Lithophragma maximum
(San Clemente Island Woodland Star)

5-Year Review:
Summary and Evaluation

Photo by Sula Vanderplank, SUVA Research

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

August 2025

5-YEAR REVIEW

Lithophragma maximum
(San Clemente Island Woodland Star)

GENERAL INFORMATION

Species: *Lithophragma maximum* (San Clemente Island Woodland Star), a plant species
Date listed under the Endangered Species Act: August 8, 1997
Federal Register citation: Service 1997 (62 FR 42692)
Classification: Endangered
Recovery Plan: Final, January 26, 1984. Recovery Plan for the Endangered and Threatened Species of the California Channel Islands. Amendment, September 2019.
Recovery Priority Number: 2 (Species with high degree of threat and high recovery potential)
Critical Habitat Designation: No critical habitat has been designated for this species

BACKGROUND

Under the Endangered Species Act of 1973, as amended (ESA or Act; 16 U.S.C. 1531 et seq.), the U.S. Fish and Wildlife Service (Service), referred to as "we" in this document, maintain lists of endangered and threatened wildlife and plant species (referred to as the List) in the Code of Federal Regulations (CFR) at 50 CFR 17.11 (for wildlife) and 17.12 (for plants). Section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years.

Most recent status review: Service. 2020. 5-year Review *Lithophragma maximum* (San Clemente Island Woodland Star) Prepared by the Carlsbad Fish and Wildlife Office, Carlsbad, California. 7 pp.

We initiated the previous status review for *Lithophragma maximum* (San Clemente Island Woodland Star) in 2019. The review was finalized on August 20, 2020, and recommended no change in status.

Federal Register notice announcing this status review: On October 16, 2024, we published a *Federal Register* notice announcing initiation of the 5-year review of this species, and the opening of a 60-day period to receive information (Service 2024, pp. 83510–83514).

Species Overview and Habitat: *Lithophragma maximum* is a rhizomatous, perennial herb in the Saxifragaceae family. It has compound, trifoliate, basal leaves and two or three stout flowering stems that range from 16 to 24 inches (in; 40 to 60 centimeters; cm.) high. It flowers from April to June and each flowering stem bears small, white, bell-shaped flowers (Bacigalupi 1963, p. 349). The species is known only from shaded, moist areas in steep, deeply incised canyons on the southeastern part of San Clemente Island (eastern escarpment), in the understory of woodland habitats (Service 1984, p. 65). The species is self-compatible and reproduces vegetatively through the production of bulbils (clones) along the stem (caudex) as well as resprouting from rhizomes (Flora of North America 2024, unpaginated).

ASSESSMENT

Information acquired since the last status review

This 5-year review was conducted by the Service's Carlsbad Fish and Wildlife Office. Data for this review were solicited from the public and interested parties through a *Federal Register* notice announcing this review on October 16, 2024 (Service 2024, pp. 83510–83514). We also contacted the U.S. Navy (Navy), U.S. Pacific Fleet, SUVA Research, and the California Botanical Garden to request any data or information we should consider in our review. Additionally, we conducted a literature search and reviewed information in our files.

SUMMARY OF NEW INFORMATION SINCE 2020

This status review relies on monitoring and research to further the conservation of *Lithophragma maximum* funded by the Navy installation at San Clemente Island and the U.S. Pacific Fleet Conservation Program. Specifically, we received monitoring data (Navy 2025, unpaginated), a draft conservation plan (Longcore 2024, entire), monitoring plan (Vanderplank et al. 2025, entire), draft seed collection, banking and bulking plan (Vanderplank 2024, entire), pollination studies (Hazelquist et al. 2004a, entire; Phillips 2024, p. entire), and a poster presentation summarizing genetic research (Hazelquist et al. 2024b, entire). Our review of this information shows the species is still present at most of the previously known populations and the species distribution remains the same as described in our last 5-year review (Service 2020, entire). The following new information does not alter our understanding of the species' current distribution.

Distribution and Abundance

The species distribution on San Clemente Island is considered one large meta-population, with multiple occurrences recorded within individual canyons (Figure 1; Vanderplank et al. 2025, p. 4). Occurrences are defined as groupings of plants that are separated from one another but are not defined by a particular buffer or distance between individuals. The number of reported occurrences and occupied canyons has increased since the species was listed in 1997 (11 occurrences; Table 1; Service 1997, p. 42694). The last 5-year review described the distribution encompassing eight canyons from north to south: Grove, Eagle, Bryce, Negative, Malo, Keco, Mosquito, and Canchalagua canyons (Service 2020, pp. 1, 3). The 2016 survey data that the review was based on noted 33 occurrences recorded since 1979 within these eight canyons with a highly variable number of plants being observed at these locations over time (SERG 2016, pp. 35–36). In some cases, the number of records we report in our status reviews are different than the survey data for the same time (Table 1) because we had not received the most recent data prior to completing the review.

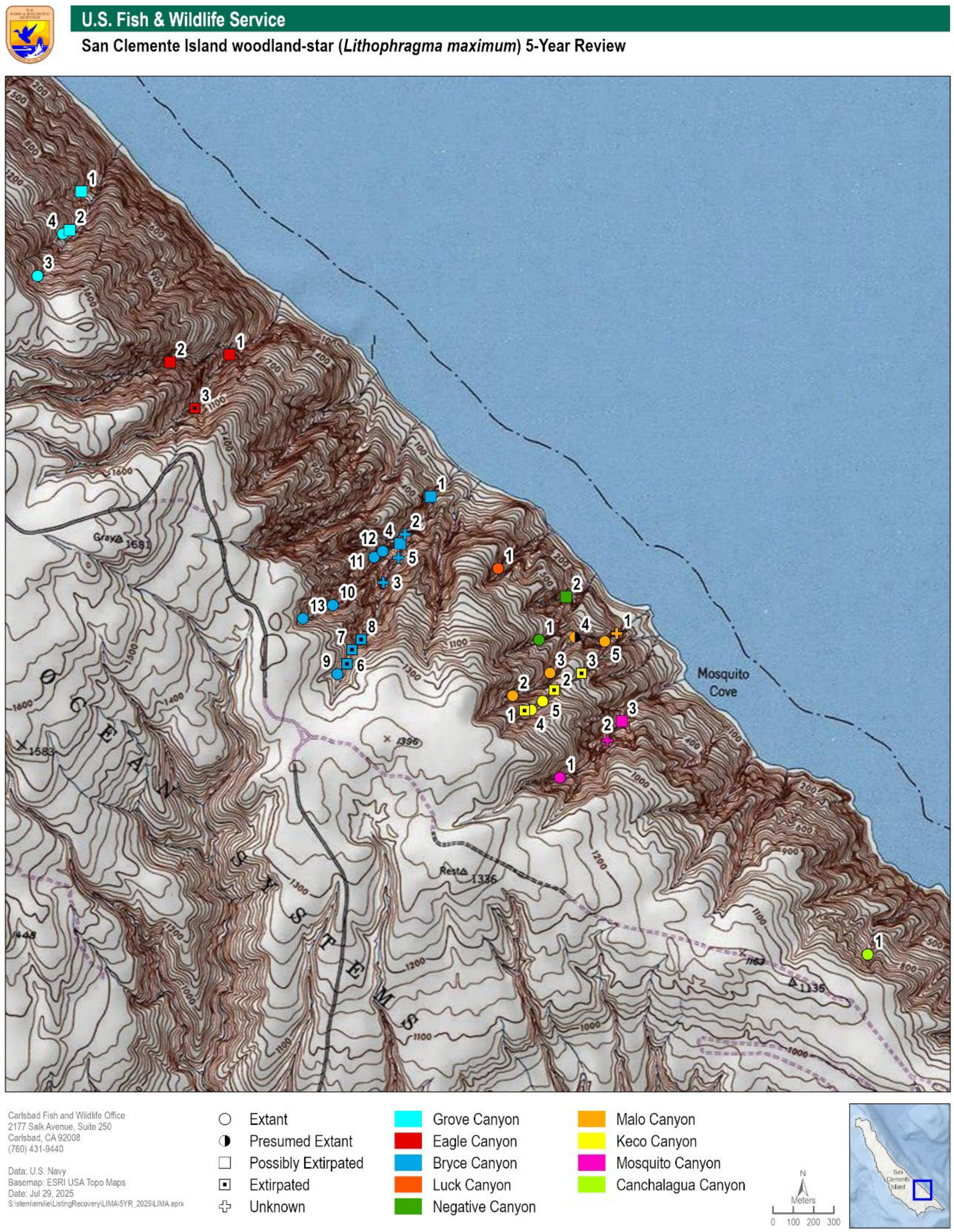

Figure 1. Map of *Lithophragma maximum* occurrences including the status and canyon where they occur.

Table 1. Summary of the number of occurrences and their status since listing.

Occurrence status	At listing 1997	2007	2020[1]	2025
Extant				16
Presumed extant				1
Possibly extirpated				8
Extirpated				7
Unknown				5
Total number of occurrences	**11[2]**	**17[3]**	**33**	**37**
Total number of canyons	**6**	**8**	**8**	**9[4]**

[1] The 2020 5-year review relied on a monitoring report from 2016 (SERG 2016, entire). Data reported in the table is based on the 2016 report.
[2] Only 11 occurrences were noted in the 1997 Listing rule (Service 1997, p. 42694); however, 15 occurrences were documented in the Navy's monitoring data for that time period (Table 2; Navy 2025, unpaginated).
[3] Only 17 occurrences were noted in the 2007 5-year review (Service 2007, p. 4); however, 25 occurrences were documented in the Navy's monitoring data for that time period (Table 2; Navy 2025, unpaginated).
[4] *Lithophragma maximum* is known from 9 canyons; however, extant occurrences are only found in 8 canyons.

Previously, we decided that the challenges to surveying for *Lithophragma maximum* and the lack of a systematic monitoring approach limited our ability to assess the status of each occurrence. The species is difficult to survey due to the steep, unstable terrain, with some sites being largely inaccessible. Additionally, absence of vegetative growth each year is not indicative of absence of the species because they can persist as bulbils that can resprout under appropriate conditions. Therefore, it was unclear whether null values represent true extirpation from a locality or merely that plants were unobserved as they are very difficult to detect when not flowering.

The Navy has monitored the species more consistently beginning in 2016, providing sufficient data for us to assess the status of occurrences (SERG 2016, pp. 28, 33). In this current review we summarize the status of *Lithophragma maximum* by occurrence (Table 2) and have adapted our status definitions to reflect the species' ecology and life history, as summarized below. In general, status considers the timeframe since the species was last detected and the number of subsequent negative detections. The threshold of 25 years was included to incorporate data from the last comprehensive rangewide surveys prior to the current systematic monitoring effort. Also, there are two records where the species was not observed for several consecutive years only to reappear in the 5th year (Canchalagua 1) and 20th year (Bryce 9; Navy 2025, unpaginated). Because we do not know whether the bulbils resprouted or the site was recolonized by seed, we generally consider 5 or more years of negative surveys to suggest that an occurrence was possibly extirpated or extirpated as outlined below.

> Extant: An occurrence is considered extant if the species was observed within the last 10 years (since 2015) and less than 5 negative surveys were recorded after the last detection.
>
> Presumed extant: An occurrence is presumed extant if the species was observed in last 11 to 24 years (since 2000) and less than 5 negative surveys were recorded after the last detection; or the species has not been observed in the last 25 years and suitable habitat is likely present, but the site is too inaccessible to be surveyed regularly.

Possibly extirpated: An occurrence is considered possibly extirpated if the species was observed in the last 24 years and there has been 5 or greater negative surveys; or if the species was observed 25 years or longer and there are 1 to 4 negative surveys (because surveys occurred less frequently historically, and all sites were not surveyed every year).

Extirpated: An occurrence is considered extirpated if there are 5 or more negative surveys over a span of 25 years or more where the species was not observed, and/or the habitat is destroyed or otherwise no longer suitable.

Unknown: An occurrence is considered unknown if the occurrence has not been surveyed for 25 years or longer.

Since 1979, the Navy detected *Lithophragma maximum* at 37 occurrences within 9 canyons (Table 1 and 2; Navy 2025, unpaginated). The number of occupied canyons is the same as previously reported, with 16 extant occurrences (46 percent of all occurrences) within 8 canyons (Grove, Bryce, Luck, Negative, Malo, Keco, Mosquito, and Canchalagua); and one presumed extant occurrence in Malo Canyon. The occurrences at Eagle Canyon are now considered possibly extirpated and the species has not been observed since 2000 or earlier; we believe the habitat is intact though there are also access constraints. New records were reported in Luck Canyon in 2021 and Bryce Canyon in 2023. The Navy documented new occurrences within occupied canyons; but our overall understanding of the species distribution is the same (Table 1). Though recent extirpations have been recorded (eight occurrences considered possibly extirpated in Grove, Eagle, Bryce, Negative, Malo and Mosquito Canyons and seven occurrences are considered extirpated in Grove, Bryce, and Keco Canyons), there are extant occurrences in all canyons, except for Eagle Canyon where occurrences are considered possibly extirpated. Five other occurrences were classified as unknown because they have not been revisited regularly and are largely inaccessible.

Although increasingly more plants have been found since 1997, all occurrences are small and range from 2 to approximately 104 individuals. Annual abundance estimates varied from 0 in 2018 to 262 in 2021 (Navy 2025, unpaginated). On average, the Navy recorded 103 plants annually over the last 20 years, though the level of survey effort varied between years. Beginning in 2016, surveys were conducted more regularly, and the average annual plant count is 160 plants across 16 occupied occurrences (Table 2).

Table 2. *Lithophragma maximum* occurrence summary including status, when first observed, last observed, abundance and whether there were recorded habitat impacts. Occurrences are grouped by canyon.

Site Name (Occurrences grouped by canyon)	Status	First Observed	Last Observed	Abundance (average)	Abundance (range)	Years of Negative Surveys	Accessibility Issues	Habitat impacts
Grove 1	Possibly Extirpated	2000	2000	35	35	3	Yes	No
Grove 2	Possibly Extirpated	2000	2016	19	9-21	6	No	No
Grove 3	Extant	2011	2024	23	7-56	2	No	Burned 2024
Grove 4	Extant	2015	2024	24	2- 60	3	No	No
Eagle 1	Possibly Extirpated	1979	1979	2	2	4	Yes	No
Eagle 2	Possibly Extirpated	1980	1981	14	12- 15	5	Yes	No
Eagle 3	Extirpated	1997	2000	25	20-29	5	Yes	No
Bryce 1	Possibly Extirpated	1980	1981	18	14-21	2	Yes	No
Bryce 2	Unknown[1]		>1979			2	Yes	No
Bryce 3	Unknown[2]		>1979			0	Yes	
Bryce 4	Possibly Extirpated	1986	1986	4	4	2	Yes	No
Bryce 5	Unknown	1986	1986	5	5	0	Yes	No
Bryce 6	Extirpated	1997	2000	14	10-18	7	No	Burned 2017
Bryce 7	Extirpated	1997	2000	15	9- 10	7	No	No

[1] Navy considers Bryce 2 an historical occurrence though the survey data was not available when this status assessment was prepared.
[2] Navy considers Bryce 3 an historical occurrence though the survey data was not available when this status assessment was prepared.

Site Name	Status	First Observed	Last Observed	Abundance (average)	Abundance (range)	Years of Negative Surveys	Accessibility Issues	Habitat impacts
Bryce 8	Extirpated	1997	2000	18	11- 25	6	No	No
Bryce 9	Extant	2003	2024	6	5- 7	7	No	Burned 2017
Bryce 10	Extant	2016	2024	19	3- 29	0	No	No
Bryce 11	Extant	2019	2023	4	1- 6	0	No	No
Bryce 12	Extant	2019	2023	1	0-1	3	No	No
Bryce 13	Extant	2023	2023	1	1	0	No	No
Luck 1	Extant	2021	2024	4	2-7	0	No	No
Negative 1	Extant	1996	2024	21	3- 104	1	No	No
Negative 2	Possibly Extirpated	1996	2000	33	30- 35	3	Yes	No
Malo 1	Unknown	1996	1996	30	30	0	Yes	No
Malo 2	Extant	1997	2024	48	15-91	1	No	No
Malo 3	Extant	2000	2022	5	0- 6	5	Yes	No
Malo 4	Presumed extant	2000	2013	5	0-5	4	Yes	No
Malo 5	Extant	2013	2013	10	3-22	0	Yes	No
Keco 1	Extirpated	1997	2000	53	10-96	7	No	Mudslide 2016
Keco 2	Extirpated	2000	2000	32	32	7	No	No
Keco 3	Extirpated	2000	2000	4	4	6	No	Burned 2024
Keco 4	Extant	2014	2023	7	2-16	0	No	No

Site Name	Status	First Observed	Last Observed	Abundance (average)	Abundance (range)	Years of Negative Surveys	Accessibility Issues	Habitat impacts
Keco 5	Extant	2014	2022	27	1-5	3	No	No
Mosquito 1	Extant	1991	2024	27	2-72	0	No	No
Mosquito 2	Unknown	2000	2000	55	55	0	Yes	No
Mosquito 3	Possibly Extirpated	2000	2000	28	55	1	Yes	No
Canchalagua 1	Extant	2003	2024	5	1-16	5	No	No

Ecology and Life History

Most of what is known about the reproductive ecology of *Lithophragma maximum* is inferred from studies of other species in the genus (Service 2007, p. 9); but the pollinator of *L. maximum* is unknown. To ascertain the presence and type of pollinators, the Santa Barbara Botanical Garden conducted two studies. In 2019, they set up sampling plots to visit plants when they were in flower. No potential pollinators were captured using sweep netting during daytime surveys (Hazelhurst et al. 2019, p. 12). However, two visitors were observed, one of which was identified as the urbane digger bee (*Anthophora urbana* subsp. *clementina*), and other potential pollinators were observed in the plot. Cameras also captured activity at dusk of a potential Alfalfa looper (*Autographa californica*), a widespread, generalist moth species (Hazelhurst et al. 2019, pp. 12, 15). Analysis of the pollen found on these specimens will be required to determine whether they pollinate *L. maximum*. In 2024, Santa Barbara Botanical Garden also investigated potential pollinators using Malaise and camera traps (Phillips 2024, pp. 11–12). Hoverflies (family Syrphidae) were identified on the camera footage (Phillips 2024, p. 9). Trap specimens were identified to morphospecies in the following orders: Hymenoptera, Diptera, Coleoptera, Hemiptera, Psocodea, and Lepidoptera, and further identification is underway.

Other species within the genus *Lithophragma* are considered to be either fully or partially self-incompatible; and we previously assumed the same for *L. maximum* (Service 2007, p. 9). New research suggests that *L. maximum* is self-pollinating and does not require a pollinator (Vanderplank 2025, p. 2).

Past attempts to propagate *Lithophragma maximum* from seed have been largely unsuccessful (SERG 2016, p. 11). Recent propagation efforts indicate that the seeds will germinate after a period of cold (Vanderplank 2025, p. 2), increasing the opportunities to augment or reintroduce occurrences.

Habitat Modeling

Lithophragma maximum is restricted to steep canyons along the eastern escarpment towards the southern end of San Clemente Island. Plants generally occur in shady conditions on steep north-facing slopes in moist canyon-bottoms or on canyon-wall ledges between elevations of 400 to 1,200 feet (120 to 366 meters). To better describe the species habitat and distribution, a species distribution model (SDM; also referred to as a habitat suitability model or environmental niche model) was developed (Longcore 2024, entire). Potentially suitable habitat was identified in northeast facing canyons, in low lying areas, with low, unobstructed visibility of the sky, and the presence of fog and low clouds (Longcore 2024, p. 8). The SDM also predicted potential suitable habitat in the southwest draining canyons. However, these areas were excluded from the final model because they are not supported by historical records.

Population Viability Analysis

The SDM described above was used in conjunction with a spatial metapopulation model to investigate the effect of potential management scenarios such as augmentation or translocation (RAMAS-GIS; Longcore 2024, p. entire). The resulting spatial population viability analysis (spatial metapopulation model) used the habitat quality and the spatial configuration of habitat from the SDM along with an assumed dispersal distance (0-984 feet (ft); 0-0.3 kilometer (km)), and existing survey data to estimate population growth. A key assumption is that annual survival is high at existing locations. Thirty (30) modeled habitat patches were identified, of which 7 are currently occupied, with some patches extending across multiple canyons at their lower extent (Longcore 2024, p. 9). A more complex age or stage-based population viability model could not be developed because vital rates at the different life stages are not available, or existing data were too variable to be useful in the model.

The spatial population viability analysis, without management, shows that the entire population is stable, with some evidence of increasing population trends predicted over the next 100-200 years. These results highlight which occurrences are most important for the long-term persistence of the population and where we may expect to see more variability in future abundance. Patches within Negative, Malo, Mosquito, and Canchalagua canyons appear to be stable or increasing, though some patches are predicted to have more year-to-year variability (Longcore 2024, pp. 17–19). Over time, patches in Bryce and Luck Canyons appear to be increasing. However, modeling suggests that Grove Canyon and Eagle Canyon have a higher probability of extirpation and will likely require augmentation to be viable in the future. When a population augmentation scenario was modeled (10 plants every 5 years in existing occupied patches in year 50 to 100), an increase the population trajectory was observed. Increases began at year 50, increased to year 100 and were approximately stable after 100 years (Longcore 2024, p. 17).

Monitoring Plan

The monitoring plan for *Lithophragma maximum* was designed to detect changes in population size and resiliency and provide data necessary for a species' status assessment (Vanderplank et al. 2025, p. entire). It identifies specific recovery and management objectives to promote species recovery (Vanderplank et al. 2025, p. 5). Based on an estimated population size of 100, up to 41 individuals will be sampled to have sufficient power to detect a trend each year. Two sentinel sites will be visited annually, and the remaining extant occurrences will be visited every 2 to 3 years. Discovery surveys will be conducted at 17 locations identified in the habitat suitability model including both occupied canyons and unoccupied canyons in years with good weather conditions (Vanderplank et al. 2025, p. 8). Historical extirpated sites and sites with difficult accessibility that have not been recently surveyed will be re-surveyed when feasible. Only sites that can be accessed safely with minimal environmental impact will be regularly surveyed.

Seed Banking

A draft seed collection, banking and bulking plan was developed to 1) conserve seed for long-term conservation; 2) bulk seed augmentation and reintroductions; and 3) develop a surplus for ecological experiments (Vanderplank 2024, entire). Seed banking for these uses was deemed practical because *Lithophrama maximum* produces in excess of 350 seeds per flower or approximately 30,000 seeds under greenhouse conditions; and collections from wild populations would be limited to less than 10 percent to minimize potential impacts on the abundance of the wild population (Vanderplank 2024, p. 3). Seed collection will be conducted under a Service ESA section 10(a)(1)(A) permit to the Navy. Methods, including tracking maternal lines, are included in the plan.

Genetics

Previous genetic research indicated evidence of inbreeding and strong population structure due to mating between closely related individuals and/or a lack of gene-flow between occurrences (Furches et al. 2009, pp. 121, 123). A recent study built on this work to inform seed banking, outplanting, and management actions (Hazelquist et al. 2024, entire). Individuals were sampled from 11 locations across Grove, Bryce, Luck, Negative, Malo, Mosquito, and Canchalagua Canyons. The study is consistent with earlier research suggesting a high degree of geographic isolation between plant occurrences and very low genetic diversity. It is not clear whether lower genetic diversity is due to self-pollination), lack of floral visitors (Hazelquist et al. 2004b, entire; Phillips 2024, p. entire), clonal life strategy, inbreeding, geographic isolation, or a combination of these factors. Occurrences at Grove (Grove 3) and Bryce (Side Bryce) to the north and Malo (Malo 2) to the south are each assigned to a single genetic group, while the other canyons sampled show some limited degree of gene flow and genetic mixing. The study recommends augmenting existing occurrences to improve genetic diversity and resiliency and establishing new occurrences using all the available genetic material.

Summary

Our understanding of the distribution of *Lithophragma maximum* is similar to that described in our last 5-year review (Service 2020, entire). It is known from a total of 37 occurrences within 8 canyons along the eastern escarpment of San Clemente Island (Table 1 and 2). The number of occurrences and individuals has increased since the last 5-year review due in part to more intensive and systematic monitoring. However, due to difficulty in accessing the terrain, infrequent and irregularly conducted surveys, and difficulty in detecting plants, it is not possible to draw conclusions about population trends at this time. Habitat suitability modeling identified more potentially suitable habitat that will be surveyed over the upcoming years. The population viability modeling identified those occurrences that are more stable and others that would benefit from augmentation. With the establishment of successful propagation techniques and conservation seed banking, the Navy is well positioned to further the recovery of *L. maximum*.

Threats

At listing, we considered that *Lithophragma maximum* was threatened by a variety of factors including grazing, fire, competition from nonnative plant species, and soil erosion (Service 1997, p. 46292). In 2007, we identified military training (land-use), restricted access, fire, erosion (exceptional events such as landslides), impacts from the spread of nonnative invasive plants and small population size (lack of pollinator services and low genetic diversity) as threats (Service 2007, pp. 10–14). Grazing, the primary threat identified in the original recovery plan, is no longer a threat because ungulates were removed from the island in 1991. Restricted access by non-military personnel to Shore Bombardment Area (SHOBA) was previously considered a potential threat to *L. maximum* because it limited the Navy's ability to monitor and manage threats (Service 2007, pp. 20–21); however, recent conservation efforts described above suggest that this is no longer considered a threat. Below we have summarized the current status of threats related to military training and fire, nonnative plants, erosion, low genetic diversity, and climate change (Table 3).

Table 3. Summary of threats to *Lithophragma maximum.*

Threat	At Listing (1997)	Recovery Plan (1984)	5-year Review (2007)	Recovery Plan Amendment (2019)	5-year Review (2020)	5-year Review (2025)
Feral Ungulates	X					
Nonnative Plants	X		X	X	X	X
Soil Erosion			X	X	X	X
Military Training		X	X	X	X	X
Fire		X	X	X	X	X
Low Genetic Diversity			X	X	X	X
Access to SHOBA			X			
Climate Change						X

Military Training and Fire

The entirety of the species' distribution occurs within the SHOBA, which has an elevated risk of fire due to military training activities with the potential to impact individuals, seed, and the surrounding vegetation (Service 2007, pp. 12–14). We do not think that *Lithophragma maximum* is adapted to fire (Service 2007, p. 14). Fire risk within SHOBA is greatest during fall months when *L. maximum* is often dormant. This may reduce the potential for impacts to individuals. However, any fire is likely to adversely impact habitat regardless of the season it occurs; and the habitat may take several years to recover. Larger fires have also occurred as early as April through mid-summer, when the species is more vulnerable to impacts. Based on the pattern of historical fires (2003-2023), wildfires generally occur within the upland grassland and shrub terraces within SHOBA. Fires along the eastern escarpment, where *L. maximum* are located, occur less often (Figure 2). Therefore, wildfire remains a threat to individuals and their habitat and is not likely to have population level impacts. To minimize the spread of wildfire to the eastern escarpment, the Navy uses Ridge Road on the east side of the Island as a firebreak. The Navy has historically enhanced the width of the road as a fuel break annually by applying herbicide, mowing, or applying fire retardant to roadside vegetation; fire retardant is no longer used because of its limited effectiveness and the fertilizing effect it has on vegetation. (O'Connor 2025, pers. comm.).

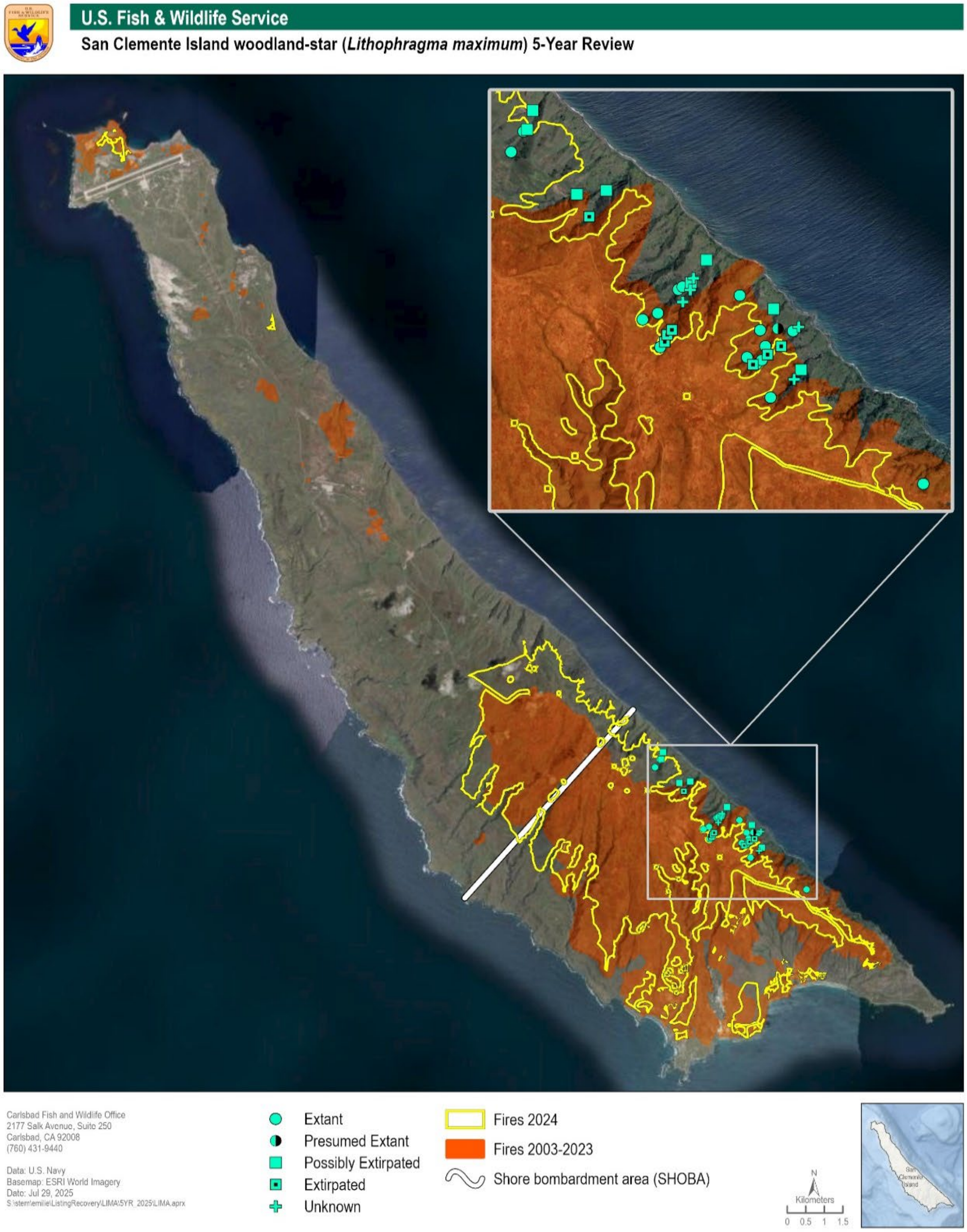

Figure 2. San Clemente Island illustrating the past fire perimeter (orange layer), the 2024 fire perimeter (yellow line), the boundary to SHOBA for reference (white line), and the *Lithophragma maximum* occurrences including those occurrences potentially impacted by wildfire.

In our 2019 Draft Recovery Plan amendment we noted that fire had affected 22 of the 33 *Lithophragma maximum* occurrences and we had little information to evaluate the species response to fire (Service 2019, p. 16; CFWO GIS internal database 2018). In the summer of 2017, three occurrences in the canyons burned and individuals were observed post-fire at Bryce 9, which was the only occurrence where individuals were observed in the years preceding the fire (Navy 2025, unpaginated). In 2024 the Escarpment fire burned habitat outside of the perimeter of repeatedly burned areas including areas north of SHOBA and the top of the canyons along portions of the eastern escarpment (Figure 2). Two occurrences burned during the fire (Grove 3 and Keco 3); we do not have information on the status of the occurrences at the time this review was completed.

Due to the species reliance on a mesic environment and that co-occurring species do not appear to be fire adapted (Service 2007, p. 14), we consider fire to be an increasing risk to *Lithophragma maximum*. Fire destroys vegetative cover to varying degrees, which can reduce habitat suitability through increased soil instability and erosion, and can promote the invasion of nonnative plants. Additional management and suppression efforts may be required to ensure that *L. maximum* occurrences are protected from fires in the future until we have a better understanding of the species ability to withstand fire.

Nonnative Plants

We lack information on the prevalence of nonnative plants at each occurrence and the extent to which they compete with *Lithophragma maximum*. However, nonnative annual grass also degrades *L. maximum* habitat by carrying wildfire into occurrences, which might not otherwise burn (Service 2007, p. 12). Nonnative annual grasses are pervasive in the upland habitat areas above the eastern escarpment. High nonnative grass fuel loads following two wet seasons are thought to have contributed, along with high wind conditions, to the spread of the 2024 fire into areas that had not burned repeatedly in recent years. Although we cannot describe the magnitude of the impacts, nonnative plants remain a threat to the species.

Soil Erosion

Lithophragma maximum occupies steep canyons, and its habitat is subject to loss from erosion from natural causes. Defoliation from historical overgrazing resulted in increased erosion and the loss of topsoil contributing to the formation of incised canyons that is still apparent on the Island. Loss of vegetation from fires and associated suppression activities nearby can also increase erosion (Service 1997, pp. 42696–42697). Foot traffic in the canyons to conduct monitoring also has the potential to increase erosion, though this potential threat is recognized in the monitoring plan and measures are incorporated to minimize it. Historically, larger erosion events have been recorded in response to heavy winter rains (Service 1997, p. 42699). Erosion threatens not only the individual plants but the entire habitat that supports them and is an on-going threat.

Low Genetic Diversity

Lithophragma maximum is a narrow endemic that has evolved within a restricted distribution, and has other life history characteristics that, individually and in combination, contribute to lower genetic diversity and may limit the ability of the species to adapt. Population abundance is small, the species is self-pollinating, does not require a pollinator, and reproduces clonally. In addition, it is geographically constrained by the steep topography where it occurs, which likely limits gene flow through restricted pollinator movement or seed dispersal. Although we do not know how genetically diverse the species was historically, we expect that it has been further limited by the impacts of ungulate grazing on the Island. Recent and past genetic research describes low genetic diversity, geographic isolation, and a reduced ability to adapt to a changing environment as a threat to the species (Hazelquist et al. 2024b, entire; Furches *et al.* 2009, entire). The conservation plan for the species includes a habitat suitability model and considers options for augmenting existing occurrences and re-introducing occurrences as measures to improve genetic diversity and redundancy (Hazelquist et al. 2024b; Longcore 2024, entire; and Vanderplank et al. 2024, entire).

Climate Change

Climate change is identified as a threat due to increasing temperatures, extreme precipitation, and the potential for decreased fog cover. The corresponding increase in aridity has the potential to impact *Lithophragma maximum* and the associated vegetation where it occurs. To assess the magnitude of the threat of climate change we evaluated historical and projected climatic water deficit data for the species' distribution (Figure 3). Climatic water deficit is the difference between potential and actual evapotranspiration. It describes the degree that the evaporative demand is not met by available water, and is a measure of drought stress, though it does not capture fog cover (Climate tool box 2024, unpaginated). The annual average climatic water deficit has increased relative to historical conditions (1971-2000) and is expected to increase in the future. Under RCP4.5 and RCP8.5, future projections are higher than historical conditions and are projected to include years where the aridity is outside of range of aridity that the species and the associated vegetation has experienced in the recent past (Figure 4). However, the effects of climate change may be mitigated to some degree by low clouds and fog, which are projected to persist though the number of cloudy days in the growing season may decrease slightly in the future under projected climate change (Clemesha et. al 2020, p. 36). Precipitation is also predicted to become more variable with the potential for extreme precipitation that could promote large erosion events and high nonnative annual grass cover that increase the risk of wildfire.

Lithophragma maximum may withstand short term drought conditions by persisting as bulbils or rhizomes underground; but long-term viability depends on maintaining a mesic environment. Solar insolation is reduced by steep topography, vegetation canopy cover, and fog cover that reduces evaporative demand. The latter two are likely to be reduced in the future; but we also expect topography and proximity to the ocean to help buffer the effects of climate. As a result, we would expect some reduction in growth, flowering, reproduction, and germination as well as reduced survival and viability. Extreme precipitation events also have the potential to increase erosion and the potential for the loss of habitat and individuals. However, we do not have data to characterize the magnitude of the threat currently.

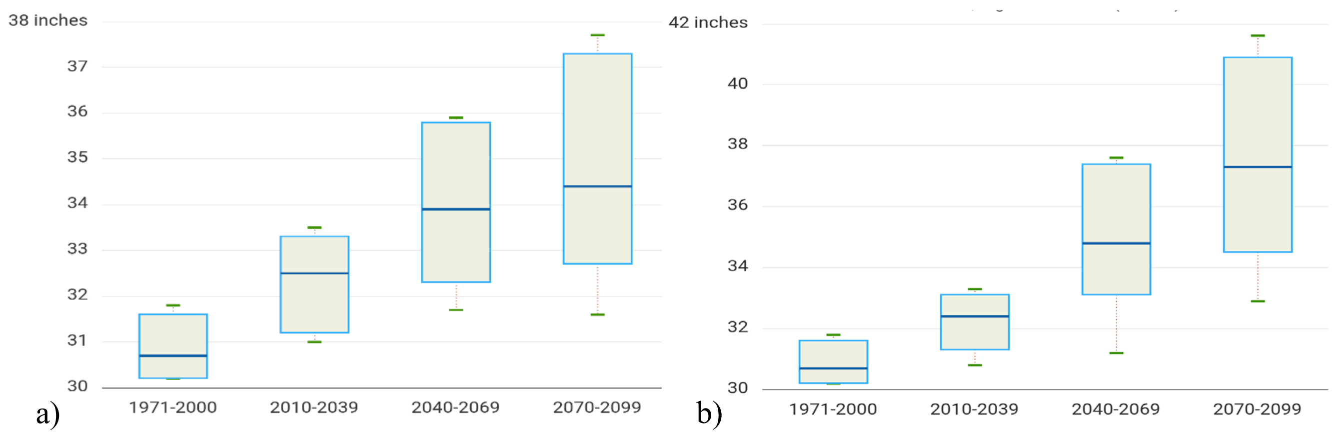

Figure 3. The annual average increase in the climatic water deficit for (a) RCP4.5 and (b) RCP8.5 on San Clemente Island (Climate toolbox 2025, unpaginated). The center line represents the median and the box covers 90 percent of the variation in climatic water deficit over each time period, and the highest and lowest values are indicated.

The species is sensitive to the effects of climate change including increasing temperatures, extreme precipitation, and the potential for reduced density and duration of fog cover. The species is currently limited to a narrow climate niche including cool, wet canyons along the east-facing escarpment of San Clemente Island (Longcore 2024, p. 30). Additionally, the seeds are reliant on a cold period to germinate (Vanderplank 2025, p. 2) and young seedlings are easily damaged by high temperatures (Longcore 2024, p. 30), though a temperature threshold has not been investigated. Though the threat of climate change on *Lithophragma maximum* is not new, it is being described for the first time in a 5-year review and is expected to increase in magnitude in the future.

Summary of Threats

The types and magnitude of threats to *Lithophragma maximum* are similar to that described in our 2007 5-year review (Service 2007, pp. 10–21). Military training, fire, nonnative plants, soil erosion, and low genetic diversity remain threats to the species. Climatic change was not specifically discussed but was a known potential threat at the time. Systematic threat monitoring is proposed in the recently developed monitoring plan that will improve our understanding of the prevalence and magnitude of these threats (Vanderplank et al. 2025, entire). Efforts have been made to maintain Ridge Road as a firebreak to minimize the spread of fire on the eastern escarpment where *L. maximum* occurs, and these efforts are expected to continue into the future. Based on recent fire activity, species specific measures are recommended as long as we consider fire a threat to the species. The effects of climate change are acting on individuals and their habitat, but population effects have not been observed. The status of the threats acting on the species has not changed substantially, and our last five factor analysis remains current (Service 2007, pp. 10–21).

RECOVERY STATUS

The Recovery Plan Amendment for the Endangered and Threatened Species of the California Channel Islands list recovery criteria related to the need for systematic demographic and threat monitoring, the minimum number of occupied canyons for the population to be viable, and the need for threats to be managed, particularly fire (Service 2019, entire). The status of each criterion is summarized in Tables 4 and 5 below.

CONCLUSION

Lithophragma maximum was listed as an endangered species in 1997 when it was only known from 11 occurrences in 6 canyons (Service 1997, p. 42694). The current distribution is similar to the distribution known at our 2020 5-year review (33 occurrences in 7 canyons; Service 2020, p. 1). Additional observations have been recorded due to the implementation of a systematic monitoring effort including 37 occurrences within 8 canyons (Navy 2025, unpaginated). This assessment includes the possibly extirpation of the occurrences in Eagle Canyon that have not been observed since 2000 or earlier. In our last five-factor analysis, we evaluated the threat of military training (land-use), fire, soil erosion (exceptional events such as landslides), and impacts from the spread of nonnative invasive plants as threats (Service 2007, pp. 10–14). The new information and updated occurrence status does not substantially alter the species’ status or the results of our five-factor analysis in the 2007 5-year review (Service 2007, pp. 10–21). Therefore, we conclude that *Lithophragma maximum* remains a federally endangered species and recommend no change in listing status.

Table 4. Summary of the status of downlisting criteria (Service 2019, entire).

Criterion Number	Downlisting Criteria	Update	Status
A.1.	Habitat loss from invasive herbivores is effectively managed and recovery of native vegetation is evident where *Lithophragma maximum* occurs.	Goats were removed from the Island in 1991, and the species is present in 8 canyons.	Completed
A.2.	A survey methodology is developed which identifies encroaching vegetation and allows tracking of persistence of *Lithophragma maximum* over time and relative changes in abundance at some selected number of occurrences; the locations will be determined based upon feasibility of maintaining consistent access. Information is quantitative in nature and includes a standardized estimate of abundance at occurrences that can be tracked over time, and indicators of demographic status (e.g., flowering; production of viable seed; relative estimated age of plants within the monitored occurrence; evidence of fruit or seed depredation; potential pollinators).	A monitoring plan has been developed and was implemented in 2024 (Vanderplank et al. 2025, entire).	Completed
A.3.	The response of *Lithophragma maximum* to fire is assessed and monitored post burn to measure persistence.	A monitoring plan has been developed that assesses the presence and impact of threats (Vanderplank et al. 2025, entire). Monitoring was started in 2024 and burned occurrences will be monitored in subsequent surveys.	In-progress. Post-fire monitoring is incorporated in the long-term monitoring program.
E.1.	A minimum of five canyons support *Lithophragma maximum* as demonstrated with persistence of at least one occurrence per canyon for a minimum of 10 years through consistent monitoring. Grove, Keco, and Mosquito canyons are included as three of the five canyons addressed by this criterion. At least one occurrence within each of the five canyons is managed for long-term persistence.	The monitoring plan was initiated in 2024 but more systematic monitoring was initiated in approximately 2016 and includes monitoring at Grove, Keco, and Mosquito. There are currently 8 canyons occupied including Grove, Bryce, Luck, Negative, Malo, Keco, Mosquito, and Canchalagua.	In-progress. At least 5 more years of systematic monitoring will be required to ensure that the occurrences will be stable into the future.

E.2.	A Fire Management Plan is developed and implemented to ensure the persistence of *Lithophragma maximum* in the canyons along the eastern escarpment where the species occurs.	The Navy is developing a fire management plan that considers the species as a high value resource and incorporates measures to minimize the impact of fire.	In-progress.
E.3.	Erosion potential from anthropomorphic activities is assessed at localities selected in Criterion E.1 (e.g., comparative assessment of on-site slope, aspect, vegetation cover, land-use, and fire-history) and managed, as feasible, to ensure long-term persistence of the species.	A monitoring plan has been developed that assesses the presence and impact of threats (Vanderplank et al. 2025, entire). Monitoring was initiated in 2024. Additional surveys will be required to characterize the degree of threat at each occurrence.	In-progress.

Table 5. Summary of the status of delisting criteria (Service 2019, entire).

Criterion Number	Delisting Criteria	Update	Status
A.5[1].	Changes to land use (e.g. training) are addressed through an INRMP, management program, or consultation in cooperation with the Service, such that training expansion does not directly or indirectly pose a threat to the persistence of *Lithophragma maximum*.	Military training needs on SCI are not static; they evolve to incorporate new technology and improve deterrence and warfighting capabilities. Currently proposed changes to military training on SCI are being evaluated under a new Environmental Impact Statement, which will be the subject of consultation between the Navy and Service under ESA Section 7. As part of that process, measures will be developed to avoid and/or minimize potential threats to *Lithophragma maximum* to ensure the species' persistence.	In-progress.
E.4.	Consistent with the downlisting criteria, a minimum of five canyons support *Lithophragma maximum* as demonstrated with consistent monitoring at each site for 20 years. A subset of the occurrences within each canyon is managed for long-term persistence through implementation of A.2 above.		In-progress. An additional 10 years of monitoring is recommended after the species is downlisted.

[1] There is no criteria associated with A.4 but the numbering was kept the same to be consistent with the Recovery Plan Amendment (Service 2019, p. 21).

RECOMMENDATIONS FOR FUTURE ACTIONS

Recovery will require stabilizing five resilient canyon scale occurrences so that they are self-sustaining and can withstand stochastic and catastrophic events. We have identified these recommendations to aid recovery of the *Lithophragma maximum*:

1. Study the reproductive ecology and mating system of *L. maximum* to determine whether populations suffer from low pollinator visitation or another mechanism that limits sexual reproduction in the species.

2. Identify the conditions and areas necessary to support all of the necessary biotic interactions (e.g. pollination, seed dispersal, population movement) for *L. maximum*.

3. Conduct research to understand what stage(s) of the species' life cycle may be limiting and identify opportunities to support recruitment or reduce threats as necessary.

4. Use existing or new seed collections to propagate individuals to augment or establish occurrences of *L. maximum* within appropriate habitat on San Clemente Island. The approach should build on modeling results described in the conservation plan and recent genetic results to inform seed selection, occurrences requiring augmentation, and potential habitat for translocations.

5. Work with the military to incorporate into the proposed Fire Management Plan an active commitment to use appropriate techniques to prevent wildfires from spreading east of Ridge Road.

6. Investigate impacts of fire in canyons along the eastern escarpment where *L. maximum* occurs by conducting post-fire monitoring at the occurrences that burned in the 2024 fire.

7. Evaluate measures to improve fire suppression within the Ship to Shore Bombardment Area or otherwise reduce the potential for fire impacts along the eastern escarpment.

8. Work with the Navy to develop a conservation agreement to secure the species long-term viability.

REFERENCES CITED

Bacigalupi, R. 1963. A new species of Lithophragma from San Clemente Island, California. Aliso 5:349-350.

Clemensha, R.E.S., A. Gershumov, D. M. Lawson. 2020. Final Report-Coastal low cloud and fog analysis for San Clemente Island. Prepared for the U.S. Pacific Fleet under Cooperative Agreement W9126G-17-2-0029). 68 pp. Climate tool box 2024. Climatic water deficit graphs for Representative Concentration Pathway 4.5 and 8.5 in the vicinity of Laguna Beach, California. https://climatetoolbox.org/tool/Future-Boxplots. Accessed June 5, 2025.

Flora of North America. 1894. Lithophragma (Nuttall) Torrey & A. Gray. 1: 582. https://floranorthamerica.org/Lithophragma. Accessed 5/22/2025.

Furches, M.S., L.E. Wallace, and K. Helenurm. 2009. High genetic divergence characterizes populations of the endemic plant *Lithophragma maximum* (Saxifragaceae) on San Clemente Island. Conserv. Genet: 115-126.

Hazlehurst, J.A., S. Calloway, and D. Knapp. Important pollinator species for conserving rare endemic island plant species on San Clemente Island, California. Prepared for the U.S. Navy. 33 pp.

Hazelquist, C.M., K.E. Hasenstab-Lehman, C.M. Guilliams, A.M. Ayers, M.B. Roberts, N. Desnoyers, B. Lee, R. Jarquin, A. Clark, R. Kaaret, K. Brine, and W. Walker. 2024. Conservation genomics of Lithophragma maximum (Saxifragaceae), the San Clemente Island woodland star. Prepared for the U.S. Navy under Cooperative Agreement N62473-23-2-0002.

Longcore, T., N. Noujdina, and S. Vanderplank. 2024. Draft Spatial Conservation Planning for the San Clemente Island Woodland Star (*Lithophragma maximum*). Chapter 2 of Report to U.S. Army Corps of Engineers under Cooperative Agreement W9126G-21-2-0057. UCLA Institute of the Environment and Sustainability, Los Angeles. 16 pp.

O'Connor, Kimberly. 2024. Email communication between J. Simonsen, USFWS Biologist, and K. O'Connor, U.S. Pacific Fleet Conservation Program Manager regarding wildfire management for the conservation of *Lithophragma maximum* including the reduced use of fire retardants.

Phillips, Z.I., 2024. San Clemente Island rare plant pollinator survey. 2024 annual report. Prepared for the U.S. Navy. 12 pp.

[SERG] Soil Ecology and Restoration Group. 2016. draft San Clemente Island Native Habitat Restoration Program, 2016 Annual Report. *Prepared by* Emma Havstad, Giovanna Figueroa, Carolyn Mills, and Thomas A. Zink, Soil Ecology and Restoration Group, San Diego State University Research Foundation, San Diego, CA *for* Zia Flossman, U.S. Army Corps of Engineers, Bryan Munson, Botany Program Manager, Naval Base

Coronado, Kimberly O'Connor, Project Manager, SSC Pacific. Agreement W9126G-15-2-0040. February 2017. 71 pp.

[Service] U.S. Fish and Wildlife Service. 1984. Recovery plan for the endangered and threatened species of the California Channel Islands. U.S. Fish and Wildlife Service, Portland, Oregon. 165 pp.

[Service] U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for Three Plants from the Channel Islands of Southern California. *Federal Register* 42: FR 42692–42702.

[Service] U.S. Fish and Wildlife Service. 2019. Recovery Plan for the Endangered and Threatened Species of the California Channel Islands. Draft Amendment. March 2019. 31 pp. 25

[Service] U.S. Fish and Wildlife Service. 2007. *Lithophragma maximum* (San Clemente Island Woodland Star) 5-Year Review: Summary and Evaluation. September 2007. 31 pp.

[Service] U.S. Fish and Wildlife Service. 2020 5-Year Review *Lithophragma maximum* (San Clemente Island Woodland Star) Prepared by the Carlsbad Fish and Wildlife Office, Carlsbad, California. 7 pp.

[Service] U.S. Fish and Wildlife Service. 2024. Initiation of 5-Year Status Reviews for 59 Pacific Southwest Species. *Federal Register* 89: 83510-83514.

[Navy] U.S. Department of the Navy. 2009. San Clemente Island Wildland Fire Management Plan, Commander Navy Region Southwest Natural Resource Office.

[Navy] U.S. Department of the Navy. 2024. *Lithophragma maximum* monitoring data 1979 to 2024.

Vanderplank, S., K. O'Connor, N. Desnoyers, B. Lee, K. Brine, and T. Longcore. 2025. Monitoring Plan for the San Clemente Island Woodland Star (*Lithophragma maximum*). Report to U.S. Army Corps of Engineers under Cooperative Agreement W9126G-21-2-0057. UCLA Institute of the Environment and Sustainability, Los Angeles. 25 pp.

Vanderplank, S. 2024. Draft Seed Collection, Banking and Bulking Plan for *Lithophragma maximum*. Chapter 4 of Report to U.S. Army Corps of Engineers under Cooperative Agreement W9126G-21-2-0057. UCLA Institute of the Environment and Sustainability, Los Angeles. 7 pp.

FIELD OFFICE APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approve

JONATHAN SNYDER Digitally signed by JONATHAN SNYDER
Date: 2025.08.26 12:49:02 -07'00'

Jonathan Snyder
Acting Field Supervisor

Recommended Citation:

U.S. Fish and Wildlife Service. 2025. 5-Year Review: Summary and Evaluation for *Lithophragma maximum* (San Clemente Island Woodland Star). August 2025. Carlsbad Fish and Wildlife Office, Carlsbad, California. 24 pp.