

Application of a field ecological study to optimize adaptive management for invasive plant eradication



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Barbed Goatgrass

(Aegilops triuncialis)

Impact, Status, Trends

- Widespread in northern Ca
- Invasive Mediterranean annual grass
- Forms dense monocultures, crowds out native species
- State Listed Noxious Weed
- In 2006, goatgrass found in San Diego County 250 miles from the nearest population



EXPERT KNOWLEDGE BY QUAD

Abundance

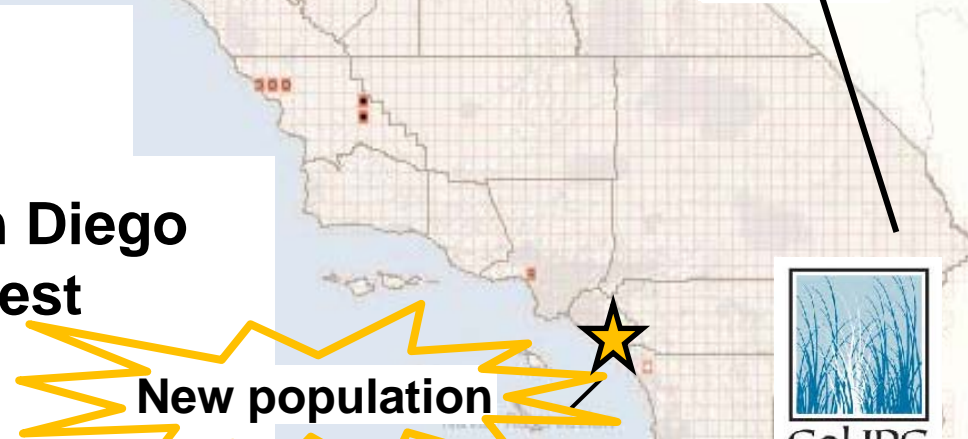
- Low
- Medium
- High

Trend

- Spreading
- Managed, spreading
- Managed, decreasing
- Eradicated

Verification Needed

- Verify Quad
- Verify Species

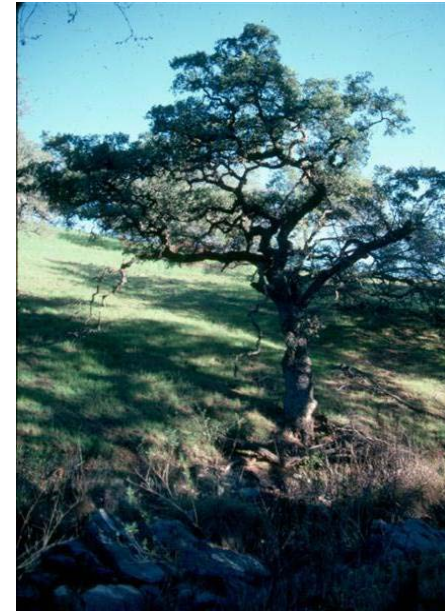


Cal-IPC

Resources At Risk



- **Biodiversity hotspot** – 381 at-risk taxa in California’s SW ecoregion (CNDDDB 2005)
- **Detachment Fallbrook**
 - **5 Federally Listed Species**
 - **28 Species of Special Concern**
 - **> 200 Migratory Birds**
 - **>15 invasive plant species targeted**



Barbed Goatgrass



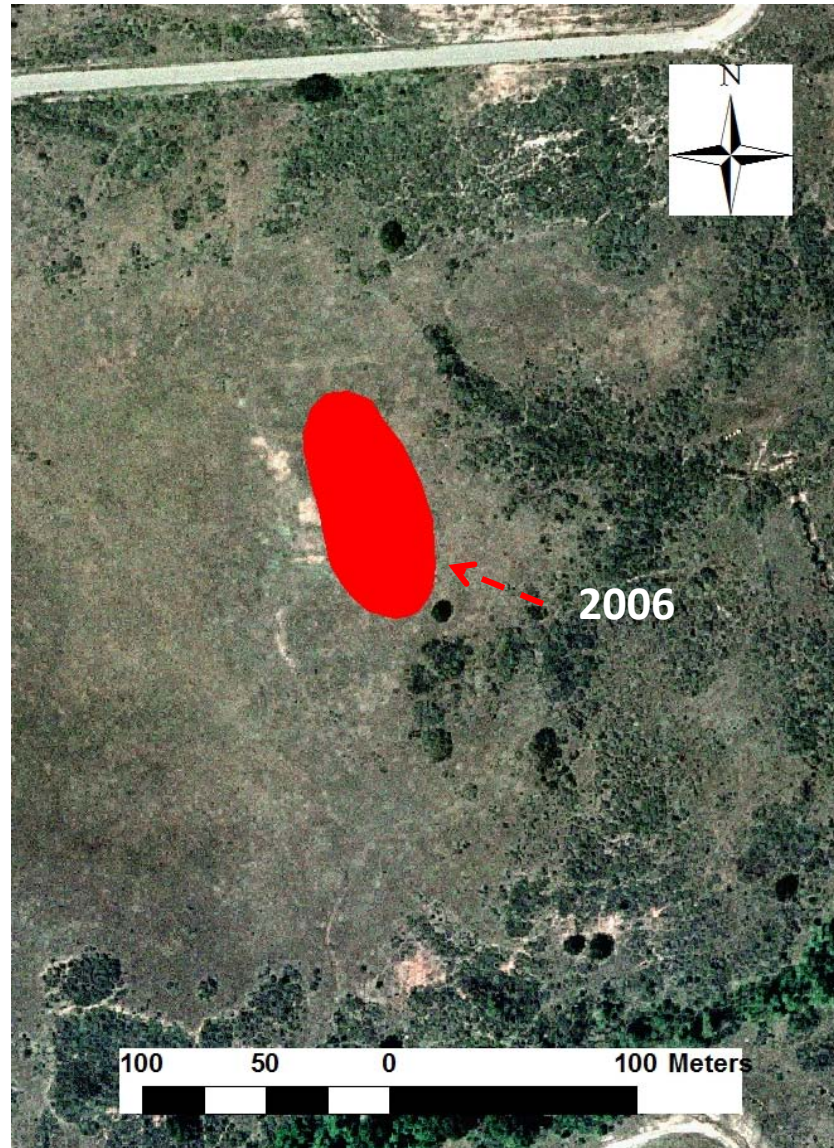
- Dispersed by gravity, wind, animals
 - 2.2 m maximum primary dispersal (Thompson 2007)
- 2 types of seeds: larger germinates 1st season, smaller is typically dormant for 2 yrs (Dyer 2004)
- Maximum dormancy is unknown, may be more than 5 yrs (Burnside et al. 2006)
- Tetraploid – single seed has enough genetic material to reestablish population (Meimberg et al. 2010)

Initial Approach



- **Goal: Eradication, not control**
- **Rationale:**
 - **High potential impact**
 - **Relatively small infestation**
 - **Individuals easy to kill**
 - **Sole population in So. California**

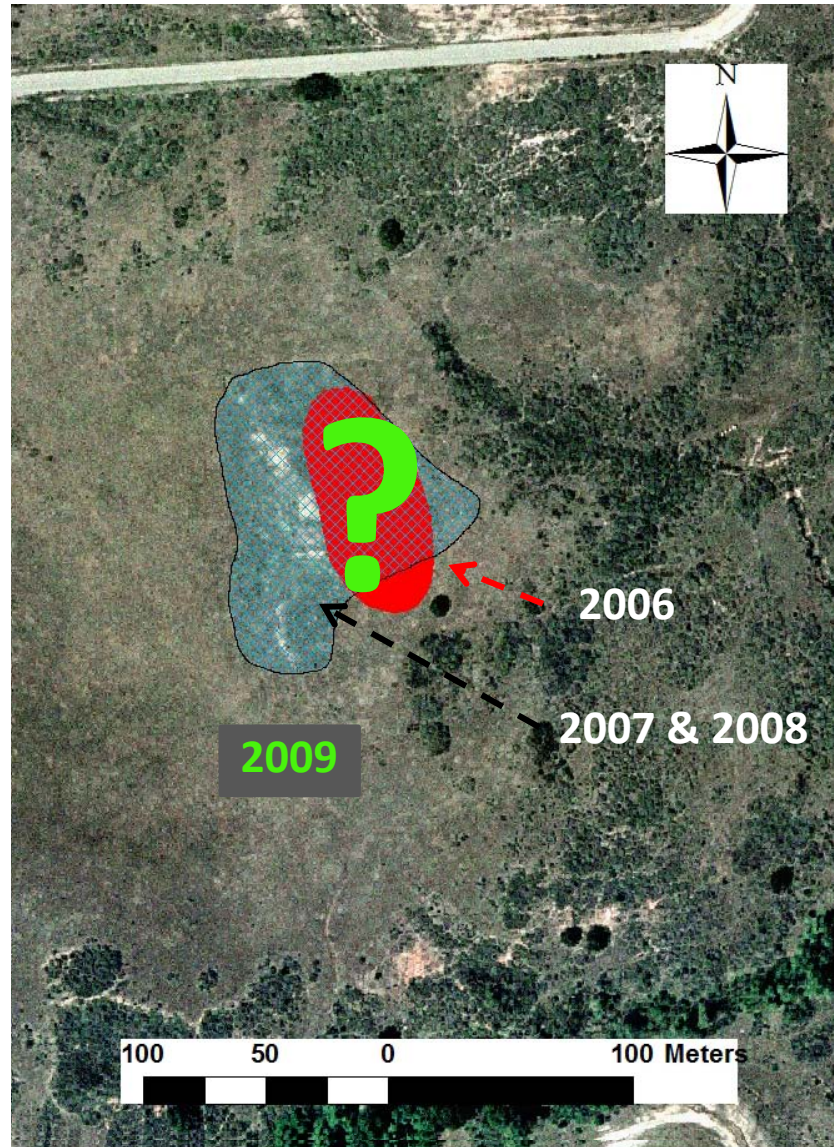
Initial Approach



Initial Approach



Initial Approach



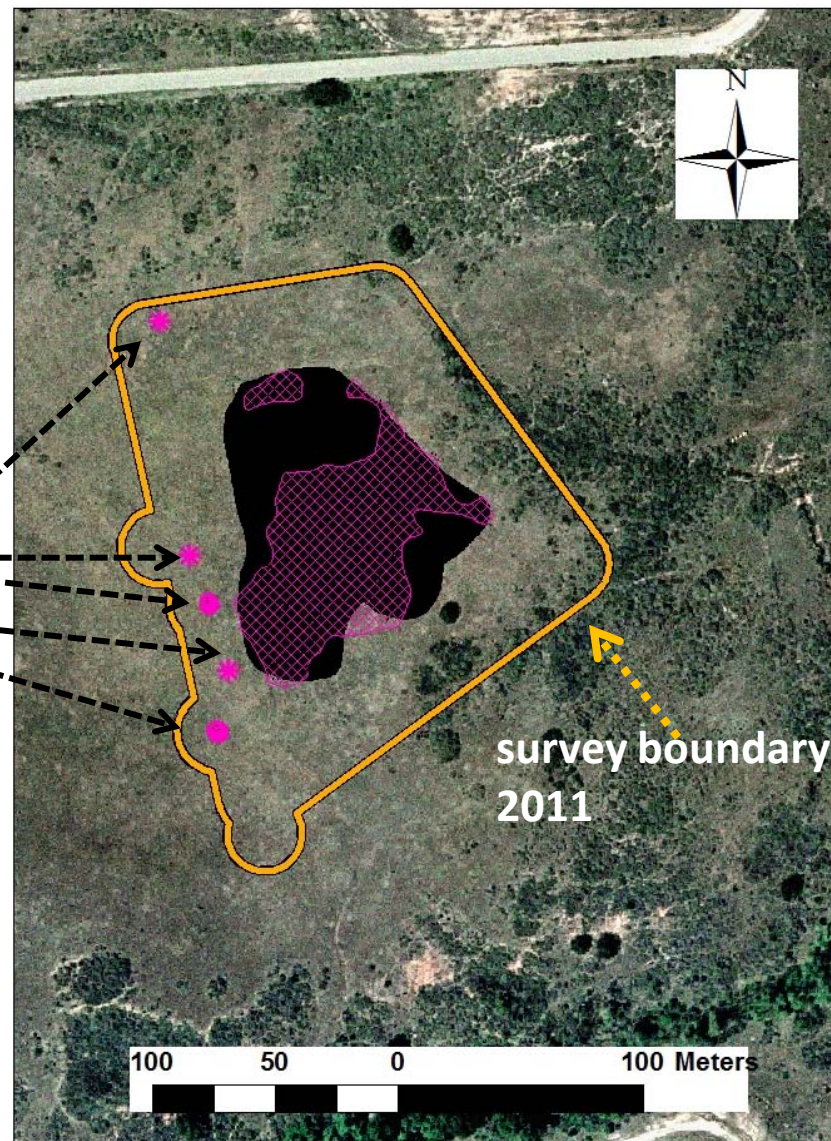


Initial Approach





Initial Approach



new observations

survey boundary
2011

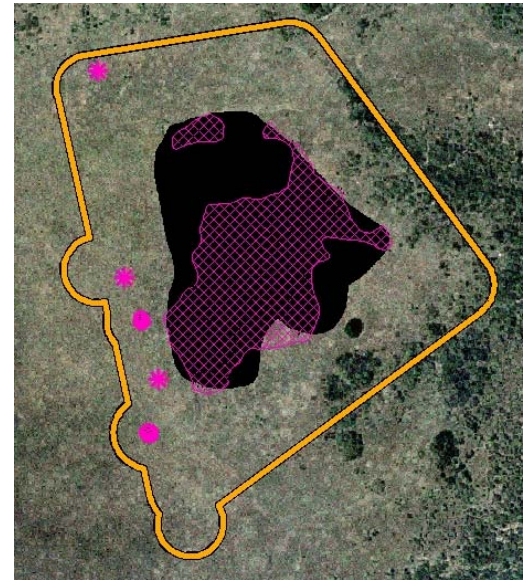
Legend

2007-10 treatments 

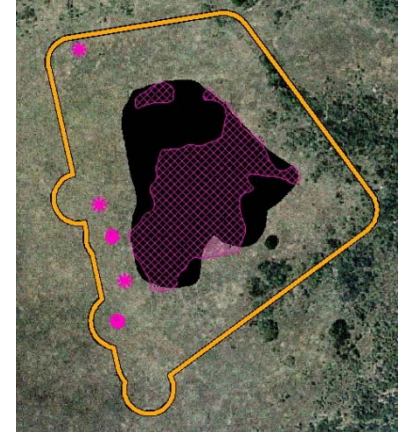
2011 treatment 

2011: Project Status

- **Spot treatment not working to eradicate population**
 - **population slowly expanding**
- **detectability declines with density**
- **optimal time for detection varies from year to year**



Adaptive Management: Reassess Objectives



■ Situation:

- Infestation larger than 2006 but still “contained”
- Risks still high – ecosystem impacts and management costs
- Eradication requires elimination of seed production until the seedbank is exhausted.

■ Finding:

- Eradication still appears feasible

But

- Methods need modification
- Knowledge gaps needed to be addressed

Adaptive Management: Reassess Methods

- **Broadcast method needed because not possible to identify every plant for spot treatment**
- **Methods considered:**
 - **Prescribed Burns**
 - **Tarping**
 - **Mowing**
 - **Broadcast Herbicide**
- **Chose broadcast herbicide application because other methods not likely to successfully eradicate species**



Adaptive Management: Uncertainty

- **Knowledge Gaps**

- **longevity of soil seedbank**
- **true extent of population**

- **Strategies to Obtain Information**

- **soil seedbank longevity study**
- **annual goatgrass surveys outside the treatment area based on likely modes of secondary dispersal**



Revised Approach

- **Broadcast herbicide treatments**
 - eliminate seed production until seedbank eliminated
- **Seedbank longevity study**
- **Surveys outside treatment area**
- **Prevention**
 - restrict grazing
 - biosecurity measures for conservation program personnel



Annual Program Assessment

- **Do viable seed remain in seedbank?**
- **Have plants been found outside treatment area?**
- **Do survey protocols need to be revised?**
- **Do project objectives remain feasible?**



**Do viable seed remain in
seedbank?**

Seedbank Longevity Study

- **Initiated in 2011**
 - **mesh seed packets with approx. 100 seed**
 - **predator proof plot cages**
 - **10 replicates; each replicate contains**
 - 3- surface packets
 - 3- 1 cm depth packets
 - 15- 10 cm depth packets
- **Annual germination tests**
- **Treatments to end after 2 years of no viable seed**



Results of Seedbank Study

- germination tests (n=3 reps; 50 seeds)

seed type	% germination for seed collected in	
	2011	2012
Small	88%	98%
Large	90%	92%



- buried seed: year 1 (n=10 seed packets)

depth of burial	seedling counts mean(stdev)		
	2012	2013	2014
surface	23.7(3.3)	1.6 (0.64)	n/a
1 cm	17.8(3.3)	0(0)	n/a
10 cm	3.4(1.1)	0.1(0.10)	0(0)

extracted
from field
germinated
in the lab

Results of Seedbank Study

- **Surprisingly seed longevity highest on surface.**
- **Plots burned in the Tomahawk fire.**
- **Any live seed likely killed in surface packets.**
- **Unfortunate because 6 seedlings emerged spring 2014 and intent was to carry out study until no live seed left.**

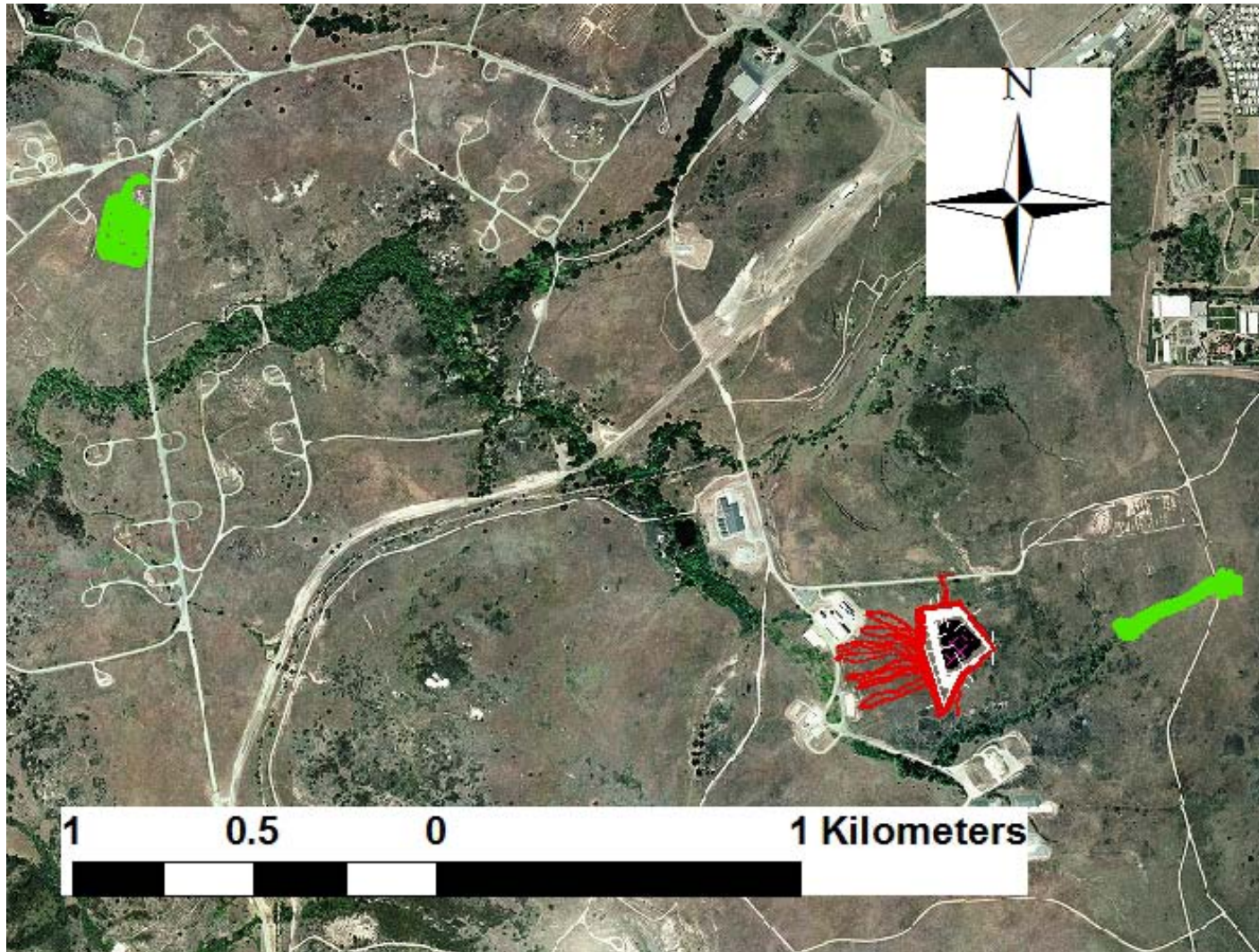


**Have plants been found
outside treatment area?**

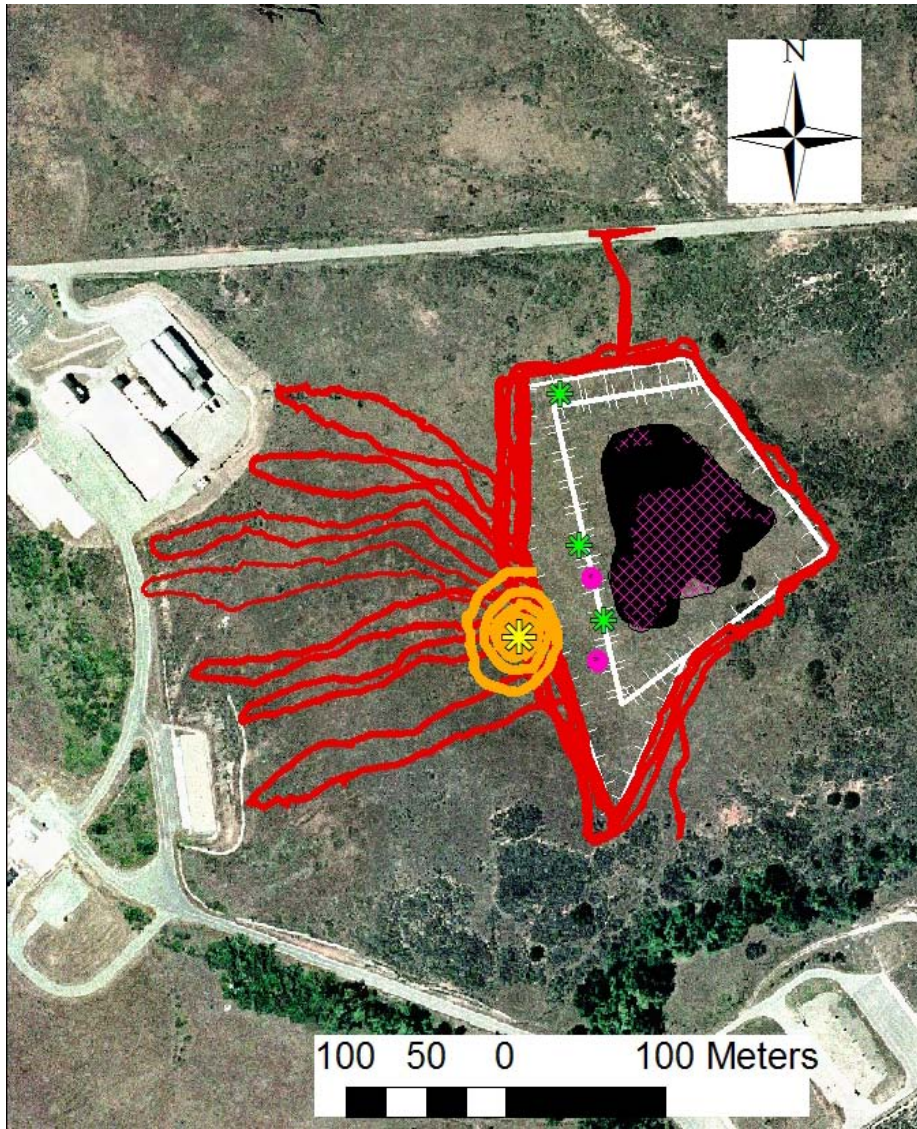
Surveys Outside Known Population

- **Vicinity of known population**
 - **considered topography, permeability of plant community**
- **Distant from known population**
 - **prior to 2005 livestock may have moved it further**
- **Ad hoc – alert biologists working on installation to look for it**

Surveys Outside Treatment Area



Results from Surveys



- **2012 – 0 plants**
- **2013 – 1 pop with 6 plants**
- **2014 – 0 plants**
- **2015 – 0 plants**

Project Assessment

- **Treatment duration may be shorter than anticipated**
 - **seed survival at 10 cm appears to be low**
- **The population appears to be contained**
 - **Labor intensive surveys can be effective in finding small patches**
 - **Dispersal on the order of 10's of meters appears uncommon**
- **The possibility of undetected dispersal remains**

Project Assessment

- **Project is on track**
- **Objective remains eradication**



Lessons Learned



- **Rapidly assess ecology of new species**
- **Even when the task seems simple clearly articulate it**
- **Doing adaptive management right takes effort and attention to detail**
- **When the objective is eradication – be
AGGRESSIVE**

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