

State of California
The Resources Agency
Department of Fish and Game
Habitat Conservation Planning Branch

Annual Artichoke Thistle Control Status Report ^{1/}

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by
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ABSTRACT

Following the Laguna Canyon Fire in October 1993, an effort to control artichoke thistle (*Cynara cardunculus*) began Spring 1994 within the San Joaquin Hills portion of the Coastal Orange County NCCP Subregion. Artichoke thistle resprouts every year from a perennial taproot and has readily adapted to Southern California's climate, becoming a widespread problem. To control further spread and reduce cover and density of existing thistle patches, sites were selected within the San Joaquin Hills to be treated with an herbicide solution consisting of Roundup (1 ounce/gallon) and the pre-emergent Telar (1.5 ounces/acre). In 1997, The Nature Conservancy (TNC) established 20x20 meter permanent monitoring plots within treatment areas on Irvine Company lands in Muddy Canyon, Sand Canyon, Shady Canyon, and along Bommer Ridge and in 1998, additional plots were established in Bommer and Muddy Canyons. Baseline data were collected prior to treatment. Each plot consisted of five transects at five-meter intervals along a pre-determined baseline. Along each transect, data were collected at five-meter intervals using a one-meter quadrat. Relative percent cover of artichoke thistle, other exotic species, native species, bare ground, rock, and litter were determined by ocular estimation. Individual artichoke seedlings and resprouts were counted in each quadrat. All transects were photo documented. This report reflects the fifth year of data collection. Not all plots were treated with herbicide every year and some received an additional treatment of prescribed fire. Additional treatment will be conducted in 2001. Data will be collected each spring to monitor the effectiveness of treatment.

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INTRODUCTION

This report summarizes the Nature Reserve of Orange County's (NROC) 2000 artichoke thistle (*Cynara cardunculus*) control efforts in the coastal San Joaquin Hills. Funding for this year's control effort was provided through a \$20,000 California Department of Fish and Game (CDFG) NCCP grant and \$105,000 in matching funds provided by NROC. The CDFG grant agreement requires a yearly reporting of expenditures and project status. The \$20,000.00 CDFG grant was awarded to NROC in 1999.

The NROC's artichoke thistle control efforts for 2000 began in mid-April in the San Joaquin Hills portion of the Coastal NCCP Subregion. This represents the seventh consecutive year of thistle control efforts in this area, which began in the spring of 1994 following the Laguna Canyon fire. Since the spring of 1994, approximately \$850,000 has been directed at the artichoke thistle control in the coastal subregion.

In 2000, \$125,000 was directed at the control of artichoke thistle. As in past years, the Orange County Department of Public Works conducted the majority of the control efforts under the direction of Manager Bill Hisey. The Nature Conservancy (TNC), the State Department of Parks and Recreation, and the County of Orange worked cooperatively to prioritize areas for treatment, identified in Figure 1. Muddy Canyon artichoke thistle spraying efforts were conducted by Nature's Image, under contract by NROC. Artichoke thistle control efforts focused on four areas within the Laguna Canyon Burn area: 1) Muddy Canyon, 2) Crystal Cove State Park (Moro Canyon, Moro Ridge, the "Meadow", and the "Bowl"), 3) Bommer Canyon, and 4) Shady Canyon. Remaining funds were applied to the control of approximately 80 acres of artichoke thistle outside the Laguna Canyon Burn area; 40 acres of artichoke thistle within Aliso and Woods Canyons Wilderness Park as well as 40 acres of artichoke thistle in the Sand Canyon area.

BACKGROUND

Artichoke thistle is a perennial weed from the Mediterranean region that was introduced to California in the mid-1800's as the cultivated edible cardoon. The plant is well adapted to California's climate and has become a problem on poorly managed, grazed lands. It is difficult to control because it resprouts every year from a perennial taproot that may be as deep as eight feet. This deep taproot makes it impossible to remove through cultural methods such as plowing, mowing, or digging. Biological control is not possible because of the plant's close relationship to the cultivated artichoke (*C. scolymus*). The County of Orange, which has dealt with this exotic on many county park lands in the past, has been successful in controlling artichoke thistle by treating with the herbicide glyphosate (Monsanto's Roundup).

METHODS

Thistle spraying is conducted when the flower stock is bolting, which is the time of maximum growth. Control efforts involve selective spraying of artichoke thistle with a herbicide solution consisting of Roundup (1 ounce/gallon) and Telar (1.5 ounce/acre). Roundup is a non-selective contact herbicide and Telar is a selective broadleaf pre-emergent herbicide. A marking dye was added to the herbicide solution to guide the spraying effort and to ensure adequate coverage of individual thistle plants by the applicator. It normally takes two to three years to control the thistle in given area, as the first year's spraying efforts are only between 40 and 90 percent successful (Bill Tidwell, pers. comm.).

An additional herbicide was tested this year on artichoke thistle in a small (<1 acre) area in Shady Canyon that also supports purple needlegrass (*Nasella pulchra*). The presence of purple needlegrass in the understory of the artichoke thistle raised concerns about the use of the non-selective herbicide Roundup. For this reason, TNC directed spray crews to use the herbicide Transline in this location. Transline is a broadleaf selective herbicide used for the control of thistle species that does not effect grasses or other monocots.

This year involved re-treating any seedlings or re-sprouts on approximately 700 acres previously treated over the past four years. Approximately 100 additional acres of artichoke thistle were treated this year, including areas in Bommer Canyon, Aliso and Wood Canyons Wilderness Park, and Shady Canyon.

MONITORING

TNC has collected vegetation data annually since 1997 from 13 permanent monitoring plots on Irvine Company lands in Bommer Canyon, Shady Canyon, Sand Canyon and Muddy Canyon (Figure 2). Data collected previously by State Parks and TNC in other treatment areas have demonstrated a 40-80 percent reduction of artichoke thistle cover following the first year of treatment. Each monitoring plot established by TNC is 20m² and data were collected along five 20m transects at 0, 5, 10, 15 and 20m intervals established along the baseline. Data on plant cover were collected from five 1m quadrats placed along each transect at 5m intervals. Ocular estimates were made on total percent cover of artichoke thistle and any other plant species occurring within each quadrat. In addition, the number of resprouts and seedlings of artichoke thistle were counted. Photos of each transect were taken from the baseline.

RESULTS

Results are summarized in Tables 1 through 13. These results include data collected from 1996 to 2000. Data collected from pre-treatment vs. post-treatment plots showed a significant reduction in thistle cover and density one year following treatment. However, artichoke quickly recovered in the plots treated the first year with Roundup with Telar but left untreated the second year. Although the number of artichoke seedlings and resprouts did not increase, the percent cover increased an average of 18 percent with no follow-up treatment. The majority of the plots sprayed the second and third years showed a continuous decline or stabilization in thistle cover and density. A few sites that increased in artichoke cover

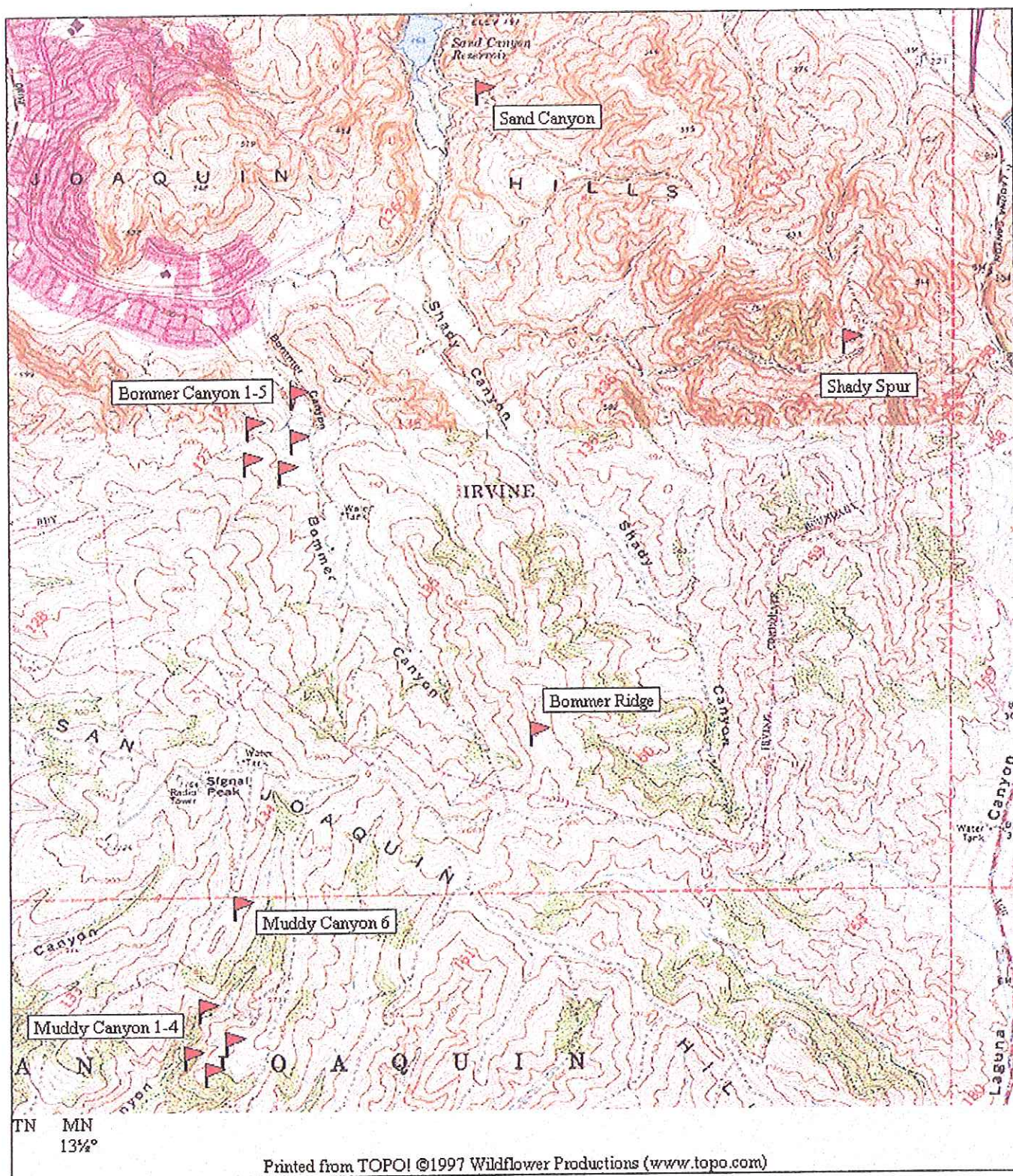


Figure 2. Artichoke thistle monitoring locations

following the first or second spraying may have had other factors influencing the success of the treatment (i.e. cattle disturbance, soil type, rainfall amounts, or poor herbicide cover).

Sand Canyon

Although not contained within the Laguna Canyon Burn area, the Sand Canyon site was selected as a treatment location because there was a concern amongst researchers studying the California gnatcatcher (*Polioptila californica californica*) and cactus wren (*Campylorhynchus brunneicapillus*) populations there (Atwood, et al) that artichoke thistle was possibly interfering with the reproductive success of these two species (Photos 1 and 2). Approximately 40 acres of artichoke thistle were treated at this site in 1997, 1999, and 2000. Because of the density of gnatcatcher and cactus wrens at this location, TNC contracted with consulting biologist Robb Hamilton to conduct nesting surveys prior to treatment to identify any locations where thistle spraying should be avoided due to nesting activity. No gnatcatcher or cactus wren nests were located by Robb Hamilton in or near areas proposed for treatment. Although thistle has been successfully controlled over much of this site through the spraying efforts, the results from the monitoring plot do not demonstrate this success. Following the initial treatment in Sand Canyon, the percent cover of artichoke thistle in the monitoring plot increased 14 percent, although density decreased by almost 50 percent (Table 1, Figure 3). And in 2000, despite three years of treatment, artichoke thistle cover within the monitoring plot remains just above 40 percent. There is no obvious explanation for why artichoke thistle cover has not declined within the monitoring plot, as there have been no other sources of disturbance (i.e., cattle) at this location.

	Control Effort (2% Roundup w/ Telaar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	Baseline data before initial treatment	13.32 (4-41 seedlings & resprouts/m ²)	43.2%	0.0%	57.0%	0%*	0%*	0%*
1998	Data after 1997 treatment	7.84 (2-18 seedlings & resprouts/m ²)	57.2%	0.0%	42.8%*	0%*	0%*	0.0%
1999	Treated in 1998	No data	No data	No data	No data	No data	No data	No data
2000	Data after 1999 treatment	3.36 (0-9 seedlings & resprouts/m ²)	41.6%	0.6%	37.3%	8.9%	11.6%	0.0%

Table 1. Sand Canyon

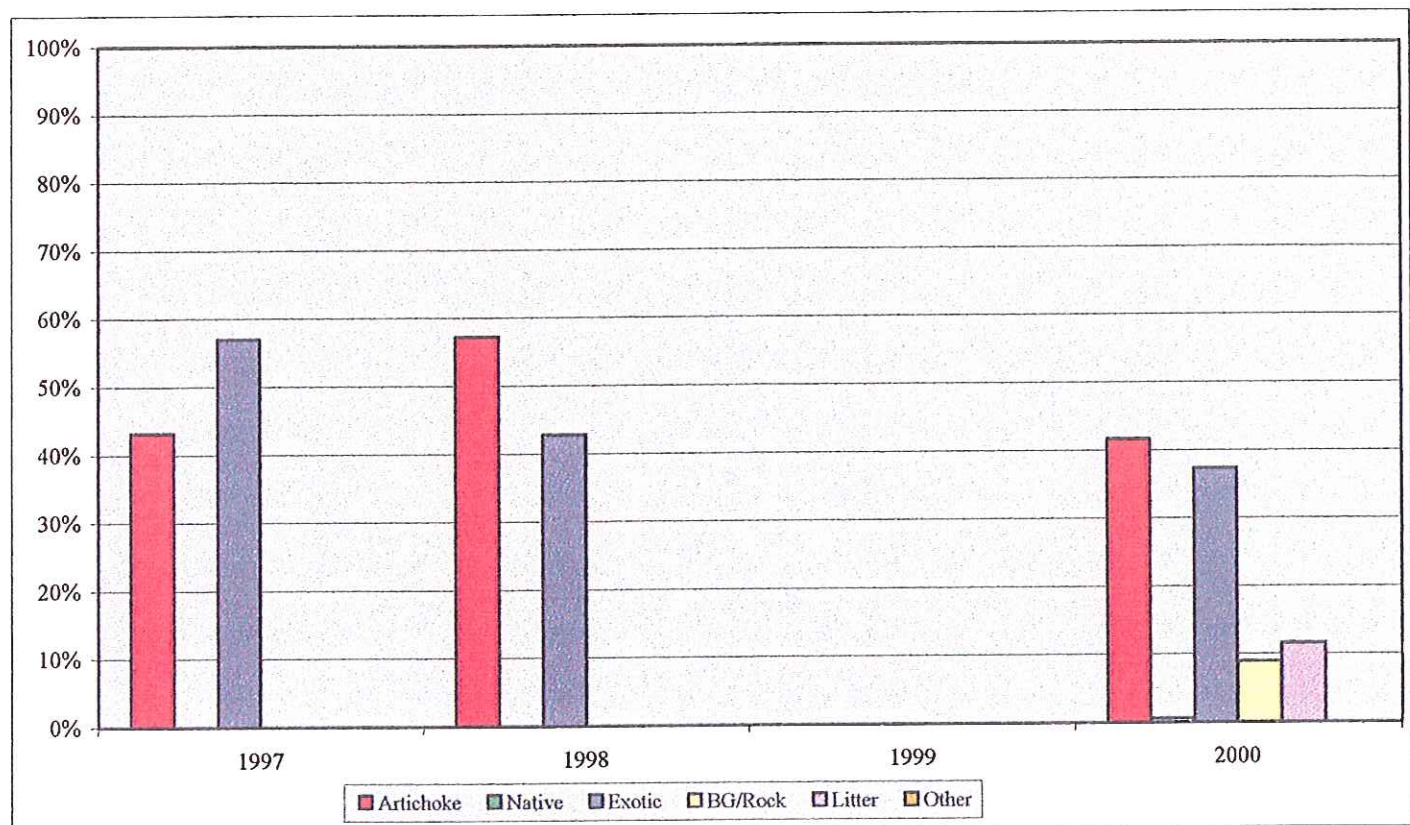


Figure 3. Sand Canyon



PHOTO 1. Sand Canyon: Pre-treatment 1997



PHOTO 2. Sand Canyon: Post-treatment 1998

Bommer Ridge

Prior to the Laguna Canyon Fire of 1993, the Bommer Ridge site was dominated by artichoke thistle (Photos 3 and 4). In the spring following the Laguna Canyon fire, cattle grazing was terminated on the east side of Bommer Ridge (Shady Canyon area) and artichoke thistle control was initiated. The control efforts were extremely successful, and within two years of initial treatment, native species such as purple needlegrass and coyote bush (*Baccharis pilularis* ssp. *consanguinea*) were recolonizing the treated areas. Artichoke thistle control was initiated on the west side of Bommer Ridge in 1997. TNC established a monitoring plot at this location prior to the first year of thistle treatment. The Bommer Ridge plot showed a considerable decrease in percent cover of artichoke thistle after the first year of treatment (Table 2, Figure 4). Cover declined by almost 30 percent. However, no control effort was conducted the second year and thistle recovered by 15 percent. Because the pre-emergent Telar was included in the herbicide mix the first year, density of artichoke continued to decline without a second year of treatment (Table 2, Figure 16). This site was sprayed again in 1999 and the thistle was almost eliminated from the plot with cover documented at only two percent. Bommer Ridge is dominated by many rock outcrops but with the thick growth of artichoke thistle prior to treatment, no bare ground/rock cover was observed in 1997. After the first year of treatment, percent cover of bare ground/ rock increased 28 percent as a result of the thistle reduction. By the third and fourth years, bare ground/ rock cover remained relatively stable. Cover of exotic species, including oats spp. (*Avena*), brome spp. (*Bromus*), ryegrass spp. (*Lolium*), and barley spp. (*Hordeum*), remained generally stable over the four year period. Possibly, exotic grasses occupied all available space within each quadrat prior to treatment. Because of the rocks present in this site, little room was left for grasses to spread within the quadrat following the reduction of artichoke. Percent cover would not increase since grasses grow tall and thin, unlike the large, leafy artichoke which easily covered the rocks in each quadrat. Two other dominant exotics, other than grasses, observed in 2000 were black mustard (*Brassica nigra*) and common sow-thistle (*Sonchus oleraceus*). Purple needlegrass and arroyo lupine (*Lupinus succulentus*) were the only native species documented in 1997. In 1998 and 1999 only purple needlegrass was present and in 2000, only pine goldenbush (*Ericameria*

pinifolia). Native species have not yet made a recovery following the reduction of thistle. This may be a result of the increase in exotic grass and artichoke thatch in each of the quadrats, inhibiting native plant germination.

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	Baseline data before initial treatment	6.16 (2-15 seedlings & resprouts/m ²)	37.8%	0.9%	61.3%*	0%*	0%*	0%*
1998	Data after 1997 treatment	1.24 (0-4 seedlings & resprouts/m ²)	8.8%	0.1%	60.5%	27.6%	3%*	0.0%
1999	No treatment in 1998	0.88 (0-3 seedlings & resprouts/m ²)	24.1%	0.2%	45.6%	18.1%	12.0%*	0.0%
2000	Data after 1999 treatment	0.28 (0-2 seedlings & resprouts/m ²)	2.2%	0.4%	59.7%	23.8%	13.9%*	0.0%

Table 2. Bommer Ridge

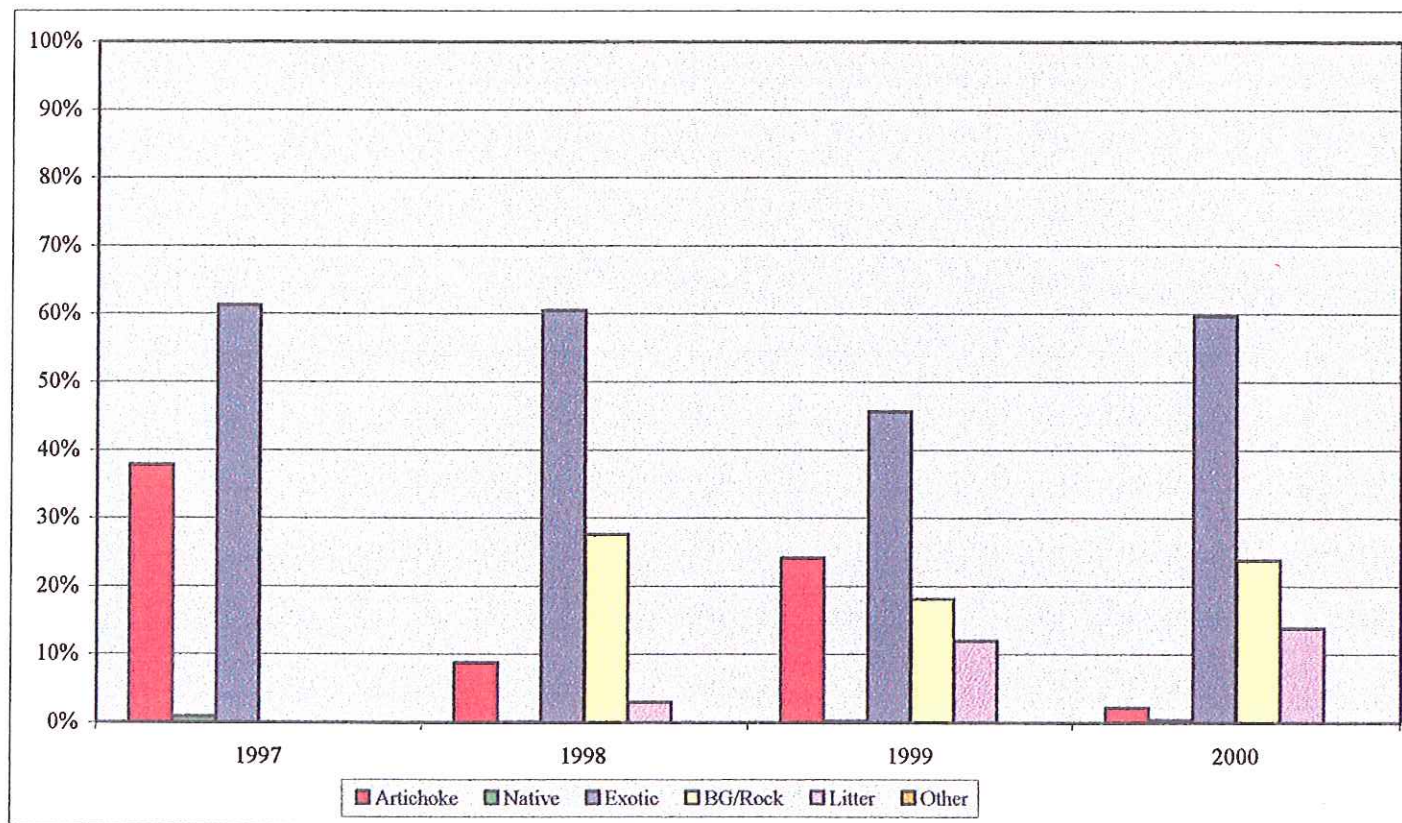


Figure 4. Bommer Ridge

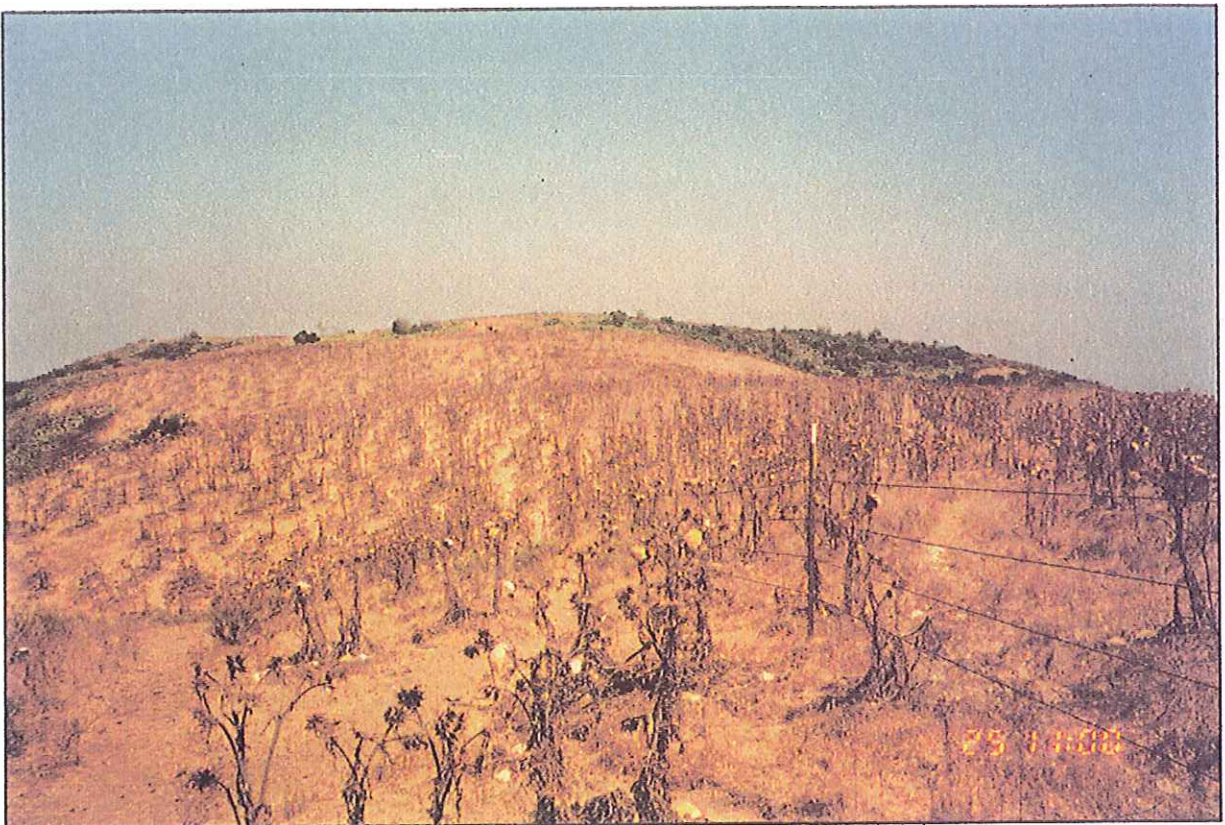


PHOTO 3. Bommer Ridge: Pre-treatment 1994

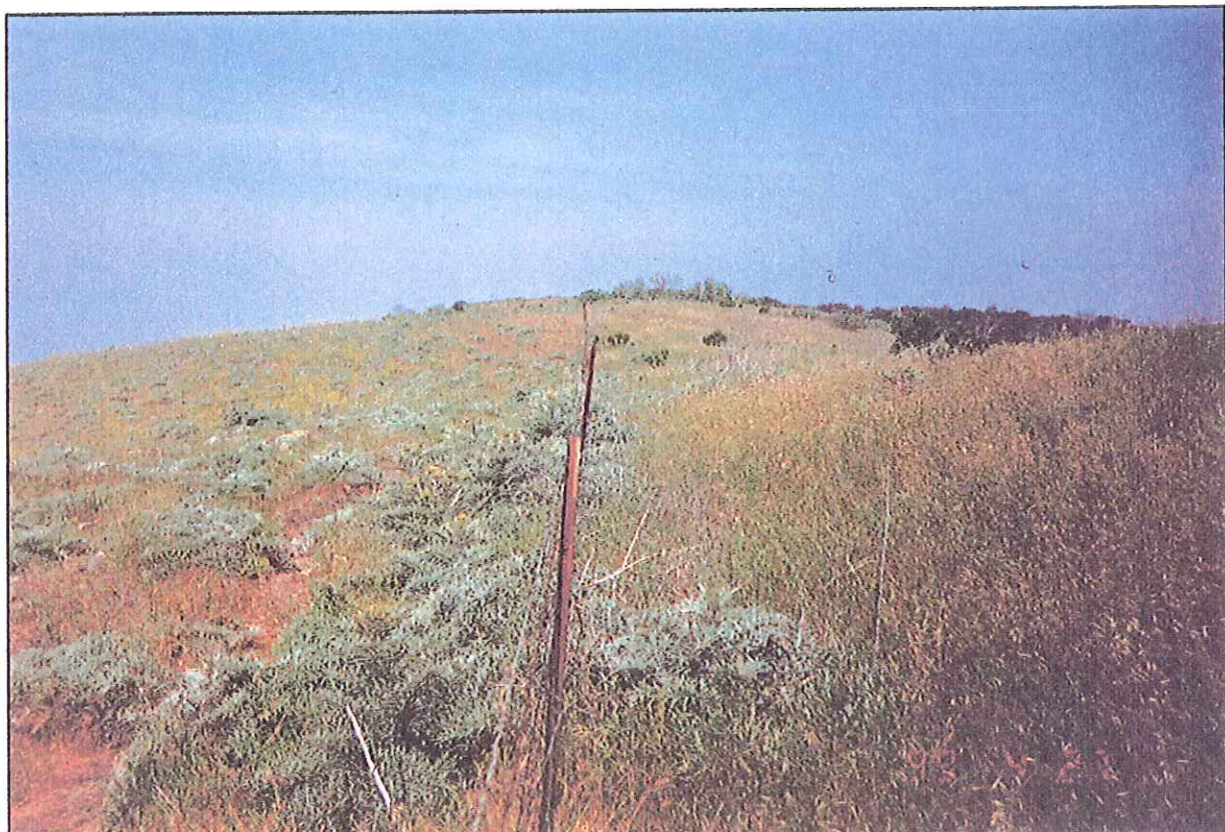


PHOTO 4. Bommer Ridge: Post-treatment 1999 (right side of fence treated)

Bommer Canyon

The Bommer Canyon area contains some of the largest patches of artichoke thistle remaining within the coastal subregion (Photos 5 and 6). This site was heavily grazed historically, likely encouraging the spread of artichoke thistle. Grazing was gradually terminated at this site beginning in 1998, providing an opportunity to initiate artichoke thistle control on approximately 100 acres. TNC established five monitoring plots within the 100-acre treatment area. Results from each monitoring plot are discussed separately below.

Bommer Canyon 1

Following the first year (1998) of treatment with 2% Roundup with Telar, percent cover of artichoke thistle decreased almost 50 percent (Table 3, Figure 5). Total thistle cover remained low after two years of treatment. With the use of Telar, density of artichoke thistle seedlings also declined after the initial treatment and remained low following the second year of spraying (Figure 16). Other exotic species benefited from the reduction in thistle. Percent cover of exotic grasses and forbs has steadily increased since baseline data were collected in 1998 with overall cover almost doubling in the two year period. Exotics included oats spp., brome spp., ryegrass spp., barley spp., fescue spp. (*Vulpia*), long-beaked filaree (*Erodium botrys*), and curly dock (*Rumex crispus*). Pre-treatment, bare ground/rock cover was zero percent, but accounted for 14 percent after the first treatment. By 2000, bare ground/rock cover returned to zero percent – once exotics became established in the areas artichoke previously occupied. Native species have not been documented yet in this plot. A less than one percent increase in native cover was observed over the three year period with finger-leaved morning glory (*Calystegia macrostegia*) as the only native documented.

	Control Effort <i>(2% Roundup w/ Telar)</i>	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	No data	No data	No data	No data	No data	No data	No data	No data
1998	Baseline data before initial treatment	1.80 (0-7 seedlings & resprouts/m ²)	51.6%	0.0%	48.4%	0%*	0%*	0.0%
1999	Data after 1998 treatment	0.16 (0-2 seedlings & resprouts/m ²)	2.5%	0.6%	57.1%	13.7%*	26.1%	0.0%
2000	Data after 1999 treatment	0.40 (0-5 seedlings & resprouts/m ²)	3.8%	0.3%	80.2%	0.6%	15.1%	0.0%

Table 3. Bommer Canyon 1

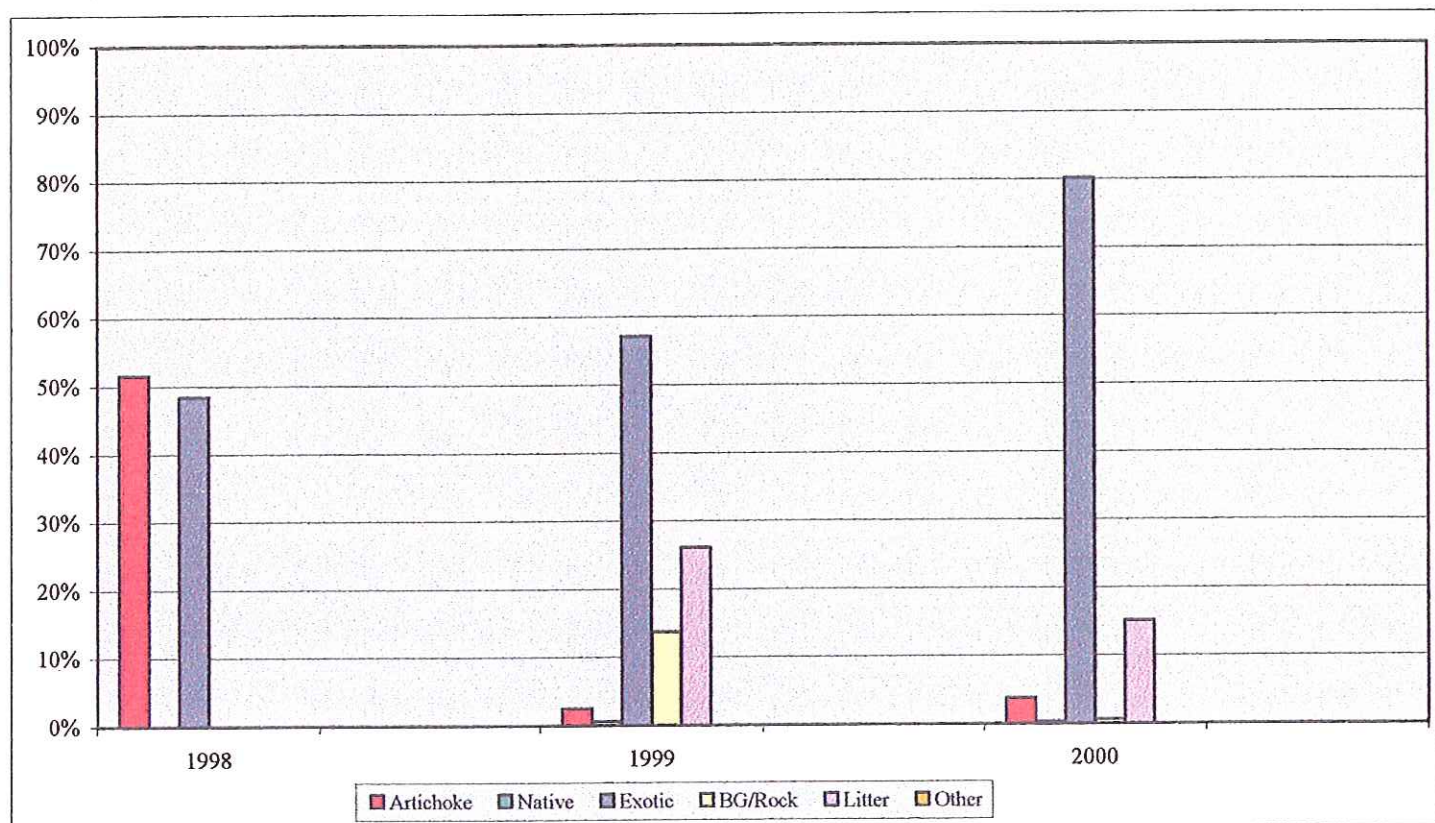


Figure 5. Bommer Canyon 1

Bommer Canyon 2

Bommer Canyon 2 was dominated by thistle and other exotic species prior to spraying in 1998. A 60 percent reduction in thistle was documented after the first treatment (Table 4, Figure 6). Thistle made a considerable recovery following the second year of treatment. This plot may have been sprayed before the majority of artichoke thistle resprouted or germinated for that spring. If treatment was conducted too early, there would be little effect on artichoke thistle, as the data demonstrate. Also, cattle may have been a factor in this recovery—approximately 40 head of cattle were temporarily held at this location during late spring of 1999. Not only do cattle consume and control the growth of grasses (leaving space for artichoke thistle to grow), but their presence also promotes soil disturbance, which may benefit thistle as well as other exotics. Following the second year of treatment, artichoke density rebounded but remained relatively low (Table 4, Figure 16). Some exotic species documented in this site included ripgut brome (*Bromus diandrus*), soft chess (*B. mollis*), wild oats (*Avena barbata*), foxtail barley (*Hordeum murinum*), black mustard, sow-thistle spp., and filaree spp.. Very few of these species were observed in 1998 following the first year of control. Instead, the majority of cover in each quadrat was from litter after the first treatment. No native species were observed in this plot pre- or post-treatment.

	Control Effort <i>(2% Roundup w/ Telar)</i>	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	No data	No data	No data	No data	No data	No data	No data	No data
1998	Baseline data before initial treatment	6.28 (0-25 seedlings & resprouts/m ²)	64.0%	0.0%	36.0%*	0%*	0%*	0.0%
1999	Data after 1998 treatment	0.28 (0-2 seedlings & resprouts/m ²)	3.9%	0.0%	3.5%	6.8%	85.8%	0.0%
2000	Data after 1999 treatment	0.84 (0-3 seedlings & resprouts/m ²)	35.9%	0.0%	37.8%	10.2%*	16.1%	0.0%

Table 4. Bommer Canyon 2

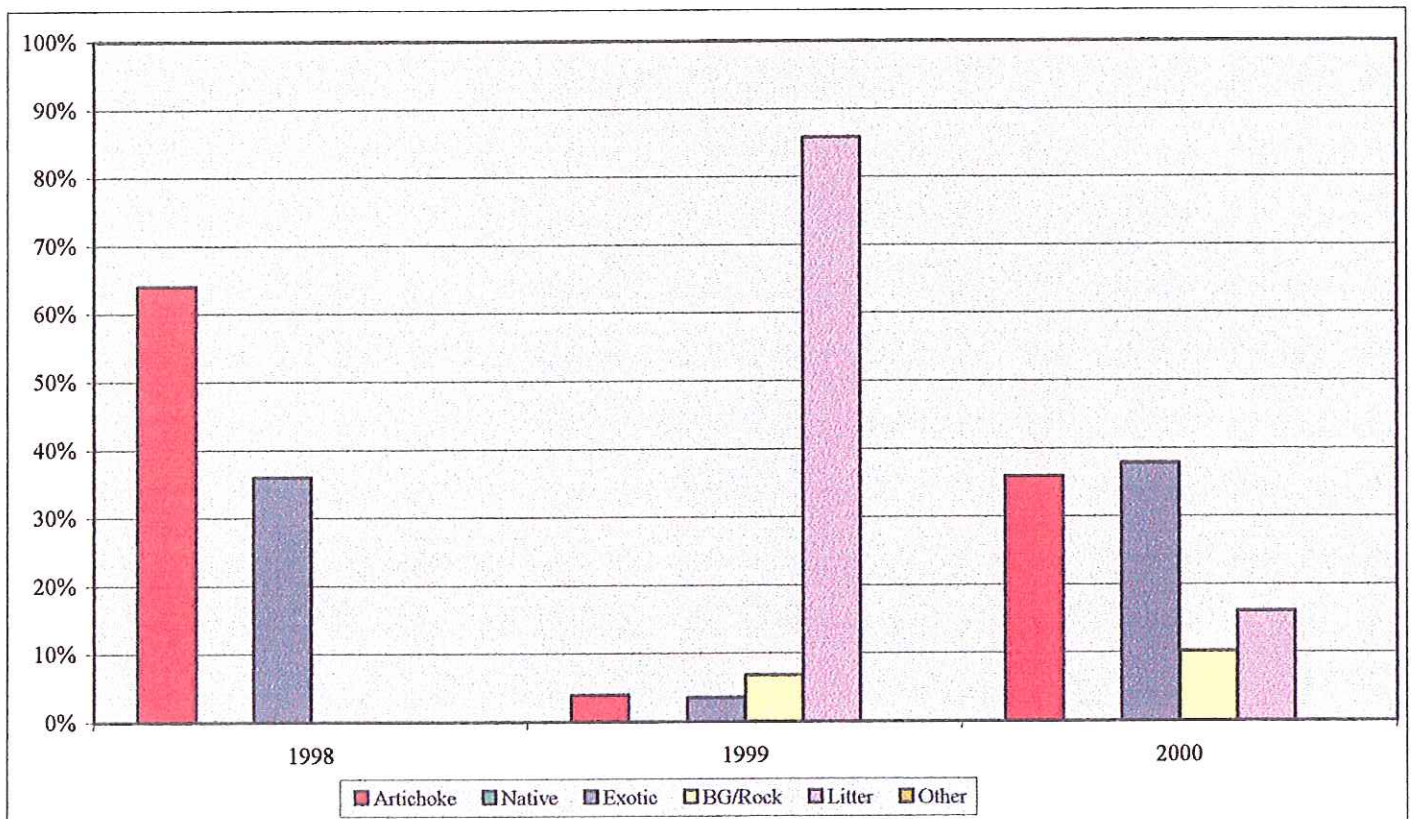


Figure 6. Bommer Canyon 2

Bommer Canyon 3

Artichoke thistle has been all but eliminated from this plot following two years of treatment. No seedlings or resprouts were present in the sampled quadrats in 1999 or 2000 (Table 5, Figure 16). Percent cover of thistle was reduced by 70 percent following the first spraying effort and remained almost zero following the second treatment (Table 5, Figure 7). Other exotic species including, ripgut brome, soft chess, red chess (*B. madritensis*), wild oats, foxtail barley, English ryegrass (*Lolium perenne*), field bindweed (*Convolvulus arvensis*), white-stemmed filaree (*E. moschatum*), and common sow-thistle, however have steadily increased in cover from 31 to 76 percent by 2000. Native cover has remained low (one percent or less) throughout the monitoring period. Prior to treatment in 1998, no native plant species were documented. In 1999, one occurrence of finger-leaved morning glory was documented and, in 2000, one occurrence of calabazilla (*Cucurbita foetidissima*) was documented. Cover of bare ground/rock was zero prior to treatment, increased after the first spray and was negligible following the second spray - once exotic grasses established in the bare areas. Percent cover of litter increased from zero pre-treatment to 43 percent post-treatment 1999. Cover of litter was lower in 2000 since the majority of artichoke had been killed the first year.

	Control Effort <i>(2% Roundup w/ Telar)</i>	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	No data	No data	No data	No data	No data	No data	No data	No data
1998	Baseline data before initial treatment	2.16 (0-8 seedlings & resprouts/m ²)	69.0%	0.0%	31.0%*	0%*	0%*	0.0%
1999	Data after 1998 treatment	0 (0 seedlings & resprouts/m ²)	0.2%	0.1%	46.9%	10.7%*	42.5%	0.0%
2000	Data after 1999 treatment	0 (0 seedlings & resprouts/m ²)	1.0%	1.2%	76.2%	0.2%*	21.4%	0.0%

Table 5. Bommer Canyon 3

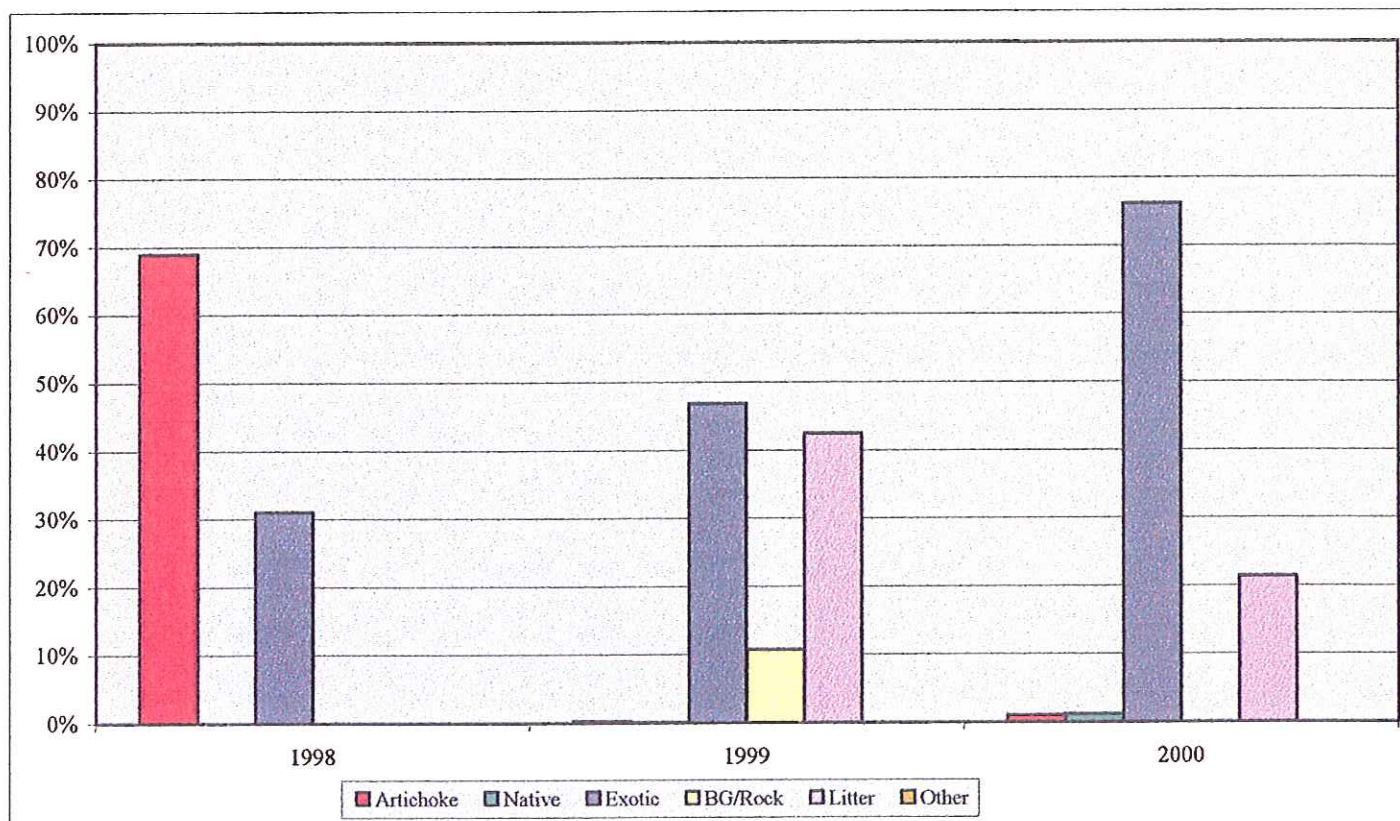


Figure 7. Bommer Canyon 3

Bommer Canyon 4

Both density and percent cover of thistle declined considerably after the first treatment with Roundup in 1998 (Table 6, Figures 8 and 16). Following the second year of treatment, percent cover of thistle recovered slightly, but density remained low and stable. Dominant exotic species documented throughout the monitoring period included ripgut brome, soft chess, wild oats, English ryegrass, purple false brome (*Brachypodium distachyon*), black mustard, sow thistle spp., filaree spp., and bur-clover (*Medicago polymorpha*). Although percent cover of exotics has increased over time, the majority of exotic annuals disappeared following the first year of treatment. Only the hardiest grasses and forbs were present in the plot in 2000. Two natives were documented in the baseline data – California chicory (*Rafinesquia californica*) and silver puffs (*Microseris lindleyi*) but native cover has remained zero percent following two years of treatment. Cover of bare ground/rock was zero prior to spraying, increased 11 percent following the first treatment, and by 2000, exotics invaded all bare areas, leaving little bare ground/rock cover. The cover of litter increased 30 percent following initial spraying but declined in 2000 as most artichoke had been eliminated from the plot the previous year.

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	No data	No data	No data	No data	No data	No data	No data	No data
1998	Baseline data before initial treatment	7.84 (2-15 seedlings & resprouts/m ²)	54.2%	0.1%	45.7%*	0%*	0%*	0%*
1999	Data after 1998 treatment	0.68 (0-3 seedlings & resprouts/m ²)	2.8%	0.0%	56.7%	10.9%*	29.6%	0.0%
2000	Data after 1999 treatment	0.68 (0-6 seedlings & resprouts/m ²)	8.3%	0.0%	72.2%	0.7%*	18.8%	0.0%

Table 6. Bommer Canyon 4

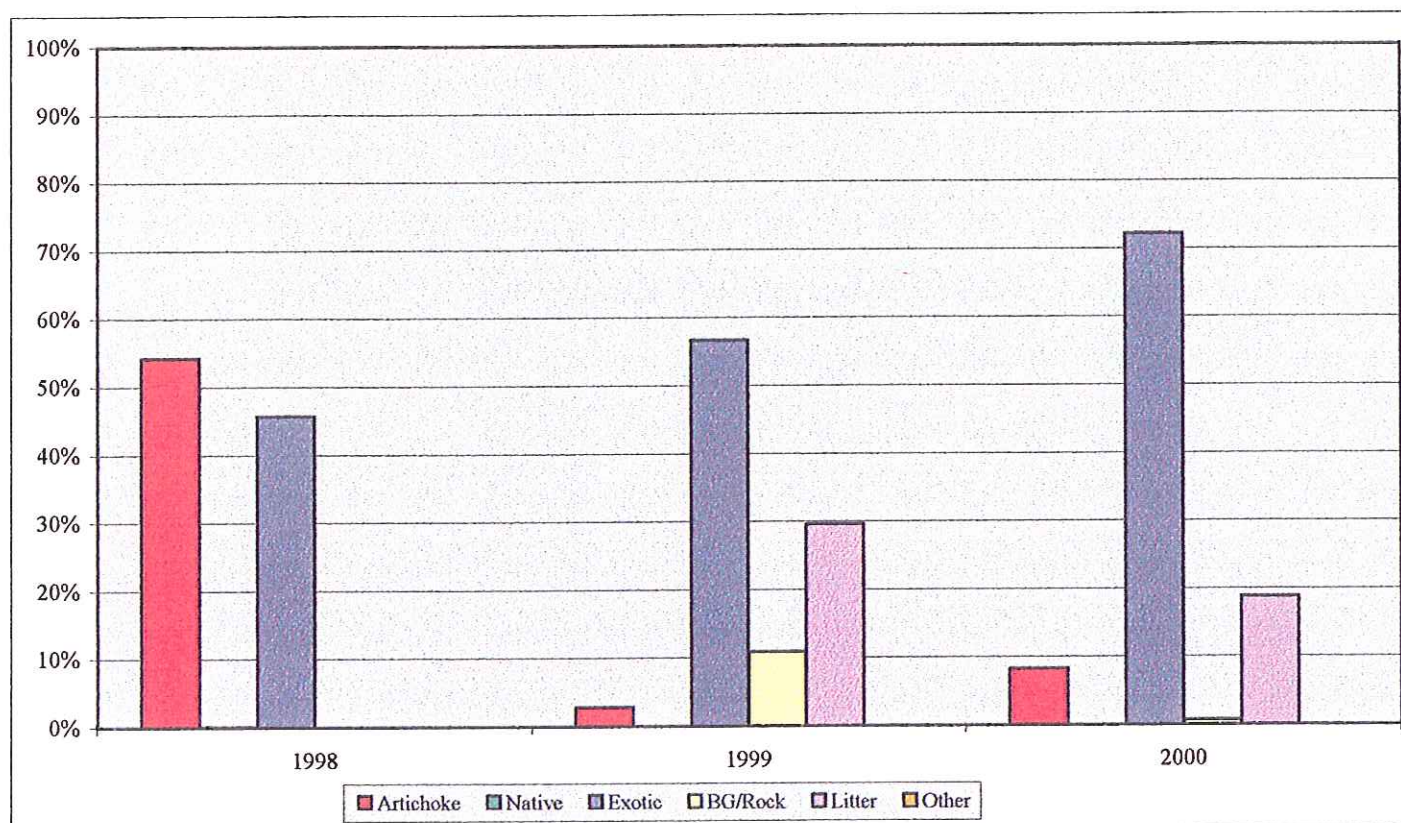


Figure 8. Bommer Canyon 4

Bommer Canyon 5

Prior to treatment in 1998, each quadrat sampled contained an average of 50 percent artichoke thistle (Table 7, Figure 9). After the initial treatment, almost 100 percent of the thistle was eliminated from the plot. Data collected in 2000, however, showed a 36 percent increase in thistle cover. As with Bommer Canyon Plot 2, premature treatment or cattle may have been a factor in the recovery of artichoke thistle. Other exotic cover, mostly European grasses, followed a similar pattern to that of the artichoke thistle. There was 50 percent cover by exotics (other than thistle) in each quadrat in 1998. When sampled in 1999 after the first treatment, there was only three percent cover of exotics, but, in 2000 exotic cover increased to 37 percent. No natives were observed in 1998 or 1999, but following the second year of treatment, calabazilla was documented. In 1999, following the first treatment, both bare ground and litter dominated the site. Once the artichoke and other exotics recovered in 2000, cover of both bare ground and litter declined.

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	No data	No data	No data	No data	No data	No data	No data	No data
1998	Baseline data before initial treatment	7.80 (2-24 seedlings & resprouts/m ²)	50.2%	0.0%	49.8%*	0%*	0%*	0%*
1999	Data after 1998 treatment	0.24 (0-4 seedlings & resprouts/m ²)	0.4%	0.0%	3.1%	23.4%	73.0%	0.0%
2000	Data after 1999 treatment	1.12 (0-3 seedlings & resprouts/m ²)	35.6%	1.1%	37.3%	9.2%*	16.8%	0.0%

Table 7. Bommer Canyon 5

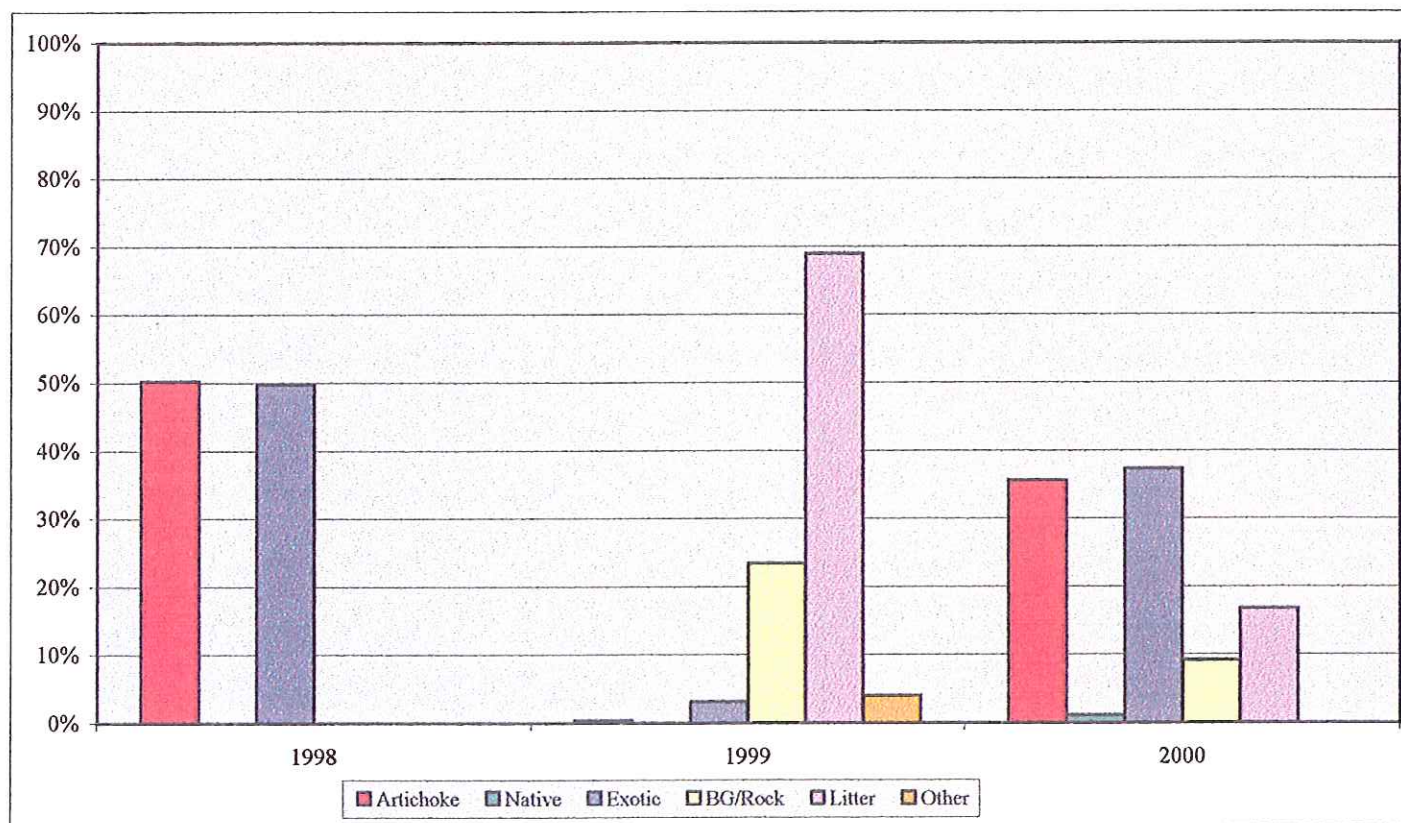


Figure 9. Bommer Canyon 5



PHOTO 5. Bommer Canyon: Pre-treatment 1998



PHOTO 6. Bommer Canyon: Post-treatment 2000

Shady Spur

The Shady Spur site is located within the watershed of Shady Canyon.. Prior to initial treatment in spring 1997, artichoke thistle dominated this site (Photos 7 and 8, Table 8). Following the first year of treatment, there was a significant 75 percent decrease in cover of thistle. No treatment was conducted in 1998 and artichoke cover increased from three to 24 percent. However, since the pre-emergent Telar was in the herbicide mix the first year, the density of thistle decreased despite the increase in cover (Table 8, Figure 16). Exotic species, including wild oats, brome spp., and black mustard, increased about 20 percent/year over the study period, replacing the artichoke thistle. Cover of bare ground/rock increased nine percent after the first treatment as a result of the reduction of thistle density, but, with no treatment in 1998, artichoke recovered and bare ground/rock cover decreased to zero. After a second treatment in 1999, bare ground/rock cover remained low because of the consistent increase in exotic species cover. Native cover decreased after the first year of treatment but increased 12 percent the second year (with no treatment). Natives identified were everlasting spp. (*Gnaphalium*) , purple needlegrass, and Mexican elderberry (*Sambucus mexicana*). Unfortunately, following the 1999 treatment, native cover decreased to two percent. With less competition for resources, the reduction in artichoke thistle could benefit native species. However, at Shady Spur, when the cover of artichoke declined, so did the native cover. Possible explanations for the decrease in native plant cover include 1) One explanation may be that some natives may have been accidentally sprayed with Roundup, 2) increased litter cover may have shaded out native species, or 3) monitoring transects/plots were placed inaccurately. Following treatment in 1997 and 1999, percent cover of litter increased 47 and 18 percent (relatively) and cover of natives decreased to almost zero percent both years.

	Control Effort (2% Roundup w/ Telaar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	No data	No data	No data	No data	No data	No data	No data	No data
1997	Baseline data before initial treatment	6.04 (1-11 seedlings & resprouts/m ²)	77.6	3.1	19.3%*	0%*	0%*	0.0%
1998	Data after 1997 treatment	3.40 (0-15 seedlings & resprouts/m ²)	2.6%	0.5%	40.5%	9.1%	46.8%	0.0%
1999	No treatment in 1998	1.08 (0-4 seedlings & resprouts/m ²)	23.9%	12.5%	63.4%	0.2%	0.0%	0.0%
2000	Data after 1999 treatment	0.36 (0-2 seedlings & resprouts/m ²)	4.6%	2.3%	75.1%	0.2%	18.1%	0.0%

Table 8. Shady Spur

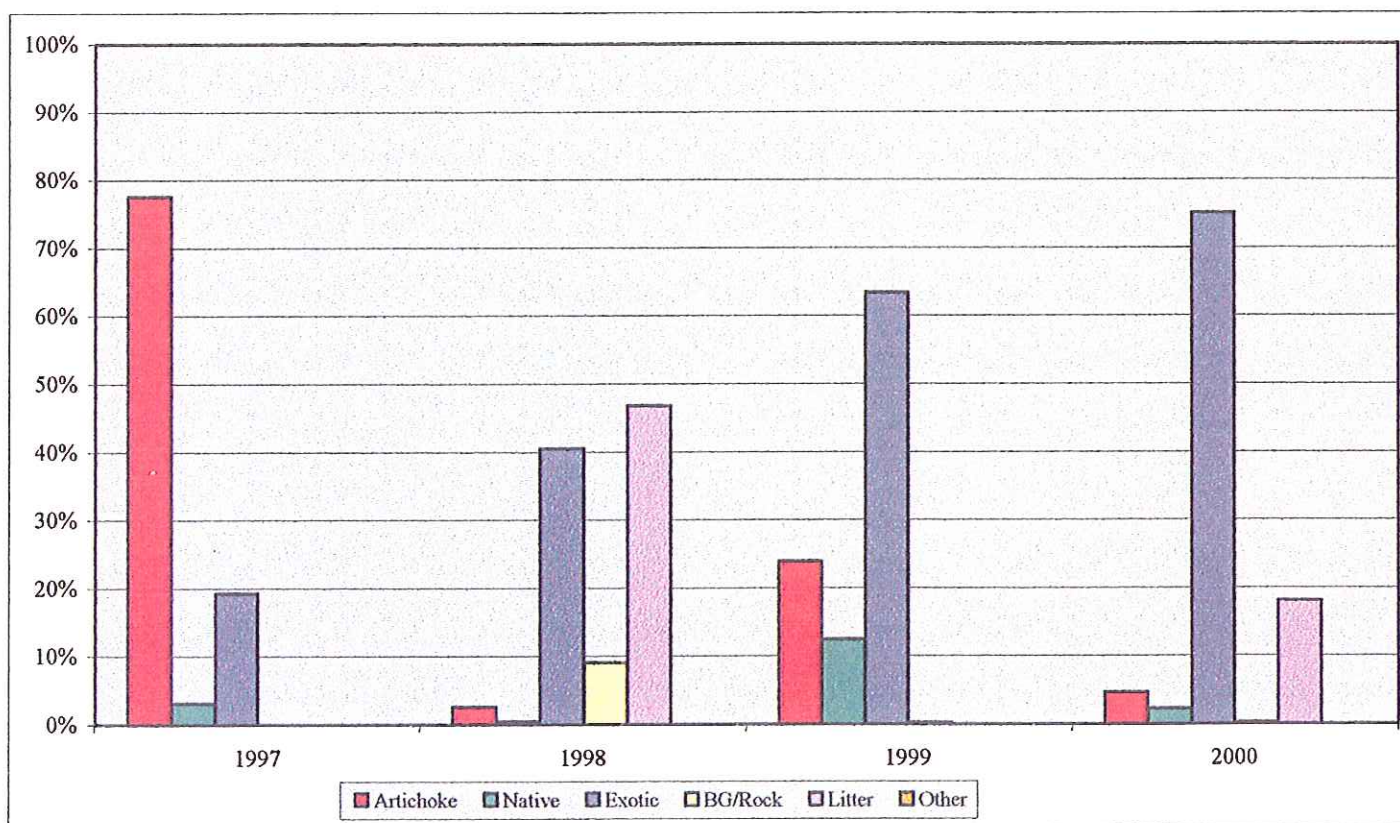


Figure 10. Shady Spur



PHOTO 7. Shady Spur: Pre-treatment 1997



PHOTO 8. Shady Spur: Post-treatment 2000

Muddy Canyon 1,2,3,4

The Muddy Canyon plots are located within The Irvine Company's Newport Coast coastal sage scrub (CSS) restoration area. Prior to thistle control efforts, this site was dominated by artichoke thistle and black mustard (Photos 9 and 10). A few isolated patches of purple needlegrass were scattered throughout the site. For three consecutive years (1996-1998), each of these plots was burned under prescription with a late spring/early summer fire. Fire was used as an additional tool to herbicide treatment of thistle to control the spread of other exotic species and to promote the growth of remnant native grasses and forbs. In addition to the burns, other restoration activities were implemented to establish native shrubs, forbs and grasses back into the system over the past several years. These activities included seeding and mycorrhizal inoculation (fall 1998), mowing (1999) and container planting (planned for winter 2001).

Baseline data was documented collectively for Muddy 1,2,3 in 1996. As shown in Tables 9-12 and Figures 11-14, percent cover of artichoke thistle decreased an average of 40 percent following the first year of spraying (except for Muddy 4, which was not established until 1998). The following three years, percent cover of thistle remained fairly low (< ten percent) and constant, but, density decreased 50-96 percent. Other exotic cover, predominantly annual grasses (wild oats and brome spp.) and black mustard decreased overall since pre-treatment in 1996. Following the first spray, exotic species took advantage of the immediate reduction in artichoke thistle; a 42 percent increase was documented. The following two years, however, a gradual decline in exotics occurred, possibly a result of the continuous burning over the past several years.

Quantitative monitoring was not conducted in 2000 because the plot markers had been removed, but visual estimates of thistle cover from the vicinity of each plot showed that artichoke thistle cover was generally less than ten percent.

It appears that, in the short-term, prescribed fire serves to promote germination of the thistle by reducing thatch cover and exposing the seed to light. Several years of burning and herbicide treatment may help to deplete the seed bank of thistle, thereby ensuring better long-term control.

Native shrubs included in the seed mix and found growing in the test plots after seeding in fall 1998 included black sage (*Salvia mellifera*), white sage (*Salvia apiana*), coastal goldenbush (*Isocoma menziesii*), and long-stemmed buckwheat (*Eriogonum elongatum*). Native herbs and grasses included California poppy (*Eschscholzia californica*), doveweed (*Eremocarpus setiger*), fascicled tarweed (*Hemizonia fasciculata*), bugle hedge-nettle (*Stachys ajugoides*), coastal goldfields (*Lasthenia californica*), California plantain (*Plantago erecta*), branching phacelia (*Phacelia ramostissima*), and purple needlegrass. All species were detected in at least one of the test plots. Although percent cover of natives not significant yet, over time shrub seedlings should become established and more dominant in each of the plots.

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	Baseline data before initial treatment	No data (1-5 seedlings & resprouts/m ²)	48.0%	0.0%	49.0%	1.5%	1.5%	0.0%
1997	Data after 1996 treatment	0	0.0%	1.8%	98.2%*	0%*	0%*	0.0%
1998	Data after 1997 treatment	0	0.0%	0.1%	97.2%	2.7%*	0.0%	0.0%
1999	Data after 1998 treatment and seeding	0	0.0%	2.5%	29.0%	24.5%	44.1%	0.0%
2000	Treated 1999	No data	No data	No data	No data	No data	No data	No data

Table 9. Muddy Canyon 1

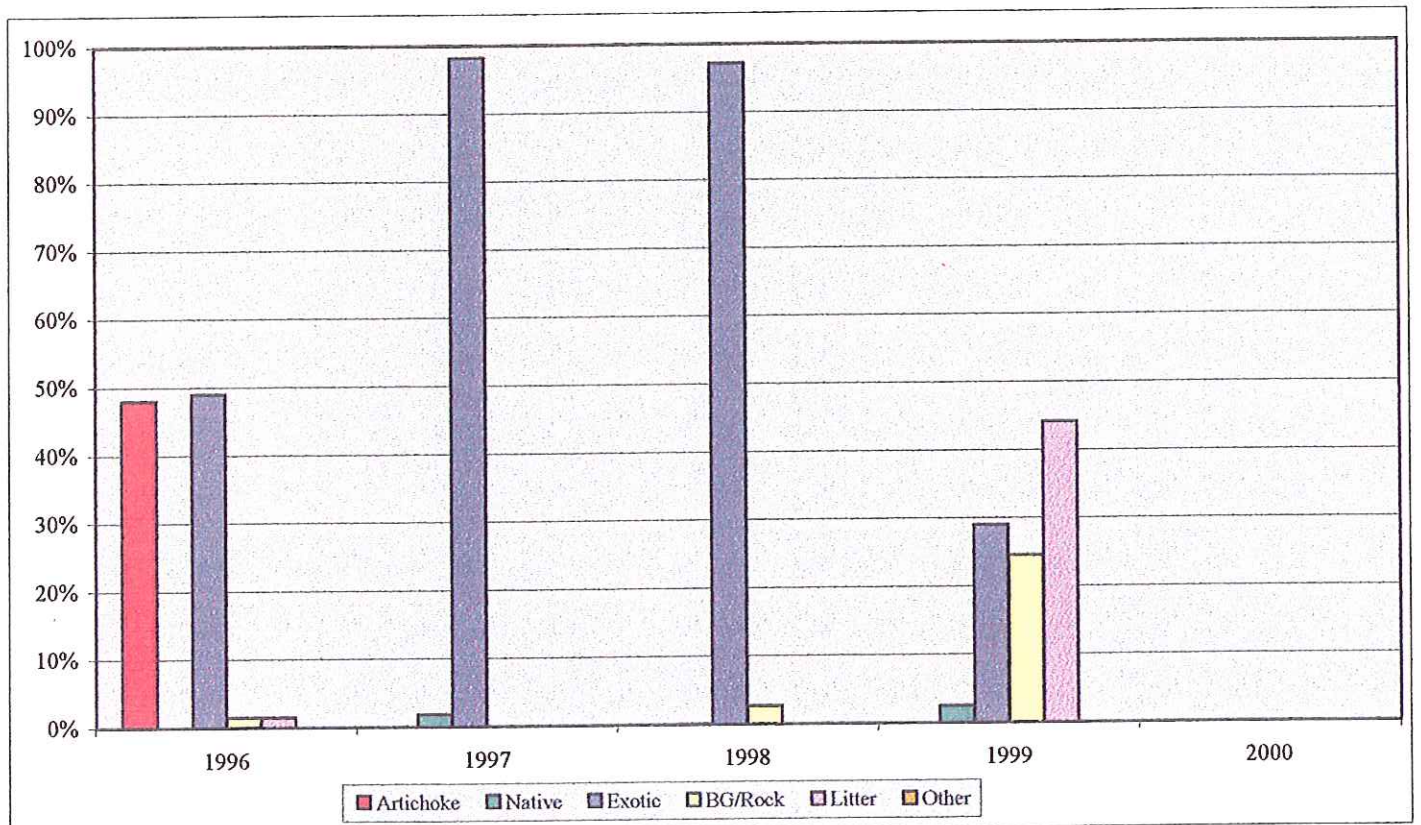


Figure 11. Muddy Canyon 1

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	Baseline data before initial treatment	No data (1-5 seedlings & resprouts/m ²)	48.0%	0.0%	49.0%	1.5%	1.5%	0.0%
1997	Data after 1996 treatment	14.84 (4-42 seedlings & resprouts/m ²)	16.3%	2.6%	76.6%	4.4%*	0.1%	0.0%
1998	Data after 1997 treatment	4.92 (1-14 seedlings & resprouts/m ²)	13.7%	1.0%	70.6%	15.0%	0.0%	0.0%
1999	Data after 1998 treatment and seeding	0.56 (0-3 seedlings & resprouts/m ²)	16.9%	1.2%	69.5%	12.8%	0.0%	0.0%
2000	Treated 1999	No data	No data	No data	No data	No data	No data	No data

Table 10. Muddy Canyon 2

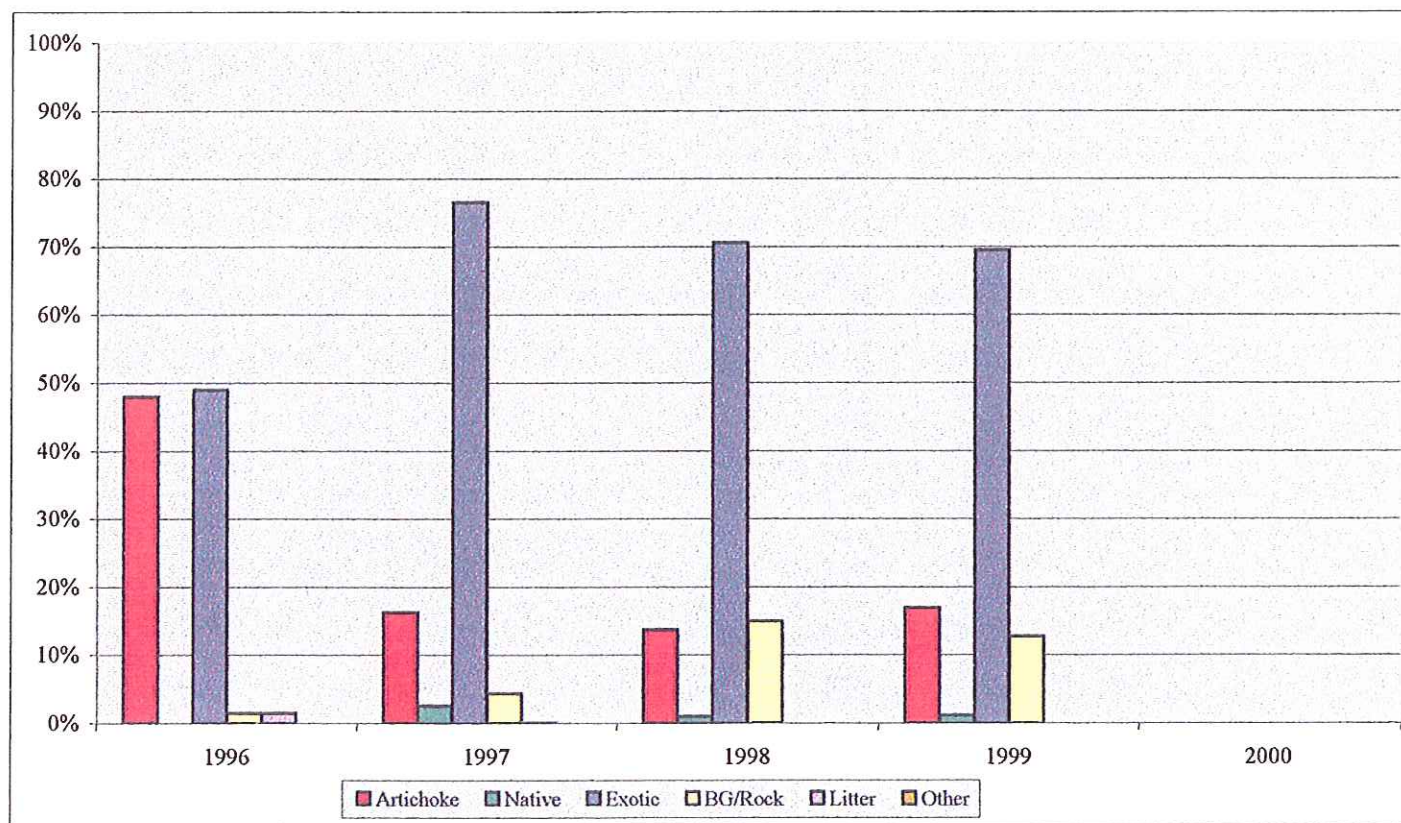


Figure 12. Muddy Canyon 2

	Control Effort (2% Roundup w/ Telar)	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	Baseline data before initial treatment	No data (1-5 seedlings & resprouts/m ²)	48.0%	0.0%	49.0%	1.5%	1.5%	0.0%
1997	Data after 1996 treatment	0.84 (1-4 seedlings & resprouts/m ²)	4.5%	0.2%	95.3%*	0%*	0.0%	0.0%
1998	Data after 1997 treatment	0.68 (0-5 seedlings & resprouts/m ²)	15.2%	0.1%	84.7%*	0%*	0.0%	0.0%
1999	Data after 1998 treatment	0.12 (0-1 seedlings & resprouts/m ²)	5.8%	1.1%	74.9%	18.2%*	0.0%	0.0%
2000	Treated 1999	No data	No data	No data	No data	No data	No data	No data

Table 11. Muddy Canyon 3

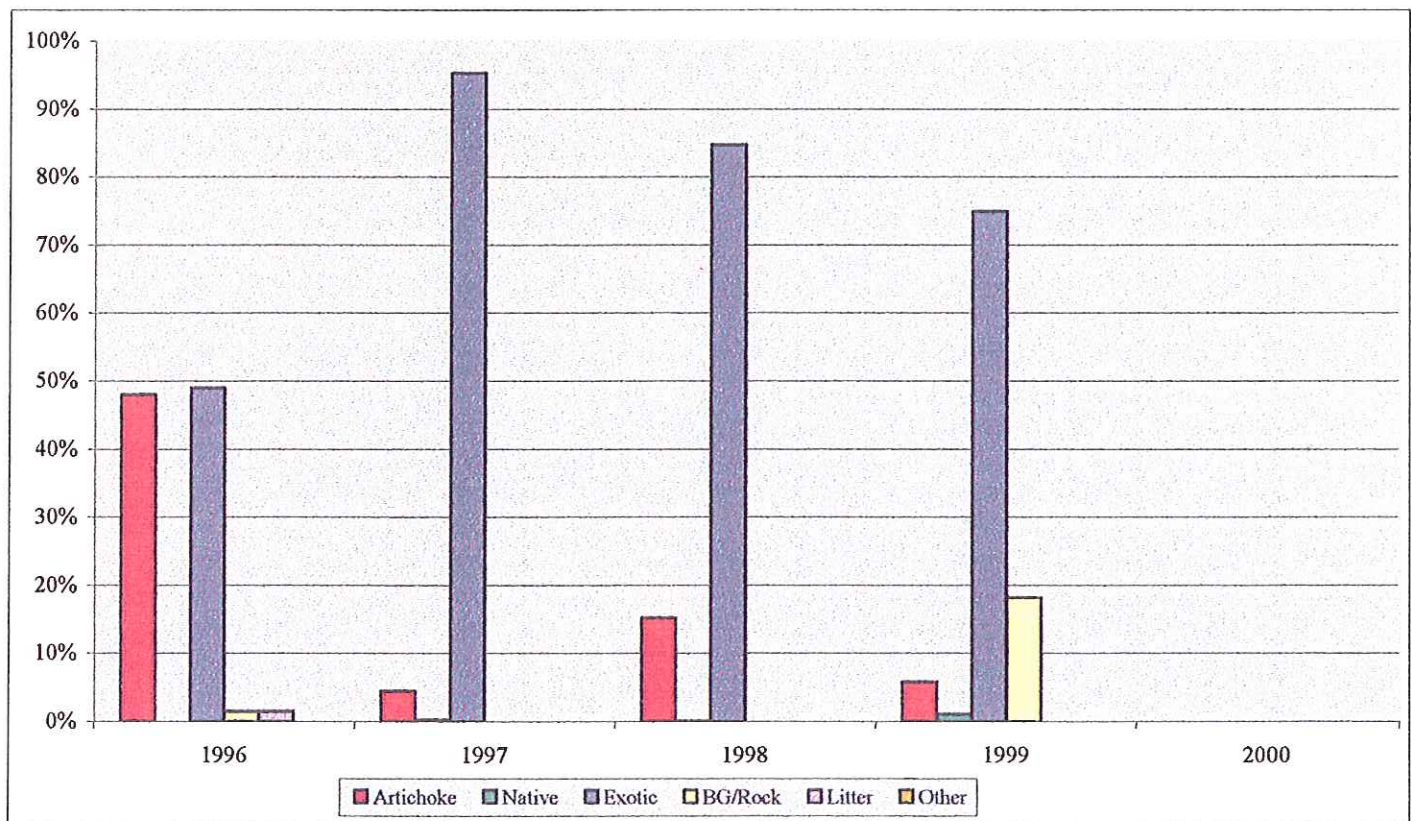


Figure 13. Muddy Canyon 3

	Control Effort <i>(2% Roundup w/ Telar)</i>	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	Sprayed / burned	No data	No data	No data	No data	No data	No data	No data
1997	Sprayed / burned	No data	No data	No data	No data	No data	No data	No data
1998	Data after 1997 treatment	0.48 (0-3 seedlings & resprouts/m ²)	3.2%	6.3%	90.5%*	0%*	0.0%	0.0%
1999	Data after 1998 treatment and seeding	0.24 (0-1 seedlings & resprouts/m ²)	3.3%	3.4%	77.1%	14.3%	2.0%	0.0%
2000	Treated 1999	No data	No data	No data	No data	No data	No data	No data

Table 12. Muddy Canyon 4

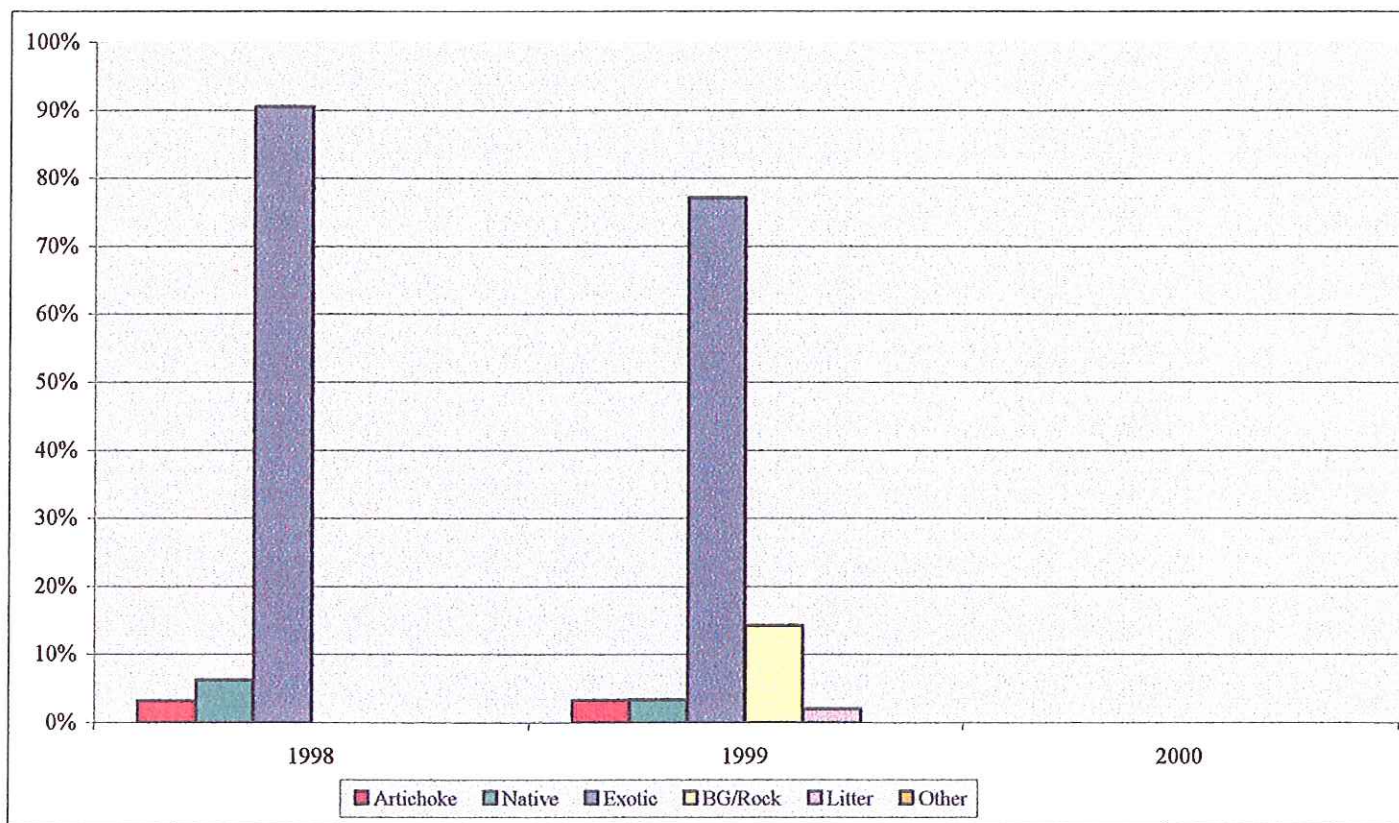


Figure 14. Muddy Canyon 4

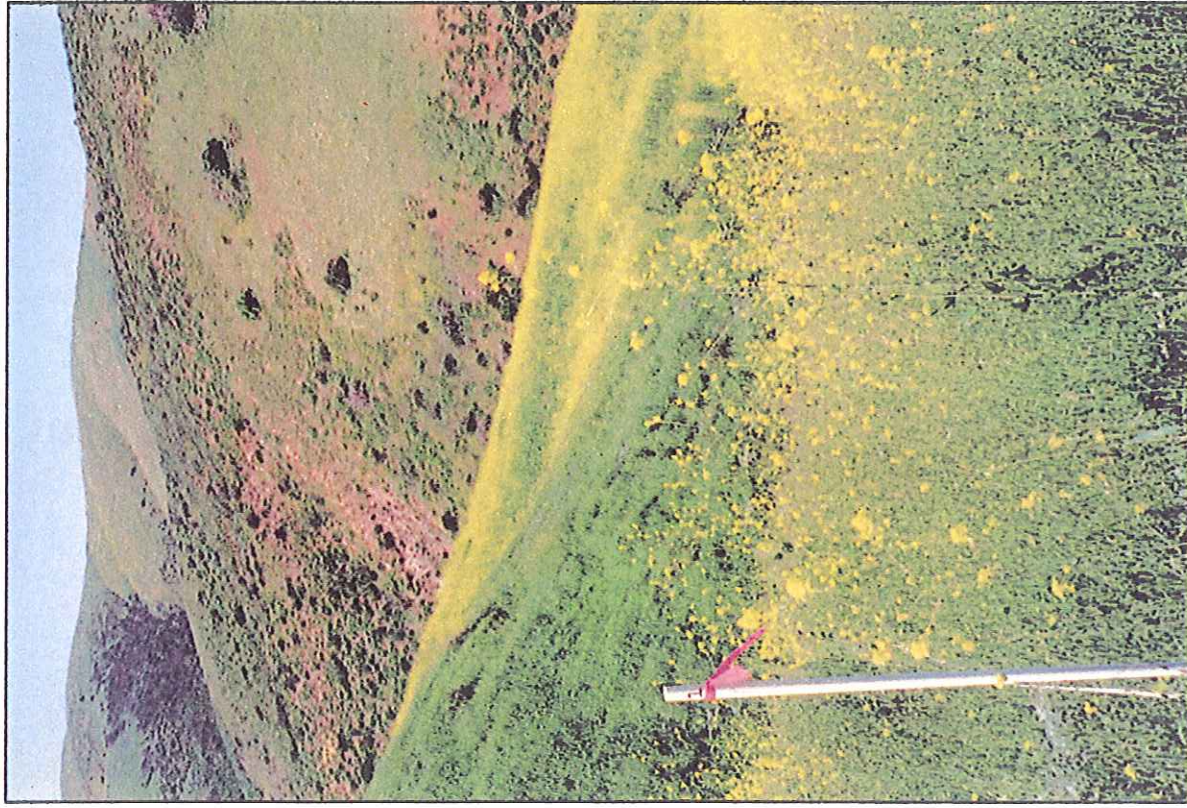


PHOTO 9. Muddy Canyon: Pre-treatment 1997

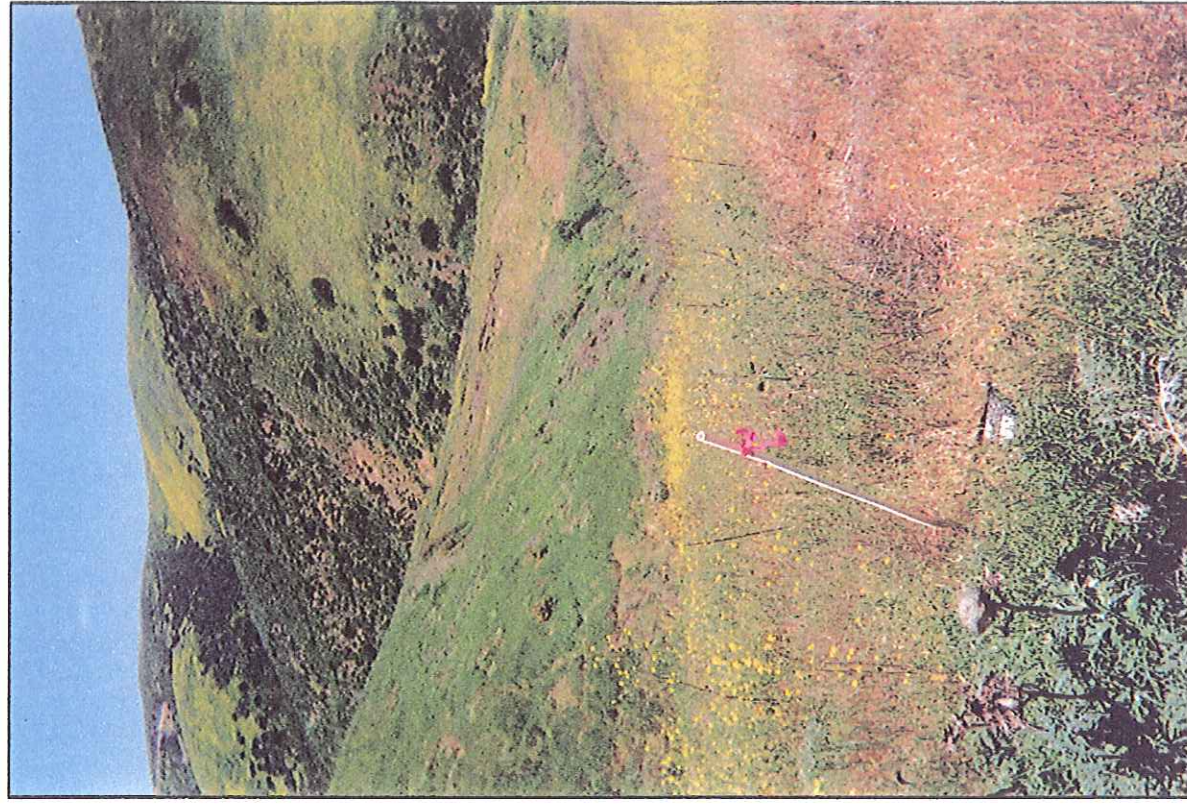


PHOTO 10. Muddy Canyon: Post-treatment 2000

Muddy Canyon 6

This site is also part of The Irvine Company's Newport Coast CSS restoration project (Photos 11 and 12). Cover of artichoke thistle decreased 25 percent following the first spray and an additional 18 percent following the second spray (Table 13, Figure 15). However, after the third treatment, thistle cover increased 13 percent. The initial decrease in thistle cover is less dramatic than that of the other Muddy Canyon test plots, which might be explained either by the absence of spring burning. Although cover did not decrease as much as the Muddy Canyon Plots 1-4, the density of thistle did – thistle density at this plot decreased 75 percent from 1997 to 1998 and again from 1998 to 1999. Exotic cover, including black mustard, summer mustard (*Hirschfeldia incana*), prickly lettuce (*Lactuca serriola*), common sow-thistle, filaree spp., ripgut brome, soft chess, red chess, wild oats, and foxtail fescue, remained constant until 1999. In 1999, this plot was dominated by black and summer mustards, doubling the exotic cover from previous years to 64 percent. Native shrub and herb cover has remained both low and constant over the study period. Natives identified over the study period included California chicory and *Microseris* spp. in 1997, California chicory and fascicled tarweed in 1998 and Douglas' nightshade (*Solanum douglasii*) in 1999. This site was sprayed and weeded in 2000 to control black mustard and Russian thistle (*Salsola tragus*), as well as artichoke thistle. Monitoring was not conducted in 2000. Muddy Canyon 6 will be included in the 50-acre Muddy Canyon mitigation project beginning in November 2000.

	Control Effort <i>(2% Roundup w/ Telar)</i>	Artichoke Thistle Density	Artichoke Cover	Native Cover	Exotic Cover	BG/Rock Cover	Litter Cover	Other Cover
1996	Baseline data before initial treatment	No data (1-5 seedlings & resprouts/m ²)	48.0%	0.0%	49.0%	1.5%	1.5%	0.0%
1997	Data after 1996 treatment	12.00 (4-31 seedlings & resprouts/m ²)	23.0%	0.7%	35.0%	0%*	41.3%*	0.0%
1998	Data after 1997 treatment	2.88 (0-12 seedlings & resprouts/m ²)	4.3%	0.1%	31.3%	47.4%*	16.9%	0.0%
1999	Data after 1998 treatment	0.72 (0-4 seedlings & resprouts/m ²)	16.6%	0.2%	65.2%	16.8%*	1.2%	0.0%
2000	Treated 1999	No data	No data	No data	No data	No data	No data	No data

Table 13. Muddy Canyon 6

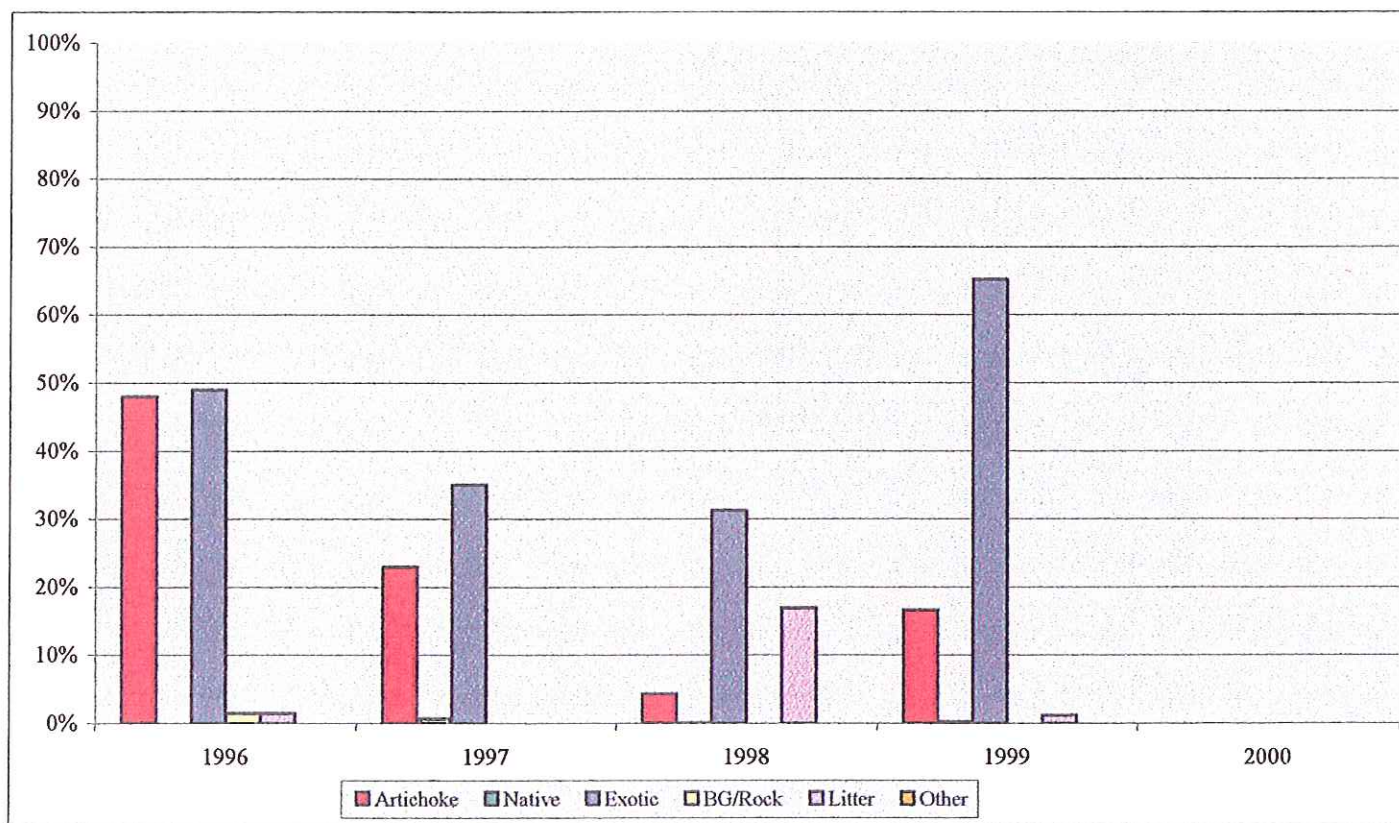


Figure 15. Muddy Canyon 6



PHOTO 11. Muddy Canyon 6: Pre-treatment 1997



PHOTO 12. Muddy Canyon 6: Post-treatment 1999

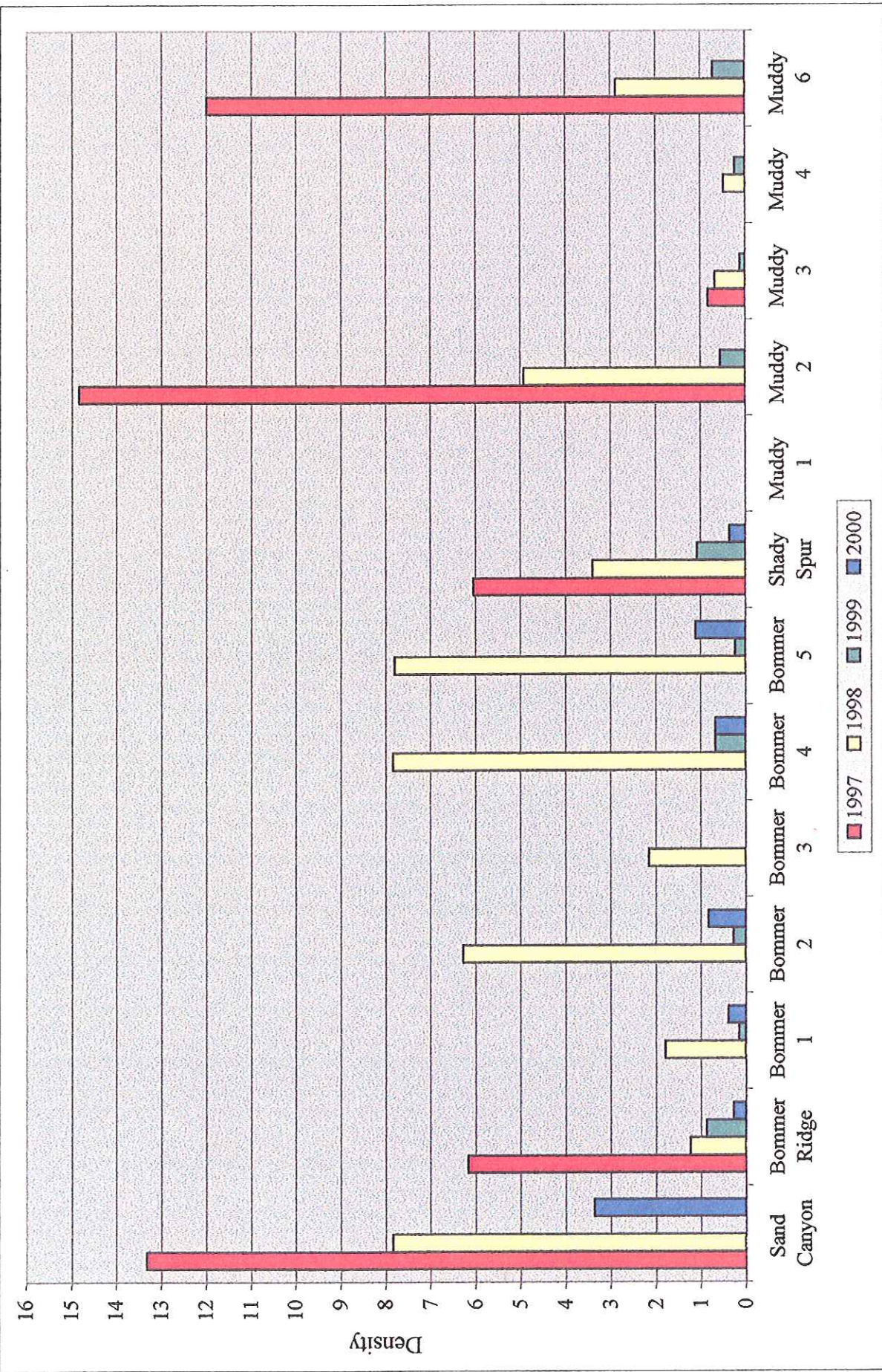


Figure 16: Density of Artichoke Thistle (1997-2000)



PHOTO 13. Aliso and Woods Canyon Wilderness Park: Future monitoring site; treated 2000



PHOTO 14. Aliso and Woods Canyon Wilderness Park: Future monitoring site; treated 2000

Note: Data collection reflected Actual Cover not Relative Cover. In areas with high artichoke thistle density, bare ground, litter, and exotic species were often present under the thistle. They were included in the percent cover value which often resulted in a value over 100%. The percent cover values (*) were adjusted to reflect Relative Cover for each category.

RECOMMENDATIONS

The NROC's Draft Habitat Restoration and Enhancement Plan identifies artichoke thistle infested sites as the second highest priority for restoration (following abandoned agricultural sites). It is estimated that, within the coastal subregion, adequate control of the estimated 3200 acres of remaining artichoke thistle will require an expenditure of \$2.4 million over the next 15 years (\$80,000-\$200,000 annually). Beyond this 15-year period, approximately \$60,000 in thistle control efforts would be required annually to keep artichoke thistle in check.

Because NROC's management endowment funding is limited, additional long-term funding sources for artichoke thistle control need to be identified and secured. In 2001, CDFG will be providing a generous \$100,000 Local Assistance Grant (to be matched 100% by NROC) for artichoke thistle control in the NROC's coastal subregion. This is the first year that this level of funding (\$200,000) has been committed to thistle control. NROC will need to work cooperatively with land managers to secure this level of funding for coming years.

Specific recommendations for the 2001 artichoke thistle control program include:

1. All artichoke thistle areas treated in 2000 should receive follow-up treatment in 2001.
2. Additional monitoring plots should be established in Aliso and Woods Canyons Regional Park, Crystal Cove State Park, and in any new treatment areas.
3. The effectiveness of Transline herbicide should be further investigated through the establishment of monitoring plots at additional native grassland sites infested with artichoke thistle.

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