Toxic Plant Research Updates

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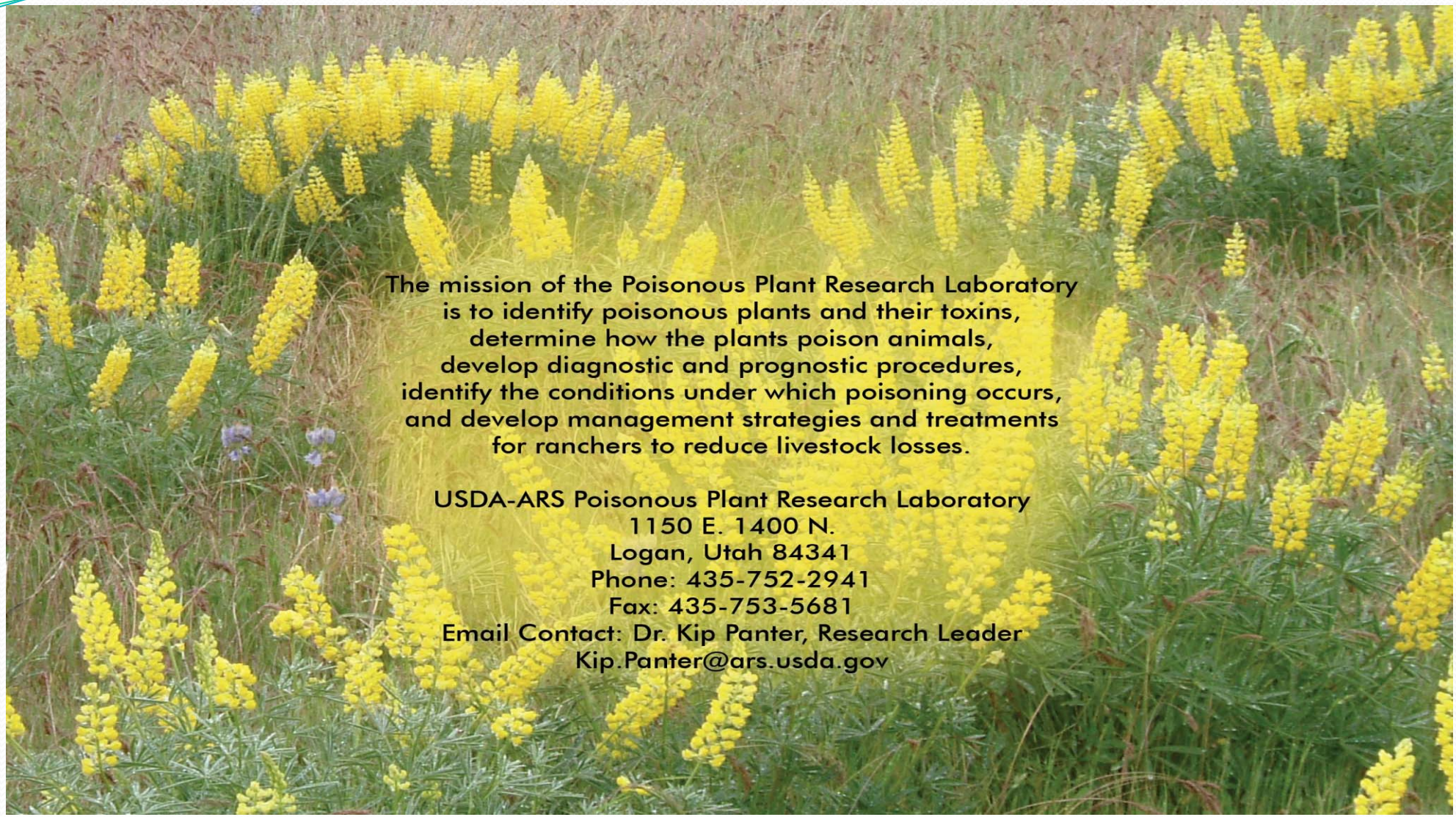

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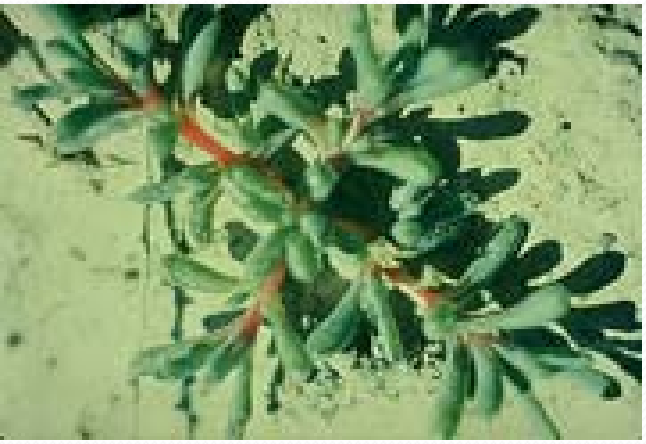
Losses to Toxic Plants

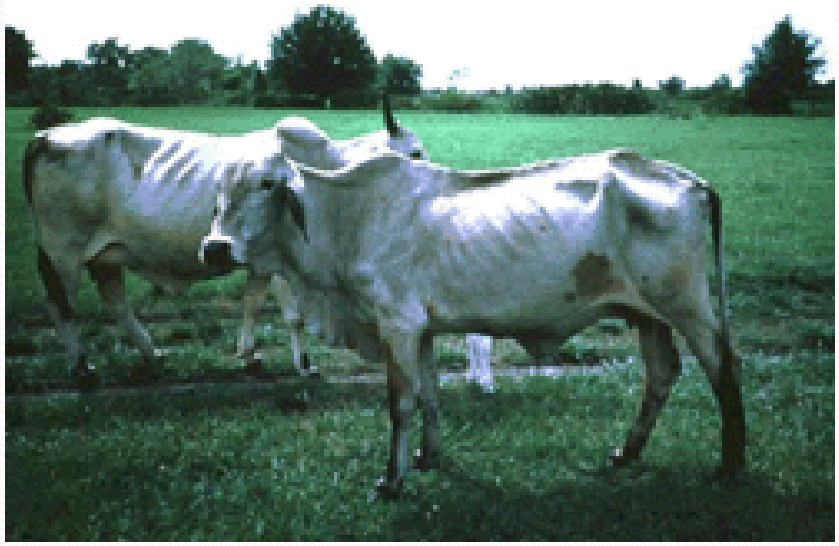


- Death
- Impaired gains
- Abortions, birth defects
- Indirect losses:
  - vet costs
  - increased risk
  - changes in management

Total annual losses in U.S. exceed $300 million

Common cause of problems

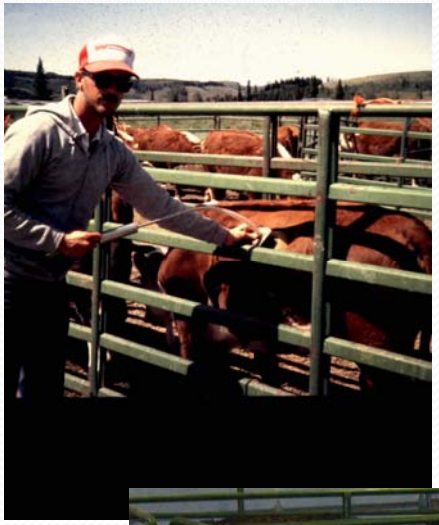
No groceryosis = toxic plant problems

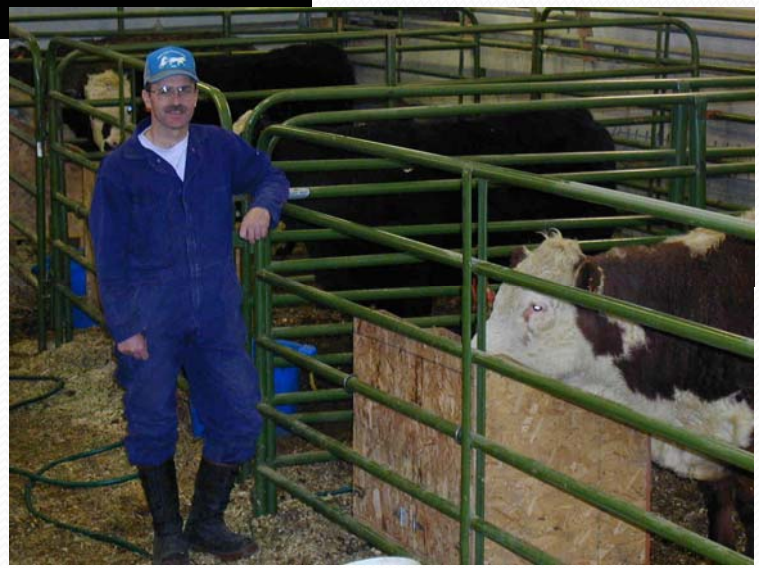


Body condition score=1

Body condition score=4

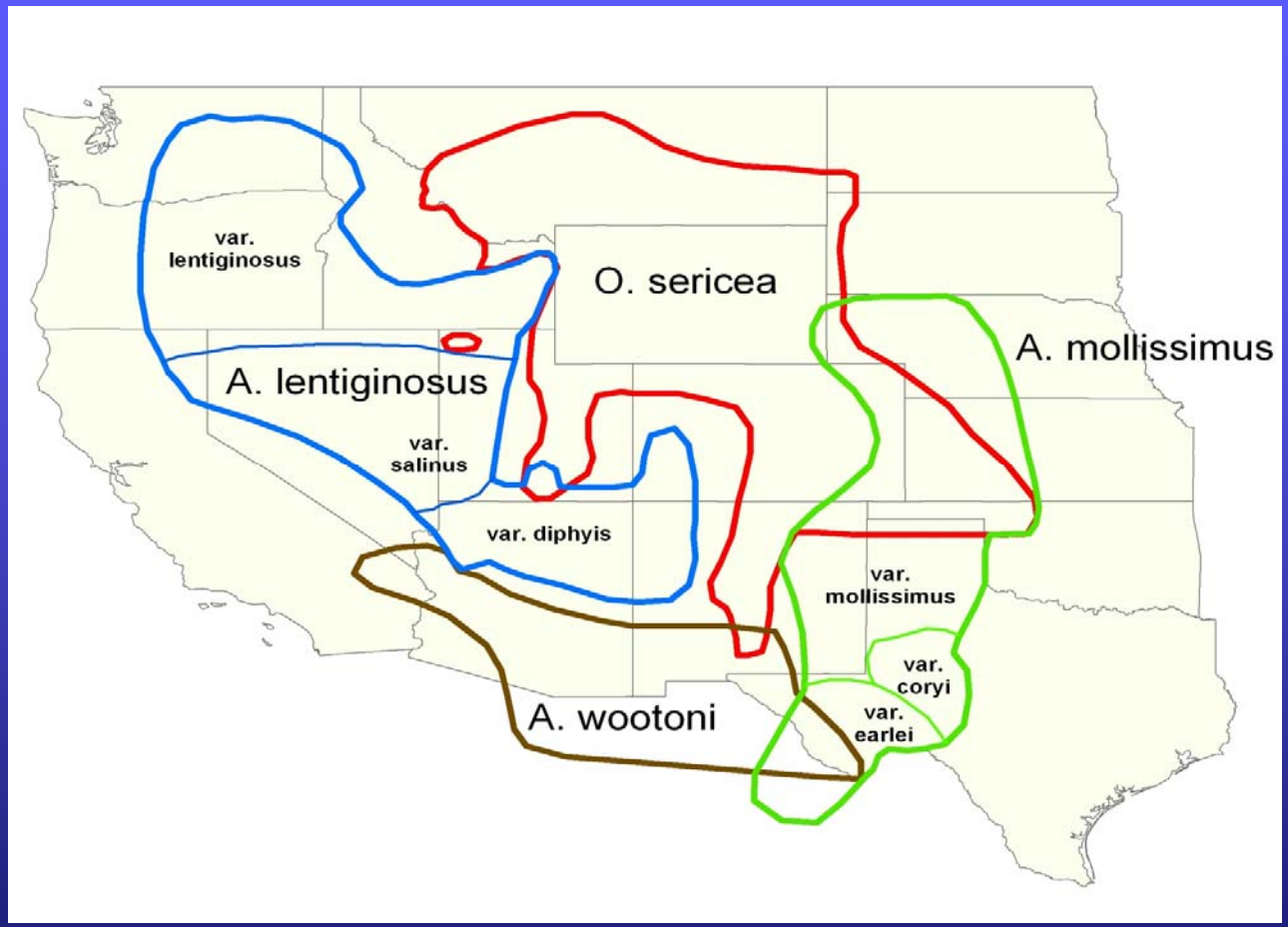
Some current research:





- Larkspurs (Delphinium):
  - Tall, Low, Plains
- Hepato and Neuro Toxins:
  - pyrrolizidine alkaloids
- Teratogenic or abortifacient plants
  - pine needles; lupines
- Locoweeds
  - Oxytropis & Astragalus
- Selenium toxicity
- Rayless goldenrod and white snakeroot toxicity

Distribution of the Major Locoweed Species



Rank Order of toxicity:

A. wootoni > A.mollissimus = A. lentiginosus > O. sericea

(garbancillo) (wooly loco) (spotted loco) (white point loco)

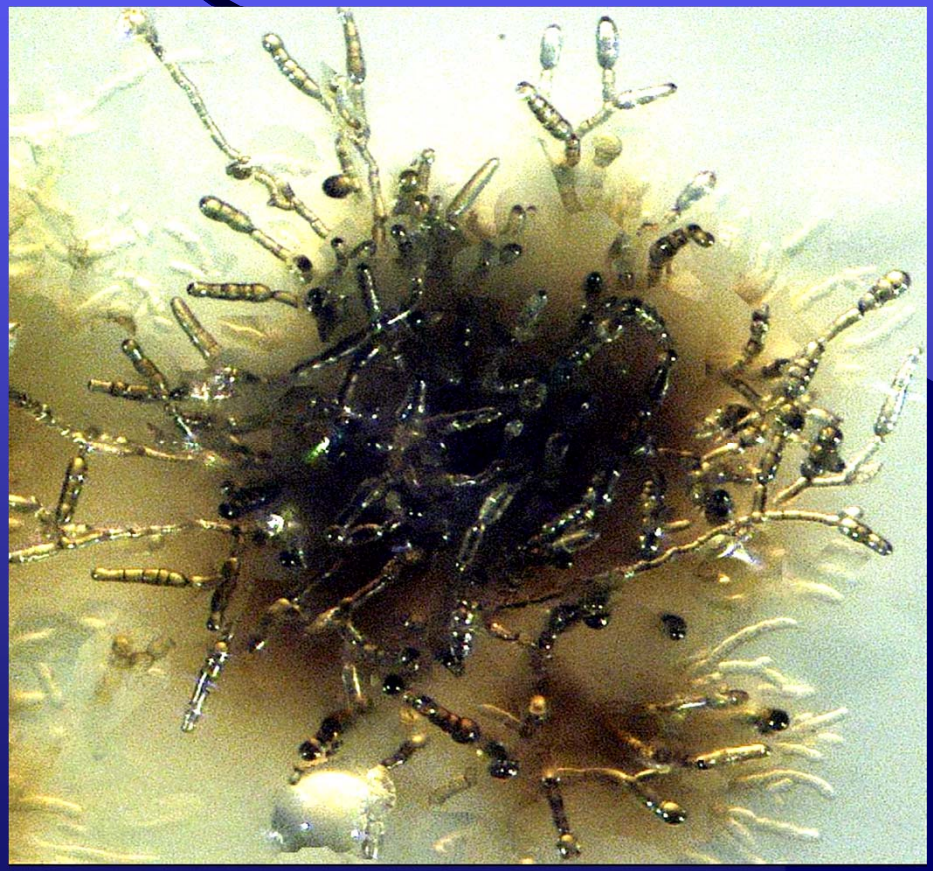
Locoweed Endophyte

-Fungal endophyte isolated from toxic locoweeds

-Produces swainsonine in culture

-Cultured from stems, leaves, seeds, and flowers of toxic field plants

-Localized to seed coat

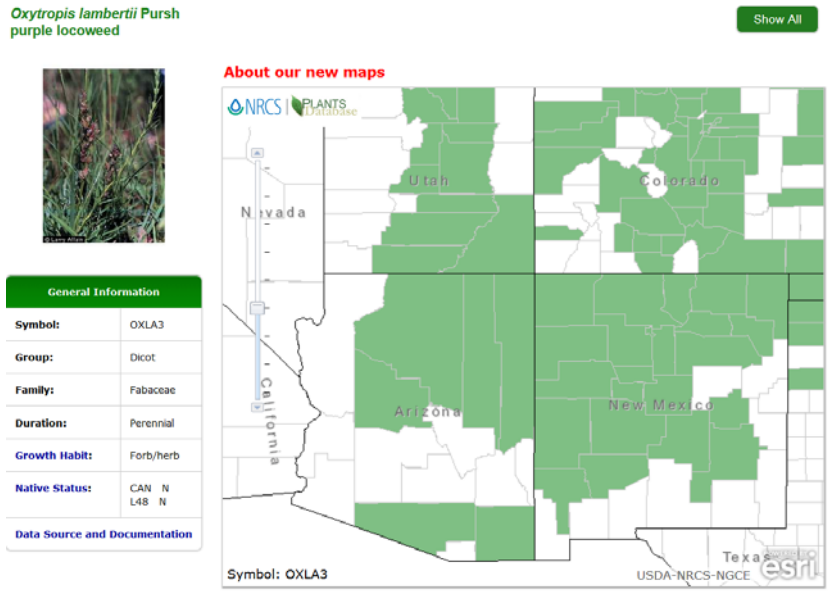


Update on Swainsonine-containing locoweeds in Arizona

- Some species thought to be toxic (i.e., contain swainsonine) are not, and other Astragalus species were found to contain swainsonine, and thus are toxic

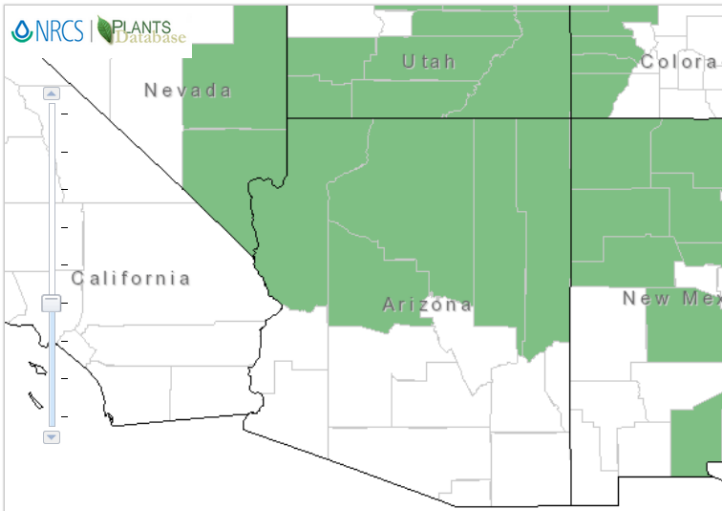
Previously Known Swainsonine-containing locoweeds

- Astragalus amphioxys (across northern Arizona)
- A. lentiginosus vars. araneousus, diphysus, lentiginosus, and wahweapensis;
- A. mollissimus vars. bigelovii, earlei, matthewsii, mollissimus, and thompsonae;
- A. wootoni (found across Arizona)
- Oxytropis lambertii
- (northern and southern Arizona);



Astragalus amphioxys **A. Gray**
Crescent milkvetch

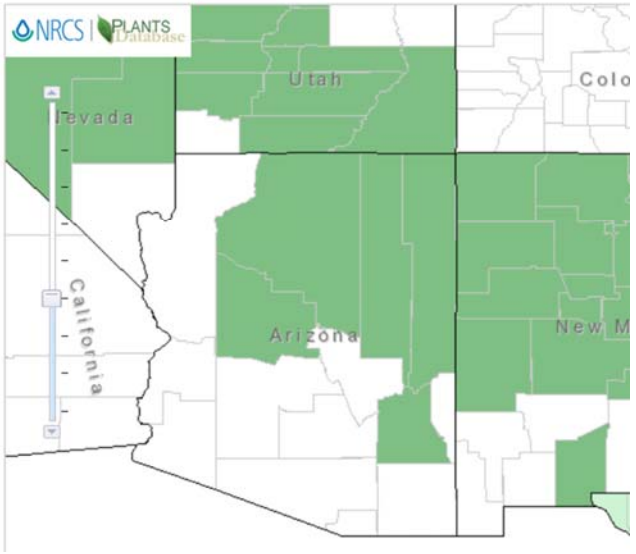
About our new maps



General Information	
Symbol:	ASAM5
Group:	Dicot
Family:	Fabaceae
Duration:	Annual Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Astragalus lentiginosus **Douglas ex Hook. var.** ***diphysus*** **(A. Gray) M.E. Jones**
freckled milkvetch

About our new maps



General Information	
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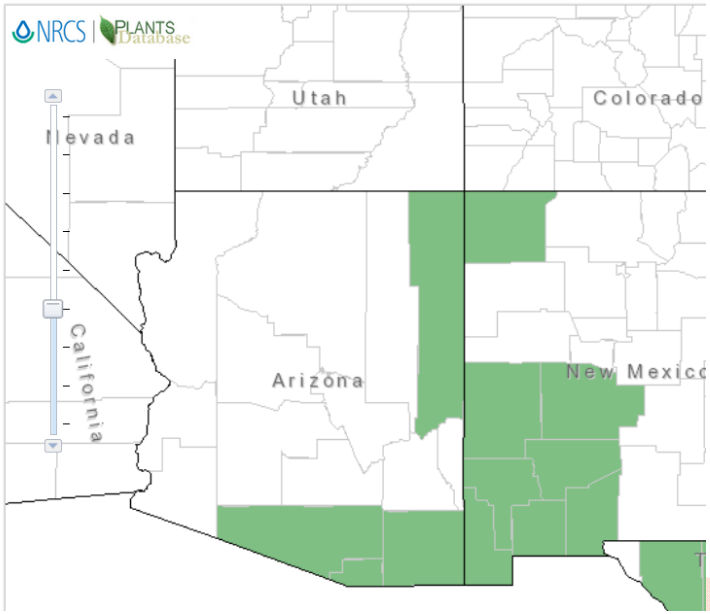
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Astragalus mollissimus **Torr. var.** ***bigelovii*** **(A. Gray) Barneby ex B.L. Turner**
woolly locoweed

About our new maps



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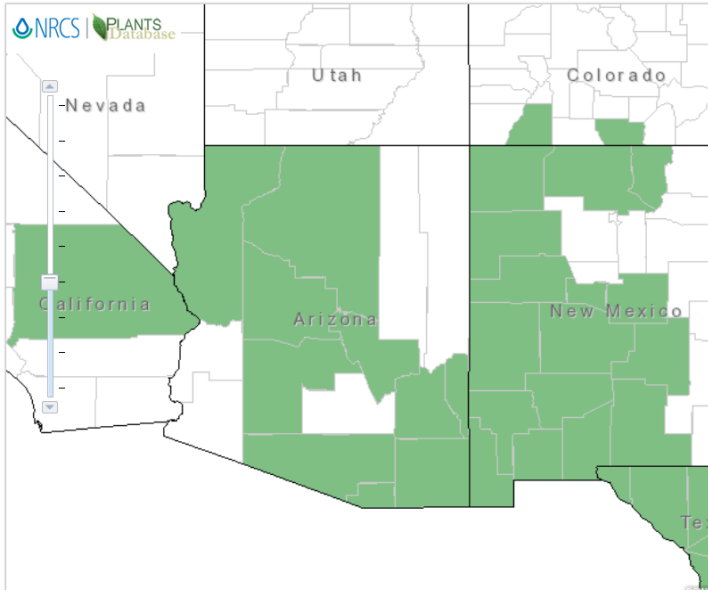
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Astragalus wootonii **Sheldon**
halfmoon milkvetch

General Information	
Symbol:	ASWO2
Group:	Dicot
Family:	Fabaceae
Duration:	Annual Biennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

About our new maps



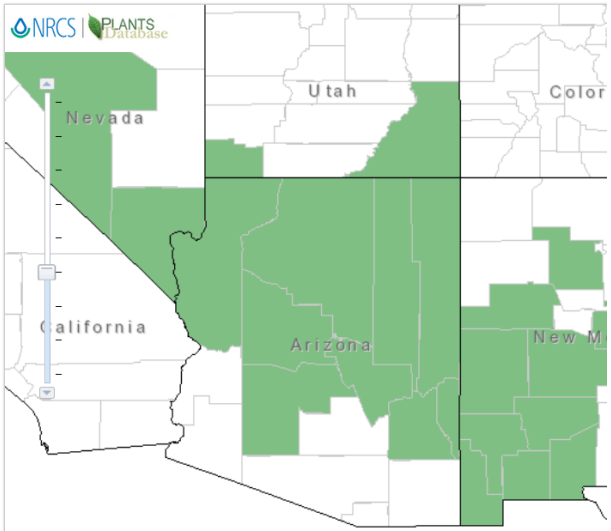
Arizona Astragalus species said to cause locoism

- A. praelongus
- A. emoryanus
- A. bisulcatus
- A. didymocarpus
- A. humistratus
- A. lonchocarpus
- A. nothoxys
- A. tephrodes

Astragalus tephrodes A. Gray
ashen milkvetch

General Information	
Symbol:	ASTE8
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

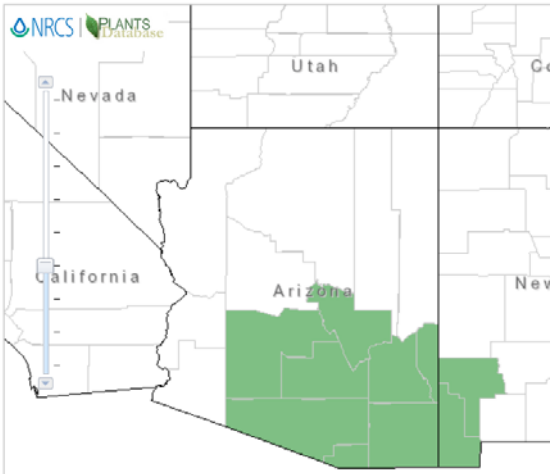
About our new maps



Astragalus nothoxys A. Gray
sheep milkvetch

General Information	
Symbol:	ASNO3
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

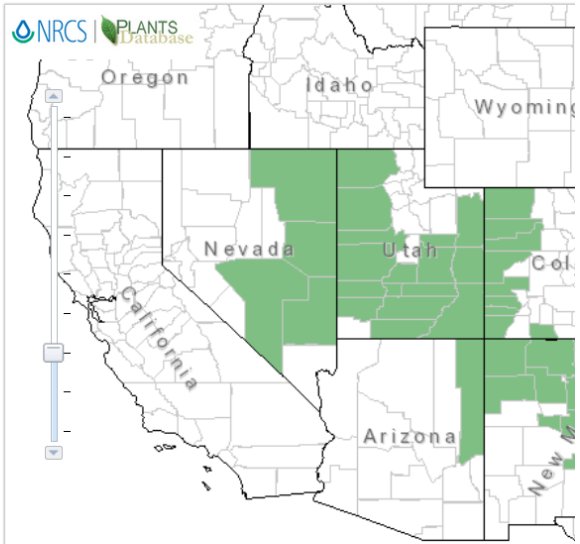
About our new maps



Astragalus lonchocarpus Torr.
rushy milkvetch

General Information	
Symbol:	ASLO3
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

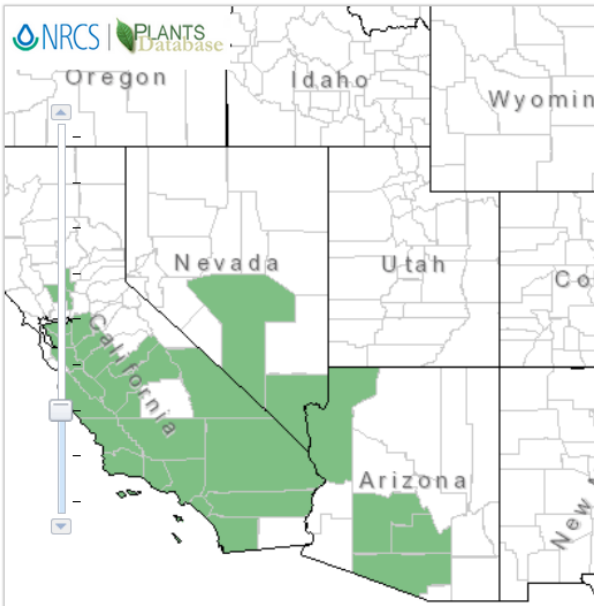
About our new maps



Astragalus didymocarpus Hook. & Arn.
dwarf white milkvetch

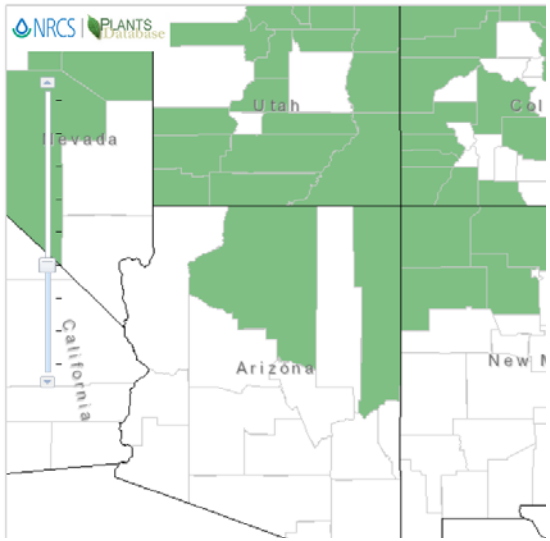
General Information	
Symbol:	ASDI3
Group:	Dicot
Family:	Fabaceae
Duration:	Annual
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

About our new maps



Astragalus bisulcatus (Hook.) A. Gray
twogrooved milkvetch

About our new maps

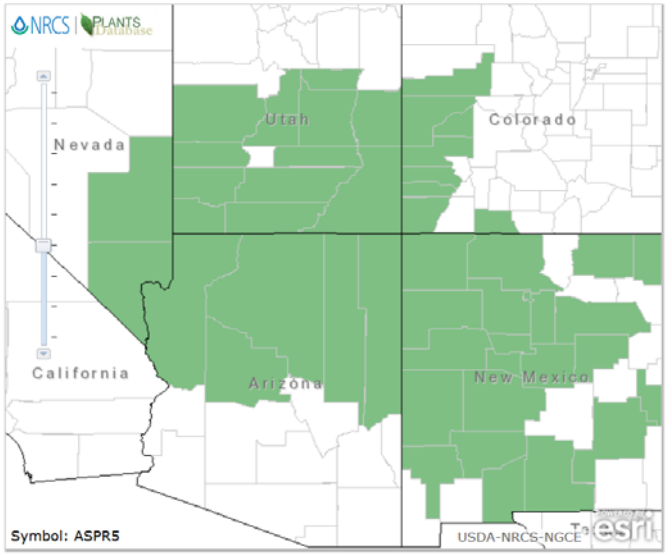


General Information	
Symbol:	ASBI2
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	CAN N L48 N
Data Source and Documentation	

Astragalus praelongus Sheldon
stinking milkvetch

Show All

About our new maps



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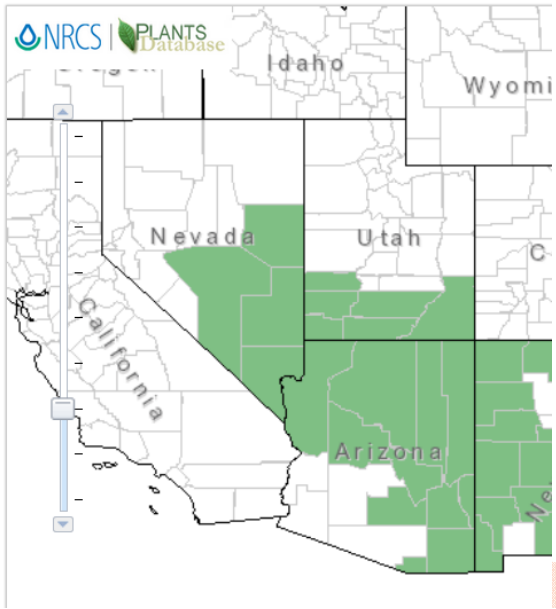
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Astragalus humistratus A. Gray
groundcover milkvetch

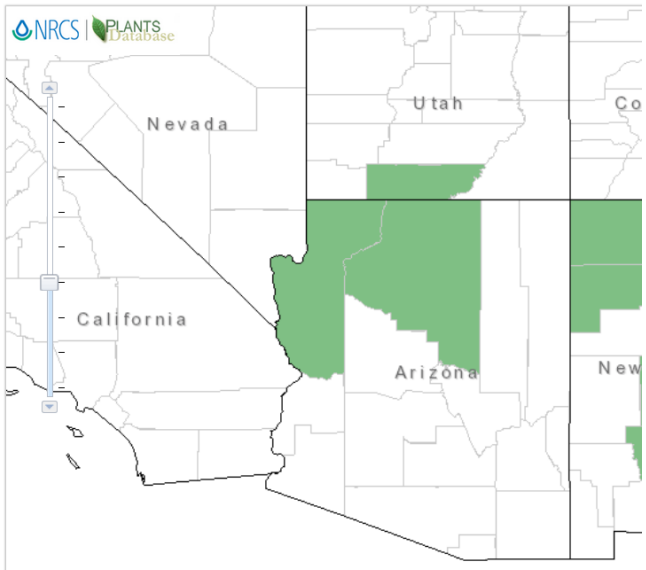
About our new maps



General Information	
Symbol:	ASHU2
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Astragalus emoryanus (Rydb.) Cory
Emory's milkvetch

About our new maps



General Information	
Symbol:	ASEM2
Group:	Dicot
Family:	Fabaceae
Duration:	Annual Biennial
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

Arizona Astragalus species said to cause locoism

- A. praelongus
- A. emoryanus
- A. bisulcatus
- A. didymocarpus
- A. humistratus
- A. lonchocarpus
- A. nothoxys
- A. tephrodes

None of these species contain swainsonine, therefore they are not toxic to livestock (unless they contain another toxin like A. bisulcatus (selenium accumulator).

Astragalus allochrous and thurberi have not been previously shown to contain swainsonine, but they do, so they are definitely toxic.

Proper identification can be very difficult with locoweeds, so it is important to consult a competent taxonomist.

Locoweed effects on livestock

- Four principal effects on livestock: (1) neurological damage; (2) emaciation; (3) reproductive dysfunction and abortion; and (4) congestive right heart failure when grazed at high elevations.

Clinical Signs of Locoweed Poisoning

- Depression; Dull dry hair coat; Eyes dull and staring
- Irregular gait or some loss of muscular control
- Weakness; Some animals show extreme nervousness; Loss of sense of direction; Animal may become violent if stressed
- Withdrawal from other animals; Some animals unable to eat or drink
- Recumbency and death may follow prolonged consumption of locoweed

Female Reproduction

- Abortion/fetal resorption
- Embryo loss
- Reduced maternal responsiveness
- Developmentally impaired lambs/ lack of nursing at birth

Male Reproduction

- Inhibits Spermatogenesis; abnormal sperm

Behavioral Aspects of Locoweed Intoxication

- Addiction, habituation or learned preference?
- Social facilitation leads to greater consumption of locoweeds
- Mother infant behaviors at birth:
  - pregnant ewes given locoweed had weak lambs
  - ewes were nervous and poor mothers
  - lambs were unable to suckle etc. normally
  - lambs recovered rapidly within about 10 days
  - when lambs were 9 months old they had recovered completely from initial intoxication

Conclusions

- Avoid locoweed during pregnancy
- Use intermittent grazing patterns
- Provide clean pastures when animals start to eat locoweed
- Breeding males should be off locoweed for at least 90 days before breeding season
- Permanent neurological disorders may preclude keeping animals for reproduction

Larkspur (Delphinium species)

Clinical Signs of Poisoning

- Staggering gait.
- Muscle trembles.
- Collapse to sternal and then lateral recumbency (this can lead to death for various reasons).
- Death occurs from neuromuscular paralysis and/or bloat.

Methods of Avoiding Larkspur Death Losses

- Drug treatment.
  - Neostigmine (0.02 mg/kg body weight) (Green et al., 2009. *Am. J .Vet. Res.* 70:539–546).
- Current management – (Toxic Window) (Pfister et al., 1999. *J. Nat. Toxins*. 8:81–94).
- Future Management – select animals with decreased susceptibility to poisonous plants.

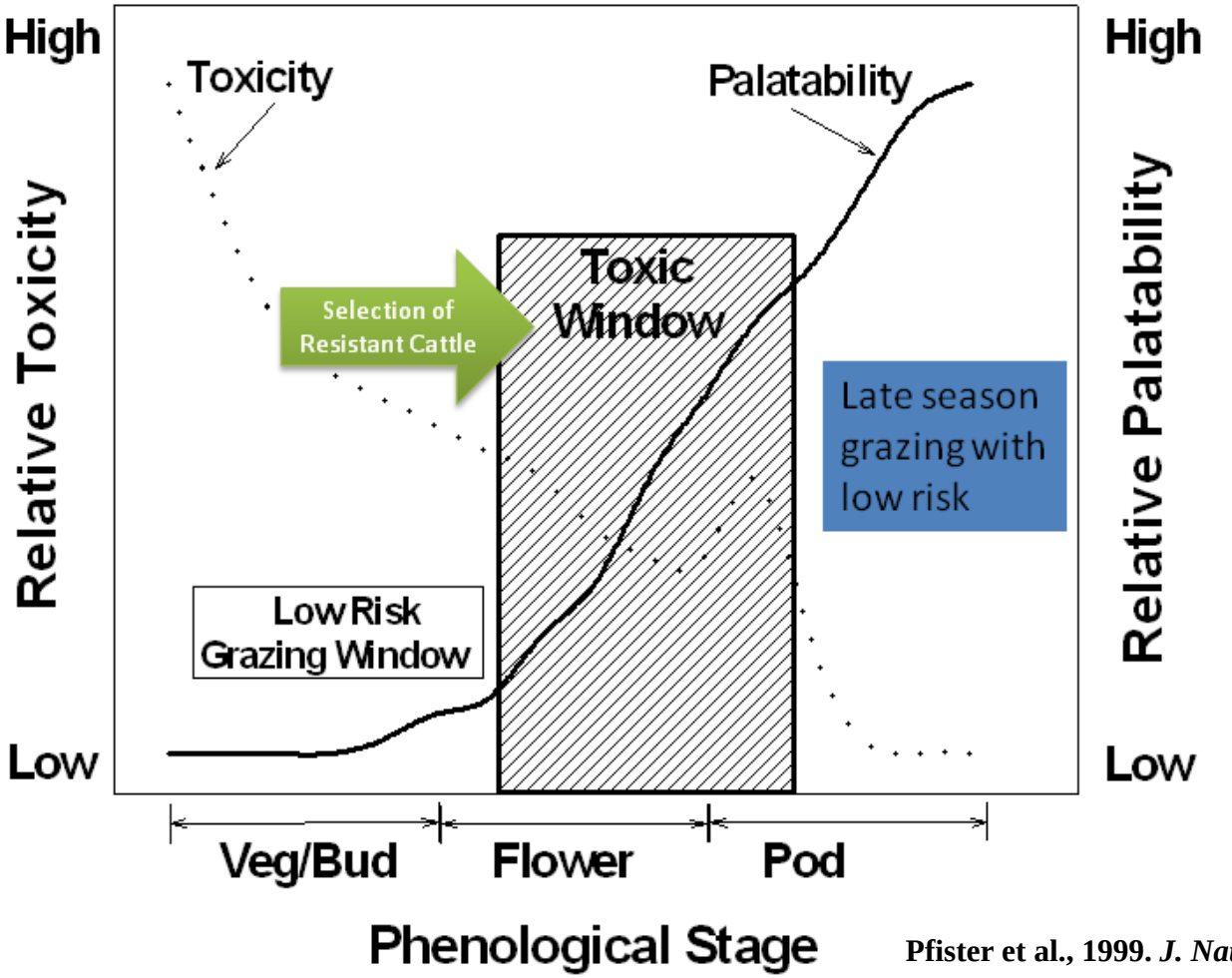
Delphinium species (larkspurs): proof of concept for selecting resistant cattle

- One solution to losses of grazing livestock

from toxic plants involves the compatibility of animals to their environment. Genetic selection of livestock has the potential to reduce livestock losses.

- Cattle differ greatly in response to larkspur toxicity; the differing susceptibility and resistance appears to be be highly heritable. Current work is focused on phenotyping cattle, and then determining the genetic basis for their response to larkspur alkaloids.

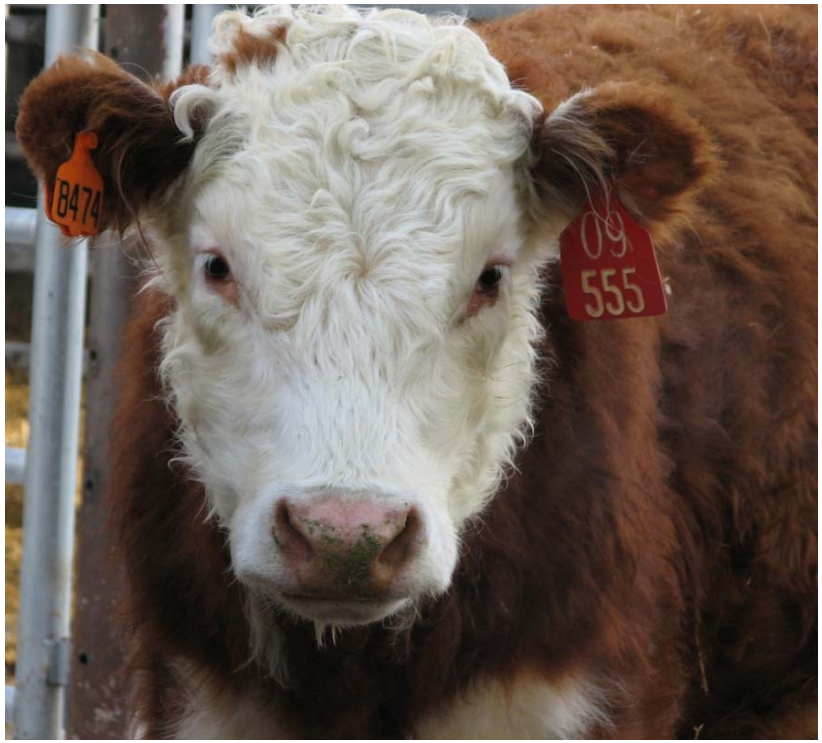
Grazing and the Toxic Window



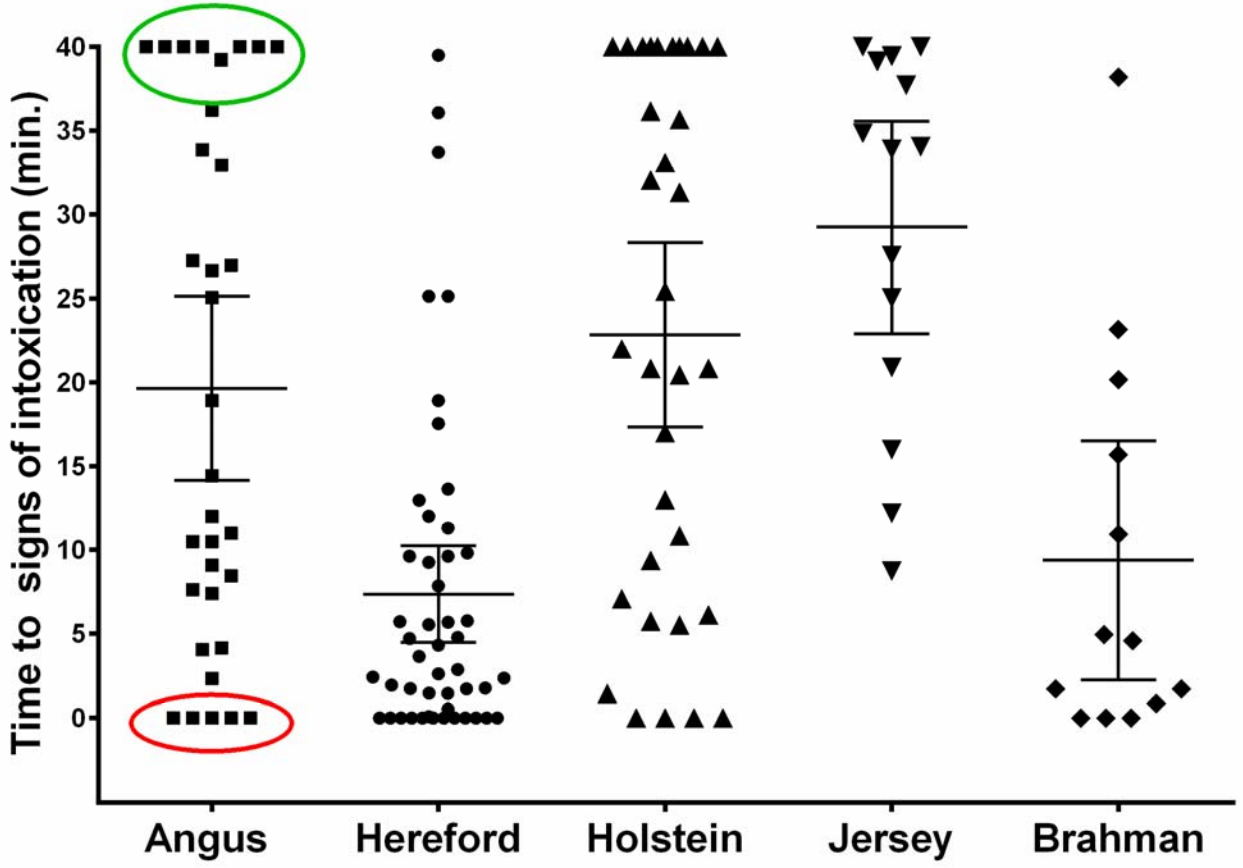
Pfister et al., 1999. *J. Nat. Toxins*. 8:81-94

Larkspur Breed Study

- Developed two quantitative measures of larkspur intoxication.
  - Heart rate.
  - Time to fatigue.
- Evaluating cattle breeds for susceptibility to larkspur intoxication.



Cattle responses to 8.0 mg/kg MSAL-type alkaloids.



Green et al., 2014. *Rangelands.* 36:10-15.

Average time to exercise-induced fatigue.

Breed, (number of animals)	Time to muscle fatigue, (minutes)
Angus, 33	17.2 ± 2.7
Brahman, 13	9.4 ± 3.3
Line 1, Hereford, 48	7.4 ± 1.4
Holstein, 15	26.8 ± 3.4
Jersey, 14	29.3 ± 2.9

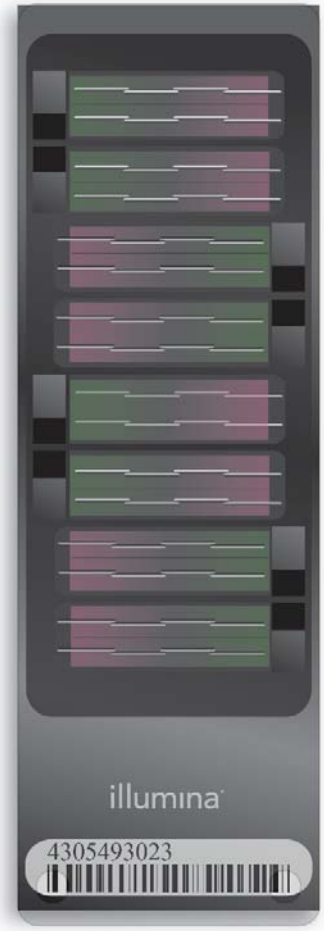
Green et al., 2014. *Rangelands.* 36:10-15.

Genomic approaches (In Collaboration with MARC)

- Whole genome association study (GWAS)
  - Multiple testing requires stringent statistical threshold
  - More likely to test SNP that are truly associated but too many false positives if threshold is not stringent.
- Candidate gene approach
  - Hypothesis driven
  - Small number of loci tested
- Most studies utilize both approaches
- GWAS can be used to identify initial candidates

Illumina Bovine SNPHD genotyping array.

- Illumina Bovine SNPHD genotyping array.
  - 777,962 polymorphisms across the entire bovine genome.
  - Breed associations currently using the BovineSNP50 for the calculation of genome enhanced EPDs.



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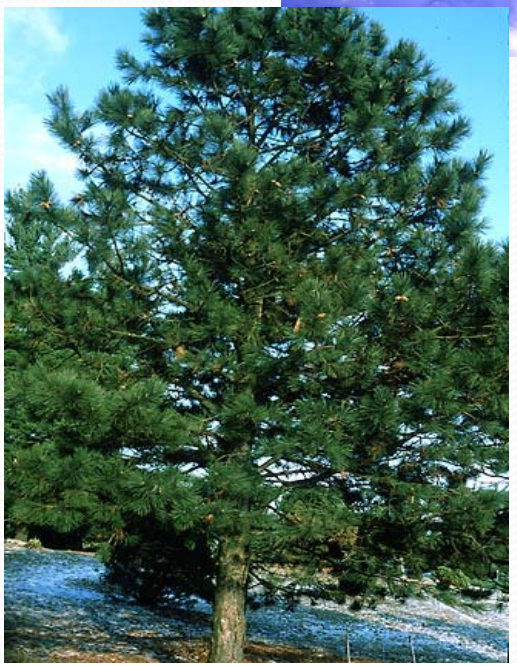
Current Work

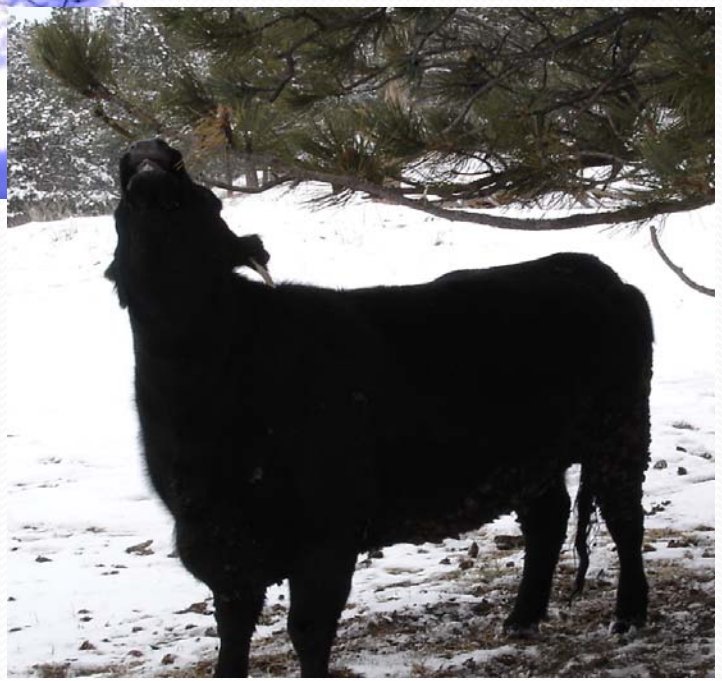
- Phenotyping 20 bulls with larkspur to provide a basis for selecting animals tolerant of larkspur.
  - Collect semen and ship to MARC for AI.
- Progeny test for larkspur resistance.
- Testing Angus steers for resistance to larkspur.

- The larkspur selection research will be a model for work with other toxic plants such as lupine.

Abortions in cattle from pine needles

- Affects only cattle in mid to late gestation
- Cows often eat needles during cold, snowy weather
- Thin cows eat more than fatter cows
- Dead calves, retained placenta





Cattle eat substantial amounts of pine needles during winter

Weather affects cattle consumption of pine needles

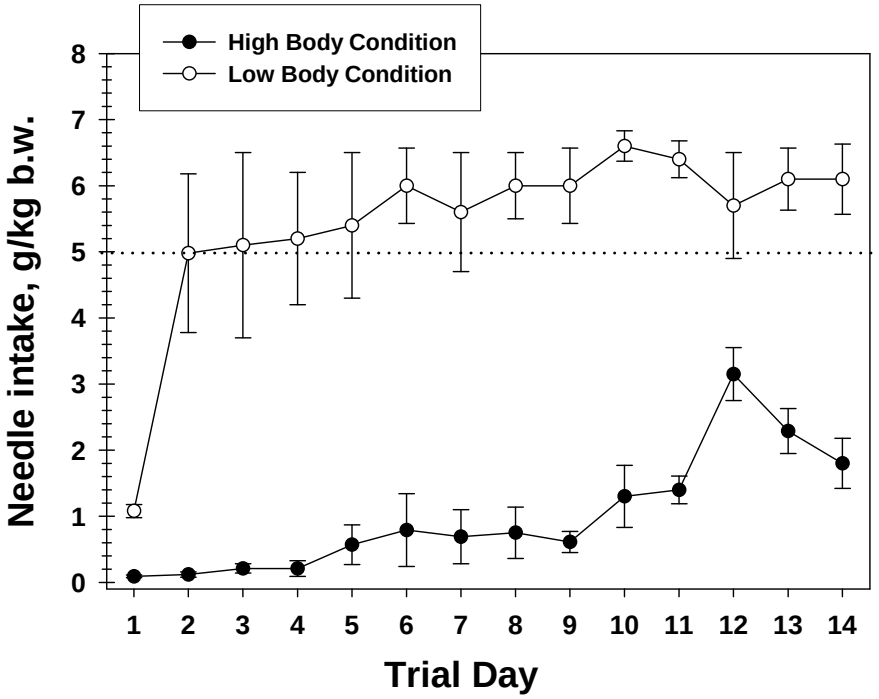
- At minimum temperatures > -5 °C, cattle in 5 winter grazing studies consumed no green needles from trees (MT, SD, OR).

Consumption (% of bites) of pine needles and other browse in Montana during winter*

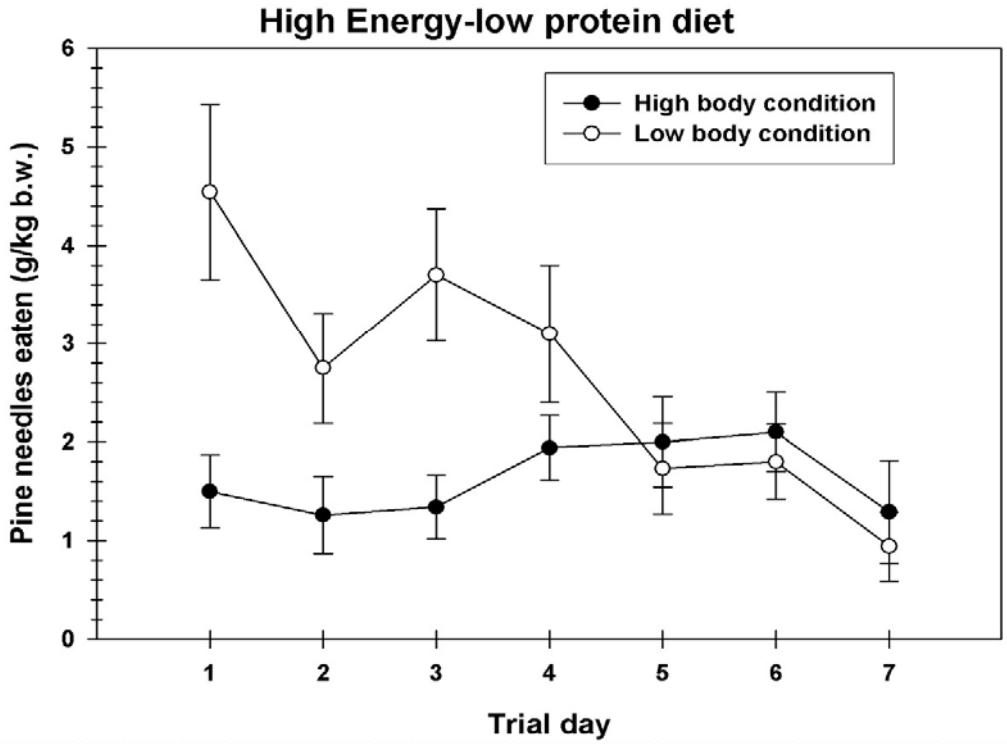
	Average snow depth (cm)		
	< 2.5	2.5-25.0	> 25.0
Pine litter	38	42	15
Green needles on tree	0	6	24
Other browse	0	16	35

***Does not include dried grass and forb**

Effect of body condition on PN consumption by cattle



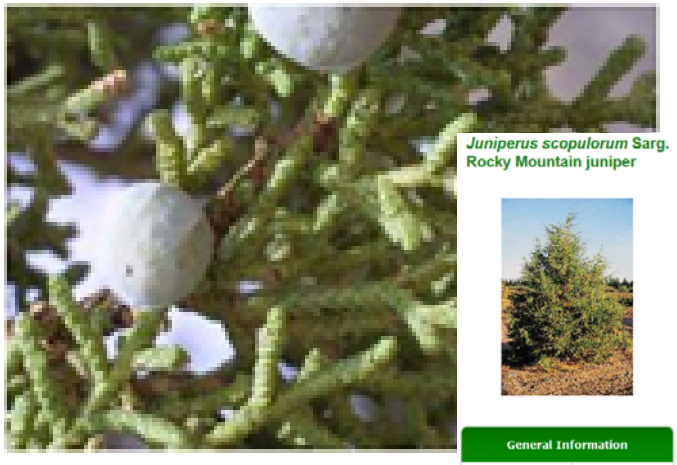
Low body condition increases PN intake



Low protein diets reduce PN intake

Juniper (*Juniperus* spp.)

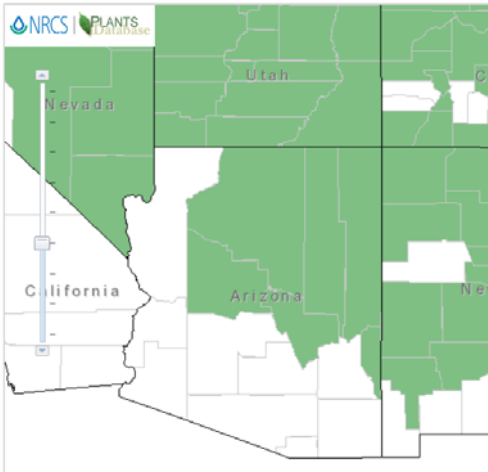
- Over 30 type of junipers
- A variety of agents have been associated with toxicity of the needles including phytoestrogens, mycotoxins, resins, and lignols. However the main component is isocupressic acid
- Experimentally, results in abortion in cattle – sheep and goats are unaffected



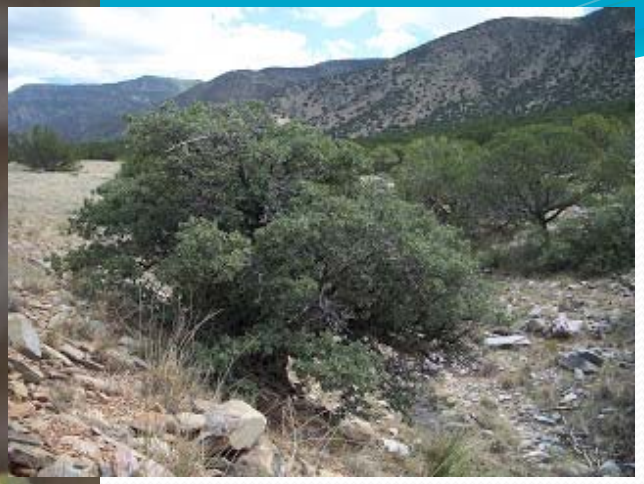
Juniperus scopulorum Sarg.
Rocky Mountain juniper

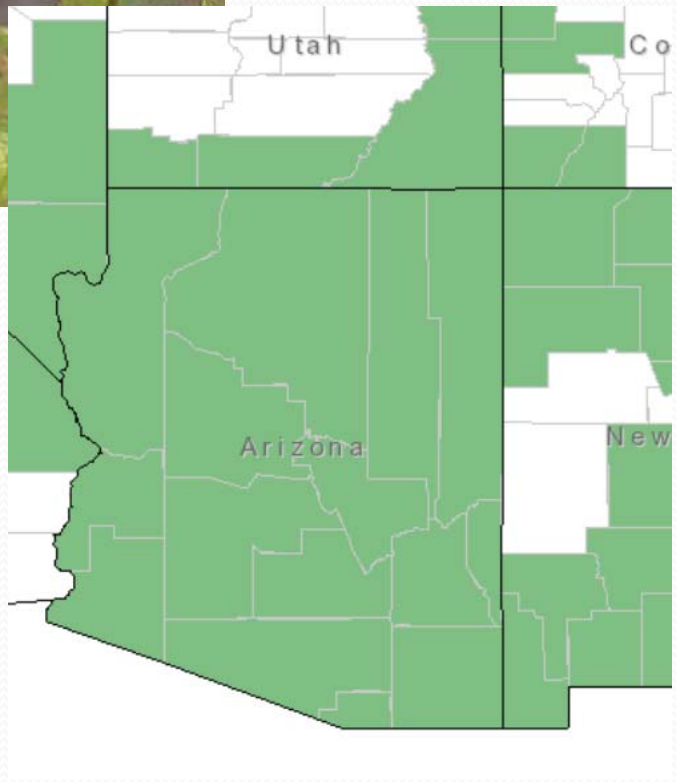
General Information	
Symbol:	JUSC2
Group:	Gymnosperm
Family:	Cupressaceae
Duration:	Perennial
Growth Habit:	Shrub Tree
Native Status:	CAN N L48 N

About our new maps



Oak Poisoning in Livestock





Quercus turbinella
Shrub live oak -
Grows in semi-arid, lower elevation shrub woodlands or deserts from CA to TX.
Most common oak in Arizona

Toxins are Tannins - concentrations may be high in oakbrush, especially in spring (% of dry weight)

	Juvenile	Mature
Gambel oak	11.1%	8.7%
Shinnery oak	15.1%	4.2%

Oak poisoning

- Ingestion of buds, leaves, stems and sometimes acorns
- Spring: buds and current seasons growth, and immature leaves.
- Consumption by cattle:
  - Data on Q. turbinella in AZ: 25-40% of diet in winter
- Generally animals must eat >50-75% of diet to be fatally intoxicated.

Toxicity to ruminants

- Clinical signs:
  - Anorexia, depression, loss of rumen motility, constipation changing to bloody diarrhea
  - Blood urea nitrogen (BUN) elevated from 10-20 mg/dl to > 150 mg/dl
  - Acute cases die in 1-3 days
  - Chronic cases linger weeks or months
  - Animals that continue to eat other forage generally recover completely
  - Most prominent finding is typically kidney lesions. Renal lesions always present; may also have necrosis of GIT
  - May have liver lesions and elevated liver enzymes

Reducing losses to Oakbrush

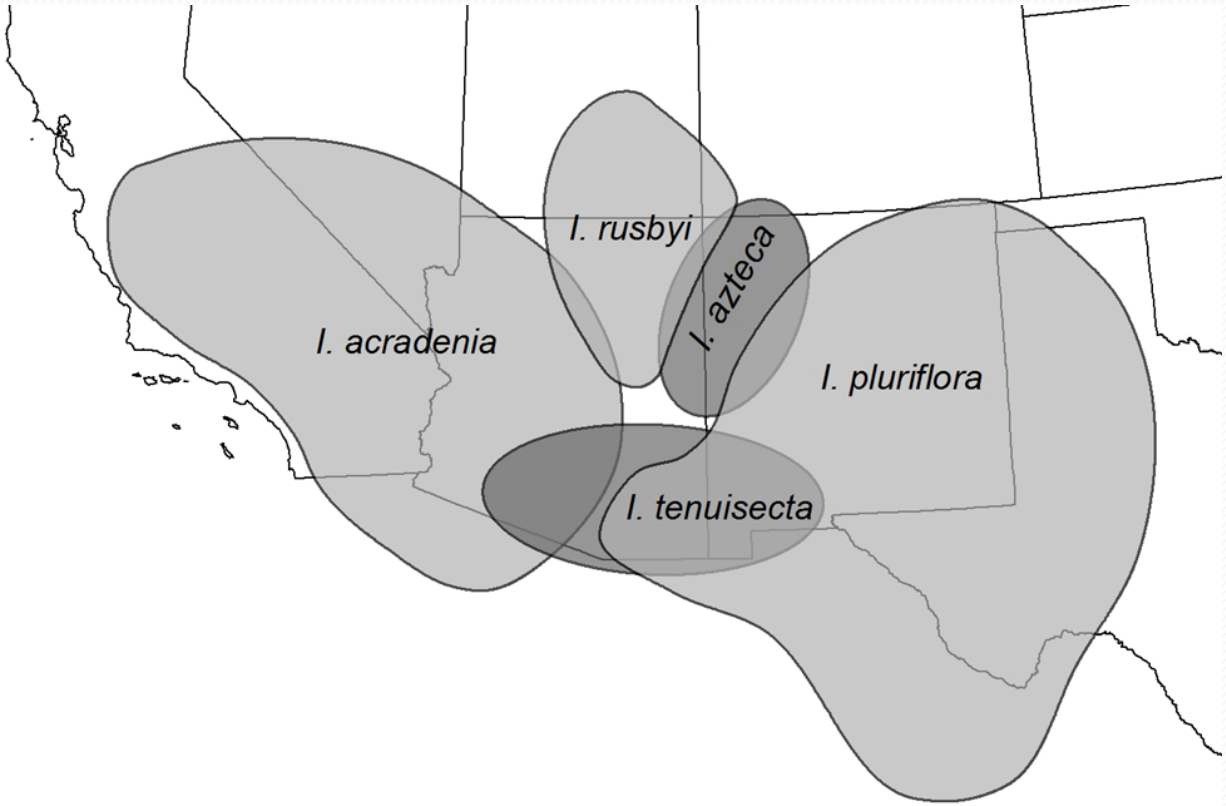
- Good range management = diverse forage base
- Mechanical or fire treatment may reduce stands (risk of increasing problems from resprouting in subsequent years)
- Keep livestock off oak stands until plants mature (i.e. > 30 days)

Reducing losses to oakbrush

- Supplemental feeding may reduce oak consumption-
- TX researchers (Dolohite) recommended feeding calcium hydroxide (10-15%) as an antidote in feed. Counteracts metabolic acidosis from organic acids.
- 4 pounds per head per day containing
  - 10 percent hydrated lime (CaOH)
  - 6 percent fat
  - 30 percent alfalfa
  - 54 percent cottonseed meal starting before the buds are set in the spring

Isocoma – Rayless Goldenrod update

- Affects nervous system
- Depression; reluctant to move
- Muscle tremors when moved
- Tremetone suggested as the toxin



Toxicity of burroweed to livestock

- RGR was dosed to Spanish goats and Jersey calves at 2 % b.w. daily;
  - clinical signs after 5-9 days of dosage.
- RGR was dosed to horses at 3 % b.w. daily;
  - After 7 days they showed decreased appetite, exercise intolerance, reluctance to stand, muscle swelling, and tremors on standing & exercise.
- RGR was dosed to lactating goats for 14 days at 2% b.w. daily.
  - Mothers showed no clinical signs
  - Kids showed no or mild clinical signs but did have greatly increased serum CK activity, indicating muscle damage.
  - No tremetone was found in the milk of lactating dams.

Toxin(s) in Isocoma species (burroweed; rayless goldenrod; goldenbush)

- Tremetone and dehydrotremetone (benzofuran ketones [BFKs] have been suggested as the toxic compounds in I. pluriflora.
- We examined I. pluriflora, I. tenuisecta, I. azteca, I. acradenia, and I. rusbyi for tremetone, dehydrotremetone, and other compounds.
- We found tremetone, dehydrotremetone, and 3-oxyangeloyltremetone in I. tenuisecta, I. azteca, I. acradenia, I. rusbyi, and several other Isocoma spp.

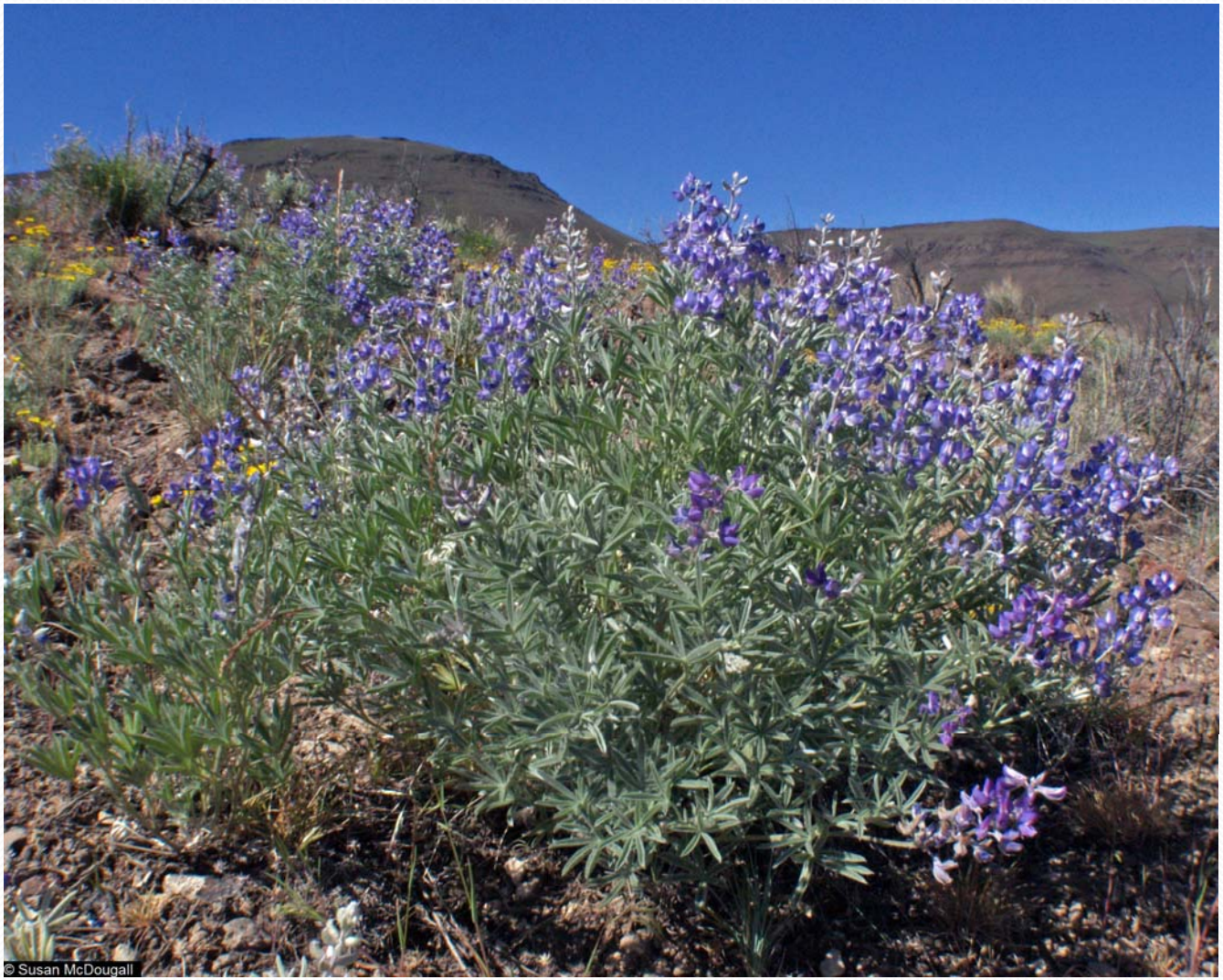
Toxin(s) in Burroweed

- **Tremetone, 3-oxyangeloyltremetone, and related BFK compounds were found for the first time in 8 other species:**
  - **Isocoma menziesii**
  - **I. coronoplofolia,**
  - **I. drummondi,**
  - **I. veneta,**
  - **I. hartwegii,**
  - **I. gypsophila,**
  - **I. tometosa,**
  - **I. arguta**

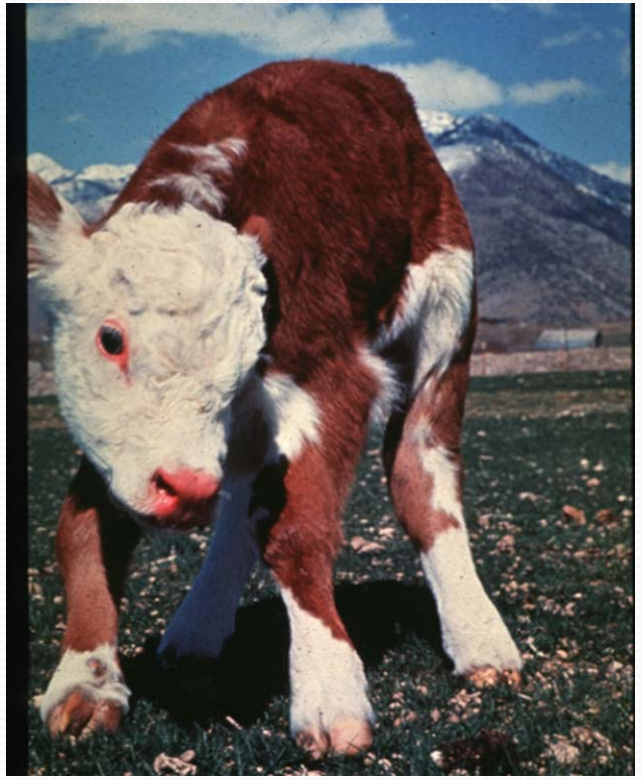
Toxicity of Burroweed

- It is well established that I. pluriflora is poisonous causing a trembles and milksickness in livestock.
- Why is there an absence of reports of livestock poisoning due to I. tenuisecta, I. azteca, I. acradenia, and I. rusbyi?
- It may be that tremetone, dehydrotremetone, and other benzofuran ketones (BFKs) are not the compounds responsible for toxicity in I. pluriflora?
- In all studies, BFKs have been found in the plants when animal toxicity has been demonstrated.
- Further work needs to be done to verify if the BFKs are the toxic compounds or if other compounds are responsible for the toxicity of these plants.

Lupine (Lupinus spp.) – Crooked calf syndrome



Lupine consumed by pregnant cattle causes several birth defects: skeletal and cleft palate



Agriculture

Weed causes epidemic of mutant calves

WASHTUCNA, Wash. (AP) — Spring calving season is off to a troubled start in Adams County, where an epidemic of deformities in newborns has left ranchers desperate.

About one of every five calves born in recent weeks has been put to death with a bullet to the head.

Ranchers say it's the best way to end the misery of animals born with crooked calf syndrome. The malady leaves calves facing an almost certain death from starvation or being eaten by coyotes.

Defects/Susceptible Gestational Periods: Caused by alkaloid-induced reduction in fetal movement

- Multiple Congenital Contractures 40-70 days
  - Arthrogryposis
  - Scoliosis
  - Torticollis
  - Kyphosis
- Cleft Palate 40-50 days

Scoliosis

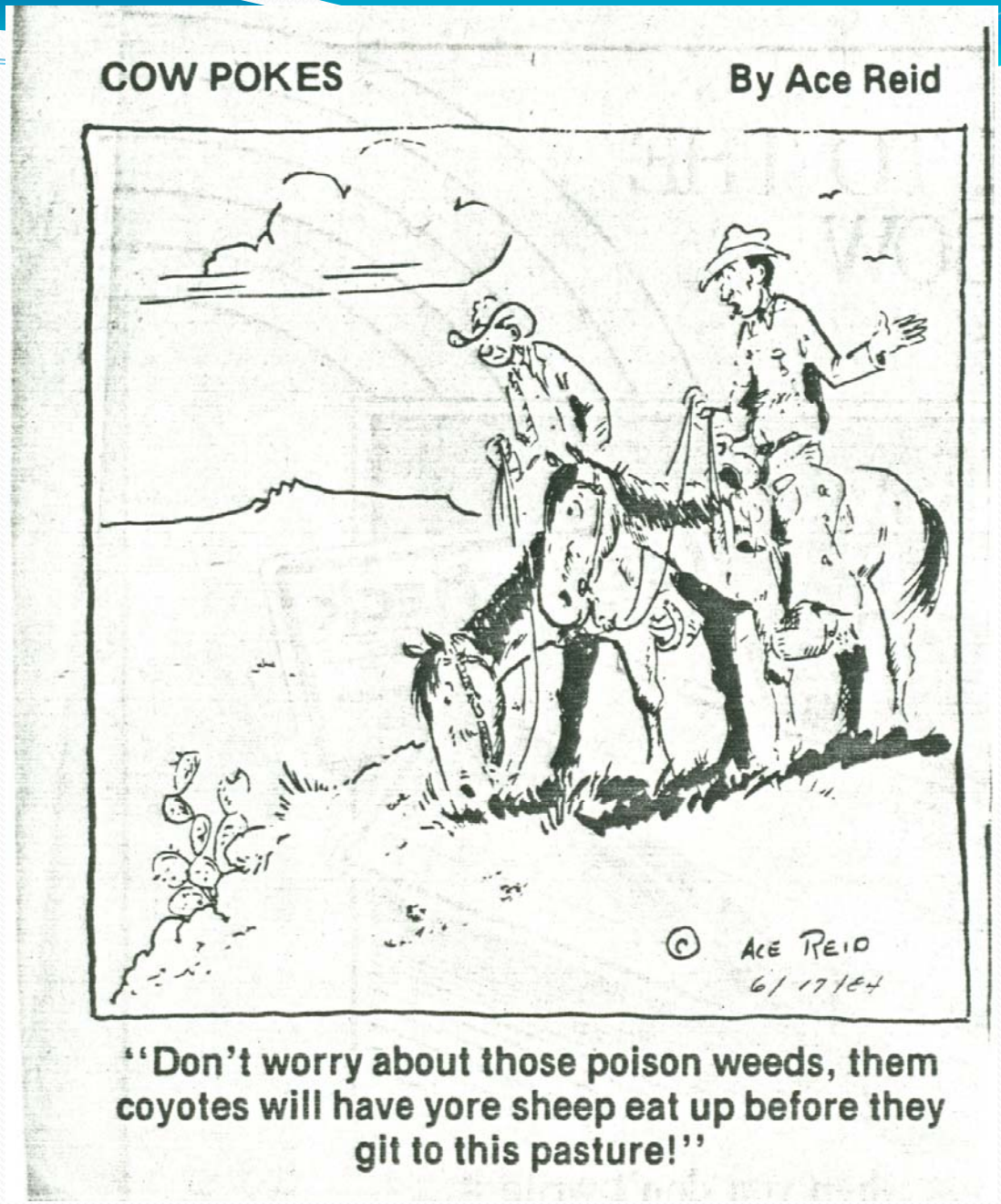
Management Recommendations

Management changes to reduce or eliminate crooked calves:

a) Intermittent grazing (clean vs. infested pastures)
b) Changing breeding program (avoid lupine during susceptible gestational period)
c) Intense management (cull lupine eaters or move them to clean pastures)
d) Graze steers or open heifers
e) Graze infested pastures after seed pods shatter


WHAT DOES YOUR DAD DO?
HE'S AN ENVIRONMENTAL ACTIVIST
ONE OF THOSE GUYS THAT CHAIN THEMSELVES TO TREES?
HE'S A FARMER
PARKER

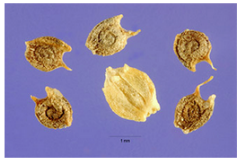
Questions?


COW POKES
By Ace Reid
© ACE REID
6/17/84
"Don't worry about those poison weeds, them coyotes will have yore sheep eat up before they git to this pasture!"

Appendix: Other toxic plants

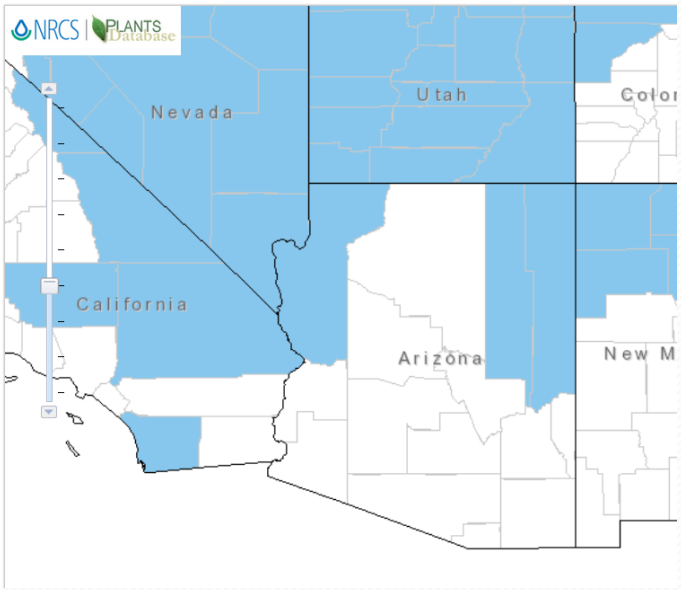
Halogeton

Halogeton glomeratus (M. Bieb.) C.A. Mey.
saltlover



General Information	
Symbol:	HAGL
Group:	Dicot
Family:	Chenopodiaceae
Duration:	Annual
Growth Habit:	Forb/herb
Native Status:	L48 I
Plant Guide (pdf) (doc)	
Data Source and Documentation	

About our new maps



- Oxalate poisoning
- Muscle weakness and collapse
- Kidney failure
- Adapted animals can eat substantial amounts

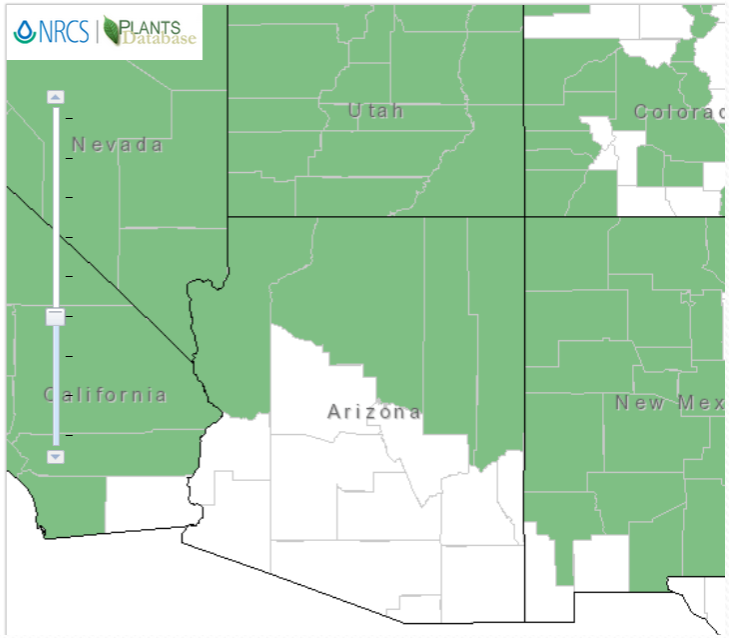
Horsebrush

- Grows with sagebrush areas
- Primarily affects sheep- “bighead”
- Photosensitization
- Typically must eat black sage first

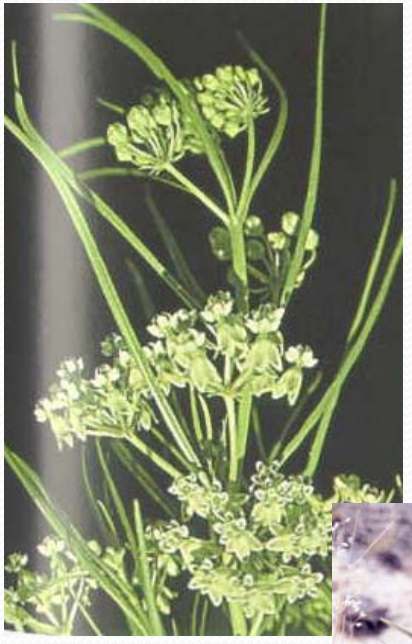
Tetradymia DC.
horsebrush

General Information	
Symbol:	TETRA3
Group:	Dicot
Family:	Asteraceae
Duration:	
Growth Habit:	
Native Status:	CAN N L48 N
Data Source and Documentation	

About our new maps



Milkweeds

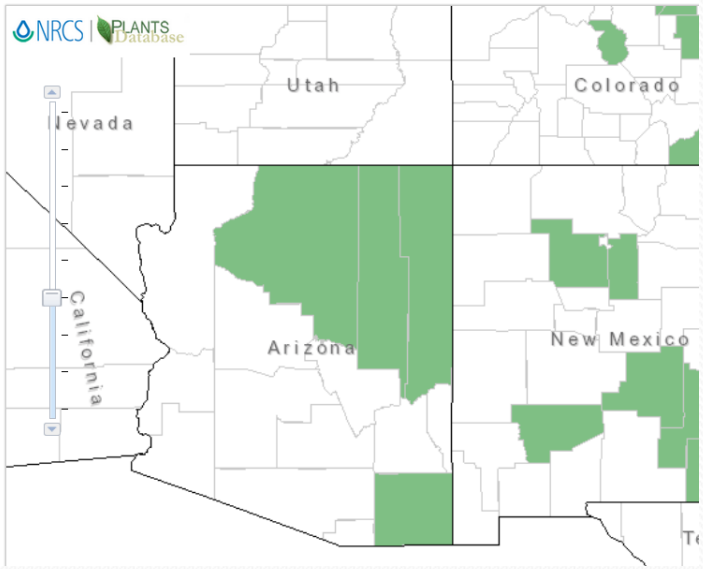


- **Contain cardiac glycosides (heart toxins)**
- **Not usually eaten unless forage v. scarce**

Senecio

Senecio riddellii **Torr. & A. Gray**
Riddell's ragwort

About our new maps



General Information	
Symbol:	SERI2
Group:	Dicot
Family:	Asteraceae
Duration:	Perennial
Growth Habit:	Forb/herb Subshrub
Native Status:	L48 N

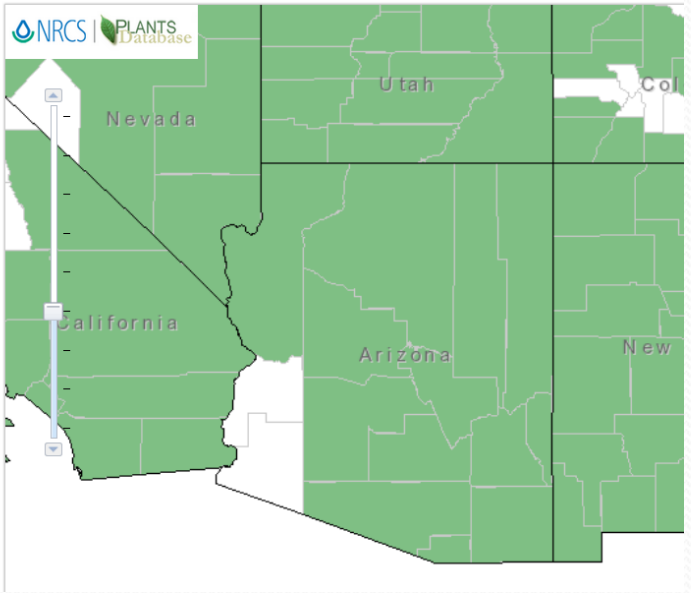
- **Potent liver toxins**
- **Wasting disease and photosensitization**

Broom snakeweed

Gutierrezia sarothrae (Pursh) Britton & Rusby
broom snakeweed

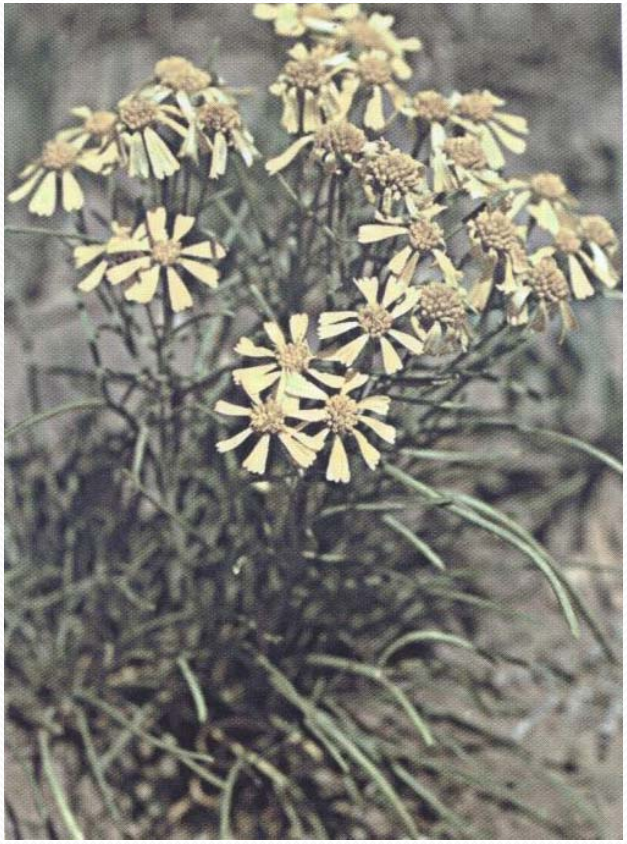
General Information	
Symbol:	GUSA2
Group:	Dicot
Family:	Asteraceae
Duration:	Perennial
Growth Habit:	Forb/herb Shrub Subshrub
Native Status:	CAN N L48 N
Characteristics	

About our new maps



- **Abortions and sick cows**
- **Toxins probably terpenes – similar to pine needle abortions**

Colorado rubberweed

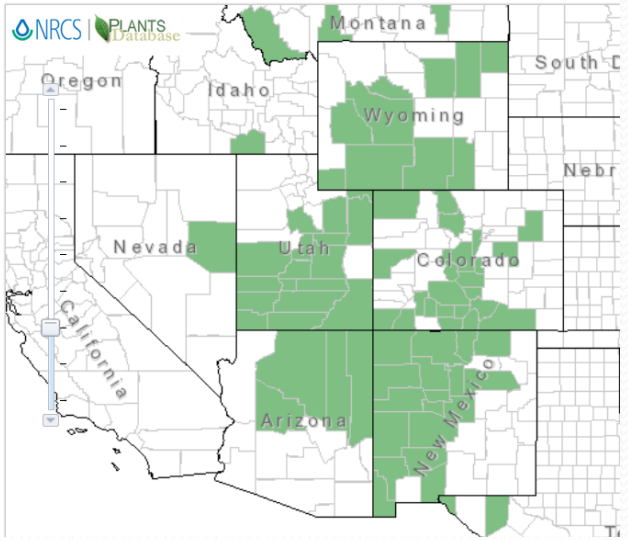


- Irritate stomach
- Clinically -sneezing, vomiting, diarrhea
- Muscle weakness; weight loss

Hymenoxys richardsonii **(Hook.) Cockerell**
pingue rubberweed

General Information	
Symbol:	HYRI
Group:	Dicot
Family:	Asteraceae
Duration:	Perennial
Growth Habit:	Forb/herb Subshrub
Native Status:	CAN N L48 N
Data Source and Documentation	

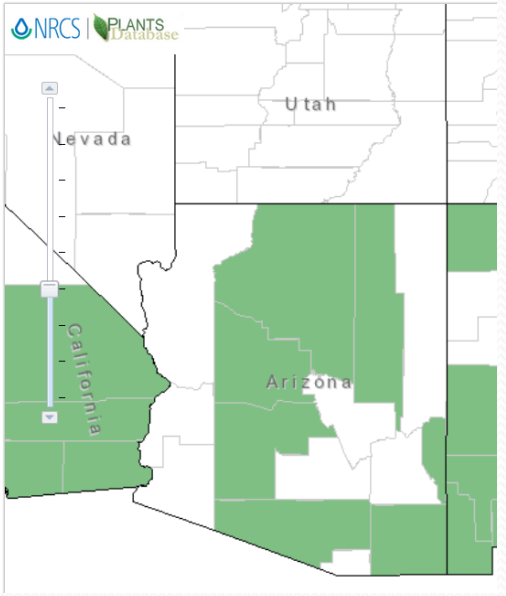
About our new maps



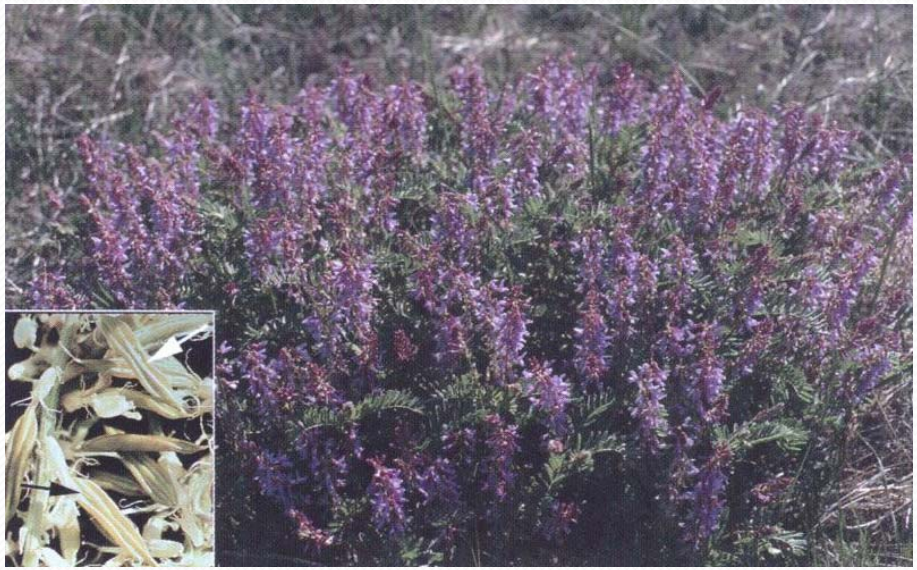
Hymenoxys odorata **DC.**
bitter rubberweed

General Information	
Symbol:	HYOD
Group:	Dicot
Family:	Asteraceae
Duration:	Annual
Growth Habit:	Forb/herb
Native Status:	L48 N
Data Source and Documentation	

About our new maps



Selenium-containing plants

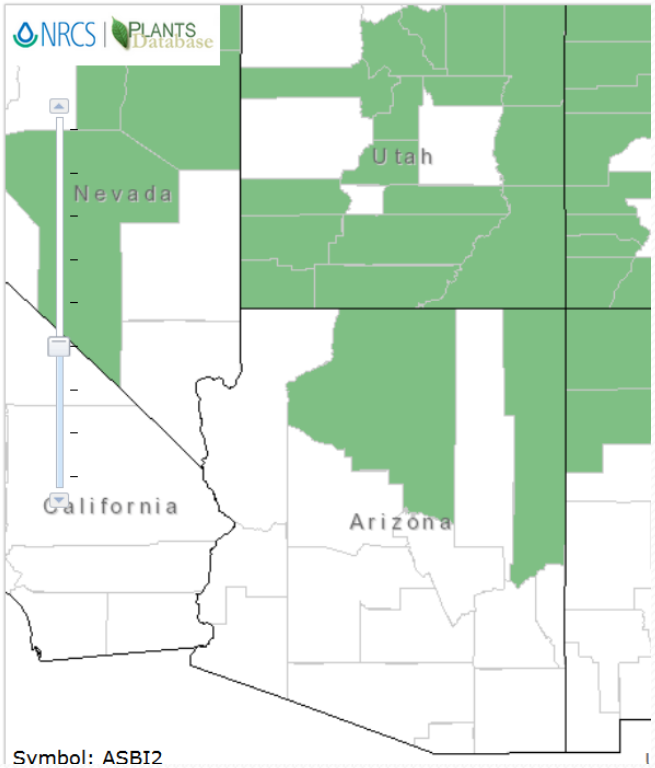


- **Se toxic to cells**
- **Causes hair to fall out and hooves to fracture (lameness**
- **Sometimes blindness and aimless wandering**

Astragalus bisulcatus **(Hook.) A. Gray**
twogrooved milkvetch

General Information	
Symbol:	ASBI2
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	CAN N L48 N
Data Source and Documentation	

About our new maps



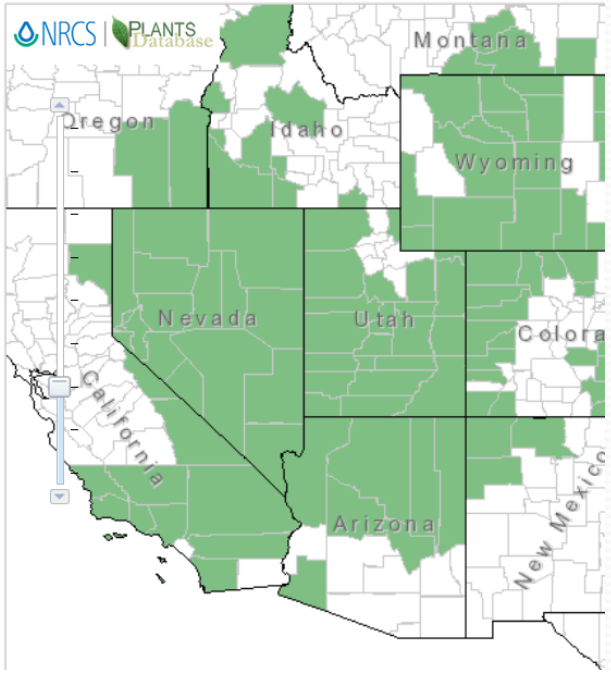
Selenium indicator plants

- Princes plume indicates soils with high Se content

***Stanleya pinnata* (Pursh) Britton**
desert princesplume

General Information	
Symbol:	STPI
Group:	Dicot
Family:	Brassicaceae
Duration:	Perennial
Growth Habit:	Forb/herb Subshrub
Native Status:	L48 N
Data Source and Documentation	

About our new maps

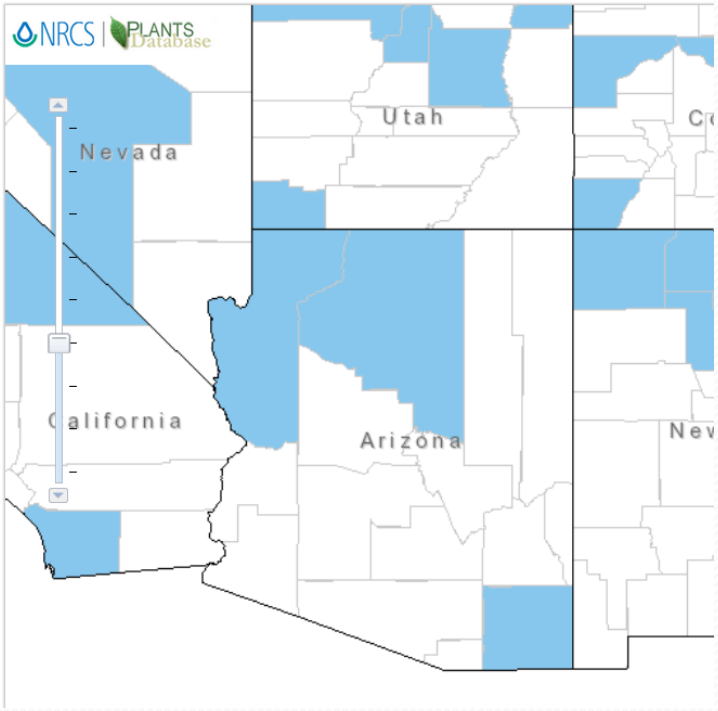


Cow Cockle

***Saponaria officinalis* L.**
bouncingbet

General Information	
Symbol:	SAOF4
Group:	Dicot
Family:	Caryophyllaceae
Duration:	Perennial
Growth Habit:	Forb/herb
Native Status:	CAN I L48 I
Other Common Names:	soapwort

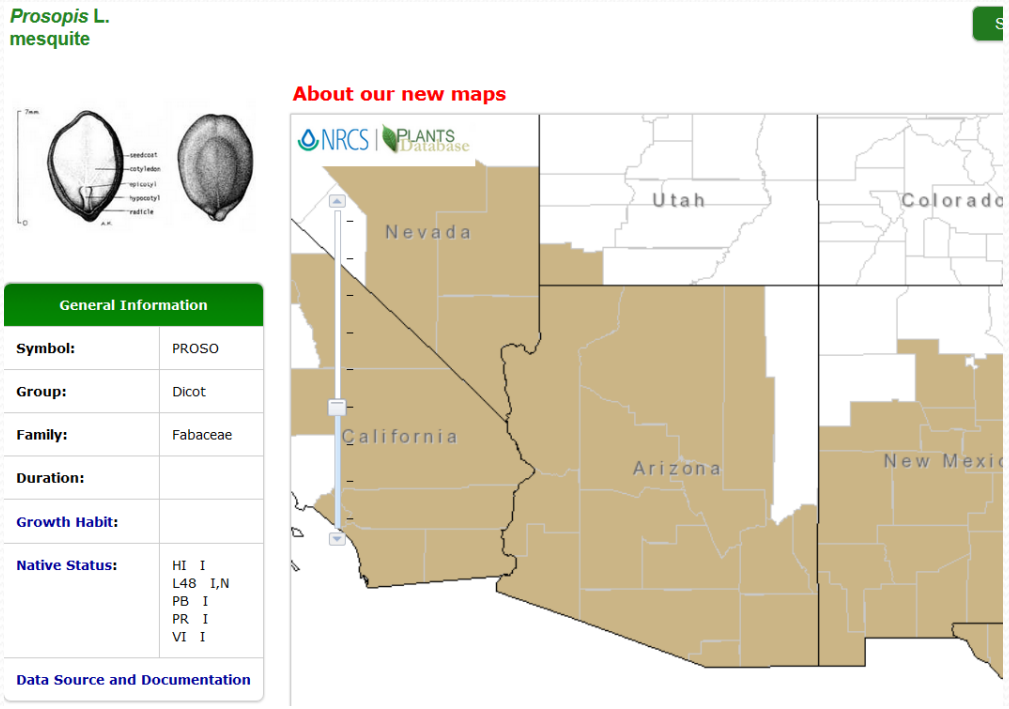
About our new maps



- **Saponaria officinalis**
- **May cause liver problems**

Mesquite

- Prosopis spp.
- Pods and beans causes rumen impaction
- Long-term consumption can cause eating impairment; protruding tongue

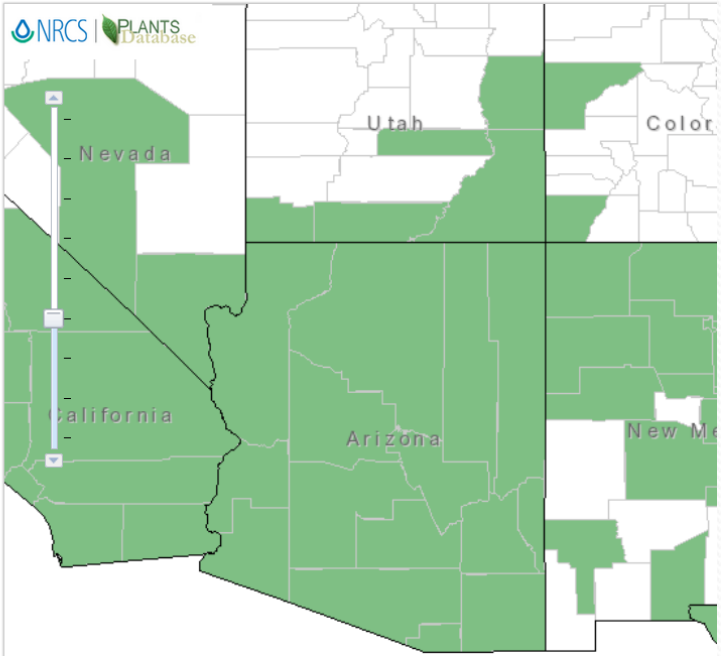


Nightshades

Solanum elaeagnifolium Cav.
silverleaf nightshade

General Information	
Symbol:	SOEL
Group:	Dicot
Family:	Solanaceae
Duration:	Perennial
Growth Habit:	Forb/herb Subshrub
Native Status:	HI I L48 N PR N
Plant Guide (pdf) (doc)	
Data Source and Documentation	

About our new maps



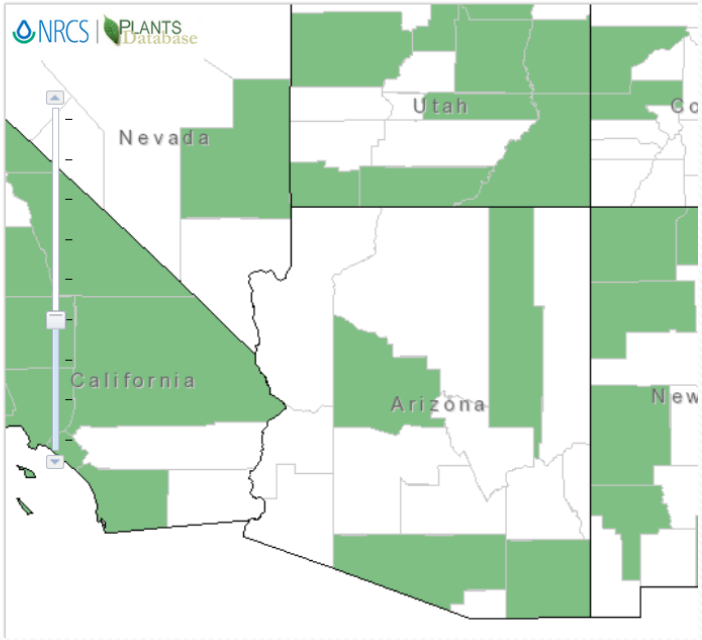
- **Solanum spp.-several species**
- **Affect nervous system**
- **Loss of balance; tremors; seizures**

Black Locust

Robinia pseudoacacia L.
black locust

General Information	
Symbol:	ROPS
Group:	Dicot
Family:	Fabaceae
Duration:	Perennial
Growth Habit:	Tree
Native Status:	CAN I L48 N

About our new maps

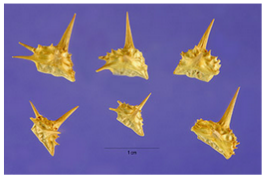


- Robinia pseudoacacia
- Toxin similar to ricin; high in bark and seeds
- Severe GIT irritation; diarrhea; shock
- Sometimes heart problems

Puncture Vine

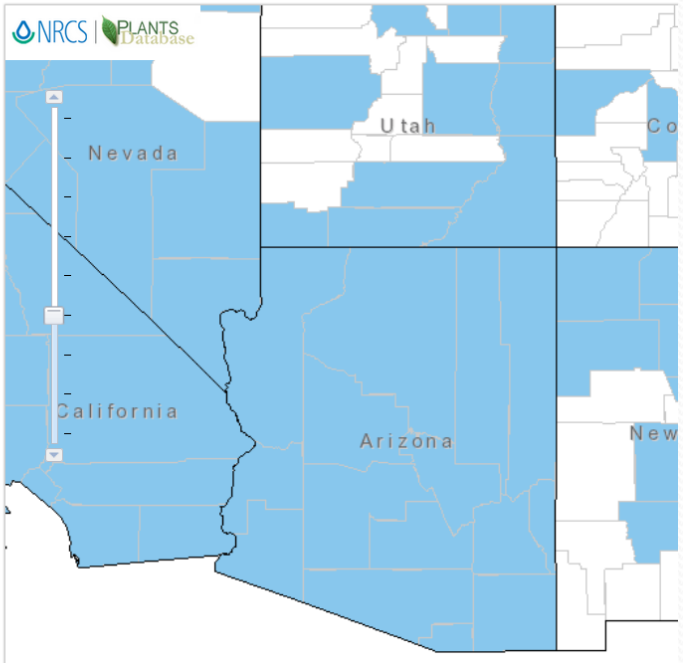
- Tribulus terrestris
- Saponins cause liver disease
- Photosensitization

Tribulus terrestris L.
puncturevine

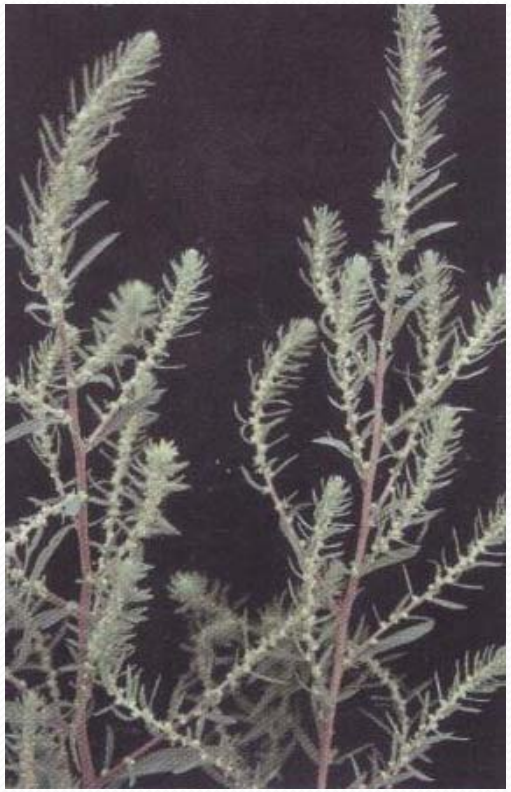


General Information	
Symbol:	TRTE
Group:	Dicot
Family:	Zygophyllaceae
Duration:	Annual
Growth Habit:	Forb/herb
Native Status:	CAN W HI I L48 I PB I
Data Source and Documentation	

About our new maps



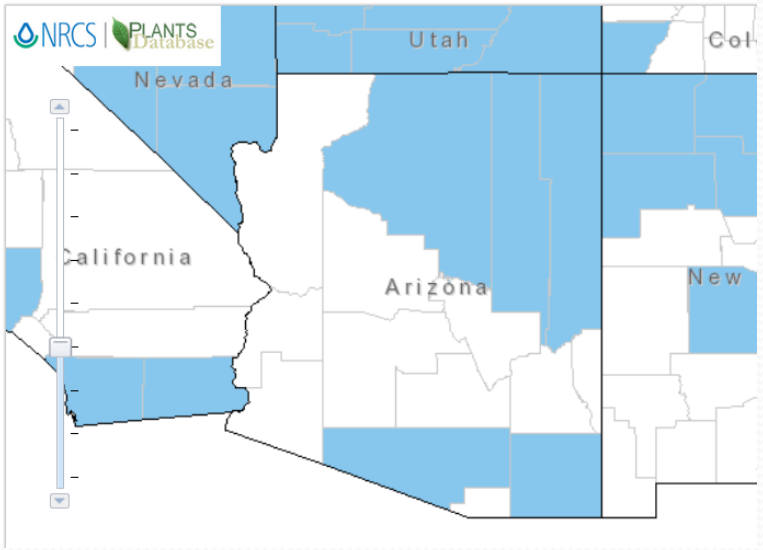
Kochia weed



- Kochia scoparia
- Accumulates nitrates; other toxins
- Causes sudden death
- Blood chocolate brown
- Also photosensitization

Bassia scoparia **(L.) A.J. Scott**
burningbush

About our new maps



General Information	
Symbol:	BASC5
Group:	Dicot
Family:	Chenopodiaceae
Duration:	Annual

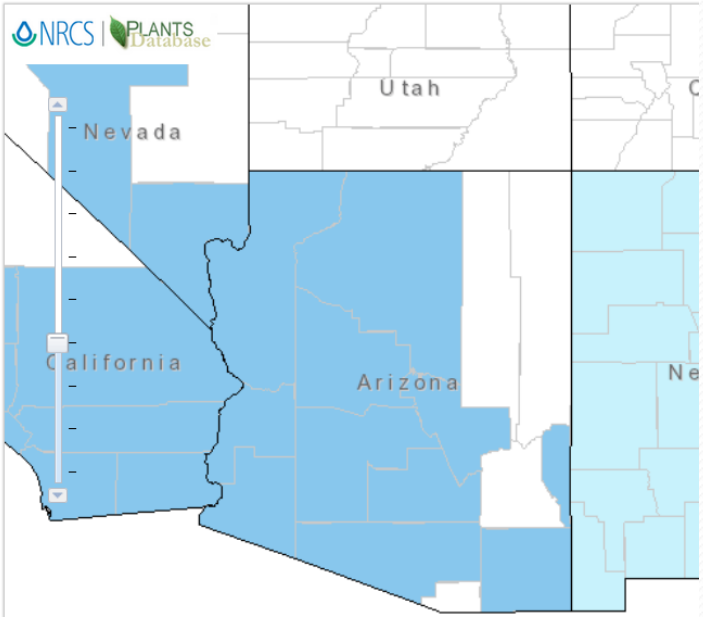
Tree tobacco

- Nicotiana spp.
- Nicotine toxicity
- Affects nervous system
- Also causes birth defects (skeletal malformations) in pregnant animals

Nicotiana glauca Graham
tree tobacco

General Information	
Symbol:	NIGL
Group:	Dicot
Family:	Solanaceae
Duration:	Perennial
Growth Habit:	Shrub Tree
Native Status:	HI I L48 I PB I
Data Source and Documentation	

About our new maps



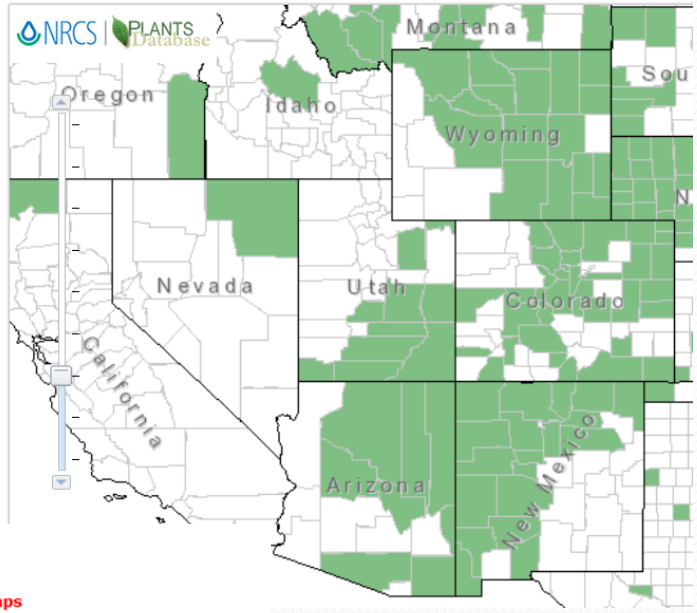
Sagewort and Sand sage

- Artemisia spp.
- Typically “saged horses”
- Nervous system- loss of balance and circling aimlessly
- Can recover on good diet

Artemisia campestris L.
field sagewort

General Information	
Symbol:	ARCA12
Group:	Dicot
Family:	Asteraceae
Duration:	Biennial Perennial
Growth Habit:	Forb/herb
Native Status:	AK N CAN N GL N L48 N
Data Source and Documentation	

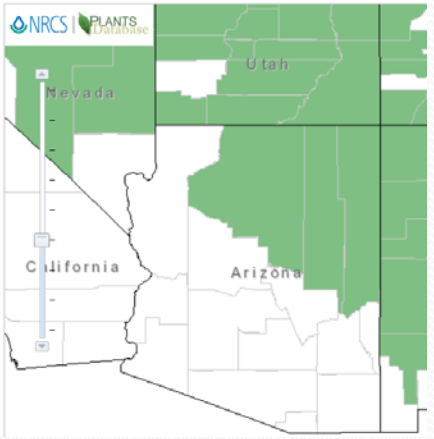
About our new maps



Artemisia frigida Willd.
prairie sagewort

General Information	
Symbol:	ARFR4
Group:	Dicot
Family:	Asteraceae
Duration:	Perennial
Growth Habit:	Subshrub
Native Status:	AK N CAN N L48 N
Characteristics	

About our new maps



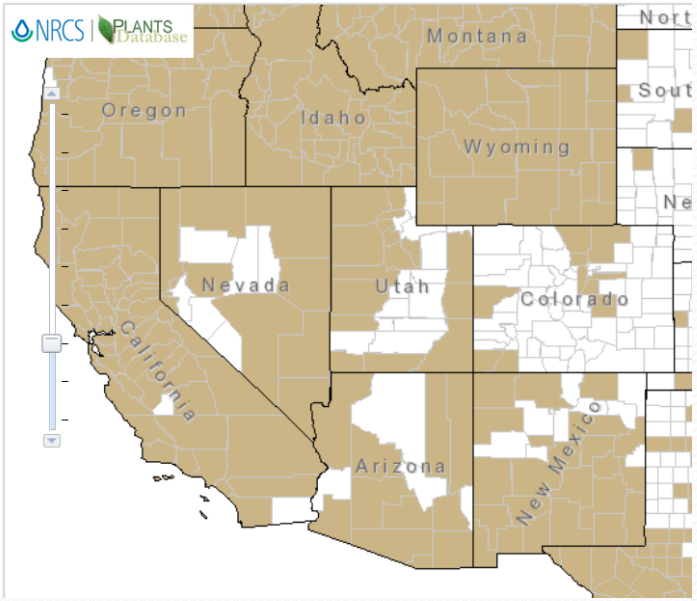
Russian knapweed

- Centauria repens
- Weedy plant
- Toxic to horses
- ‘Chewing disease’ after prolonged consumption
- Food cannot be eaten normally

Centaurea L.
knapweed

General Information	
Symbol:	CENTA
Group:	Dicot
Family:	Asteraceae
Duration:	
Growth Habit:	
Native Status:	AK I CAN I GL I HI I L48 I,N SPM I
Data Source and Documentation	

About our new maps

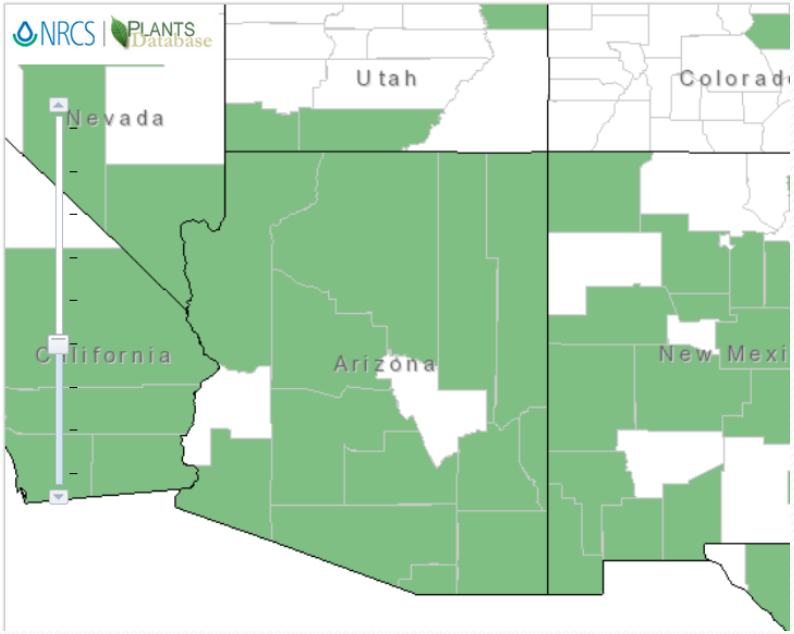


Carpetweed

Kallstroemia Scop.
caltrop

General Information	
Symbol:	KALLS
Group:	Dicot
Family:	Zygophyllaceae
Duration:	
Growth Habit:	
Native Status:	L48 N PR N VI N
Data Source and Documentation	

About our new maps



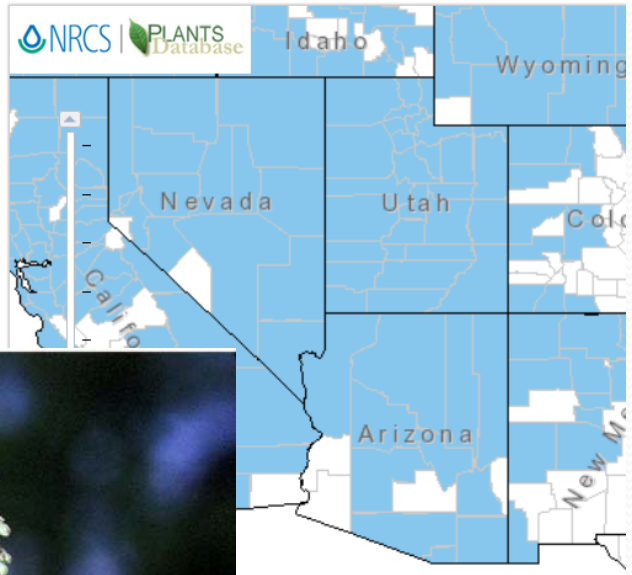
- Kallstroemia spp
- Can form dense carpet of plants
- Hind limb weakness; convulsions; sheep may walk on knees

Dock

- Rumex spp.
- Contain oxalates
- Muscle tremors; weakness; reluctant to move
- Coma; death
- Adapted animals not usually affected

Rumex crispus L.
curly dock

About our new maps



Symbol:
Group:
Family:
Duration

	Average Compound Concentration ± SD (n=10)				
	µg/mg dry weight				
Isocoma spp. / Site	1	2	3	4	5
I. pluriflora					
Pecos	0.4 ± 0.3	2.6 ± 0.7	4 ± 1	---	---
Carlsbad	0.16 ± 0.08	0.8 ± 0.2	1.9 ± 0.7	---	---
I. tenuisecta					
Tuscon	0.2 ± 0.1	1.7 ± 0.5	2 ± 1	0.4 ± 0.4	1.1 ± 0.4
Red Rock	0.11 ±0.08	0.7 ± 0.5	1.3 ± 0.9	0.09 ± 1.0	0.1 ± 0.5
I. azteca					
Newcomb	6 ± 2	0.8 ± 1	2 ± 3	0.7 ± 0.4	---
Tsaya	8 ± 2	0.0004 ± 0.001	0.5 ± 0.3	0.8 ± 0.4	---
I. acradenia					
Mesa	1.0 ± 0.2	1.0 ± 0.4	1.1 ± 0.9	0.4 ± 0.4	0.10 ± 0.04
Kingman	0.3 ± 0.3	4 ± 2	4 ± 2	1 ± 1	0.10 ± 0.02
Wickenburg	1.1 ± 0.4	1.1 ± 0.5	1.2 ± 0.4	0.6 ± 0.4	0.09 ± 0.03
I. rusbyi					
Marble Canyon	0.7 ± 0.6	0.6 ± 0.6	4 ± 1	0.07 ± 0.03	0.4 ± 0.3
Tuba City	2 ± 1	---	0.4 ± 0.2	0.02 ± 0.02	0.07 ± 0.1
Holbrook	2 ± 1	2 ± 2	7 ± 3	0.13 ± 0.07	---