

## Statewide weed education: what works, and what doesn't

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**Summary** For decades, the state of Nevada has largely ignored the issue of invasive weeds, especially those found in riparian areas. State statutes requiring control of noxious weeds have not been enforced. It is no surprise, then, that the proliferation of *Lepidium latifolium* L. (perennial pepperweed, called tall whitetop locally) finally reached epidemic levels and attracted the attention of legislators in 1999.

Tall whitetop is an exotic weed particularly suited to Nevada's saline and alkaline soils and riparian areas. Originating in south-eastern Europe and south-western Asia, it has been documented in California since the 1930s, and anecdotally in Nevada since the 1950s. From 1992 to 1999, estimates of infested area along the Truckee River grew from 4900 to 8100 hectares, and sightings in dry, rangeland habitats were also reported.

In 1999, the Nevada State Legislature appropriated US\$75,000 with the instruction that Cooperative Extension 'abate tall whitetop.' The funds were used to launch a two-year Tall Whitetop Initiative, a public education and action campaign to teach Nevadans how to recognise, control and prevent further spread of this invasive species. This was the first-ever statewide weed education program in Nevada. The goals of the campaign were to increase the average citizen's ability to recognise tall whitetop and identify its detrimental qualities; teach people appropriate control methods and motivate them to apply these controls; identify and map tall whitetop infestations; and educate Nevadans about the damage and costs associated with noxious and invasive weeds.

A variety of methods were used to convey these messages, including a newspaper supplement that was inserted in nearly every major Nevada newspaper (130,000 copies); printed full-colour fact sheets; posters and displays incorporating handouts; bookmarks; television and radio public service announcements (PSAs); news releases; workshops, training sessions, demonstration sites, tours and weed pulls; billboards; t-shirts; a video; a slide presentation; and a website.

The newspaper insert and PSAs were effective at reaching the general public, although it was impossible to quantify impacts. However, nearly 400 phone calls were logged into Cooperative Extension offices after the campaign was launched in May 2000. Workshops,

training events, slide shows, and demonstrations aided in weed identification and motivation, and thousands of fact sheets were distributed to callers and attendees. The public reported hundreds of weed locations, which were then added to the state weed map. Collaborations resulted in \$218,022 in matching funds and labour allocated to the project.

We soon discovered, however, that while we were effective at increasing the public's ability to identify tall whitetop, and identify the problem of invasive weeds, they were reluctant to take personal action. Many callers assumed 'someone else' would take care of the problem. We also found that our methods did not adequately educate state legislators.

**Keywords** Statewide weed education, perennial pepperweed, *Lepidium latifolium* L., Tall Whitetop Initiative.

### INTRODUCTION

Tall whitetop (*Lepidium latifolium* L., *Brassicaceae*) is formally known in the United States as perennial pepperweed. This perennial is native to southeastern Europe and south-western Asia (Young *et al.* 1998). It appears to have been introduced to the United States as a contaminant of sugar beet seed (*Beta vulgaris* L.) imported from eastern Europe (Young *et al.* 1995). Native, desirable plants are quickly displaced by this invasive weed, resulting in a monoculture of tall whitetop (Renz and DiTomaso 1999).

One of the first infestations in California was traced to seed imported to Yolo County in the Sacramento Valley (Robbins 1940, Young *et al.* 1997). It is currently found along the east coast from Massachusetts to Long Island, New York, in the central Great Plains, all western states, Mexico, and Canada (Robbins 1940, Rollins 1993, Young *et al.* 1997). Tall whitetop is on the prohibited list in Western Australia (Western Australia Department of Agriculture 2002).

Tall whitetop commonly grows 0.5 to 1 m tall, but may reach 2 m or more in height in wet areas (Young 1995). The base of the stem is semi-woody, growing from a woody crown at the soil surface. The leaves form a basal tuft and have toothed blades that taper to an elongated petiole. The upper leaves are much reduced in size and sessile, but do not clasp the stem (Young 1995). The white flowers occur in clusters

of six to eight in dense panicle. The plant generally blooms during midsummer, and the profuse white flowers result in the common name 'tall whitetop.'

Tall whitetop is a prolific plant, capable of producing more than 16 billion reddish-brown seeds per hectare (Young *et al.* 1997). The seeds are borne in individual tiny flattened pods, 1 to 2 mm in diameter. The seeds are released at irregular intervals during the winter. The dynamics of the seed bank are not well understood, although laboratory tests have shown that the seeds can be highly viable over a wide range of temperatures (Miller *et al.* 1986). Seedlings of tall whitetop are difficult to recognise, as the pale green cotyledons are easily confused with many other adventitious mustards.

A more significant method of propagation occurs via expansion of creeping underground roots that grow 1 to 3 m from the original plant and send up shoots to form new plants. The majority of root mass occurs in the top 60 cm of the soil, and constitutes 40% of the plant's overall biomass (Renz and DiTomaso 1999). Plants can grow from extremely small segments of roots.

Tall whitetop is very tolerant of halomorphic soils, both in coastal and interior areas (Young *et al.* 1997). It establishes first along river systems from the lower edge of coniferous forests to saline/alkaline deltas and sinks, invading riparian areas and wetlands (Young *et al.* 1995). It is not, however, restricted to salt influenced soils. It is also found in native hay meadows, abandoned agricultural lands, pastures, hayfields, residential areas and along roadsides. The impacts include decreased forage nutrient value, loss of waterfowl nesting cover, decreased habitat diversity and species numbers, and water quality degradation due to increased rates of soil erosion (Young *et al.* 1998).

From 1992 to 1999, estimates of area infested along the Truckee River in Northern Nevada grew from 4900 to 8100 hectares, and sightings in dry, rangeland habitats were also reported. A catastrophic flood of the Truckee in 1997 contributed to the rapid spread of this weed into the Carson River drainage via the Truckee canal, and into many other areas previously considered too dry to support growth of tall whitetop. Concern grew among the agricultural community after shipments of infested hay were refused at the California border in 1998. Media also began to focus attention on the increasing problem of invasion into parks, recreational areas and subdivisions. By 1999, constituents were clamouring for a solution to the problem, and the Nevada State Legislature appropriated \$75,000 to University of Nevada Cooperative Extension to 'abate tall whitetop.'

## MATERIALS AND METHODS

University of Nevada Cooperative Extension is the outreach arm of the University, providing programs designed to address critical community needs and issues. While weed identification and management programs were underway in several counties in 1999, there was no unified statewide approach to weed education, nor did a state weed plan exist. State law (Nevada Revised Statutes 555) listed 29 noxious weed species and placed responsibility for control on each landowner or occupier; however, no practical mechanism for enforcement existed.

After convening a series of meetings of educators with experience or interest in weed management, we determined that the goals of our weed education program were to (1) increase the average citizen's ability to recognise tall whitetop and identify its detrimental qualities; (2) teach people appropriate control methods and motivate them to apply these controls; (3) identify and map tall whitetop infestations; and (4) educate Nevadans about the damage and costs associated with noxious and invasive weeds. We decided to take a three-pronged approach that included public awareness and education; mapping and inventory; and demonstration and weed eradication.

**Public awareness campaign** The public awareness campaign focused on the slogan 'Tall Whitetop: It's Not Just a Pretty Face' to emphasise the deceptive appearance of the weed. The primary messages of the public awareness campaign were: watch for, identify, and report sightings of the weed; join volunteer efforts aimed at mapping and control; take personal responsibility; and 'help fight the war on weeds'.

A variety of outreach tools were developed, including an eight-page full colour newsprint tabloid. Inserting the piece into 20 newspapers around the state in May 2000 allowed distribution of 130,000 copies. An additional 20,000 copies were distributed at educational workshops, fairs, and other activities. News releases and television and radio public service announcements accompanied the inserts. An existing fact sheet including specific information on control was updated and printed in full colour. A video produced in 1998 was re-edited to reduce the length to nine minutes, and copies were distributed and shown statewide. Full colour billboards were placed at various locations throughout the state urging residents to 'Watch Out For Tall Whitetop Weed - Call xxx.' Other tools included stand-up posters distributed by volunteers, bookmarks, one-page fliers, signs for state parks and demonstration gardens, travelling exhibits, a scripted slide show used for educational presentations, and t-shirts for volunteers involved in mapping

and control projects. Many presentations, workshops, educational events and demonstrations accompanied the awareness campaign.

**Mapping and inventory** Because no comprehensive inventory of tall whitetop infestations had been completed by 1999, an immediate focus was to locate and map as many infested hectares as possible using Geographic Information System (GIS) techniques. With the support of federal land managers (responsible for the public lands that comprise 87% of the state of Nevada), infestations along the Walker, Carson, and Humboldt Rivers and the Tahoe Basin were mapped. A new infestation was discovered in the Las Vegas Wash, the first known occurrence in southern Nevada. A map was constructed showing estimates of tall whitetop acreage as of 2001. All 17 counties were infested to some extent, ranging from 0.2 ha in Esmeralda County to 5000+ ha in Washoe County.

The mapping data was used both to increase public awareness of the extent of the problem and to allow for feedback and evaluation of weed control projects.

**Demonstration and weed control projects** A variety of demonstration and weed control projects were initiated throughout the state. In agricultural areas, projects included workshops at which control methods were demonstrated. Other projects enhanced cooperation among counties or river groups to encourage an integrated approach to weed identification, mapping, and control. White Pine, Nye, and Lincoln counties formed a Tri-County Weed District, complete with funding allocated to tall whitetop control. The Humboldt County Noxious Weed Task Force used prison crews to spray a 2.4 km demonstration site along the Humboldt River, working with federal, state, and local partners. Volunteer 'Weed Warriors' attended a seven-hour training and then became active in various projects, including pulling and mapping in a variety of locations. Youth were involved via the 4-H Club program, with sheep used to graze seedlings in a fenced riparian area.

Agricultural economists collaborated with educators to conduct a benefit-cost analysis using the West Fork of the Walker River as a case study area. The project examines the ecological and economic impacts of various chemical treatment and revegetation strategies to help land managers better control tall whitetop. In addition, a study on the cost of delaying treatment was performed.

RESULTS

Following the launch of the public awareness campaign in May 2000, nearly 400 phone calls were logged into Cooperative Extension offices, and more than 100 new

tall whitetop sightings were reported by the public. The television and radio PSAs appeared to be the most universally recognised elements by the public. Most billboards were placed at locations selected by companies that donated the space, and thus placement was not always optimal.

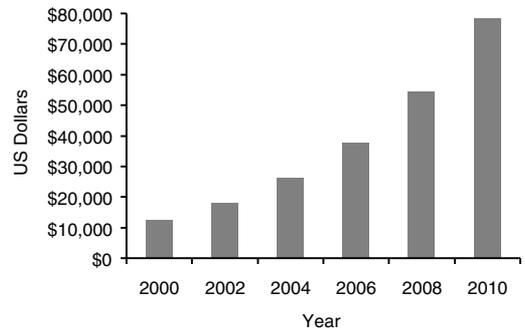
Acreage treated with herbicides varied by project. All known locations in the Tahoe Basin, the Nevada State Railroad Museum and the Las Vegas Wash were treated. In Douglas County, all 60 known infestations (46.5 ha) were mapped and sprayed. Forty ha along the Walker River were also treated, as was a 2.4 km stretch along the Humboldt River. In Elko County, a 7.3 ha demonstration area was mapped, burned, and sprayed.

The economic analysis of the cost of delaying treatment was estimated based on a theoretical annual expansion rate of 20 percent. The initial cost of treatment was derived from data from the Douglas County tall whitetop control project. Delaying control for four years would more than double the first-year costs, demonstrating that a failure to devote resources initially results in a much greater financial burden in the future (Figure 1).

The initial allocation of \$75,000 from the legislature was matched almost three-fold by in-kind contributions from a variety of sources (Table 1), allowing for a broadening of project scope and coverage.

DISCUSSION

The basic project goals required a number of steps: first, develop awareness about the invasive weed problem using tall whitetop as an example; next, provide education so that the public could identify the weed and assist in inventory efforts; and last (and perhaps most important) change behaviour to create acceptance



**Figure 1.** Increased costs associated with delayed treatment (assumes 20% annual expansion rate). From Eiswerth *et al.* 2001.

**Table 1.** In-kind support.

| Amount    | Source  |
|-----------|---|
| \$173,382 | Outside funds, donated equipment, chemicals and labour                    |
| \$2,640   | Labour from Weed Warriors and other western Nevada volunteers (264 hours) |
| \$42,000  | Donated time (TV, radio) and space (newspapers and billboards)            |
| \$218,022 | Total   |

of personal responsibility for managing tall whitetop. The first two goals — awareness and education— were largely achieved by our three-pronged approach. Based on statewide feedback, the number of individuals who were aware that tall whitetop was a serious problem increased, as did their ability to identify the plant.

We found that certain materials were more effective than others. Events such as weed pulls helped create awareness because the press responded well to press releases to promote the events, and gave them great coverage. On the other hand, the billboards were so complex in their design that it was difficult for viewers to read and comprehend them at high-speed locations.

We soon discovered, however, that while we were effective at increasing the public's ability to identify tall whitetop, and identify the problem of invasive weeds, they were reluctant to take personal action. Many callers assumed 'someone else' would take care of the problem. Some of the frustration resulted from an increase in the number of individuals familiar with Nevada's unenforced weed statutes.

We also learned that we had created a pent-up demand for an easy and effective solution for a weed species that is complex and difficult to control. We lacked a well-organised and coordinated volunteer program that would be ready to funnel the energies of the newly-aware public into constructive projects. We also lacked a 'cookbook' one-size-fits-all approach to the control of tall whitetop, which frustrated the public further.

Lastly, we discovered that our methods did not adequately educate state legislators, who perceived the awareness campaign as disconnected from behaviour change (i.e., legislators were only interested in 'dead weeds').

During the year since the initiative ended, however, awareness continues to grow, as evidenced by

the formation of a Tahoe Basin Weed Coordinating Group; efforts on the part of Washoe County to create an integrated weed management area; and other groups that have formed to fight invasive weeds.

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