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Forestry Research West

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A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

In This Issue

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Scientists at the Intermountain Station are studying the effects of global climate change on western forests. Here, Project Leader Ray Hoff observes genotypic variation in a high-elevation "garden" in the Priest River Experimental Forest in northern Idaho. Read about it beginning on page 8 .

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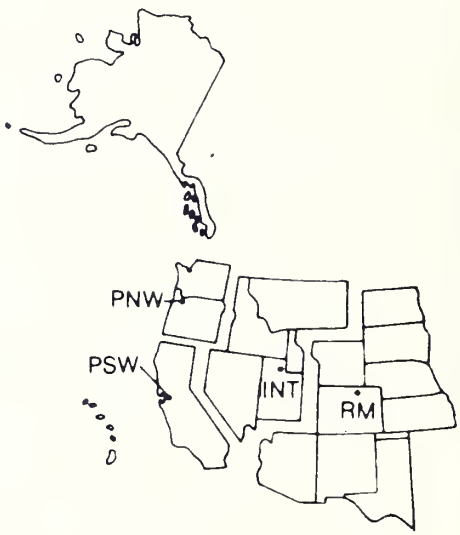


A new cultivar for rangelands

by Louise Mastrantonio, for Pacific Northwest Station

A pretty little half-shrub of the Interior West is the latest cultivar to be "released" for use in that region. The plant, a member of the knotweed family, is 'Umatilla' snow buckwheat (*Eriogonum niveum*).

Snow buckwheat is a low-growing, pioneering plant common to big sagebrush and bitterbrush plant communities ranging from British Columbia to central Oregon, and from the east slope of the Cascade Range to west-central Idaho. Snow buckwheat makes up about one-sixth of the total vegetative cover in these plant communities.

Release was made in July 1991 by the USDA Soil Conservation Service (SCS) in cooperation with the USDA Forest Service, the Washington Department of Wildlife, and the Washington State and Oregon State University Agricultural Experiment Stations.

A cultivar is any wild plant that has been tested and evaluated for its performance characteristics. It is essentially an ecotype, a locally occurring variety of a particular species. The 'Umatilla' variety of snow buckwheat came from seed collected near Juniper Canyon in Umatilla County, eastern Oregon, in 1979. In subsequent years of laboratory and field testing by the Forest Service and the Soil Conservation Service, the 'Umatilla' variety, known initially only as Forest Service accession U-10, consistently outperformed 113 other seed sources.

Typical snow buckwheat habitat near Entiat, Washington.

Outplantings were made at the following locations: Pullman, Washington, at the SCS's Plant Materials Center; at Lind, Central Ferry, Entiat, Hanford, and Moses Lake, in Washington; at Moro, Oregon; and at Boise, Idaho. 'Umatilla' was selected by SCS because it had better seed production, larger height and crown spread at maturity, and the best survival in climates with low precipitation. Vigor and survival were better at all locations except Pullman, where rainfall is considerably higher than in its native habitat.

As a result of these tests, "We know a lot about its performance and how it performs compared to other ecotypes of the species," says Art Tiedemann, a range ecologist with the Forest Service's Pacific Northwest Station at La Grande. "We have a pretty good idea what the germination rate will be, how fast it will grow, and its survival rate in the field,"

'Umatilla' has potential for a number of range management purposes—to revegetate burned rangelands, for recreation and wildlife planting, for erosion control on road cuts and fills, and possibly for horticultural use. A side benefit is that it is an important early forage plant for deer and elk.

In the wild, snow buckwheat typically grows at lower elevations (400-2,000 feet) where rainfall is low, from 6-18 inches a year. It is technically a half-shrub, midway between a forb and a shrub, growing up to 20 inches in height, with spreading branches. Its attractive flowers are white to pinkish, appear in late summer, and are a good source of nectar for honey bees. The foliage is retained through the winter. Leaves are light green, ovate to elliptical, and covered by a dense mat of soft white hairs.

Other successes

'Umatilla' is the latest in a number of range plants to be released to commercial growers in recent years. Others include:

'Hatch' winterfat, an erect half-shrub used to revegetate mine disturbances and depleted sites.

'Lassen' antelope bitterbrush, an upright spreading brush useful for wildlife and livestock ranges, conservation planting, and reclamation projects.

'Immigrant' forage kochia, a semi-evergreen perennial subshrub, originally introduced from southern Eurasia, and useful as a forage and reclamation plant.

'Rincon' fourwing saltbush, an evergreen, woody shrub used for wildlife and livestock range and disturbed land reclamation.

Tiedemann examines "Umatilla" snow buckwheat.

Release procedures

Compared to agricultural plants, for which there is a formal release procedure, the release of range plants is somewhat informal. The SCS evaluates the test data, prepares a release notice in cooperation with other agencies, submits it to the cooperating agencies for signature, and arranges for seed and plant materials to be made available to growers. The plant is given a new name that is a registered trademark ('Umatilla' snow buckwheat) and a PI or plant introduction number (537595). In addition, SCS prepares a brochure describing the new cultivar and arranges for publication in technical and trade magazines.

In the case of 'Umatilla' snow buckwheat, seeds will be stored at the SCS Plant Materials Center at Pullman, Washington. The center will maintain the original mother plants and seed for supplying foundation stock and seed to commercial growers.

The release process provides a way to make high-quality seed available to government agencies or commercial growers, according to Scott Lambert, Plant Materials Specialist with the SCS in Spokane. Lambert says several growers have shown an interest in 'Umatilla.' Seed should be available commercially sometime this year (1992).

Very little seed, only abut 1-2 pounds, is currently available. "Snow buckwheat is not a real high seed producer," according to Tiedemann. "We will need to do additional work to produce more seed."

It was Tiedemann, then project leader at the Intermountain Station in Provo, Utah, along with Charles Driver at the University of Washington, who first recognized the potential of snow buckwheat for rangeland use. In the mid 1970s, the two began a study to determine its potential for erosion control.

Results were published in 1983 ("Snow Eriogonum: A Native Half-shrub to Revegetate Winter Game Ranges," Arthur R. Tiedemann and Charles H. Driver, Reclamation and Revegetation Research 1(1983)31-39, Elsevier Science Publishers BV., Amsterdam—The Netherlands.

Tiedemann and Driver were so impressed with the little shrub that they recommended pilot tests be conducted to fully assess its suitability for revegetation purposes. "It appears," they wrote, "to have wide ecological amplitude, and is highly desirable for providing aesthetically pleasing erosion control cover for roadcuts and fills, firelines, and other disturbed areas. In addition, the plant comprises a substantial proportion of the early spring diet of mule deer along the Columbia Breaks in north-central Washington."

Native plants

At La Grande, Tiedemann continues to pursue a long-standing interest in using native plants for rangeland revegetation and restructuring in addition to his regular research assignment. Three other plants currently have his interest: a bitterbrush (shrub), a winterfat (half-shrub), and the forb balsam root.

"In our search for plants to control erosion, we have often overlooked native plants," he says. Native plants, however, may have better growth and survival, provide better forage for wildlife, and aid in restoring the natural mix of plant species on damaged rangelands. "There is always a demand. There are numerous wildfires every year and an urgent need for plants for revegetation purposes."

"Umatilla" snow buckwheat at peak bloom.

Considerable interest exists currently in reintroducing native plants in the Interior West—the vast rangeland areas of Utah, Montana, Wyoming, Idaho, eastern Oregon and Washington, and California. Hundreds of thousands of acres of rangelands are depleted, damaged over the years by unsuccessful farming, wildfire, and livestock grazing.

"The general perception of the pioneers about much of the grasslands was that they were a 50-50 mix of wormwood (sagebrush) and perennial grasses and forbs," according to Tiedemann. "There was apparently not a lot of ungulate use. When settlers arrived with sheep, cattle, and horses, the native grasses and forbs were eliminated, opening the way for shrubs such as sagebrush to take over.

"Our simplistic way of reversing the damage was to get rid of the sagebrush and, in many cases, we wound up with stands of nothing but cheatgrass, an introduced species that is very aggressive and tends to perpetuate itself. Cheatgrass rangelands are generally depleted rangelands and they exist on hundreds of thousands of acres."

The goal today is more likely to be biological diversity, often best achieved by replacing cheatgrass with a variety of native species. "We can actually restructure these plant communities if the plant materials are available," Tiedemann reports. Testing and releasing the best ecotypes of native species is a way to assure their availability for rehabilitation purposes.

Additional information about 'Umatilla' snow buckwheat may be obtained from Scott Lambert, Plant Materials Specialist USDA Soil Conservation Service, Rock Point Tower Suite 450 West, 316 Boone Ave., Spokane, WA 99201.

Attractants can help manage windbreak borers

by Rick Fletcher
Rocky Mountain Station

During the 1920's and 30's, thousands of miles of windbreaks were planted throughout the Great Plains. Although some windbreaks have succumbed to insects, diseases, or have been removed to provide more space for crops, many still remain. These windbreaks are as valuable today as they were during the Dust Bowl days. They help reduce soil erosion, increase soil moisture and crop yields, provide wildlife habitat, help reduce windchill effects and drifting snow, and add aesthetic value to a region largely devoid of trees.

Today, many landowners are faced with a host of problems in keeping their windbreaks growing and healthy. Insects can be the most threatening of these problems. "Though there are many types of insects and damage they can cause, borers are the most destructive for the Great Plains region. Borers mine buds, sapwood and innerbark, weakening and killing parts of or entire trees. They usually are difficult to detect because the larvae are hidden within the tree, thus a tree can be severely damaged and have few visible signs," says Mary Ellen Dix, Research Entomologist with the Rocky Mountain Station's Forestry Sciences Laboratory in Lincoln, Nebraska. She is a member of a team of scientists that is focusing on insect and disease problems in Great Plains windbreaks. One of their efforts centers on using chemical sex attractants to learn more about the biology and behavior of borers, and to develop techniques for managing outbreaks. Sex attractants are perfumes released by a female insect that attract males of the same species. Chemical attractants are artificially produced to mimic the natural attractants, and are placed on a dispenser that releases the compound at a specific rate. Often the dispensers are placed in sticky traps which catch the male moths.

Sticky trap with male lilac borers.

Attractants can be used to: (1) detect infestations and differentiate between pest species; (2) monitor adult flight; (3) estimate current, and predict future, population size or damage levels; and (4) reduce population size or damage levels. They may be used alone or in combination with other pest management approaches.

Windbreak characteristics

"Each windbreak is a unique ecosystem, with its own combination of size, shape, tree species, density, understory vegetation, and neighboring land use," says Dix.

"Windbreaks differ from natural forests because trees within a windbreak normally are all the same age and are planted in a certain place and configuration for a specific purpose." The uniqueness of each windbreak makes it difficult to establish general guidelines for the use of attractants.

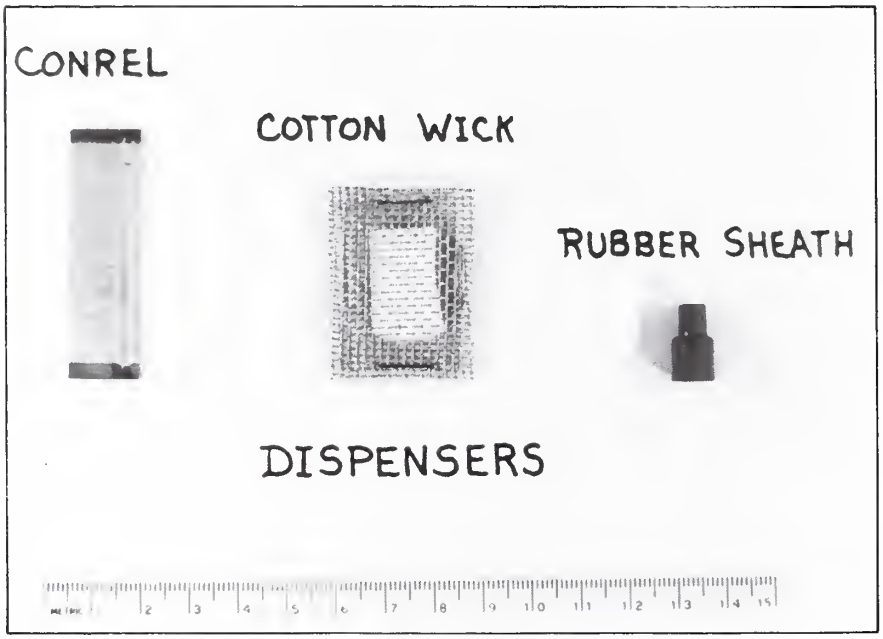
Detecting, identifying, and monitoring outbreaks

Attractants can provide a very effective and quick means for detecting populations of potentially damaging borers, and can provide an early warning system for detecting population build-ups. At present, attractants are used to detect carpenterworms, lilac borers, Nantucket pine tip moths, metallic pine pitch nodule moths, and boxelder twig borers. Scientists at the Lincoln facility have helped identify, for carpenterworms, lilac borers and metallic pine pitch nodule moths, the most effective trap density, placement, height, and maintenance schedule, duration of trapping, attractant release rate, and attractant formulation.

Dix explains that identifying the species of borer damaging a tree is frequently difficult because the larvae and their tunnels are concealed within the tree, several species may cause similar damage, and many windbreak managers are unskilled in the identification of these insects. Because each species has its own blend of attractants, attractants can be used to help with borer identifications. For example, three species of *Proteoteras* that mine boxelder twigs have similar morphology, life cycles,

Placing pheromone trap in tree.

Sticky trap (cup) with male metallic pitch nodule makers and septum dispenser.



Attractant dispensers: conrel hollowfiber, cotton wick, rubber sheath or septa.

ranges, and damage characteristics. Therefore, attractants can be used to identify the species present in a windbreak so that the control measure most appropriate for the species can be selected.

Tree managers and researchers also use attractants to delineate flight periods of borers. For example, spring emergence of adult carpenterworms depends on temperature, and can vary between years by up to four weeks. Traps baited with the male attractant can be used to identify the start, peak, and end of the adult flight period.

Evaluating and predicting populations

Dix is helping identify attractants that can assess and predict populations of metallic pine pitch nodule moths, carpenterworms, and other borers in windbreaks. "Attractants also are ideal for determining the relative abundance of borer species, especially those with small and widely distributed populations," she says. " Attractants can be used by people unskilled in insect identification and recognition of insect damage. Also, sampling populations with attractants is less time-comsuming, labor-intensive, and destructive than cutting the branch tree and splitting it open to look for larvae. However, sampling with attractants is not as precise as the destructive sampling methods."

Several factors need to be considered for developing evaluation techniques using attractants. Repetitive visits to sample sites are often needed to record trap catch data and maintain traps. And, abundance assessments can be made only after larvae have damaged the tree and adults have emerged.

Assessment techniques should be adapted to individual windbreaks because windbreaks differ greatly. Survey results are affected by a number of factors including trap location within or near the windbreak, windbreak design, and direction of prevailing winds. For example, traps are more effective if evenly spaced along the entire length of a single-row windbreak. In wide multiple-row windbreaks, traps are more effective if arranged in a block design.

Trap placement in relation to undergrowth is also important. Traps placed in heavy understory vegetation will catch fewer moths than those placed above the understory or at sites where the understory vegetation is sparse.

Controlling populations

Dix says that attractants can be used in four ways to reduce infestation or damage levels: (1) to time insecticide applications, (2) to prevent mating by removal of all the males from the area, (3) to disrupt mating, and (4) as an integrated approach with other control techniques.

"Using traps baited with attractants to time insecticide applications is an inexpensive, time-efficient, and uncomplicated procedure widely used by tree managers," says Dix. "A typical application of this technique is the use of a lilac borer attractant, (Z,Z)-3,13-octadecadienyl acetate, to time insecticide applications against first instar larvae.

Sticky traps baited with the attractant are placed in the infested windbreaks at least two weeks before the expected start of male flight. Timing is critical because initiation of moth flight is dependent on spring temperatures and can vary by up to six weeks," she says. An observer who can identify lilac borers checks traps for males at least once each week, preferably every one to three days. About 10 to 14 days after the first male moth is caught, trunks and large branches of ash and lilac should be sprayed with an insecticide registered for control of the lilac borer. Similar techniques can be used to reduce the population of carpenterworms, tip moths, metallic pine pitch nodule moths, and other borers whose male attractants have been identified.

Scientists at the Lincoln lab have found that mass trapping with attractants can be used to remove male borers from windbreaks. "This procedure can substantially reduce or eliminate mating," says Dix. "To be effective, traps need to be spaced one to three trees apart throughout the site, and changed before they become saturated with moths."

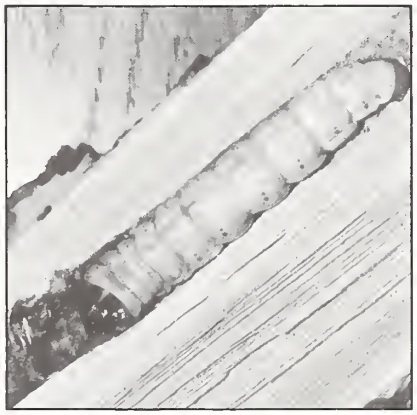
Mating can also be disrupted and reduced by inundating an area with an attractant or a chemical that prevents mating. This procedure can effectively reduce damage when a pest population is small and isolated. It also can be used as a preventative maintenance treatment in high-risk areas, and to create a buffer zone to reduce the possibility of a pest infesting a high-value planting.

Integrated control

According to Dix, the most effective strategy for reducing pest populations and damage levels when pest densities are high, is to combine insecticidal control with attractants. "Insecticide applications can reduce large populations to a size that can be effectively reduced still further by mass removal of the males or mating disruption," she says. "A completely integrated control and monitoring program includes the use of attractant traps to detect new populations, assess their size, identify the most appropriate time to apply an insecticide, and further reduce or maintain low population levels. As commercial attractants become available for more pest species, the use of an integrated approach will become more common."

Conclusions

Simple, inexpensive, and effective techniques have been or are being developed for detecting and monitoring pest populations, evaluating population size, and timing insecticide applications. Tree managers and researchers can use modifications of these techniques to help identify pest species. Attractants should be very effective in windbreaks that are well isolated from neighboring windbreaks or trees.



Carpenterworm larva.

Techniques developed for reducing damage levels by mass removal of males and mating disruption will likely be most effective for small, isolated populations.

Additional information on this and related research is available in a newly published conference proceedings titled *Insects of Windbreaks and Related Plantings: Distribution, Importance, and Management*, General Technical Report RM-204. The Rocky Mountain Station has copies. You may also contact Mary Ellen Dix at the Station's Forestry Sciences Laboratory, East Campus, University of Nebraska, Lincoln, 68583, (402) 437-5178, FTS 541-5178.

Genes for surviving global climate change

by David Tippets
Intermountain Station

What if in 50 to 100 years the climate of New York City resembles that of Tallahassee, Florida? What if during the same period the average temperature of Albuquerque warmed to about that of Tucson today? What if mean annual precipitation on the Idaho Panhandle National Forests dropped to the average for eastern Montana's Custer National Forest in a period of less than 100 years?

Although climate has always changed, the rate of change many forecast as a result of the greenhouse effect will be faster than any documented in the history of modern civilization—a rate of change much faster than ice age transitions when many species failed to adapt and perished. Yet a modest warming of only 4° C given constant correlations between temperature and precipitation will produce climate changes about like those questioned above: New York City as balmy as Tallahassee, Albuquerque as warm as Tucson in winter, and Coeur d' Alene as dry as Billings.

In time, plants with mobile-enough seeds would migrate northward or up in elevation. The pinyon-juniper and ponderosa pine forests would

Already growing near timberline at the top of mountains and suffering mortality from blister rust, whitebark pine could face extinction in a warmer-drier climate change scenario that would move the Douglas-fir zone 800 meters upslope.

expand their territories. Other species, such as whitebark pine, could loose their niche over most or even all of their natural range.

Mass extinctions of species are imminent, many scientists believe, even with society's most conscientious efforts to mitigate human impacts. Consider that over 90 percent of all the species ever to live on the earth are now extinct. While geologic disruptions and climatic influences altered the environment beyond the ability of species to adapt in the past, humans now create an alarming amount of environmental change at an even more alarming rate.

"Adjusting to a variable climate is nothing new," Plant Geneticist Gerald E. Rehfeldt says, "but the rate of change caused by people is very rapid." As a scientist with the Silviculture and Genetics unit at the Intermountain Research Station's Forestry Sciences Laboratory, at Moscow, ID, Rehfeldt studies the genetic variability of western conifers and their ability to cope with a changing environment.

Today, as through the ice ages and earlier epochs, organisms respond to change through natural selection. Evidence points to some catastrophic events in the earth's past that created sudden change for some species, but in general species have adapted over long periods. Projections for the human-caused greenhouse effect indicate the rate of change will be faster.

Plant Geneticist Gerald Rehfeldt shows how some genetic differences are easily observable in a uniform garden.

Hit a moving target

"Natural selection as process is trying to hit a moving target, climate change," Rehfeldt says, explaining that the target is accelerating—making survival of species even more difficult.

"We are going to have a wholesale change in the genetic constitution of populations," he adds, pointing to dramatic landscape changes as well. Species won't be able to just migrate north, or up in elevation, to cooler climates as a group of similarly adapted species; new species will come into an area from all directions to form new kinds of communities or habitat types. There will be entirely new environments.

The rapid rate of change will let scientists observe evolution in progress more easily than ever before. Evolution will cull the unfit and leave behind populations with great genetic variability or the ability to migrate rapidly. The natural process of evolution will determine most of the new flora and fauna.

For humans in need of food and shelter the natural process of evolution will work too slowly. Since every generation can only work with the genes passed down by its parents; there is a lag time between adaptation to change and the needs of the current generation. Forest geneticists can help reduce the time it will take for new healthy forests to adapt to the new climates through a program of gene resource management that identifies plants adapted for survival before nature's stresses finish testing the parent generation.

To understand how gene resource management will help foresters manage forests during global climate change, imagine first the way foresters manage every day for climate change. A forester gets out of bed in the morning and looks out the window to see if it's hot, cold, raining, or snowing. The forester then adapts to the climate by deciding what kind of boots to put on and what coat to wear. The boots and the coat must be adapted to the climate, and the forester can simply look at them to know if they will be adapted.

When a forester decides what kind of tree to plant it's more complicated than picking his boots or coat, because the tree must be adapted to the climate for 365 days of the year and not just the day the forester looks out the window. And if the rotation age of the stand is 100 years, the tree must be adapted to weather patterns that will exist in 50 years that the forester may never have seen looking out his window. And unlike his boots or coat, the adaptive ability of the tree can't be observed by looking at it—the adaptive ability is determined by genetic code hidden at the molecular level.

Hidden code

Forest geneticists can decipher the genetic codes and catalog them for the forester, so that when the climate is adequately forecast the forester can go to his closet of genetic resources and pick the genes that fit the climate. Genetics research will enable foresters to know where to collect seed to provide nurseries to grow seedlings for planting that will regenerate stands with trees that will not only survive but will thrive.

But forest geneticists are concerned about some forest species that may not have the ability to survive. Gene resource management is essential to conservation of species and not just to commercial forestry. In the past, genetics has been too often promoted as economic botany—how to increase production to increase profits. But as we cope with climate change, genetics will become essential to conservation biology and the preservation of species.

"For western redcedar climate change will pose an incredible problem because there isn't enough genetic variability," Rehfeldt says. "We'll have to keep an eye on cedar for gene conservation," he adds, explaining the importance of maintaining the genetic material of species that will fail to adapt to the rapidly changing environment.

Preservation of species

"For rare, threatened, or endangered species, biologically sound programs will begin after the system of genetic variability is understood," Rehfeldt says, stressing that gene resource management starts with understanding variability.

He expresses concern for some southwestern species such as Apache pine and Colorado cypress that occur just in small pockets. The pine has heavy seeds that are unlikely to migrate fast enough to keep up with climate change. Scientist don't know enough about their genetic variability to predict whether or not they can adapt to rapid change.

For other species known to have great genetic variability, such as Douglas-fir, a 4° C temperature increase and drier climate would simply require the species to move up in elevation about 800 meters. In this scenario Rehfeldt could already identify Douglas-fir with the appropriate genes that are not only adapted to the changing climate but would maintain a healthy forest. He cautions, however, that many of the higher elevation sites are too fragile for harvesting.

Change the scenario by changing the relationship between temperature and precipitation and forest geneticists aren't as well prepared. If the climate gets warmer and wetter it will send foresters scrambling to identify and collect genetically suitable plants.

A third scenario places scientists even farther behind in dealing with rapid global change. Some give evidence that the extremes of temperature and rainfall are widening as a result of the greenhouse effect. This situation requires yet another set of genes for survival.

Rehfeldt investigates if trees have the genes needed to survive the different scenarios of climate change by subjecting them to environmental extremes. "Our objective is to classify genetic variability among trees and stands," he says.

Forestry Technician Pat Wells measures height as one type of genotypic variation first observed in a greenhouse uniform garden.

Together with Forestry Technician Pat Wells, he collects samples of seed from both the elevation and geographic range of a species. Starting in a greenhouse, seeds are planted in a "common or uniform garden" so that their genetic variation can be observed.

After periodic measurement and evaluation in the greenhouse, they plant the seedlings in four climatically different, but individually uniform, environments with different temperature, precipitation, frost-free period, and other monitored climatic differences. As measurement and evaluation continues, they learn the genetic adaptability of given populations to climate change.

"The important thing," Rehfeldt says, "is to understand the natural genetic system well enough so that when someone gives us a reasonable range of scenarios we can predict tree response to the changes."

Reasonable scenarios

Rehfeldt need only look down the hall from his office in the Moscow Forestry Sciences Laboratory to find "someone" who is working on another part of the global change challenge. Research Forester Robert Monserud of the Station's Quantitative Analysis Unit, is cooperating with the International Institute for Applied Systems Analysis (IIASA) to develop a computer model to predict global change. Together with some of the top scientists from the Soviet Union, The Netherlands, Sweden, Norway, Hungary, and other countries, Monserud is working to narrow the range of scenarios so that society can more effectively work to buffer the impacts of global change.

When the results of both kinds of global change research are combined, foresters can act to make sure our grandchildren will still have healthy and productive forests in the different world of tomorrow.

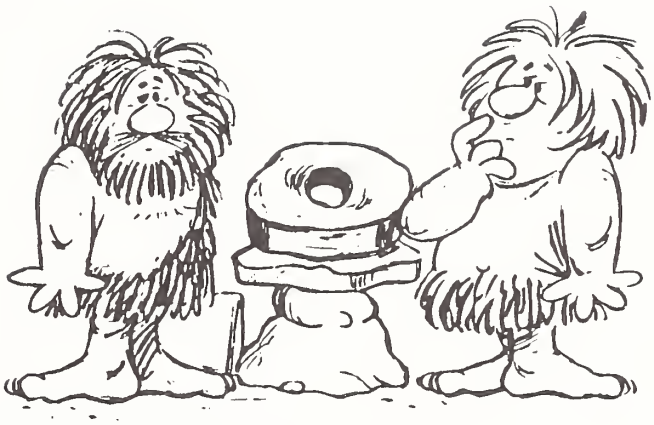
Reinhard F. Stettler of the University of Washington, College of Forest Resources states an urgent need to prepare now for global change. In a talk published in German in 1986, he said, "Even environmentally conscious societies will, of necessity, lag behind in preventive measures. . . . This should not reduce vigilance, but merely recognizes that even with rapid prognosis and diagnosis, the limiting factor will be the traditional reaction time of social mechanisms. . . .

What is important is that we foresters concern ourselves with the likely conditions of the future and that we inform ourselves adequately. Pertinent scientific information is abundantly available. It is important that we see not merely ourselves forced into a passive role, but that we actively engage in determining the fate of future forests."

Rehfeldt's research is socially proactive; it addresses society's needs long before people have smelled the smoke of global change and cried fire. For those few with a vision of the future who see evolution proceeding in high gear with a wake of extinctions, the alarm has already sounded. But most others won't hear the alarm until the price of housing or food rises too high for their pocketbooks. Before then foresters can have seedlings with the correct genetic code for tomorrow's forests in tomorrow's climate already planted where the trees will thrive. Understanding genetic variability and gene resource management can help foresters make correct decisions for truly sustainable resource management.

In the most commonly accepted scenario for global climate change, a hotter and drier climate, single-leaf pinyon as seen growing here on a south-facing slope at the extreme northern edge of its range in the Mollens Hollow Research Natural Area on the Wasatch-Cache National Forest, would expand its range farther north and up in elevation.

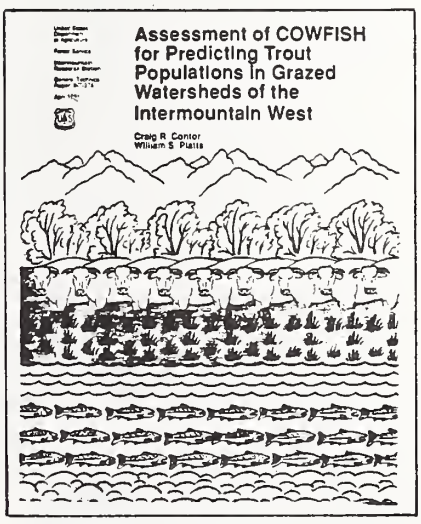
New from research



Assessment of COWFISH

Forest Service Fisheries Biologist Jim Lloyd designed a model, COWFISH, to estimate livestock impacts on streams, riparian zones, fish abundance, and fisheries economic values in central Montana. Lloyd cautioned others not to apply it outside of the area where it was developed. But because land managers urgently needed such a model, and with the promotion of the model by the Environmental Protection Agency, the model has been widely applied in the West.

Craig Contor and Bill Platts tested the model on 14 streams in Idaho and Nevada, finding that without modification the model could not be reliably used on the streams where it was tested. Most notably, they learned that it did not correctly predict fish abundance or economic impacts.



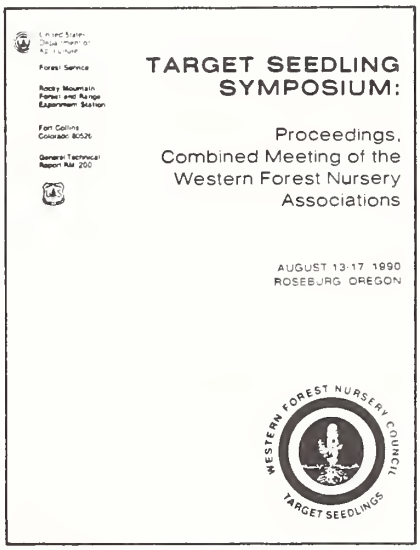
The researchers learned, however, that with modification the model has promise as a tool to help estimate streambank and channel conditions. For those wishing to improve COWFISH for this application, this publication by Contor and Platts tells where modifications need to be made.

The researchers suggest that it would take little additional effort to determine fish abundance by electrofishing sample reaches of the stream, and the results would yield more reliable data for predicting trout populations.

Request *Assessment of COWFISH for Predicting Trout Populations in Grazed Watersheds of the Intermountain West*, General Technical Report INT-278, from the Intermountain Research Station.

Incorporating the target seedling concept into reforestation efforts

For years, foresters have been frustrated about poor seedling survival and growth. What makes a seedling succeed or fail in outplanting? Traditionally, experts have graded seedlings according to their stock-type designation, height and caliper. Now there is an alternative.



Nursery technology has advanced to the point where it is possible to achieve greater predictability in how seedlings will perform. The concept of target seedling has played a role in this advancement. Not only do appliers of this concept single out specific characteristics of a seedling as high quality, they also target physiology and morphology traits of the seedling which promote successful reforestation at a specific site.

A symposium was recently organized by the Western Forest Nursery Associations to explore the theoretical and practical aspects of the Target Seedling Concept. If you are interested in receiving a copy of the proceedings, contact the Rocky Mountain Station and request *Target Seedling Symposium: Proceedings, Combined Meeting of the Western Forest Nursery Associations*, General Technical Report RM-200.

Bird populations in logged and unlogged forests

Of 32 abundant breeding birds, only 10 species' populations differed significantly between small logged areas and the adjacent uncut forest. As might have been expected, the difference for these species could be explained to a large extent by their feeding habits.

The scientists who conducted this study in the Coram Experimental Forest in northwestern Montana point to the importance of the lack of difference in 22 species, and the significance of the way that the area was logged. Not only were the cutting units small, they also contained abundant snags of aspen, cottonwood, and birch. The results of the study also suggest that if the objective is to retain all tree-dependent bird species, foresters should plan to leave snags from some of all the commercial tree species in the unit in addition to the broadleaf trees that were left standing. The investigation also determined that unburned slash piles improved the habitat value of the logged units for some species.

The Coram Research Natural Area was used as a comparison or control area. Some of the species that favored uncut forest were more abundant in the uncut forest adjacent to logged areas than they were within the Research Natural Area.

This publication includes numerous useful management recommendations, which the authors summarize: "In short, diversity in habitat will likely promote diversity in bird assemblages."

Request *Bird Populations in Logged and Unlogged Western Larch/Douglas-fir Forests in Northwestern Montana*, Research Paper INT-442, from the Intermountain Research Station.

What does the future hold for CRP lands?

The Conservation Reserve Program (CRP), a 10 year effort designed to improve soil erosion, water and air quality, and wildlife habitat in the Northern Great Plains, expires in 1996. What will happen to these lands at that time? A symposium was held in January, 1991 to offer insight on this pressing question.

The symposium, co-sponsored by the Great Plains Agricultural Council Range Plant Task Force and the Society for Range Management Task Force explored answers to such intriguing questions as: what ecological and sociological effects result from preserving the land in the CRP; what options do landowners have when the CRP ends; and what effect does the CRP have on wildlife and recreation?

If you are interested in receiving a copy of the proceedings of the symposium, request General Technical Report RM-203, titled *The Conservation Reserve–Yesterday, Today and Tomorrow*, available from the Rocky Mountain Station.

A dwindling southwestern resource

Native freshwater fishes of the desert Southwest are disappearing. Many are considered endangered, threatened, or under special concern. These fishes have received little attention from resource managers or the public, simply from lack of knowledge. A succinct report which includes colored photographs of 46 species of fishes and their habitats was recently printed to help raise awareness of their uniqueness and plight.

The text is written in simple language, and is not overbearing; it focuses on rivers and springs in the Southwest, where they are, when they formed, and how they work. The photographs were chosen to illustrate not only the fishes various body shapes, but also their functional features such as breeding color and morphologic variation.

If you would like a copy of this publication, funded by the USDA Forest Service, Colorado State University, and the USDI Bureau of Reclamation, request General Technical Report RM-206, *Native Fishes of Arid Lands: A Dwindling Resource of the Desert Southwest* from the Rocky Mountain Station.

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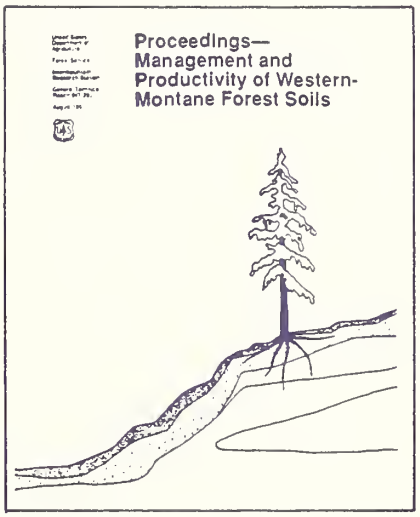
Proceedings—management and productivity of western-montane forest soils

Too often in the past, soils knowledge has not been fully integrated into silviculture, yet it is critical to regeneration, productivity, nutrient value, and the moisture retention ability of forest lands.

If New Perspectives, with its emphasis on sustainability and water quality, is to succeed there must also be a "New Silviculture" that never forgets the importance of soil. But in reality, when the old silviculture was practiced correctly, it always put soils in a total ecosystem equation.

This proceedings is a one-volume source for foresters who want to review much of the most current scientific knowledge about how soils fit into forest management. It is a reminder and a tool to help silviculture and New Perspectives join together on the land.



Request *Proceedings—Management and Productivity of Western Montane Forest Soils*, General Technical Report INT-280, from the Intermountain Research Station.

Aspen regeneration

From evaluating suckering on burned sites in western Wyoming, scientists learned that they could predict long-term response to burning by the end of the second year after burning. There was a strong relationship between the number of suckers after 6 years and the number observed at the end of the second year.

The season of burning appeared to be an important factor. Sites burned in the spring produced over twice as many suckers as those burned in the fall. The researchers, however, caution managers not to conclude too much from these seasonal differences because too many unmonitored factors could have influenced the differences in seasonal response.

Sucker numbers varied greatly between burns. Generally suckers were relatively abundant after the first growing season, but then began to decline rapidly after the third season. The research suggests minimum suckering response necessary to regenerate a stand.

Request *Regeneration of Aspen by Suckering on Burned Sites in Western Wyoming*, Research Paper INT-448, from the Intermountain Research Station.

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