Deschutes National Forest
Region 6 FID Technology Development Project Proposal
submitted by Katie Grenier, Helen Maffei, and Gregg Riegel
10/12/99

PROJECT STATUS: New, not previously funded.

PROJECT NUMBER: R6-2000-01

PROJECT TITLE: Noxious Weed Site Revegetation.

SUBJECT: Revegetation of noxious weed sites.

PROJECT OBJECTIVES:

1. Test the effectiveness of revegetating noxious weed sites using the model developed by Sheley et. al. (1996) (described below under "Research Basis"). Specific questions:
    - Did native plant species effectively colonize the site?
    - Was there a reduction in density, frequency and/or cover of the noxious weed(s)?
2. Develop revegetation prescriptions that enhance native plant community diversity and weed-resistance. Specific questions same as above for #1.
3. Develop and test revegetation method(s) on dry sites with the levels of disturbance commonly encountered in central Oregon. Long-term objectives of testing revegetation on roadside sites are: 1) to determine long-term solutions for reducing noxious weed populations, thereby preventing further transport of seeds into National Forest land, reduce the reliance on herbicides, and 2) meet vegetation management objectives for a variety of agencies (e.g., Oregon Dept. of Transportation, Oregon Dept. of Fish & Wildlife, Deschutes National Forest Service, and Deschutes County Public Works). Specific questions:
    - Did the revegetation project meet road management objectives?
    - Did the revegetation project change the roadside environment to be unfavorable for the establishment of weeds?

BRIEF DESCRIPTION OF PROJECT: Test effectiveness of revegetation using native plant species with various spatial and temporal resource use strategies on noxious weed sites that represent different disturbance intensities. However, introduced plant species may be tested for use along highly disturbed sites such as state highways.

FHP PERSON WHO WILL LEAD THE PROJECT: Helen Maffei, Central Oregon Area IV Pathologist.

JUSTIFICATION: Developing weed-resistant plant communities is a long-term solution to preventing noxious weed establishment and reducing existing noxious weed populations. There are many potential benefits including potential reduction in the need for herbicides, increased ecosystem resilience, increased forage and nesting material for birds and small mammals, etc.

URGENCY: Currently, fire hazard conditions on the Deschutes National Forest are extremely high due to years of fire suppression and correlated build-up of fire fuels. Many of the noxious weed species that threaten the relatively weed-free Deschutes National Forest proliferate following fire. It is urgent that we develop strategies to revegetate sites. While the Deschutes National Forest is relatively weed-free, adjacent communities such as Bend, Sisters, and Redmond, Oregon contain large infestations that will provide an increasing source of seeds onto the Forest. If we can revegetate disturbed sites and shift the balance in favor of native plants, we

can reduce the potential seed sources and risk of further invastion, as well as provide revegetation recommendations following fires in areas of noxious weeds and to private landowners to try and solve weed problems at urban interface areas.

LINK TO NATIONAL FHP TECHNOLOGY: This proposal addresses Objective #4: Proposals that deal with management of exotic weeds, that result in technologies or methods that contribute to our ability to prevent introductions.

SCOPE OF APPLICATION: At a minimum, the results of this project would be applicable to the Deschutes, Ochoco, Winema and Fremont National Forests, Prineville BLM, and private landowners, particularly in urban interface areas.

RESEARCH BASIS: Sheley et. al. (1996) proposed a model for weed management that is based on the primary causes of plant succession: site availability, and availability and performance of different plant species. The goal is to shift the dynamics toward a desired plant community. A healthy, weed-resistant plant community consists of a diverse group of species which occupy most of the niches. These communities may include an early emerging species (e.g., shallow-rooted Sandberg's bluegrass, *Poa sandbergii*), which uses the resources that are available in the upper soil profile early in the growing season and during periods of light precipitation. As the season progresses, species which initiate growth later, and continue growth later into the season, are needed to use available soil resources from moderate soil depths. Finally, the diverse plant community may include a deep taprooted, very late maturing species, such as big sagebrush (*Artemisia tridentata*). These species are capable of extracting resources from deep in the soil profile and throughout much of the growing season.

Herbicides provide an opportunity to open niches for two to three years -- to create opportunities to revegetate, introducing desirable plant species and taking advantage of the residual native plant community (Sheley 1998, personal communication). Using the model described above, Sheley suggests comparing rooting depth, phenology and growth rates of groups of species to design weed-resistant plant communities.

In a more recent publication (Sheley and Petroff 1999), the authors state that introducing and establishing competitive plants is essential for successful management of weed infestations and the restoration of desirable plant communities. The authors provide suggestions on treating noxious weeds at selected sites and then revegetating those sites. A combination of disking the soil and herbicide application reduces the number of weed seeds in the seedbank and reduces weed competition the following spring. On sites that are inaccessible to machinery, site preparation is limited to removal of competitive plants via herbicide or fire. The authors suggest that in areas where the soil is not tilled, one should use a higher seeding rate than would be used on plowed ground.

METHODS: The hypothesis to be tested is: Can we revegetate a site so that a weed-susceptible area becomes resistant to colonization by noxious weeds (such as spotted knapweed and dalmation toadflax) and that there is a decrease in density, frequency or biomass of noxious weeds, while an increase in density, frequency or biomass of native plant species? A paired experimental design would be used to test the effects of treatment (i.e., revegetation) vs. no treatment. Repeated measures analysis and ANOVA (Analysis of Variance) would be used to test the difference between treatment means.

The revegetation treatments would test a variety of plant species (native and possibly non-native) based on a thorough literature review, selecting species appropriate for each site based on their spatial and temporal resource uses, and site characteristics (i.e, existing vegetation, plant association, precipitation zone, site capability, and expected frequency of future disturbance).

It is planned to conduct these tests on sites that represent three disturbance intensities:

- High frequent disturbance (potential sites include State Highway 97 and Tenmile Snow Park).
- High infrequent disturbance (potential sites include along Indian Ford Road on Sisters Ranger District, a former dump site near Sisters Ranger District and an area called "Skeleton Fire" that burned in 1996).
- Low to Moderate disturbance (potential sites include fish access areas along Fall River, Tumalo Creek and off-trail sites at Pilot Butte in cooperation with State Parks and the Native Plant Society of Oregon).

Three to five study areas would be chosen representing disturbance intensities. The Review Team has suggested that 3-5 areas total would probably not be enough replications and we should consider dropping one of the regimes. If this project is funded, we will evaluate this and make a decision. If we drop a disturbance regime, it is likely that we will drop the low to moderate disturbance sites because these sites usually have well-established native plant populations that are available to spread naturally into areas cleared of noxious weeds by manual and/or chemical treatments.

At each of these study areas, we would establish six macroplots (three control replicates and three treatment replicates). Macroplot size will be consistent for the control and treatments at each study area but may vary between different study areas; macroplot size will depend on the size of the noxious weed infestation and may range from .5 ac. to 1 ac. in size. Pre- and post-treatment data on plant species density, nested frequency, and/or biomass would be collected.

On each site, noxious weeds would be eliminated by one of the following methods: manual, chemical, or fire. Following elimination of noxious weeds, treatment areas would be revegetated with no revegetation occurring in the control areas. If this project is accepted, revegetation choices will be preceded by a rigorous literature review and consultation with Tony Svejcar (Research Unit Leader, Burns, OR and co-author on Sheley et. al. 1996), Roger Sheley (lead author of Sheley et. al. 1996), Paul Doescher (Professor of Rangeland Resources, Oregon State University), Lee Eddelmann (Professor of Rangeland Resources, Oregon State University), and Deschutes National Forest Botanists.

To determine if the established vegetation is actually reducing noxious weed invasion, sites would be monitored for a minimum of three years, yet we hope to continue long-term monitoring for 5-10 years. Prior to implementation, site-specific management and sampling objectives would be developed. The following exemplifies the type of management and sampling objectives that may be established:

> <u>Management Objective:</u> Decrease frequency of spotted knapweed at the selected site along Indian Ford Road by 75% by year 2003 and see this reduction maintained or further reduced by year 2005.
>
> <u>Sampling Objective:</u> To be 90% certain of detecting a 75% decrease in the frequency of reed canary grass with a false change error rate of .1.

The Review Team has requested that we address how we will measure or challenge the remaining invasive species seed bank. An invading plant species is not eradicated until its vialbe propagules are depleted from the soil (Sheley and Petroff 1999). A model developed by Zamora et. al. (1989) predicts the years required to deplete the viable propagules (i.e., seed bank), incorporating natural factors that affect reproduction and the probability of escaping eradication. They found that when 99.9% of common crupina (Crupina vulgaris) is controlled, less than 1 seed/m2 remains in the soil after two years. When 95% of common crupina is controlled, it takes 138 years before the seed bank declines to less than 1 seed/m2. As long as control is less than 100%, there will always be viable seeds in the soil, emphasizing that reproduction must be stopped completely if eradication is to succeed. In this study, we cannot attempt to totally eliminate the seed bank and we do not intend to measure the seed bank. However, we can

estimate the amount of seed that may be in the seed bank, based on known biology of the species at each site. We can attempt to reduce the seed bank by using a residual herbicide that affects germinating seedlings.

Study areas will require internal and interagency coordination in order to ensure that these areas are not inadvertently disturbed. Signs may be required on some sites. If state or county roads are selected for this study, we will coordinate with Oregon Dept. of Transportation and Deschutes County Public Works.

MEASURE OF SUCCESS: A significant **decrease** in noxious weed abundance (density, frequency, or biomass) in treatment areas compared to control areas, and a significant **increase** in abundance (density, frequency, or biomass) of native species.

POTENTIAL COOPERATORS: The following cooperators have expressed interest to begin or continue working with us on stewardship issues related to noxious weeds and/or revegetation. Cooperators would provide labor instead of matching funds, and would pull weeds, collect native seeds and plants, and help revegetate the noxious weed sites.

- A **consortium of 6 state & federal agencies, one non-profit organization, and one homeowner's association** has obtained a grant from the Governor's Watershed Enhancement Board to do a two-year noxious weed education program. As part of this program, we will be controlling noxious weeds in 3 demonstration areas by involving the public in control efforts. We will attempt to establish at least one study area within one of these demonstration areas. These partners are: Deschutes National Forest, Deschutes County Watershed Council; Deschutes Co. Public Works, Oregon Dept. of Agriculture, Oregon Dept. of Fish & Wildlife, Native Plant Society of Oregon, Prineville BLM, and Woodside Ranch Homeowner's Association.
- **Boy Scout Troop** #18 (active stewardship partners in controlling knapweed at a popular recreation site that is a potential revegetation site).
- LaPine **Garden Club** (Partner in successful revegetation of a site in Newberry National Volcanic Monument, and interested in helping us revegetate a noxious weed site in the same area).
- Sisters **Middle School** (unconfirmed partner, yet long history of involvement by students in revegetation and data collection for projects on Sisters Ranger District).
- **Central Oregon Intergovernmental Council** (COIC) (This program for at-risk youth provides education and work experience for troubled kids while helping complete projects on the Deschutes NF. For several years, COIC crews have helped collect native plant seeds and manually control noxious weed sites on the Deschutes NF.
- **Youth Conservation Corps** (YCC). (In FY99, there may be up to 11 crews available to do projects across the Forest. These crews have helped collect native plant seeds and manually control noxious weed sites on the Deschutes NF.)

PRODUCTS: We would develop guidelines for revegetating noxious weed sites based on what we learned in this study. These guidelines would be available in FY 2002, and distributed to central Oregon agencies (e.g., Deschutes, Fremont, Ochoco and Winema National Forest employees, Prinevill BLM, Deschutes County Public Works, Oregon Dept. of Transportation) and private landowners in the communities of Bend, Sisters, Redmond, and LaPine Oregon.

PUBLICATION: Effectiveness of revegetating noxious weed sites in various disturbance intensities in central Oregon.

TECHNOLOGY TRANSFER: Development of a list of guidelines that would be distributed to National Forests east of the Cascade Mts. and made available to private landowners in urban interface areas.

PROJECT DURATION: We are requesting funding for 3-5 years.

LONG TERM BUDGET:

FY 2000	$27,430
FY 2001	9,115
FY 2002	$ 6,320
FY 2003	$ 6,320

FY 2000 BUDGET REQUEST:

Item	Requested FHP STDP Funding	Other Sources amount	Organization Name
Admin Items:			
Salary	$26,800	9,000	contributed input from Dr. Helen Maffei and Dr. Gregg Riegel.
		4,740	YCC Crews
Overhead			
Travel (Vehicle & Gas)	200		
Procurements:			
Equipment			
Supplies			
Signs	300		
Monitoring Equipment	100		

TOTAL FY 1999 BUDGET: **$41,140 (includes contributed time)**

BENEFIT AND COST: See Appendix 1.

LITERATURE, CITATIONS, ATTACHMENTS, etc.:

Sheley, Roger L., Tony J. Svejcar, and Bruce D. Maxwell. 1996. A Theoretical Framework for Developing Successional Weed Management Strategies on Rangeland. Weed Technology, Volume 10:766-773.

Sheley, Roger L. 1998. Personal communication. Plant, Soil and Environmental Sciences Department, Montana State University, Bozeman, Montana.

Sheley, Roger L. and Janet K. Petroff (Editors). 1999. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis, Oregon.

Enclosure 2a

Appendix 1. STDP PRODUCTION FUNCTION

PROJECT NUMBER: R6-99-01

PROJECT COST: $70,485
STDP REQUEST: $56,745

PROJECT OBJECTIVE (BRIEF DESCRIPTION OF THE PROJECT AND EXPECTED OUTCOME):
To determine if it is effective to revegetate noxious weed sites by using native or non-native plant species that occupy different niches thus preventing noxious weeds from establishing on the site. Intangible benefits not quantified are increased ecosystem resilience and sustainability, and improved wildlife habitat.

ASSUMPTIONS:
- Noxious weeds, once established, are difficult to control and eliminate.
- Revegetating noxious weed sites would decrease threats to neighboring uninfested lands from noxious weed encroachment.
- Revegetation of noxious weed sites could provide a long term solution to the noxious weed problem in some areas.
- An area that contains a diversity of plant species that use different spatial and temporal resources (i.e. occupying different niches) is more weed-resilient than an area that has low species diversity and the species occupy essentially the same niche.
- Approximately 2200 acres with noxious weeds will be treated each year; approximately 1000 of those acres will be treated using the species replacement alternative.
- In both treatment scenarios a combination of herbicide treatment and handpulling for two years will be required to initially remove most, but not all noxious weeds from the sites.
- Because of the number of acres to treat, land managers would not return to the same site for more than two years of consecutive treatment; however, it could take as many as eight years of persistent treatment to completely remove the weed species from a site.
- In both treatment scenarios residual weed species will remain; in the absence of competing native species the weed species will re-occupy the site within 2-3 years; on revegetated sites, appropriate species will out-compete noxious weeds for available niches.
- On traditionally treated sites, once the noxious weeds have re-established and occupy the site, they will continue to spread onto surrounding uninfested lands at the rate of 14% per year for the next 3 years, at which time the original area plus the area invaded at 14% per year (1000 acres plus 920 acres = 1920 acres) area will be retreated with the previous treatment regime of a combination of herbicide and mechanical treatment the first year, followed by additional hand-pulling the second year.

BACKGROUND DATA:
With Traditional Treatment
- Control of noxious weeds averages $332/acre for manual treatments, $90/acre for chemical, and $45/acre for biological control (USDA Forest Service 1998). A combination of manual and chemical treatment would cost $422/acre.

- Treatment scenario:
  - -year 0 - 1000 acres herbicide plus handpulling = $422/acre
  - -year 1 - additional handpulling on 1000 acres = $332/acre
  - -years 2-3 - weeds will become re-established as a result of latent seed, remaining weeds and reinvasion.
  - -years 4-6 - weeds will continue to occupy the site and spread at a rate of 14%/yr to uninfested area.
  - -year 7 - 1920 acres will be treated with handpulling and chemical treatment
  - -year 8 - follow-up handpulling will be conducted.

With Site Revegetation Treatment:

- Costs for grass seed production at J.Herbert Stone Nursery varies considerably. Examples of the cost of various species of grass seed per acre are:
  Bromus carniatus - $2975/acre; *Deschampa elongata* - $24/acre; *Pao secunda* - $344/acre; and
  Fescue idahoensis - $1578/acre. These grasses are representative of the range of costs of native grasses per acre.
- Assuming a 1:1:1:1 mix of each species, an average of $880/acre as a cost for rehabilitating a site with native seed.

- Treatment scenario:
  -year 0 - 1000 acres herbicide plus handpulling($422/acre) + $880/acre for native seed = $1302/acre
  -year 1 - additional handpulling on 1000 acres = $332/acre
  -year 2-8 - revegetated native species are fully occupying the site and out-competing the noxious weeds.

CALCULATIONS

EXPENDITURE & OUTPUT VALUES (EOV) WITHOUT PROJECT:

year	costs	present value costs (discounted 4%)
0	$422,000 (handpulling + herbicides)	$422,000
1	332,000 (handpulling)	319,615
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	$810,240 (handpulling + herbicides)	$618,503
8	618,240 (handpulling)	465284
total		**$1,825,402**

EXPENDITURE & OUTPUT VALUES (EOV) WITH PROJECT:

year	costs	present value costs (discounted 4%)
0	$422,000 (handpulling + herbicides)	$422,000
1	332,000 (handpulling)	319,615
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
total		**$1,621,615**

BENEFIT (CHANGE IN EOV) ATTRIBUTABLE TO PROJECT:
B = $(with) - $(without)

Benefit = $1,825,402 - $1,621,615 = $203,787

BENEFIT/COST RATIO:
B/C = $(with) - $(w/o)
$(STDP cost) + $(treatment cost, where applicable)

$203,787/ ($56,745+$13,680) = 2.89

BENEFIT ATTRIBUTABLE TO STDP:
Benefit attributable to STDP funds = $(STDP cost) x (B/C)

$56,745 x 2.89 = $163,993

PNV OF PROJECT:
PNV of project = $(Benefit) - $(cost)

$203,787 - $70,455 = $133,332

PNV OF STDP:PNV of project = $(Benefit attributable to STDP) - $(STDP cost)

$163,993 - $56,745 = $107,248

Appendix 2. Estimated timeline, tasks, and costs for the Noxious Weed Site Revegetation Study.

Budget for Noxious Weed Revegetation Study -- 10/12/99					
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GS-Level	**Cost per Day**	**# Days**	**Total Cost per Task**	**Timeline**	**Task**
GS-11	220	20	4,400	Apr-00	Scientist consultation & sumarize applicable literature from literature review that was completed in fall 1999. Develop criteria for selecting revegetation sites. Develop site-specific management & sampling objectives.
GS-11	220	7	1,540	Apr-00	Partnership development & coordination.
GS-11	220	7	1,540	May-June 00	Select range of potential noxious weed sites using GIS analysis (soil types, plant associations) & field reviews.
GS-9	180	5	900	May-June 00	Develop educational signs and plan to restrict disturbances. Coordinate with district personnel & projects.
GS-11	220	5	1,100	May or June 00	Site-specific soil analysis to determine site condition.
GS-11	220	5	1,100	May or June 00	Site-specific vegetation condition analysis (to evaluate presence of residual native plant community within & adjacent to site.
GS-11	220	10	2,200	May or June 00	Develop list of revegetation species by comparing rooting depth, phenology, and growth rates of groups of species.
GS-11	220	8	1,760	May-July 00	Develop & write monitoring plan to evaluate project success. Peer review of monitoring plan.
GS-11	220	8	1,760	Jun-00	Collect pre-treatment data (3 days prep to gather equipment, design data form, set up database; 1 day/site to collect data X 5 sites).
			7,000	May-July 00	Treat noxious weed sites (mostly manual and/or chemical treatments; may consider burning one potential site. Treatment costs average: Manual = $330/ac; Chemical - $90/ac; Burning = $125/ac.
GS-7	175	20	3,500	June-Sept. 00	Collect native plant seeds.

Subtotal FY 2000 Funding Needs			**26,800**		
GS-7	155	5	775	Oct-Nov 00	Site preparation, sowing, transplanting.
GS-9	180	10	1,800	Oct-Nov 00	Site preparation, sowing, transplanting.
GS-11	220	10	2,200	Oct-Nov 00	Site preparation, sowing, transplanting. Field review by project lead.
GS-11	220	7	1,540	Dec-00	Preliminary report summarizing 1st year results. Enter data into database.
GS-11	220	10	2,200	Jun-01	Field monitoring of sites.
Subtotal FY 2001 Funding Needs			**8,515**		
GS-11	220	16	3,520	Fall 2001	Enter data, analyze results, write progress report.
GS-11	220	10	2,200	Jun-02	Field monitoring of sites.
Subtotal FY 2002 Funding Needs			**5,720**		
GS-11	220	116	3,520	Fall 2002	Enter data, analyze results, write progress report.
GS-11	220	10	2,200	Jun-03	Field monitoring of sites.
Subtotal FY 2003 Funding Needs			**5,720**		
Subtotal Admin Items (Salary)			**46,755**		
Signs			900		For FY 2000 through FY 2003
Monitoring Equipment			300		For FY 2000 through FY 2003
Travel (vehicle & gas)			600		For FY 2000 through FY 2003
Subtotal Miscellaneous			**1,800**		
TOTAL REQUEST FY00-FY03			**48,555**		

Appendix 3. Summary of Three-Year Costs for Noxious Weed Revegetation Study

Summary of Three-Year Costs	
for Noxious Weed Revegetation Study	
Salary	26,800
Signs	300
Monitoring equipment	100
Travel	200
Total FY 2000 Costs	**27,400**
Total FY 2001 Costs	**9,115**
Total FY 2002 Costs	**6,320**
Total FY 2003 Costs	**6,320**
TOTAL 3-Year	
Study Costs	**49,155**