects for some treatments or influences that may complicate the observed patterns. As USFWS and CDFW have noted, "[r]egardless of the cause of the observed fluctuations in the PPM population, the monitoring results clearly illustrate that this population remains vulnerable to extirpation due to its isolation and small population size." (USFWS and CDFW 2022).

Although there is limited ability at present to track changes in PPM genetic diversity over time (due to lack of sampling or modest numbers of mice sampled historically), genetic diversity itself is certainly dynamic—changing over time in response to natural processes including adaptation, migration, genetic drift, and mutation. To some extent, genetic diversity can be influenced, although not directly managed, by providing conditions conducive to effective reproduction and with extreme interventions such as removing or introducing mice. Genetic diversity is the basis for long-term adaptation and very low levels may indicate concern, under certain conditions, for negative effects from inbreeding depression. Recent increased analysis of the mitochondrial genome revealed higher levels of nucleotide and haplotype diversity for the Dana Point PPM population than previously reported (Shier et al. 2022). In fact, the Dana Point population had haplotype diversity almost as high or higher than the other two populations. While this is reassuring information for the Dana Point population of PPM (although this is still based on just a sample from the mitochondrial genome and a sample of Dana Point mice), the information that the Camp Pendleton populations do not have significantly higher diversity (given the size and context of those populations) is somewhat surprising. Further, chromosomal differences that have been detected between the Dana Point population and the two at Camp Pendleton create more challenges in using assisted migration of mice among populations to increase genetic diversity at any of the populations. Although a well-constructed breeding strategy could potentially overcome those barriers, that intervention remains uncertain.

3.4. Changes in vulnerability of Pacific pocket mouse to extinction at the population and species levels

At the time the Preserve was established in 2005, there were only four known populations of the Pacific pocket mouse. In fact, PPM were thought to be extinct beginning in the early 1970s until rediscovered in 1993 at what is now the Dana Point Preserve (Brylski 1993, USFWS 1994). Subsequent to its rediscovery, PPM was found in three additional locations on Marine Corps Base, Camp Pendleton (North San Mateo, South San Mateo, and North Santa Margarita). Although the most recent species-wide status assessment noted that its status has improved since its listing in 1994 with the discovery of those populations (USFWS 2020), PPM, at the species level, has become rarer and hence more endangered since 2005 as PPM have not been documented at one of those three locations (North San Mateo) since 2003 (Natural Resource Assessment Inc. 2003, USFWS 2010). Therefore, it is suspected that this population has since been extirpated, leaving only three wild populations. The PPM population on

Dana Point is the only non-federally owned property where the PPM occurs naturally and has become more important for the persistence of the species.

Further, two of the extant populations—those on Marine Corps Base, Camp Pendleton—are vulnerable to impacts from military training activities. To offset training-related impacts, CNLM and the Department of Defense (DoD) entered into an agreement in 2020, approved by USFWS, to use DoD funding to enhance conditions for PPM on the Dana Point Preserve.

Extinction risk of a species is related to the number of populations and the probability of persistence of each of those populations. With only three populations remaining in the wild, extinction risk of PPM is high even with the efforts towards establishing more populations with captive-bred mice. Establishing new populations of wildlife is challenging and the use of captive-bred mice may provide even more challenges due to some unintended and unavoidable consequences from their more domesticated origin. It will require many years (and PPM generations) before it could be determined whether any new (introduced) populations were truly “established”. Given the current or likely disconnected nature of wild and introduced populations of PPM and the threats that are widespread as well as others that may be more population-specific, all populations would be even more vulnerable to extirpation without professionally implemented adaptive management using all available stewardship tools to avoid, minimize, and control threats.

CNLM has been using stewardship tools to address those threats that can be managed. For example, with respect to vegetation management, increased management resources can be used to best effect for PPM persistence but many factors are largely or totally uncontrollable. While vegetation is manageable to some extent (influencing the amount of ground cover and species composition with trimming and removal, possibly some planting), it is still a function of natural processes and affected by weather conditions and climate change—largely unmanageable factors. Some of the growing threats to the Preserve cannot be directly managed or controlled, such as climate change, or the spread of certain diseases and viruses. Because of the increasing threats to PPM at the both the population and species level, adaptive management requires measures to address known and manageable threats, which include impacts from public access.

3.5. Changes in threats to the natural resources

The Preserve and its habitat and resident species are vulnerable to a number of threats of which we are currently aware. Vegetation condition is somewhat manageable (i.e., is also affected by weather, browsing, insects, and disease, etc.) and both the knowledge base and intensity of management by CNLM have increased over time. As such, vegetation conditions for PPM have likely improved, reducing this somewhat as a threat.

Rabbit hemorrhagic disease virus serotype 2 (RHDV2)—a highly transmissible and frequently fatal disease of rabbits—was documented in California in 2020. RHDV2 has since rapidly spread throughout the state and as of December 2022 the virus has been documented in 20 counties including Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties. This virus can be vectored on shoes and clothing of the visiting public and can persist in the environment for a very long time, making disease control efforts extremely challenging once it is in wild rabbit populations. Infections on the Preserve or its vicinity would not only almost certainly result in the death of the rabbits but have further consequences for the ecosystem. But RHDV2 is just one example of viruses or other causes of extreme disease that will occur from time to time and can be spread by human visitors on the Preserve.

Snake fungal disease (*Ophidiomyces ophidiicola;* SFD) was also recently (2019) confirmed in California (CDFW 2019). SFD affects many snake species and presents a threat to the eight species of snakes found on the Preserve. Cases of SFD can be moderate to fatal. SFD lives in soil and can be transmitted to snakes by direct contact with infected animals or a contaminated environment; spread of the fungus to new locations may occur when people track contaminated soil embedded in clothing or shoes (Cornell University 2019).

Some inherent life-history characteristics make species more or less vulnerable. For example, a relatively short life-span creates a necessity for frequent and successful reproductive events to avoid extirpation. PPM has a short life-span in the wild—the average being approximately one year, although survival for as long as three to five years is not uncommon (French et al. 1967, 1974). Even with some mice experiencing life expectancies at the longer end of the range, PPM populations are very vulnerable to threats that are constant and may have a depressing effect on successful reproduction, or those that are periodic and may severely reduce or completely undermine reproduction for several consecutive years (e.g., years-long droughts).

Climate change is a continuing and expanding influence with uncertain impacts on the Preserve's natural resources. Across southern California, the average annual minimum and maximum temperature increased during the span of 1918-2006, +0.17 °C and +0.07 °C per decade respectively (EcoAdapt 2016a). In addition to the general warming effect of climate change, the occurrence of extreme weather events has also increased (IPPC 2022). Heat wave activity increased across California between 1950-2010, and heat wave conditions (3 or more days with temperatures above 32°C) are projected to occur more frequently in California by the end of the century (Gurshunov and Guirguis 2012), and are expected to last longer, feature higher temperatures, and affect larger geographic areas (Gershunov et al. 2013). Moreover, the probability of co-occurring extremely warm and extremely dry conditions (1.5 SD anomaly) remains greatly elevated throughout the 21st century (Diffenbaugh et al. 2017). While increased annual temperatures will have impacts to the Preserve, it is likely that changes in annual seasonal variability will have a higher impact on the Preserve. Changes in maximum annual temperatures, rather than increased annual temperatures, have been shown to be correlated with local extinction events (Roman-Palacios and Wiens 2020).

Since 2005, the Preserve has experienced some drought effects. The longer-term influences of rapid climate change on weather patterns influencing the Preserve have some uncertainty. Nevertheless, any significant changes from historic patterns will undoubtedly have consequences for the plants and animals onsite (Table 5). Changes in processes such as nitrogen deposition, decomposition, pollination, and soil water recharge could also have onsite consequences. These changing conditions can be stressors on plant and animal life, and consequences could include depressing effects on the food supply and habitat conditions for the Pacific pocket mouse and gnatcatcher, for example. Sage scrub—the predominant vegetation type on the Preserve—does exhibit plasticity in response to drought and precipitation variability; however, altered precipitation timing, soil moisture, and drought severity may affect composition, distribution, and survival of this community. Many sage scrub species are projected to experience a >50% decline in suitable habitat in southern California by mid-century (EcoAdapt 2016b).

Table 5. Projected climate-driven impacts on sage scrub habitat (EcoAdapt 2016b).

Projected Climate and Climate-Driven Changes	Potential Impacts on Sage Scrub Habitats
Variable precipitation, reduced soil moisture, increased drought *Variable annual precipitation; increased climatic water deficit; increased drought frequency and length*	• Altered distribution, species composition, survival, recruitment, germination, productivity, and phenology; potential conversion to more xeric shrub communities and/or non-native annual grassland • Less frequent/larger rainfall events: sage scrub may gain competitive advantage over chaparral and invasive grasses
Increased temperatures and heat waves *+2.5 to +9°C by 2100; increased heat wave frequency and length*	• Altered distribution and species composition • Decreased germination success for some species • Altered susceptibility to exotic invasion
Altered fire regimes *Increased fire size, frequency, and severity*	• Native species declines via resprout mortality and reduced seedbank • Increased exotic species establishment and abundance, potentially exacerbating shifting fire regimes and leading to habitat conversion

The Argentine ant (*Linepithema humile*, Mayr), a non-native invasive ant species, is considered a threat to many native terrestrial species in California and is listed as a global species of concern (ISSG 2021). In California, Argentine ants are more likely to be in high abundance along the coast than inland areas and in urban and agricultural areas more so than large natural open spaces (Mitrovich et al. 2010, Richmond et al.

2021). It is not surprising that, being coastal and urban, Argentine ants are present throughout the Preserve (CNLM 2019). While it is unknown when the Argentine was established in the Preserve, the infestation does appear to be at higher density than when the first CNLM Argentine ant survey was conducted in 2014. At that time, the Argentine ant naïve occupancy estimate (the number of points with ants detected out of the number of points monitored) was 65.6% (82/125 grids) while in 2018 the naïve occupancy estimate was 94.6% (123/130) with more grids (87/130) having a "high number" of Argentine ants present on bait (i.e., >250 individuals) than in 2014 (32/125) (see CNLM 2014 and 2019).

The impact of Argentine ants on the arthropod community has been widely studied in agriculture and in urban and natural settings. Research has shown a negative relationship between Argentine ant presence and diversity of arthropods including native ant species and pollinators in their introduced range (e.g., Lach 2007, Naughton et al. 2020, Richmond et al. 2021)—both of which can impact pollination success (Rankin et al. 2018), seed set, seed dispersion, and germination success of plant species (Carney et al. 2003, Lach 2007). In addition, research has shown negative impacts of Argentine ant infestations on reptile and avian species (e.g., Suarez et al. 2005, Alvarez-Blanco et al. 2020). Within the Preserve, Argentine ants have been documented in failed gnatcatcher nests (K. Merrill pers. comm.). Direct impacts to mammals are less known. However, during PPM trapping events at Camp Pendleton Argentine ants were found in traps with and on PPM (and other small mammal species) (Brehme et al. 2014). Argentine ants are tramp species, likely drawn to the trap for the seed bait, and can quickly monopolize resources including small vertebrates such as PPM, targeting their vulnerable areas (i.e., nose, mouth, ears, and eyes). Argentine ants were also noted scavenging on two dead PPM, which were casualties associated with a live trapping event in 2020 (K. Merrill pers. comm.). While it is uncertain if the ants were the direct reason for the deaths, the negative impacts of Argentine ants on ecosystem health are known (e.g., Carney et al. 2003, Lach 2007, Rankin et al. 2018). As a result, the threat of Argentine ants has been highlighted in recovery plans for threatened or endangered species, including PPM (USFWS 1998). It is possible that Argentine ants directly impact PPM through predation in their burrows (Brehme et al. 2019) by foraging on young, and indirectly through harvesting seed caches. Trash left by visitors (i.e., food and beverages) exacerbates the threat by providing additional resources (sugary drinks in particular) to Argentine ants along the trail, in the adjacent parking lot, and within PPM habitat (K. Merrill pers. comm.)

Ongoing and increasing residential development in the vicinity of the Dana Point Preserve has the potential to increase indirect threats to sensitive species on the Preserve. Such threats include an increase in the number of domestic cats and other non-native and native predators generally associated with human development (crows, ravens, raccoons, red foxes, opossums), as well as negative impacts from vibrations, noise, artificial lighting (USFWS 1998, 2010, Brehme et al. 2013-2020, D. Shier pers. comm.), and recreation (USFWS 1998).

3.6. Public impacts from trail use: scientific research

3.6.1 Introduction

Section 3.8 below describes the challenges in designing an experimental frame that would directly determine impacts of public access on wildlife at the Preserve. As part of adaptive management, CNLM relies on relevant information in the extensive scientific literature on this topic and applies that knowledge and experience to the likely influences and impacts on the Dana Point Preserve.

Given all the influences on species in their natural environments, it is rarely possible to construct an experimental frame that allows one to test the response of a species to a single variable—such as public use of a trail. It is particularly difficult to derive such direct information in a short period of time, or when rare or endangered species are involved (thus limiting the ability to manipulate and place at risk those species). However, science-based information that is relevant to guiding management of conservation areas can be reasonably gained from studies in other locations where the research can be designed more appropriately, conducted over a longer period of time, or accumulated from many sources. Indeed, selection and application of appropriate scientific principles and peer-reviewed scientific literature are the foundation of managing specific natural areas. From this literature review, there is much evidence and reason for concern about the impacts of public use of the trail.

<u>The topic as framed in the literature</u>: The scientific literature on studies of the relationship between public access and natural areas has not only continued to grow, but is now supported by the discipline of recreational ecology—an interdisciplinary field that studies the ecological impacts of recreational activities and the management of these activities. The most basic principle in that field is that if outdoor recreation is allowed in an area, impacts to that ecosystem are inevitable (D'Antonio 2020). The term "passive recreation" is essentially obsolete. One recent collection of papers on recreational ecology was prefaced by the statement that "an increasing body of evidence is emerging that indicates non-consumptive recreational activities like hiking, which [doesn't] involve harvesting of resources, can have harmful effects on species, their habitat, and efforts to protect them" (Unger 2020).

<u>Literature inclusion</u>: For the purpose of this Plan, the literature was queried for studies related to public trails and/or recreation and related impacts, if any, on natural resources. The most recent literature to be included has a publication date of 2023, but not all 2023 publications were yet available for inclusion. The amount of literature queried and included is extensive—given that several systematic reviews of effects of recreation on wildlife were included in addition to over 100 other, individual studies. Due to the amount of literature queried, a table was prepared to provide a means of quick access to key results and context (i.e., taxa, location, objectives, results) and is provided in Appendix A. This is not a comprehensive list but a sample of literature pertaining to public access, anthropogenic disturbance, and the effects on natural resources of public use.

<u>Literature reviews/meta-analyses</u>: The increasing awareness of potential effects of recreation on wildlife has not only led to a proliferation of research but further prompted

systematic reviews and syntheses of these studies (e.g., Larson et al. 2016, Larson et al. 2019, Miller et al. 2020, Dertien et al. 2021, Rosenthal et al. 2022). Larson et al. (2016) reviewed 274 scientific articles that were global in geographic scope and included a broad range of taxonomic groups. The objective of that review was to identify knowledge gaps and assess evidence for effects of recreation. In that review, it was found that 93% of published studies documented at least one effect of recreation on animal species and most of those effects were negative (Figure 7).

In 2019, Larson et al. conducted a meta-analysis of recreation effects on vertebrate species richness and abundance. In this analysis, they parse recreation by terrestrial and aquatic and wildlife by carnivores, herbivores, and omnivores, as well as by taxa (Larson et al. 2019). Another review by Miller et al. (2020) investigated the effects of recreation in the context of public lands and recreation management. They categorized recreational activity into five types based on the use/non-use of motorized equipment, season, and location (terrestrial vs. aquatic) and within these categories, synthesized existing research for each of six taxonomic groupings of species. The authors' objectives were to provide a reference for public land planners and managers, describe management principles, and outline priority research and administrative study areas towards better understanding recreation-wildlife interactions and minimizing negative effects on wildlife while maximizing the benefits gained by recreationists. Another review by Dertien et al. (2020), which included 38 years of effect of non-consumptive recreation on wildlife, identified and quantified "effect thresholds", or the point at which recreation begins to exhibit behavioral or physiological change to wildlife. These authors provided quantitative guidelines for various wildlife groupings (wading birds, raptors, songbirds, ungulates, rodents, etc.) that can be used by planners and natural resource managers for the design of recreation infrastructure and management of recreation activities.

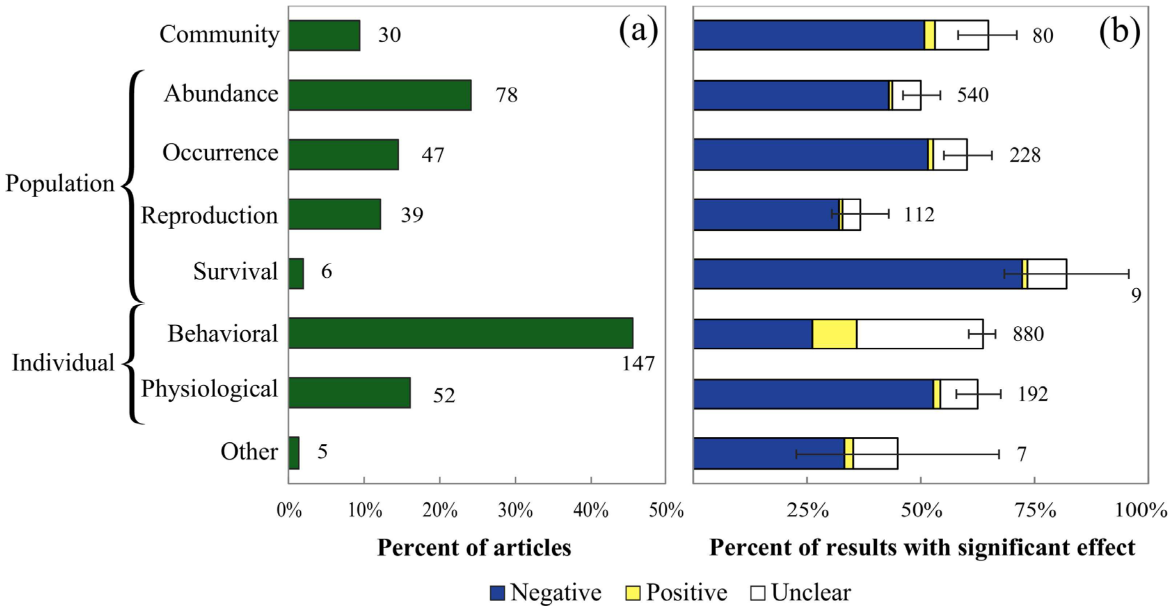

Figure 7. Types of animal responses to recreation from article review (excerpt from Larson et al. 2016). Response types are categorized into community-, population-, and individual-level responses. Panel a) shows the percent of articles in which each response type is tested (numbers of articles follow the bars). Panel b) shows the percent of results in which a statistically significant effect of recreation on an animal species was observed (number of results follow the bars). Total percentages are divided into negative, positive, and unclear effects of recreation. Error bars show standard error for the sum of all effects.

The final systematic study that was reviewed provided a comparison of the threats that affected species at risk. Specifically, a database of Canadian species "at risk" as defined by the Species at Risk Act (2002) was queried and potential threats to 280 "at risk" species (that could include populations or varieties described as species in the database) were compared for relative impact. Recreation activities were one of the five threat categories identified. Although the records for recreational impact for these species ranged from negligible to low, such (recreational) activities affected more species at risk than any other category of threat. When negligible and unknown effects were excluded, recreational activities were the third-greatest threat, after invasive species and roads/railroads (Rosenthal et al. 2022). The authors pointed out that while recreational activities presented no higher than a medium intensity threat to the at-risk species, increases in recreational use and cumulative effects could result in more significant impacts. They further emphasized the importance of managing recreational activities in natural areas, since recreational activities tend to occur in natural areas often set aside specifically for the protection of rare species and habitats.

Reports on positive effects from public visitation: The literature review affirmed the importance of context when applying research results. The majority of studies reported negative effects on wildlife—see, for example, the meta-analysis by Larson et al. (2016). However, some studies did report “positive effects” from public visitation. For those studies, the reason for positive effects was usually due to one of the following explanations:

1) Habituation and/or increases in biodiversity (even if due to increases in non-native species) were considered positive.
2) Public visitation was tied to financial support for the conservation area and suffered if tourism was reduced.
3) A positive effect was recorded for some species because a negative effect was recorded for another (e.g., large- and medium-sized carnivores were negatively affected, moving away from the human-influenced areas. Small mammals (deer mice and woodrats) evidently benefited, increasing habitat use and foraging (Suraci et al. 2019).

None of these positive effects are relevant to PPM and the Dana Point Preserve. Habituation (see Section 3.7) may not occur and would likely have negative effects if manifest at all. The value of biodiversity in this conservation context would not include the presence of non-native species (e.g., domestic cats, weeds). There is no financial benefit to the Preserve or PPM from public visitation. Relevant PPM predators at Dana Point (e.g., fox, racoon, domestic cat) are attracted to, rather than displaced from, human activity.

Results from COVID-related park closures: More recently, the COVID-19 pandemic, with its associated closures of many public parks and preserves, provided an unprecedented experimental frame in which to evaluate wildlife and other natural resource responses to exclusion of the public for some time. (The authors acknowledge that the opportunity provided to scientists by COVID-19 closures of natural areas was and remains a tragic occurrence.) Although there were many anecdotal observations of unusual wildlife sightings and interactions when parks and preserves were closed, some formal studies were also undertaken, although all may not yet be assessable given the time typically involved from study initiation to publication in a scientific journal.

In one recently published study, the authors used the “natural experiment” of the COVID-19 closure within a heavily visited and highly protected national park (Glacier National Park, MT, USA) to examine how “low-impact” recreational hiking affects the spatiotemporal ecology of a diverse mammal community. Using camera traps to record wildlife observations when the park was closed and then subsequently open to recreation, the authors found consistent negative responses to human recreation across most of the assemblage of 24 species. Those negative responses were manifest as fewer detections of wildlife, reduced site use, and decreased daytime activity. The authors noted that “the dual mandates of protected areas to conserve biodiversity and promote recreation have potential to be in conflict, even for presumably innocuous recreational activities” (Anderson et al. 2023).

<u>Extent of negative effects from public interactions with wildlife</u>: Negative effects related to recreational disturbance have been documented across a wide variety of species and taxa including, mammals, birds, reptiles, amphibians, and even invertebrates (e.g., Steven et al. 2011, Bennett et al. 2013, Larson et al. 2019). In general, damaging effects on animals resulting from recreation activities include reduced reproductive success (Beale and Monaghan 2005), declines in abundance and occurrence (Reed and Merenlender 2008), modified habitat use (George and Crooks 2006), and altered species richness and community composition (Kangas et al. 2010). Disturbance from recreation may have both immediate and long-term effects on wildlife. The immediate response of many animals to disturbance includes physiological stress, change in behavior (interruption of foraging, fleeing), or altering reproductive behavior (Persons and Eason 2017, Gutzwiller et al.1994, Arlettaz et al. 2007). Over time, energetic losses

from flight, decreased foraging time, or increased stress levels come at the cost of energy resources needed for individuals' survival, growth, and reproduction. The cumulative, compounding adverse effects of predator-avoidance behaviors can have impacts on fecundity and every component of offspring survival, with long-term implications for population growth (Allen et al. 2021).

Human disturbance on wildlife from non-consumptive recreation can result in altered spatiotemporal habitat use (Kangas et al. 2010), extirpate wildlife from otherwise suitable habitat, or cause animals to shift geographically into areas of lower quality habitat to avoid areas with human activity (Taylor and Knight 2003, Ficetola et al. 2007, Finney et al. 2005, Kangas et al. 2010, Mallord et al. 2007, Dertien et al. 2021). Thus, recreational disturbances can both reduce habitat suitability and ultimately result in functional habitat loss (Gutzwiller et al. 1994, Frid and Dill 2002, Tost et al. 2020). Fragmented habitats may present unique stressors if there is no adjacent habitat for animals to relocate to, forcing individuals to remail in proximity to disturbance that they would otherwise avoid (Frid and Dill 2002).

There is much complexity in studying, and then understanding, the interaction between recreational activities and wildlife response. Conceptual frameworks can assist in structuring such complexity and informing experimental designs. One such framework identifies three important factors or "modulators" in these interactions: wildlife, human, and context (Figure 8, Tablado and Jenni 2017). The framework represents increasing levels of complexity in the mechanisms for wildlife response—from sensory detection; to short-term behavioral changes and physiological responses; to changes in survival, reproduction, spatial use of the habitat, and chronic stress; and finally, changes in population trends and distribution. These levels of complexity also mirror the level at which the effect is occurring: from individual- to population-level, and the latter then also affecting species-level condition. In a review of global literature on wildlife-recreational interactions, many of the articles reviewed reported impacts at both the individual- and population-level, and of the former, the most often noted were behavioral impacts (Larson et al. 2016, Figure 7).

At the individual level, wildlife-recreational interactions can elicit responses that are generally categorized as behavioral or physiological. Behavioral interactions can be both short term and longer term and can be innate (perhaps genetic) or learned, or a combination. Examples of short-term and longer-term behavioral responses have been provided in a recent literature review and analysis of such interactions (Table 6, Miller et al. 2020). The responses are highly variable (from attraction to avoidance, and from habituation to sensitization)—thus emphasizing the complexity of these interactions and their dependence on the specific human, wildlife, and context “modulating factors”.

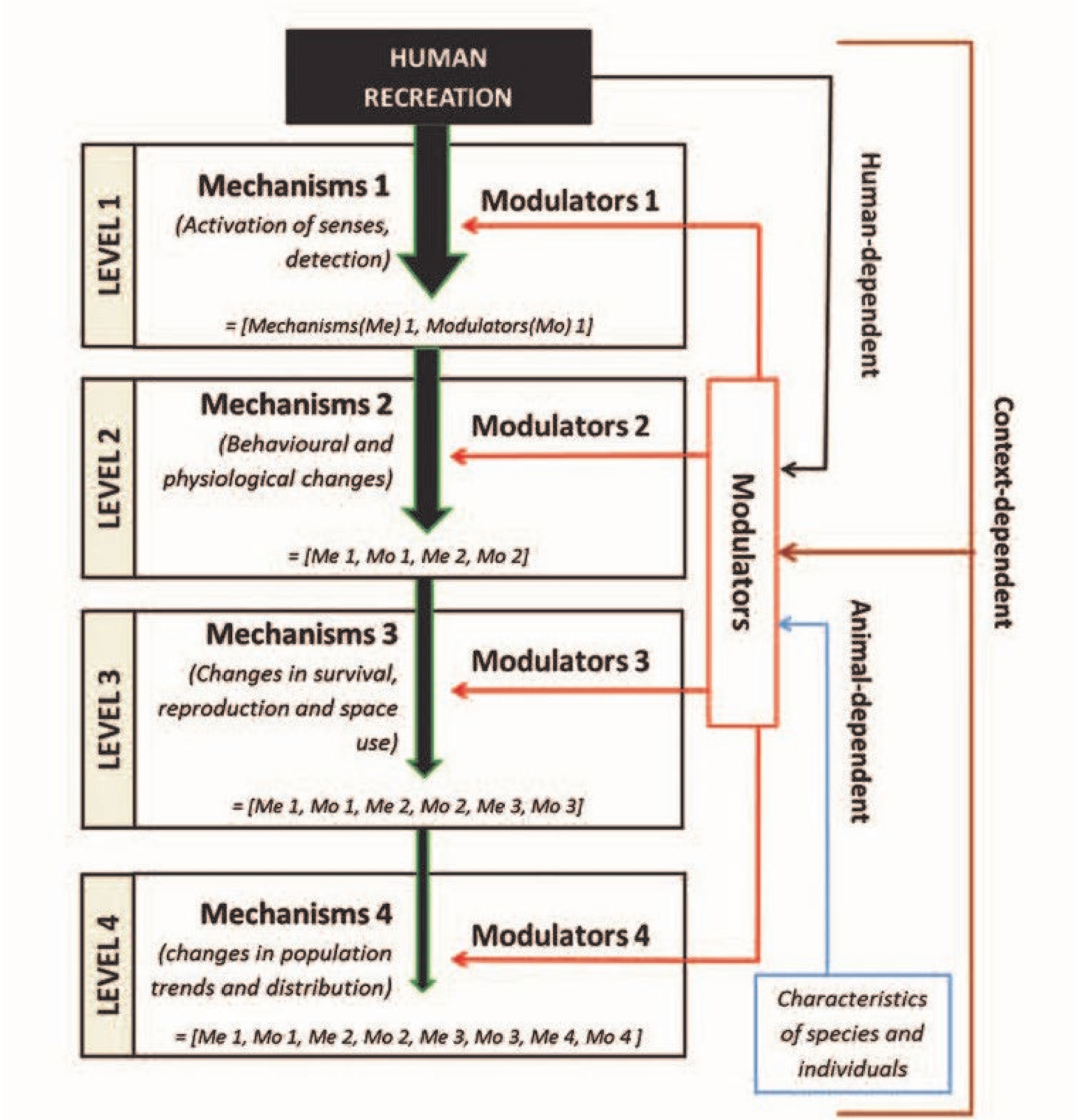

Figure 8. Conceptual framework showing different levels in the processes of human-wildlife interactions (excerpt from Tablado and Jenni 2017).

Table 6. Short-term and long-term learned behavioral responses of wildlife to human activity (excerpt from Miller et al. 2020).

Behavioral response	Definition	Example	Source
Short-term responses:			
Attraction	The strengthening of an animal's behavior because of rewards or positive reinforcement.	A chipmunk is attracted to areas where recreationists leave food.	Knight and Gutzwiller 1995
Avoidance	The strengthening of an animal's behavior because of persecution or negative reinforcement.	Grizzly bears in an area with high human activity levels often flee from people, while those in an area with no or little human activity do not.	Knight and Gutzwiller 1995
Tolerance	Intensity of disturbance that an individual tolerates without responding in a defined way.	Terns ignore heavy vehicle and boat traffic. This is measured in the short term, and evidence of this tolerance increasing over time is absent.	Nisbet 2000
Long-term responses:			
Habituation	Waning of a response to a repeated stimulus that is not associated with either a positive or negative reward.	Birds habituate to stimuli that are predictable and nonthreatening, such as road traffic, but are startled by sudden and unpredictable noises such as gun shots.	Eibl-Eibesfeldt 1970
Sensitization	Increased behavioral responsiveness over time when animals learn that a repeated or ongoing stimulus has significant consequences for the animal.	Avoidance of noise or other stimuli associated with danger; entails an increased energy expenditure to avoid danger.	Richardson et al. 1995

In the following sections, there is continued discussion of the relevant literature, beginning with a description of the ecology of the Pacific pocket mouse so as to better allow connections to be made with potential influences or threats to this subspecies. Following that, the literature has been categorized by general taxonomic groups: vertebrates, invertebrates, and habitat and vegetation communities. Given the likelihood that dogs would be perceived as a threat to PPM and that they are occasionally brought onto the Preserve by visitors, some literature is presented that examines wildlife responses to domestic dogs. Finally, the topic of habituation is explored, given that it is a potential modulator in the response of wildlife to public recreation on the Preserve.

3.6.2. Pacific pocket mouse ecology and impacts from human disturbance

The Pacific pocket mouse is a nocturnal, aggressively solitary, and semi-fossorial rodent in the family Heteromyidae that is physiologically adapted to warm and dry climates (USFWS 1998). It is the smallest subspecies of the little pocket mouse (*Perognathus longimembris*), generally ranging between 7-9 grams in adult body mass (USFWS 1998). Adults weighing as little as 5 grams and as much as 12 grams have been trapped on the Dana Point Preserve (K. Merrill pers. comm.). Average life expectancy in the wild is approximately 1 year, with survival for as long as 3–5 years not uncommon (French et al. 1967, 1974). This short life expectancy contributes to the population's vulnerability: significant impacts to even one reproductive cycle could have serious consequences for the sustainability of the population.

The onset of breeding is typically in early spring and lasts through July (USFWS 1998). The time period during which a female PPM is in peak estrus can be extremely limited (i.e., as brief as one hour per cycle, D. Shier pers. comm.). Disturbance during this time could dissuade reproductive behavior. Females gestate young for approximately three weeks and wean after 30 days.

Reproduction is also influenced by food availability. In fact, reproduction may not occur in years of low food resources (Brehme et al. 2019) but in high resource years, adult females in the wild may have up to two litters, with their female offspring mating and reproducing concurrently in a single season (Miller and Pavelka 2008). PPM is largely granivorous, specializing on grass and forb seeds (USFWS 1998). A positive relationship was found between forb cover and PPM occupancy at Marine Corps Base Camp Pendleton (MCBCP, Brehme et al. 2014) and at the Preserve (Brehme et al. 2020). Genetic analysis of PPM scat has shown that diet varies across populations and that within one season, regardless of available seed resources from shrubs and grasses, they tend to select a wide variety of forb species (Iwanowicz et al. 2016). Years with low forb growth and early forb die-offs have been associated with PPM declines (Brehme et al. 2019). Food availability is thus related to successful production of grass and forb seeds (for the most part) on site—which is, in part, weather-related. Considerable research has tied reproduction in heteromyids and other desert rodents to precipitation (Beatley 1969, Kenagy 1973, Reichman and Van De Graaff 1975, Kenagy and Bartholomew 1985). But food availability can also be influenced by competition from other species for the same food resources, loss of food sources from insects and disease, and destruction of plants from trampling or picking.

PPM create and live in burrows beneath the soil surface, and cache seeds below ground and within burrow systems for sustenance throughout the year (e.g., Randall 1993). More recent research has provided evidence that both pit caches and larders may be used (Chock et al. 2019). In sand dunes in Oceanside, CA, burrows were found approximately one foot below the surface under vegetation edges and ended in a single nest chamber (Bailey 1939). Burrows and tunnels can sometimes be even closer to the surface—as little as 1 to 4 inches below ground (D. Shier pers. comm.). As such, sounds and vibrations from above-ground disturbances such as trail users, could affect PPM below ground. In sandy habitats, burrows are particularly vulnerable to compaction by foot traffic. Brehme et al. (2014) reported a strong negative effect of human foot traffic on PPM occupancy. Although much remains to be studied regarding burrow architecture, recent observations have indicated that the height of the burrows may be very shallow (e.g., 1 inch)—further indicating their vulnerability to collapse.

Pacific pocket mice, while remaining below-ground for substantial amounts of time, of course need to conduct life-sustaining activities at the surface including feeding and food collection, selecting mates and mating, territory exploration and expansion, and bathing (i.e., sand baths). The average PPM core home range size is estimated to be 0.017 hectares, or ~13 meters in diameter (Shier 2009) but individuals have been recorded traveling 181 meters in a single night, with average movement distances reported of 10 meters to 30 meters between successive captures (Dodd et al. 1998, 1999, Miller and Pavelka 2008). Mark-and-release studies indicate limited adult movement and juvenile dispersal distances (Swei et al. 2003).

PPM above-ground activities are typically conducted at night or during low-light levels. As such, artificial night-time lighting may cause problems for nocturnal rodents such as the Pacific pocket mouse, through potential modification of predation rates, obscuring of lunar cycles, and/or causing direct habitat avoidance (USFWS 1998, Shier et al. 2020). A study of the effect of different levels and orientation of (artificial) night lighting on PPM at Marine Corps Base Camp Pendleton indicated that anthropogenic light negatively affected foraging of PPM (Wang and Shier 2017).

Additionally, the presence of humans during low-light levels of the day (towards sunset or for some time after sunrise, and as influenced by fog or cloud cover) likely also impacts PPM behavior and shortens or discourages such essential activities by altering their perceived predation risk (Persons and Eason 2017).

PPM use seasonal heterothermy (winter torpor and facultative summer aestivation) in response to environmental stresses of food shortage and/or low temperatures (Chew et al. 1965, Bartholomew and Cade 1957). The onset of torpor is marked by a large drop-off in activity that can occur from June to November and is highly spatially variable within and among years (Meserve 1976a, Shier 2009, Brehme et al. 2014, 2020). During torpor, the mice alternate between periods of dormancy and feeding on cached seeds. Periods of dormancy have neither a daily nor strictly seasonal pattern (Brehme et al. 2014). In captivity, dormant individuals may show some activity each day within their burrows. Emergence typically occurs in late winter to early spring (February-March) and is thought to coincide with seed availability (Meserve 1976b). It has been suggested that the trigger for emergence may be changes in soil temperature (French 1977).

As the beneficial aspect of torpor or aestivation is to reduce energy expenditure, any disturbance that disrupts these states can have a negative effect. Again, such disturbances could include human-caused sounds or vibrations—especially if burrows are shallow and/or close to the surface. Further, because Heteromyids have expanded middle ears, they are especially sensitive to low frequency sound (D. Shier pers. comm.).

Another variable that may be useful in an experimental framework to study wildlife-recreational interactions is distance from the source of the potential disturbance. The source could be a trail, for example, and potential impacts measured for a variety of species at varying distances from the trail (assuming the trail is regularly used for recreation). Reasonably, the effects may be related to the spatial scale at which various species occupy and use the area, and perhaps also may be seasonally dependent (e.g., populations may be more or less sensitive during certain stages of a life-cycle). In a recent study to examine potential impacts of public access to trails, “threshold buffers” (distances from the trail within which effects might be expected to occur) were determined for three taxonomic groups (perching birds, ungulates, and apex predators) (Dertien and Larson 2018). Given the meandering nature of the public trails, these trail buffers overlapped almost all of the subject property, resulting in no contiguous areas across the property that were free from potential recreation effects.

Using a similar approach for the Pacific pocket mouse population at Dana Point, three “distance zones” (or threshold buffers, using the previous terminology) were superimposed on the Preserve to provide a sense of how this concept might be experienced. Three zones—13, 50, and 100 meters from the trail—were mapped (Figure 9). Given the meandering nature of the trail, even the shortest (potential) impact zone (13 meters) covers a significant portion of the Preserve (16%). That distance was selected on the basis that this may be the average diameter for PPM core home range (Shier 2009). The other two distance zones, 50 and 100 meters, reflects some literature that found that smaller rodent species avoided areas within 50-100 meters of trails or people (Dertien et al. 2021). At 100 meters, almost 90% of the Preserve is included in the potential impact zone, which does not include impacts from the adjacent parking lot and roads. If those (latter) impacts are included the threshold buffer for the Preserve, the entire Preserve would be potentially impacted.

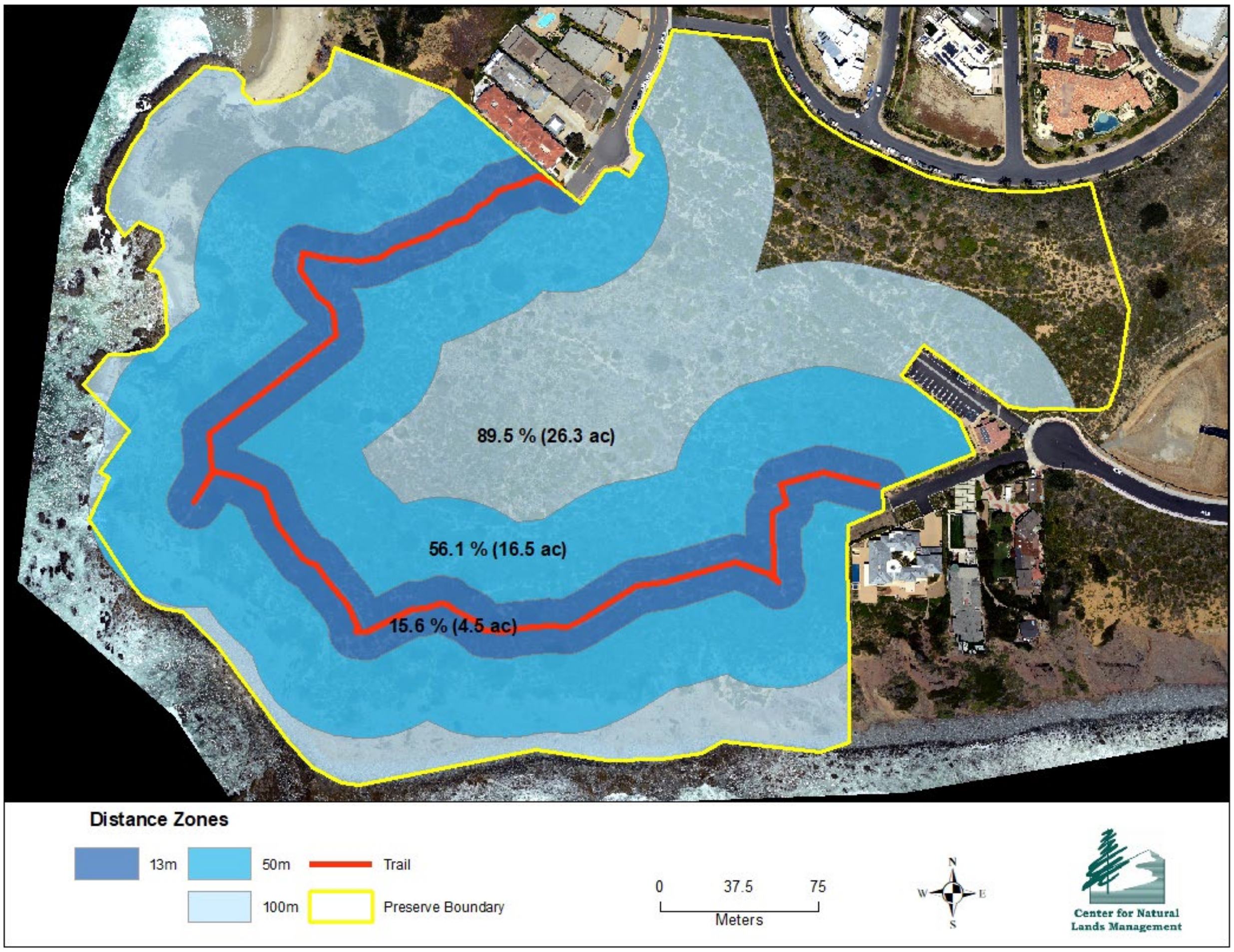

Figure 9. Zones of varying distance (13 meters, 50 meters, 100 meters) from the trail at the Dana Point Preserve. Values show proportion (%) and area (acres) of the Preserve covered by each zone.

3.6.3. Impacts on vertebrates

Across many vertebrate species, species richness and abundance are lower in association with higher levels of recreation, and the negatives effects of recreation appear to be most pronounced for birds and mammals (Larson et al. 2019). Research on impacts to reptiles and amphibians are less represented but the majority of existing studies have found effects are negative (Miller et al. 2020). Even quiet recreation such as walking and wildlife viewing can have significant negative impacts on vertebrate wildlife (Papouchis et al. 2001, Arlettaz et al. 2007, Reed and Merenlender 2008, Hennings 2017), such as increased time spent in flight and vigilance behaviors (Naylor et al. 2009). Disturbance increases with intensity (a combination of people per day, noise level, and speed) of recreational activity, and is greater in response to less predictable activities (Shutt et al. 2014, Miller et al. 2020).

Indirect effects of increased human presence can occur when humans create an environment of higher predator pressure or cause animals to temporally shift their activities to avoid human activity. In an urban park, white-footed mice (*Peromyscus leucopus*)—primarily a crepuscular-nocturnal forager—spent less time foraging in areas of high human use even though people were not allowed in this park after dusk, possibly due to increased predator presence along trails (Persons and Eason 2017). Temporal shifts to avoid human activity can cause some species to become more nocturnal; such "diel shifts" can bring predator-prey species into greater overlap, with increase predation risks (Patton et al. 2019), or lead to suboptimal foraging conditions (Wheat and Wilmers 2016)

Artificial illumination (artificial light at night; ALAN) is an increasing form of human-caused disturbance that can affect vertebrate behavior and ecology. Small prey species may be particularly susceptible to ALAN as it makes them more conspicuous and thus more vulnerable to predation by visual predators. A study by Shier et al. (2020) examined impacts of ALAN on foraging decisions of the endangered Stephen's kangaroo rat (SKR, *Dipodomys stephensi*). ALAN decreased the probability of resource patch depletion compared to controls, indicating that ALAN reduced habitat suitability for this at-risk nocturnal rodent.

The presence of recreational trails in natural areas can limit the abundance or density of some bird communities (e.g., Bötsch et al. 2017), particularly of those species which nest or forage on the ground (Thompson 2015). For birds, impacts associated with trails may be due to interference with breeding behavior (Gutzwiller et al.1994), a reduction in foraging time (Frid and Dill 2002), alteration to vegetation structure near trails (Fernández-Juricic et al. 2001), the introduction of invasive species (Loss and Blair 2011), or increased presence of nest predators (Miller and Hobbs 2000). A review by

Steven et al. (2011) that included 69 research papers on the effects on birds of non-motorized recreation, found that 88% of these studies reported negative effects, including impacts to physiology, behavior, abundance, and reproduction.

Increased anthropogenic noise can interfere with avian acoustic communication (Slabbekoorn and Ripmeester 2008, Barber et al. 2010). Impaired communication resulting from anthropogenic noise has been linked to altered predator avoidance behaviors (Anze and Koper 2018), lower lek attendance in greater sage-grouse (*Centrocercus urophasianus*) (Blickley et al. 2012), reduced pairing success in ovenbirds (*Seiurus aurocapilla*) (Habib et al. 2007), and impaired nestling development in house sparrows (*Passer domesticus*) (Schroeder et al. 2012), indicating that the impacts of noise on communication have the potential to interfere with reproductive processes. Anthropogenic noise may function as a deceptive signal to wildlife, causing animals to engage in false responses that may be energetically and biologically costly. Evidence of this is provided by a study of endangered SKR, in which traffic noise not only masked but also mimicked foot-drumming signals (Shier et al. 2012). For vulnerable species such as SKR, the combined effects of communication disruption and signal deception may further tax already endangered populations.

3.6.4. Impacts on invertebrates

Predator-avoidance responses are not limited to vertebrates. Endangered Karner blue butterflies (*Lycaeides melissa samuelis*) were found to be sensitive to recreational disturbance and responded to recreationists as they would from natural threats, such as predators (Bennett et al. 2013). Through simulations these authors determined that regular disturbance could reduce egg laying potential and significantly restrict host plant choice, which in turn, could impact the butterfly's population dynamics. Invertebrates including butterflies, ground beetles, and spiders can also be affected by changes in vegetative structure (Blair and Launer 1997, reviewed in Miller et al. 2020). Butterfly species richness and diversity were lower in recreational areas as compared with biological reserves where recreation was prohibited (Blair and Launer 1997). Other general anthropogenic impacts to insect populations can result from light pollution. ALAN strongly reduced moth caterpillar abundance compared with unlit sites, affected caterpillar development, and disrupted the feeding behavior of nocturnal caterpillars (Boyes et al. 2021).

3.6.5. Impacts on habitat and vegetation communities

Recreation can impact wildlife habitat by altering soil characteristics, water quality, and vegetative communities (Cole 1995, Barros and Pickering 2017, reviewed in Miller et al. 2020). Direct impacts to habitat and vegetation from trail use include through a loss of vegetative cover (Cole 1995, Barros and Pickering 2017), a decrease in vegetation biomass, or damage to tree and shrub seedlings (Sun and Liddle 1993). Recreational trails can function as corridors that facilitate the spread of non-native plant species into wildlands (Underwood et al. 2004, Wells et al. 2012, Liedtke et al. 2020). Trailheads, in particular, have been found to harbor high diversity and abundance of non-native plants within the seedbank and may function as a source point for invasions into protected areas (Wells et al. 2012). Additional indirect effects of recreation on vegetation community can occur when humans facilitate the spread of pathogens. The exotic pathogen, *Phytophthora ramorum*, for example, which is the cause of Sudden Oak Death, is likely spread by humans both within already infected areas and to novel locations (Cushman and Meentemeyer 2008).

3.6.6. Impacts of domestic dogs

The presence of pets and companion animals in open space and other protected areas may also cause direct and indirect impacts to wildlife species (Reilly et al. 2017). The effects of domestic dogs (*Canis lupus familiaris*) on wildlife have been reviewed extensively and disturbances to wildlife from domestic dogs and dog-walking are well documented (Banks and Bryant 2007, Steven et al. 2011, Hennings 2016, Reilly et al. 2017). Dogs are a domesticated subspecies of wolf and their presence and scent (which remains after dogs are gone) repels many wildlife species and incites antipredator responses (Epple et al. 1993).

A review by Hennings (2016, 2017) on the effects of dogs concludes that (1) people with dogs on leash, and even more so off-leash, are more alarming and detrimental to wildlife than any non-motorized recreational user group without dogs and that (2) people with dogs substantially increase the amount of wildlife habitat affected. The effects of dogs may be long-lasting and linger after the dog is gone, because the scent of dogs repels wildlife (Epple et al. 1993). It may be, too, that wildlife do not habituate to dogs (particularly off-leash dogs) because wildlife perceive dogs as predators, and because their behavior can be unpredictable (Banks and Bryant 2007, Weston and Stankowich 2014, Hennings 2016, Gomez-Serrano 2021).

People with dogs may represent the highest disturbance type of recreation for birds (Miller et al. 2020, Gomez-Serrano 2021). Dog walking in woodlands lead to a 35% reduction in bird diversity and 41% reduction in abundance, not just in areas where dog walking was common, but also where it was prohibited (Banks and Bryant 2007). Moreover, this study found no evidence of habituation even with leashed dogs and even where dog-walking was frequent; the disturbance was much weaker for people than dogs (Banks and Bryant 2007). Studies in California and Colorado showed that bobcats avoided areas where dogs were present, both in terms of spatial displacement (George and Crooks 2006, Lenth et al. 2008, Reed and Merenlender 2011) and temporal displacement in which bobcats switched to nighttime for most activities (George and Crooks 2006). In Colorado, mule deer showed reduced activity within 66 meters of trails where dogs were prohibited (i.e., response to people only), but within 100 meters of trails where dogs were allowed (Miller et al. 2001). Similar effects were also found for small mammals, including squirrels, rabbits, chipmunks, mice, prairie dogs (Bekoff and Ickes 1999, Lenth et al. 2008), and marmots (Griffin et al. 2007).

3.7 Habituation of wildlife to human disturbance

First described in the field of neuroscience, habituation is a concept that should be considered relative to potential impacts of the visiting public on wildlife. As applied to wildlife ecology, habituation has been defined as “a decrease in the strength of a response after repeated presentations of a stimulus that elicits that response” (Mazur 2006). As such, habituation typically is viewed as a negative consequence of human interactions with wildlife due to the likely consequential reduction of population fitness arising from, for example, reduced danger flight response (Higham and Shelton 2011).

Habituation would not be expected to result from all stimuli or impacts. For example, habituation to the presence or activity of dogs is highly limited (Hennings 2017, Gomez-Serrano 2021). This limitation is likely related to the unpredictable, erratic behavior and movements of domestic dogs, which influences three key factors wildlife use to judge the threat of predation: predictability, proximity, and speed (Glover et al. 2011, Weston and Stankowich 2014). Similarly, there is less likelihood of habituation to public use of trails because of the unpredictable and always changing noise levels and quality (e.g., different voices), smells, movements, and vibrations (e.g., different weights of individuals or groups at different times of day).

Habituation, were it to occur, would be very difficult to study. First, given that habituation is experienced at the neural and physiological levels, this results in a poor fit between observable animal behavior and internal state (Ellenberg et al., 2006). In other words, the apparent tolerance of some wildlife species to human presence does not necessarily mean that these wild animals are not being impacted (Higham and Shelton 2011). Further, there is evidence from wildlife studies that propensity toward habituation varies not only by species but by sex, breeding status, and even individual temperament (Papouchis et al. 2001, Martin and Reale 2008), Papouchis et al. 2001, Gómez-Serrano 2021).

Bejder et al. (2009) explain that what may seem like wildlife tolerance of human stimuli may, in fact, arise from various factors including:

> (1) Displacement: e.g., less tolerant individual animals may be displaced, resulting in a bias towards more tolerant animals that remain at a given site.
> (2) Physiology: e.g., reduced responsiveness to human stimuli due to physiological impairment.
> (3) Ecology: e.g., lack of suitable adjacent habitat to which animals may otherwise relocate.

In other situations, exposure to human activity can cause animals to shift temporal activity patterns (e.g., Frid and Dill 2002). In all of these cases, there is actually a negative impact from human presence but the result may appear to be tolerance or habituation.

Species that are more likely to habituate to recreation-related disturbances are often habitat generalists, and some studies have documented habitat generalists moving into a disturbed area while habitat specialists become displaced (e.g., Ballenger and Ortega 2001, Rolando et al. 2013). Some habitat generalist species, such as crows and ravens, may also represent additional predation pressure on the resident community. Predator, meso-predator, and prey species can also be differentially affected by recreation and these dynamics can lead to altered wildlife community composition (Miller et al. 2020). On the Dana Point Preserve, habituation, if it occurs at all in wildlife, may be most expected in some species as foxes and raccoons, predators to PPM.

3.8 Experimental design for assessing public use effects

Designing an experiment to study the impact of public access to the trail at the Preserve on the sensitive species at the Preserve faces numerous complications and challenges, including:

1. Masked effects: Many wildlife species may exhibit apparent tolerance to human disturbance, which may mask or mitigate long-term effects of disturbance (Nisbet, 2000, Baudains and Lloyd 2007, Jimenez et al. 2013, Geffroy et al. 2015). See the previous discussion regarding habituation.
2. Internal vs. external response: The effect is likely to be mediated through a physiological reaction and related consequences. The monitoring of physiological responses is very invasive and involves a study design of trapping mice which itself would illicit a physiological response that could not be disentangled from the response to public presence, not to mention the lag time (see next point).
3. Time between public presence and wildlife response: There may be lag in response, thereby further disconnecting the cause from the effect. In some cases, the impacts may be direct and obvious (e.g., vegetation or burrows trampled when by public, birds scared from nests), but many potential effects would extend beyond the time of impact (e.g., stress from public access, that may then manifest in weight loss, abortion, lower reproduction rates, etc.).
4. Cumulative effects: There could be several to many potential stressors which are additive towards a threshold of consequence. There are no doubt other stressors and impacts from natural, introduced, or anthropogenic causes (see previous sections). Disentangling those individual effects—particularly as they may not be apparent and would vary over time—is not feasible.
5. Variation in effects: As previously discussed, the effects from public presence are reasonably not expected to be the same for all individuals (e.g., of PPM) and may additionally vary by sex, time of day, season (i.e., either weather-related or related to life-cycle stage such as breeding season).

6. No treatment option: Determining effects from certain conditions is often investigated as a set of “treatments” for those conditions—typically ranging from control (no treatment) to putatively below-threshold treatments, to above-threshold treatments. If public presence is considered a “treatment” for which we seek a measurable response, we are limited in imposing any treatments or conditions that would potentially cause harm or “take”. This undermines the efficacy of this approach.
7. Small size of the Preserve: Any design that involves contrasting different public use scenarios is limited by the small size of the Preserve. Further, other factors (e.g., vegetation status, microclimate, perhaps distance from parking lot or other disturbances) would need to be controlled for or similar for all the public use scenarios—requiring a much larger area than available. That is, the preponderance of confounding effects would undermine any such approach.
8. Absence of “control” area or plot(s): More than 56% of the Preserve is within 50 meters of the trail and 90% is within 100 meters of the trail. With potential impacts from public presence within those zones, there is little opportunity to establish a “control” or unimpacted area during public access. Further, areas outside of those zones would need to be comparable in habitat quality and known PPM use to be used as control areas. Based on data collected to date on patterns of PPM distribution, there would be no satisfactory control area.

The most direct measurements of PPM presence and impacts on presence from trail use comes from live-trapping data of PPM (less inference than from track-tube monitoring) and from lengthy periods when public was not present as compared to lengthy periods when the public was present. Those data are presented in Table 3. Data collected from before the trail was open to the public probably cannot be reproduced except possibly after very long periods of trail closure. However, other conditions have changed since then as well. These data, although superficially seeming to be the most “black and white” depiction of effects, still are affected by confounding conditions (e.g., changes in site conditions due to management impacts on vegetation, weather, other stressors) and cannot serve on their own to provide complete information.

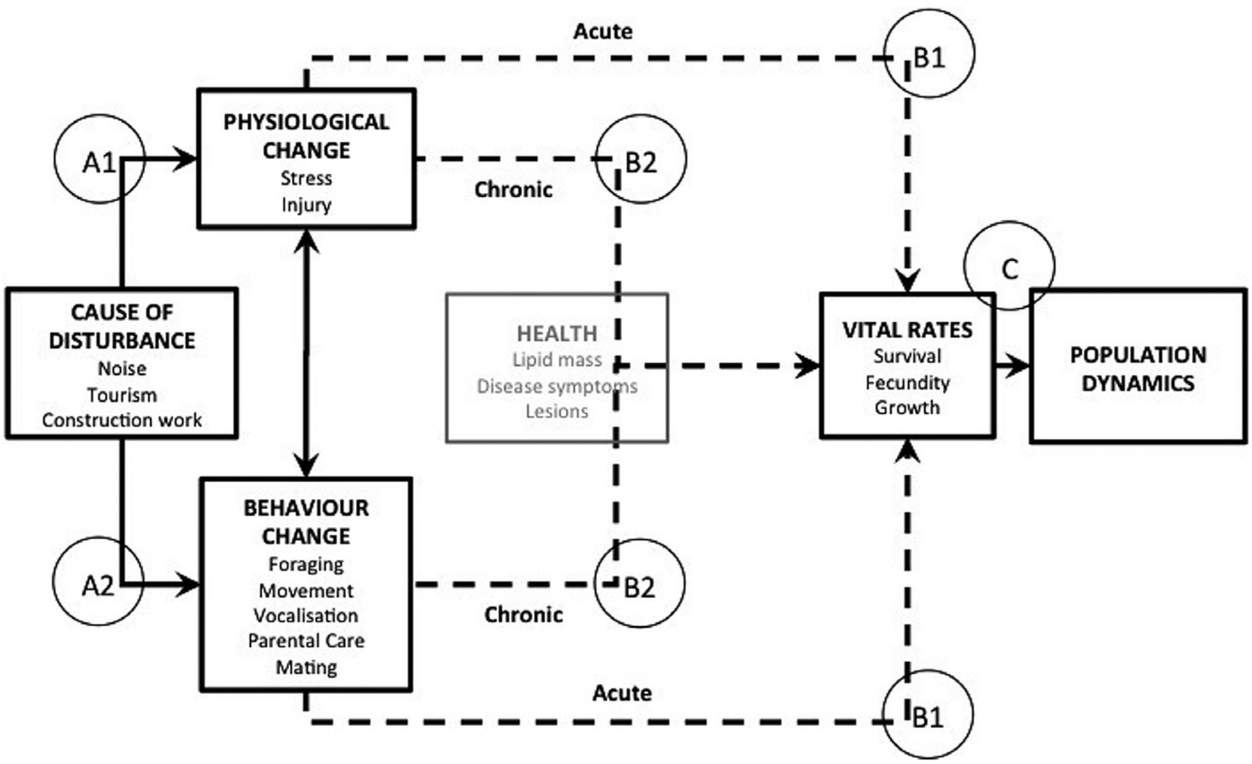

Figure 10. The interim population consequences of disturbance framework (excerpt from King et al. 2015). Circled letters identify transfer functions describing the relationship between the variables at either end of the arrow. Dotted lines indicate transfer functions that have been parameterized using expert elicitation.

Acknowledging the limitations and challenges of experimental design imposed by a small, limited site; a focal species that is endangered; a focal species that is cryptic given its largely under-ground presence; and a history of public access that potentially affects most of the Preserve; we nevertheless sought monitoring guidance from the scientific literature that may be applicable and useful for the context of PPM and the Dana Point Preserve. The authors of a study of potential public trail use impacts on wildlife that was undertaken recently in northern California provide some key elements for monitoring that may be more feasible to implement (Dertien et al. 2018). Their recommendations for monitoring to assess future changes in recreation and wildlife include the following:

1. Implement long-term monitoring: A long time series of data is needed to document whether wildlife detections, habitat use, or species richness are changing in correlation with increasing or decreasing human recreation and to inform adaptive management decisions.
2. Complete trail maps: The full spatial footprint of human recreation activity on the landscape is essential. For the Dana Point Preserve, this is well described by the current footprint of the trail, but additional data are provided by known instances of trespass (off-trail public use).
3. Monitor human recreation patterns: To assess impacts on wildlife, the potential stressor (human presence/activity) must be documented and measured to the greatest extent practical. In the case of the 2018 study, the authors employed camera traps as well as any other available information. They further recommend the use of on-the-ground technicians directly observing human recreation activity, social surveys of visitors, or expert opinion surveys of land managers who can provide valuable information to guide future management decisions. For the Dana Point Preserve, even more quantitative information on public use is available through the use of counters at the trail entrances. Additional information is available from staff who are frequently onsite and who document compliance with trail rules and incidents of trespass.
4. Compare recreation activities: Types of permitted human recreation activities often vary among parks and open spaces, and these different activities may have variable effects on target wildlife species. Relatively few studies to date have directly compared the effects of different activities at the same time, in the same place, and on the same target species (e.g., Taylor and Knight 2003). While this is a reasonable approach to parsing effects from different activities, it is probably not applicable or valuable in relation to studying public use impacts at Dana Point. The types of activities allowed are well defined and have a relatively

narrow range (i.e., no bicycles, horses or other recreation conveyances are allowed nor are dogs). Further, within the range of allowed uses, these could not be reasonably divided for an experimental purpose (e.g., only walking allowed on some days, only running on another, etc.). This recommended element for studying public use of preserves/parks and impacts on the public is more applicable to large recreational areas with various kinds of allowed recreation, and the ability to compare different uses. Further, such a study would have questionable application because if there were demonstrated differences in impacts from these recreational activities, it would not likely be enforceable to selectively prohibit those (e.g., no running only walking; or no walking only running).

5. Include reference conditions: It is important to include a reference condition or treatment in a study design to establish a baseline to detect potential effects of human recreation activity. For a study of the effects of recreation in general, a reference condition would be protected lands with no public access. For a study of the effects of dog management policy, a reference condition would be protected lands that do not permit dogs (Dertien et al. 2018). In the case of Dana Point, there are no off-site reference conditions due to the limited extant range of PPM and the different conditions at Camp Pendleton. Further, baseline conditions are limited to the data that were collected prior to the initiation of public use of the trail.

In summary, it is infeasible to design a study that would not impact and further endanger PPM, would control for all other variables, and would allow the detection of a direct cause-effect relationship between public use and impacts on PPM. However, specific types of monitoring and data collection can be informative towards detecting patterns and trends and these are largely already in place (see Section 5.3). Conducting such monitoring over a long period of time is essential towards providing an opportunity to account for other co-variates including weather and vegetation management, and other potential stressors.

4. Discussion on public use and impacts

At the population level, the Dana Point PPM population has been managed since 2005 to minimize the risk of extirpation. The Preserve is managed by dedicated and professional preserve management staff with input from scientists who are conducting research on this species as well as regulatory personnel for guidance in risk management. With such information and guidance, and using available financial resources (primarily the endowment established for the Preserve in 2005, and including the recent additional resources resulting from the agreement with Camp Pendleton), CNLM staff have focused on managing the vegetation for best effect, monitoring vegetative response and wildlife (PPM and gnatcatcher; other species informally), and managing public access.

For much of the period from 2009—when the trail on the Preserve was first opened to the public—until the COVID-related closure in 2020, the trail generally was open to the public seven days per week, 7:00 a.m. to sunset. However, there was no underlying research or principles that supported this amount of public access in relation to the need to protect the sensitive onsite natural resources. Indeed, if the only goal pertaining to the Preserve was to protect the Pacific pocket mouse, the most protective strategy would be to prohibit public access. The Preserve is an exceedingly small area of habitat, only 29 acres, and is surrounded by development that destroyed much of the original similar habitat.

As described above, natural resource impacts from public access may include trampling the burrows of Pacific pocket mouse; damaging plants that serve as food sources, nesting locations, shelter, and protection for wildlife; harassment of wildlife including impacts on reproduction; and interference with wildlife foraging, nesting, and predator avoidance. Although some prohibited activities can be reduced by constant monitoring, it is not feasible to completely eliminate such behaviors or the impacts of allowed public access, without limiting the amount and timing of public access.

In addition to public access to the trail, there are a number of other potential human impacts on the Preserve that cannot be avoided. These uses include first responders, management and monitoring by CNLM, and, to some extent, research activities on the resident species and habitat. This recognition of all human uses—including those that are and are not allowed—is significant because the potential for impacts from all of those uses are cumulative, and potentially additive and interactive.

As described above in Section 3.2, public use of the Preserve has been increasing every year, as reflected in trail use counter data. Average per-day use doubled over a seven-year period (2011-2017) and data from early 2020 indicated that these rates were continuing to increase. Further, plans for a hotel adjacent to the Preserve could result in additional visitation, and associated impacts related to development (e.g., the use of rodenticide, artificial lighting, noise, vibration, and disease/virus transmission).

Impacts from public visitation are also related to the time of year and time of day of public use. Public presence on site during low-light conditions (early morning and late afternoon) have the potential for greater impacts because, as discussed above, PPM are nocturnal and tend to be more active at night and during periods of low light. Certain times of year (for example, corresponding with reproductive activity of certain species), may also be indicative of the potential for greater impact from the visiting public.

The trail use data in 2021-2023 provide some insight into average daily use during periods where different hours and days of operation are used. The data indicate that a reduction in number of days per week and hours per day that the trail is open to the public resulted in a decrease in average daily visitors onsite, as compared to a schedule of seven days per week, 7 a.m. to sunset. CNLM would expect this type of schedule to similarly result in a decrease in the average weekly and annual number of visitors, as compared to a schedule of seven days per week, 7 a.m. to sunset. Although those data indicate that potential visitors do not simply funnel into a shorter time period if the trail is open fewer hours than seven days per week, 7 a.m. to sunset, the average daily visitation rates during a three days per week schedule of eight hours per day remain higher than the average per-day visitation rates in 2011. While a schedule of public access for three days per week, eight hours per day—has been shown to reduce number of visitors and thus likely impact, data also show that reduced access during those days and hours still allows public use of the trail at a rate similar to or greater than that in 2009 when the trail was first opened to the public.

In considering appropriate means of reducing the impacts from public use of the Preserve, the potential for habituation of wildlife species was researched and considered (i.e., whether a regular and daily schedule of public use would cause fewer impacts to the species than some daily closures). The scientific literature is far from comprehensive on this topic and none of it is based specifically on gnatcatcher or Pacific pocket mouse. However, in both theory and in the case studies that were reviewed, there is little evidence to suggest that there would be habituation to public presence, or that the habituation, if attained, would not cause impacts to the species. Regarding the latter, habituation would not likely cancel the public effect, but, at most, reduce it. Further, habituation could be maladaptive. But most importantly, there is no reason to assume that the public presence is perceived as “one stimulus” to which any species could become habituated. The public presence is a constellation of stimuli—sights, sounds, smells, vibrations, and movements—that change over the course of the day and between days. Further, there is evidence that males and females may habituate differently, if at all. Together, there was no indication that habituation was likely or would be beneficial. As such, the value of relief from such stimuli by designating some days as having no public hours for visitation, remained as a consideration with much merit. Furthermore, this approach would allow for more influence on the degree of public visitation than could be afforded simply by reducing the number of hours per day.

In summary, information on increasing use of the Preserve by the public, combined with the increasing evidence of negative impacts from human use on the natural resources including the listed species onsite, as well as the extreme vulnerability of the Pacific pocket mouse, strongly indicate a need for adaptive management that minimizes the impact of public access on the species on the Preserve. For nature preserves with public access, there are limited options for adaptive management to address these impacts, namely:

- Controlling types of activities allowed (assuming some have the potential to cause more impacts to the species than others)
- Managing or changing the spatial footprint of recreational trails; and
- Controlling the number and schedule of visitors (Dertien et al. 2018)

At the Dana Point Preserve, the first option is already employed, and monitored as much as possible. The second option is not feasible as there is not a location for the trail within the Preserve that would have a lesser impact. The management tool that is most well-suited to address these challenges is to control the number and schedule of visitors to the Preserve, by adjusting the number of days and number of hours that the trail is open for public access.

5. Proposed public access, rationale, adaptive management, and alternatives

5.1 Proposed public access schedule

The purpose of the proposed public access schedule is to provide appropriate public access to the trail on the Dana Point Preserve while protecting the rare and sensitive (and, in the case of two species, endangered or threatened) species on the Preserve. It is acknowledged that these two objectives are conflicting (e.g., Anderson et al. 2023). As such, the proposed public access schedule and related activities are intended to provide a reasonable compromise informed by scientific studies and current species and site conditions, and that takes into consideration the trajectory of increasing public use of the trail and additional threats to the species. As USFWS and CDFW noted in comments on an earlier version of a similar plan, “[it is critical] to conserve the remaining genetic variation within the Dana Point population by maximizing the size of this population”, which likely requires limitations on the amount and intensity of public access to the Preserve.

Based on the scientific literature, CNLM's experience and expertise, as well as discussions with interested parties (e.g., Wildlife Agencies, California Coastal Commission, the City of Dana Point, visiting public and researchers), the proposed public access schedule is as follows:

- Days of the week the trail will be open:

  Tuesday, Thursday, Saturday, and Sunday

- The hours the trail will be open will reflect general daylight conditions and be adjusted for two seasons: summer and winter.

  Summer hours: 8:00 a.m. to 6:00 p.m. Memorial Day weekend (the last Monday of May) to Labor Day weekend (the first Monday of September)

  Winter hours: 8:00 a.m. to 4:00 p.m. (the first Tuesday of September to the Friday of Memorial Day weekend)

- Hours of public access commence at the time indicated (8:00 a.m.) with the gates being open at that time. Public access ends (i.e., the public should be off the Preserve) at the time indicated, by season (i.e., 4:00 p.m. or 6:00 p.m.).

Exceptions and variation on proposed schedule:

- Dedication of public hours for special uses: Two afternoons (the first and third Tuesday) per month, will be reserved for special uses that serve the purposes of environmental justice, focused educational events, research, or other public interest as overseen by CNLM staff. The trail may be closed to other members of the public for these events.

- Necessary closures: For weather events that affect trail condition and sensitivity, wildlife emergency closures (e.g., nests or PPM burrow(s) adjacent to trail or overlooks), emergency personnel access (e.g., rescue or recovery events, fire threats, health concerns, etc.) and occasional management requirements (e.g., fence and trail repairs or installation, vegetation or habitat enhancement or maintenance, etc.). Following guidance from CNLM's past practices, the trail may be closed for up to 72 hours following rain events for public safety and trail sustainability, which has been the status quo for CNLM's management of the trail since the trail was initially opened to controlled public access in 2009. Management and maintenance activities (e.g., habitat maintenance, fence and trail repairs) also dictate the need for temporary trail closures (e.g., hours or days) as required to maintain public safety, the long-term sustainability of the trail, and the protection of the Preserve—which in turn will maintain or increase the public enjoyment of the trail. When possible, prior notification of closures will be posted for the public onsite and on CNLM's website.

5.2 Considerations and rationale

1. Control of amount and timing of public access and related impacts: Controlling public access based on a schedule of four days per week should allow some moderation and overall reduction in visitation (acknowledging that four days will increase annual visitation compared to visitation rates from 2021-2022). This is supported, at least in part, by the public visitation levels under the schedule of three days per week that was in effect from June 2021 to November 2022, which suggested that controlling the number of days and hours of access may result in reduced public visitation.

   Further information towards appropriately controlling public access on the Preserve was sought from a query of public access to other preserves and parks in southern California. A number of publicly accessible conserved lands in Southern California only allow controlled public access through a reservation system (e.g., Arroyo Hondo Preserve, Bolsa Chica Ecological Reserve, Seal Beach National Wildlife Refuge, Carpinteria Salt Marsh Reserve), scheduled volunteer and educational events (e.g., Starr Ranch Sanctuary, Irvine Ranch Open Space), or docent-led hikes (e.g., Ballona Wetlands Ecological Reserve, Jack and Laura Dangermond Preserve, Wren's View Preserve, and Trabuco Rose Preserve). Examples of how public access to these protected lands may be prohibited due to temporal or seasonal risk to public safety or temporary, seasonal, or situational risk to the sensitive biological species, are found throughout the state and within the Coastal Zone. Various recreational opportunities, such as hiking trails and campgrounds, may be closed temporarily or seasonally to protect the integrity of the public facilities (e.g., Palos Verdes Nature Preserve) or reduce the risk of exposing the public to unsafe trail conditions (e.g., Laguna Coast Wilderness Park, Aliso and Wood Canyons Wilderness Park), hazardous weather or environmental exposure (e.g., Malibu Creek State Park, Hollister Ranch Preserve, Huntington Beach, Cabrillo State Beach), or wildfire (e.g., Tumey Hills, Cleveland National Forest). As of February 2023, 16 of the reviewed protected lands have implemented partial or complete closure of publicly accessible trails and campgrounds due to the impacts of the January 2023 storms and are expected to remain closed until maintenance activities are completed. Many conserved lands, such as the Laguna Coast Wilderness Park restrict public access "when necessary to minimize impacts to sensitive habitat, to prevent user conflicts with wildlife" (Laguna Coast Wilderness Park Resource Management Plan, 1998). Cleveland National Forest and Pinnacles National Park implement seasonal restrictions on recreational activities on cliffs that support sensitive nesting raptors. Multiple conserved lands managed by the City of Malibu and the Palos Verdes Peninsula Land Conservancy temporarily close portions of public hiking trails to minimize impacts to nesting birds, such as the federally endangered California least tern (*Sterna antillarum browni*) or the coastal California gnatcatcher. Orange County Parks close sections of their trails during the riparian bird (i.e., to protect the federally and state-listed least Bell's vireo) breeding season (March 15-September 15) per Orange County Ord Sec 2-5-46(a) that allows the County to close recreational areas in the interest of protecting public convenience, public safety, or for protection of natural and cultural resources. Similarly, officials of the City of Lake Elsinore and Riverside County announced on February 2, 2023 that Walker

Canyon will be closed to public access for the duration of the 2023 wildflower bloom season to protect the habitat from environmental damage as seen in 2019 when tens of thousands of visitors arrived to view the "super bloom". Instead of opening Walker Canyon to visitors, the County of Riverside has installed a live-stream camera to allow the public to view the 2023 bloom (http://www.lake-elsinore.org/Home/Components/News/News/3754/26).

Other means of controlling public access were considered for the Dana Point Preserve trail, including restriction of access during critical breeding seasons, limiting the density of visitors on site, and limiting the total number of daily visitors. The first consideration of biologically sensitive seasonal closures, while meaningful and most likely to be best connected with reduction of impacts, was ultimately abandoned as being unacceptable given the large amount of time per year that would necessitate trail closures. Given that PPM could be active above ground much of the year and coastal California gnatcatchers nest February through September, a public access schedule based on species sensitivity would result in closure much of the year.

Limiting the number of visitors or density control by only allowing access through docent/volunteer led hikes or a reservation system (as implemented on OCTA Preserves and the Irvine Ranch Conservancy, for example) was also considered impractical and unacceptable.

Another means of reducing and controlling public access is through imposition of access fees (e.g., day use fees at most County and State parks). However, fees can be exclusionary and would likely make the trail inaccessible to some communities, thus was not further considered as a public visitation control method for the Dana Point Preserve.

2. Days of week: Reflecting observed visitor use and visitor preferences expressed to staff (K. Merrill pers. comm.), data obtained from an informal survey of preferred days and times of trail use (unpublished CNLM data), and input from

California Coastal Commission staff, weekend days were included in the public access schedule. Also considered was overlap with the City's Nature Interpretive Center public hours, currently closed on Mondays and some holidays (K. Merrill pers. comm., website queried 2/23/2023 https://www.danapoint.org/department/general-services/parks/natural-resources/dana-point-headlands-conservation-area/nature-interpretive-center).

3. Hours per day: The proposed hours per day were determined to avoid low-light times of day when PPM is most sensitive and may be above ground or in a more alert state underground (see Section 3.6.2). Also considered was the importance of consistent public hours rather than varying from day to day based on cloud cover or sunrise or sunset conditions. Determination of public access based on those constantly changing hours have been noted to cause confusion and frustration in the visiting public, as well as constant public management and posting of information by Preserve staff. In addition, data collected by staff show increasing incidents of trespass after sunset (Figure 5). This is a crucial time when the public should not be on the Preserve, including the trail, to avoid harassment or harm to PPM that are active above ground at that time (see Section 3.6.2). The most effective way to control public access and prevent trespass after sunset has been to move the closing time further from sunset.

4. Seasonal differences (winter and summer hours): As a compromise between constant daily hours throughout the year, affording maximum predictability for the visiting public, as well as allowing longer visitation hours when daylight hours were longer, CNLM is proposing two seasons with different public access hours: summer and winter. The dates (coincident with Memorial Day and Labor Day) were selected as these are commonly considered the unofficial start and end dates of summer and winter in state, regional, and local parks and thus may be more familiar for the public. Many public parks similarly employ different hours of opening during different seasons.

Seasonal hours were informed by actual sunrise and sunset conditions for Dana Point (timeanddate.com). In summer, the latest sunrise time is approximately 6:27 a.m. and the earliest sunset time is at approximately 7:10 p.m. In winter, the latest sunrise time is approximately 7:13 a.m. and earliest sunset time is approximately 4:42 p.m. Those statistics represent the longest periods of daylight during those two seasons. Some buffer between these times is important to avoid, as much as possible, low-light periods. During the winter schedule—which is the greater part of the year (approximately eight months)—this only provides a buffer of approximately 45 minutes for some days.

5. Alternate public access locations nearby: Given that there is no direct access to the water or the beach from CNLM's Dana Point Preserve trail, the proposed access schedule will not impact the ability of the public to access the water or the beach. Additionally, trail users are still able to use an interconnecting network of City trails during the times that the Preserve trail is closed. The Preserve trail provides coastal views, which can also be enjoyed by the public from other locations within City parks that do not sustain sensitive populations of endangered and threatened species. When the Preserve trail is closed, the public can experience such coastal outlooks at the adjacent Hilltop, Harbor Point, and Strands Conservation Parks, especially for sunset as seen at the City's Harbor Point (Figure 11). Further, there is no direct access from the network of City trails to the ocean/beach east of the Dana Point Preserve, regardless of whether the Dana Point Preserve trail is open. Rather, the public can use the City's pedestrian/bicycle trail to either connect with trails that lead to the beach or with trails that lead to the street that can then be followed to the beach. The closure at certain times of the Dana Point Preserve Trail does not affect the public's ability to get access to the coast or beach nor does it disrupt connectivity to the city-owned trails at Strands, Hilltop or Harbor Point or to the Dana Point Harbor (Figure 12). To access CNLM's coastline (a pebble beach at the bottom of the Preserve's cliffs), the public may do so at low tide, entering from the north

at Strands Beach or from the south via the Ocean Institute. There is never access to this pebble beach from the trail at the Preserve.

According to the City of Dana Point's website, the City has over 28 parks within city limits for recreation, coastal access, exercise, and nature appreciation. Most of these parks have trails and/or coastal views including, but not limited to, Bluff Top (near the Dana Point Preserve), Hilltop, Harbor Point, Chloe Luke Overlook, Crystal Cove Park ("Ocean Knoll"), and Dana Point Harbor (Table 7).

Table 7. Public open space and trail access opportunities within the City of Dana Point.

Open Space Name	Ownership/ Land Manager	Size (acres)	Trail Length (miles)	Coastal View
Bluff Top Trail	City of Dana Point		0.2	Yes
Chloe Luke Overlook	City of Dana Point	0.4	n/a	Yes
Crystal Cove Park (aka Ocean Knoll)	City of Dana Point	1.6	n/a	Yes
Dana Cove Park	Orange County	5.4	n/a	Yes
Dana Point Harbor Park	Orange County	5.9	2	Yes
Doheny State Beach	California Department of Parks and Recreation	76	7	Yes
Harbor Point	City of Dana Point	9.3	0.3	Yes
Hilltop	City of Dana Point	11.7	0.7	Yes
Heritage	City of Dana Point	16.1	1	Yes
Lantern Bay	Orange County	15	1	Yes
Louise Leydon	City of Dana Point	0.5	n/a	Yes
Palisades Gazebo Park	City of Dana Point	0.7	n/a	Yes
Pines Park	City of Dana Point	4.7	n/a	Yes
Salt Creek Beach County Park	Orange County	45	1.2	Yes
Sea Terrace Park	City of Dana Point	27	Connector trail	No
Sea View Park	City of Dana Point	0.47	0.4	Yes
Strand Vista Park (South Strands Park)	City of Dana Point	16	1.2	Yes
Sycamore Creek Trail	City of Dana Point	n/a	0.5	No
Total		**236**	**16**	

Figure 11. View from Harbor Point Conservation Park. Photo taken by CNLM Ranger James Ligoretti, 2022.

Expanding outside of the city limits, in Orange County, within 10 miles of the Dana Point Preserve, there are at least 42 other open spaces located in the California Coastal Zone that provide over 20,000 acres of public access with hiking and recreational opportunities along an estimated 174 miles of trails, boast scenic ocean views, and/or provide beach access, including the Marblehead ("Sea Summit") Preserve in San Clemente, managed by CNLM (Appendix B). Approximately 3 miles east of the Dana Point Preserve, Doheny State Beach transitions into the Capistrano Beach Park, a 55-acre public beach with over 4 miles of beach trails. Approximately 3 miles northwest of the Preserve lies Aliso Creek County Beach, a 64-acre beach that provides multiple amenities, such as a playground, parking lot, and opportunities for recreational water sports, in addition to beach access, scenic views, and tidepools. One mile inland, the Aliso and Wood Canyons Wilderness Park, a 4,500-acre park, provides multiple opportunities for recreational activities and exposure to native coastal habitat, through its 50 miles of multi-use trails, scenic views of the ocean, picnic areas, and visitor center. All of these Orange County locations provide immense opportunities for varied recreational activities, outreach and education opportunities, exposure to native coastal habitats, or beach access.

6. Special events: Special events offer a valuable opportunity to provide access to a variety of groups, and community organizations but also may cause a congregation of individuals and increase visitation—either of which could result in concerning conditions for the natural resources onsite or decrease the Preserve experience for individual visitors. As such, CNLM proposes to use a modest amount of public access hours dedicated to special events such as educational tours on the first and third Tuesday of each month from 12:00 p.m. to 4:00 p.m. (see Section 5.1, Proposed public access schedule). On these days and times the trail will be closed to general public access but open to group tours. Individuals and groups will be able to sign up for tours in advance by contacting CNLM staff. If no groups or individuals have signed up for a tour, the trail will revert to being open to the general public access. These tours will be led by CNLM staff or CNLM volunteers and will be education-focused (see Section 5.3.9). Large, organized groups will be prohibited on the trail outside of these hours as the impact on public access would be substantial.

Figure 12. Dana Point Trail Map from the City of Dana Point. (Downloaded from City's Natural Resources website, 13 February 2023. https://www.danapoint.org/department/general-services/parks/natural-resources/dana-point-headlands-conservation-area/trail-system.

5.3 Adaptive management of public access

Information presented in this 2023 Plan represents relevant data, experience, and scientific knowledge to date. To continue to ensure that the most appropriate balance is achieved between controlled public access of the Preserve and protection of the sensitive natural resources onsite, there will be ongoing collection of data, review of scientific literature, and acquisition of experience, with well-considered application to the management of the Preserve.

5.3.1. *Monitoring of amount of public access*

To monitor public visitation, infrared pedestrian trail counters placed near both the Scenic and Selva gates will be maintained (batteries replaced, wire connections secured, corroded parts replaced, etc.), and data collected and analyzed (using the online TRAFx portal, trafx.net, or a CNLM created database) on a quarterly schedule if not monthly. Placement and location of the trail counters will need to be revisited annually to improve utility and the quality of data collected. Staff and volunteers will note in weekly reports unusual or extreme visitation during their patrol shifts, biological monitoring, and management tasks. From this, average daily visitation rates and annual visitation rates can be interpreted and inform management.

5.3.2. *Monitoring of public behavior*

Similar to monitoring the amount of public access, monitoring public visitation behavior (compliance, incidents, impacts, resources used) will take a multi-faceted approach: CNLM staff will continue to use trail counters, trail cameras, and on-the-ground observations to report (e.g., dogs or other pets on the trail), document, and analyze visitation behavior. CNLM staff will continue to be onsite to patrol the trail and provide educational material to the visiting public, enforce trail rules, and report onsite conditions. This information will influence CNLM’s updates to signage, rules, education material, and management.

5.3.3. *Monitoring of habitat quality*

As a potential correlate to gnatcatcher and PPM population size, CNLM will continue to monitor the vegetative cover (composition and spatial distribution) of the Preserve (excluding the cliff areas). Since 2006, monitoring of the coastal sage scrub has been conducted using twenty permanent point-intercept line transects. Each year a subset of five of these twenty transects are monitored on a rotating schedule so all twenty are monitored in a four-year period. More PPM-focused habitat suitability monitoring, similar to those conducted in 2020 and 2022 (Brehme et al. 2020, CNLM 2022, 2023), will be conducted every 3-5 years or sooner if a shorter interval is required (e.g., after a fire event, or extreme drought conditions) and as resources allow. Adjustments or changes to the habitat monitoring schedule or protocol will be evaluated and implemented as new information is learned through CNLM's experience and staff recommendations, collaboration with other researchers (e.g., USGS, SDZWA and wildlife agencies), scientific literature and advances in conservation technologies (i.e., remote sensing technologies).

5.3.4. *Monitoring of Pacific pocket mouse site use (i.e., area occupied)*

Since 2011, CNLM has used track tubes to monitor PPM using methods developed by experts in the field and following USFWS survey protocols. Track-tube monitoring will continue to be conducted annually to provide information on presence/absence, area occupied, and habitat suitability of PPM on the Dana Point Preserve. As previously practiced, CNLM will attempt to coordinate annual monitoring activities with the City of Dana Point to monitor their Hilltop Park adjacent to the Preserve to maximize the data collected and minimize sampling bias.

5.3.5. *Intermittent direct detection of Pacific pocket mouse (live-trapping)*

Live trapping of PPM will continue to be used to supplement track-tube monitoring to provide additional estimates of population size, as well as phenological and demographic data. This type of monitoring carries risks to both PPM as well as non-target wildlife and, as such, is used less frequently than track-tube monitoring. During live-trapping other information can be gathered from supplemental collection/research such as dietary preferences through fecal analysis of collected scat or genetic information through ear-snip collections to name a few. CNLM historically has conducted live trapping every 3-5 years or soon as warranted (e.g., such as in 2019 when limited trapping was conducted to determine the status of PPM reproductive activity, CNLM 2020) and will likely maintain this schedule in the future.

5.3.6. *In situ research*

The limitations on direct research onsite regarding public access effects have been previously described. Factors inherent to the biology and status of the species as well as the Preserve context and lack of temporal (i.e., "before public visitation") and spatial (reference sites) experimental controls, are some of the limitations. The onsite research that can be conducted is that of long-term monitoring of PPM, gnatcatcher, and certain other site conditions (e.g., vegetation). Although those monitoring results would reflect a composite of all influences, data collected over the long-term may provide patterns that can be interpreted for management purposes. Over time, improvements in the technology for remote sensing and monitoring may provide more intimate insights into PPM status and behavior and allow more direct linkages with other factors.

5.3.7. *Ex situ research*

The growing body of scientific research on public-wildlife interactions, particularly with small nocturnal mammals and birds, will continue to provide information towards understanding the interactions between PPM (and gnatcatchers) and the visiting public and, as such, how to better avoid and minimize any negative impacts. Some research being conducted with captive bred mice on stress-mediated relationships between PPM and certain stimuli could also provide more direct information (D. Shier pers. comm.). However, captive bred mice may also have different or decreased stress response because of exposure to more domesticated conditions and exposure to humans. As such, extrapolation from any studies with captive-bred mice would require careful consideration.

5.3.8. *Summary of information*

Adaptive management requires not only the collection of data (or other representations of conditions and experience) over time, but inspection, analysis, interpretation, and application. It is anticipated that there will be an annual review of this information to determine the general status of PPM on the Preserve, amount and nature of public visitation, and status of other elements of PPM habitat. Relevant scientific literature will be queried to refresh our awareness. Although this information will be assessed for management implications, it is acknowledged that there is some tension between the value or need to change public access hours (increasing or decreasing) and the interest in collecting information. Frequent adjustments in public access schedule have the consequence of reducing the ability to see patterns on public use impacts (or lack of)

PPM over time–that is, it reduces the general experimental frame to detect correlations or other patterns. Further, frequent changes (or changes in direction) in the public access schedule can cause confusion and frustration by the public as well as lessen compliance, leading to drain on staff resources and increased incidence of trespass and potential impacts.

5.3.9. *Outreach and education*

As a current practice that CNLM plans to continue to the extent supported with financial and staff resources, CNLM enhances visitor experience with information provided directly by staff and indirectly with other media. To the extent feasible CNLM will refresh educational signs and interpretive panels, brochures, and website info, provide guided public tours, and increase public awareness of conservation issues through providing more detailed information to the public regarding literature and the science behind it related to public impacts on natural resources. Focus will be to enhance CNLM's current outreach activities through grants and other funding sources. To extend capacity to provide such enhanced experience, CNLM will apply for grants or otherwise seek opportunities to: (1) update existing Dana Point Preserve outreach materials (including signs, pamphlets, and other media) to be more accessible by those for whom English is not the first language (i.e., translations) and underrepresented members of the visiting public and (2) design and develop workshops based on coastal conservation, pollution, climate change, and best stewardship practices using CNLM's Dana Point Preserve for context. If feasible, workshops are expected to foster discussion, utilize multiple educational tools, and provide interactive activities (e.g., onsite and offsite opportunities for public engagement). In addition, CNLM will continue to develop partnerships with outreach and education organizations to increase public outreach across multiple platforms and engage further with underrepresented communities.

If resources become available, CNLM plans to install a camera on the Preserve that would allow live-streaming views of the Preserve (similar to what has been implemented in Walker Canyon, see section above), accessible through the CNLM website. The camera would serve the dual purpose of research, in addition to outreach, providing additional data on activity and use at the Preserve. This visual (and potentially auditory) platform would provide the public with an additional type of access for a much longer period than direct visitation hours and be available for a more geographically distant public, as well as those with limited mobility who may not be able to access the Preserve trail.

5.3.10. *Other potential use and partner relationships*

CNLM plans to continue to maintain relationships with CDFW's Enforcement branch (i.e., Game Wardens), Orange County Sheriff's Department, and Orange County Fire Authority regarding protection of the Preserve, emergency use, and training. In addition, CNLM will maintain and revise the protocol for any proposed research needing access to the Preserve, including review of research proposals for risks, conservation value, and opportunity to conduct research elsewhere.

5.3.11. *Consistency with the Coastal Act, CDP No. 04-23 and the HDCP*

The adaptive management activities, including the hours of operation for the trail, proposed in this 2023 Plan are consistent with Master CDP No. 04-23 and the HDCP, which, along with the Coastal Act, require a balance between public access and protection of natural resources. As noted in Section 5.1 of the HDCP, "[t]he primary purposes of the Coastal Act are to protect, maintain, and, where feasible, enhance and restore the natural and scenic qualities of the coastal zone resources; assure an orderly and balanced use and conservation of coastal zone resources; maximize public access consistent with conservation principles and constitutionally protected private property rights; assure priority for coastal-dependent and coastal-related development; and encourage state and local cooperation concerning planning and development." This Plan proposes to apply conservation principles to ensure that public access is consistent with protection and maintenance of the natural qualities of the coastal zone resources.

The Coastal Act requires maximum access, "consistent with . . . the need to protect . . . natural resource areas from overuse" (CA Public Resources Code section 30210). The Coastal Act specifically contemplates that public access may not be unlimited, and requires that public access policies be implemented in a way that "takes into account the need to regulate the time, place, and manner of public access" depending on a number of factors, including "[t]he capacity of the site to sustain use and at what level of intensity. . . and the fragility of the natural resources in the area. . . ." (CA Public Resources Code section 30214). As noted in Section 3.2 above, the intensity of use of the trail on the Preserve has increased dramatically since the trail was planned and first opened to the public in 2009, and the fragility of the natural resources has become more apparent. The HDCP implements these Coastal Act provisions through its policy to "[r]egulate the time, manner and location of public access to parks and open space containing sensitive biological resources to maintain and protect those sensitive resources . . . while honoring the public's constitutional right of access to navigable waters." (HDCP Policy 5.20). Additionally, HDCP Policy 3.11 limits uses within the Preserve to "passive public recreational facilities such as trails, benches, and associated safety fencing and interpretive/directional signage provided those uses do not significantly disrupt habitat values." Similarly, the City's Municipal Code sections regarding lateral public access and bluff top public access require that "in some cases controls on the time, place and manner of uses may be justified by site characteristics including sensitive habitat values. . . ." (DMPC section 9.27.030(a)(4)(A)(1), (C)(1) and (D)).

The Conservation Easement for the Preserve fulfills Condition No. 36 of CDP No. 04-23, which requires dedication of a conservation easement to preserve environmentally sensitive habitat areas (ESHA). The Conservation Easement implements the intent of the City and CNLM "that the natural habitat, aesthetic, landform, ecological and educational values of the [Preserve] be further protected in perpetuity against any activities that would detrimentally harm the habitats, sensitive species and natural landforms on the Property." The Conservation Easement itself does not describe the appropriate level of public access to the trail, except to say that such access shall be "controlled" and "limited to the nature trail and overlook areas. . . ." (Conservation Easement, section 5.2(d)). The City and CNLM are required by the Conservation Easement to ensure that public access does not "materially impair or interfere with [the biological] values and resources" of the Preserve (Conservation Easement section 2.).

USFWS and CDFW are third party beneficiaries of the Conservation Easement and have the right to enforce it (Conservation Easement section 10.1.).

Given the small size of the Preserve, the increasing number of visitors on the Preserve trail, the unavoidable instances of trespass off trail and after sunset, and the sensitivity of the species at the Preserve, a conservative and adaptive management approach that takes into account the abundance of information now available on the impacts of passive recreation is needed. A reduction in the number of hours that the trail is open to the public should lead to a decrease in the number of people on the trail, which should result in decreased impact on the species and habitat. Although such reductions and impacts may be difficult to quantify precisely with currently available information, the obligations under the entitlements for the Headlands development project and the NCCP/HCP, as well as the Conservation Easement for the Preserve, require limitations on public access to minimize further adverse effects on the species and habitat.

The proposed hours for operation of the trail and for associated adaptive management activities are consistent with the public access program and the conservation program of the HDCP (see, e.g., Table 4.5.1). The trail will remain in place and open to public access for controlled access and periods of time intended to limit impact on the sensitive species. It shall continue to remain accessible to the public year-round, unless USFWS and CDFW determine that it should be closed for a specific period to protect on site resources. CNLM, the non-profit organization that owns and manages the Preserve, is determining hours of daily operation through the proposals in this Plan. The view overlooks will continue to provide signage, educational material, and other relevant information that is accessible to the public when the trail is open, during times of least impact to the species. Public access to areas outside of the trail and overlooks shall continue to be prohibited and pets will continue to be prohibited in the Preserve. CNLM will continue its efforts to ensure that visitors adhere to these prohibitions.

This Plan also conforms to the Design Concept outlined in the HDCP (See Section 4.4.B.1). The Preserve is and will remain an area "to permanently preserve the significant landform, and conserve, manage, and preserve the existing flora and fauna. The [Preserve] shall consist of natural open space and be dedicated to the conservation and enhancement of the existing habitat." The proposed hours of public access and associated adaptive management activities will contribute to the conservation, preservation, and enhancement of the Preserve's natural resources. This Plan is one component of the "long-term management programs for the study and maintenance of the natural resources," as required by the HDCP, and serves to "[d]efine an appropriate level of public access along" the trail, as specifically described in the Design Concept for the Preserve (HDCP Section 4.4.B.1). When the trail is open to visitors, it will serve as a throughway connection between trails owned and managed by the City in the Headlands area, as well as other parts of the City of Dana Point. When the trail is closed, recreational users will still be able to access and use the Headlands trails owned and managed by the City. Direct access of recreational users to the beaches and water will not be affected by the Preserve's trail access schedule since the trail on the Preserve does not provide access to the beaches or the water.

6. Literature cited

Allen, M.C., M. Clinchy, and L.Y. Zanette. 2021. Fear of predators in free-living wildlife reduces population growth over generations. Proceedings of the National Academy of Sciences 119(7) e2112404119.

Alvarez-Blanco, P., J. Broggi, X. Cerdá, O. González-Jarri, and E. Angulo. 2020. Breeding consequences for a songbird nesting in Argentine ant invaded land. Biol Invasions 22:2883-2898.

Anderson, A.K., J.S., Waller, and D.H. Thornton. 2023. Partial COVID-19 closure of a national park reveals negative influence of low-impact recreation on wildlife spatiotemporal ecology. Scientific Reports 13:687. DOI: 0.1038/s41598-023-27670-9.

Arlettaz, R., P. Patthey, M. Baltic, T. Leu, M. Schaub, R. Palme, and S. Jenni-Eiermann. 2007. Spreading free-riding snow sports represent a novel serious threat for wildlife. Proceedings of the Royal Society B 274:1219-1224.

Antze, B. and N. Koper. 2018. Noisy anthropogenic infrastructure interferes with alarm responses in Savannah sparrows (*Passerculus sandwiche*nsis). Royal Society Open Science 5:172168.

Baharudin, N.S., M. Mohd, M. Faris, R. Subari, N.S.A. Subiyri, T. Rinalfi, and P.T. Azizan. 2022. Updated assessment of ground-dwelling mammals in Ayer Hitam Forest Reserve, Selangor. Journal of Sustainability Science and Management 17:313-333.

Bailey, V. 1939. The solitary lives of two little pocket mice. Journal of Mammalogy 20:325-328.

Ballenger, N. and C.P. Ortega. 2001. Effects of Ski Resort Fragmentation on Wintering Birds in Southwest Colorado. Journal of the Colorado Field Ornithologists. 3:122-128.

Banks, P.B. and J.V. Bryant. 2007. Four-legged friend or foe? Dog walking displaces native birds from natural areas. Biology Letters 3:611-613.

Bar-Ziv, M., A. Sofer, A. Gorovoy, and O. Spiegel. 2022. Beyond simple habituation: Anthropogenic habitats influence the escape behavior of spur-winged lapwings in response to both human and non-human threats. Journal of Animal Ecology 92:417-429. DOI: 10.1111/1365-2656.13858.

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2010 The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25:180-189.

Barcelos, D., E.M. Vieira, M.S. Pinheiro, and G.B. Ferreira. 2022. A before−after assessment of the response of mammals to tourism in a Brazilian national park. Oryx 56:854-863.

Barros, A. and C.M. Pickering. 2017. How networks of informal trails cause landscape level damage to vegetation. Environmental Management 60:57-68.

Bartholomew, G.A. and T.J. Cade. 1957. Temperature regulation, hibernation, and aestivation in the little pocket mouse, *Perognathus longimembris*. Journal of Mammalogy 38:60-72.

Baudains, T.P. and P. Lloyd, 2007, Habituation and habitat changes can moderate the impacts of human disturbance on shorebird breeding performance. Animal Conservation 10:400-407. https://doi.org/10.1111/j.1469-1795.2007.00126.x

Bateman, P. and P. Fleming. 2017. Are negative effects of tourist activities on wildlife over-reported? A review of assessment methods and empirical results. Biological Conservation. 211:10-19. 10.1016/j.biocon.2017.05.003.

Beale, C.M. and P. Monaghan. 2005. Modeling the effects of limiting the number of visitors on failure rates of seabird nests. Conservation Biology 19:2015-2019.

Beatley, J.C. 1969. Dependence of desert rodents on winter annuals and precipitation. Ecology 50:721-724.

Bejder, L., A.M.Y. Samuels, H. Whitehead, H. Finn, and S. Allen. 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series *395*. DOI: 10.3354/meps07979.

Bennett, V.J., V.S. Quinn, and P.A. Zollner. 2013. Exploring the implications of recreational disturbance on an endangered butterfly using a novel modelling approach. Biodiversity Conservation 22:1783-1798.

Blair, R.B. and Launer, A.E. 1997. Butterfly diversity and human land use: Species assemblages along an urban gradient. Biological Conservation. 80:113-125.

Blickley, J.L., D. Blackwood, and G.L. Patricelli. 2012. Experimental evidence for the effects of chronic anthropogenic noise on abundance of greater sage-grouse at lek. Conservation Biology. 26:461-471.

Bötsch, Y., Z. Tablado, and L. Jenni. 2017. Experimental evidence of human recreational disturbance effects on bird-territory establishment. Proceedings of the Royal Society B 284:20170846.

Boyes, D.H., D.M. Evans, R. Fox, M.S. Parsons, and M.J.O. Pocock. Street lighting has detrimental impacts on local insect populations. 2021. Scientific Advances 7.

Brehme, C.S., D.T. Adsit-Morris, T.K. Edgarian, and R.N. Fisher. 2019. Permit Report: Pacific Pocket Mouse Monitoring Results for 2019 on Marine Corps Base, Camp Pendleton. Draft Final. USGS Cooperator Report to U.S. Fish and Wildlife Service, Carlsbad, CA, USA.

Brehme, C.S., K. Merrill, D.T. Adsit-Morris, T.K. Edgarian, and R.N. Fisher. 2020. Dana Point Headlands (CNLM, City of Dana Point) Pacific Pocket Mouse Monitoring Results for 2020. USGS Cooperator Report to U.S. Fish and Wildlife Service, Carlsbad, CA, USA. Interagency Agreement 4500139540.

Brehme, C.S., J. Sebes, T. Matsuda, D. Clark, and Fisher, R.N. 2014. MCBCP Pacific Pocket Mouse Monitoring Results for 2013 and Multi-year Trend Analysis from 2012 to 2013. Prepared for AC/S Environmental Security, Marine Corps Base, Camp Pendleton. 69p.

Brylski, P. 1993. A focused survey for the Pacific pocket mouse on the Dana Point Headlands, Orange County, CA. Prepared for EDAW, Inc. by the Planning Center, Newport Beach, CA. August 1993.

California Department of Fish and Wildlife (CDFW). 2019. CDFW News: Snake Fungal Disease Detected in California. November 2019. Accessed on March 15, 2022, from: https://cdfgnews.wordpress.com/2019/11/05/snake-fungal-disease-detected-in-california/.

Carney, S.E., M. Brooke Byerley, and D.A. Holway. 2003. Invasive Argentine Ants (*Linepithema humile*) Do Not Replace Native Ants as Seed Dispersers of *Dendromecon rigida* (Papaveraceae) in California, USA. Oecologia 135: 576-582.

Cassirer, E.F., D.J. Freddy, and E.D. Ables. 1992. Elk Responses to Disturbance by Cross-Country Skiers in Yellowstone National Park. Wildlife Society Bulletin 20:375-381.

Center for Natural Lands Management (CNLM) and City of Dana Point (City). 2005. Conservation Easement. Recorded by the County of Orange, December 20, 2005.

Center for Natural Lands Management (CNLM). 2014. CNLM Annual Report of Management Activities for the 2013-2014 Fiscal Year. Dana Point Preserve (S033). December 15, 2014. Unpublished internal report.

__ 2019. CNLM Annual Report of Management Activities for the 2017-2018 Fiscal Year. Dana Point Preserve (S033). March 4, 2019. Unpublished internal report.

__2020. CNLM Annual report of Management Activities for the 2018-2019 Fiscal Year. Dana Point Preserve (S033). 13 April 2020.

__2021. CNLM Annual Report of Management Activities for the 2019-2020 Fiscal Year. Dana Point Preserve (S033). February 9, 2021. Unpublished internal report.

__2022. Dana Point Preserve Pacific Pocket Mouse 5-year Enhanced Vegetation Management Plan. 03 January 2022.

__2023. CNLM Dana Point Preserve Pacific Pocket Mouse Enhanced Management Plan Fiscal Year 2022 Summary Report. 14 January 2023.

Chew, R.M, R.G. Lindberg, and P. Hayden. 1965. Circadian rhythm of metabolic rate in pocket mice. Journal of Mammalogy 46:477-494.

City of Dana Point. 2005. Master Coastal Development Permit CDP 04-23. Issued January 19, 2005.

Cole, D.N. 1995. Experimental trampling of vegetation. I. Relationship between trampling intensity and vegetation response. Journal of applied ecology. 32: 203-214.

Cornell University. 2019. Snake Fungal Disease Fact Sheet. Cornell University, College of Veterinary Medicine. Accessed March 21, 2022, from: https://cwhl.vet.cornell.edu.

Cushman, J.H. and R.K. Meentemeyer. 2008. Multi-scale patterns of human activity and the incidence of an exotic forest pathogen. Journal of Ecology 96:766-776.

D'Antonio, A. 2000. Non-consumptive recreation and wildlife conservation: Coexistence through collaboration. Pp 9-10 in Effects of Non-consumptive Recreation on Wildlife in California. California Fish and Wildlife Journal, Recreation Special Issue 2020, California Department of Fish and Wildlife.

Derryberry, E.P., J.N. Phillips, G.E. Derryberry, M.J. Blum, and D. Luther. 2020. Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown. Science 370:575-579.

Dertien, J.S., C.L. Larson, and S.E. Reed. 2018. Adaptive management strategy for science-based stewardship of recreation to maintain wildlife habitat connectivity. Wildlife Conservation Society, Americas Program, Bronx, NY, USA.

Dertien, J.S., C.L. Larson, and S.E. Reed. 2021. Recreation effects on wildlife: a review of potential quantitative thresholds. Nature Conservation 44:51-68.

Diffenbaugh, N.S., D. Singh, J.S. Mankin, D.E. Horton, D.L. Swain, D. Touma, A. Charland, Y. Liu, M. Haugen, M. Tsiang, and B. Rajaratnam. 2017. Quantifying the influence of global warming on unprecedented extreme climate events. DOI 10.1073/pnas.1618082114.

EcoAdapt. 2016a. Southern California Climate Overview. Version 1.0. EcoAdapt, Bainbridge Island, WA. http://ecoadapt.org/programs/adaptation-consultations/socal

EcoAdapt 2016b. Jesse Kershner (Principal Investigator), California Landscape Conservation Cooperative(funder), California Landscape Conservation Cooperative(administrator), 2017-04-01(Publication), Adaptation Strategies for Coastal Southern California Habitats, http://climate.calcommons.org/climate-smart-southern-california-habitats, http://ecoadapt.org/programs/adaptation-consultations/socal-asproducts

Ellenberg, U., T. Mattern, P.J. Seddon, and G. L. Jorquera. 2006. Physiological and reproductive consequences of human disturbance in Humboldt penguins: the need for species-specific visitor management. Biological Conservation 133: 95e106.

Fernández-Juricic, E., M.D. Jimenez, and E. Lucas. 2001. Alert distance as an alternative measure of bird tolerance to human disturbance: implications for park design. Environmental Conservation 28:263-269.

Ficetola, G.F., R. Sacchi, S. Scali, A. Gentilli, F. De Bernardi, and P. Galeotti. 2007. Vertebrates respond differently to human disturbance: Implications for the use of a focal species approach. Acta Oecologica 31:109-118.

Finney, S.K., J.W. Pearce-Higgins, and D.W. Yalden. 2005. The effect of recreational disturbance on an upland breeding bird, the golden plover *Pluvialis apricaria*. Biological Conservation 121:53-63.

French, A.R. 1977. Circannual rhythmicity and entrainment of surface activity in the hibernator, *Perognathus longimembris*. Journal of Mammalogy 58:37-43.

French, N.R., B.G. Maza, and A.P. Aschwanden. 1967. Life spans of *Dipodomys* and *Perognathus* in the Mojave Desert. Journal of Mammalogy 48:537-548.

Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6:11-26.

Geffroy, B., D.S.M. Samia, E. Bessa, and D.T. Blumstein. 2015. How Nature-Based Tourism Might Increase Prey Vulnerability to Predators. Trends Ecology and Evolution 30:755-765. DOI: 10.1016/j.tree.2015.09.010.

George, S.L. and K.R. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. Biological Conservation 133:107-117.

Gill, J.A., K. Norris, and W.J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265-268.

Glover, H.K., M.A. Weston, G.S. Maguireb, K.K. Millera, and B.A. Christiea. 2011. Towards ecologically meaningful and socially acceptable buffers: Response distances of shorebirds in Victoria, Australia, to human disturbance. Landscape and Urban Planning. DOI:10.1016/j.landurbplan.2011.08.006.

Gómez-Serrano, M.A. 2021. Four-legged foes: dogs disturb nesting plovers more than people do on tourist beaches. Ibis 163:338-352.

Grissom, N. and S. Bhatnaga. 2009. Habituation to repeated stress: Get used to it. Neurobiology of Learning and Memory 92:215-224.

Gershunov, A., B. Rajagopalan, J. Overpeck, K. Guirguis, D. Cayan, M. Hughes, . . . M. Alexander (2013). Future Climate: Projected Extremes. In G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy (Eds.), Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment (pp. 126-147). Washington, D.C.: Island Press.

Gutzwiller, K.J., R.T. Wiedenmann, K.L. Clements, and S.H. Anderson. 1994. Effects of human intrusion on song occurrence and in subalpine birds. Auk 111:28-37.

Habib, L., E.M. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seiurus aurocapilla*. Journal of Applied Ecology 44:176-184.

Headlands Reserve LLC and City of Dana Point. 2004. The Headlands Development and Conservation Plan. General Plan Amendment, Planned Development District (Zoning), Local Coastal Plan and Policies, Local Coastal Implementing Actions Program. Adopted by the Dana Point City Council September 22, 2004. Certified by the California Coastal Commission August 11, 2004.

Hennings, L. 2016. The impacts of dogs on wildlife and water quality: a literature review. Metro Parks and Nature, Portland, OR, USA. Included in Hennings 2017 as Appendix 1.

__ 2017. Hiking, mountain biking and equestrian use in natural areas: a recreation Ecology literature review. Metro Parks and Nature, Portland, OR, USA.

Higham, J.E.S., E.J. Shelton. 2011. Tourism and wildlife habituation: Reduced population fitness or cessation of impact? Tourism Management 32(1290-1298). DOI: 10.1016/j.tourman.2010.12.006.

Invasive Species Specialist Group (ISSG). 2021. The Global Invasive Species Database. Version February 2021. http://www.issg.org/worst100_species.html. Accessed 13 December 2021.

IPCC. 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

Iwanowicz, D.D., A.G. Vandergast, R.S. Cornman, C.R. Adams, J.R. Kohn, R.N. Fisher, and C.S. Brehme. 2016. Metabarcoding of Fecal Samples to Determine Herbivore Diets: A Case Study of the Endangered Pacific Pocket Mouse. PLoS ONE 11(11): e0165366. doi:10.1371/journal.pone.0165366.

Jimenez, G., L. Melendez, G. Blanco, and P. Laiolo. 2013. Dampened behavioral responses mediate birds' association with humans. Biological Conservation 159: 477–483.

Lach, L. 2007. A Mutualism with a native membracid facilitates pollinator displacement by Argentine ants. Ecology 88:1994-2004.

Lei, B., Z. Zheng, J. Cui, J. Zhao, C. Newman, and Y. Zhou. 2022. Ecotourist trail-use affects the taxonomic, functional and phylogenetic diversity of mammals in a protected area: lessons for conservation management. Integrative Zoology 0:1-14. DOI: 10.1111/1749-4877.12688.

Kamel, M. 2021. Hiking trails effects on the diversity of gall-inducing insects in high altitude ecosystem, St. Katherine Protectorate, Egypt. Zoology in the Middle East 67:148-56. DOI: 10.1080/09397140.2020.1859975.

Kangas, K., M. Luoto, A. Ihantola, E. Tomppo, and P. Siikamäki. 2010. Recreation-induced changes in boreal bird communities in protected areas. Ecological Applications 20:1775-1786.

Kenagy, G.J. 1973. Daily and Seasonal Patterns of Activity and Energetics in a Heteromyid Rodent Community. Ecology 54:1201-1219.

Kenagy, G.J., and G.A. Bartholomew. 1985. Seasonal reproductive patterns in five coexisting California USA desert rodent species. Ecological Monographs 55:371-398.

Larson, C.L., S.E. Reed, A.M. Merenlender, and K.R. Crooks. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. PLoS ONE 11(12):e0167259.

__2019. A meta-analysis of recreation effects on vertebrate species richness and abundance. Conservation Science and Practice. 1:e93. https://doi.org/10.1111/csp2.93.

Liedtke, R., A. Barros, F. Essl, et al. 2020. Hiking trails as conduits for the spread of non-native species in mountain areas. Biological Invasions 22:1121-1134.

Loss, S.R. and R.B. Blair. 2011. Reduced density and nest survival of ground-nesting songbirds relative to earthworm invasions in northern hardwood forests. Conservation Biology 25:983-92.

Lucas, E. 2020. A review of trail-related fragmentation, unauthorized trails, and other aspects of recreation ecology in protected areas. 2020. California Fish and Wildlife, Recreation Special Issue 95-125.

Mallord, J.W., P.M. Dolman, A.F. Brown, and W.J. Sutherland. 2007. Linking recreational disturbance to population size in a ground-nesting passerine. Journal of Applied Ecology 44:185-195.

Martin, J.G. and D. Réale. 2008. Animal temperament and human disturbance: Implications for the response of wildlife to tourism. Behavioural Processes 77:66-72.

Mazur, J. (2006). Learning and behaviour (6th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Meserve, P.L. 1976a. Food relationships of a rodent fauna in a California coastal sage scrub community. Journal of Mammalogy 57:300-302.

__ 1976b. Food relationships of a rodent fauna in a California USA coastal sage scrub community. Journal of Mammalogy 57:200-319.

Miller, J. R., and N. T. Hobbs. 2000. Recreational trails, human activity, and nest predation in lowland riparian areas. Landscape and Urban Planning 50:227-236.

Miller, W.B. and M. Pavelka. 2008. Monitoring of the Pacific pocket mouse (*Perognathus longimembris pacificus*) population in the Oscar One training area on Marine Corps Base, Camp Pendleton 2003-2006. Draft Report. Prepared for Wildlife Management Branch, AC/S Environmental Security, Marine Corps Base Camp Pendleton.

Miller, A.B., D. King, M. Rowland, J. Chapman, M. Tomosy, C. Liang, E. Abelson, and R.L. Truex. 2020. Sustaining Wildlife with Recreation on Public Lands: A Synthesis of Research Findings, Management Practices, and Research Needs. U.S. Department of Agriculture Forest Service Pacific Northwest Research Station Portland, Oregon General Technical Report PNW-GTR-993. December 2020.

Mitrovich, M.J., T. Matsuda T, K.H. Pease, and R.N. Fisher. 2010. Ants as a measure of effectiveness of habitat conservation planning in Southern California. Conservation Biology 24:1239-1248.

National Research Council. 2004. Council, Adaptive Management for Water Resources Planning.

Natural Resources Assessment Inc. 2003. Presence/absence trapping studies for the Pacific pocket mouse on the Foothill/Eastern Transportation Corridor South. Unpublished report prepared for P and D Consultants, San Diego, California. November 7, 2003. 13pp. +appendix.

Naughton, I., C. Boser, N.D. Tsutsui, and D.A. Holway. 2020. Direct evidence of native ant displacement by the Argentine ant in island ecosystems. Biological Invasions 22:681-691.

Naylor, L.M., M.J. Wisdom, and R.G. Anthony. 2009. Behavioral responses of north American elk to recreational activity. Journal of Wildlife Management 73:328-338.

Nisbet, I.C.T., 2000. Disturbance, Habituation, and Management of Waterbird Colonies. Waterbirds: The International Journal of Waterbird Biology, 23:312–332. http://www.jstor.org/stable/4641163

Papouchis, C.M., F. Singer, and W.B. Sloan. 2001. Responses of Desert Bighorn Sheep to Increased Human Recreation. Canyonlands Research Bibliography. Paper 94. https://digitalcommons.usu.edu/crc_research/94.

Pauli, B.P., R.J. Spaul, and J.A. Heath. 2017. Forecasting disturbance effects on wildlife: tolerance does not mitigate effects of increased recreation on wildlands. Animal Conservation 20:251-260.

Patten, M.A., J.C. Burger, and M. Mitrovich. 2019. The intersection of human disturbance and diel activity, with potential consequences on trophic interactions. PLoS ONE 14: e0226418. https://doi.org/10.1371/journal.pone.0226418.

Persons, W.E. and P. Eason. 2017. Human activity and habitat type affect perceived predation risk in urban white- footed mice (*Peromyscus leucopus*). Ethology 123:348-356.

Procko, M., R. Naidoo, V. LeMay, and A.C. Burton. 2022. Human impacts on mammals in and around a protected area before, during, and after COVID-19 lockdowns. Conservation Science and Practice 4: e12743.

Reichman, O.J. and K. Van De Graaff. 1975. Association between ingestion of green vegetation and desert rodent reproduction. Journal of Mammalogy 56:503-506.

Randall, J.A., 1993. Behavioural adaptations of desert rodents (Heteromyidae). Animal Behaviour, 45:263-287.

Rankin, D.T., C.J. Clark, and E.E. Wilson Rankin. 2018. Hummingbirds use taste and touch to discriminate against nectar resources that contain Argentine ants. 2018. Behavioral Ecology and Sociobiology 72:44.

Reed, S.E. and A.M. Merenlender. 2008. Quiet, non-consumptive recreation reduces protected area effectiveness. Conservation Letters 1:146-154.

Reilly, M.L., M.W. Tobler, D.L. Sonderegger, and P. Beier. 2017. Spatial and temporal response of wildlife to recreational activities in the San Francisco Bay ecoregion. Biological Conservation 207:117-126.

Richmond, J.Q., T. Matsuda, C.S. Brehme, E.E. Perkins, and R.N. Fisher. 2021. Predictability of invasive Argentine ant distribution across Mediterranean ecoregions of southern California. Western North American Naturalist 81:243-256.

Rolando, A., E. Caprio, and M. Negro. 2013. The effect of ski-pistes on birds and mammals. In: The Impacts of Skiing and Related Winter Recreational Activities on Mountain Environments, pp.101-122. Bentham Science. Eds. C. Rixen and A. Rolando. 10.2174/97816080548861130100009.

Rogers, D.L. 2007. Center for Natural Lands Management white paper on adaptive management. Internal unpublished document, December 20, 2007.

Roman-Palacio, C., and J.J. Wiens. 2020. Recent responses to climate change reveal the drivers of species extinction and survival. Proceedings of the National Academy of Sciences 117:4211-4217.

Rosenthal, J., R. Booth, N. Carolan, O. Clarke, J. Curnew, C. Hammond, *et al*. 2022. The impact of recreational activities on species at risk in Canada. Journal of Outdoor Recreation and Tourism 40:100567.

Rutz, C., M-C. Loretto, A.E. Bates, S.C. Davidson, C.M. Duarte, W. Jetz, M. Johnson, A Kato, R. Kays, T. Mueller, R.B. Primack, Y. Ropert-Coudert, M.A. Tucker, M. Wikelski, and F. Cagnacci. 2020. COVID-19 lockdown allows researchers to quantify the effects of human activity on wildlife. Nature Ecology and Evolution 4:1156-1159.

Salvatori, M., V. Oberosler, M. Rinaldi, A. Franceschini, S. Truschi, P. Pedrini, and F. Rovero. 2023. Crowded mountains: Long-term effects of human outdoor recreation on a community of wild mammals monitored with systematic camera trapping. *Ambio* 1-13. DOI: 10.1007/s13280-022-01825-w.

Schroeder, J., S. Nakagawa, I.R. Cleasby, and T. Burke T. 2012. Passerine birds breeding under chronic noise experience reduced fitness. PLoS ONE 7, e39200.

Shier, D.M. 2007. Behavioral ecology and translocation of the endangered pacific little pocket mouse (*Perognathus longimembris pacificus*. Interagency Agreement between U.S. Fish and Wildlife Service and CRES, Zoological Society of San Diego.

__ 2008. Behavioral ecology and translocation of the endangered pacific little pocket mouse (*Perognathus longimembris pacificus*. Final Annual Report, January 2008 - December 2008. Federal Permit Number TE-142435-2; State SC -002508.

__ 2009. Behavioral ecology and translocation of the endangered Pacific little pocket mouse (*Perognathus longimembris pacificus*). Interagency Agreement between U.S. Fish and Wildlife Service and CRES, Zoological Society of San Diego.

__ 2014. Captive Breeding, Anti-Predator Behavior and Reintroduction of the Pacific Pocket Mouse (*Perognathus longimembris pacificus*). Final Report to State of California Department of Fish and Wildlife.

Shier, D.M., A.K. Bird, and T.B. Wang. 2020. Effects of artificial light at night on the foraging behavior of an endangered nocturnal mammal. Environmental Pollution 263.

Shier, D.M., A.J. Lea, and M.A. Owen. 2012. Beyond masking: Endangered Stephen's kangaroo rats respond to traffic noise with footdrumming. Biological Conservation 150. 53-58.

Shier, D.M., S. Leivers, S. King, R. Chock, and J.P. Montagne. 2016. Captive Breeding, Anti-Predator Behavior and Reintroduction of Pacific Pocket Mouse (*Perognathus Longimembris Pacificus*) 2014-2016. Final Report to California Department of Fish and Wildlife.

Shier, D.M., Wilder, A., Miller, W.B, Curry, C., King, S.N.D., Chock, R.Y., Greggor, A., and Houck, M.L. 2022. Draft Genetic Management Plan for the Pacific Pocket Mouse (*Perognathus longimembris pacificus*), Escondido, CA pp. 77.

Shutt, K., M. Heistermann, A. Kasim, A.Todd, B. Kalousova, I. Profosouva, K. Petrzelkova, T. Fuh, J. Dicky, J. Bopalanzognako, and J.M. Setchell. 2014. Effects of habituation, research and ecotourism on faecal glucocorticoid metabolites in wild western lowland gorillas: Implications for conservation management. Biological Conservation 172:72-79.

Slabbekoorn, H. and E.A. Ripmeester. 2008. Birdsong and anthropogenic noise: implications and applications for conservation. Molecular Ecology 17:72-83.
Steven R, Pickering C, Castley JG. 2011. A review of the impacts of nature based recreation on birds. Journal of Environmental Management 92:2287-2294.

Species at Risk Act, SC 2002, c 29, <https://canlii.ca/t/55xjz> retrieved on 2023-02-27.

Suarez, A.V., P. Yeh, and T.J. Case. 2005. Impacts of Argentine ants on avian nesting success. Insects and Society 52:378-382.

Sun, D. and M.J. Liddle. 1993. A survey of trampling effects on vegetation and soil in eight tropical and subtropical sites. Environmental Management 17:497-510.

Suraci, J.P., M. Clinchy, L.Y. Zanette, and C.C. Wilmers. 2019. Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice. Ecology letters 22:1578-1586.

Swei, A., P. Brylski, W. Spencer, S. Dodd, and J. Patton. 2003. Hierarchical genetic structure in fragmented populations of the Little Pocket Mouse (*Perognathus longimembris*) in southern California. Conservation Genetics 4:501-514.

Sytsma, M.L., T. Lewis, B. Gardner, and L.R. Prugh. 2022. Low levels of outdoor recreation alter wildlife behaviour. People and Nature 4:1547-1559. DOI: 10.1002/pan3.10402.

Tablado, Z. and L. Jenni. 2017. Determinants of uncertainty in wildlife responses to human disturbance. Biological Reviews 92:216-233.

Taylor, A.R. and R.I. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963.

Thompson, B. 2015. Recreational trails reduce the density of ground-dwelling birds in protected areas. Environmental Management 55:1181-1190.

Thompson, R.F and W.A. Spencer. 1966. Habituation: A model phenomenon for the study of neuronal substrates of behavior. Psychological Review, 73:16-43. https://doi.org/10.1037/h0022681.

Tost, D., E. Straub, K. Jung, and U. Siebert. 2020. Impact of tourism on habitat use of black grouse (*Tetrao tetrix*) in an isolated population in northern Germany. PLoS ONE 15(9): e0238660. https://doi.org/10.1371/journal.pone.0238660.

Underwood, E.C., Klinger, R. Moore, and P.E. 2004. Predicting patterns of non-native plant invasions in Yosemite National Park, California, USA. Diversity and Distributions 10:447-459.

Unger, R. 2020. Can our outdoor enthusiasm and nature co-exist? Pp 6-8 in Effects of Non-consumptive Recreation on Wildlife in California. California Fish and Wildlife Journal, Recreation Special Issue 2020, California Department of Fish and Wildlife.

URS and Center for Natural Lands Management (CNLM). 2004. Habitat Management and Monitoring Plan for Dana Point Headlands Biological Open Space.

U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Pacific Pocket Mouse. Federal Register 59:49752-49764.

__1998. Pacific Pocket Mouse (*Perognathus longimembris pacificus*) Recovery Plan. Portland, OR.

__2010. Pacific Pocket Mouse (*Perognathus longimembris pacificus*) 5-Year Review: Summary and Evaluation. Report by U.S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

__2020. Pacific Pocket Mouse (Perognathus longimembris pacificus) 5-Year Review and Evaluation. (ed. Office CFaW), pp. 1-34, Carlsbad, California.

U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW). 2022. Response to Update to the Habitat Management and Monitoring Plan for Dana Point Headlands. Biological Open Space, City of Dana Point, California. FWS/CDFW-OR-2022-0016223. March 23, 2022.

Wang, T.B. and D.M. Shier. 2017. Effects of anthropogenic lighting on pacific pocket mouse (*Perognathus longimembris pacificus*) foraging behavior, persistence and fitness. Final Report prepared for Wildlife Management Branch Environmental Security Dept. Marine Corps, Base Camp Pendleton.

Wheat, R.E. and C.C. Wilmers. 2016. Habituation reverses fear-based ecological effects in brown bears (*Ursus arctos*). Ecosphere 7:e01408.

Weston, M.A. and T. Stankowich. 2014. Dogs as agents of disturbance. In: Free-Ranging Dogs and Wildlife Conservation. Ed: M. E. Gompper. Oxford Scholarship Online: May 2015. DOI: 10.1093/acprof:osobl/9780199663217.001.0001.

Wilder, A.P., A.Y. Navarro, S.N.D. King, W.B. Miller, S.M. Thomas, C.C. Steiner, O.A. Ryder, and D.M. Shier. 2020. Fitness costs associated with ancestry to isolated populations of an endangered species. Conservation Genetics 21:589-601.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

Appendix A. Summary of literature pertaining to biological impacts of recreational and anthropogenic disturbances.

Author	Taxa or Species	Location	Objectives	Result
Allen et al. 2021	Song sparrows (*Melospiza melodia*)	British Columbia, Canada	Experimentally manipulated fear in wild songbird populations over 3 breeding seasons by broadcasting playbacks of either predator or nonpredator vocalizations, quantified effects on components of population growth.	Fear (stimulated by predator call playback) significantly reduced population growth rate through cumulative, compounding adverse effects on fecundity and offspring survival. Parents exposed to predator playback produced 53% fewer recruits to adult breeding population. “Fear” itself was projected to halve the population size in 5 years.
Anderson et al. 2023	Mammals	Glacier National Park, MT, USA	Used a COVID-19 closure within a heavily visited national park to examine how “low-impact” recreational hiking affects the spatiotemporal ecology of a diverse mammal community.	Camera trap data from park closure period and subsequently re-opening to recreation showed consistent negative responses to human recreation across most of assemblage of 24 species, with fewer detections, reduced site use, and decreased daytime activity after re-opening.
Anze and Koper 2018	Savannah sparrows (*Passerculus sandwichensis*)	Alberta, Canada	Influence of anthropogenic noise (industrial Infrastructure) on anti-predator behavior.	Greatest impacts on behavior were detected at the noisiest treatment; feeding latency was shortened compared with control sites, which may expose nests to greater predation risk.
Arlettaz et al. 2007	Black grouse (*Tetrao tetrix*)	Switzerland	Evaluated the physiological stress response (corticosterone levels) after disturbance induced by snow sports.	Birds in disturbed habitat had significantly higher concentrations corticosterone metabolites than those in habitats with no/very limited human disturbance. Corticosterone did not differ between habitats with moderate vs. high human disturbance.
Baharudin et al. 2022	Small mammals	Malaysia	Surveyed non-volant small mammals in a forest preserve unit to inform conservation and management.	Species composition of non-volant small mammals was reduced in areas with greater anthropogenic activity (jogging, hiking and camping).
Banks and Bryant 2007	Birds, multiple species	Australia	Experimentally manipulated dog walking at woodland sites adjacent to urban areas and monitored response of multi-species bird assemblages.	Dog walking in woodlands led to a 35% reduction in bird diversity and 41% reduction in abundance, both in areas where dog walking is common and where dogs are prohibited.
Bar-Ziv et al. 2022	Spur-winged lapwing (*Vanellus spinosus*)	Israel	Investigated escape behaviors of lapwings in open space and human dominated habitats (HDH).	Lapwings in HDH were bolder in their predator-avoidance sequence (shorter FIDs, shorter distances fled, and a higher probability of escape by running vs. flying) towards both human and non-human threats; this suggest that HDH impose a broader behavioral change on lapwings, rather than just simple habituation.

Author	Taxa or Species	Location	Objectives	Result
Barber et al. 2010	Multiple species	Multiple	A review of impacts of chronic noise exposure studies on terrestrial organisms.	A broad range of findings that indicate the potential severity of this threat to diverse taxa, and recent studies that document substantial changes in foraging and anti-predator behavior, reproductive success, density, and community structure in response to noise.
Barcelos et al. 2021	Mammals	Cavernas do Peruaçu National Park, Brazil	Used camera traps to surveys trails before and after national park opened to tourists to investigate effects of trail use on mammal species richness, probability of using trails, activity levels, and daily activity patterns.	Overall, results show that the initial years of visitation at the park had limited negative impacts on the target mammal species, although some species were displaced or showed temporal adjustment.
Barros and Pickering 2017	Plant communities	Argentina	Impact of informal trails and off-rail use on plant communities in protected areas of high conservation value.	Vegetation in 90% of valley damaged by visitor use. Informal trails and trampling off-trail can cause landscape-scale damage.
Bateman and Fleming 2017	Multiple species	Multiple	Literature review to compare and contrast different measures of response to tourist activities (avoidance responses, time budgets, and physiological responses).	Most studies reviewed interpret data as negative impacts of tourist activities; this review finds that behavioral data (flight responses and time budgets) often indicated positive effects; time budget data are often ambiguous, while physiological data tended to show negative responses.
Beale and Monaghan 2005	Black-legged kittiwakes (*Rissa tridactyla*), common murres (*Uria aalge*)	Scotland	Examined the relationship between daily visitor numbers and daily failure rates of nests in two species of seabirds.	Daily failure rates for kittiwakes increased slightly on days with higher visitor numbers. For murres, failure rate declined seasonally but was not significantly correlated with visitor numbers.
Bejder et al. 2009	Multiple species	Multiple	Reviewed the conceptual framework for the use of habituation, sensitization, and tolerance, and provide a set of principles for their appropriate application in studies of behavioral responses to anthropogenic stimuli.	Describe how cases of presumed habituation or sensitization may actually represent differences in the tolerance levels of wildlife to anthropogenic activity.
Bennett et al. 2013	Karner blue butterfly (*Lycaeides melissa samuelis*)	Indiana, USA	Used field surveys and simulations to examine response of butterflies to recreation, including oviposition rate and host plant choice; tested management strategies to alleviate recreation impacts.	Butterflies were sensitive to recreational disturbance and flushed at similar speeds and distances from recreationists as they would from natural threats, such as predators. Simulation models indicated that regular disturbance could reduce egg laying potential and significantly restrict host plant choice.
Blair and Launer 1997	Multiple	California, USA	Butterfly diversity and human land use; Species assemblages along an urban gradient.	Species richness and diversity of butterflies peaked at moderately disturbed sites while relative abundance decreased from natural to urban areas.

Author	Taxa or Species	Location	Objectives	Result
Blickley et al. 2012	Greater Sage-Grouse (*Centrocercus urophasianus*)	Wyoming, USA	Experimentally tested effects of chronic noise from human activities on sage grouse at leks.	Peak male attendance (i.e., abundance) at leks experimentally treated with anthropogenic noise from natural gas drilling and roads decreased 29% and 73%, respectively. There was limited evidence for an effect on peak female attendance.
Bötsch et al. 2017	Forest-nesting birds, multiple species	France	Measured disturbance of walking trail activity on birds during territory establishment.	Number of territories and species richness in disturbed (recreational walkers) areas substantially reduced compared with control plots (no walkers). Species most affected were open-cup nesters and above-ground foragers.
Boyes et al. 2021	Moth caterpillars (Lepidoptera)	England	Evaluated the impacts of nighttime lighting on wild caterpillars.	Street lighting strongly reduced moth caterpillar abundance compared with unlit site, affected caterpillar development, and disrupted the feeding behavior of nocturnal caterpillars.
Cassirer et al. 1992	Elk (*Cervus elaphus*)	Montana and Wyoming, USA	Measured movements of habituated and unhabituated populations of elk when disturbed by cross-country skiers to assess energy costs and identify factors that might influence elk behavior.	Among habituated elk, "predictability" of disturbance influenced response. Unhabituated elk responded similarly to skiers and logging disturbance; flight distance was related to topographic features. Elk often returned to area following displacement. Estimated energy expenditure from displacement was 5.5% of total daily expenditure, increasing exponentially with snow depth.
Cushman and Meetenmeyer 2008	Forest pathogen (*Phytophthora ramorum*)	California, USA	Examined the influence of humans and a range of environmental factors on the distribution of *P. ramorum* at three distinct spatial scales (along hiking trails, open space with public access, and human population density).	*P. ramorum* more commonly occurred in soil on hiking trails used heavily by humans than in soil from adjacent areas off trails. Forests on public land open to recreation had higher prevalence of disease than forests on private lands. Probability of disease occurrence increased significantly with population density in the surrounding area.
Derryberry et al. 2020	White-crowned sparrow (*Zonotrichia leucophrys*)	California, USA	Compared soundscapes and songs before and during Covid-19 shutdown; evaluated whether a songbird exploited newly emptied acoustic space.	Noise levels in urban areas were substantially lower during the shutdown, characteristic of traffic in the mid-1950s. Birds responded by producing higher performance songs at lower amplitudes, effectively maximizing communication distance and salience.
Dertien et al. 2021	Multiple species	Multiple	Reviewed research on the effect of non-consumptive recreation on wildlife to identify effect thresholds or the point at which recreation begins to exhibit behavioral or physiological change to wildlife.	Threshold distances varied substantially within and amongst taxonomic groups. Threshold distances for wading and passerine birds were <100m, but >400m for hawks and eagles. Mammal threshold distances varied widely from 50m for small rodents to 1,000m for large ungulates.

Author	Taxa or Species	Location	Objectives	Result
Fernández-Juricic 2001	House sparrow (*Passer domesticus*), common blackbird (*Turdus merula*), common wood pigeon (*Columba palumbus*), Eurasian magpie (*Pica pica*)	Spain	Examined factors that influence alert distances to pedestrian approaches in five large wooded open space.	Habitat structure modified alert distances: bird tolerance increased with greater availability of escape cover. Alert distances varied among species, with large species being less tolerant of human disturbance than small ones.
Ficetola et al. 2007	Terrestrial vertebrates (small mammals, birds, reptiles, and amphibians)	Italy	Examined recreation disturbance (people presence, trampling) on distribution of animals in urban parks.	Disturbance and forest maturity influenced the distribution of some species and the species richness of amphibians and reptiles; however, the pattern was not consistent across species within taxa or among taxa.
Finney et al. 2005	Golden plover (*Pluvialis apricaria*)	United Kingdom	Impact of recreational disturbance (intensity and extent) on the distribution and reproductive success of plovers breeding in proximity to an intensively used trail.	Prior to trail resurfacing, when people strayed from the footpath, plovers avoided areas within 200m of the trail during chick-rearing. After trail resurfacing, >96% of walkers remained on-trail, and plovers avoided areas within only 50m of the footpath. No detectable impact of disturbance on reproductive performance.
Frid and Dill 2002	Multiple species	Multiple	A review of studies where predation and nonlethal disturbance stimuli are proposed to create similar trade-offs between avoiding perceived risk and fitness-enhancing activities (feeding, parental care, mating); provide theoretical framework for human-caused disturbance stimuli as a form of predation risk.	Most literature examples were consistent with predictions of the risk-disturbance hypothesis (human-caused disturbance stimuli as a form of predation risk).
George and Crooks 2006	Bobcat (*Lynx rufus*), coyote (*Canis latrans*), and mule deer (*Odocoileus hemionus*)	California, USA	Investigated the relationship between large mammal spatial and temporal activity patterns and human recreation in an urban nature reserve using camera trapping.	Bobcats, and to a lesser degree coyotes, exhibited both spatial and temporal displacement in response to human recreation. No effect was detected for mule deer.

Author	Taxa or Species	Location	Objectives	Result
Gill et al. 2001	Multiple	Multiple	The effect of human disturbance on animals is frequently measured in terms of changes in behavior in response to human presence and the magnitude of these changes in behavior is often used as a measure of the relative susceptibility of species to disturbance. This paper discusses whether such assessments are accurate measures of the relative susceptibility of species to human disturbance.	The authors suggest that the degree of avoidance/durance resulting from human presence may be a misleading measure of impact particularly when a species is constrained in its ability to avoid or relocate in response to disturbance.
Glover et al. 2011	Shorebirds, multiple species	Australia	Measured the distance at which a response (flight initiation distance [FID]) occurred among 28 shorebird species when presented with an approaching human.	FID differed by species; species with higher body masses had longer FIDs. Mean FIDs for species were 18.6–126m. FID was influenced by starting distance of human approach, flock size, previous exposure to humans, and stimulus type (walker, jogger, walker with dog).
Gomez-Serrano 2021	Kentish plover (*Charadrius alexandrines*)	Spain	Estimated the impact of human presence affects breeding birds.	Walkers, when accompanied by dogs flushed plovers 80-93% of the time, whereas pedestrians alone flushed plovers 13-47.6% of the time. Nest return times were shorter on disturbed beaches, suggesting habituation to the human disturbance.
Gutzwiller et al. 1994	Birds, multiple species	Wyoming, USA	Effects of human intrusion on song occurrence and singing consistency in subalpine birds.	Singing by several species was not influenced by intrusion. For some species, song occurrence and singing consistency were higher on controls than on intruded sites, indicating intrusion reduced singing activity.
Habib et al. 2007	Ovenbirds (*Seiurus aurocapillain*)	Alberta, Canada	Assessed pairing success and age distribution of birds in boreal forests around noise-generating compressor stations compared with areas around habitat-disturbed, but noiseless, wellpads.	Significant reduction in ovenbird pairing success at compressor sites compared with noiseless sites. Significantly more inexperienced birds breeding for the first time were found near noise-generating compressor stations than noiseless well pads.
Hennings 2016, 2017	Multiple species	Multiple	This document reviews the literature on overall and relative effects of three user groups – hikers, mountain bikers and equestrians – on trails, habitat, and wildlife to help inform ecologically appropriate placement and construction of trails in natural areas.	Trails and trail use can damage natural areas by negatively affecting soils, vegetation, water quality, plants, and animals. Human disturbance increases animals' stress and can cause them to hide, change behavior or flee. Some species, such as those that do well in urban areas, are generalists and can tolerate human disturbance. Other species such as pregnant animals, long-distance migrants, and habitat specialists tend to be more stressed and displaced by trail users. Some species may permanently leave a natural area.

Kamel 2020	Invertebrates	Egypt	Surveyed spatial variation of the diversity of gall-inducing insects at different distances from a hiking trail.	Species richness and abundance of gall-inducing insects were significantly positively correlated with the distance from the trail. In most species, the proportion of galled plants was significantly positively correlated with the distance from the hiking trail.
Kangas et al. 2010	Birds, multiple species	Finland	Examined effects of recreation on forest bird communities in protected areas. Bird data collected along hiking trails and in undisturbed control areas were related to number of visits, area of tourism infrastructure, and habitat variables.	Results indicate that number of visits affects occurrence and composition of bird communities, but not species richness. Open-cup nesters breeding on ground showed strongest negative response to visitor pressure, while open-cup nesters in trees/shrubs were more tolerant. No significant impact detected for cavity-nesting birds.
Larson et al. 2016	Multiple species	Global	Conducted a systematic review of the scientific literature and analyzed 274 articles on the effects of non-consumptive recreation on animals, across all geographic areas, taxonomic groups, and recreation activities. Quantified trends in publication rates and outlets, identified knowledge gaps, and assessed evidence for effects of recreation.	Over 93% of reviewed articles documented at least one effect of recreation on animals, the majority of which (59%) were classified as negative. Studies of amphibians, reptiles, and fish are lacking. Some taxonomic groups (e.g., raptors, shorebirds, ungulates, and corals) had greater evidence for an effect of recreation. Non-motorized activities had more evidence for a negative effect of recreation than motorized activities, with effects observed 1.2 times more frequently.
Larson et al. 2018	Multiple species and subspecies of conservation concern in southern Ca.	California, USA	Modeled visitation rates for regional preserves, exposure of sensitive species, factors driving visitation rates.	Accessibility (numbers of housing units and parking lots) had positive relationships with visitation rates. Orange-throated whiptail (*Aspidoscelis hyperythra*), western spadefoot (*Spea hammondii*), and coastal California gnatcatcher (*Polioptila californica californica*), are likely exposed to high levels of recreational activity.
Larson et al. 2019	Birds, mammals, reptiles	Global	Conducted a global meta-analysis of the effects of recreation on vertebrate richness and abundance. Included 34 articles.	Species richness and abundance were lower in association with higher levels of recreation. In approximately 7 of 10 comparisons, vertebrate richness or abundance is expected to be lower with higher levels of recreation.
Lei et al. 2022	Mammals	China	Assessed taxonomic, phylogenetic, and functional diversity for a mammal community in a protected area to examine how trail use and habitat variables affected sightings and signs of mammals.	More developed and heavily used trail types had greater adverse effect on all diversity richness indices than did less intensively used trail types. Consequently, tourist pressure was associated with a general tendency to homogenize the site’s mammal community. The effects of trail types on diversity evenness indices were non-significant.

Liedtke et al. 2020	Native and non-native plants, multiple species	Chile	Evaluated the importance of hiking trails for plant invasion in protected mountain areas.	Hiking trails foster non-native species (NN) spread into mountains; NN at higher elevations are a subset of the lowland source pool and NN number and cover decreases with increasing elevation and distance to trails.
Lucas 2020 (*in* CDFW 2020)	Multiple species	Multiple locations	A literature review of recreation-related disturbances to wildlife; explores sustainability of dual-role preservation area (those used for conservation and recreation).	Evidence from literature indicates incompatibility between recreation and conservation goals of dual-role protected areas.
Mitrovich et al. 2020 (*in* CDFW 2020)	Multiple species	USA	Review of effects of recreation on wildlife; Case study of recreation-wildlife conflicts; discussion of options to balance human interest for recreation and the impacts on wildlife.	Authors provide comprehensive list of recommendations to achieve best recreation and conservation outcomes and minimize negative impacts of recreation.
Mallord et al. 2007	Woodlark (*Lullula arborea*)	England	Impact of recreational disturbance on population size	Bird density lower on sites with more disturbance. Probability of suitable habitat being colonized s lower in areas with greater disturbance. No relationship between disturbance and daily nest survival rates. Birds on heaths with higher levels of disturbance fledged more chicks (per pair) because of a strong density-dependent increase in reproductive output.
Martin and Réale 2008	Eastern chipmunks (*Tamias striatus*)	Quebec, Canada	Investigated the relationship between exploration, grooming-scanning continuum, emotionality, and docility of individual chipmunks and location of their burrow respective to frequentation by humans; assessed the relationship between hair cortisol and both temperament and frequentation by humans.	Explorative or docile chipmunks were more common in frequented areas. Hair cortisol increased with docility but was not related to human frequentation, indicating that temperament may cause animals to distribute themselves in a non-random way in response to human disturbance.
Miller et al. 2001	Birds, multiple species; Mule deer (*Odocoileus hemionus*)	Colorado, USA	Assessed the “area of influence” for human disturbance treatment by determining the probability that an animal would flush or become alert (for mule deer only).	For mule deer, the presence of a dog resulted in a greater area of influence, alert and flush distance, and distance moved than when a pedestrian was alone while for grassland and forest birds, the reaction to dogs and people were similar.
Miller and Hobbs 2000	Birds (artificial nests), multiple species	Colorado, USA	Effect of recreational trails on the risk of nest predation and nest predator activity at lowland riparian sites.	Predation rates were high (94%). Vulnerability to predation differed by transect types (on-trail, off-trail, near trail); predation rates tended to increase with distance from trails. Birds predators were more common near trails than away from trails, whereas mammals appeared to avoid nests near trails.

Naylor et al. 2009	American elk (*Cervus elaphus*)	Oregon, USA	Measured responses of elk (*Cervus elaphus*) to motorized and nonmotorized off-road recreational disturbance (ATV, mountain biking, horseback riding, hiking).	Elk increased their travel time in response to all disturbance types especially ATVs, followed by mountain biking, hiking, and horseback riding. Feeding time decreased during ATV exposure and resting decreased when elk were subjected to mountain biking and hiking disturbance.
Papouchis et al. 2001	Desert bighorn sheep (*Ovis canadensis nelsoni*)	Utah, USA	Compared behavioral responses of sheep to recreational activity between a low visitor use area and a high visitor use area by observing behavioral responses, distances moved, and duration of responses to vehicles, mountain bikers, and humans on foot.	Hikers caused more severe disturbance than vehicles and mountain bikers. There was considerable individual heterogeneity in responses, as well as differences in responses by male and females depending on breeding status. Avoidance of road corridor by some animals represented 15% less use of potential suitable habitat.
Patton et al. 2019	Mammals, multiple species	California, USA	Examined diel shifts in response to human activity; implication for predator-prey dynamics.	Two species, one predator and one prey, avoid human activity via a temporal shift to become more nocturnal—activity was centered near dawn on days without human activity but nearer to midnight on days with human activity.
Pauli et al. 2016	Golden eagle (*Aquila chrysaetos*)	Idaho, USA (simulation)	Created a model that incorporated tolerance behaviors and natural selection to simulate interactions between recreationists and nesting raptors to assess effect of human disturbance (hiking and OHV) on raptor populations and test if changes in tolerance to disturbance could mitigate negative consequences.	In the presence of recreation, simulated eagle populations had significantly lower and more variable growth rates, population sizes, and territory occupancy. Annual increases in recreation of 1–2% greatly exacerbated population declines; results suggest that long-lived species that experience encroachment from human activities may not adapt to human disturbance at a rate that compensates for changes in disturbance.
Persons and Eason 2017	White-footed mice (*Peromyscus leucopus*)	Kentucky, USA	Effects of habitat and abiotic factors, and human presence on anti-predator behavior of mice foraging in an urban park.	Increased human presence negatively affected foraging behavior across treatments. Human presence and light pollution led to modification of foraging behavior.
Procko et al. 2022	Mammals	British Columbia, Canada	Used camera traps to monitor human activity and terrestrial mammals in protected areas during and after COVID-19 public closures to discern relative effects of various forms of recreation on mammals.	Species responded variably. Negative effects of hikers on weekly bobcat habitat use; increased cougar detection rates in the during the COVID-19 closure; decreased cougar detection rates and increased black-tailed deer detection rates upon reopening of the protected area to public.
Reed and Merenlender 2008	Mammalian carnivores, multiple species	California, USA	Combined noninvasive survey techniques and DNA verification of species identifications to survey for mammalian carnivores in 28 parks and preserves.	Paired comparisons of neighboring protected areas with and without recreation show that presence of dispersed, nonmotorized recreation led to a five-fold decline in the density of native carnivores and a substantial shift in community composition from native to nonnative species.

Reilley et al. 2017	Mountain lion (*Puma concolor*), Virginia opossum (*Didelphis virginiana*), coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*)	California, USA	Used camera traps to quantify habitat use and activity patterns of wild mammals and human recreationists in protected areas; modeled habitat use with a multi-species occupancy model.	Habitat use was most associated with environmental covariates. Domestic dog presence was negatively associated with habitat use of mountain lions and opossum. Coyotes were more active at night/less active during day in areas with high levels of recreation. Skunks were more active in late morning in areas with human recreation. Smaller nocturnal carnivores may not be directly affected by daytime recreational activities.
Rolando et al. 2013	Multiple species	Italy	Quantify effects of effect of ski-pistes on birds and small mammals.	Ski-pistes below tree line produce a negative edge effect and were associated with lower bird diversity and species richness; forest plots adjacent to ski-pistes had lower bird abundance; small forest mammals avoid ski-pistes, but open habitat species colonized them.
Rosenthal et al. 2022	Multiple (at-risk) species	Canada	Conducted systematic comparison of threat categories for 300 Canadian species at risk.	Accounting for threat intensity, recreational activities was the third-greatest threat to species at risk in following “Invasive Species” and “Roads and Railroads”. Among species for which recreational activities posed at least a low-level threat the second most common recreational threat was hiking (after off-road vehicle use).
Rutz et al. 2020	Multiple species	Global	Discussion of COVID-19 lockdown effects on wildlife and the opportunity this presents for researchers to quantify the effects of human activity on wildlife.	Reduction in human mobility during Covid-19 shutdown (“Anthropause”) is unparalleled. Anecdotal observations show wildlife responded by increased movement into new places, etc. Authors encourage and discuss how collaborative research on Anthropause effects can maximize scientific insight and enable detailed, mechanistic understanding of human-wildlife interactions.
Salvatori et al. 2023	Mammals	Italy	Used systematic camera trapping over seven years to examine if tourism affected wild mammals and if it elicited spatial or temporal avoidance; estimated trends in occurrence at community and species levels.	Human presence intensified over 7-year period and both community and most species-level occurrences increased. However, human activities caused a strong temporal avoidance in the whole community, especially in most disturbed sites, while spatial avoidance was observed only for bigger-sized species.
Schroeder et al. 2012	House sparrow (*Passer domesticus*)	United Kingdom	Examined how noise might reduce reproductive output in passerine birds: e.g., by impairing mate choice, by reducing territory quality, and/or by impeding chick development.	Nests in areas affected by noise from large generators produced fewer young, of lower body mass, and fewer recruits; females nesting in noisy areas fed young less often. Nest box occupancy, parental body mass, age and reproductive investment did not differ significantly between noisy and quiet areas.

Schrimpf et al. 2021	Birds, multiple species	Canada and USA	Used records of >4.3 million birds observed by volunteers from March to May 2017-2020 to examine how reduced human activity during COVID-19 altered avian land use.	Counts of 80% of focal bird species changed in pandemic-altered areas, usually increasing in comparison to pre-pandemic abundances in urban habitat, near major roads and airports, and in counties where lockdowns were more pronounced or concurrent with peak bird migration.
Shier et al. 2012	Stephen's kangaroo rat (*Dipodomys stephensi*; SKR)	California, USA	Examined response of SKR to playbacks of footdrumming overlaid with experimental and control background noises.	Spectral characteristics of traffic noise overlap extensively with footdrumming signals of SKR. Traffic noise masks, and may mimic, footdrumming signals. Results suggest that anthropogenic noise may function as a deceptive signal.
Shier et al. 2020	Stephen's kangaroo rat (*Dipodomys stephensi*)	California, USA	Impacts of artificial light at night (ALAN) on foraging decisions of kangaroo rats.	Artificial light negatively impacted foraging decisions of endangered kangaroo rats; ALAN reduces habitat suitability and may potentially impede the recovery of at-risk nocturnal rodents.
Shutt et al. 2014	Western lowland gorillas (*Gorilla gorilla gorilla*)	Central African Republic	Investigated effects of ecotourism on the faecal glucocorticoid metabolites (FGCM) response of wild gorillas.	Two out of three human-contacted groups had higher FGCMs than unhabituated gorillas. FGCMs increased in between contacts up to 21 days in gorillas under habituation.
Slabbekoorn and Ripmeester 2008	Great tits (*Parus major*); additional songbird species covered in review	Western Europe	Reviewed current evidence for whether and how anthropogenic noise plays a role in patterns of decline in bird diversity and density.	Omnipresence of anthropogenic sounds can negatively affect birds. Behavioral flexibility, such as song plasticity, may allow some species more time to adapt to human-altered environments.
Steven et al. 2011	Birds, multiple species	Global	A review of the recreation ecology literature published in academic journals.	Of 69 papers (1978-2010) that examined recreation effects on birds, 61(88%) found negative impacts, including changes in physiology, immediate behavior, changes in abundance, and reproductive success.
Sun and Liddle 1993	Vegetation	Australia	Examined impacts of recreation (vehicles and walkers) on plant species richness, vegetation characteristics, soil penetration, and soil organic matter.	Plant species differed in sensitivity to degrees of trampling. Woody plants occurred only on untrampled areas. Total species and vegetation height and cover were reduced as wear increased. Plant height was reduced dramatically by even light trampling. No clear relationship between soil organic matter content and trampling intensity.
Suraci et al. 2019	Mammals	California, USA	Conducted a landscape-scale playback experiment using a recording of humans speaking to generate a "landscape of fear" and examined behavioral response of wildlife communities.	Large carnivores avoided human voices and moved more cautiously when hearing humans; medium-sized carnivores became more elusive and reduced foraging; small mammals increased habitat use and foraging.

Sytsma et al. 2022	Mammals	Glacier Bay National Park, Alaska, USA	Used camera traps to investigate the spatial and temporal responses of large mammals to experimentally manipulated levels of human activity in a protected area.	Detections did not exceed five per week for any species unless human activity was absent. However, spatial and temporal patterns of wildlife activity in relation to human activity were nuanced and species-specific.
Taylor and Knight 2003	Bison (*Bison bison*), mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*)	Utah, USA	Measured responses of animals to hikers and mountain bikers at a state park by comparing alert distance, flight distance, and distance moved.	Based on a 200-m “area of influence” (7%) of park was potentially unsuitable for wildlife due to disturbance from recreation. Wildlife did not respond differently to mountain biking vs. hiking; there was a negative relationship between wildlife body size and response.
Thompson 2015	Birds, multiple species	Ontario, Canada	Impacts of recreational trails on a forest-dwelling bird community.	Significant positive influence of the area of trail-free habitat on bird density, but not species richness. Birds that nest or forage on the ground exhibited greatest response to presence of recreational trails.
Tost et al. 2020	Black grouse (*Tetrao tetrix*)	Germany	Trail use and activity impacts on habitat use of an endangered grouse.	Birds avoided the vicinity of public routes at distances directly related to intensity of human activity. Recreational disturbances appeared to significantly affect the effective habitat availability.
Wells et al. 2012	Native and non-native plants, multiple species	Colorado, USA	Examined distribution of alien plants at trailheads and trails.	Plant communities at trailheads and trails, and seed banks at trailheads, contain substantial diversity and abundance of non-native plants. Recreational trails may function as corridors that facilitate the spread of non-native species into wildlands.
Weston and Stankowich 2014	Multiple species	Global	This book chapter reviews evidence of disturbance to wildlife caused by dogs not accompanied by humans.	Summary of evidence from literature of dog disturbance on wild birds and mammals, as well as reptilian and amphibian species. Provides management recommendations.
Wheat and Wilmers 2016	Brown bears (*Ursus arctos*)	Alaska, USA	Tested how habituation and fear drive the foraging ecology of bears feeding on salmon.	Higher human activity was associated with increased nocturnality of non-habituated bears, likely leading to suboptimal foraging, but had no effect on habituated individuals.

Appendix B. Alternatives for public access and recreation in Dana Point and coastal Orange County.

Coastal Open Space / Park Public Access Opportunities in Orange County[1]			
Open Space Name	**Ownership/ Land Manager**	**Size (acres)**	**Trail Length (miles)**
Within Dana Point City Limits			
Bluff Top Trail	City of Dana Point	n/a	0.2
Chloe Luke Overlook	City of Dana Point	0.4	n/a
Crystal Cove Park (aka Ocean Knoll)	City of Dana Point	1.6	n/a
Dana Cove Park	Orange County	5.4	n/a
Dana Point Harbor Park	Orange County	5.9	2
Doheny State Beach	California Department of Parks and Recreation	76	7
Harbor Point	City of Dana Point	9.3	0.3
Hilltop	City of Dana Point	11.7	0.7
Heritage	City of Dana Point	16.1	1
Lantern Bay	Orange County	15	1
Louise Leydon	City of Dana Point	0.5	n/a
Palisades Gazebo Park	City of Dana Point	0.7	n/a
Pines Park	City of Dana Point	4.7	n/a
Salt Creek Beach County Park	Orange County	45	1.2
Sea Terrace Park	City of Dana Point	27	0.3
Sea View Park	City of Dana Point	0.5	0.4
Strand Vista Park (South Strands Park)	City of Dana Point	16	1.2
Sycamore Creek Trail	City of Dana Point	n/a	0.5
Total		**236**	**16**
Coastal Orange County			
Aliso and Wood Canyons Wilderness Park	Orange County	4,500	30
Aliso Beach Park	Orange County	39	n/a
Aliso Creek County Beach	Orange County	27	n/a
Bolsa Chica Ecological Reserve	California State Lands Commission	1,300	4.5
Buck Gully Preserve	City of Newport Beach	298	4.5
Capistrano Beach Park	Orange County	55	3.9
Corona del Mar State Beach	California Department of Parks and Recreation	35.8	0.5
Cresent Bay Point Park	Orange County	1.5	n/a
Crystal Cove State Park	California Department of Parks and Recreation	3,936	20

Coastal Open Space / Park Public Access Opportunities in Orange County[1]			
Open Space Name	**Ownership/ Land Manager**	**Size (acres)**	**Trail Length (miles)**
Heisler Park	City of Laguna Beach	8.47	1.5
Huntington State Beach	California Department of Parks and Recreation	121	15.7
Laguna Coast Wilderness Park	Orange County	7,000	40
Laguna Laurel Ecological Reserve	California Department of Fish and Wildlife	78	3.3
Laguna Niguel Regional Park	Orange County	227	1.8
Lantern Bay	Orange County	15	1
Marblehead (Sea Summit) Preserve	Center for Natural Lands Management[2]	106	4
Newport Beach Marine Life Refuge	Orange County	16	n/a
Pacific Horizon Preserve	Orange County Transportation Authority	151	n/a
San Clemente State Beach	California Department of Parks and Recreation		4.5
Santa Ana River County Beach	Orange County		1
Seal Beach National Wildlife Refuge	United States Fish and Wildlife Service	965	2
Talbert Nature Preserve	Orange County	190	6.7
Treasure Island Park	City of Laguna Beach	10.3	0.9
Upper Newport Bay Ecological Reserve	California Department of Fish and Wildlife	752	8
Upper Newport Bay Nature Preserve	Orange County	135	8
Subtotal		**19,967**	**162**
Total		**20,203**	**178**

Acreage and mileage estimates are based on information available on agency websites and Esri ArcGIS.
[1] Open space and parks found within the California Coastal Zone in Orange County, does not mean the coastline is accessible at all of these sites and it is not a definitive list.
[2]CNLM is the perpetual land manager, not the landowner.