



Leafy Spurge *News*

Agricultural Experiment Station
NDSU Extension Service
North Dakota State University, Fargo, ND 58105

Volume XXIII, Issue 3 September 2001

From the Editor's Desk

Here is news hot off the press — **Proposal Under Consideration for Closure of APHIS, PPQ, Bozeman, MT, Biological Control of Weeds Station.** The USDA APHIS PPQ Bozeman, MT Station is under consideration for closure with redirection of staff to other APHIS Center For Plant Health Science and Technology Laboratories (CPHST) in Phoenix, AZ and Michigan. This proposed action is currently awaiting final approval from the USDA Undersecretary of Agriculture.

The APHIS Station has been involved since 1987 in the implementation of biological control methodologies for a number of Noxious weed species in the Eastern and Western United States. Weed targets have included, diffuse and spotted knapweeds, purple loostrife, Dalmatian toadflax, Russian knapweed and leafy spurge. New projects under consideration are biological control activity for salt cedar and Canada thistle. The closure and consolidation are designed to reduce overhead costs, concentrate the workforce at a few locations, reconstitute APHIS programs and foster synergy among staff in developing new perspectives towards projects. These directives are under the guidance of Dr. Gordon Gordh, director of CPHST,. Bob Richard, APHIS entomologist and former station director in Bozeman, indicated that the changes proposed are for the benefit of the Agency. "Dr. Gordh has visited our facility and we are excited about his plans," said Richard. Dr. Gordh has indicated in a recent memo to field locations in APHIS that "through this transition all of CPHST's commitments to other agencies, partners and stakeholders will be honored."

"That is great news and I am supportive of Dr. Gordh's commitments" Richard said, "considering several of our projects are ongoing and need to be completed." Tentative date for the relocation is Jan 2002.

SPURGE FEST II is now history! From my perspective it was a real success and 182 people came the first day to hear 24 presentations and learned the latest that is going on. The second day, 187 people, in 6 buses and a host of cars, went out to the nearby research plots to see first-hand the results of various chemical and biological control plots. The third day 204 people registered and we had an opportunity to collect flea beetles in Roosevelt National Park, near one of the campgrounds close to the Little Missouri River. It was quite a sight and many cars on the road stopped, wondering what was going on with people using insect nets sweeping furiously! This was followed by a very tasty Pitch Fork fondue at the Tjaden Terrace/Burning Hills Amphitheater, an Awards ceremony, and finally the insect distribution. Thirteen states plus Washington DC were represented and 3 Canadian Provinces. What a great turnout!

The weather cooperated with no rain. The educational sessions were very informative and I was fortunate enough to go to the Medora Musical in its lovely setting. It was most enjoyable For those of you who were unable to come to this excellent gathering and missed the educational sessions, an abstract of all the presentations given at Medora will be printed in this and future issues of **Leafy Spurge News**. I have

Continued on page 2

Leafy Spurge Honoree Dr. Robert M. Nowierski



Bob Nowierski spent most of his childhood in Boise, Idaho and graduated cum laude from the University of Idaho in Moscow with a B.S. degree in Pre-Dentistry/ Biology in 1973. After taking an entomology course his senior year he decided to pursue a career in entomology. He received an M.S. degree in Entomology

(systematics) in 1975 from the University of Idaho and was awarded the Department's H.C. Manis award for excellence in entomological research. Dr. Nowierski received a Ph.D. in 1979 from the University of California at Berkeley in entomology with an emphasis in biological control, insect ecology, and integrated pest management. From 1980-1982, Dr. Nowierski was employed as a systems analyst at UC-Berkeley, and was a member of the original Scientific Core Group that helped develop the Statewide Integrated Pest Management Program for California. Since 1982 to

present Dr. Nowierski has been an entomology professor at Montana State University-Bozeman. He has taught courses in biological control of weeds and insects, integrated pest management, insect ecology, natural resource entomology, and research methods. Dr. Nowierski has authored or co-authored over 80 technical publications including more than 40 refereed journal articles and book chapters. His research interests are broad — emphasizing such topics as biological control of weeds and insects, insect and plant ecology, population modeling, insect molecular genetics, sampling theory, and cold-tolerance studies of natural enemies of weeds and insects.

Dr. Nowierski is currently Chairman of Biological Control Subsection Ca of the Entomological Society of America, and is a member of the Experiment Station Committee on Organization and Policy – Working Group on Biological Control (ESCOPE-WGBC). Since 1998 he has served as U.S. Chairman of the Toadflax Consortium responsible for coordinating funding, research, and implementation of biological control for Dalmatian and yellow toadflax between the U.S. and Canada. In 1992 and 1993 Dr. Nowierski coordinated biological control activities for the Russian wheat aphid for North America, and has conducted biological control research on weeds and millipedes in Europe and Africa, respectively. In the U.S. Dr. Nowierski's research has focused on the biological control of leafy spurge, Dalmatian/yellow toadflax, and spotted knapweed. Dr. Nowierski was Co-Chairman of the X International Symposium on Biological Control of Weeds held at Montana State University-Bozeman in 1999. Most recently, he was a member of the Organizing Committee for the International Symposium entitled "The Practice of Biological Control," which was held at MSU-Bozeman in August 2001. Dr. Nowierski also is a member of the Editorial Board for the journal *Biological Control: Theory and Applications in Pest Management*.

Dr. Nowierski's first introduction to leafy spurge and biological control was as a graduate student at the University of Idaho, helping with the first releases of the clear-winged moth, *Chamaesphecia tenthrediniformis*, against leafy spurge in Idaho. Bob recalls that a bundle of leafy spurge stems, containing larvae of the moth, were received in 1975 from the USDA Biological Control of Weeds Laboratory, Albany, California. He and fellow graduate students were instructed to make

Editor's Desk continued from page 1

included all the names for each presentation so you will know who is doing what. Steve Merritt summarized the whole event very well and that is included in this issue.

Our honoree for this issue is Dr. Robert Nowierski, Montana State University, Department of Entomology. He has been involved for a long time in the fight against leafy spurge. I am sure you will find his story interesting.

Once again I ask for your support as I need articles and items that I can put in future issues. I report the news and information, but I cannot make them. So please send them to me via E-mail, regular mail, floppies, makes no difference as long as **YOU** send them!

Claude H. Schmidt

Editor

1827 N3rd Street, Fargo ND 58102-2335

(701) 293-0365, Fax (701) 231-8474

e-mail: cschmidt@ndsuent.nodak.edu

a release of this biological control agent by extracting larvae from the stems, cutting leafy spurge stems in the field and attempting to place the larvae within the pith of the freshly cut shoot tips. After watching the wiggling larvae progress to rigor mortis, Bob thought to himself that this release appeared to be doomed to failure and that there must be a better way to go about this! Although the release was unsuccessful, this fostered an early interest in biological control that he would later pursue in his academic career as a graduate student at the University of California-Berkeley, and as a professor at Montana State University in Bozeman.

After arriving at Montana State University in 1982 as an Assistant Professor in the Plant and Soil Science Department, Dr. Nowierski was encouraged to pursue biological control efforts against leafy spurge. One of his most intriguing memories of leafy spurge occurred when he brought a bouquet of leafy spurge back to his office and placed it in a container of water. After a few minutes he began hearing some strange noises and then suddenly was hit in the face with one of the leafy spurge seeds. Bob recalls musing to himself, "Now this is a weed with character that I am definitely going to have to work on!"

One of the first insects that Dr. Nowierski worked on was the leafy spurge hawkmoth, *Hyles euphorbiae*. In 1984 he coordinated the first mass collection and redistribution of this biological control agent in the United States. Bob recalls another poignant occasion when he received a call one Saturday from Dr. Pete Fay, a professor at Montana State University who specialized in the chemical management of weeds. Dr. Fay was working at his office at Montana State University when apparently three hawkmoth larvae escaped from Nowierski's laboratory on the 8th floor of Leon Johnson Hall and crawled into Dr. Fay's office on the 7th floor! For Dr. Fay this must have been a harbinger of things to come — as biological control would eventually emerge to play a very important role in the future management of leafy spurge!

Over the years Dr. Nowierski's research group on spurge (Bryan FitzGerald, Zheng Zeng, Nik Wiman, Matt Grieshop, Greg McDermott, Steve Harvey, and Noah Poritz), and collaborators (David Kazmer, Rich Hansen, Paul Mahlberg, Norm Rees, Dieter Schroeder, Andre Gassmann, Massimo Cristofaro, Jim Story,

David Horvath, Jack Butler, Don Kirby, Amy Parker, and Karl Brown) tackled numerous projects concerning the biological control and ecology of leafy spurge. Research included life table and population ecology studies of the spurge hawkmoth; taxonomic studies of North American and European spurge species; habitat associations of European spurges; habitat associations of flea beetles in the *Aphthona* complex associated with leafy spurges in Europe; habitat associations of the flea beetles established against leafy spurge in North America; molecular genetic studies of the flea beetles and leafy spurge; sex ratio studies of the flea beetles; ecological amplitude studies of leafy spurge; and the impact of flea beetles on plant species richness, diversity and plant community structure.

For the past five years Dr. Nowierski has participated in the TEAM Leafy Spurge project that focused on the ecologically-based, area-wide integrated weed management of leafy spurge in the Little Missouri River system in eastern Montana, western North Dakota, western South Dakota, and eastern Wyoming. Bob was team leader for the Ecological Barriers Group (Co-PI: David Kazmer; Cooperators: Rich Hansen, David Horvath, and Tony Caesar) within TEAM Leafy Spurge. Research from the group focused on identifying ecological barriers that might affect the establishment and rate of population increase of the flea beetles on leafy spurge, including the implications of releasing the flea beetles in the wrong habitats; genetic variability of leafy spurge and the *Aphthona* species; implications of female-biased sex ratios in *Aphthona nigricutis*; and temporal patterns in flea beetle mating success.

Dr. Nowierski has very much enjoyed the comradery and inter-agency collaboration associated with the management of leafy spurge over the years, and is grateful to have been associated with such a fine group of people.

Dr. Nowierski is currently Professor of Entomology at Montana State University-Bozeman. In January 2002, he will assume the position of National Program Leader for Bio-Based Pest Management with CSREES (the Cooperative State Research, Education, and Extension Service) in Washington, D.C. He will represent the Land Grant University System for insect, weed, and plant pathogen biocontrol, and plant immunity.

Spurgefest II Deemed A Success

TEAM Leafy Spurge's "Spurgefest II," held June 19-21 in Medora, N.D., went off without a hitch, with both planners and participants describing the event an overwhelming success. "It's a great feeling to look back and realize how much was accomplished in three short days," said Gerry Anderson, an ecologist with the USDA-ARS Northern Plains Agricultural Research Laboratory in Sidney, Mt., and co-principal investigator of the TEAM Leafy Spurge program. "When you consider the diverse cross-section of people that attended, the level of interest they brought to the event, and the amount of information they left with — well, it's really pretty incredible."

A follow-up to the equally successful "Spurgefest '99," also held in Medora, "Spurgefest II" was attended by nearly 300 ranchers, landowners, land managers, and representatives from numerous local, state and federal organizations and agencies. The three-day event featured a TEAM Leafy Spurge symposium, tours of biologically based integrated pest management (IPM) research and demonstration sites, a hands-on flea beetle collection demonstration, and a leafy spurge flea beetle distribution.

The most satisfying highlight for TEAM Leafy Spurge program coordinator Chad Prosser was getting a chance to hear from ranchers who attending Spurgefest '99, were impressed with what they saw and learned, then "went home and started their own biologically based IPM programs." "I talked with several people who got their first flea beetles at Spurgefest '99, and most of them already have established populations they've been collecting from," he said. "Some of these guys have been fighting leafy spurge for 30 or 40 years without much success, and seeing how excited they are after just two years of biologically based IPM really makes our efforts worthwhile."

Lori Williams, executive director of the National Invasive Species Council, said the TEAM Leafy Spurge program and events like Spurgefest provide great examples of bringing federal, state and local interests together in a united effort to battle invasive weeds.

When the council was created by Executive Order 13112 in February of 1999, she said, there were "at least" 22 federal agencies with invasive weed programs. "But there was no coordination, no plan, no real

effort to get all of these agencies working together with state and local groups," she said. "This program is serving as a model and showing how coordination can help reduce the impact of invasive species."

The roster of participants backs Williams' assessment up. The event drew participants from 11 different states and two Canadian provinces, including two state department of agriculture commissioners and representatives from a multitude of local, state and federal groups and agencies.

And planners saved the best for last. After the symposium, tours and demonstrations, the event concluded with the distribution of more than three million flea beetles to ranchers, landowners and land managers from around the region. More than 300,000 flea beetles were given to two Canadian provinces, with state agencies from Iowa, Idaho and Nebraska also getting into the act.

California was also represented by Baldo Villegas, an entomologist with the California Department of Food & Agriculture, who left with enough information and flea beetles to start the state's first leafy spurge biocontrol program.

TEAM Leafy Spurge is a five-year IPM research and demonstration project funded and led by the USDA-ARS in partnership with the USDA-Animal & Plant Health Inspection Service. Its goal is providing landowners and land managers with proven leafy spurge control techniques based on IPM strategies.

Sponsors for Spurgefest II include the USDA-ARS, USDA-APHIS, Theodore Roosevelt National Park/ National Park Service, the U.S. Forest Service, the Bureau of Land Management, the BASF Corporation and Dow Agrisciences Corporation. For additional information on TEAM Leafy Spurge, leafy spurge biocontrol or Integrated Pest Management, see the TEAM Leafy Spurge website at

www.team.ars.usda.gov/ or send an e-mail to **teamls@sidney.ars.usda.gov**

This story, accompanying photos (both black-and-white jpgs and color tiffs) and photo captions can be retrieved at **<ftp://ftp.sidney.ars.usda.gov/pub/outgoing/sfest>**

Steve Merritt

406-488-9440

smerritt@sidney.ars.usda.gov

Proceedings

from Spurgefest II, June 19-21, 2001

Introduction to the Symposium

In 1997 The Ecological Area-wide Management (TEAM) Leafy Spurge program became a reality. The program was funded as part of the USDA-ARS Area-wide Program and conducted cooperatively with the USDA-Animal and Plant Health Inspection Service (APHIS). The original concept of the program was to conduct demonstrations of integrated leafy spurge management strategies for state, federal and private land managers.

The TEAM Leafy Spurge (TLS) program has evolved substantially since its inception. Nineteen ninety seven saw the departure of the USDA-ARS Co-Principal Investigator, Dr. Paul Quimby Jr. and the subsequent assignment of Dr. Gerald L. Anderson as the ARS Co-Principal Investigator along with Dr. Lloyd Wendel of USDA-APHIS. The scope of the program was broadened to include research needed to complement the existing body of work, public relations and education became a major priority, and due to the abundance of biological control agents — the program distributed more than 40 million insects within the four state study region, as well as, three additional states (enough for more than 13,000 releases). TLS will distribute an additional 20 million insects within the original study area plus Iowa, Nebraska, Colorado, Idaho and two Canadian Provinces if all goes as planned in 2001.

The papers presented in these proceedings represent the culmination of three to four years of research and demonstration, conducted in North Dakota, South Dakota, Wyoming and Montana. TLS will officially end 30 September 2001, however, a great deal of work remains. ARS will continue to provide administrative support for the next one to two years to ensure research and demonstration results are synthesized, published and provided to users in a usable format.

How will TLS be remembered? Hopefully we will be remembered for conducting a fair, comprehensive and coordinated approach to leafy spurge management. The intent of the program managers and the ad-hoc advisory committee continues to be heightening awareness of the problem leafy spurge poses and the various integrated pest management tools needed to effectively manage the weed. Program development

was also designed to establish of a new level of understanding and increase the participation of individuals in all sectors of society.

Two parting thoughts from the Principal Investigators:

1. Given the state of our agricultural economy and current funding levels, leafy spurge and other invasive weeds are not a problem we can expect landowners and land managers to deal with effectively alone. This means that we all have to be proactive in supporting local weed control efforts in the private and public sector. Simply put, invasive weeds are everybody's problem regardless of how the situation came about. We will never legislate weeds away nor will we kill a single weed by pointing fingers at those who are "the problem," but we can work together to ensure sufficient resources are available to get the job done. This extends to federal and state lands as well. Under funded and unfunded mandates have already stretched most agencies beyond their ability to comply with existing invasive weed mandates. We encourage you to remember that federal and state lands belong to all of us and if they are not being managed properly, then it is up to us to ensure they have the resources needed to meet the obligations that have been placed on them.
2. Integrated pest management (IPM) provides the only hope for successfully controlling invasive weeds and preventing the establishment of new problem species. But, IPM is more than a set of weed management tools. True IPM includes the integration of landowners, land managers, policy makers and agency decision makers. If you are on the front lines of the weed control battle and there aren't at least ten people tripping over their feet trying to provide you with support, then something is wrong. Don't stop the fight, simply start contacting your state and federal representatives and impress upon them that your income is as important to our nation and your state as it is to you and your family.

TLS has contributed to our understanding of the weed and how to control it. However, the success achieved

Continued on page 6

Proceedings

from Spurgefest II, June 19-21, 2001

Operations Component Contributions to Team Leafy Spurge, Area Wide Integrated Management of Leafy Spurge (*Euphorbia Esula*)

USDA, APHIS and USDA, ARS teamed together to organize, manage, and implement a biologically-based Integrated Pest Management (IPM) project, focused along 300 miles of the Little Missouri River in Wyoming, Montana, North Dakota, and South Dakota. The Ecological Area-Wide Management of Leafy Spurge (TEAM LS) began in 1997. The goal of the project was to develop and demonstrate ecologically-based IPM strategies that could be used to achieve affordable, effective self-sustainable leafy spurge control. Successes in establishment and collection allowed for over 13,000 releases of *Aphthona* spp. throughout the Little Missouri drainage. Additionally, through TEAM

Leafy Spurge Operations, insects have been provided to additional states and provinces for leafy spurge control.

Within the "TEAM" Program, biological control methodologies were designed as a control foundation, to be used alone or as a base strategy, coupled with other control methods, such as multi-species grazing and herbicides. Specific contributions of Operations include development of large volume insect collection, sorting, packaging for transport, and delivery of biological control insects. More than 40 million *Aphthona* spp. insects were collected from established populations. These insects provided the basis for research and demonstration projects within the program. Operations developed and provided a standardized scalable data collection form, used by all research assessment teams within the four state area and provided spreadsheets of the data for their use in interpreting insect establishment and leafy spurge control. Operations supported and hosted nine tours and field demonstrations in four states, developed "Leafy Spurge Biological Control Information and Photo Resource Gallery" CD, and provided information and support for the development of CD multimedia biological control information suite, including: Biological Control of Leafy Spurge Brochure, Power Point presentation, Biological Control Photos, and Information and Resources.

Robert D. Richard

Station Director, USDA, APHIS, PPQ
Bozeman Laboratory, Bozeman, MT 59717

Chad W. Prosser

TEAM Leafy Spurge Coordinator, USDA, ARS
Sidney, MT 59270

Connie O'Brien

Field Technician
North Dakota State University, Belfield, ND 58622

Syposium Intro continued from page 5

during the program was only possible because of the contributions of countless individuals who have been fighting invasive weeds most of their careers, and in some cases their all their lives. Thank you for your efforts and thanks to all the partners that participated in the program. TLS is your program and we hope that TLS under-girded your efforts and promoted new management approaches that will be useful for years to come. The legacy of TLS is yet to be determined, but we hope it will be this — TLS made a difference — in controlling leafy spurge and in providing an effective example for future invasive weed programs.

Dr. Gerald L. Anderson

USDA, ARS
Sidney, MT

Dr. Lloyd Wendel

UDSA, APHIS
Mission, TX

Proceedings

from Spurgefest II, June 19-21, 2001

Leafy Spurge Bio-Control in the Little Missouri River Drainage

The study began in 1997 to assess the impacts of biological control agents (*Aphthona* spp.) on leafy spurge and the ecological effects of leafy spurge on mixed grass prairie. Biocontrol agents, flea beetles, were released into leafy spurge infested rangeland in 1998. In only two growing seasons, leafy spurge control has been phenomenal. Of 98 release sites, 85% have had good leafy spurge control ($>400\text{m}^2$), while only 5% have shown poor control ($<200\text{m}^2$). Leafy spurge canopy cover at release sites was reduced from 40% to less than 5%. Leafy spurge control has been similar across aspects, topographic positions, soil types and range sites.

Results from a soil seedbank study indicated that over 70% of seedlings germinated from soils taken across light-to-heavy leafy spurge-infested rangeland were leafy spurge. Desirable cool- and warm-season grasses only comprised 5% of the seedlings germinated from soil cores. The dominance of leafy spurge and other “weedy” plant species in the soil seedbank of leafy spurge-infested rangeland will necessitate a long-term leafy spurge control program for these affected sites.

Don Kirby

Professor, Department of Animal and Range Sciences
North Dakota State University, Fargo, ND 58105

TEAM Leafy Spurge Demonstration Assessment, Medora N.D.

TEAM Leafy Spurge demonstrations are an important link between research and managers. The Medora N.D. demonstrations included grazing treatments, biological control releases and herbicide applications. Our objective was to collect data to determine the outcome of, and evaluate the demonstration treatments. The grazing demonstration was conducted at two sites and had 4 grazing treatments consisting of cattle and sheep grazing in season long pastures or rotation grazing. *Aphthona* flea beetles were also released in the pastures.

James S. Jacobs and Roger S. Sheley

Montana State University, Bozeman MT

Assessing Biological Control Agents for Area-wide Control of Leafy Spurge with Foci in Montana and South Dakota

The objective of this study is to document micro-scale distribution, density, dynamics and trends of leafy spurge populations in response to flea beetle control within the Montana and South Dakota study areas. Ninety-three permanently located sample sites were established during the 1998 field season within the Mill Iron (Montana) and South Fork of the Moreau River (South Dakota) study areas. The selected sites represent the wide range of topographic, soil, vegetation, and landform situations typical of the region. Approximately 6,000 beetles (3,000 *Aphthona lacertosa* and 3,000 *A. nigriscutis*) were released in June 1998 at each of the 62 permanently located release sites. Beetle abundance was estimated using insect sweeps conducted in 1999 and 2000. Foliar cover of leafy spurge was estimated in 1998, 1999, and 2000 using a digital analysis system. Species composition and foliar cover of the extant vegetation was estimated on each sample site during the 1998 and 2000 field seasons.

Beetle numbers increased dramatically between 1999 and 2000, and did not appear to demonstrate any particular affinity for site differences in slope and aspect in either South Dakota or Montana. Concomitantly with the increases in insect abundance, foliar cover of leafy spurge decreased an average of 76% and 77% in South Dakota and Montana, respectively, from 1998 to 2000. The native vegetation increased in frequency and abundance in response to the decrease in leafy spurge. Grass foliar cover at the Montana site increased 42% while species richness increased 27% in the two years following flea beetle release.

Matthew S. Parker and Jack L. Butler

Department of Biology
Central Missouri State University
Warrensburg, MO 64093

Claude Schmidt
Agricultural Experiment Station
North Dakota State University
Fargo, ND 58105

Non Profit Org.
U.S. Postage

Paid

Permit No. 818
Fargo, N.D.

Proceedings

from Spurgefest II, June 19-21, 2001

Wyoming Assessment Project and Remote Sensing of Leafy Spurge

In the Wyoming component of the TEAM Leafy Spurge Assessment Project, large mixed-species releases (3,000 each of *A. nigricutis* and *A. lacertosa* per site) resulted in not only significant, but very large reductions of leafy spurge in just two years. In contrast, non-release sites showed constant or increasing levels of leafy spurge during the three years of this study. Flea beetles were effective in reducing leafy spurge in all habitat types including riparian areas of very dense leafy spurge, wooded areas, and open upland areas. Flea beetles also effectively reduced leafy spurge on all aspects and soil textures.

A. lacertosa was observed in greater numbers than *A. nigricutis* on almost all of the release sites. In addition, *A. lacertosa* appeared to be more effective in controlling leafy spurge in a wide variety of conditions, with the largest crater sizes, and therefore the most rapid control occurring in cooler, moister riparian and north and east facing sites.

A fundamental research need in leafy spurge

management and invasive plant management as a whole is cost-effective, large-scale mapping of plant populations. We acquired hyperspectral Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) data over a 25 square-mile study area in Crook County, Wyoming on July 6, 1999. In 1999, we used an ASD FieldSpec spectroradiometer to collect ground calibration and reflectance data of leafy spurge, other vegetation, and soils. These spectra were used to perform spectral mixture analysis on the AVIRIS scene. A major advantage of this technique is that it can effectively “unmix” a pixel and provide an estimate of the areal extent of leafy spurge within the pixel. With its hyperspectral capabilities, AVIRIS provides the best resolution (spectrally, radiometrically, and spatially) for detecting and mapping leafy spurge.

Amy Parker Williams and David J. Kazmer

Department of Botany

Department of Renewable Resources

University of Wyoming, Laramie, WY 82071