

-  Interstate Highways
-  Other Highways / Roads
-  San Diego County
-  MCB Camp Pendleton

Marine Corps Base, Camp Pendleton
Regional & Vicinity Map



Map Source:
AC/S Environmental Security
IS Branch

Source: Assistant Chief of Staff
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Date: July 2003

The Fennel Battle on MCB Camp Pendleton: Partnerships and Techniques in Combating the Invasion

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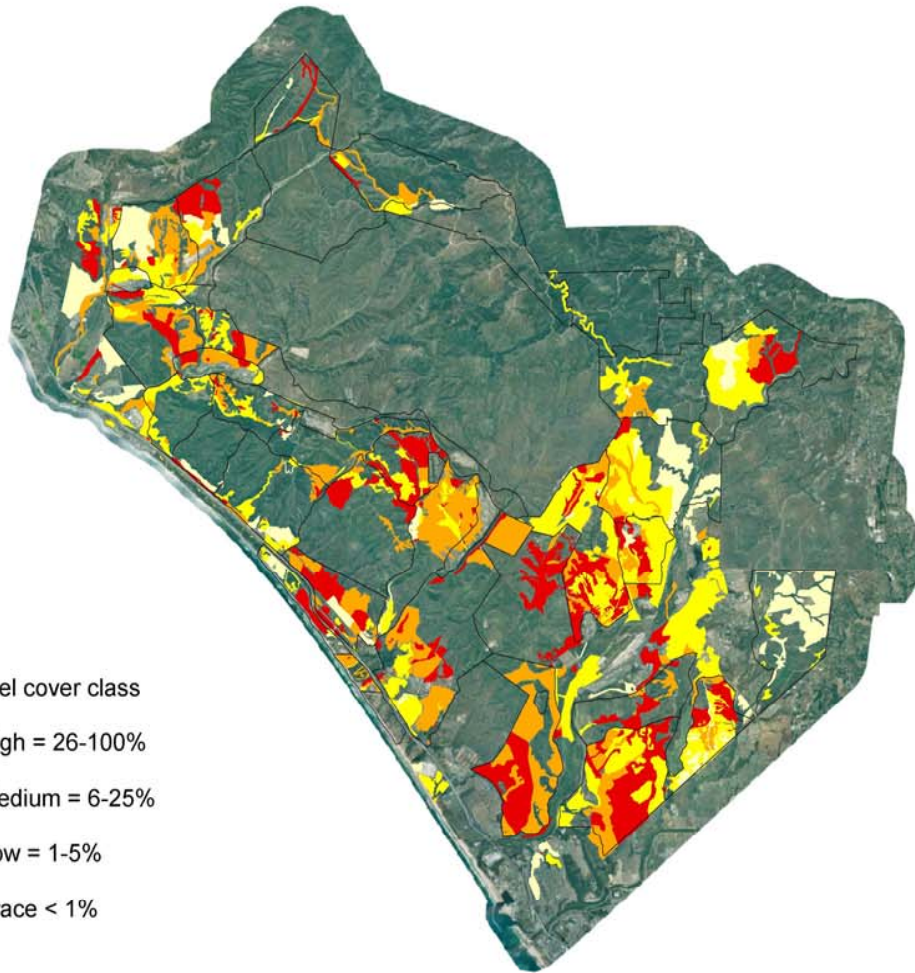
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Upland Weed Control Program

MCB Camp Pendleton



- Collaborative efforts to control fennel, artichoke thistle, and other upland weeds
- Artichoke thistle (*Cynara cardunculus*) control initiated in 1984
- Fennel (*Foeniculum vulgare*) is the most widespread upland weed on Base today
- Over 1,200 acres of fennel dominated habitat treated; over 18,466 acres remain



- Fennel cover class
- High = 26-100%
 - Medium = 6-25%
 - Low = 1-5%
 - Trace < 1%

Fennel Cover Classes on MCB Camp Pendleton - 2005

Map Source:
AC/S Environmental Security
Land Management Branch



Map Prepared On: September 28, 2005

Fennel Biology / Ecology



- **Apiaceae family; perennial herb**
- **Native to S. Europe & Mediterranean**
- **Commercially grown for young edible root and seeds for cooking**
- **Reproduces via rhizome and seed**
- **Prolific seed production and viability**
- **Disperses via water, traffic, wildlife, etc.**
- **Disturbance (e.g., vehicles) can encourage dispersal and establishment**



Baseline Research



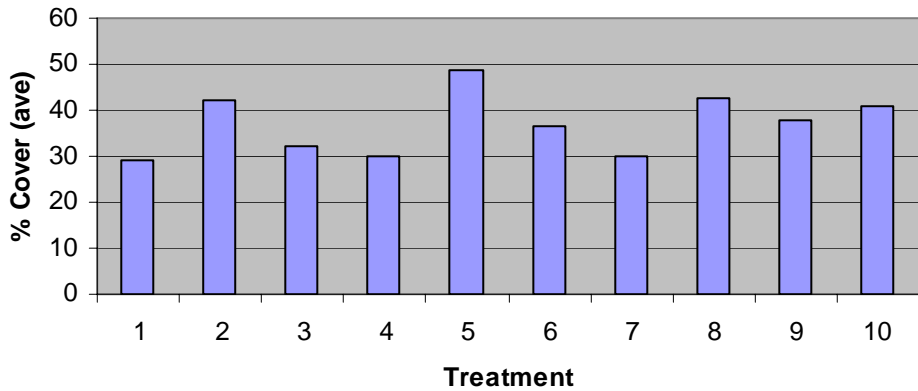
- **Santa Cruz Island study**
 - Wet season herbicide applications significantly more effective than dry season application (Brenton & Klinger 2002, 1994)
 - Triclopyr (Garlon) applied in early spring had 95-100% kill
 - Glyphosate (Roundup) applied in early spring had 75-80% kill (Dash & Gliessman 1994 in Bossard *et al.* 2000)
- **Base funded study by SDSU**
 - Fennel density and height was significantly lower in annually burned vs. unburned areas before treatment
 - No significant difference between burned and unburned areas 1 year after treatment
 - Garlon treatments are far more effective than burning alone
 - Remove biomass before treatment

UC Extension Treatment Study

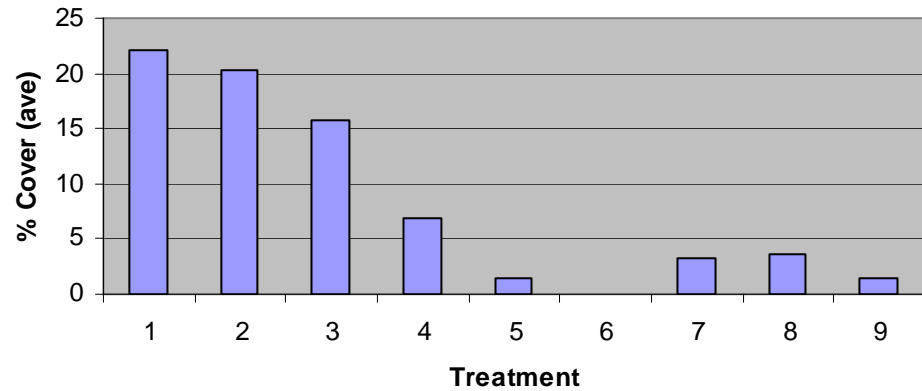


- 4 replications of 9 different treatments & 1 untreated control for two years (plots = 15'x2')
- Results indicate Triclopyr and a mix of Glyphosate/Triclopyr to be more effective on fennel than Glyphosate alone @ 1 & 2 lbs/A
- % cover and biomass for the Glyphosate/Triclopyr (1+2 lbs/A) treatment was 0
- Triclopyr did not appear to affect purple needle grass (*Nassella pulchra*)

Fennel cover before treatment



Fennel cover 4 months after treatment



Treatments	Rate (lbs/A)
1. Glyphosate	1
2. Glyphosate	2
3. Triclopyr (Garlon 4)	1
4. Triclopyr (Garlon 4)	2
5. Glyphosate + triclopyr	1+1
6. Glyphosate + triclopyr	1+2
7. Glyphosate + triclopyr	2+1
8. Glyphosate (spot spray)	2%
9. Triclopyr (spot spray)	1%
10. Untreated control	

Untreated control 4 mo. after treatment

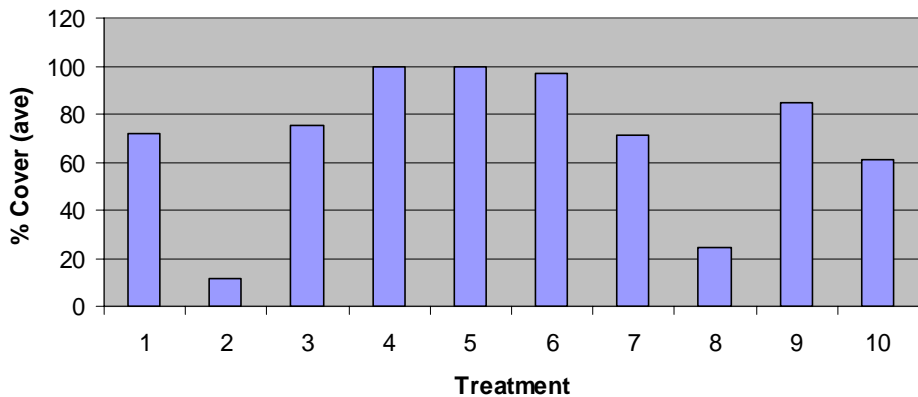
Fennel

biomass = 2.475 kg/15'x2'

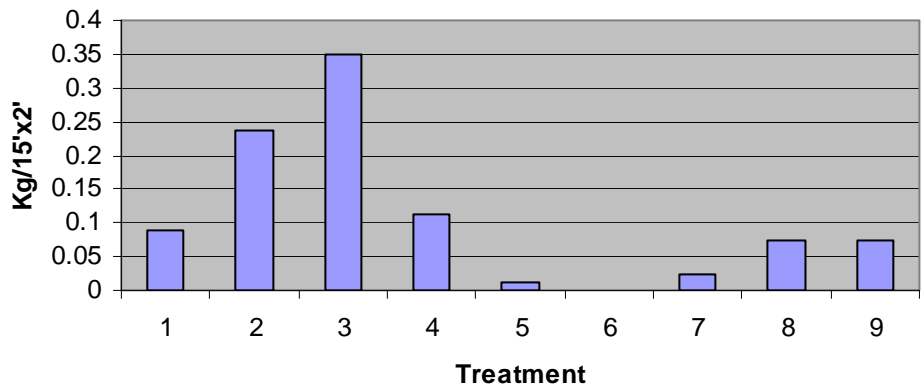
cover = 65.414%

(Bell C. 2005)

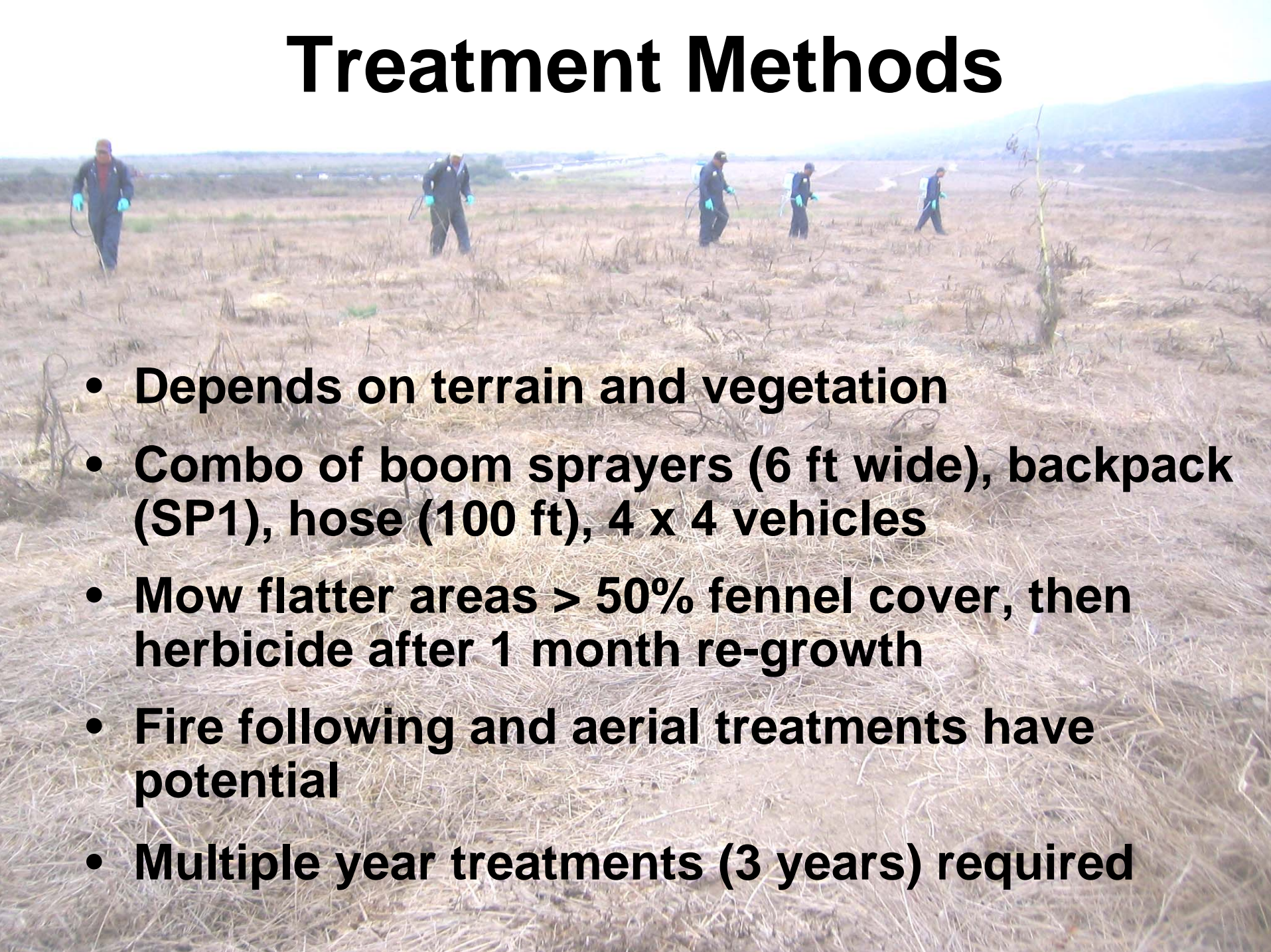
Purple needle grass cover 4 months after treatment



Fennel biomass 4 months after treatment



Treatment Methods

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- A photograph showing five workers in a field, each wearing a dark jacket and a backpack sprayer. They are walking across a field of dry, brown vegetation, likely fennel, and appear to be applying herbicide. The background shows a hazy landscape with hills under a bright sky.
- **Depends on terrain and vegetation**
 - **Combo of boom sprayers (6 ft wide), backpack (SP1), hose (100 ft), 4 x 4 vehicles**
 - **Mow flatter areas > 50% fennel cover, then herbicide after 1 month re-growth**
 - **Fire following and aerial treatments have potential**
 - **Multiple year treatments (3 years) required**

Strategies & Implications



- **Large scale treatment strategy**
 - Base-wide weed mapping (every 5 years)
 - Prioritize areas for treatment using ranking system and GIS modeling
 - Monitor to determine success
- **Cost effectiveness**
 - Best herbicide(s)/qty. (e.g., Garlon vs. Telar)
 - Long-term goals (e.g., restoration/succession)
- **Research and fennel data needed**
 - Population biology (e.g., seed production, germination, viability, etc.)
 - Invasion and treatment following fire
 - Biocontrol: no insects or fungi known; grazing
 - New technology: equipment, prediction, aerial, etc.

Conclusions

- **Cooperation & vast efforts are required**
- **Available current research & reporting**
 - Online & grey literature
 - Open communication
- **Long term monitoring**
- **Adaptive management**



Acknowledgments & Sources



- **Funded by: MCB Camp Pendleton**
- **Partners / contactors:**
 - Agrichemical Supply and Recon Environmental
 - Seiger *et al.*, San Diego State University, 2003
 - Bell, UC Cooperative Extension, 2005
- **Sources:**
 - Personal communication with partners / contractors
 - Brenton & Klinger 2002, 1994; Dash & Gliessman 1994; Miller in Bossard *et al.* 2000

Questions ?

