2010 INVASIVE PLANT CONTROL REPORT FOR THE SANTIAGO BURN AREAS

(EL TORO REFUGE and LIMESTONE CANYON - WHITING RANCH WILDERNESS PARK)

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CONTRACT # P0850009

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Since 2004 the Nature Reserve of Orange County (NROC) has been targeting control of artichoke thistle (*Cynara cardunculus*), garland chrysanthemum (*Chrysanthemum coronarium*), castor bean (*Ricinus communis*) and tree tobacco (*Nicotiana glauca*) within two areas of the Central NCCP Subregion: the El Toro Refuge (El Toro) and the Limestone Canyon and Whiting Ranch Wilderness Park (Limestone-Whiting). The October 2007 Santiago Fire created opportunities for these invasive species to spread once again. NROC received a grant from the California Department of Fish and Game (CDFG) to continue weed control in theses two areas.

Garland chrysanthemum, artichoke thistle, tree tobacco and castor bean were treated at El Toro in 2009 and 2010. Artichoke thistle was treated at Limestone-Whiting in 2009 and 2010. Garland chrysanthemum was not documented at Limestone-Whiting and there were no significant concentrations of tree tobacco or castor bean requiring treatment.

At El Toro the cover and distribution of garland chrysanthemum, artichoke thistle, tree tobacco and castor bean has been significantly reduced. By 2010 the majority of areas supporting garland chrysanthemum had less than 20% cover, and more than half the occupied areas were reduced to less than 5% cover of garland chrysanthemum. Artichoke thistle, tree tobacco and castor bean have been reduced to a few small areas with low weed cover and a few isolated seedlings.

At Limestone-Whiting the area occupied by artichoke thistle has been reduced and the majority of areas supported less than 20% cover of artichoke thistle in 2010 compared to the baseline year (2004) when the majority of occupied areas supported greater than 30% cover of artichoke thistle.

Despite the success, continued control is necessary to prevent the target weeds from recovering. Long term conversion of disturbed weedy habitats to native habitats would assist in preventing these weeds from re-establishing in cleared areas.

1.0 INTRODUCTION

1.1 Scope and objectives

The Nature Reserve of Orange County (NROC) is responsible for implementing the Orange County Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP) program. The NROC designs and implements reserve-wide programs for target species monitoring, fire management, habitat restoration, and invasive species control. Since 1996, NROC has been implementing a comprehensive invasive plant control program targeted at high priority, widespread invasive plants, including artichoke thistle (*Cynara cardunculus*), veldt grass (*Ehrharta calycina*), and garland chrysanthemum (*Chrysanthemum coronarium*). Wildfires can be a major catalyst for the spread of invasive plants and the NROC incorporates invasive species control as part of its post-fire management actions. The October 2007 Santiago Fire created opportunities for the spread of very problematic weeds within two areas of the Central NCCP Subregion: the El Toro Refuge and the Limestone Canyon and Whiting Ranch Wilderness Park.

Since 2004, NROC and others have spent nearly $200,000 targeting control of artichoke thistle, garland chrysanthemum, castor bean (*Ricinus communis*) and tree tobacco (*Nicotiana glauca*) at these two locations. However, the Santiago Fire created opportunities for these invasive species to spread once again; and threaten the recovery of coastal sage scrub (CSS) and other natural communities. NROC received a grant from the California Department of Fish and Game (CDFG) to continue weed control in theses two areas (Agreement No. P0850009).

The objectives of the CDFG grant are to control artichoke thistle, garland chrysanthemum and castor bean at the El Toro Refuge and the Limestone Canyon and Whiting Ranch Wilderness Park during 2009 and 2010. Specifically, the scope of work included preparation of weed maps for both sites, identification of control methods, removal/control of target weeds, monitoring of control efforts and preparation of a report documenting all actions and results.

NROC hired Nakae and Associates to conduct the control efforts and Harmsworth Associates to conduct monitoring and supervision of eradication efforts at El Toro and; to prepare the compliance report. OC Parks staff conducted monitoring at Limestone Canyon and Whiting Ranch Wilderness Park.

This report documents the results of mapping, weed control efforts and monitoring activities, conducted in 2009 and 2010.

1.2 Background

1.2.1 Location

Both the El Toro Refuge and the Limestone Canyon and Whiting Ranch Wilderness Park are located within the Central NCCP Subregion, in eastern Orange County (Figure 1). The El Toro Refuge (El Toro) is located approximately north of Irvine Boulevard and south of the 241-tollroad; while Limestone Canyon and Whiting Ranch Wilderness Park (Limestone-Whiting) is located approximately north of Glenn Ranch Road and south of Santiago Canyon Road. Both areas are located within the El Toro U.S. Geological Survey (USGS) topographic quadrangle.

1.2.2 Site Description

El Toro is located in open space that was a part of the El Toro Marine Corps Air Station and is currently managed by the Federal Aviation Authority (FAA). El Toro encompasses approximately 890 acres, including coastal sage scrub, non-native grassland, and riparian habitats but also includes disturbed areas, old buildings and roads, two closed landfills and existing uses areas (e.g., small arms range).

Limestone-Whiting encompasses approximately 4,000 acres of coastal sage scrub, chaparral, native and non-native grassland, oak and riparian woodlands. The area is characterized by scenic rock formations, deeply forested canyons, rolling hills and steep slopes. Three intermittent streams; Borrego, Serrano and Aliso Creek meander through the park.

Both ares support a high diversity and abundance of native plants and wildlife including several unique and rare species.

1.2.3 Control History

Weed control at El Toro and Limestone-Whiting has been ongoing since the early 1990s, with the emphasis on artichoke thistle and garland chrysanthemum. Although initial control efforts were relatively successful, access issues, the 2007 Santiago Fire and the inherent difficulty in completely controlling these species required additional efforts to keep these invasive species in check.

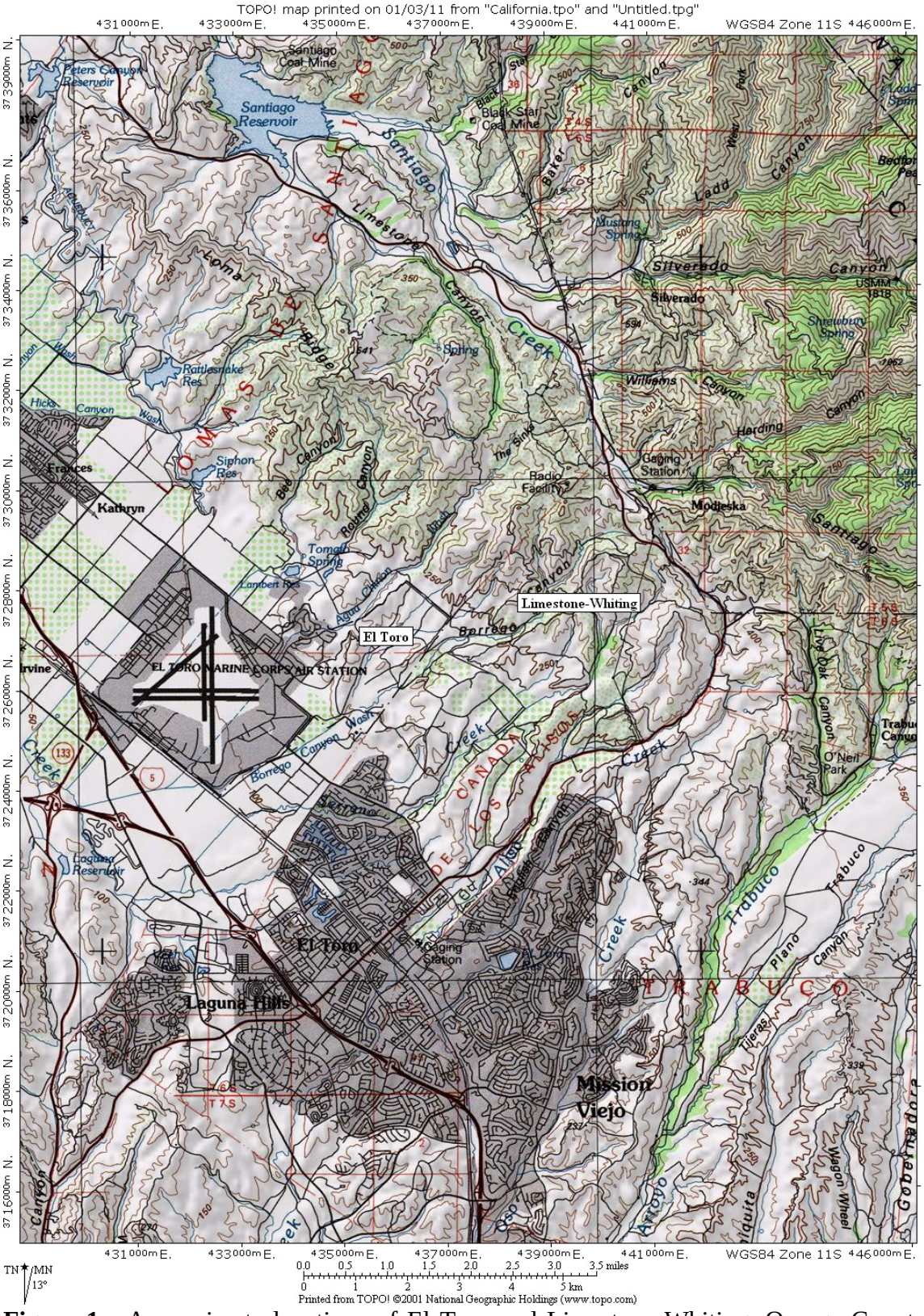

Figure 1: Approximate locations of El Toro and Limestone-Whiting, Orange County, California. Source: U.S.G.S. topographic quadrangle El Toro.

1.2.4 Target Weeds

All of the exotic plant species targeted for removal (artichoke thistle, garland chrysanthemum, castor bean, tree tobacco) are characterized by their ability to occupy disturbed areas and reproduce quickly. These traits, along with a lack of natural controls and an abundance of historically disturbed sites, have allowed the targeted exotic species to spread rapidly in southern California and out-compete native plants. Along with reducing biodiversity and impairing ecosystem functions, exotic plant populations displace many wildlife species. The practice of using herbicides on invasive exotic plants has gained recognition as a safe, effective, and low-cost means of treatment. Background information on the targeted exotic species and the herbicides used to treat them follow.

Artichoke Thistle
Artichoke thistle is a spiny, invasive, perennial weed introduced to California from the Mediterranean region during the mid-1800s. Artichoke thistle is found throughout the Coastal and Central Subregions in both native and non-native grasslands, and in grassland/coastal sage scrub ecotone. Artichoke thistle out-competes native vegetation for light, water, and nutrients. It is well adapted to the climate of southern California and re-sprouts each year from a taproot that can reach a depth of nearly 8 feet (3m). The deep taproot makes artichoke thistle particularly difficult to control with physical methods, such as plowing, mowing, and digging. Artichoke thistle cannot be controlled with biological methods because the plant is closely related to the cultivated artichoke (*Cynara skolymus*). Chemical control is the most effective way to kill artichoke thistle. Treatment experiments have shown that it is best to use Transline® during the rosette stage of development and use Round Up® when the artichoke is mature and bolting. Yearly monitoring and repeat eradication are needed to combat this thistle's ability to re-sprout after chemical spraying and to build up a seed bank that lasts over 5 years.

Garland Chrysanthemum
Garland chrysanthemum is an annual forb that reproduces prolifically from seed. Originally from the Mediterranean region, it invades disturbed areas, grasslands, and increasingly, coastal sage scrub. Physical control includes hand-pulling plants before the seeding period, but that is labor intensive. Biological controls are not known. Herbicide treatment with Aquamaster was used to control garland chrysanthemum.

Castor bean
Castor bean is an herbaceous plant or semi-woody large shrub or small tree (family Euphorbiaceae), depending on growing conditions and location. Native only to Africa, it grows quickly in mild climates and has escaped cultivation to become a noxious weed in southern and central California. In California it grows along streams and rivers and in riparian habitats. Castor bean contains ricin, an extremely toxic chemical that can kill an adult who consumes only four to eight seeds. Handling foliage and seeds can cause severe dermatitis. Physical control includes hand-pulling plants before the seeding period, or bagging the seed and cutting down the mature plants but that is labor intensive.

Biological controls are not known. Castor bean was cut and stump treated with Roundup-Pro or Aquamaster.

Tree tobacco

Tree tobacco is a tree/shrub from the family Solonaceae, which stands 10-20 feet tall and is short-lived. Tree tobacco is native to South America but it is now widespread as an introduced weed in the southwestern United States. Tree tobacco was introduced to California about 100 years ago and is found growing up to 5,000 feet in disturbed soils, vacant lots, along roadsides, on hillsides, in scrub habitats, along streams and riparian areas. Physical control includes hand-pulling plants or cutting down the mature plants but that is labor intensive. Biological controls are not known. Tree tobacco was cut and stump treated with Roundup-Pro or Aquamaster.

2.0 METHODS

2.1 Mapping

Prior to initiating control efforts each season monitoring biologists mapped the weed infestations in each area. Mapping occurred before control efforts in order to provide the most accurate and up-to-date information to the contractor and to accurately map the weed locations before the contractor started to remove or spray weeds.

Weeds were mapped in the field on large scale aerial photographs and later transferred to the OC Parks GIS system by OC Parks GIS staff. Location and size of mapping polygons were determined by target weed density, topography and the presence of fence lines or roads. Mapped information included polygon boundary, % cover of target weed species, distribution and condition of target weed species, other weeds present, vegetation community, % cover of native species, physical features of the polygon and any other noteworthy features.

Mapping and data collection was conducted at El Toro in April 2008, April 2009 and March 2010; and at Limestone-Whiting in May 2008, March 2009 and March 2010.

Because mapping was conducted each year prior to control treatment, the mapping reflects the success of the previous years control efforts; thus the results of the 2010 control efforts will not be detected in the 2010 mapping. The 2011 mapping will reflect the results of the 2010 control efforts.

2.2 Sensitive Plant And Animal Surveys

Rare and sensitive plant surveys were conducted at each site prior to treatment efforts. Rare plants and sensitive habitat areas were identified with bright colored flagging and therefore avoided by work crews. Native needlegrass grasslands were avoided when the area contained no exotics. In addition, crew activity and footpaths were monitored daily to minimize overall disturbance to needlegrass grassland and coastal sage scrub (CSS) communities.

Harmsworth Associates biologist, Brian Karpman, conducted California gnatcatcher (*Polioptila californica californica*) and cactus wren (*Campylorhynchus brunneicapillus*) surveys at all treatment areas where CSS was present. No California gnatcatcher or cactus wren nests were located within the immediate treatment areas or impacted by treatment events.

2.3 Weed Control

Nakae and Associates conducted the weed control in 2009 and 2010, mostly utilizing herbicide but also physical removal in some situations. The contractor prioritized treatment areas, methods and timing based on weather conditions, weed infestations and site conditions as directed by the monitoring biologist.

El Toro
Artichoke thistle, tree tobacco and castor bean were treated at El Toro in 2009 and 2010. Garland chrysanthemum was only treated in 2010, it was not treated in 2009 since the El Toro access permits were granted following seed maturation and dispersal making control efforts futile. Treatment totaled 5 days in 2009 (between April 3 and 10, 2009) and 5 days in 2010 (between March 1 and 10, 2010).

Garland chrysanthemum was foliar sprayed with the herbicide Aquamaster prior to setting seed. Artichoke thistle, small or seedling tree tobacco and small or seedling castor bean were treated with Round-up Pro or, Aquamaster if within 100 feet of a drainage. Larger tree tobacco and large or mature, fruit-bearing castor bean were cut down, removed from site and stump treated with Round-up Pro or Aquamaster.

Limestone-Whiting
Artichoke thistle was treated at Limestone-Whiting in 2009 and 2010. Treatment totaled 5 days in 2009 (between March 17 and 21, 2009) and 3 days in 2010 (between March 29 and 31, 2010).

Artichoke thistle was treated with the herbicide Transline both years.

Garland chrysanthemum was not documented at Limestone-Whiting and there were no significant concentrations of tree tobacco or castor bean requiring treatment in 2009 or 2010.

Herbicide Use

A foliar spray application method was used for all herbicides; both the foliage and base of target weeds were sprayed. Easily accessible areas with high percent cover of target weeds were sprayed with a hose directly from a truck. In areas with limited access, the spray crews used individual five-gallon backpack tanks. Backpack tanks were also used in needlegrass grasslands and in areas with low percent cover of exotics.

Favorable weather conditions for maximum uptake and effectiveness of herbicides include the following: high irradiation, low humidity, wind speed less than five mph, and a minimum ambient temperature of 65 F. In general, weather conditions in winter and spring of 2010 met these criteria. Treatment was cancelled when conditions were overcast and the likelihood of precipitation was greater than 50%, or when wind speed exceeded five mph.

Artichoke thistle was treated with Transline. Transline, or clopyrlid, is a broadleaf-selective herbicide that does not affect grasses or other monocots. The presence of purple needlegrass (*Nassella pulchra*) and native bulbs in the understory of artichoke thistle in many areas prioritized for treatment raised concern about the use of the non-selective herbicide Round Up at these sites. Comparative treatments of Transline with Telar and Roundup-pro with Telar at a small test site proved Transline more effective in reducing artichoke thistle cover without harming native grasses or bulbs (TNC 2002). Treatment with Transline is most effective when conducted in the early spring when artichoke thistle is still in the rosette stage, before the flower stock bolts. Transline was applied at a concentration of 24 ounces per 100 gallons of water (0.18% solution).

2.4 Monitoring

HWA staff conducted the monitoring at El Toro, OC Parks staff conducted the monitoring at Limestone-Whiting. In both areas monitoring visits were conducted regularly to direct and oversee control efforts, to assist the contractor, to ensure quality control, to assess control efforts, and to collect monitoring data.

Monitoring data collected included the percent cover of exotics, amount and type of chemical used, total acreage treated, crew size, and total hours worked. In addition, all areas were photographed to monitor treatment efforts.

3.0 RESULTS

3.1 El Toro

Artichoke thistle, tree tobacco and castor bean were treated at El Toro in 2009 and 2010. Garland chrysanthemum was only treated in 2010, as access permits were issued after plants had gone to seed and it was too late for effective treatment. A total of 24.5 acres were treated in 2010. Garland chrysanthemum was the most problematic weed at El Toro; artichoke thistle, tree tobacco and castor bean were more localized in distribution and occurred in lower densities (see attached Figures and Photographs 1-8).

Garland chrysanthemum

At El Toro garland chrysanthemum was widespread in distribution and occurred at high densities. Fortunately it was restricted to the edges of dirt roads and other disturbed places and generally did not occur in native habitats (CSS or riparian areas). Approximately 23 acres were occupied by garland chrysanthemum in 2008 (Tables 1 and 3; attached Figure – El Toro 2009). The majority of areas supported greater than 20% cover of garland chrysanthemum and almost half had greater then 50% cover of garland chrysanthemum. In 2010 (after treatment in 2008 but prior to treatment in 2010) approximately 22 acres were occupied by garland chrysanthemum (Tables 1 and 3; attached Figure – El Toro 2010). By 2010 the majority of areas supported less than 20% cover of garland chrysanthemum and more than half the occupied areas were reduced to less than 5% cover of garland chrysanthemum.

Table 1: Acreage of garland chrysanthemum by cover class, El Toro 2008 and 2010.

Garland chrysanthemum cover	2008	2010
<2%	0.2	14.04
2-10%	2.4	3.39
10-20%	2.8	3.40
20-30%	3.0	0.00
30-50%	3.7	0.25
>50%	11.1	0.85
Total	**23.2 acres**	**21.92**

Artichoke thistle

Artichoke thistle was localized at El Toro, being restricted to a few small hillsides totaling less than 5 acres in 2008 (Table 3; attached Figure – El Toro 2009). All areas supported less than 25% cover of artichoke thistle in 2008. In 2010 (after treatment in 2008 and 2009 but prior to treatment in 2010) less than 3 acres were occupied by artichoke thistle (Table 3; attached Figure – El Toro 2010); and all remaining areas

supported less than 2% cover of artichoke thistle. A few individual isolated artichoke thistle occurred outside the mapped areas in 2010 and these were spot sprayed. Some additional artichoke thistle also occurred outside the accessible area and these were not treated.

Tree tobacco

Tree tobacco was localized and sporadic at El Toro. In 2008 tree tobacco occupied less than 4 acres, consisting of two mapped polygons and isolated clumps that were spot mapped (Table 3; attached Figure – El Toro 2009). The two polygon areas supported 5% and 25% cover of tree tobacco in 2008; the spot mapped locations were 100% tree tobacco. In 2010 (after treatment in 2008 and 2009 but prior to treatment in 2010) tree tobacco has been almost completely removed for El Toro (Table 3; attached Figure – El Toro 2010). A few individual isolated tree tobacco seedlings occurred in 2010 (not mapped) and these were spot sprayed. Some additional tree tobacco also occurred outside the accessible area and these were not treated.

Castor bean

Castor bean was sporadic but widespread at El Toro. In 2008 castor bean occupied less than 3 acres, consisting of two mapped polygons and isolated clumps that were spot mapped (Table 3; attached Figure – El Toro 2009). The two polygon areas supported 5% and 25% cover of castor bean in 2008; the spot mapped locations were 100% castor bean. In 2010 (after treatment in 2008 and 2009 but prior to treatment in 2010) castor bean occupied less than 1 acre, consisting of one mapped polygon with 10% cover of castor bean (Table 3; attached Figure – El Toro 2010). Castor bean had been eliminated from everywhere else at El Toro except a few individual isolated seedlings (not mapped) and these were spot sprayed. Some additional castor bean also occurred outside the accessible area and these were not treated.

Other weeds

Other weed species of concern that occurred at El Toro included sweet fennel (*Foeniculum vulgare*) and black mustard (*Brassica nigra*). Sweet fennel was common in some of the washes (attached Figure – El Toro 2009), while black mustard was widespread along dirt roads and in other disturbed areas, often occurring adjacent to garland chrysanthemum. These species were not treated.

3.2 Limestone-Whiting

Artichoke thistle was treated at Limestone-Whiting in 2009 and 2010. A total of 85.2 acres were treated in 2010 (Photographs 9-16).

Artichoke thistle

Artichoke thistle was widespread at Limestone-Whiting, occurring in a variety of upland habitats including CSS and grasslands (Table 4; attached Figure – Limestone-Whiting 2004). Prior to the Santiago Fire and current treatment efforts (2004 is the base year for reference) artichoke thistle occupied approximately 85 acres in Limestone-Whiting (Table 2). The majority of occupied areas supported greater than 30% cover of artichoke thistle and half had greater than 50% cover of artichoke thistle. There were no polygons with less than 10% cover. By 2010, artichoke thistle had been reduced both in area of infestation and percent cover. In 2010 (after treatment in 2008-2009 but prior to treatment in 2010) there was an 11% reduction in area invaded by artichoke thistle (Tables 2 and 4: attached Figure- Limestone-Whiting 2010). There was a substantial decrease in artichoke thistle cover with 21% of infested areas having less than 10% cover and the remainder falling within the 10-20% cover category.

Although the total area infested with artichoke thistle decreased between 2004 and 2010, in some polygons the infested area actually increased between 2004 and 2010 (Table 4). This was a result of the 2007 Santiago fire allowing the artichoke thistle to spread over larger area in the absence of competition with native shrubs. Due to the control efforts the cover of artichoke thistle in these polygons decreased between 2004 and 2010.

Two monitoring plots were established at Limestone-Whiting – Water Tank and Coyote Bush Monitoring Plots to track weeding success. Cover of weed species, native species and photographic documentation were conducted at these two monitoring plots in 2005 through 2007. Since the Santiago Fire in 2007 only cover of weed species and photographic documentation were conducted at these two monitoring plots.

Other weeds

Garland chrysanthemum was not documented at Limestone-Whiting and there were no significant concentrations of tree tobacco or castor bean requiring treatment. Other weed species of concern that occurred at Limestone-Whiting included Italian thistle (*Carduus pycnocephalus*), milk thistle (*Silybum marianum*) and black mustard (*Brassica nigra*). Italian and milk thistle occurred primarily in canyon bottoms under tree canopy while black mustard was widespread in grassland areas and along dirt roads and in other disturbed areas. These species were not treated.

Table 2: Acreage of artichoke thistle by cover class, Limestone-Whiting 2004 and 2010.

Artichoke thistle cover	2004	2010
<5%	0.0	6.8
5-10%	0.0	9.4
10-20%	0.5	59.4
20-30%	9.4	0.0
30-50%	31.9	0.0
>50%	43.4	0.0
Total	**85.2**	**75.6**

3.3 Sensitive plant and wildlife species

No rare or sensitive plant species were documented in control areas at El Toro or Limestone-Whiting during the study period.

The only rare or sensitive wildlife species documented in control areas at El Toro or Limestone-Whiting during the study period was western spadefoot (*Spea hammondii*) at El Toro. Spadefoot tadpoles were documented in shallow man-made pools in polygon 7 at El Toro.

Exotic Plant Treatment Sites 2009

El Toro

Nature Reserve of Orange County Weeding Program

Exotic Species Points

- Artichoke Thistle
- Castor Bean
- Sweet Fennel
- Tree Tobacco

Exotic Species Areas

- Garland Chrysanthemum
- Tree Tobacco and Artichoke Thistle

NCCP Reserve

- Boundary

N

0 300 600 1,200 Feet

DESIGNED AND PRODUCED BY:
OCCR - OC Parks GIS
John M. Taylor

DATA SOURCE:
ESRI Data & Maps 2010
OC Parks/NROC Data Set

DATE:
August 11, 2010

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Exotic Plant Treatment Sites 2010

El Toro

Nature Reserve of Orange County Weeding Program

Species

- Artichoke thistle
- Castor bean
- Garland chrysanthemum

Percent Cover

- 0-2% Cover
- 2-10% Cover
- 10-20% Cover
- 30-50% Cover
- 50-100% Cover
- NCCP Reserve Boundary

N

0 400 800 Feet

DESIGNED AND PRODUCED BY:
OCCR - OC Parks GIS
Albert Lucero

DATA SOURCE:
ESRI Data & Maps 2010
OC Parks/NROC Data Set
2009 Eagle Aerial

DATE:
December 14, 2010

OCPHQ096//I:_ArcGISfiles\OrangeCo\projects\2010_Weeds_for_Kris\2010 Harmsworth Surveys\Weeds2010 (El Toro) 11x17.mxd

Exotic Plant Treatment Sites 2004

Whiting Ranch

Nature Reserve of Orange County Weeding Program

Water Tank Monitoring Plot

Coyote Brush Line Shack Monitoring Plot

Artichoke Thistle Coverage

- 2-10% Cover
- 20-30% Cover
- 30-50% Cover
- >50% Cover

NCCP Reserve

- Boundary

DESIGNED AND PRODUCED BY:	OCCR - OC Parks GIS Albert Lucero
DATA SOURCE:	ESRI Data & Maps 2010 OC Parks/NROC Data Set
DATE:	December 22, 2010

0 250 500 1,000 Feet

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Exotic Plant Treatment Sites 2010

Whiting Ranch

Nature Reserve of Orange County Weeding Program

Water Tank Monitoring Plot

Coyote Brush Line Shack Monitoring Plot

Percent Cover

- <5% Cover
- <10% Cover
- <15% Cover
- <20% Cover
- 15 - 25% Cover

NCCP Reserve

- Boundary

0 400 800 Feet

DESIGNED AND PRODUCED BY: OCCR - OC Parks GIS Albert Lucero
DATA SOURCE: ESRI Data & Maps 2010 OC Parks/NROC Data Set
DATE: December 22, 2010

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Table 3: Cover, acreage and other data on exotic weeds at El Toro by mapped polygons 2008 and 2010. Habitat, % native cover, polygon description and weed notes from 2010. % Weed cover refers to garland chrysanthemum (GC) unless stated, AT= artichoke thistle, TT = tree tobacco, CB = castor bean. NNG = non-native grassland; GL = grassland with some native cover (needlegrass or herbs); CSS = coastal sage scrub.

Polygon	Acres	% Weed cover		Habitat	% Native cover	Polygon description	Weed notes
		2008	2010				
1	1.3	2-20%	1-10%	CSS/NNG	10%	Flat area Divided by fence and road	GC mostly near the road
2	0.2	25%	20%	CSS/NNG	15%	S Facing 20% slope Disturbed, near road	GC patchy, mostly near bunker
3	0.1	2%	1%	NNG	2%	W Facing, 3% slope Adjacent road	GS scattered
4	0.1	2%	1%	NNG	10%	Flat area Edge of road	GC scattered
5	2.8	2% AT 5% TT	1% AT	CSS	95%	Hillside with multiple slopes, 20%	A few AT at bottom of hill, all tree tobacco gone
6	0.3	20%	10%	CSS/NNG	20%	W Facing 1% slope Disturbed, adjacent road	GC scattered
7	0.2	35%	10%	NNG	30%	N Facing 2% slope Spadefoot toads in pools	GC scattered; a few AT and pampas grass also present
8	0.1	8% AT	2% AT	NNG	30%	W Facing 6% slope Adjacent road	AT scattered, a few garland chrysanthemum present
9	0.1	15%	8%	NNG	1%	E Facing 8% slope	GC concentrated in spots
10	0.1	12%	5%	NNG	1%	E Facing 20% slope Mostly on the dirt road	GC concentrated in spots
11	0.1	15%	10%	NNG	1%	SE Facing 20% slope	GC concentrated in spots
12	0.4	25%	20%	NNG	1%	W Facing 5% slope Mostly along the dirt road	GC density highest at turnout
13	<0.1	15%	10%	NNG	0%	N Facing 10% slope Shoulder of dirt road	GC concentrated in spots
14	<0.1	5%	1%	CSS	80%	W Facing 4% slope Disturbed	Just a few GC present
15	<0.1	5%	1%	NNG	10%	W Facing 4% On shoulder of paved road	GC scattered

Polygon	Acres	% Weed cover		Habitat	% Native cover	Polygon description	Weed notes
		2008	2010				
16	0.1	5%	1%	NNG	20%	W Facing 4% slope Shoulder of paved road	GC scattered
17	0.2	5%	1%	CSS	20%	W Facing 35% slope On small hillside	GC scattered
18	0.1	5%	1%	NNG	3%	S Facing 3% slope Adjacent paved road	GC scattered
19	<0.1	5%	1%	NNG	25%	S Facing 2% slope Side of paved road	GC scattered
20	0.3	5%	1%	NNG	3%	W Facing 3% slope Along dirt road	GC scattered
21	0.2	15%	10%	CSS	70%	E Facing 45% slope Restored CSS	GC scattered
22	0.3	15%	0%	NNG	1%	E Facing 2% slope	No GC present
23	0.1	55%	30%	NNG	5%	S Facing 5% slope	Lots of small GC along road
24	0.1	45%	30%	NNG	1%	W Facing 5% slope Edge of dirt road	GC along edge of road
25	0.6	25%	10%	NNG	10%	W Facing 5% slope Along dirt road	Dense patches of GC within polygon
26	0.1	25%	10%	NNG	10%	S Facing 20% slope	Dense patches of GC within polygon
27	1.0	5% GC 5% AT 25% TT 5% CB	2% GC	NNG	1%	S Facing 5% slope Along dirt road	GC scattered; AT, TT and CB all gone
28	0.1	5%	1%	NNG	10%	Flat area Adjacent paved road	GC scattered
29	0.9	75% GC 25% AT 25% CB	15% GC 10% CB	NNG	5%	SW Facing 3% slope Along dirt road	Small patches of GC, one large area of CB
30	1.2	35%	10%	NNG	1%	W Facing 3% slope Along dirt road	Small patches of GC

Polygon	Acres	% Weed cover		Habitat	% Native cover	Polygon description	Weed notes
		2008	**2010**				
31	13.4	1-100%, mostly >50%	1-100%, mostly <2%	CSS/NNG	10%	Flat, ridgeline top Along dirt roads and slopes on sides of road	GC in small patches, mostly dense where is still remains; formerly whole polygon dense GC
32	<0.1	35%	1%	CSS	90%	N Facing 15% slope Disturbed	GC scattered
33	<0.1	35%	10%	CSS	90%	W Facing 2% slope Disturbed	GC scattered
34	<0.1	25%	10%	CSS	90%	W Facing 2% slope Disturbed	GC scattered
35	<0.1	25%	1%	CSS	90%	N Facing 15% slope Disturbed	GC scattered

Table 4: Cover, acreage and other data on exotic weeds at Limestone-Whiting by mapped polygons 2004 and 2010. Habitat, % native cover, polygon description and weed notes from 2010. NNG = non-native grassland; GL = grassland with some native cover (needlegrass or herbs); CSS = coastal sage scrub.

Polygon	Artichoke Thistle % cover & area		Habitat	% Native cover	Polygon description	Weed notes
	2004	**2010**				
A	>50% 0.7 acres	<5% 2.4 acres	NNG	<5%	SE facing slope Side of dirt road on ridgeline Water Tank Monitoring Plot	AT scattered throughout
B	30-50% 5.3 acres	<15% 15.2 acres	CSS/GL	>10%	SE facing slope Upper end of valley	AT scattered near road, dense toward bottom of gully; mature plants
C	20-30% 2.6 acres	<5% 2.9 acres	CSS/GL	>10%	SE Facing slope Bordered on three sides by park trails/roads. Old road alignment bisected polygon	AT scattered
D	10-20% 0.5 acres	<5% 0.8 acres	GL	>10%	Flat area Next to road	AT scattered
E	>50% 11.9 acres	15-25% 7.1 acres	NNG	<5%	Flat, along ridgeline Bisected by park road; may be old grazing site.	AT scattered and dense in spots; heavy mustard
F	30-50% 13.7 acres	<15% 20.1 acres	CSS/GL	10%	SE Facing slopes Edison access road bisects and borders polygon. Mix of disturbed and intact habitat.	AT scattered
G	>50% 5.7 acres	15-25% 4.2 acres	GL	10%	SE Facing slopes Isolated from park roads and trails.	AT scattered
H	>50% 13.7 acres	<10% 5.1 acres	GL	10%	SE Facing slopes and flat areas Bisected by park road.	AT scattered
I	30-50% 16.0 acres	<5% 3.1 acres	GL	>10%	Primarily W-facing slope. Heavy mustard and Edison tower at top of slope. Bisected by two park roads.	AT scattered
J	>50% 12.1 acres	<20% 22.9 acres	NNG	<5%	SE and W Facing slopes Mostly isolated from park trails/roads. Includes Coyote Brush monitoring plot.	AT scattered; heavy mustard.

Polygon	Artichoke Thistle % cover & area		Habitat	% Native cover	Polygon description	Weed notes
	2004	**2010**				
K	30-50% 2.2 acres	<20% 5.1 acres	NNG	<5%	SE Facing slope Isolated from park trails/roads, partially bordered by HOA fuel mod. Slump area.	AT scattered
L	20-30% 6.8 acres	<10% 4.3 acres	NNG/CSS	>10%	W Facing slope and gully Includes park road and Edison tower and access road.	AT scattered

4.0 DISCUSSION

Weed control at both El Toro and Limestone-Whiting prior to the 2007 Santiago Fire was successful in reducing or controlling the cover of target species. However, the Santiago Fire heavily impacted both sites, removing native vegetation, disturbing soils and providing opportunities for non-native species to re-invade. Weed control conducted in 2008/2009 and 2010 was successful and resulted in a significant reduction in the cover and distribution of target weed species.

At El Toro the cover and distribution of garland chrysanthemum, artichoke thistle, tree tobacco and castor bean has been significantly reduced. By 2010 the majority of areas supporting garland chrysanthemum had less than 20% cover, and more than half the occupied areas were reduced to less than 5% cover of garland chrysanthemum. Artichoke thistle, tree tobacco and castor bean have been reduced to a few small areas with low weed cover and a few isolated seedlings.

At Limestone-Whiting the area occupied by artichoke thistle has been reduced and all areas supported less than 20% cover of artichoke thistle. In comparison, the baseline year (2004) had 75% of the invaded area with greater than 30% artichoke thistle cover and no areas with less than 10% cover.

Despite the success, continued control is necessary to prevent the target weeds from recovering. At El Toro some weeds were located outside the accessible area and could not be treated. Future programs should seek to gain access to these areas and start controlling these weeds.

The control methods used for this project have proven to be effective and efficient at controlling the target weed species. This and other programs have shown that the most effective way to kill artichoke thistle is with Transline® during the rosette stage of development and with Round Up® when the artichoke is mature and bolting. One treatment per year during the rosette stage of development is the ideal way to control artichoke thistle.

Aquamaster has proven to be effective for garland chrysanthemum and ideally it should be applied early in the growing season prior to the plant setting seed. Manual control is too labor intensive. For the castor bean and tree tobacco the most efficient method is to cut down the mature plants and stump spray. This method is efficient and effective for these species due to their large size (would require a lot of spray) and low occurrence (reduces the manual labor effort).

For all species treatment should be continued until all weeds are removed from the area, otherwise the species is likely to re-invade. Ideally, successful control should be followed with a planting/enhancement program to re-establish native habitats. Currently, where target weeds have been significantly reduced they are generally replaced by other

weed species, such as mustards and non-native grasses (Photographs 1-16). Long term conversion of disturbed weedy habitats to native habitats would assist in preventing these weeds from re-establishing in cleared areas.

4.1 Recommendations

- Continue weed control program at El Toro and Limestone-Whiting to further reduce target weed cover and to prevent the weeds from re-establishing in cleared areas.
- Obtain access to all areas of El Toro and control target weeds in previously inaccessible areas.
- Explore opportunities for conversion/creation of native habitats in areas cleared of target weeds.

5.0 REFERENCES

Bossard C., J. Randall, and M. Hoshovsky (eds.) 2000. Invasive Plants of California's Wildlands. University of California Press. Berkeley and Los Angeles, California: Pickleweed Press, 2000

DeSimone, Dr. S.A. 1997. Biology and Control of *Cynara cardunculus*/Bunchgrass Grassland Restoration. Starr Ranch.

The Nature Conservancy (TNC). 2002. Annual Exotic Plant Control Program Report. The Nature Conservancy. Irvine, California.

6.0 APPENDICES

6.1 Appendix A: Photographs

Photograph 1: El Toro Polygon 7, showing GC along road edge, recently burned area, 2008.

Photograph 2: El Toro Polygon 7, no GC present, 2010.

Photograph 3: El Toro Polygon 31, showing GC along dirt road edge, recently burned area, 2008.

Photograph 4: El Toro Polygon 31, along dirt road edge, no GC present and area recovering from fire, 2010.

Photograph 5: El Toro Polygon 31, showing GC along dirt road edge, recently burned area, 2008.

Photograph 6: El Toro Polygon 31, showing a few seedlings GC and black mustard along dirt road edge, 2010.

Photograph 7: El Toro Polygon 31, showing dense GC along dirt road edge, recently burned area, 2008.

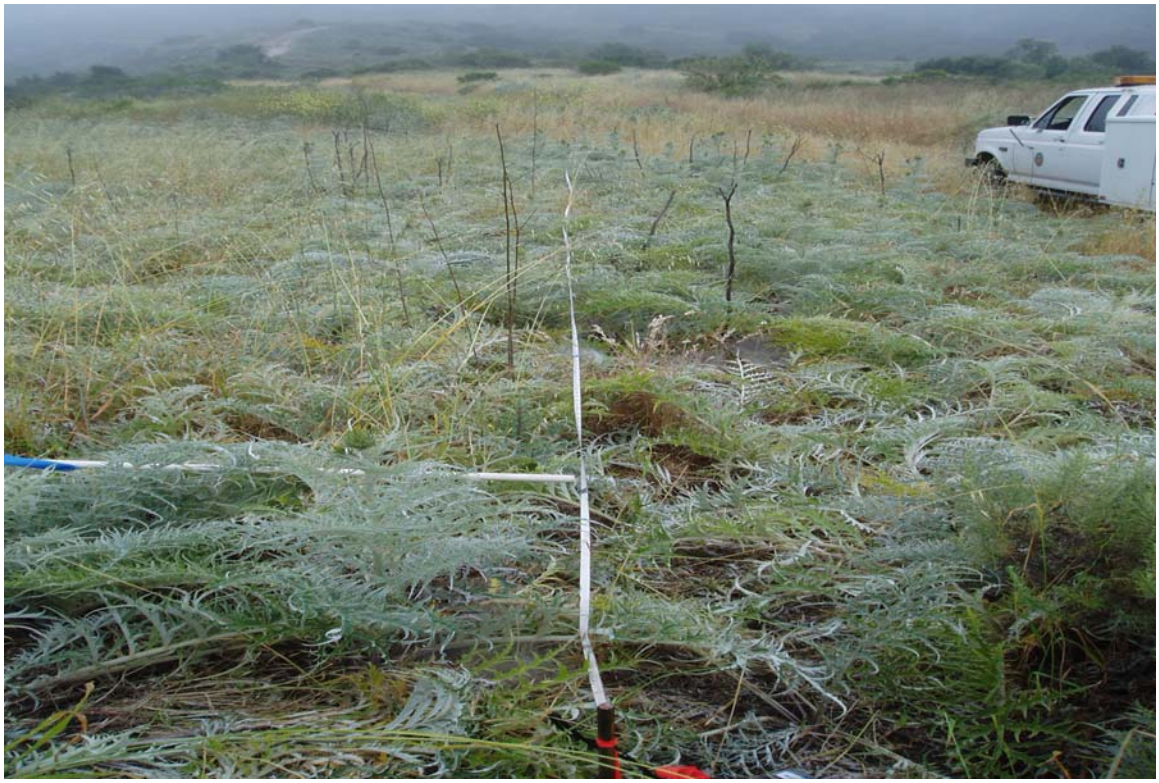
Photograph 8: El Toro Polygon 18, showing area almost cleared of GC, 2010.

Photograph 9: Limestone-Whiting Polygon A, showing area dominated by AT, 2004.

Photograph 10: Limestone-Whiting Polygon A, showing area almost AT free, 2010.

Photograph 11: Limestone-Whiting Polygon A, showing area dominated by AT, 2004.

Photograph 12: Limestone-Whiting Polygon A, showing area almost AT free, 2010.



Photograph 13: Limestone-Whiting Polygon J, showing area dominated by AT, 2004.

Photograph 14: Limestone-Whiting Polygon J, showing area almost AT free, 2010.