FORMER FORT ORD, MONTEREY, CALIFORNIA

FINAL

2005 ANNUAL BIOLOGICAL MONITORING REPORT, RANGES 43-48

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Monterey County, California

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prepared by

PARSONS

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2005 Annual Biological Monitoring Report

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2005 ANNUAL BIOLOGICAL MONITORING REPORT
FORMER FORT ORD

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2005 ANNUAL BIOLOGICAL MONITORING REPORT FORMER FORT ORD

1 INTRODUCTION

This 2005 biological monitoring study was conducted as a requirement of the Installation-Wide Multispecies Habitat Management Plan (HMP) [Ref. 1]. The HMP identifies rare, threatened, or endangered species and habitats designated for protection and future management after completion of munitions removal and other clean-up operations. The HMP also outlines mitigation measures necessary if Army-related munitions cleanup activities have significantly impacted these rare species and habitats. To determine whether mitigation measures could be necessary to restore populations of HMP-listed species, the plan requires five years of annual monitoring for rare species following completion of the munitions cleanup on each site designated to be managed as future habitat for HMP-listed species. Annual monitoring results may be used for comparison with a site's baseline survey data to assess whether recovery and regeneration of the protected habitat and its associated rare plant species are proceeding toward baseline conditions.

For 2005, Parsons was tasked at the request of the Army Corps of Engineers, to complete the annual biological surveys for the Ranges 43-48 site. Munitions removal work began in December 2003 and was completed by September 2005. This was the second season for annual monitoring on this site.

1.1 SITE DESCRIPTION

The munitions removal site in this study is Ranges 43-48, an approximately 483-acre site at the north end of the Impact Area on Fort Ord, located about eight miles north of Monterey, California (Map 1, Appendix A).

The portion of the site covered in this study and for which annual monitoring is required, is designated in its entirety for future management as habitat for rare, threatened, or endangered species and their habitats.

The vegetation type in the Ranges 43–48 site is primarily central maritime chaparral with patches of annual grasslands along the site's west, east, and south boundaries. Central maritime chaparral is a vegetation type protected under the HMP because of its association with significant numbers of rare, threatened, and endangered species. Terrain over most of the site consists of rolling hills with elevations ranging from 375 to 550 ft.

1.2 SPECIES INCLUDED IN 2005 HABITAT AND RARE SPECIES MONITORING

The primary habitat of concern on the Ranges 43-48 Munitions Removal Site is central maritime chaparral. Species considered for monitoring in 2005 are a variety of central maritime chaparral species including many that are rare, threatened, or endangered and are listed in the HMP. These plant species, listed in Table 1 in Appendix C, include a variety of shrub and annual plants such as sandmat manzanita (*Arctostaphylos pumila*), Monterey ceanothus (*Ceanothus cuneatus var. rigidus*), Eastwood's golden fleece

(*Ericameria fasciculata*), sand gilia (*Gilia tenuiflora ssp. arenaria*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and Seaside bird's-beak (*Cordylanthus rigidus ssp. littoralis*). Since there are no wetland areas on the site, wetland species are not considered in this report.

1.3 PREVIOUS SURVEYS CONDUCTED ON THE SITE

1999 and 2000: Eighty transects were established on the site over a two-year period [Ref. 2] to capture baseline shrub percent cover and diversity on the site, prior to the prescribed burn or munitions-removal activities. The HMP requires five years of chaparral species monitoring to assess whether chaparral regeneration, (i.e. species diversity and abundance,), is proceeding normally toward the baseline conditions.

2000: Surveys were completed for three rare HMP annuals (sand gilia, Monterey spineflower, and Seaside bird's-beak)

2001 to 2003: No surveys were done because no Army remedial actions had occurred.

2003: Prescribed burn was conducted in October.

2004: In the first spring following the burn, a survey was conducted by MACTEC [Ref. 3] for three rare HMP annuals: sand gilia, Monterey spineflower, and Seaside bird's-beak. No vegetation transect data were collected, since it was only a few months following the burn, and there was insufficient regeneration of shrubs to provide adequate assessment of shrub recovery. Note that these surveys represent baseline conditions post-burn since munitions removal work on the site had barely begun at this time.

2005: This report includes survey results for three rare HMP annuals: sand gilia, Seaside bird's-beak, and Monterey spineflower. For Monterey spineflower, only presence/absence data were collected. It also includes the first year of transect monitoring data for shrubs and perennials.

1.4 2005 ANNUAL HMP SPECIES SURVEYS

Parsons conducted surveys for three rare annual species, sand gilia, Seaside bird's-beak and Monterey spineflower. For the first two species, data were collected on population area and density. For Monterey spineflower, data were collected on presence or absence only within each 100 x 100-ft grid system. Monterey spineflower density could not accurately be assessed over the 500 acres due to time limitations and the size of the site.

1.5 2005 CENTRAL MARITIME CHAPARRAL SHRUB/PERENNIAL MONITORING

Central maritime chaparral monitoring of shrub and perennial seedlings was conducted from August 8 through Sept 11, 2005. Data were collected on abundance of maritime chaparral shrub and perennial species along seventy-nine 50-m transects that were established in the two years prior to the prescribed burn, and reported in the baseline study report of 2000 [Ref. 2]. Year 2005 is the first season for which shrub-monitoring data have been collected since the site burned in October 2003. In the spring and summer of 2004, re-growth and germination of shrub species was still limited, and since

munitions removal work had barely begun, the Army determined that the second year following the burn would provide more useful data to assess chaparral recovery following munitions removal work.

1.5.1 EFFECT OF WORK-RELATED DISTURBANCES TO MARITIME CHAPARRAL SPECIES

Part of the goal of annual monitoring on Fort Ord is to be able to examine trends in recovery of health and diversity of rare habitats such as maritime chaparral, following cleanup activities such as that on the Range 43-48 site. This site can be divided into two areas, Zone A and Zone B, which received different treatments. Zone A received a complete munitions removal to depth on 256 acres (Map 2, Appendix A). The remaining 229 acres, Zone B, received only a surface munitions removal. The munitions-removal activities occurring in each zone are described below.

Zone A Munitions Removal Activities:

a) Burned completely.

b) Burned plant stems were cut to a height of 6 inches using a large tracked excavator modified with a mowing head.

c) Surface clearance of munitions and explosives of concern by visual search (walking).

d) Munitions removal of ferrous items using the Shoenstedt GA-52Cx analog magnetometer, and excavation of all anomalies encountered ranging from depths of a few inches to more than 4-ft depth.

e) Digital geophysical surveying of all grids to locate remaining non-ferrous and ferrous anomalies encountered. Digital geophysical surveys involved driving over terrain with a "towed array" setup, a two-wheeled cart pulled by either an all-terrain vehicle (ATV) or a small tractor. In some areas an EM-61 was pulled by hand.

f) Global Positioning System (GPS) was used by re-aquisition teams who walked each grid to flag locations for digitally acquired anomalies.

g) Excavation teams revisited each grid and conducted another dig phase, varying from a few items to 200-plus additional digs per grid and with the depth again ranging from a few inches to four feet or more.

h) Backhoe excavations were performed on areas where digs were deeper or more extensive than could be done by hand.

Zone B Treatments:

a) Burned completely.

b) Burned plant stems were cut to a height of 6 inches using a large tracked excavator modified with a mowing head.

c) Surface clearance of munitions and explosives of concern by visual search (walking).

Zone A received many disturbances over a period of 24 months to complete a thorough investigation of all metal items below ground over the roughly 297-acre area. Each area of the site had multiple periods of disturbance, by trampling, driving with an ATV or tracked vehicle, and a large number of ground excavations. Zone B received few disturbances, and no digging or excavations.

Disturbance levels are dramatically different between the two areas, providing a "treatment area" and "reference site" that can indicate trends for how intensive disturbance by trampling and excavation affects the rare annual plants species and chaparral shrub regeneration. Results of the survey are broken down by zone to compare the rare species' distribution and abundance within each zone.

1.5.2 EFFECT OF VEGETATION AGE ON RECOVERY OF MARITIME CHAPARRAL SPECIES

The initial 2000 study divided transects into three groups based on estimated age of chaparral stands: disturbed, intermediate or mature. The transect study results for 2005 are also grouped by these three classes to observe trends in species recovery related to chaparral age.

1.6 MITIGATION MEASURES IMPLEMENTED DURING MUNITIONS REMOVAL

Chapter three of the HMP [Ref.1], lists the mitigation measures that should be followed during munitions removal activities. These measures are as follows:

1) Minimize disturbance associated with munitions removal, by impacts to the smallest area possible; placement of staging areas, access roads, and facilities to avoid HMP species wherever possible; using existing roads wherever possible, and limit off-road vehicles to the greatest extent practicable.
2) Where feasible, avoid populations of sand gilia and Seaside bird's-beak, particularly in the growing season prior to seed set. Fence or flag known populations.
3) Educate work crews as to the location and identification of HMP plant and animal species. Conduct environmental training of all incoming field personnel

In addition to these, the following measures were added:

4) Training workers on topsoil replacement during digs. This was introduced to attempt to minimize the impact of digs by preserving as much of the seedbank as possible.
5) HMP plant seed salvage. Mature seed of sand gilia, Monterey spineflower and Seaside bird's-beak was collected during seedset in a few acres where large excavations (greater than 10 sq.ft. in size) were performed within a population of these plants. The salvaged seed was broadcast back onto the site following completion of the digs. Sand gilia seed salvaged in 2004 from an area designated for future development (Range 45, see Map 2) has been stored at the Army Base Realignment and Closure Office.

2 METHODS

2.1 METHODS FOR SAND GILIA AND SEASIDE BIRD'S-BEAK SURVEYS

For consistency with previous surveys on the site, methods for conducting data for the 2005 sand gilia monitoring were the same as those used in the 2004 survey. The 2004 methods are based on the Protocol for Conducting Vegetation Sampling at Fort Ord in compliance with the Habitat Management Plan [Ref.4].

The sand gilia population was surveyed between April 11 and May 12, 2005 during the peak bloom period for the species. The site was subdivided into 100-ft square grids after the prescribed burn for ease of field orientation. These markers provided the reference point for assessing presence or absence of plants and their densities. Each 100-ft grid was assigned a density class based on number of individual plants per grid as follows:

0,

1 to 50,

51 to 100,

101 to 500, and

>500

Numbers of plants counted were estimates made to the best ability of the surveyors, given the limited time available to cover the entire site. Accuracy of counts became a factor in high-density grids in which numbers of plants exceeded 500 plants. When the number of gilia plants exceeded 500 plants, the best approximation of the density was made using 1-m transects initially to standardize estimates, and then using visual estimates thereafter. Approximately 32 acres were omitted from the survey because the bloom season ended before the end of the survey. After peak bloom, plants are no longer adequately visible for survey.

The grids omitted were mostly concentrated in areas of tall non-native grasslands where sand gilia are unlikely to occur.

Seaside bird's-beak were surveyed later in the season (28 June through 26 July) during the peak bloom for this species, using the same protocol as for sand gilia. Areas for Seaside bird's-beak were based on the known population boundaries established during two individual site surveys in 2004 by both MACTEC and by Parsons. Areas not known from previous years to host Seaside bird's-beak were not surveyed in detail. These areas were given a cursory inspection during the sand gilia survey, and no new populations were identified. These are labeled "not surveyed" on Map 4 in Appendix 1.

2.2 METHODS FOR MONTEREY SPINEFLOWER SURVEY

Data for Monterey spineflower populations were collected by noting presence or absence within each 100-ft grid on the site during the sand gilia and Seaside bird's-beak surveys. Due to time and resource limitations and because of the size of the site and the need to collect data for other rare annuals on the site, density estimates are not included in this survey. Monterey spineflower is known to be widely distributed on the site and well

adapted to conditions of moderate disturbance. Consequently, it was considered a priority to focus on sand gilia and Seaside bird's-beak for the 2005 surveys.

In addition to time constraints of conducting three full-scale surveys over a large site, density data for Monterey spineflower would be inaccurate when collected prior to the peak bloom time for sand gilia survey). At neither of these times were spineflower populations at peak bloom, during which accurate estimates could be reported. Data collection is designed to represent distribution of the species rather than density. Approximately 32 acres were omitted from the survey due to limited time available for surveying during the bloom season.

2.3 METHODS FOR VEGETATION TRANSECT SAMPLING

Vegetation transect sampling was conducted from the beginning of August through the end of August, 2005.

Methods used to collect data for the second year post-burn differed from the baseline method of using line-intercept. The method was revised for this year because at 22 months after the burn many shrub and perennial seedlings were still quite small, and the number of seedlings was determined to better represent the progress of species' regeneration than would percent cover measurements.

Transect locations were found using GPS data acquired at the time the original locations were established. A 50-m measuring tape was laid between the transect endpoints, and a one-quarter meter square (50x50cm) quadrat was placed at 10m intervals along the tape, alternating left and right sides of the tape, at 0m (L), 10m (R), 20m (L), 30m (R), and 40m (L). Transect BG8 (see Map 2, Appendix A) was eliminated as a result of a large-scale soil sifting operation in the Range 45 area to remove high density live munitions. This reduced a 14-acre area at the north central part of the site to bare mineral soil. Since this was an anomalous work procedure this transect was removed from the dataset. It occurs in a parcel now designated for future development as a result of the Parker Flats and East Garrison Land Use Modification Assessment. Two additional transects, BD-4 and 17-1 (see Map 2, Appendix A), were also removed from the dataset because they were located outside the prescribed burn area within a fuel break zone and did not receive the same burn and munitions removal treatments as the rest of the site.

The number of transects for which data were collected in each of the three vegetation age groups are as follows: Disturbed chaparral – 11; Intermediate-aged chaparral – 31; Mature chaparral – 32. Age groups were defined according to canopy cover estimated from aerial maps and from field observations when transects were originally established in 1999 and 2000 [Ref. 2].

The number of transects located in Zone A (impacted by the full munitions-removal process) was 43, and in Zone B was 31. Transects were assigned to a given zone if more than half the transect length occurred in that zone.

The number of individual seedlings was counted for each shrub species listed in Table 1 (Appendix C). Plants were counted if rooted within the quadrat. Percent cover of live vegetation, dead vegetation, wood and litter, and bare ground was also estimated within each quadrat.

The species listed are shrubs and woody perennial plants that occur in maritime chaparral or in associated grassland areas. These species were included in the baseline surveys, and include several special-status species as noted in Table 1 (Appendix C).

3 RESULTS

3.1 RESULTS OF SAND GILIA SURVEY

Sand gilia was present in 287 acres on the Range 43-48 site, approximately 58% of the total site area. This compares to last year's occupied area of 193 acres, or 39% of the site (Table 2, Appendix C). This represented an increase in distribution in 2005 over approximately 19% of the site. The distribution and abundance in 2005 are shown on Map 3 (Appendix A).

Total number of sand gilia plants counted in 2005 was 284,380 compared with 66,328 plants observed in 2004 [Ref. 3]. This represented approximately a four-fold increase in total gilia population.

In 2005, area in acres of sand gilia at each density was as follows:

0 plants/grid: 183 acres
1-50 plants/grid: 119 acres
51-100 plants/grid: 42 acres
101-500 plants/grid: 91 acres
>500 plants/grid: 37 acres

In 2004, for comparison, area in acres of sand gilia at each density was [Ref. 3]:

0 plants/grid: 280 acres
1-50 plants/grid: 139 acres
51-100 plants/grid: 21 acres
101-500 plants/grid: 32 acres
> 500 plants/grid: 2 acres

These areas are compared graphically in Figure 1 in Appendix B.

3.1.1 COMPARISON OF SAND GILIA DENSITIES IN ZONE A VERSUS ZONE B

Results broken down for Zone A and B are shown in Table 2 in Appendix C. Density of plants per acre occupied by sand gilia was 894 in Zone A compared to 1086 in Zone B.

3.2 RESULTS OF SEASIDE BIRD'S-BEAK SURVEY

Seaside bird's-beak was present in 63 acres on the Range 43–48 site, approximately 12% of the total site area (Table 2, Appendix C). This compares to last year's occupied area of 18 acres, or about 4% of site [Ref. 3]. This represented an increase in distribution in 2005 over approximately 9% of the site area. The distribution and abundance of Seaside bird's-beak is shown on Map 4 (Appendix A).

The number of Seaside bird's-beak plants counted in 2005 was 68,774. A total of 3317 plants was reported in 2004 [Ref. 3], representing almost a twenty-fold increase in total Seaside bird's-beak population.

Area of Seaside bird's-beak at each density was as follows:

1-50 plants/grid: 21.3 acres
51-100 plants/grid: 7.7 acres
101-500 plants/grid: 22.8 acres
>500 plants/grid: 10.8 acres

For comparison, results from 2004 were as follows [Ref. 3]:

1-50 plants/grid: 13.3 acres
51-100 plants/grid: 2.3 acres
101-500 plants/grid: 1 acre
>500 plants/grid: 0

These areas are compared graphically in Figure 2 in Appendix B.

3.2.1 COMPARISON OF SEASIDE BIRD'S-BEAK DENSITIES IN ZONE A VERSUS ZONE B

Results broken down for Zone A and B are shown in Table 2 in Appendix C. Density of plants per acre occupied by Seaside bird's-beak was 946 in Zone A, compared to 1444 in Zone B.

3.3 RESULTS OF MONTEREY SPINEFLOWER SURVEY

The distribution and abundance of Monterey spineflower is shown on Map 5 (Appendix A.) Total acreage of Monterey spineflower in 2005 was 330 out of 433 acres surveyed (Table 2, Appendix C). It is expected that the acreage of Monterey spineflower is actually higher by about 35 acres. Comparing distribution to the previous years distribution, and allowing for known inaccuracies of recording presence in certain areas, this yields an adjusted estimate of 365 acres of spineflower present.

Acreage broken down by zone is shown in Table 2 in Appendix C. Of the total occupied area, 53% occurred in Zone A and 47% in B.

3.4 RESULTS OF SHRUB TRANSECT MONITORING

Raw data for each transect are presented in Table 3 in Appendix C. Numbers shown are total number of seedlings counted summed over the five transects and average (± sd) of the percent cover of live vegetation, dead vegetation, wood/litter, and bare ground.

3.4.1 SHRUB AND PERENNIAL SEEDLING ABUNDANCE – ALL TRANSECTS COMBINED

The abundance of shrub/perennial seedlings for all transects on the site are summarized in Table 4 in Appendix C. The number of seedlings of each species are shown ranked under the Grand Total column. The most common perennial species that were encountered as seedlings or two-year old plants germinating since the October 2003 burn were (grand total of number of seedlings in parentheses): rush rose (1410), HMP-listed Monterey ceanothus (260), dwarf ceanothus (203), golden yarrow (194), black sage (100); and chamise (87).

Rush rose was by far the most dominant plant by abundance of seedlings. By percent cover, however, Ceanothus species were visually observed to be most dominant, because seedling sizes were on average much larger. The results are consistent with what would be expected after a fire, with known fire-following species topping the list.

Special status species present on the site in the baseline survey for Ranges 43–48 [Ref. 2] were all represented in the current survey. Total number of seedlings counted for 2005 were as follows: Monterey ceanothus (260), sandmat manzanita (22), and Eastwood's golden fleece (4).

3.4.2 COMPARISON OF TRANSECT SAMPLING BETWEEN ZONE A AND ZONE B

Average number of all seedlings per transect was 30 for Zone A and 42 for Zone B (Table 4, Appendix C), roughly 41% higher in Zone B, the area which had no impacts from excavations for sub-surface munitions.

Diversity of chaparral plant species was fairly close in the two zones, with 21 and 18 species appearing in Zones A and B respectively, out of the 23 included in the survey. HMP-listed Monterey ceanothus and Eastwood's golden fleece occurred at greater frequency in Zone B, while HMP-listed sandmat manzanita was counted about equally in both zones. The breakdown of seedlings by species in Zone A and Zone B is graphically represented in Figure 3 in Appendix B.

3.4.3 COMPARISON OF TRANSECT SAMPLING AMONG VEGETATION AGE GROUPS

Total shrub and perennial seedling abundance was highest in the Intermediate-aged transect group at 39.4 seedlings/transect, compared to 30.2 for the Disturbed age group, and 32.7 for the Mature age group (Table 6, Appendix C). The breakdown by species is graphically shown in Figure 4 (Appendix B).

Diversity of species was slightly higher in the Intermediate age group at 17 species, compared to 14 for the Disturbed group and 15 for the Mature group. MACTEC in 2000 [Ref. 2] recorded 18 species in the Intermediate age group, 16 in the Disturbed group, and 18 in the Mature group. Of the three HMP-listed shrubs, both Monterey ceanothus and sandmat manzanita occurred in all three vegetation age groups, consistent with the results from baseline study in 2000. Eastwood's golden fleece however, was absent from the 2005 seedling survey in Mature habitat, whereas it had been present in 2000 (though at only 0.01% cover).

3.5 PERCENT COVER OF LIVE VEGETATION, DEAD VEGETATION, WOOD/LITTER, AND BARE GROUND

Total percent covers averaged over the entire site are also shown in Table 4 (Appendix C). Average percent covers over the 77 transects were as follows:

% Live Vegetation: 24.9 (± 23.9)
% Dead Vegetation: 9.9 (± 15.7)
% Dead wood and Litter: 23.8 (± 15.4)
% Bare Ground: 41.4 (± 24.9)

The most commonly encountered shrub species representing live percent cover were adult shaggy-bark manzanita and chamise. Both of these species form underground

woody burls, from which new shoots which will typically re-sprout quickly following a burn.

Note that no measurement of live herbaceous cover was made because the transect data were collected in summer after herbaceous cover had died back.

4 DISCUSSION

4.1 SAND GILIA POPULATION

Acreage of sand gilia was 287 acres in 2005 compared to 193 acres in 2004 [Ref. 3]. This represents an increase in distribution of 94 acres in 2005 over the previous year, in addition to a larger proportion of the population occurring at high densities (greater than 50 plants per grid).

Several factors that may have contributed to the difference in years. One was higher rainfall: there were approximately 31 inches of total rainfall in Monterey during the 2004/2005 season compared to 17 inches in 2003/2004. The second factor was the extent of disturbance activities in the form of digging throughout the site as part of the munitions removal work. This could result in either an increase or decrease in annual plant population density, depending on extent and depth of digging. The third factor is time since the prescribed burn. Sand gilia is an early-successional annual plant species that thrives in conditions where there is lowered competition with other plants for resources such as light, water, and nutrients. Prescribed burns provide the right conditions by reducing plant competition to a minimum. The second spring following a burn would be expected to have lower levels of soil nutrients and increased plant competition compared to the first spring, resulting in an expected decline in population density of post-burn annual plants.

Of the three main factors, rainfall is likely the major contributor to the increase in population density of sand gilia. Past data on Fort Ord have shown much higher germination rates of sand gilia in higher rain years [Ref. 5]. Since rainfall was much higher in 2004/ 2005, it is not possible to assess the effect of digging disturbances alone on the sand gilia population on the site. While it is commonly known that moderate disturbance levels can increase populations of these rare annuals by decreasing competition from other plants, it is unlikely that the high sand gilia population could be attributed to this disturbance because the benefits of disturbance result from increasing open ground space within closed shrub canopy. In this second year following the burn open ground is unlikely to be a limiting factor since percent bare ground is still high at 38-45% (Table 6, Appendix C). In addition, the extent and depth of munitions removal activities on the site exceeds what might be termed a “moderate” level of disturbance in a large percentage of the site.

Regardless of the contribution of each of these factors to sand gilia abundance, it is evident that very high densities of gilia occurred in both Zones A and B of the site. The consistency in high density in both the disturbed Zone A and the non-disturbed Zone B suggests that the increase in population density was not related to the munitions removal activities. It is also probable that high rainfall in 2004/2005 greatly compensated for any

negative impacts to the sand gilia populations that may have resulted from munitions removal, or from the increased plant competition from vegetation regrowth.

The average density per acre of gilia plants in Zone A was 894 and in Zone B was 1086. These numbers are close enough to suggest no significant difference in sand gilia abundance in these areas with very different disturbance levels. Differences in sand gilia habitat quality between Zone A and B may also contribute to these results to an unknown degree, so the effect of munitions-removal-related disturbances alone cannot be quantified. It is likely that the mitigation measures listed in Section 1.6 were effective in reducing the effects of work-related disturbances in the specific areas where they were applied.

4.2 SEASIDE BIRD'S-BEAK SURVEY

Acreage of Seaside bird's-beak was 63 acres in 2005 compared to 18 acres in 2004 [Ref. 3]. This represents an increase in distribution of 45 acres in 2005 over the previous year. As with sand gilia, a large proportion of the population was at high densities (greater than 50 plants per grid).

Seaside bird's-beak is similar to sand gilia in its ecological requirements. It is also an early-successional species that often thrives in conditions of moderate disturbance that reduces plant competition. The same factors that could have influenced sand gilia as discussed in the above section also apply to Seaside bird's-beak. For the same reasons as discussed for sand gilia, rainfall is also likely to be the predominant factor contributing to the large increase in Seaside bird's-beak population density.

The average density of Seaside bird's-beak plants in Zone A was 946 and in Zone B was 1444, or about 52% higher in Zone B. This is enough difference to suggest the possibility that yearlong impacts from munitions-removal has significantly decreased population density. It is also possible that there are inherent differences in habitat quality between the two zones. A direct comparison by area to last year's data is not possible because the 2004 population was so much smaller in size. Again, munition-removal impacts alone cannot be quantified, but negative impacts would have been adequately mitigated by the high rainfall year. In addition, it is likely that the mitigation measures listed in Section 1.6 were effective in reducing the effects of work-related disturbances in areas where they were applied.

4.3 MONTEREY SPINEFLOWER SURVEY

Monterey spineflower is known to be widespread on Fort Ord, and often occurring at high densities. Both the original baseline survey for Fort Ord completed in 1992 [Ref. 6], and the recent 2004 spineflower survey conducted after the 2003 prescribed burn [Ref. 3] on Range 43-48 indicate a large number of plants and large areal coverage.

Population area in 2005 was about 330 acres. In 2004, it was 294 acres. These numbers are quite similar, indicating that the species may depend less on rainfall for germination than either sand gilia or Seaside bird's-beak. This is supported by recent studies on Monterey spineflower on Fort Ord by Dr Laurel Fox [Ref. 5]. There was no decline in areal extent that could be attributed to munitions removal activity or to increased plant competition in the second year following the burn.

Visual observations during surveys for other species confirmed consistently high densities of spineflower in many areas of the site. Many of these were areas where spineflower is known to have also occurred in high densities in 2004.

4.4 VEGETATION TRANSECT SURVEY

4.4.1 COMPARISON BETWEEN ZONE A AND ZONE B

Average number of all seedlings per transect was roughly 41% higher in Zone B, the area less impacted by munitions removal. The higher number in Zone B is exactly what would be expected based on the extent of digs required to remove munitions in Zone A. Large numbers of digs conducted throughout the 18-month project would likely have incidentally removed significant numbers of plant seedlings. Future monitoring that compares the seedling germination within these zones will be necessary to show whether this difference in seedling abundance will persist through time, or whether the shrub seedlings will increase again in Zone A now that human disturbances to the site have ceased. The average percentages of bare ground were equal in both zones, which was somewhat surprising. It was expected that bare ground would predominate by some extent in Zone A due to the frequency of digs, in parallel with the finding of lower seedling abundance. This could be explained by the fact that most seedlings were very small in size and did not contribute much to the percent live cover measurements.

Diversity of chaparral species was comparable in the two zones, with 21 and 18 species appearing in Zone A and B respectively. All HMP species were present in both Zone A and B, though the numbers were somewhat lower in Zone A for two of the shrubs. But this would be expected based on the overall result showing lower seedling abundance in Zone A.

The results of the transect study as well as field observations ascertain that, although impacts due to munitions removal have reduced the seedling populations to some extent, it is not sufficient to lead to concern for the recovery of the species. Visual observations confirm that abundance of all HMP shrubs was high enough to ensure likelihood that robust populations will continue. Eastwood's golden fleece, though detected as seedlings in only a few transects (see Table 4, Appendix C), was observed to be present in several healthy populations throughout the site. Adult plants apparently survived the burn and flourished as the root crowns resprouted. Monterey ceanothus was observed to be one of the most common seedlings in both zones. Sandmat manzanita was an exception among the HMP shrubs. It was notable for its low numbers in proportion to the relatively high percent cover of adult plants reported for the site in the 2000 baseline survey.

The high percentage of bare ground may encourage continued seedling germination of HMP species and other chaparral shrubs over the next year and may thus reduce the differential in seedling abundance we observed in 2005. Another other possibility is that seedbank has undergone significant burial by the extensive digging over the site over the 18 month work period. While munitions-removal workers were instructed to replace topsoil after digs, it is not known how effective its implementation was. In this case seedling germination may not continue over the next year. Next year's annual monitoring could show whether shrub seedlings continue to germinate into the third year following the prescribed burn.

4.4.2 COMPARISON BETWEEN VEGETATION AGE GROUPS

Average shrub/perennial seedling abundance was highest in the Intermediate-aged transect group at 41.9 seedlings/transect, compared to 27.5 for the Disturbed age group, and 32.7 for the Mature age group (Table 6 in Appendix C). The trend tends toward highest seedling abundance in the intermediate-aged chaparral. This could be expected based on the from the conditions present before the burn. Intermediate aged chaparral would consist of a relatively high percentage of shrub cover and relatively high species diversity, which would contribute to a healthy seedbank. Openings between shrubs which are typical of intermediate aged vegetation stands would provide the right soil conditions for germination of many species. The closed canopy typical of mature chaparral creates build-up of chaparral leaf litter with characteristic allelopathic properties that inhibit growth and germination of other shrub species. Even after burns, it is observed that plant germination tends to be very low in mature stands of chaparral. Lower seedling abundance could be expected in disturbed chaparral because there is a less developed seedbank due to lower overall percent cover of live shrubs.

Diversity of species was slightly higher in the Intermediate age group at 17 species, compared to 14 for the Disturbed group and 15 for the Mature group. Intermediate-aged chaparral could be expected to have the highest diversity of shrubs, since the full complement of early and later-aged species could be present. The trend seems to point in that direction, although the difference measured here may not be large enough to be statistically significant.

The three HMP-listed shrub species known to occur on Range 43-48 are sandmat manzanita, Monterey ceanothus, and Eastwood's golden fleece. Both sandmat manzanita and Monterey ceanothus seedlings were present in all vegetation age groups. Eastwood's golden fleece, however was absent in Mature habitat in 2005. Since the original percent cover in 2000 was very low, only 0.01%, it is likely to have been missed in sampling because of its relative rarity.

4.5 PERCENT COVER OF LIVE, DEAD, WOOD/LITTER AND BARE GROUND

By percent cover of all live vegetation over the entire site, the commonest plants were shaggy-barked manzanita, and chamise. These are the most common of the burl-forming species that resprout readily following a burn, and contribute most of the live vegetation cover on the site (see Photographs 1 and 2 show in Appendix D).

The results of cumulative data on percent cover show that on average there was no difference between Zones A and B in the percent of live vegetation, dead vegetation, litter, or bare ground. This is different from what might be expected. The high number of excavations in Zone A would be expected to result in a significantly lower percent live cover, and higher percent bare ground.

There was large variation in individual quadrat data, as the minimum and maximum ranges show (and as shown in Table 3, Appendix C). This variation would be expected from relatively small quadrats. High variation makes it difficult to collect enough data to detect a measurable difference in percent cover of vegetation or bare ground.

It may be that sampling was insufficient to detect a measurable difference. It is possible that quadrat size was too small, or that the number of transects was insufficient. It is also possible that using more transects in the survey or larger quadrat size (such as 1x1m) could have detected a difference.

A small percentage of grids in Zone A were visually observed on site visits to have a high percentage of bare ground compared to other grids. These represented areas where unusually high concentration of munitions were removed, backhoe excavations were conducted, or where excavation was conducted in the recent past, compared to areas that may have been complete more than a year ago. The percentage of data collected in these areas was too small to result in a measurable difference between Zone A and B overall.

5 CONCLUSIONS

5.1 SAND GILIA, SEASIDE BIRD'S-BEAK, AND MONTEREY SPINEFLOWER SURVEYS

The main reasons for the large increase in sand gilia and Seaside bird's beak populations since the baseline year (2000), are likely to be the effects of both the prescribed burn conducted in November 2003, and the high rainfall occurring in winter 2004/2005.

Habitat monitoring at Ranges 43 - 48 will continue through 2008 to ensure species diversity within the habitat reserve portion of the site have fully recovered following the MEC remedial actions. In addition, the mitigation measures described in Section 1.6 will be continued during future munitions removal projects.

Results of annual habitat surveys at Ranges 43 - 48 will be available in the Administrative Record in early 2006.

5.2 VEGETATION TRANSECT SURVEY

Zone A received the full impacts of munitions removal activities compared to Zone B, which received very little impact after the prescribed burn. A difference of 41% in counts of germinating shrub and perennial seedlings were found in Zone A compared to Zone B. HMP seedlings were found in both zones in numbers that are probably adequate for full recovery of the populations, although further study is needed to establish whether seedling abundance in Zone A will continue to be lower than Zone B. Seedling abundance within the different vegetation age groups differed as would be expected. Sandmat manzanita populations should be monitored closely to determine whether regeneration is continuing toward baseline conditions.

5.3 PERCENT COVER

Percent cover of live and dead vegetation, wood and litter, and bare ground were comparable in both zones. Live percent cover and percent bare ground is close to what would be expected for maritime chaparral in the second year following a burn.

6 RECOMMENDATIONS

6.1 EVALUATION OF TRANSECT SAMPLING METHODS USED IN 2005

For the vegetation transect survey in 2005, we used number of seedlings counted in quarter meter square quadrats, rather than percent cover on a line transect, to measure the progress of chaparral shrub recovery. For this reason, the transect results for 2005 are not directly comparable to the baseline data.

The advantage of using this method is that the abundance of shrub species is probably better represented for the current year than would have been possible with the line-intercept methods used in the baseline study. Species abundance data for 2005 are consistent with what we visually observed on the site. Diversity is fairly well represented as well, with the exception of those species that occur more rarely on the site. Eastwood's golden fleece is an important HMP shrub on the site that was counted in only two quadrats out of 385 total. However, it may be difficult to estimate its abundance using the line-intercept method as well. The 2004 data also detected only a very small percent cover. Other non-HMP species observed to be present in low densities but not encountered in any quadrats were *Cortaderia jubata* (pampas grass, a non-native weed), *Garrya elliptica* (silktassel), *Lepechinia calycina* (pitcher sage), and *Quercus agrifolia* (coast live oak)

Quadrat sampling did succeed, at least, in establishing the presence of seedlings of all three HMP shrub species on the site overall. Next year, 2006, will be the third year following the burn and the second year after the completion of the munitions removal. By then, shrub cover should be sufficiently high that the line-intercept method can provide comparable results to the baseline data. Since the two methods are not derectly comparable, it is highly recommended that line-intercept sampling be resumed, at least in the fourth and fifth year of post-action sampling so that a true comparison can be made to the baseline data.

7 REFERENCES

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