An issue focusing on public lands.

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Native vs. Introduced Species: The New Range War

This range war probably won't be a big draw at the box office. No bellicose barroom brawls, bullets or confrontations under open skies. The combatants in this conflict dodge paper fusillades, nurse ulcers and batter each other with competing paradigms. A lot of the battles are fought in carpeted rooms where the tones are polite, the arguments become soporific and the air is conditioned and filtered.

But don't kid yourself. There's a lot at stake here, much more than when sheepherders and cattleman noisily squared off last century. Public rangelands, which were always an ecological experiment on a grand scale, are now becoming an ecological experiment on a deliberate scale.

The debate is percolating through academic institutions and government agencies, accompanied by a blizzard of papers, memos, articles and faxes. Livestock producers have a definite stake in the outcome, although they have much less say in the matter than

Photo: Jerry Chatterton
they did a century or so earlier. This is definitely a twentieth century range war, a feisty hybrid of economics, politics and science.

The main issue is biological diversity on public rangelands: nearly everyone agrees that more is desirable. Beyond that, however, matters become muddled and consensus thins dramatically.

In the 1930s, millions of acres of public rangelands in the West were planted to introduced species, most of them grasses that thrived on abandoned farmlands and lands scarred by drought, erosion and overgrazing. At the time, the fact that these plants weren't indigenous to the area, or that they were planted in tracts large enough to be visible from outer space wasn't nearly as important as the fact that they healed the battered landscape. Forage for livestock was an added bonus.

Things have changed. As more of the country is slathered in concrete and asphalt, public lands are viewed as ecological treasures. The introduced grasses, once viewed as replenishing the landscape, are now criticized as interlopers. Critics claim that lush growth masks an impoverished ecosystem and that while native vegetation may not support as many cows, sheep and big game, it nourishes a richer and more-diverse ecosystem, which they want back.

They might not be able to have it, but not because people aren't trying.

Perhaps the most famous (or notorious, depending on your perspective) of the nonnatives is crested wheatgrass, which had been seeded on more than 12 million acres in the West by 1981 and which
probably occupies an even greater acreage today. It offers excellent grazing but many criticize these large monocultures as an assault on biological diversity, an opinion that was easy to form considering some of the gargantuan reseeding efforts in the 1950s in which crested wheatgrass carpeted the horizon in every direction, a particularly disconcerting sight in late summer when the growth of crested wheatgrass falters and turns brown. Most range managers now disavow such large-scale, single-species seedings.

"I chose to work with crested wheatgrass because it has excellent grazing qualities," says Kay Asay, a geneticist with the USDA Forage and Range Research Laboratory, who has studied the grass for 18 years. But that's not all. Crested wheatgrass is easy to establish, has good-quality seed and has the ability to shrug off drought, diseases and insects, as well as tolerating grazing. It also stabilizes sites by reducing erosion. "Although it was once seeded in monocultures, there's no reason that it can't be grown with other species, including natives," Asay says.

That's not enough to assuage some critics. Crested wheatgrass is foreign. (It originated in Asia.) And one of the basic ecological principles is that native plants should fare well on sites where they originated—with the caveat that these sites haven't been altered.

Most have and that's the crux of the problem. Soils have eroded. The microclimate has changed. As a result, natives often do poorly on sites where they originally flourished and the choice is often not between introduced grasses and native plants, but between introduced species and bare erodible soil. Or between improved introduced species and cheatgrass, a particularly nefarious annual weed that has elbowed out other vegetation on millions of acres in the Intermountain West and which makes it even more difficult to establish perennial seedings.
One suggested tactic—let introduced species upgrade ranges and improve the microclimate so natives can gain a foothold.

The issue of native versus introduced species has been around for a while. Some of the first attempts at revegetation of western rangelands used native grasses. Only after these attempts failed did scientists turn to introduced species that were adapted to the altered rangelands.

Jerry Chatterton, research leader of the USDA’s Forage and Range Research Laboratory who oversees a team of plant breeders, plant physiologists, range scientists and plant geneticists, views the bias against “foreign” plants as debilitating and as short-sighted as similar discrimination against humans, the product of a misplaced belief that any native plant is, ipso facto, automatically and intrinsically better than a nonnative plant.

Many people assume that a native plant has an ecological edge over a nonnative plant, the result of their adaptation to sites over eons. That’s only true, if plants and sites evolved together and if the sites haven’t been altered.

A concomitant belief is that a nonnative plant has aggressive and invasive tendencies that threaten to overwhelm the entire ecosystem.

Chatterton admits there is evidence for both beliefs. Weeds and pests carelessly or accidentally introduced in the past have cut a wide and devastating swath through large sections of the country. However, the USDA has stringent guidelines and procedures now guard against the introduction of any organism of this type.

In effect, plant breeders say they are able to tailor plants to survive specific sites, mimicking natural adaptation that would otherwise take thousands of years, or circumventing site restoration that would be
prohibitively expensive. It may not be ideologically pure, but it works. And it works well.

The debate is clouded by semantic issues. What is a native plant? Is it one that predates white settlement? Or one that existed thousands of years ago? Exactly how many years?

If it's several thousand years ago, then a native plant could include many relatives from Europe and Asia that evolved simultaneously with North American species. In their search for new genetic combinations, USDA researchers have spent decades tracing the lineage of several important forages and some of the genealogies are still in doubt. Trying to classify hundreds or thousands of plants as native or nonnative would be a Herculean task. It might also be futile since plants are constantly exchanging genetic material.

Tom Jones, USDA research plant geneticist, prefers the evaluation of rangelands according to management objectives, rather than their similarity to pristine status (which really isn't known anyway). He calls the preference for native plants over introduced plant materials based strictly on a plants' domestic origin a type of "ecological reductionism."

ALFALFA-GRASS SELECTION PRACTICES SHOULD BE SIMILAR TO PLANTING PRACTICES

Grasses and alfalfa are often planted together on rangelands. It appears that they should also be interplanted during the selection process.

That's usually not the case. During the first stage of selection, only alfalfa is usually grown in spaced-plant nurseries, although some breeders overseed these nurseries with one type of grass. Mel Rumbaugh, USDA research plant geneticist, wondered if alfalfa's performance would be affected by interseeding with different types of grasses.

To find out, he grew alfalfa clones with four species of grass. The difference in the shoot growth of alfalfa was large enough (about 10 percent) to justify the simultaneous selection of grass and alfalfa. It's also important to interplant the grass and legume at a density and pattern similar to that found on rangelands.

"The bottom line is that if you want to breed alfalfa that grows with a species of grass, you should select clones grown with that species of grass," Rumbaugh says. He says such interseeding may seem to be a "little unnatural" to grass and alfalfa breeders, who usually have separate selection programs. Interseeding during selection should pay off later on rangelands, however.

Mel Rumbaugh 750-3077
Basing the acceptability of plants according to an errant foreign gene or two creates all sorts of ludicrous possibilities and intractable problems. For example, the morphology of native bluebunch wheatgrass differs from that of its counterparts in Asia, but its genetic composition is almost identical, notes Kevin Jensen, USDA research plant geneticist.

The genus *Leymus*, which includes native beardless wildrye, Great Basin wildrye and other minor taxa, is genetically similar to *Leymus* species in other parts of the world. Western wheatgrass, a native grass, evolved from a natural hybridization between thickspike wheatgrass and beardless wildrye, a genetic combination whose forebears could have just as well included the introduced species *Elymus caninus* and *Leymus multicaulus*.

“If we carry the elimination of introduced species to the extreme, does that mean we limit introduced species such as wheat from Egypt and corn from South America on midwestern farm land that was once a high grass prairie? And what about an originally native species that has had a single beneficial gene introduced through plant breeding or genetic engineering?” Jensen asks.

“We are observing ecosystems through a very small window in time. We have very little information regarding the nature of these plant complexes over an extended period of time,” says Howard Horton, USDA range scientist. “We know that many genetic complexes existing in native material today co-evolved with those in introduced species.”

There is concern that introduced plants will become naturalized and perpetuate themselves at the expense of other native species, but crested wheatgrass is an example of an introduced plant that has proved to be
remarkably well mannered. It is less aggressive than critics think, in spite of its visibility. In the western Great Basin, it has seldom wandered from the rows where it was planted 40-60 years ago. It hasn’t died out in spite of severe grazing and an inhospitable climate, nor has it regenerated itself and threatened to crowd out other plants. If not already present, similar traits can be bred in other introduced plants.

Because natives often disappear when planted with introduced wheatgrasses, many observers believe wheatgrasses have displaced natives, Horton says. Introduced wheatgrasses may not be responsible for the vanishing act, however. Often the natives never germinated or became established. In many instances, natives would have failed even in a native monoculture seeding. The perception that introduced grasses displaced natives was also fostered by the practice of planting introduced grasses in pure stands, or by intensive grazing by livestock and wildlife, which favored the more-grazing tolerant introduced species and led to monocultures.

Large-scale monocultures were also responsible for the belief that range improvement is incompatible with the management of big game and upland bird populations. Not so. Many types of wildlife thrive in mixed plantings. For example, mule deer make heavy use of crested wheatgrass in the early spring. Mixtures of shrubs and perennial grasses are more desirable habitat for mule deer than are degraded sites containing only big sagebrush or crested wheatgrass. Many mixtures of grasses (including crested wheatgrass) and shrubs favor wildlife, as do plantings that provide ample boundaries with other types of vegetation.

“Not all introduced species are desirable, but not all of them are weeds either,” says Asay, who cites grasses such as crested wheatgrass, intermediate wheat-
A REPOSITORY OF GERMPLASM

Seeds, thousands of them, including those from the genera Elymus, Elytrigia, Agropyron, Leymus, Pseudoegneria and Psathyrostachys.

Those are just some of the types of 1,800 lots of seed that the Forage and Range Research Laboratory will distribute during 1992 to cooperators across the United States and around the world. The seeds are essential in plant breeding and research in genetics, cytogenetics and taxonomy.

A field near Logan is also the site of the U.S. Living Collection of Perennial Triticeae Grasses, which contains about 70 percent of the 260 perennial species of grass plants of the tribe Triticeae, and over 400 interspecific and intergenomic hybrids within the tribe. Plants are observed, evaluated and increased for distribution to users around the world.

Kevin Jensen    750-3099

grass, tall wheatgrass, Russian wildrye and smooth and meadow bromegrass as having markedly improved rangelands. A particularly promising tactic is to include native and introduced grasses in a grazing system—the growth of native grasses and forbs during mid to late summer would compensate for the sluggish hot-weather growth of introduced cool-season grasses such as crested wheatgrass.

Native plants that can assert themselves would definitely make for a more varied landscape. Tom Jones is studying several promising native species, including bluebunch wheatgrass, Snake River wheatgrass, Indian ricegrass and Basin wildrye. There’s commercial interest in all of these species, although efforts to improve them via hybridization and artificial selection lag far behind progress with introduced species.

Jones says the evaluation of promising accessions collected by the Soil Conservation Service and other agencies is a “logical first step, but if possible we would like to move beyond evaluation and into plant breeding.” This requires a resolution to the thorny question of how much human intervention is compatible with “native plants.”

Many of the controversial issues reflect the rifts between disciplines, Jones says. Those trained in agriculture are comfortable manipulating the environment, a concept which is foreign to those trained in the natural resources, who prefer to work with land and vegetation in situ. Moreover, some wildlife agencies responsible for managing often view matters from the perspective of elk, deer and other wildlife populations, but have little control over wildlife habitat.
“It’s hard to get cooperation when agencies have different objectives,” Jones says. And it’s even harder when the protagonists antagonize each other, even inadvertently. Some managers dislike plants—even native plants—that are seeded in rows and that bias seeps through in all kinds of ways. For example, those who chafe at introduced species may refer to “pure stands” of native plants but “monocultures” of introduced species. Plant breeders take a proprietary interest in the varieties they develop and may react defensively to criticism of these varieties. Breeding and releasing new varieties is an exacting and competitive endeavor and some plant breeders don’t look kindly on those with limited training who are now dabbling in the profession.

“A lot of people are posturing and making arguments that are only half true,” Jones says. “But even the most belligerent individuals tend to calm down when they get out to research sites and see for themselves what works.”

Natives may have more-exacting planting requirements and may entail more risk than introduced species, but that doesn’t mean natives should summarily be rejected, says Mel Rumbaugh, plant geneticist with the USDA. Many of the problems with natives can be solved by learning their germination requirements and by employing better seeding techniques. He also notes that any limits on introduced plants that curtail forage production on public lands could provide additional incentives to increase forage production on private lands, which are usually more fertile.

“The next 10 years are going to be very interesting,” Rumbaugh says. “It’s a very emotional issue. I anticipate that there will be restrictions on where introduced species are allowed because of the strong public support for reintroducing native plants, even among many scientists who view species as intact, distinct entities.”

Melvin Rumbaugh
Many Americans like the idea of restoring rangelands to their “original” condition. Nurturing native vegetation could salve our conscience about a host of unnatural acts, ranging from the widening ozone hole to trammeling of native culture. Most probably envision lush, productive, low-maintenance rangelands when they think of native vegetation, or at least a chance to snatch our pristine, wild past from the clutches of cows or the peregrinations of scientists who simply won’t stop tinkering with the natural order of things.

If only that were so.

The argument that an introduced plant may be better suited to a site than a native plant often falls on deaf ears. As we become more insulated from natural rhythms, natural (read native) sells in a society with a penchant for anything “natural,” whether it’s crackers, shampoo or socks.

“Millions of dollars are wasted every year in attempts to re-establish native plants on sites they are no longer adapted to,” Chatterton says. “This is irresponsible.

“For years I have asked to see a successful planting of native plants on more than an acre or two of rangeland. There aren’t any.”
Wilderness Use
Difficult to Predict

Who will use wilderness in Utah and how often?

No one knows and it won’t be easy to find out, say USU economist Bruce Godfrey and Kim Christy, a former graduate student, who analyzed the use of wilderness administered by the U.S. Forest Service. Wilderness use could be an important component in determining whether communities derive economic benefits from wilderness.

Although total use of wilderness increased since the late 1970s, there’s been a decline in the intensity of use (as measured by the visitor days per acre). Among the possible reasons for this decline—restrictions associated with wilderness, which encourage users to shift some activities to other lands, an aging population less inclined to pursue wilderness activities and the increased popularity in newly designated wilderness at the expense of “original” wilderness. Visitors also aren’t staying as long.
Recreational visitor days per acre on wilderness lands in Utah administered by the Forest Service by area, 1986-1990.

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Source: USDA, Forest Service

In some respects, wilderness sites compete against each other and some areas are much more popular than others. For example, during 1984, six areas accounted for about one-third of the recreational use of all wilderness areas administered by the Forest Service.

And who visits? Studies conducted by the Forest Service in other states suggest that wilderness users appear to be stereotypical yuppies—
educated young people with relatively high incomes. Most visitors are college-educated, who tend to stay a relatively short time (1 day). Heaviest use occurs during the summer and, somewhat surprisingly, most use involves repeat visits by local residents.

Some of the trends that characterize wilderness use in Utah are similar to those on a national level—there’s been an increase in acreage and in total use coupled with a gradual decline in the intensity of use, except for the Lone Peak wilderness area near Salt Lake City, which, like most wilderness areas that are located near population centers, is used intensively.

Godfrey can’t predict the use of newly designated wilderness. Although use tends to increase following designation of wilderness (a phenomenon known as the “designation effect”), many of the areas considered for wilderness designation in Utah are in remote areas with limited access, which are unlikely to attract as many visitors as those located near the Wasatch Front.

Another factor is whether existing wilderness areas and national parks in the region will attract or deter users of newly designated wilderness. Much of the land proposed for wilderness is at lower elevations and drier than existing wilderness areas in the region. This may encourage use during the spring, fall and winter, although the heat and limited water may deter use during the summer. The red rock formations in many of the proposed wilderness areas are similar to those in the national parks in Southern Utah, including nearly 1.3 million acres of land that the Park Service has recommended for wilderness designation.

IMPROVING NATIVE WHEATGRASS

Grazing-tolerant native wheatgrasses are on the drawing board.

One promising cross involves thickspike wheatgrass and Snake River wheatgrass. Snake River wheatgrass is so closely related to bluebunch wheatgrass that it wasn’t identified as a separate species until 1986. It is more grazing tolerant than bluebunch wheatgrass.

Thickspike wheatgrass, another relative of bluebunch wheatgrass, is even more grazing tolerant.

Tom Jones, USDA, research plant geneticist, has crossed the two species and thinks a cultivar may be available in five years. In addition to increasing grazing tolerance, crossing with thickspike also eliminates the awn from Snake River wheatgrass. The cultivar will be a Snake River wheatgrass, which contributes seven-eighths of the genetic material.

Tom Jones 750-3082
How much do wilderness users spend? For example, most downhill skiers hail from out of state and spend $100 to $200 per day. Studies conducted in other states indicate that users of wilderness tend to be local residents who are likely to spend much less, usually $10 to $20 per day, much of it on food and fuel that are brought in other areas. (However, discussions with federal land managers suggest that a fairly large percentage of wilderness users in Southern Utah are not local residents.)

“The most recent study of wilderness users involved the Appalachian area. We don’t expect that the situation will be the same as in the area around St. George,” Godfrey says.

Will new wilderness areas encourage Utahns to stay in-state instead of heading out-of-state? If so, they could capture valuable travel dollars. There are similar economic benefits in attracting out-of-state residents.

KG

Bruce Godfrey 750-2294
Slime Mold
Genealogy

Slime mold. Definitely not a glamour field but interesting. And revealing.

Just ask molecular biologist Dennis Welker, who is studying how lowly slime molds process information that govern the expression of genes. It turns out that slime mold, humans and other animals have some important and revealing biochemical similarities.

Welker says slime molds contain plasmid DNA, small, circular molecules, rather than the long, linear chromosomes that are found in most similar cells. As a result, researchers can put the genes of interest on the plasmid, add the plasmid to a cell and see what happens.

Welker and coworkers are studying the basic biology of the slime molds, which he calls “plasmid genealogy,” in order to group plasmids into “families.” (They’ve identified four families so far.)

Determining relationships between plasmids and how they can be combined will indicate the functions of each section of the plasmid, findings that eventually could help determine, for example, how genes are expressed during the development of a fetus or why cancerous cells continue to divide.

One topic of interest—how cancer cells amplify certain genes to counter agents used in chemotherapy.

The researchers are also studying how cells become resistant to nickel, cobalt and other elements.

That’s a lot to learn from organisms that most of us associate with primordial ooze.

LH

Dennis Welker 750-3552

Awards & Honors

R. J. Hanks, Pants, Soils & Biometeorology Department, was honored at a symposium during the 1992 meeting of the American Society of Agronomy held in Minneapolis. The symposium, entitled “Modeling With One Foot in the Field,” reflects Hanks’s approach to research, which couples computer modeling with field experiments. Hanks retired from USU this year. He is widely known for developing models of the soil-plant-atmosphere system.
Studies Put A Value on Recreation

What’s it worth, the opportunity to hunt a buck in the wild or to haul in a lunker at a reservoir?

Establishing the market price for these experiences can help wildlife resource managers make policy decisions about the recreational use of natural resources. USU economist John Keith heads a team that is doing this for the Utah Division of Wildlife Resources.

In one study, researchers asked more than 700 people who had purchased licenses to hunt big game whether they would also purchase a deer tag priced anywhere from $5 to $25. (The type of “bidding games” used in this type of economic analysis is known as contingent valuation.)

Hunters’ willingness to pay depended on the importance they placed on hunting and on household income. However, hunters said price was less important than being allowed to choose their weapons and to select one hunting season each year. (Respondents were asked to choose between the hunting season then in place, to select one of two shorter seasons, or to participate in one hunt per year but to choose either a rifle, muzzleloader, or bow.)

Two weeks after Keith and sociologists Richard Krannich and Victoria Rhea submitted their report, the Division of Wildlife Resources adopted the “choose your season” option. “This is the first time I’ve worked on a project and had our recommendations adopted so quickly,” Keith says.

A similar study concerns the value of recreation at a prospective reservoir. One question concerned whether the a new recreational location would reduce the number of trips to other spots.

Managers and economist previously assumed that people made more total visits as new recreational sites were developed. However, most people take about the same number of boating or fishing trips each year, so any visits to a new site will probably mean they take fewer trips to old haunts.

“Our department has studies of deer hunting and boating dating back to the 1960s,” Keith says, which lets researchers monitor changes in willingness to pay for recreation and attitudes about recreation.

“Contingent valuation is being used to measure the value people place on a lot of things, even those they might not use, such as a state park or wilderness area.

“People value those things just because they know they are there, even if they never go to see them,” Keith says.

LH

John Keith 750-2303
Study Outlines Opportunities, Problems for Utah Agriculture

Will Utah agriculture wither?

Definitely not, according to a recent report prepared by the Governor’s Task Force on Agribusiness Development, which outlines new opportunities for agribusiness. But don’t expect change overnight, says Donald Snyder, USU economist who served on the task force.

And it won’t be easy. In addition to a shortage of capital, Snyder says Utah agriculture faces competition for land and water.

Agriculture in Utah accounts for a substantial slice of the state’s economic activity—$2.4 billion annually, according to a recent estimate. And even though some niche markets may be alluring, Snyder says traditional agriculture, primarily livestock-related enterprises, will continue to account for most of the state’s agricultural revenues because it capitalizes on the resource base of the state.

“We need to maintain a mix of traditional and innovative enterprises. Improving agriculture at the margin will allow producers to stay in business,” Snyder says.

Marketing efforts can strengthen demand for Utah-raised products, but price is still paramount to consumers, Snyder says. One example is the production of “natural” beef, which could be an attractive enterprise if consumers are willing to pay more. So far, however, they’re not. “It’s uncertain whether people are willing to differentiate between ‘traditional’ products such as beef and alfalfa on the basis of quality, but quality appears to be important in niche markets,” he says.

USU has a key role in invigorating agriculture, both by identifying profitable options and alternatives, and by conducting basic and applied research. And while research can benefit all producers, it often gives in-state processors and producers valuable lead time. Patents on many technological breakthroughs return additional revenue to the state.

Snyder says the state’s agricultural industries have been more willing to fund research, a development which he largely attributes to leadership provided by the Utah Department of Agriculture. Nonetheless, Snyder says support for new agricultural industries pales in comparison to the support provided by many other states.

“It’s unbelievable what Texas does to support agriculture—tax incentives, tax-free enterprise zones, support for feasibility studies and tax-free bonds.”

Snyder also believes that Utah may attract farmers from the West coast who are being squeezed out by increased costs and dwindling water supplies.

“Perhaps the biggest benefit of the study was that it brought together people in the same industry who had never talked to each other before. It’s vital to continue this type of communication,” Snyder adds.

KG

Don Snyder 750-2305
Rebecca Austin, Family & Human Development Department, is studying how to improve child care services in rural northern Utah with a grant from the W. K. Kellogg Foundation.

Gail Bingham, Plants, Soils & Biometeorology Department, is conducting a mesoscale study of surface heat fluxes and boundary layer processes in a desert region with support from the National Aeronautics and Space Administration. Others participating in the study are Larry Hipps, Plants, Soils & Biometeorology Department, Chris Neale, Biological & Irrigation Engineering Department, and Paul Riley, Civil & Environmental Engineering Department.

Charlotte Brennand, Nutrition & Food Sciences Department, is studying the consumption of dairy products by the elderly. Her research is funded by the National Dairy Promotion and Research Board.

Paul Savello, Nutrition & Food Sciences Department, is studying the manufacture, shelf stability and acceptability of aseptically packaged unripened soft cheese manufactured by various methods. His research is funded by the National Dairy Promotion and Research Board.

Lynn Dudley, Plants, Soils & Biomeeteorology Department, is studying the effect of land disturbances in the Intermountain West on the soil and water chemistry with funding from the USDA/Forest Service.

The Utah Department of Agriculture funds a study of computerized hypertext information systems by Philip Rasmussen, Agricultural Systems Technology & Education Department.

Rodney Brown, Nutrition & Food Sciences Department, is studying the activation of plasminogen for the improved ripening of Swiss cheese. The research is funded by the National Dairy Promotion and Research Board.

The City of Ogden is developing a parkway botanical garden with the assistance of William Varga, Plants, Soils & Biomeeteorology Department.

Edward Evans, Biology Department, is studying the biological control of noxious weeds. His research is supported by the U.S. Department of Interior/Bureau of Land Management.

New Faculty

G. Reed Holioak, research assistant professor with the Animal, Dairy & Veterinary Sciences Department, studies scrapie in sheep and reproductive viral diseases in livestock. He received a DVM degree from Washington State University and a Ph.D. in veterinary infectious diseases from the University of Kentucky.

Kenneth C. Olson is associate professor with the Animal, Dairy & Veterinary Sciences Department. His research concerns ruminant livestock nutrition. Olson was on the faculty at Kansas State University. He earned a Ph.D. in range science from USU.

Philip Rasmussen has been named head of the Agricultural Systems Technology & Education Department. He was assistant department head and professor with the Plants, Soils & Biomeeteorology Department at USU.

Eugene W. Schupp is assistant professor and plant population ecologist with the Range Science Department. He earned BA and MA degrees from the University of Southern Florida and a Ph.D. in Biology from the University of Iowa. Before joining USU he was employed at the Savannah River Ecology Laboratory at the University of Georgia.
Globemallows

Ready for Release

After several years of careful evaluation, two populations (ecotypes) of globemallows are nearing release, either as germplasm or cultivars.

Both of the drought-tolerant forbs thrive on sites that receive less than 12 inches of precipitation annually. The lack of forages that can survive on these sites should ensure widespread use of these forbs.

Scarlet globemallow (*Sphaeralcea coccinea*), a showy, low-statured forb that spreads by rhizomes, anchors the soil and aids conservation. Melvin Rumbaugh, plant geneticist with the USDA, says its attributes as a wildflower should also make it popular for roadside beautification and in natural plantings. “Scarlet globemallow and crested wheatgrass should make an attractive, low-maintenance plantings for areas such as highway rest stops,” Rumbaugh says.

Munro globemallow (*S. munroana*) is taller and was selected for its ability to produce forage in harsh, dry locations. It will probably be popular in mixtures containing crested wheatgrass.

Mel Rumbaugh


VARIETIES OF CRESTED WHEATGRASS FOR LAWNS

Crested wheatgrass may be just the ticket for thirsty lawns.

Researchers are developing turfgrass varieties of the drought-tolerant forage grass that require about half as much water as conventional lawn grasses. Other big pluses—greater resistance to insects (billbugs should be a thing of the past) and less mowing.

The last hurdle is whether close mowing affects persistence and turf quality, says Kay Asay, research geneticist with the USDA’s Forage and Range Research Laboratory who has studied the lines for almost a decade. Seed from several promising lines should be available in about three years.

The lines of crested wheatgrass for lawns are shorter and have narrower leaves than those found on rangelands. They also spread by rhizomes instead of the bunch-like growth that characterizes most rangeland types of crested wheatgrass.

Most of the 50 lines that are being evaluated are from Turkey. One line is from Iran. Populations recently collected in Kazakhstan will also be studied.

Kay Asay 750-3069

The two finalists were selected from seeds from dozens of populations collected as far south as Mexico and as far north as the Canadian border. Populations from the southern U.S. didn’t survive northern winters. The scarlet globemallow finally selected was originally collected from northern Idaho and the munro globemallow was originally collected from Hyrum, Utah.

Globemallows aren’t as palatable as alfalfa, but sheep like them. In grazing trials involving 14 accessions conducted over four years, sheep preferred alfalfa and crested wheatgrass to globemallows. In the spring, alfalfa was the favorite forage, but sheep preferred globemallows over crested wheatgrass.

Some globemallow seed is now collected from wildlands, but supplies are limited and the quality is variable. Globemallows are indeterminate, i.e., they flower and produce seed throughout the summer, which hampers commercial production and limits seed yields. Rumbaugh hopes to develop determinant populations of globemallows.

KG

Mel Rumbaugh 750-3077

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Grazing Effects:
There’s More to Learn

Why don’t native grasses survive as well as some introduced species? Grazing may be partially responsible, says a range scientist with the USDA Forage and Range Research Laboratory.

It’s not a new idea, but Jerry Cox is approaching it from a different angle—the roots.

Native species often aren’t as persistent or as competitive as introduced species, even though the physical and soil chemical characteristics of sites where natives thrive often aren’t appreciably different from those sites where they fail.

The reason might be that many of the natives did not evolve under heavy grazing pressure. This hypothesis has been extensively studied but so far there’s little solid aboveground evidence to implicate grazing.

The reasons may be underground, Cox says.

He is conducting some “pointed and simple experiments” to find out how grazing affects root growth of native and

Jerry Cox
SECRET TO CHEATGRASS GROWTH COULD AID CROPS

Researchers have identified a metabolic process that helps cheatgrass gain a foothold on rangelands.

Cheatgrass germinates and grows in the fall when temperatures are cooler and there's more soil moisture. The weed stays green throughout the winter and is poised to grow rapidly during the spring. Later, however, it goes dormant and its dry foliage creates an flammable mat that easily erupts into flame, destroying other vegetation.

Jerry Chatterton and co-workers with the USDA-ARS Forage and Range Research Laboratory characterized the fructans, a major nonstructural carbohydrate, in cheatgrass. They are now characterizing the proteins associated with fructan biosynthesis, findings that will help researchers identify DNA sequences and, ultimately, the genes associated with fructan synthesis. Those genes can then be transferred to other crops to improve their cool-season growth.

Some plants accumulate starch and sucroses, others accumulate fructans and sucrose. Chatterton says cool-season grasses and small grains rely on fructan metabolism, as do onions, Jerusalem artichokes and other weeds such as dandelions, quackgrass and Canada thistle.

Plants that accumulate fructan and sucrose have not been studied as extensively as those that accumulate starch and sucrose, in large part because analytical techniques for fructan analysis were only recently developed.

Jerry Chatterton
750-2249

In an experiment in southern Arizona, a single defoliation reduced the root biomass of the native grass (which did not evolve under heavy grazing pressure) by 50 percent and reduced the root biomass of an African grass (which did evolve under grazing pressure) by only 20 percent.

Changing the grazing sequence might markedly improve the persistence of natives, Cox says.

Cox doesn't think recent livestock grazing is solely responsible for the putative decline in biological diversity on western rangelands because there's been a substantial decline in the number of livestock on federal land in the western states from 1920 to 1980: The number of cattle on federal land declined from 12.1 to 3.4 million head and the number of sheep on federal land declined from 22.8 to 3 million head.

"And even though there are more livestock in the West than ever before, there are probably fewer livestock on public lands than at any time in the last 100 years,"

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Cox says. The difference is that livestock are concentrated on private lands.

Cox has studied several aspects of range management, including the role of livestock in the spread of undesirable shrubs. Conventional wisdom blames livestock for aiding the spread by excreting seeds.

Many other factors appear to be involved, says Cox, who studied factors that govern the spread of two undesirable shrubs, whitethorn acacia and velvet mesquite, in the Sonoran desert.

Only a small percentage of the seeds of these shrubs that passed through the digestive tract of cattle and sheep were able to germinate. However, kangaroo rats harvested seeds of these shrubs, some of which were excreted by livestock, removed seed coats and buried them at depths that were ideal for germination.

They appeared to aid spread of these shrubs far more than did livestock.

ECONOMIC ADVANTAGES OF NATIVE PLANTS DIFFICULT TO ASSESS

Are there economic advantages to revegetating rangelands to native plants?

Answering that question promises to occupy economists for quite a while.

It's usually more expensive to reseed with native species, says USU range economist John Workman, due to factors such as a limited supply of seed. Those costs are relatively easy to quantify.

It's not as easy to assess some of the other attributes, however, such as aesthetic qualities, the preservation of endangered species, a reduction in erosion and the value to wildlife.

Returns aren't the only factor, however.

"Where the land has been abused, there's often no hope of obtaining a sufficient return from forage production to pay for revegetation. That doesn't mean we shouldn't revegetate. Revegetation is often required under environmental laws, although we have an obligation to do it as cheaply as possible," a goal that Workman calls trying to produce "a specified bang for the smallest buck." (He compares that to trying to maximize net returns or getting the "biggest bang for the buck.")

One benchmark of economic feasibility is forage production, but even that's not easy to assess, says USU economist Bruce Godfrey. Timing is important. For example, crested wheatgrass (introduced from Russia) is more productive, palatable and tolerant of grazing in early spring. Other species such as blue gamma (a native grass) are more productive later in the season.

Environmental factors determine seeding success and when grazing animals need forage. One of the most important factors is balancing the supply of forage with the demand, either by domestic livestock or wildlife.

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USU Study Examines Costs, Benefits of Wilderness Designation
The terrain is etched with some of the most remarkable friezes on the Earth’s crust. Some think these areas should be designated as wilderness, some don’t. And there’s considerable disagreement how much land deserves this protection, or on how wilderness designation is likely to affect economic growth.

Surprisingly, there’s little impartial information about the dollars and cents of wilderness designation, which has made the debate over how much land should be designated as wilderness even more contentious. A USU study is taking a closer look at the issue.

Much of the debate pits the economic benefits of traditional enterprises such as mining and ranching against the revenue and jobs generated by tourism and recreation. Some wilderness advocates argue for preservation, with limited use by man.

“Some estimates of the economic impact of wilderness designation seem to be wildly inaccurate and not based on any solid information,” says Jay Andersen, USU economist who is heading a 2 1/2-year study of the economic impact of wilderness designation in Utah. The Office of Vice President for Research at USU has provided mineral lease funds for the study.

Proponents and opponents of wilderness have widely different perceptions of the economic effects of
wilderness designation. Considering this gulf, any findings of the USU researchers are likely to be controversial. "It doesn't matter where we come out, one side or the other won't be happy. However, we question the perception that wilderness designation will be either a bane or savior of rural economies," says USU economist Bruce Godfrey.

And the study is unlikely to provide a definitive answer, not only because its scope is limited but because the legal and administrative definitions of wilderness are still evolving. However, researchers will be able to provide a range of outcomes and determine the general magnitude of the economic impact of wilderness designation on income and employment. "We will not determine whether areas should or shouldn't be designated as wilderness," Andersen says.

The study involves recreation, mining, water rights and the management of adjacent land. A separate but related study by Godfrey concerns the impact on grazing.

Economists John Keith and Chris Fawson are studying the economic impact of recreation. The solitary habits of wilderness users makes it difficult to determine users' spending habits. Unlike most recreationists who tend to congregate at selected vantage points, small groups of wilderness users usually diffuse into the wild from scattered locations.

"From an empirical point of view, we know nothing about wilderness users in Utah, although preliminary results suggest that wilderness users in Southern Utah differ from users in other areas. There are several studies concerning recreation and tourism, but none that concern wilderness users in Utah," Godfrey says.
There are also potential costs associated with wilderness designation when activities such as mining and the use of off-road vehicles are prohibited. Lands under consideration for wilderness designation are already being used in ways that are compatible with the Wilderness Act, probably due to low net returns. However, some studies indicate that potential costs increase as larger tracts of land are designated as wilderness. “The first areas designated as wilderness probably have few alternative uses. As more acreage is designated, it probably includes land with alternative uses,” Godfrey says. However, these costs haven’t been determined for most areas.

Like all public decisions, wilderness designation will benefit some and harm others, Godfrey says. Wilderness designation would probably be much less controversial if wilderness users were charged fees, a portion of which could be used to compensate those who are harmed by designation. For example, fees could be used to purchase and retire grazing permits or for payments to local communities.

Most of the area proposed for wilderness is in Southern Utah, where many ranchers have relied on grazing rights on public lands for generations. Many fear that grazing rights will be sacrificed to assuage public criticism of grazing. Many hikers dislike seeing any evidence of cattle on the range. “Grazing is specifically allowed under wilderness designation, but there is some evidence that grazing costs may increase following wilderness designation,” Godfrey says.

Cattle production has significant economic clout in many of the sparsely populated counties in southern Utah, even though its overall contribution to state economic growth is relatively minor. Moreover, income generated by local ranches tends to

A PERSPECTIVE ON THE ACREAGE INVOLVED

The federal government has long colored development in the West, first by parceling out land, water and other favors to encourage settlement, and now by the regulations promulgated for the land under its purview.

At stake now are proposals to designate from 1.9 to 5.7 million acres in Utah as wilderness. Most of the land now under consideration is in Southern Utah; all of these lands are by the Bureau of Land Management. (Most of the land previously designated as wilderness was administered by the U.S. Forest Service.)

If 5.7 million acres were designated as wilderness, it would equal about 14 percent of the acreage in the state and is a nearly 10-fold increase in the acreage now designated as wilderness in Utah. This is about 3.5 times the cropland in the state and is an area about equal to one-half the privately owned land in the state.
foster more local economic growth than many other types of enterprises.

Godfrey is determining ranchers' dependence on grazing on land proposed for wilderness, an indication of how cattle production may be affected if access to grazing is restricted, limited or becomes more expensive.

Economist Donald Snyder is studying the impact of wilderness designation on water rights, a highly visible issue in a state weathering the sixth year of drought.

The federal government retains dibs on water when it reserves land for any purpose, Snyder says. The amount of federal reserved water depends on the purpose for which land was reserved. For example, enough water must be reserved to irrigate all arable land on Indian reservations. Indian claims on water in the Colorado River now exceed the total amount of water that's available.

Snyder says there are several legal precedents, some of them contradictory, that could be used to reserve water for wilderness.

"The issue gets sticky and confusing because state law allocates water rights according to when land was reserved. This means that land reserved after all water was allocated would receive no appropriation. It's not clear whether this principle applies to lands such as national monuments or wilderness areas.

"Generally, however, states have been willing to negotiate water rights with the federal government," Snyder says.

In the West where water is allocated according to the principle of "first in time, first in right," much hinges on the date when land is designated as wilderness.
"It's possible that the date established for wilderness designation could preclude existing rights, a principle which has been used to allocate water for aboriginal use. We don't know if the same logic applies to wilderness areas. There is a real question as to how existing uses will be interpreted," Snyder says.

Economist Robert Lilieholm and Snyder are studying the economic impact of "buffer zones" created around wilderness areas where some activities may be prohibited to protect the quality of wilderness areas. "These areas may be larger than the wilderness areas. Technically, they do not exist but they can be administered as if they do," Snyder says.

A century or so ago, the federal government lured settlers westward by promising them nearly unlimited use of wilderness. Since then, wilderness has entered the political and legal lexicon, a man-made artifact synonymous with either loathsome regulation or benevolent protection.

Thousands of Utahns live near the rugged terrain that epitomizes the original definition of wilderness. The trees, streams, minerals and wildlife are oblivious to Congressional action or court decisions that will demarcate wilderness.

People aren't oblivious. Jobs might not be either.
Revegetating Rangelands: Small Phenomena Make A Big Difference

Swept away in a deluge. Baked in the sun. Desiccated on parched ground. Devoured by insects, grazed by wildlife and livestock, crowded out by cheatgrass, or elbowed aside by sagebrush.

Pity the poor plant trying to get a toehold on rangelands in the Intermountain West—it often isn’t easy, as range scientists and ranchers have discovered repeatedly. Now, however, range scientists are looking at matters from a different vantage point where imperceptible events, such as the shade from leaf litter or the moisture trapped in a crevice, can make all the difference in the world to a seed or seedling.

The findings, part of a larger effort concerning the ecology of range revegetation, promise to improve both the
revegetation and the long-term productivity of rangelands.

About 100 years ago, range scientists began trying to reestablish vegetation on rangelands scarred by overgrazing. The new discipline of rangeland revegetation was largely an applied science, one heavily influenced by techniques used in crop production on more hospitable terrain and one which emphasized short term problems. But that's changing.

"We didn't understand the number and complexity of processes involved in the revegetation of arid and semiarid rangelands," says USU range scientist Chris Call. "Essentially, we took a shotgun, trial-and-error approach in which we planted several different species on several different sites and evaluated how they did."

This technique meant that trials had to be repeated on different sites or when conditions changed, an expensive process that revealed little about the underlying ecological processes governing revegetation.

Revegetation has become more complex as range scientists try to create more-diverse "synthetic" communities of grasses, forbs and shrubs that are compatible with multiple uses, often using techniques used to reclaim drastically disturbed sites such as surface mines.

GUARANTEEING SEED QUALITY

Much of the seed planted on rangelands is from certified varieties, seed which meets the minimum standards for genetic purity and identity established by the Association of Official Seed Certifying Agencies.

The Utah Crop Improvement Association certifies seed in Utah as an agent for Utah Agricultural Experiment Station and the Utah Department of Agriculture.

The factors considered in accepting a variety for certification include yield, insect and disease resistance. The breeding or selection procedures vary and the uniqueness of a variety must be carefully documented. Fields used to produce certified seed are checked several times to make sure they are free from other varieties, noxious weeds and other species of grasses or other types that might not be removed during cleaning.

Stringent standards also govern labeling and other aspects of seed production.

UCIA Secretary-Manager Stanford Young says range grass accounts for about 2,000 acres of the 5,000 acres devoted to certified seed production in Utah. Prices of certified grass seed range from 75¢ to $5.00 per pound, of which growers receive 50-60 percent.

Stanford Young 750-2082

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"Multiple use may require a couple of grass species, both bunch and sod-forming grasses, one or more forb species important in the diets of wildlife, and species of shrubs. We may have 8 to 12 different species, each with different germination requirements, palatability and growth patterns," Call says.

With this many variables, the trial-and-error approach becomes prohibitively expensive. Instead, researchers are determining how factors such as rainfall and temperature affect establishment and succession. This information can then be used in a model to predict the fate of these plants and plant communities.

On rangelands, revegetation tends to proceed slowly and randomly, subject to the whims of nature and often limited by a lack of moisture. (For example, one study found that there's enough moisture in the arid salt desert
shrublands in the Great Basin to allow successful seedings only once or twice every 15 years.) In contrast, artificial revegetation often tries to compress the process, regardless of environmental conditions.

Call says much more is known about the early processes of succession such as germination and seedling establishment than about equally important processes that occur later, such as competition, reaction and stabilization. More also must be learned about relationships with other plants, animals, microorganisms, soil processes and climatic factors.

Call says mixed communities have definite advantages (including increased productivity) but they are much more difficult to establish than monocultures. Each type of plant may respond differently to the location, grazing and neighboring plants.

For example, shrubs and clusters of shrubs can compete with other vegetation or they can create a more favorable environment for other plants by trapping wind-blown soil and other debris, including microorganisms. Some provide resting sites for animals that provide shade and nutrient-rich wastes, and may reduce insect damage by sheltering spiders and other predators.

Getting plants to form a community is about as problematical as having house guests stay for a few years. Some guests keep the music low and pick up after themselves, others squeeze the toothpaste from the top and leave their socks in the living room. Similarly, some plants continually compete with each other for scarce nutrients and moisture while others actually facilitate the growth of their neighbors. Compatibility often isn’t apparent until organisms live in close quarters for a while.
TRIP RESULTS IN PROMISING FORAGES

Researchers with the USDA Forage and Range Research Laboratory in Logan recently returned from Kazakhstan, a former republic of the Soviet Union, with more than 350 accessions (47 species), including several promising drought-resistant forms of crested wheatgrass.

Plant scientists in Kazakhstan will send seeds of prostrate Kochia and other shrub and forb species later this fall, after seeds mature.

Kay Asay and Doug Johnson collected crested wheatgrass on range sites in Kazakhstan that receive less than 6 inches of precipitation annually. The area, which is between Chelkar and the Aral Sea, was previously closed to foreigners.

“We are confident that we collected unique germplasm from this area, particularly of the Siberian form of crested wheatgrass, *Agropyron fragile*, that was not previously included in U.S. seed inventories,” Asay says.

The new accessions will be used to develop more drought-resistant cultivars of crested wheatgrass. The Standard and Fairway forms of crested wheatgrass, which are now the most common in the U.S., were not found in extremely droughty areas, but were collected from areas that received more precipitation.

Kay Asay 750-3069
Doug Johnson 750-3067

Even something as supposedly simple as planting is poorly understood, Call says. Germination and seedling establishment have primarily been studied under laboratory conditions that seldom typify rangelands. Moreover, the seedbed microclimate has not been studied adequately.

Establishment of a species is the result of a fortuitous set of conditions, including arrival of a seed at the right location, enough precipitation for germination and seedling establishment, and the luck to avoid excessive grazing or competition.

“We still try to compensate for our lack of understanding of plant-site relationships by increasing the number of species in seeding mixtures and/or increasing seeding rates,” Call writes in a review article that appeared in the *Journal of Range Management.*

The number of seedlings depends on the number of seeds in “safe sites” rather than on the total number of seeds. And the fate of a seed or seedling often depends on the microtopography of the soil surface, a landscape in which tiny cracks, depressions, stones and organic debris can make a big difference. For example, the surface of slightly depressed soil is a much more favorable environment than smooth soil, in part because it retains more moisture and atmospheric conditions are more benign. Depressions also trap wind-blown soil to help cover seeds.
Call says research is hampered by lack of instruments capable of monitoring conditions at such a small scale. Eventually, climatic data will be used to develop models of the water and temperature conditions necessary for germination and seedling development, making it possible to predict how weather and other conditions affect revegetation.

This doesn't mean we will be able to duplicate the plant communities that existed before Europeans arrived.

"We can't just harvest the original plants and plant them. We have to strike a balance, perhaps by reintroducing some plants on some sites to create a community of grasses, forbs and shrubs that perform the same functions as the original communities, even if they don't exactly duplicate these communities," Call says.

Studying the ecology of revegetation will make sure that these introductions are the prelude to a long and productive stay.


KG

Chris Call 750-2477