

**2020 ANNUAL RARE PLANT SURVEY
FOR THE ENHANCED IN SITU BIOREMEDIATION (EISB)
DEPLOYMENT AREA 3A AT THE OPERABLE UNIT CARBON
TETRACHLORIDE PLUME (OUCTP), FORMER FORT ORD,
CALIFORNIA**

Prepared for:



**U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922**

**Prepared by:
Bart Kowalski
Chenega Tri-Services**

August 2020

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TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	3
3.0 OVERVIEW OF RARE PLANT SURVEY METHODS	4
3.1 MONTEREY SPINEFLOWER SURVEY METHODS	4
3.2 SAND GILIA SURVEY METHODS	5
4.0 RESULTS OF 2020 PLANT SURVEYS	5
4.1 MONTEREY SPINEFLOWER RESULTS	5
4.2 SAND GILIA RESULTS	6
5.0 DISCUSSION	11
5.1 MONTEREY SPINEFLOWER.....	11
5.2 SAND GILIA.....	12
5.3 SUCCESS CRITERIA.....	12
6.0 CONCLUSION AND RECOMMENDATIONS	12
7.0 REFERENCES	14

LIST OF FIGURES

Figure 1	Locations of Reference Site 1 and 2020 EISB survey area	2
Figure 2	Reference Site 1 HMP Annuals Survey Results 2016 (Baseline) and 2020 (Year 4).....	7
Figure 3	OUCTP EISB Area HMP Annuals Survey Results 2016 (Baseline) and 2020 (Year 4).....	8
Figure 4	Example of an area browsed by brush rabbits and occupied by Monterey spineflower.....	9
Figure 5	Example of an area browsed by brush rabbits and occupied by Monterey spineflower.....	9
Figure 6	Example of an area browsed and disturbed by California ground squirrels and occupied by Monterey spineflower.....	10
Figure 7	Example of an area dominated by annual grasses with no HMP annuals detected.....	10

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

CDFW	California Department of Fish and Wildlife
EISB	Enhanced In Situ Bioremediation
FONR	Fort Ord Natural Reserve
ft ²	square feet
GIS	geographic information system
GPS	global positioning system
HMP	Habitat Management Plan
OUCTP	Operable Unit Carbon Tetrachloride Plume
PBO	Programmatic Biological Opinion
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

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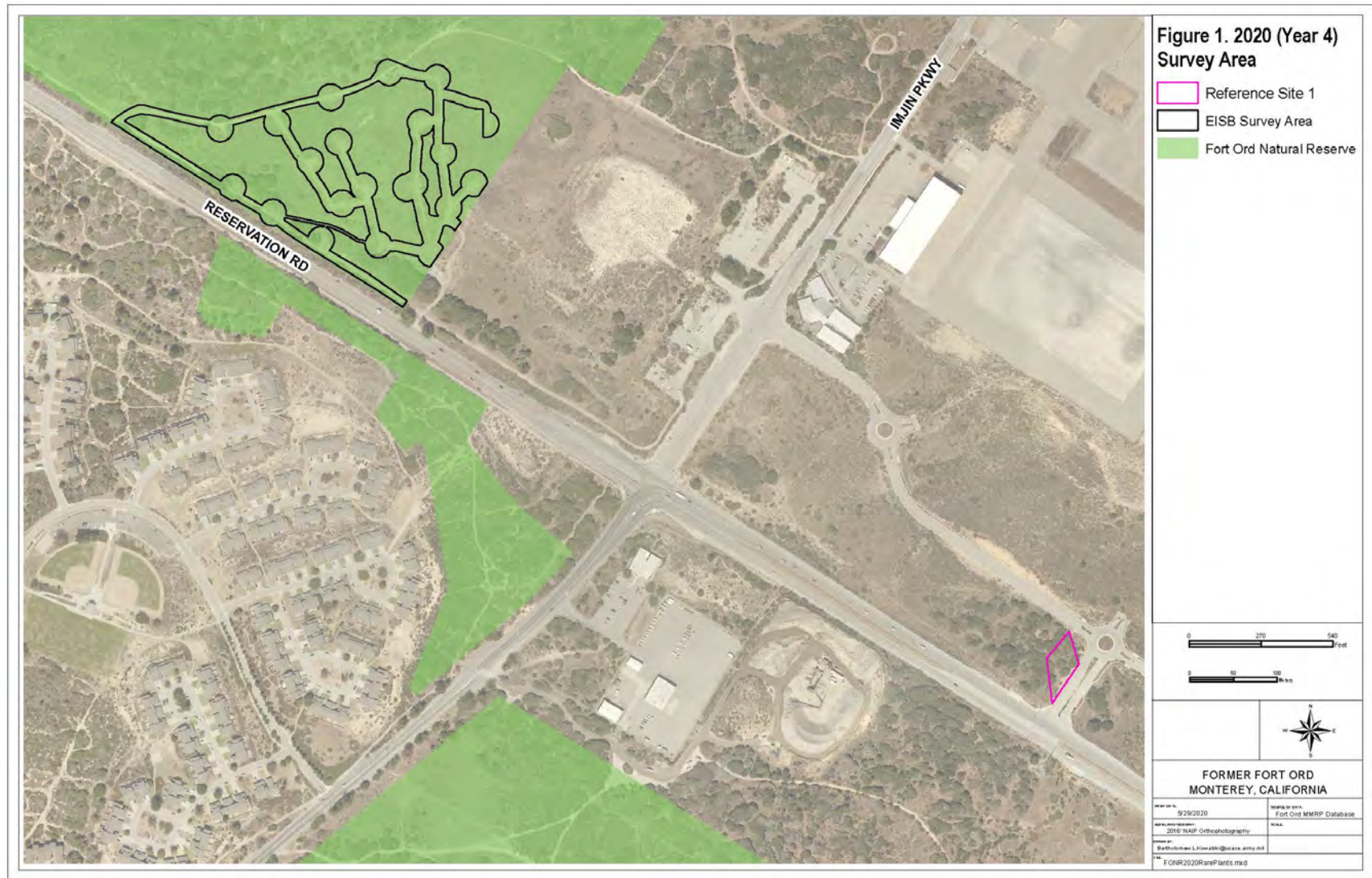
1.0 INTRODUCTION

This report describes the methods and results for the 4th year follow up monitoring of rare plants after the installation of the Enhanced In Situ Bioremediation (EISB) in the Deployment Area 3A of the Operable Unit Carbon Tetrachloride Plume (OUCTP), located in Fort Ord Natural Reserve (FONR), on the former Fort Ord, California.

FONR North is located on the former Fort Ord, Marina, California and is adjacent to the Marina Municipal Airport (the former Fritzsche Army Airfield) (Figure 1). A portion of the Operable Unit Carbon Tetrachloride Plume (OUCTP) in the A-Aquifer underlies FONR North. The chemicals of concern associated with OUCTP in the A-Aquifer are carbon tetrachloride (CT), tetrachloroethene, chloroform, 1,1-dichloroethene, total-1,2- dichloroethene, methylene chloride, vinyl chloride, and trichloroethene. The presence and concentration levels of CT are used to define the extent of OUCTP. The remedy for OUCTP in the A-Aquifer is EISB, which involved construction of wells, pipelines, conduits, and mowing of the corresponding access routes. EISB has been implemented at three deployment areas in FONR in the past.

Rare plant surveys are required by the Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord, California (HMP; USACE, 1997) and the Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (PBO; USFWS, 2017) in areas that are disturbed during groundwater remediation activities. Project activities undertaken must protect and maintain the special-status species found within FONR. Efforts are taken to avoid or minimize impacts to all HMP species, with emphasis on three federally listed plant species: Monterey spineflower (*Chorizanthe p. pungens*), Monterey gilia (*Gilia tenuiflora ssp. arenaria*), and Yadon's piperia (*Piperia yadonii*). In accordance with the conservation measures outlined in the Programmatic Biological Opinion (USFWS 2015) the Army conducted baseline surveys in 2016 prior to EISB construction, and three years of follow-up surveys for federally listed species Monterey spineflower and Yadon's piperia and federally and state listed sand gilia to assess the impact of the activity. Data from the follow up surveys indicated a steady decrease in populations of Monterey spineflower (Ahnta 2020), and USFWS expressed concern about potential adverse effects from EISB construction on that species. USFWS requested that the Army conduct an additional (Year 4) follow up survey at EISB (Army 2020). This report covers the methods, results, and discussion of those surveys.

Figure 1. Locations of Reference Site 1 and 2020 EISB survey area



2.0 SITE DESCRIPTION

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the U.S. Secretary of Defense announced the closure of the base. In August 1994, portions of the property were transferred to University of California Monterey Bay Education, Science, and Technology Center (UC MBEST), and FONR was established as part of the Natural Reserve System operated by UC Santa Cruz.

Former Fort Ord is located in the northwestern part of Monterey County, California, on the boundary of Monterey Bay, approximately 80 miles south of San Francisco. FONR comprises 605 acres of coast live oak woodland, coastal scrub, maritime chaparral, and annual grassland in the northern portion of the former Fort Ord. The property is divided into two parcels, FONR North and FONR South. EISB is located in the south east corner of the northern parcel. The area's maritime climate is characterized by cool, overcast, foggy summers, and cool rainy winters, with the warmest days generally occurring in late summer and early fall.

EISB area is dominated by annual grasses, interspersed with strands of mock heather (*Ericameria ericoides*). Coast live oaks (*Quercus agrifolia*) and maritime chaparral shrubs are present on the edges of the grassland area. Herbivorous species such as brush rabbits, mule deer, and California ground squirrels are common, as are carnivorous species such bobcats and coyotes.

Several protected species are known or suspected to be present within the FONR. These include the federally threatened Monterey spineflower, and the federally endangered and state threatened sand gilia. State endangered Seaside bird's beak (*Cordylanthus rigidus ssp. littoralis*) is present in the reserve but not within EISB area. Yadon's piperia was included in rare plant surveys beginning in 2016 per agencies request, but since 1992 the species was never found on the reserve during the annual surveys conducted by the Army, FONR staff, and academic researchers. This species has been found in two primary habitat types: ridges in maritime chaparral, and Monterey pine forest (USFWS 2009a). In maritime chaparral habitat in northern Monterey County, plants grow on sandstone ridges where soils are shallow (USFWS 2009a), features that are not present in FONR. Several other special status plant and animal species listed in the HMP and PBO that are or may be present in the FONR include the following:

- Coast wallflower (*Erysimum ammophilum*)
- Sandmat manzanita (*Arctostaphylos pumila*)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Eastwood's goldenbush (*Ericameria fasciculata*)
- California black legless lizard (*Anniella pulchra nigra*; BLL) – state species of concern

- California tiger salamander (*Ambystoma californiense*; CTS) – federally threatened, state threatened
- Monterey ornate shrew (*Sorex ornatus salarius*) – state species of concern

The area surveyed in 2020 consisted of Reference Site 1 and the EISB Deployment Area 3A which included the deployment area (approximately six acres) and access routes (approximately five acres, Fig 1).

3.0 OVERVIEW OF RARE PLANT SURVEY METHODS

The surveys for Monterey spineflower and sand gilia were conducted with the same methods as previous surveys (Ahtna 2017, 2020) and were timed to coincide with the peak blooming period which was determined by observing known occurrences of the species in the nearby areas and within the survey area. Baseline survey within the EISB deployment area and access routes was conducted on April 26-27, and May 6, 2016 for Monterey spineflower and on May 6, 2016 for sand gilia survey (Ahtna 2017). Year 4 follow up monitoring survey for Monterey spineflower was conducted on May 5 and 7, 2020 and April 14th, 2020 for sand gilia.

Within EISB, each rare plant survey was conducted along well locations and existing access routes. The survey area consisted of approximately 50-foot buffer around the extraction and injection wells and a 20-foot buffer around access routes. If a rare plant population was identified, the survey in that area was extended to the boundary of the population encountered. Populations separated by less than three feet were mapped as a single population, with the occasional exception when the populations were separated by clear boundaries, such as between access roads and grassland areas.

All GPS data were collected using a Trimble Geoexplorer 6000 unit, processed using Trimble GPS Pathfinder Office Software v5.80, and mapped using ESRI ArcMap 10.7 GIS software.

3.1 Monterey Spineflower Survey Methods

Monterey spineflower groups of five or less were mapped as points with attributes to identify the number of individuals at each location. Areas of Monterey spineflower with populations greater than five individual plants were mapped as polygons. When a populations of Monterey spineflower was identified, the survey in that area was extended to the boundary of the population encountered. In populations with greater than five individual plants, the quantity of Monterey spineflower was characterized as the percentage of the polygon covered by the Monterey spineflower within the polygon. The cover classes are defined as follows:

- Very Sparse (corresponding to an absolute cover of less than 3 percent);
- Sparse (3 to 25 percent);
- Medium Low (26 to 50 percent);

- Medium (51 to 75 percent);
- Medium High (76 to 97 percent); and
- Very High (greater than 97 percent).

3.2 Sand gilia survey methods

Areas of sand gilia with populations greater than five individual plants were mapped as polygons using a GPS unit. Plant groups of 5 or less were mapped as points, and the number of individuals was recorded at each group location. When a population of sand gilia was identified, the survey in that area was extended to the boundary of the population encountered. All individual plants within each population were counted.

4.0 RESULTS OF 2020 PLANT SURVEYS

4.1 Monterey spineflower results

Within Reference Area 1 Monterey spineflower was generally found within the same areas of small grassland patches surrounded by oak trees but at lower density than in the Baseline survey (Fig 2). A single population of Monterey spineflower extended toward the eastern edge of Reference Site 1, which is more exposed and contains loose sandy soil that is not covered by annual grasses. There were seven Monterey spineflower populations in the Very Sparse cover class covering 1020 ft², one population in the Sparse cover class covering 1593 ft², and six locations with fewer than 5 plants (Table 1).

In the EISB deployment area, the extent of Monterey spineflower populations was similar to Baseline (Fig 3). The species was found within 50 feet of 13 wells, one less than in Baseline. Monterey spineflower was not found within 50 feet of wells EW-BW-162-A, EW-BW-168-A, and IW-BW-167-A in 2020 although they were there in 2016. In 2020, Monterey spineflower was found within 50 feet of two wells where it wasn't found in 2016; IW-BW-166-A and IW-BW-168-A in 2020 (Figure 3). Population near well EW-BW-166-A was much smaller than in Baseline. There were 39 Monterey spineflower populations in the Very Sparse cover class covering 16,124 ft², 33 populations in the Sparse cover class covering 51,481 ft², and three populations in the Medium low cover class covering 93 ft² (Table 1).

Populations of Monterey spineflower appeared to be present near edges of shrubs where annual grasses have been browsed by brush rabbits (Figs 4 and 5), and in areas with active burrows of California ground squirrels (Fig 6). Areas devoid of Monterey spineflower were often densely covered with annual grasses, such as the area between wells EW-BW-166-A and EW-BW-167-A, which was one of the areas where Monterey spienflower decreased from Baseline (Fig 7).

4.2 Sand gilia results

Within Survey Area 1 sand gilia was generally found within the same areas of small grassland patches surrounded by oak trees, but in much lower numbers than in the Baseline survey (Fig 2). Several populations of sand gilia were found near the eastern edge of Reference Site 1, which is more exposed and contains loose sandy soil that is not covered by annual grasses. There were 21 sand gilia populations covering 256 ft², and 44 locations with fewer than 5 plants. Total number of sand gilia plants within Reference Site 1 was 256 (Table 2).

In the EISB deployment area, location of the single sand gilia population was almost identical to Baseline (Fig 2). There were only two single sand gilia plants present, a decrease from Baseline survey, but similar to the results from the follow-up surveys (Table 2).

Table 1. Monterey spineflower results for Year 4 and previous years at Reference Site 1 and EISB Survey Area (2010 -2019, DD&A, 2020 Chenega)

Year	Location	# of populations	# of points	# of polygons	Polygons per Cover Class				Total Area of Polygons (ft2)	Area Percent Change
					Very Sparse (<3 % cover)	Sparse (3-25 % cover)	Medium Low (26-50 % cover)	Medium (51-75 %cover)		
2010	Reference Site 1	2	0	2	1	0	1	0	2,846	N/A
2011	Reference Site 1	1	0	1	0	1	0	0	2,865	1%
2012	Reference Site 1	3	1	2	0	2	0	0	1,494	-48%
2013	Reference Site 1	7	0	7	0	6	1	0	2,813	88%
2014	Reference Site 1	7	1	6	0	6	0	0	1,119	-60%
2015	Reference Site 1	4	1	3	0	1	1	1	2,114	89%
2016	Reference Site 1	2	0	2	0	0	1	1	3,241	53%
2017	Reference Site 1	4	0	4	0	3	1	0	2,855	-12%
2018	Reference Site 1	5	2	3	1	2	0	0	3,078	8%
2019	Reference Site 1	12	4	8	1	6	1	0	2,283	-26%
2020	Reference Site 1	15	6	9	7	2	0	0	2,614	14%
2016	EISB	76	22	54	0	39	12	3	117,397	N/A
2017	EISB	62	31	31	0	26	5	0	89,649	-24%
2018	EISB	104	58	44	2	32	10	0	72,816	-19%
2019	EISB	188	109	78	15	53	8	2	30,203	-59%
2020	EISB	100	58	75	39	33	3	0	68,634	127%

Table 2. Sand gilia results for Year 4 and previous years at Reference Site 1 and EISB Survey Area (2010 -2019, DD&A, 2020 Chenega)

Year	Location	# of populations	Individual Plants	# of points	# of polygons	Total Area of Polygons (ft2)	Area Percent Change	Individual Percent
2010	Reference Site 1	14	1086	7	7	1715	N/A	N/A
2011	Reference Site 1	16	318	4	12	1410	-18%	-71%
2012	Reference Site 1	16	70	12	4	210	-85%	-78%
2013	Reference Site 1	20	736	7	13	1281	511%	951%
2014	Reference Site 1	4	97	2	2	370	-71%	-87%
2015	Reference Site 1	11	1078	4	7	1512	309%	1011%
2016	Reference Site 1	12	1090	6	3	1964	30%	1%
2017	Reference Site 1	8	463	6	2	1950	-1%	-58%
2018	Reference Site 1	21	352	8	13	481	-75%	-24%
2019	Reference Site 1	18	3065	8	10	717	49%	771%
2020	Reference Site 1	65	614	44	21	256	-64%	-80%
2016	EISB	1	36	0	1	84	N/A	N/A
2017	EISB	1	7	0	1	29	-65%	-81%
2018	EISB	0	0	0	0	0	-100%	-100%
2019	EISB	1	4	1	0	0	N/A	400%
2020	EISB	2	2	2	0	0	N/A	-50%

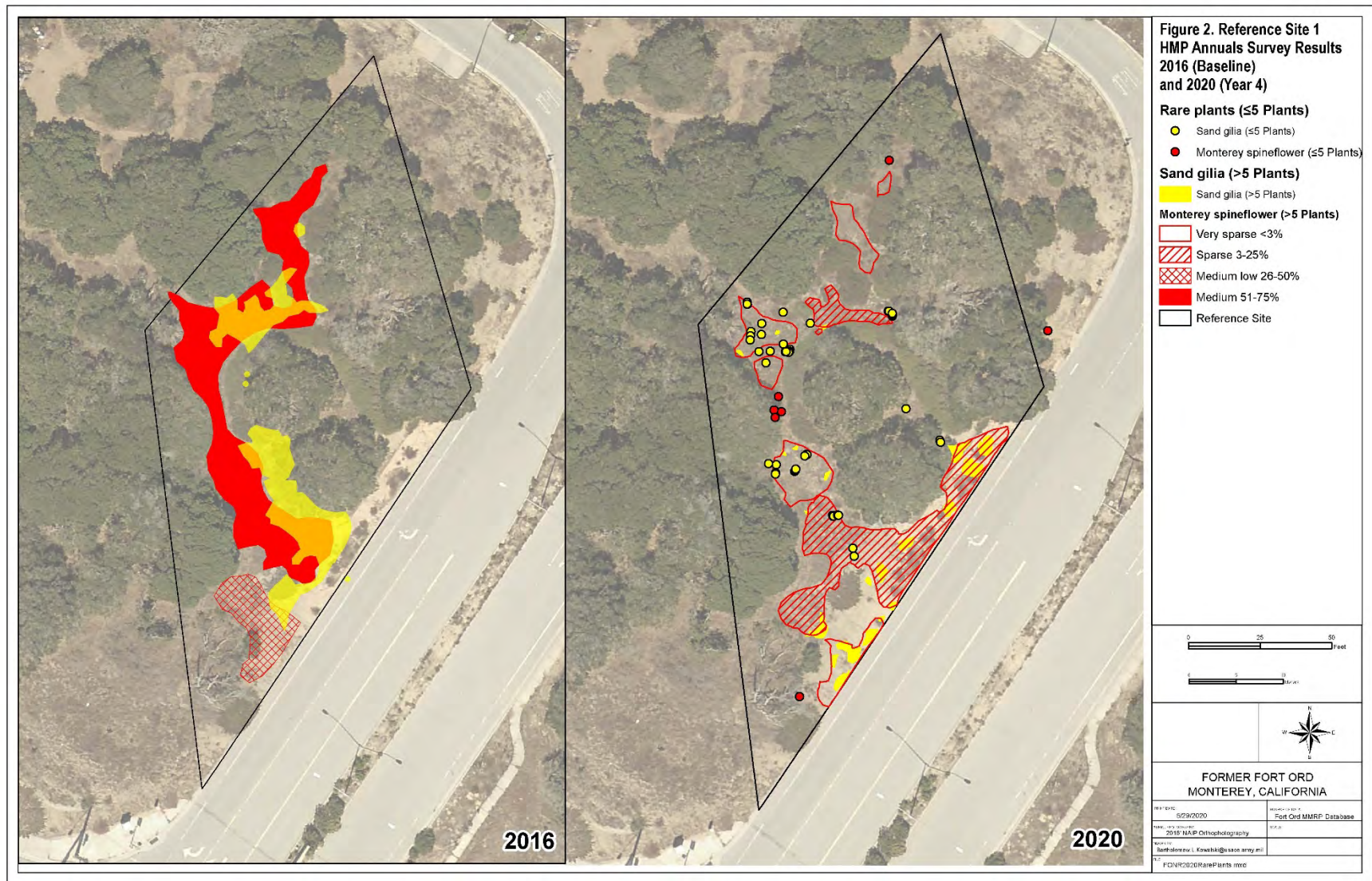


Figure 2. Comparison of Year 4 follow up monitoring for Monterey spineflower and sand gilia in Reference Site 1.

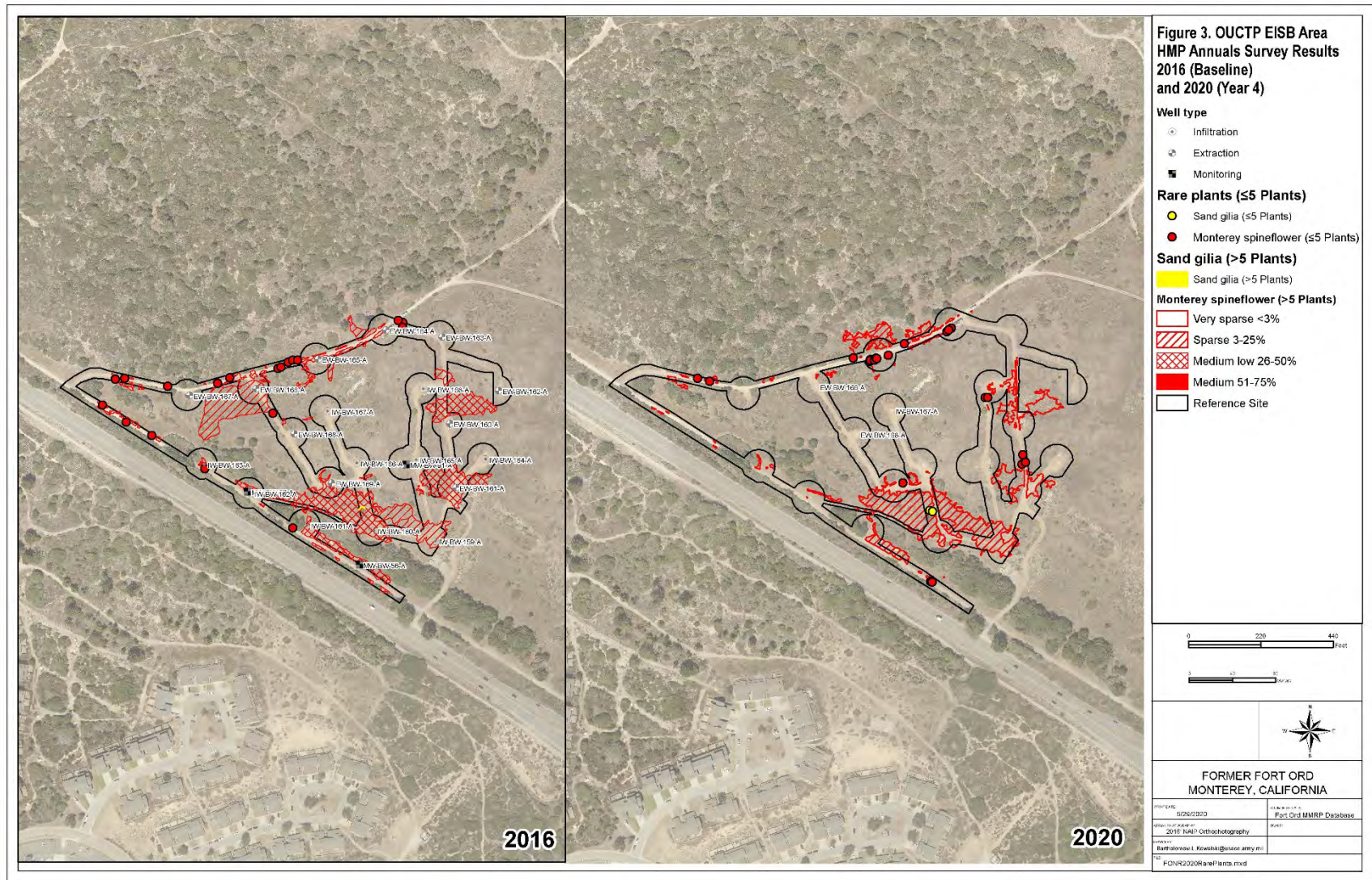


Figure 3. Comparison of baseline and Year 4 follow up monitoring for Monterey spineflower and sand gilia OUCTP-EISB Area.



Figure 4. Example of an area browsed by brush rabbits and occupied by Monterey spineflower



Figure 5. Example of an area browsed by brush rabbits and occupied by Monterey spineflower



Figure 6. Example of an area browsed and disturbed by California ground squirrels and occupied by Monterey spineflower



Figure 7. Example of an area dominated by annual grasses with no HMP annuals detected

5.0 DISCUSSION

EISB treatment was undertaken by AHTNA in 2016 to treat GW contaminants within OUCTP portion of FONR (Ahtna 2020). Conservation measures implemented to minimize impact to the listed species included the following;

- Baseline surveys for special status species
- Habitat Checklist for the field crews
- Environmental awareness training for the field crews
- Presence or on call availability of a qualified biologist during construction activities
- Staging equipment outside of the areas with special status species
- Minimizing area disturbance by using established and pre-defined access routes

These conservation measures along with three years of follow-up monitoring were implemented to ensure continued existence of HMP annual species within GW remediation areas. Following the Year 3 follow up survey, USFWS expressed concern about the decreasing trend of Monterey spineflower population at EISB (Table 1). USFWS requested that the Army conduct an additional (Year 4) follow up survey at EISB to determine if the Monterey spineflower population was continuing to decrease (Army 2020).

5.1 Monterey Spineflower

The 68,634 ft² of Monterey spineflower in EISB area represents an increase of 127% from the year prior, while in Reference Site 1 the Monterey spineflower cover increased by 14%. The cover area of Monterey spineflower at EISB in Year 4 was similar to 72,816 ft² observed in Year 2 follow-up survey. While these values are less than the observed cover in Baseline survey, the declining trend observed during the three years of follow up surveys reversed in 2020. This suggests that during favorable conditions the seed bank of Monterey spineflower present within EISB area is sufficient to dramatically increase in cover area, and that the low numbers observed in 2019 were within the normal range of variation for the species. The dramatic annual changes in Monterey spineflower cover observed since 2010 in Reference Site 1 further corroborate that high variability for this annual species can occur due to environmental factors alone (Table 1). The percent cover of Monterey spineflower decreased in both Reference Site 1 and in EISB survey area when compared to Baseline surveys.

The number of wells where Monterey spineflower was detected was 13, one less than in Baseline survey. The three wells where Monterey spineflower was found in 2016 where it wasn't in 2020 were EW-BW-162-A, EW-BW-168-A, and IW-BW-167-A. The populations within the 50 ft boundary of all three wells in 2016 covered 1.5, 111, and 18.7 ft² respectively, and represented a small fraction of the total cover area.

Within EISB survey area, Monterey spineflower appeared to be more likely detected in areas with signs of recent activity by small herbivorous mammals. Browsed areas near edges between shrubs and grasslands were often occupied by Monterey spineflower. These transition areas between shrubs and grasslands are more intensely browsed by brush rabbits because shrubs provide refugia from predation (Chapman 1974). Since Monterey spineflower occupies microhabitats found

between shrubs where there is little cover from other herbaceous species (USFWS 2009b), it may benefit in heavily browsed areas through indirect commensalism, as herbivores open up suitable habitat by consuming its competitors. Monterey spineflower itself was not affected by herbivory in a two-year field experiment (Fox 2007), possibly due to its spinescence.

5.2 Sand gilia

There were only two sand gilia plants present in EISB in 2020 survey, which is 50% less than the year prior. This represents a 94% decrease from Baseline survey in which 36 individual plants present in the same location (Table 2). In the Reference Area 1 the species declined by 80% from 2019. The small size of the EISB population makes it extremely vulnerable to any environmental or anthropogenic impacts, however, the decrease from Baseline is less than observed variability in Reference Site 1, and is within the normal range.

In 2016, Monterey gilia was not observed within 50 feet any of the well locations, but it was observed on the access route in between IW-BW-166-A and IW-BW-160-A. In 2020, the two sand gilia plants were identified in the same location.

Fox (2007) compared vital rates of sand gilia and Monterey spineflower in an study where herbivory and water were varied experimentally. While herbivory did not affect vital rates of Monterey spineflower, it was a main driver of sand gilia's. This effect was especially impactful on sand gilia in low water years when plant cover was low. Thus, in areas with small sand gilia populations, herbivory can have a disproportionate impact on this species.

5.3 Success criteria

The success criteria for HMP annual species are identified in the 2017 PBO as:

1. Densities and acreage of HMP annual species are within normal range compared with information from reference sites.
2. The number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.

Success criterion 1 for Monterey spineflower has been met in 2020. The succession criterion 1 for sand gilia was met in 2019 and 2020 when compared to variability of the sand gilia population in Reference 1 (Ahtna 2020)

The success criterion 2 for Monterey spineflower was met in 2019, where Monterey spineflower was detected in 15 wells (Ahtna 2020). The success criterion 2 for sand gilia was also met in 2019 (Ahtna 2020).

6.0 CONCLUSIONS AND RECOMMENDATIONS

The results presented in this report are from Year 4 follow up surveys for rare plant species in the EISB deployment area in FONR. The trend of decreasing Monterey spineflower populations

observed in the three years following Baseline did not continue, and populations of that species rebounded from the low numbers observed in 2019. The populations of Monterey spineflower in Reference Area 1 also increased from 2019. Although the populations of Monterey spineflower were lower in both Reference Site 1 and EISB deployment area than in Baseline, the observed variations in the follow up surveys are within normal range.

Sand gilia population within EISB area was found in the same location as in Baseline survey, and although the number of individual plants was 94% lower, dramatic swings in population numbers have been observed in Reference Site 1 since 2010. The small size of the initial population at ESIB makes it vulnerable to impacts from competition, herbivory, and other environmental variables which makes it susceptible to drastic annual variation.

Between Year 3 and Year 4 of follow up surveys, both species met the success criteria specified in the 2017 PBO, and no further monitoring is recommended at this time. When EISB wells will be planned for destruction in the future, an additional round of rare plant surveys will be conducted as part of the conservation measures described in the PBO.

The qualitative observations of Monterey spineflower populations occurring along edges between grasslands may indicate that the species benefits indirectly from small mammals browsing on annual grasses, while previous study demonstrated a strong effect of herbivory on sand gilia. Additional research into the relationship between rare plants and herbivores may shed a further light on the complexities of population dynamics of these federally listed annual plants.

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