Gaviota Tarplant (*Deinandra increscens* ssp. *villosa* [*Hemizonia increscens ssp. villosa*])

5-Year Review:
Evaluation and Summary

Kristie Scarazzo, USFWS 2021

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

August 2022

5-YEAR REVIEW
Gaviota tarplant (*Deinandra increscens* ssp. *villosa* [*Hemizonia increscens* ssp. *villosa*])

GENERAL INFORMATION

Species: *Deinandra increscens* ssp. *villosa*
FR citation: 65 FR 14888-14898 (as *Hemizonia increscens* ssp. *villosa*)
Date listed: March 20, 2000
Classification: Endangered

BACKGROUND

Most recent status review:
U.S. Fish and Wildlife Service. 2011. *Deinandra increscens* ssp. *villosa* (Gaviota tarplant) 5-Year Review: Summary and Evaluation. Ventura Field Office. Ventura, California.

FR Notice citation announcing this status review:
Initiation of 5-Year Status Reviews of 76 species in California and Nevada. Notice of initiation of reviews; request for information (86 FR 27462-27464), May 20, 2021.

Critical Habitat Designation:
The Service designated critical habitat for Gaviota tarplant in 2002 (67 FR 67968-68001).

State Listing:
The state listed Gaviota tarplant as endangered under the California Endangered Species Act in 1990 (California Natural Diversity Database [CNDDB], California Department of Fish and Wildlife [CDFW] 2022a).

Recovery Plan:
The Service has not yet completed a Recovery Plan for Gaviota tarplant.

ASSESSMENT

Overview:
Gaviota tarplant is an annual herb in the Asteraceae (daisy family) that grows up to 45 centimeters (18 inches) tall. It is shorter in stature and more decumbent than its closely related counterpart, grassland tarweed (*D. i.* ssp. *increscens*). Gaviota tarplant has head-like inflorescences in tight (compact) groups or pairs. The heads are composed of two different types of flowers, called disks and rays. Gaviota tarplant tends to have 13 ray flowers per head and this is often used as a distinguishing characteristic (Tanowitz 1982, pg. 331). However, it varies, and the species can have eight or 15 rays. The individual flowers are inserted on a common receptacle (thickened, flat end of the stem). The disks are more abundant than the rays and occur towards the center of the inflorescence. The rays occur at the outer edge in a single ring, surrounding the disks. The disks and rays are separated from each other by another ring of scale-

like bracts called paleae. Both types of flowers are yellow and typically bloom June through September (Baldwin 2012, website).

Gaviota tarplant is self-sterile, meaning that there is some mechanism that prevents seed set in fertile plants after self-pollination events (Baldwin 2012, website; Ferrer and Good 2012, pg. 536). Therefore, insect pollinators are likely required for outcrossing and successful reproduction. Because the composite flowers of Gaviota tarplant open successively over the blooming period, pollination can be achieved by several different visitors, which likely confers increased genetic diversity in the species (Knapp et al. 2021, pg. 3). Gaviota tarplant fruits are achenes, which are single-seeded, dry, indehiscent fruits typical of Asteraceae. Like the flowers, Gaviota tarplant achenes are dimorphic (two different types). The ray achenes are three-angled, with rounded backsides and the disk achenes are cylindric, (in the shape of an inverted cone). Gaviota tarplant ray achenes do not have a pappus, which is a modified calyx that sits on top of the ovary/fruit and functions in wind dispersal (Wachtier-Perner 2020, pg. 48). The disk achenes have a pappus comprised of several small, fringed scales (Tanowitz et al. 1987, pg. 304-305).

Dimorphism in the species' fruits has implications in its dispersal, dormancy, and seed bank. The ray achenes are larger and heavier and are therefore dispersed by animals or are retained near the parent plant. The disk achenes are smaller, lighter, and have a pappus, indicating wind dispersal at greater distances. Studies show the ray achenes have longer dormancy, delayed germination, but are produced in much greater abundance. Disk achenes germinate earlier and have higher germination rates, but far fewer of them are produced (Tanowitz 1987, pgs. 307 and 310). Drastic fluctuations in Gaviota tarplant distribution and abundance indicates presence of a seed bank, which is a common characteristic of annual species (ManTech SRS Technologies Inc. 2020, pg. 5 and 12; Marcon 2022a, pers comm). Seed banks of the species consist mostly of ray achenes because of their different attributes. We do not yet know how long the seeds remain viable as a seed bank. Ray achenes are important for sustaining populations through stochastic events and cycles of environmental variation. Disk achenes are important for the species to be able to colonize new areas (Tanowitz 1987, pg. 311).

Gaviota tarplant requires grassland habitats. Occupied areas often intergrade with coastal sage scrub communities and are dominated by nonnative, Mediterranean annual grasses such as wild oat (*Avena* spp.), bromes (*Bromus* spp.), false brome (*Brachypodium distachyon*), and nonnative forbs like storksbill (*Erodium* spp.). Native grasses and forbs can also co-occur with Gaviota tarplant but are typically less dominant. Shrubs are largely absent in stands occupied by the species, although shrubs may occur in intergrade zones and other successional areas, like saw-tooth goldenbush (*Hazardia squarrosa*), California buckwheat (*Eriogonum fasciculatum*), and coyote brush (*Baccharis pilularis*). Areas that provide suitable grassland habitats for the species include marine terraces, coastal bluffs, active and inactive cattle ranches, undeveloped plains and prairie areas, and open fields.

Information acquired since the last status review:
This 5-year review was conducted by the U.S. Fish and Wildlife Service (Service), Ventura Fish and Wildlife Office. Announcement of this review occurred through a Federal Register notice on May 20, 2021 (Service, 86 FR 27462-27464). We contacted other agencies and species experts

to request any data or information we should consider in our review. We also conducted a literature search and a comprehensive review of information in our files.

New information has become available since our last 5-year review (Service 2011). We have updated information about the species current distribution and abundance, taxonomy, morphology and stand composition, genetics, conservation seed banking, and pollinators. We also have additional information regarding threats from several development projects and climate change effects. Discussions of these topics are included in the assessment.

Population Distribution and Abundance:
Listing and Critical Habitat Designation. At the time of listing in 2000, there was only one known location of Gaviota tarplant. It occurred within southern Santa Barbara County, California along coastal terraces adjacent to the Pacific Ocean in the immediate vicinity of the unincorporated community of Gaviota. The population was scattered over approximately 24 hectares (ha) or 60 acres ([ac] Service 2000, 65 FR 14888-14898). CDFW estimated that it consisted of approximately 20 colonies (or stands) separated from one another by no more than a few hundred feet (Howald 1989, pg. 4). However, data from census counts or total population abundance were not available and are difficult to track over time. When listed, Gaviota tarplant was considered a coastal endemic.

Several new locations of the species became known over the two years after listing and when we designated critical habitat in 2002. From Gaviota, moving north, these new sites included multiple colonies west of Gaviota, along the immediate coast and a few more inland on south-facing slopes of the Santa Ynez Mountains. All these colonies occurred within the 14,400-acre Hollister Ranch subdivision located between Gaviota State Park and what is now the Jack and Laura Dangermond Preserve (Dangermond) property. The interior locations were the first inland observations of Gaviota tarplant, and these higher elevations were considered a novel ecological setting for the species. Occupied locations were also noted further west along the coast at Point Conception and Government Point, which are now part of Dangermond. Numerous locations were also reported from Vandenberg Space Force Base (VSFB). These included locations northwest and inland of Dangermond, near Sudden Peak and Tranquillon Mountain (also upland/inland), sites immediately west along the coast at Point Arguello, and multiple locations south of Point Sal and around Lions Head (Service 2002, 67 FR 67968-68001). Again, data from census counts or total population abundance were not available in 2002 and are difficult to track over time. Gaviota tarplant was now regarded as both a coastal and upland species, with locations interior from the coast at higher elevations.

5-Year Review. We completed the first Gaviota tarplant 5-year review in 2011 (Service 2011). At this time, the Service refined knowledge of the species distribution and identified seven main populations based on the known locations described above. From the south to the north, these included: 1. the first known Gaviota coastal sites; 2. the Hollister Ranch coastal sites; 3. the Hollister Ranch upland sites within the Santa Ynez Mountains; 4. coastal sites associated with Point Conception on Dangermond; 5. inland sites on Tranquillon Mountain and Sudden Peak (several on VSFB); 6. the Point Arguello sites on VSFB; and 7. the Point Sal/Lions Head sites on VSFB (Service 2011, pg. 5-6). Population abundance and trend information were largely unavailable in 2011. But new information started to emerge from monitoring efforts that the

numbers of above ground plants in any given year varied considerably. For example, annual estimate data from the Gaviota Coast population showed that some colonies had thousands of individuals in some years and less than approximately 100 individuals in other years. Similarly, the colonies within the Point Conception/Dangermond population were estimated to contain more than 10,000 individuals in some years and less than 10 individuals in others. This newly observed interannual variability alluded to notions about the importance of Gaviota tarplant seed banks in maintaining populations of the species through periods of environmental stochasticity (Service 2011, pg. 8).

Current Status. We use the term "occurrence" to mean a specific location where Gaviota tarplant is or has been documented to occur. An occurrence typically represents a summary or compendium of all known observation data and other information for a known location of the species, and most include several years of data from a variety of sources, summarized into a single record. By convention, we separate occurrences when there is at least 0.4-kilometer (km)/0.25-mile (mi) distance between documented locations. Our definition is consistent with how the term occurrence is used by CDFW in the CNDDB (2020, pg. 9-10). We used observation data and other location information for Gaviota tarplant to complete a spatial analysis in geographic information system (GIS) to determine the species' current range and distribution. We compiled all available data for this analysis from the following sources:

- Government version of the CNDDB through the Biogeographic Information and Observation System (CNDDB 2022b, website),
- Specimen data from the Consortium of California Herbaria (CCH2) Data Portal (CCH2 2022, website),
- Survey data from private landowners/stakeholders, and
- Gaviota tarplant survey data from VSFB collected between 2010 and 2019 (VSFB 2022, pers comm).

In most cases, data from these different sources overlap and consist of several points and/or polygons, all associated with a single, more general locality. We grouped and condensed the data for each occurrence into single, discrete points using GIS software to create the final, current Gaviota tarplant distribution map (Figure 1). For example, occurrence 1 (Figure 1) includes five CNDDB polygons, three CCH2 records, and 38 points/polygons from VSFB (CNDDB 2022b, website; CCH2 2022, website; VSFB 2022, pers comm). Detailed information about the datasets that compose each known Gaviota tarplant occurrence is provided in Appendix A.

Gaviota tarplant is now known from a total of 27 occurrences all within southwestern Santa Barbara County (Figure 1). Most of the occurrences are distributed across the same seven core populations identified in our 2011, 5-year review (Service 2011, pg. 6). From Gaviota, traveling north these include: 1. Gaviota Coast; 2. Hollister Ranch Coast; 3. Hollister Ranch/Santa Ynez Mountains; 4. Point Conception/Dangermond; 5. Sudden Peak/Tranquillon Mountain; 6. Point Argeullo; and 7. Point Sal/Lions Head. There are two new Gaviota tarplant occurrences, numbers 13 and 14 that are recently discovered colonies mapped along the coast, in areas north of Jalama Beach, predominantly on VSFB (VSFB 2022, pers comm). Portions of occurrence 14 were first mapped on VSFB in 2015 (ManTech SRS Technologies 2016, pg. 20; ManTech SRS Technologies 2020, pg. 12). There is also a historical herbarium record within occurrence 14

collected in 1928 (CCH2 2022, website). The rest of the colonies within occurrence 14, and all of occurrence 13, were mapped on VSFB in 2019 (ManTech SRS Technologies 2020, pg. 12 and 41). Therefore, we now recognize a new eighth population of Gaviota tarplant that we are referring to as Jalama Beach (Figure 1).

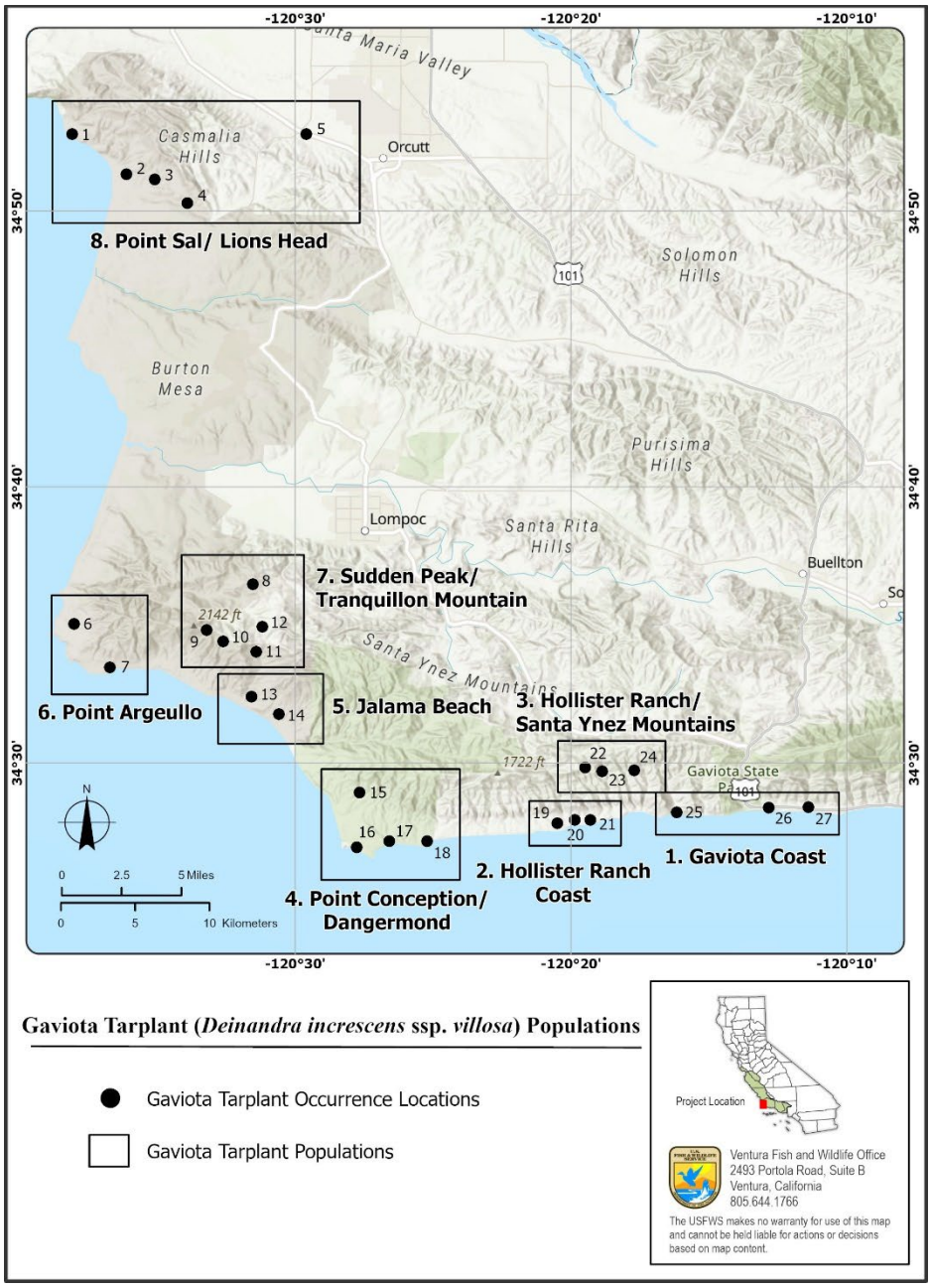

Figure 1. Distribution and range of Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) occurrences, Santa Barbara County, California, including the eight existing Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) populations. The species current range and distribution is based on data from the California Natural Diversity Database (CNDDB), Consortium of California Herbaria (CCH2) Data Portal, and Vandenberg Space Force Base ([VSFB] CNDDB 2022b, website; CCH2 2022, website; VSFB 2022, pers comm).

The quantitative data available for the occurrences are highly variable (Appendix A). Several of them have minimal quantitative data, have not been surveyed in recent years, or have not been revisited since their initial documentation. Simple presence/absence notations are more frequent than comprehensive estimates of abundance and censuses. Only a few complete counts have been conducted within mapped areas that support the species, both in general and since the 2011 5-year review (Service 2011). Rough estimates of the total number of individuals observed within occupied areas are more typical in the dataset. For example, the oldest and most limited data in the set is for occurrence number 5. This occurrence is based on a single herbarium specimen collected in 1962 and that is the only information we have for this location (CCH2 2022, website). Alternatively, occurrence number 12 is comprised of 85 points and polygons and this occurrence was surveyed consecutively from 2019 to 2021 (CNDDB 2022b, website; CCH2 2022, website; Marcon 2022a, pers comm). We assume all 27 Gaviota tarplant occurrences are extant, even though several of them need updated survey information. This assumption is based on the data and on a review of recent aerial imagery conducted for occurrences without more recent surveys, showing evidence that the species' habitat is still extant and has not been completely converted to development (ESRI World Imagery 2022, application).

The 2019 through 2021 Gaviota tarplant abundance survey data for occurrence 12 are provided below in Table 1. The survey methods used, and the actual areas surveyed varied slightly across years. However, methods are similar enough to best represent abundance for most of the Sudden Peak/Tranquillon Mountain Population/occurrence 12 (Marcon 2022a, pers comm).

Table 1. Abundance data for Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) occurrence 12 (Sudden Peak/Tranquillon Mountain Population) from 2019 through 2021. Data from Marcon 2022a, pers comm and LLC. 2022, pgs. 28-29.

Gaviota tarplant occurrence 12 Sudden Peak/Tranquillon Mountain Population	**2019**	**2020**	**2021**
Number of Individuals	6,039,777	3,454,451	2,185,551
Acres Occupied	56.61	49.51	24.4

Gaviota tarplant experts speculate that annual precipitation and timing of precipitation are likely the most important drivers of observed annual population fluctuations, which is true for many California native annual forbs (ManTech SRS Technologies 2020, pg. 12). Preliminary analyses performed with the abundance data from the Sudden Peak/Tranquillon Mountain Population/occurrence 12 show annual Gaviota tarplant abundance, and possibly aerial extent and density correlations with annual rainfall (Marcon 2022b, pers comm).

Relative Size of the Populations Based on Occupied Area. Although we do not have a lot of quantitative data for the eight Gaviota tarplant populations, we do have some information about their relative size, based on occupied area mapped, and gleaned from the existing spatial dataset (CNDDB 2022b, website; CCH2 2022, website; VSFB 2022, pers comm). The Sudden Peak/Tranquillon Mountain is by far the largest population. The next largest is Point Sal/Lions Head, with Jalama Beach and Point Argeullo closely after. Point Sal/Lions Head is roughly three quarters as large as the Sudden Peak/Tranquillon Mountain population. Jalama Beach and Point Argeullo populations are approximately half the size of Sudden Peak/Tranquillon Mountain. The

remaining populations (Point Conception/Dangermond, Gaviota Coast, Hollister Ranch Coast, and Hollister Ranch/Santa Ynez Mountains) are similar in size and occupy a much smaller total area. They consist of between two to four small aggregates of mapped colonies and are nearly or less than one sixth of the size of the Sudden Peak/Tranquillon Mountain population.

We conducted another analysis to compare the relative size of the seven known Gaviota tarplant populations using the largest number of plants (individuals) ever recorded for each of the documented CNDDB element occurrences (Service 2020, pgs. 32-34). This analysis did not include the newly documented, eighth population of Gaviota tarplant, (Jalama Beach), because it was previously unknown. Results are summarized below in Table 2.

Table 2. Relative size of the seven known Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) populations using largest number of plants ever recorded. Data from Service 2020, pgs. 32-34.

Population Name	**Largest number of Plants Recorded**	**CNDDB Element Occurrence Numbers Included within the Population**
Sudden Peak/Tranquillon Mountain	6,644,767	18, 24, 25, 26, 27, 28, 29, and 30
Point Conception/Dangermond	58,000	10 and 15
Gaviota Coast	12,000	1 and 4
Hollister Ranch Coast	1,202	8, 9, 21, and 22
Point Arguello	750	19
Hollister Ranch/Santa Ynez Mountains	700	6, 7, and 20
Point Sal/Lions Head	611	5 and 52

Taxonomy, Morphology, and Colony Composition:
Listing and Critical Habitat Designation. In 2000, the Service listed Gaviota tarplant under the recognized name at the time (*Hemizonia increscens* ssp. *villosa*; Service 2000, 86 FR 27462-27464; Tanowitz 1982). The taxonomic treatment for the species followed the first edition of the Jepson Manual: Higher Plants of California in 2000 ([Jepson Manual] Hickman 1996, pgs. 281 and 283). When we designated critical habitat in 2002, we utilized a new name (*Deinandra increscens* ssp. *villosa*) based on a revised taxonomic treatment for North American tarweeds, which used new phylogenetic information, among other things (Service 2002, 67 FR 67968-68001; Baldwin 1999, pgs. 467-469).

5-Year Review. Use of the name *Deinandra increscens* ssp. *villosa* continued through 2011, when we completed the first 5-year review (Service 2011). In 2007, Baldwin revised one of the formerly treated subspecies (*D. i.* ssp. *foliosa*) and elevated it to species paniculate tarplant (*D. paniculata*). He also simultaneously treated a new subspecies *D. i.* ssp. *increscens*, leaving it (grassland tarweed) and Gaviota tarplant as the two remaining forms in the *D. increscens* complex because they formed a monophyletic group (Baldwin 2007a, pg. 240 and 248). Baldwin also completed an updated taxonomic treatment online for the genus *Deinandra*, as part of the

Jepson Flora Project in 2010 (Jepson Flora Project 2010, website). This new treatment further refined understanding of the morphological characters that delineate the two *Deinandra increscens* subspecies.

Current Status. The two subspecies names Baldwin assigned for Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) and grassland tarweed (*D. i.* ssp. *increscens*) are still currently used. Baldwin published slightly updated treatments for the two subspecies and the dichotomous key, based on morphology to distinguish them, in the hard copy second edition of the Jepson Manual in 2012 (Baldwin et al. 2012, pgs. 296-299). There have been no subsequent changes to the treatments or currently assigned names (Baldwin 2012, website).

VSFB conducted a series of survey efforts between 2011 and 2019 that identified areas onsite with "pure" Gaviota tarplant (*Deinandra increscens* ssp. *villosa*), "hybrids" (plants with intermediate morphologies between either of the two different species, *D. increscens* [either Gaviota tarplant or grassland tarweed] with paniculate tarplant [*D. paniculata*]), and "intergrades" (plants with intermediate morphologies between the two subspecies, Gaviota tarplant and grassland tarweed). After synthesis of all the available data, the only occurrences on VSFB currently identified to contain pure Gaviota tarplant include Point Sal/Lions Head Population/occurrences 1, 2; Sudden Peak/Tranquillon Mountain Population/occurrence 9; and Jalama Beach Population/occurrences 13, 14 (Figure 2; Science Applications International Corporation [SAIC] 2012, pg. 10, and 25-26; ManTech SRS Technologies 2016, pg. 19-21; (ManTech SRS Technologies 2020, pg. 3, 12, 37, and 42; VSFB 2022, pers comm).

Occurrence composition nuances on VSFB have regulatory ramifications because colonies not currently considered to contain any pure Gaviota tarplant would not be considered the listed entity and are therefore subject to removal and other impacts without the requirement of compliance with the Endangered Species Act of 1973.

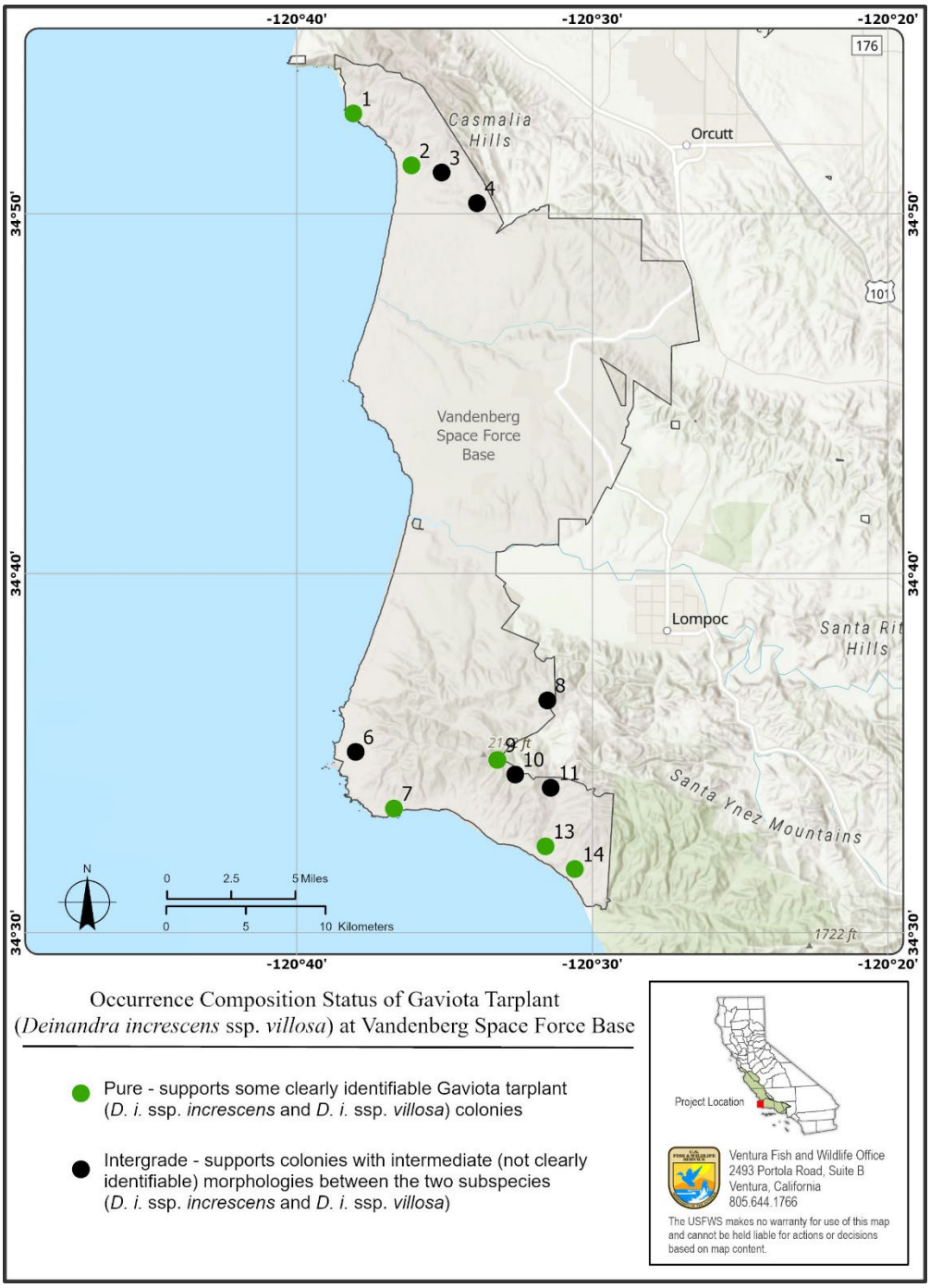

Figure 2. Locations of Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) occurrences on Vandenberg Space Force Base (VSFB) documented to support pure and intergrade colonies of the species (ManTech SRS Technologies 2016, pg. 19-21; ManTech SRS Technologies 2020, pg. 3, 12, 37, and 42). The species current range and distribution is based on data from the California Natural Diversity Database (CNDDB), Consortium of California Herbaria (CCH2) Data Portal, and Vandenberg Space Force Base ([VSFB] CNDDB 2022b, website; CCH2 2022, website; VSFB 2022, pers comm).

Genetics:

Listing and Critical Habitat Designation. We did not have any specific genetic information on Gaviota tarplant when the Service listed it in 2000 (Service 2000, 65 FR 14888-14898) and none was gleaned when we designated critical habitat for the species in 2002 (Service 2002, 67 FR 67968-68001). However, researchers were conducting initial phylogenetic studies in several tarweed groups, including the genus *Hemizonia*, which contained the listed entity at the time. Phylogenetic information, (along with biosystematic and cytogenetic data), informed the revised taxonomy that assigned Gaviota tarplant to the genus *Deinandra* and *D. i.* ssp. *villosa*, where it has remained since the time of listing (Baldwin 1999, pg. 462, 467, and 469).

5-Year Review. Gaviota tarplant genetic work continued to focus mostly on the systematics and evolutionary relationships of the species to other members of *Deinandra* and closely related groups within Asteraceae through 2011, when we completed the last 5-year review (Service 2011). Studies conducted in 2007 provided additional molecular evidence to support conclusions that *D. increscens* is a monophyletic group and that prehistoric gene flow likely occurred from interior areas outward towards the coast (Baldwin 2007a, pg. 240; Baldwin 2007b, pg. 12). However, this work did not clarify the identities of plants from VSFB and did not resolve the more inherent taxonomic ambiguities associated with the two *D. increscens* subspecies (Baldwin 2007b, pg. 14).

In 2009, we funded a genetic study partially aimed at resolving the identities of plants on VSFB and to re-examine the inter- and intraspecific taxonomy of *D. increscens* (Baldwin 2009, pg. 1). The study results added evidence to corroborate results of previous work for interspecific, prehistoric gene flow from interior *D. paniculata* outward to coastal *D. increscens*. Further, most of the *D. increscens* used in the study contained both types of the DNA sequences evaluated (interior *D. paniculata* and coastal *D. increscens*), meaning these individuals are in a polymorphic state that resulted from prehistoric gene flow from the interior lineage, outward to the coastal types. Few individuals contained only coastal *D. increscens* sequences, meaning that most of the species is more recently evolved, with polymorphic origins (Baldwin 2009, pg. 8-9, and 12-13). Other data from the study showed that Gaviota tarplant occurred at the Point Conception area (Point Conception/Dangermond population; region with occurrence numbers 15, 16, 17, and 18 on Figures 1, 2, and 3) and the Sudden Peak area (Sudden Peak/Tranquillon Mountain population; region with occurrence numbers 8, 9, 10, 11, and 12 on Figures 1, 2, and 3), which included several VSFB occurrences. These data also showed Gaviota tarplant occurred at Gaviota, along the coast (Gaviota Coast and Hollister Ranch Coast populations; occurrence numbers 19-21 and 25-27 on Figure 1) and in the Santa Ynez Mountains (Hollister Ranch/Santa Ynez Mountains population; occurrence numbers 22-24 on Figures 1, 2, and 3), where it was previously known to occur at the time of listing (Baldwin 2009, pg. 9, 12-14). Gaviota tarplant was also found to occur at the Lion's Head region (Point Sal/Lions Head population; occurrence numbers 1-4 on Figure 1, 2, and 3) on VSFB (Baldwin 2009, pg. 15). Lastly, the data showed that plants approaching, but not fully (or totally) encompassing the complete morphological condition of listed entity, occurred in Jalama Beach, Point Arguello, and Surf Beach areas (Jalama Beach and Point Argeullo populations; occurrence numbers 13-14 and 6-7 on Figures 1, 2, and 3), all on VSFB (Baldwin 2009, pg. 14). The Surf Beach area was later rejected and is therefore not depicted on Figures 1 and 2.

Current Status. No new Gaviota tarplant genetics work has been conducted since 2009 (Baldwin 2009). However, a new population genomics project using whole genome sequencing is currently underway that should be completed by summer of 2024 (Podolsky 2022, pers comm). This project has several objectives including to: 1. quantify the current and historical effective population sizes and level of inbreeding within the Sudden Peak/Tranquillon Mountain population, (colonies within occurrence number 12 on Figure 1), 2. quantify the degree of isolation between different Gaviota tarplant colonies to evaluate stability and levels of genetic variation, 3. measure associations between genetic and landscape-level variation to gain insights about how selection may be acting on Gaviota tarplant populations, and 4. quantify changes in rates of inbreeding, gene flow, and selection over time for populations and landscape gradients. The project researchers intend for these data to help inform future Gaviota tarplant management (Dudek 2021, pg. 55 [Appendix A, pg. 1]).

Conservation Seed Banking:
Listing and Critical Habitat Designation. The Santa Barbara Botanic Garden (SBBG) runs a conservation seed bank to protect rare plants from extinction and catastrophic loss. The conservation seed bank is part of a state and national network. SBBG made several Gaviota tarplant seed accessions in 1994, 1996, and 1998, totaling approximately 1,500 seeds by the time the taxon was listed in 2000 (Schneider 2022, pers comm; Service 2000, 65 FR 14888-14898). SBBG made two more Gaviota tarplant seed accessions totaling approximately 700 seeds when we designated critical habitat for the species in 2002 (Schneider 2022, pers comm; Service 2002, 67 FR 67968-68001).

5-Year Review. SBBG made several more Gaviota tarplant seed accessions in 2004, 2007, and 2011 totaling approximately 3,700 seeds (Schneider 2022, pers comm). These were the only seed banking activities that occurred through 2011 (Service 2011).

Current Status. In 2020 and 2021, SBBG increased the amount of Gaviota tarplant accessions within its bank considerably by collecting an estimated 74,733 seeds (Schneider 2022, pers comm). Another conservation seed banking affiliate, the California Botanic Garden (CBG), also made accessions in 2019 that totaled 9,942 seeds (Birker 2022, pers comm). Between these two affiliates (SBBG and CBG), there are approximately 90,575 total Gaviota tarplant seeds banked for conservation purposes.

Periodic seed viability testing is conducted to support conservation seed banking that provides information about viability in long term storage conditions. SBBG and CBG both found a much greater abundance of ray achenes than disks from their accessions. They observed between 90 and 100 percent germination in tested disk achenes, and between zero and 50 percent germination in tested ray achenes (Schneider 2022, pers comm; Birker 2022, pers comm). These data corroborate earlier work showing that disk achenes germinate earlier and have higher germination rates than the ray achenes, and also that far fewer of them are produced (Tanowitz 1987, pgs. 307 and 310).

Pollination Work:
Listing and Critical Habitat Designation. Information about Gaviota tarplant pollinators and its pollination system was not included in the final listing rule (Service 2000, 65 FR 14888-14898).

However, we provided information on the subject when we designated Gaviota tarplant critical habitat in 2002, including observations of flies, bees, skippers, and butterflies interacting directly with the flowers. It was noted that insects are required for transfer of pollen between individuals, and thus for successful reproduction because the species is self-incompatible. Maintenance of connectivity for pollinators between Gaviota tarplant populations was another related concept emphasized in the designation, noting that native plant diversity in general was important for persistence of the species in occupied sites because it attracts pollinators (Service 2002, 67 FR 67968-68001).

5-Year Review. There was no new information about Gaviota tarplant pollinators or its pollination system in 2011, when we completed the species 5-year review. But the review did emphasize that small populations are more vulnerable to extirpation because they likely have reduced genetic diversity and overall lowered pollination success. Gene flow between small populations via pollinators is integral to persistence because the species is self-incompatible (Service 2011).

Current Status. SBBG completed two new studies focused on Gaviota tarplant pollinators and other factors associated with pollination of the species at the Sudden Peak/Tranquillon Mountain population/occurrence 12 (Figure 1). In the first study, Knapp et al. (2021) found that Gaviota tarplant attracts a diversity of insect flower visitors in five orders: Coleoptera (beetles), Diptera (flies), Hemiptera (true bugs), Hymenoptera (sawflies, wasps, bees, and ants), and Lepidoptera (butterflies and moths). Of a total of 110 flower visitors observed during the study, 99 of them were using Gaviota tarplant and only 11 were using other co-occurring species. Therefore, Gaviota tarplant may be a magnet species within areas it occupies, such that it increases pollination of other less attractive, co-occurring species and is the main agent drawing pollinators to occupied areas. They also found that percent cover of Gaviota tarplant and sampling month were the most important factors affecting the model for flower visitor richness and abundance. Maximum pollinator activity occurred during the months of July and August, which corresponded to the peak robustness of Gaviota tarplant observed through the month of August. Other important variables, including distance to nearest wind turbine (because the study plots are located within a wind-energy construction site), number of Gaviota tarplant flowers present, richness of flowering species present, and cover of blooming, non-Gaviota tarplant species also contributed to the best fit model. But none of these other variables were statistically significant (Knapp et al. 2021, pg. 9-11, 23).

In the second study, SBBG characterized the vegetation within their sampling plots. They found the plots on average to be composed of the following: 17 percent bare soil, one percent rock, and 81 percent litter. Above-ground vegetation cover was approximately 71 percent, where 35 percent was nonnative grass and approximately eight percent was Gaviota tarplant. On average, each of the plots contained 10 other/not Gaviota tarplant, plant species including both native and nonnatives. They collected a total of 45 pollinators for the study and 35 of these were from Gaviota tarplant, corroborating the hypothesis that it may be a magnet species within this community. The three most common pollinators observed visiting flowers within their plots were two different types of bees (*Lasioglossum* spp. and *Eucerini* spp., respectively) and soft-wing flower beetles (*Dasytinae* spp.). Flower visitor richness was slightly lower in this study than in the previous year. However, mean abundance and richness of floral visitors were similar in both

years. The most important variables affecting floral visitor abundance and richness were abundance of Gaviota tarplant flowers, abundance of non-Gaviota tarplant flowers, and sampling month. Wind speed also had an influence on the final model but was not statistically significant (Knapp et al. 2022, pg. 5-6, 14-15). SBBG is funded to continue this pollination work for three more consecutive years.

Evaluation of Threats:

Listing and Critical Habitat Designation. When listed in 2000, the known threats to Gaviota tarplant were habitat loss, fragmentation, and alteration (which includes further reduction of its limited distribution resulting from development and ongoing maintenance of existing facilities-particularly oil, gas, and water infrastructure, roads and recreational pathways, and other energy-related infrastructure); and introduction, invasion, or encroachment from nonnative, invasive weeds. Other threats mentioned at this time included overgrazing practices; fire and fuels management activities, alterations of the natural fire regime, and accidental fire events; and oil spills and other accidents associated with the oil and gas industry (extraction and processing facilities), VSFB mission operations, and other biohazardous waste or remediations (Service 2000, 65 FR 14888-14898).

5-Year Review. When we completed the Gaviota tarplant 5-year review in 2011, all previously identified threats to the species were on-going. We noted that threats causing degradation and loss of habitat resulting from agriculture and urban development had increased since listing and cited several known residential development projects, as well as agricultural discing and trampling from grazing activities within and adjacent to known Gaviota tarplant occurrences. We also remarked that threats to the species resulting from nonnative, invasive weeds and mission operations at VSFB had also increased. Lastly, the Service identified two new threats to Gaviota tarplant in the 2011 5-year review: habitat loss resulting from wind energy developments and from sea level rise caused by climate change (Service 2011).

Current Status. With our current understanding of the status and distribution of the species, and the known land uses of occupied and surrounding areas, all previously described threats continue to act on Gaviota tarplant. These threats include habitat loss, fragmentation and alteration from development (such as residential, wind energy, oil and gas, mission operations at VSFB, ongoing maintenance of existing facilities, agriculture, and over grazing); adverse effects from nonnative, invasive weeds; and climate change effects (including sea level rise). New information about these threats is provided below.

Habitat Loss, Fragmentation and Alteration from Development

VSFB. All Gaviota tarplant occurrences on VSFB face risk of removal, fragmentation, and edge effects resulting from implementation of development projects, ongoing operational and maintenance activities, accidental or inadvertent impacts (such as fire, gas and oil spills), and execution of other mission-related actions. These risks are intensified because of the taxonomic ambiguities inherent to the species (Figure 2).

Strauss. The Strauss Wind Energy Farm Project (Strauss) is currently being constructed on 5,618 acres within the extent of the Sudden Peak/Tranquillon Mountain Gaviota tarplant population (occurrence 12; Figure 1). While the project obtained all the necessary environmental permits

and regulatory authorizations prior to implementation, full effects of the construction and operation of the wind farm on Gaviota tarplant is unknown. For example, we do not yet understand the effects of wind energy turbines on coastal fog distribution, Gaviota tarplant pollinators, and other ecological variables such as evapotranspiration. There is also potential for accidental or inadvertent impacts (such as fire, gas and oil spills) during both the construction/development and operations and maintenance stages of the project. These parameters are being monitored throughout the development and operation of the project and mitigation such as habitat restoration and outplanting is being implemented. The ultimate effects from the wind farm and success of mitigation actions are uncertain and therefore, there is the possibility that this development project may have a net detrimental effect on Gaviota tarplants' overall status because the extent of the project is so large, and because the affected population is the biggest known.

Plains. The Plains All American Pipeline Company (Plains) proposes to replace an existing, shut-in, crude oil pipeline system that spans the Gaviota Coast population (occurrences 26-27; Figure 1). This project is in the regulatory permitting phase. Like the Strauss project, it will have a construction/development phase and an ongoing operations and maintenance phase. Both phases have potential to adversely affect the species and its habitat via removal, fragmentation, and negative qualitative impacts on its habitat. There is also potential for accidental or inadvertent impacts (such as fire, gas and oil spills) during both project phases. If implemented, this development project could have a net detrimental effect on Gaviota tarplant's overall status throughout the range because the extent of the project is extensive, and it will affect the southern-most coastal population of the species. This population is highly vulnerable to extirpation because it has already sustained impacts from previous oil, gas, and utilities developments, and other threats from recreation, nonnative invasive weeds, and it is extremely fragmented from roads, highways, and the Union Pacific Railway.

Nonnative, Invasive Weeds

Nonnative, invasive weeds compete directly with native species for resources and degrade habitat quality. Further, buildup of thatch from nonnative, invasive weeds can inhibit and arrest germination of natives and suppress their seedbanks. Strauss, and other future development projects, will have ongoing operational and maintenance components that have potential to continue to adversely affect the species and its habitat via introduction and spread of nonnative, invasive weeds. Development increases habitat fragmentation, which increases edge effects around occupied areas, that results in expansion and spread of nonnative, invasive weeds and increased fire risk. In turn, shifts in the plant species community composition can adversely affect pollinators, and increased fire frequency typically results in increased spread and expansion of nonnative, invasive weeds.

Climate Change Effects

Langridge et al. (2018) provides a comprehensive assessment of the climate changes that will affect California's Central Coast bioregion, which includes Santa Barbara County. Anticipated changes consist of increased maximum and minimum temperatures, slightly increased precipitation with substantially increased variability, increased locally extreme rainfall events, accelerated sea level rise, and increased drought (Langridge et al. 2018, pg. 6). The tolerance of Gaviota tarplant to these climate changes is unknown. We provide specific data for expected

changes in precipitation and increased maximum and minimum temperatures at four key locations throughout the species range in Table 2 (Cal-Adapt 2022, website).

Table 2. Changes in precipitation, minimum average temperature, and maximum average temperature for low and high emissions scenarios, compared to historical averages for four key locations within Gaviota tarplants' geographic range

	Precip (inches)	**Precip (inches)**	**Min T (deg. F)**	**Min T (deg. F)**	**Max T (deg. F)**	**Max T (deg. F)**
Location	Historical Average	RCP 4.5/ RCP 8.5	Historical Average	RCP 4.5/ RCP 8.5	Historical Average	RCP 4.5/ RCP 8.5
Gaviota	19.5	20.3/21.3	46.1	49.6/51.0	71.6	75.1/76.6
Point Conception	14.5	15.2/15.9	46.1	49.6/51.1	70.0	73.4/74.9
Point Arguello	14.1	14.8/15.4	46.4	49.9/51.4	69.8	73.2/74.6
Lion's Head	15.1	15.7/16.5	45.3	49.0/50.4	68.2	71.8/73.2

Precip = Precipitation; Min T = Minimum Average Temperature; Max T = Maximum Average Temperature. Reported values for the modeled futures are based on the average of the HadGEM2-ES (warmer and drier) and CNRM–CM5 (cooler and wetter) future scenarios. The Representative Concentration Pathway (RCP) 4.5 scenario refers to a future scenario where emissions peak near 2040 and then decline, while RCP 8.5 refers to a scenario where emissions continue to rise strongly through 2050 and plateau near 2100. The historical average is based on the years 1950–2000 as reported by cal-adapt.org. The modeled values are estimates from the years 2022–2099. Reported values are from spatial files delineating a location grid cell approximately 6 km by 6 km/3.7 by 3.7 mi in size that includes the extent of each population.

Loarie et al. (2008) predicts ranges of many (591 California native plant species with the best available distribution data) commonly occurring plant species, such as manzanitas (*Arctostaphylos* spp.), buckwheats (*Eriogonum* spp.), lupines (*Lupinus* spp.), oaks (*Quercus* spp.), and sages (*Salvia* spp.) to change following climatic conditions that are favorable for persistence and survival (pgs. 3-5 and Table S2). Rare species like Gaviota tarplant, which have reduced geographic ranges and other habitat restrictions, are unlikely to be able to disperse along changing climatic gradients.

Counties along the Central Coast of California may experience sea level rise of approximately 0.24 meter by 2050, relative to the baseline year 2000, and 1.0 meter by 2100 (Sweet et al. 2022, pg. 19 and 23). Although identified as a potential threat in 2011 5-year review, sea level rise is unlikely to directly affect Gaviota tarplant because the coastal occurrences are on top of relatively high bluffs. For example, elevations within occupied areas mapped on the southern side of the Union Pacific Railroad within the Gaviota Coast population range between approximately 65 to 85 feet above mean sea level. Therefore, coastal populations of Gaviota

tarplant are high enough on bluffs that predicted sea level rise by year 2100 is not likely a direct threat to the species. within the timespan of the projections.

However, higher sea levels exacerbate the impacts of storm surge, high tides and king tides, and coastal erosion. Changes in sea level rise and other associated wave effects can alter coastal erosion processes and increase erosion along coastal landscapes (Sweet et al. 2022, pgs. 2, 28, 33). Therefore, increased coastal erosion associated with sea level rise has potential to indirectly effect coastal populations of Gaviota tarplant. Until we improve our understanding of the implications of coastal erosion processes associated with sea level rise, we cannot completely rule out this threat.

RECOVERY CRITERIA

A recovery plan has not been prepared but is scheduled for development in 2024.

CONCLUSION

The evaluation of threats affecting the species under the factors in 4(a)(1) of the U.S. Endangered Species Act of 1973 (as amended) and the analysis of the status of the species indicate that Gaviota tarplant remains in danger of extinction throughout its range. We therefore conclude that the species still meets the definition of an endangered species and recommend no change in status at this time.

RECOMMENDATIONS FOR FUTURE ACTIONS

1. Obtain access (if possible) to all mapped Gaviota tarplant occurrences to conduct comprehensive surveys of the status of the species and threats at these locations. Include estimates of numbers of individuals present, global positioning system (GPS) mapping of occupied spatial area, co-occurring and co-dominant vegetation, presence of natives versus nonnative species, timing of phenology, and observations of potential insect pollinators. Update information in resource agency databases (CNDDB) to ensure that these data remain accurate and current.

2. Create a standardized annual, quantitative Gaviota tarplant monitoring protocol that includes the parameters outlined in item 1 above. Organize occurrence landowners and other stakeholders to commit to conducting annual monitoring for a minimum of five consecutive years, in support of the next 5-year review.

3. Conduct experimental research on strategic, applied grazing as a management tool for Gaviota tarplant recovery and nonnative, invasive weed controls.

4. Implement management activities to ameliorate threats at each occurrence, including vegetation management such as trimming and removal, applied-strategic grazing, invasive weed abatement, and erosion controls.

5. Conduct research across the species range to improve and refine our understanding of taxonomy to achieve a consensus on morphological identification of the species. Data from this assessment will ideally resolve taxonomic ambiguities to inform rapid visual identification of Gaviota tarplant in the field. This work will also help us better understand the natural spectrum of variant morphologies associated with normal phenotypic plasticity, likely resulting from different ecological conditions (such as shallow soils and interior versus coastal populations).

6. Continue conducting genetics research to better understand and delineate Gaviota tarplant from grassland tarweed using modern molecular techniques intended for these types of resolutions. This will improve our knowledge of how these two subspecies are separated genetically and help reach a standard for how genetic data should be used to define and interpret the listed entity.

7. Continue making accessions for conservation seed banking throughout the species range, so that all populations are represented in the collections.

8. Pursue opportunities to work with landowners and other stakeholders to augment extirpated and/or declining Gaviota tarplant occurrences and locate and prioritize other areas where introduction of the species via outplanting for recovery could be feasible. New introduction projects will focus on re-establishing and maintaining connectivity of other extant populations throughout the species range.

APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approved JENNY MAREK Digitally signed by JENNY MAREK Date: 2022.09.01 08:22:41 -07'00'

Acting for Stephen P. Henry, Field Supervisor

REFERENCES

Baldwin, B.G. 1999. New Combinations and New Genera in the North American Tarweeds (Compositae-Madiinae). Novon 9(4): 462-471.

Baldwin, B.G. 2007a. Adaptive Radiation of Shrubby Tarweeds (*Deinandra*) in the California Islands Parallels Diversification of the Hawaiian Silversword Alliance (Compositae-Madiinae). American Journal of Botany 94(2): 237-248.

Baldwin, B.G. 2007b. A Systematic Investigation of *Deinandra increscens*, with Special Reference to Subsp. *villosa*. Jepson Herbarium and Department of Integrative Biology, University of California, Berkeley, California. Unpublished technical report prepared for Ventura Fish and Wildlife Office, Ventura, California.

Baldwin, B.G. 2009. Morphological and Molecular Reconsideration of *Deinandra increscens*, subsp. *villosa*. Jepson Herbarium and Department of Integrative Biology, University of California, Berkeley, California. Unpublished technical report prepared for Ventura Fish and Wildlife Office, Ventura, California.

Baldwin, B.G. 2012. *Deinandra increscens* subsp. *villosa*, in Jepson Flora Project (eds.) Jepson eFlora, Available online at: https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=80115.

Birker, C. 2022. Email from Cheryl Birker, California Botanic Garden, to Kristie Scarazzo, Ventura Fish and Wildlife Office, regarding Gaviota tarplant accessions. July 12, 2022.

Cal-adapt. 2022. Annual Averages Data Viewer. Available online at: https://cal-adapt.org/tools/annual-averages. Accessed August 2022.

California Natural Diversity Database [CNDDB] 2020. California Natural Diversity Database (CNDDB) Management Framework. California Department of Fish and Wildlife, Biogeographic Data Branch, Sacramento, California.

[CNDDB] California Natural Diversity Database. 2022a. State and Federally Listed Endangered, Threatened, and Rare Plants of California. California Department of Fish and Wildlife, Biogeographic Data Branch, Sacramento, California.

[CNDDB] California Natural Diversity Database 2022b. RareFind 5. California Department of Fish and Wildlife, Government Version. Biogeographic Information and Observation System Viewer. Available online at: https://apps.wildlife.ca.gov/bios/.

Consortium of California Herbaria Portal [CCH2]. 2022. Data for *Deinandra increscens* ssp. *villosa*. Available online at: http://cch2.org/portal/index.php.

Dudek. 2021. Gaviota Tarplant Mitigation and Monitoring and Long-Term Management Plan for the Strauss Wind Energy Project. Dudek, Encinitas, California. Unpublished technical report prepared for Strauss Wind, LLC, Carlsbad, California.

ESRI. 2022. ESRI World Imagery, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Ferren, M.M. and S.V. Good. 2012. Self-sterility in Flowering Plants: Preventing Self-fertilization increases Family Diversification Rates. Annals of Botany. 110: 535-553. Doi: 10.1093/aob/mcs124.

Hickman, J.C. (Ed.). 1996. The Jepson Manual. Higher Plants of California. University of California Press, Berkeley, California.

Howald, A.M. 1989. Report to the Fish and Game Commission on the Status of Gaviota Tarplant (*Hemizonia increscens* ssp. *villosa*). Natural Heritage Division, Sacramento, California. Unpublished technical report prepared for California Department of Fish and Game, Sacramento, California.

Jepson Flora Project (eds.). 2010. Jepson eFlora. Available online at: https://ucjeps.berkeley.edu/eflora/eflora. Version no longer available. Last edited 2012.

Knapp, D., K. Etter, C. Richart, and J. Lesage. 2021. Flower Visitors of *Deinandra increscens* ssp. *villosa*. 2020 Findings Report. Santa Barbara Botanic Garden, Santa Barbara, California. Unpublished technical report prepared for Strauss Wind, LLC, Carlsbad, California.

Knapp, D., K. Etter, S. Cusser. 2022. Flower Visitors of *Deinandra increscens* ssp. *villosa*. 2021 Findings Report. Santa Barbara Botanic Garden, Santa Barbara, California. Unpublished technical report prepared for Strauss Wind, LLC, Carlsbad, California.

Langridge, R. 2018. Central Coast Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-006. University of California, Santa Cruz. Santa Cruz, California.

Loarie, S.R., B.E. Carter, K.H. Hayhoe, S. McMahon, R. Moe, C.A. Knight, and D.D. Ackerly. 2008. Climate Change and the Future of California' Endemic Flora. PLoS ONE 3(6): e2502. Doi: 10.1371/journal.pone.0002502. Table S2 available online at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0002502#s5.

ManTech SRS Technologies, Inc. 2016. 2015-2016 Threatened and Endangered Plant Surveys on Vandenberg Air Force Base, California. Lompoc, California. Unpublished technical report prepared for Vandenberg Air Force Base, Vandenberg Air Force Base, California.

ManTech SRS Technologies, Inc. 2020. 2019-2020 Threatened and Endangered Plant Surveys on Vandenberg Air Force Base, California. Lompoc, California. Unpublished technical report prepared for Vandenberg Air Force Base, Vandenberg Air Force Base, California.

Marcon, J. 2022a. Email from Jake Marcon, Dudek, to Kristie Scarazzo, Ventura Fish and Wildlife Office, regarding Gaviota tarplant abundance data. May 25, 2022.

Marcon, J. 2022b. Email from Jake Marcon, Dudek, to Kristie Scarazzo, Ventura Fish and Wildlife Office, regarding Gaviota tarplant precipitation data. May 26, 2022.

Podolsky, R. 2022. Email from Richard Podolsky, BayWa, to Kristie Scarazzo, Ventura Fish and Wildlife Office, regarding Gaviota tarplant genetics work. May 25, 2022.

Science Applications International Corporation [SAIC]. 2012. Results of Surveys for Federally-Listed Plant Species on Vandenberg Air Force Base, California. Lompoc, California. Unpublished technical report prepared for Vandenberg Air Force Base, Vandenberg Air Force Base, California.

Schneider, H. 2022. Email from Heather Schneider, Santa Barbara Botanic Garden, to Kristie Scarazzo, Ventura Fish and Wildlife Office, regarding Gaviota tarplant seed banking data. May 25, 2022.

U.S. Fish and Wildlife Service [Service]. 2000. Endangered and Threatened Wildlife and Plants; Final Rule for Endangered Status for Four Plants from South Central Coastal California. 65 FR 14888-14898.

[Service] U.S. Fish and Wildlife Service. 2002. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for *Eriodictyon capitatum* (Lompoc yerba santa) and *Deinandra increscens* ssp. *villosa* (Gaviota tarplant). 67 FR 67968-68001.

[Service] U.S. Fish and Wildlife Service. 2011. *Deinandra increscens* ssp. *villosa* (Gaviota tarplant) 5-Year Review: Summary and Evaluation. Ventura Field Office. Ventura, California.

Service] U.S. Fish and Wildlife Service. 2020. Biological Opinion on the U.S. Army Corps of Engineers' Proposed Authorization of the Discharge of Fill for the Strauss Wind Energy Project in Santa Barbara County, California. (File No. SPL-2018-00819-CLH). Ventura Field Office. Ventura, California.

[Service] U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 76 Species in California and Nevada. 86 FR 27462-27464.

Strauss Wind, LLC. 2022. Gaviota tarplant mitigation monitoring and long-term management 2021 annual report for the Strauss Wind energy project. Lompoc, California. Unpublished technical report prepared for Strauss Wind, LLC. Carlsbad, California.

Sweet, W.V., B.D. Hamlington, R.E. Kopp, C.P. Weaver, P.L. Barnard, D. Bekaert, W. Brooks, M. Craghan, G. Dusek, T. Frederikse, G. Garner, A.S. Genz, J.P. Krasting, E. Larour, D. Marcy, J.J. Marra, J. Obeysekera, M. Osler, M. Pendleton, D. Roman, L. Schmied, W. Veatch, K.D. White, and C. Zuzak. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD.

Tanowitz, B.D. 1982. Taxonomy of *Hemizonia* sect. Madiomeris (Asteraceae: Madiinae). Systematic Botany. 7(3): 314-339.

Tanowitz, B.D., P.F. Salopek, and B.E. Mahall. 1987. Differential Germination of Ray and Disc Achenes in *Hemizonia increscens* (Asteraceae). American Journal of Botany. 74(3): 303-312.

Vandenberg Space Force Base [VSFB]. 2022. Email from Nina Isaieva, VSFB, to Sarah Termondt, Ventura Fish and Wildlife Office, regarding Gaviota tarplant survey information on VSFB from 2010-2019. May 17, 2022.

Wachtler, M. and T. Perner. 2020. The Origin and Evolution of Angiosperms – Early Permian Flowering Plants. Chapter 30, The Origin of the Asteraceae Early Permian Evolution. Dolomythos Museum, South Tyrol, Italy.

APPENDIX A

Detailed information about each known Gaviota tarplant occurrence throughout its range in Santa Barbara County, California (CNDDB 2022, website; CCH2 2022, website; VSFB 2022, pers comm).

Occurrence Number	CNDDB Occurrence Number	Number of CNDDB Data within Occurrence[1]	Number of CCH2 Records within Occurrence	Total Number of Vandenberg 2022 Data (2010-2019) within Occurrence[2]	Other Data within Occurrence	Land Ownership	*Mixed Colony	Most Recent Surveys or Updates/Year	Survey Notes
1	5	5	3	38	0	VSFB	yes	2015	VSFB, ManTech 2016
2	52	2	4	22	0	VSFB	no	2020	CNDDB, SBBG vouchers
3	none	0	0	6	0	VSFB	yes	2015	VSFB, ManTech 2016
4	none	0	0	2	0	VSFB	yes	2015	VSFB, ManTech 2016
5	none	0	1	0	0	Private	no	1962	CCH2 record
6	19	6	3	0	0	VSFB	no	2015	VSFB, SAIC 2012
7	58	1	1	0	0	VSFB	no	2011	VSFB, SAIC 2012
8	24	2	2	9	0	VSFB	yes	2015	VSFB, ManTech 2016
9	59	2	2	2	0	VSFB/Private	no	2020	CNDDB, Dudek 2020

[1] Data refers to spatial information in the form of individual points and/or polygons used in GIS platforms obtained from the CNDDB.

[2] Data refers to spatial information in the form of individual points and/or polygons used in GIS platforms obtained from VSFB between monitoring years 2010 through 2019.

Occurrence Number	CNDDB Occurrence Number	Number of CNDDB Data within Occurrence[1]	Number of CCH2 Records within Occurrence	Total Number of Vandenberg 2022 Data (2010-2019) within Occurrence[2]	Other Data within Occurrence	Land Ownership	*Mixed Colony	Most Recent Surveys or Updates/Year	Survey Notes
10	29	1	0	0	0	VSFB	no	2019	CNDDB, Aspen 2007
11	30	1	0	0	0	VSFB	no	2019	CNDDB, Aspen 2007
12	18	68	15	2	0	Private	no	2021	Strauss, Willoughby 2021
13	none	0	0	56	0	VSFB	no	2019	VSFB, ManTech 2020
14	none	0	1	304	0	VSFB/Private	yes	2019	VSFB, ManTech 2020
15	none	0	1	0	0	Private	no	2019	CCH2 record
16	10	4	3	0	0	Private	no	2020	TNC, SBBG tissue samples
17	14	2	1	0	0	Private	no	2020	TNC, SBBG tissue samples
18	15	1	1	0	0	Private	no	2020	CCH2 record
19	22	2	1	0	0	Private	no	2004	CNDDB, Rindlaud 2002 and maps 2004

Occurrence Number	CNDDB Occurrence Number	Number of CNDDB Data within Occurrence[1]	Number of CCH2 Records within Occurrence	Total Number of Vandenberg 2022 Data (2010-2019) within Occurrence[2]	Other Data within Occurrence	Land Ownership	*Mixed Colony	Most Recent Surveys or Updates/Year	Survey Notes
20	8	1	1	0	0	Private	no	2000	CNDDB, Wilken 2000
21	21	1	0	0	0	Private	no	2002	CNDDB, Rindlaud 2002 and maps 2004
22	6	1	4	0	0	Private	no	2000	CNDDB, Wilken 2000
23	20	1	0	0	0	Private	no	2004	CNDDB, Rindlaud 2002 and maps 2004
24	7	1	1	0	0	Private	no	1998	CNDDB, Wilken voucher
25	9	1	2	0	0	Private	no	2000	CNDDB, Wilken voucher
26	1	1	12	0	0	Public	no	2012	CNDDB, SWCA field survey form
27	4	1	13	0	3	Public/Private	no	2020	CNDDB, SBBG vouchers