Castilleja

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In this issue:

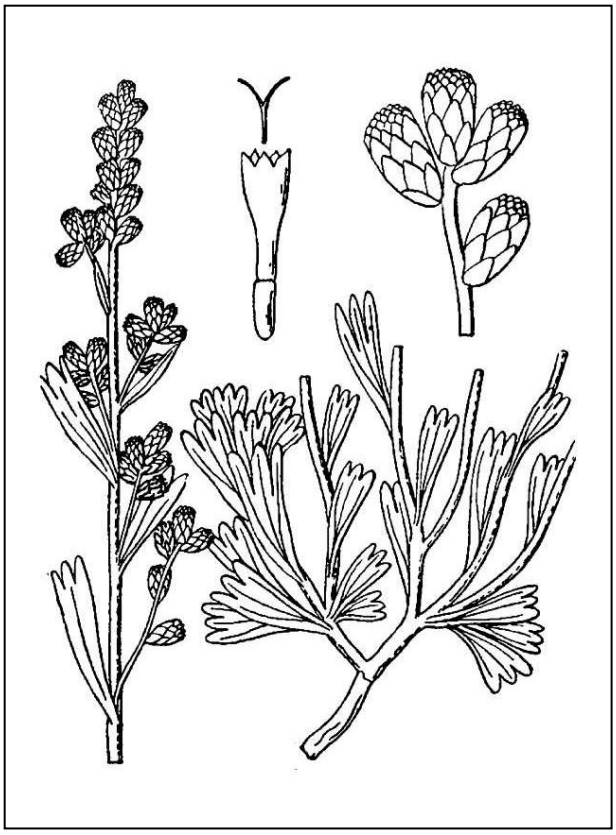
Powerhouse among Wyoming Flowers

By Bonnie Heidel

The small flowers of Big sagebrush (*Artemisia tridentata*) lack flamboyance, but they give new meaning to the term "Flower Power." The flower parts of most plants are energy sinks that tap energy produced by the rest of the plant, though Big sagebrush flowers can produce more energy than vegetative leaves, supporting their own growth and respiration (Evans et al. 1991)[1].

Under well-watered conditions, Big sagebrush flowers have some of the highest reported photosynthesis levels among all flowers. The well-watered conditions across the state early in 2009 resulted in a flowering bonanza of Big sagebrush, elevating activity after low flowering levels during prior years of prolonged drought.

Big sagebrush flowers are late bloomers. Inflorescences emerge in late spring, but don't expand until summer and mature in fall. It is thought that vegetative growth in the spring separated from reproductive growth in the fall avoids competing demands (Evans et al. 1991). The flowers are at work even when xylem water potentials plunge. This capacity to respond to infrequent rainfall and operate with limited moisture is an adaptation for fall flowering in an arid climate.



Above: *Artemisia tridentata* Nutt. *In*: Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 3: 530. Courtesy of Kentucky Native Plant Society.

Big sagebrush has been interpreted as a likely colonizer over most western states in the Pleistocene (Welch 2005) – though palynologists are quick to note that it is not possible to identify *Artemisia* pollen to species. …Big sagebrush may have been the "flower that won the West."

(*For the list of references, see p. 5*)

[1] The study was conducted on *Artemisia tridentata* var. *tridentata* in the state of Washington. This variety is one of three common varieties of Big sagebrush in Wyoming.

WNPS News

New Members: Please welcome the following new members to WNPS: Courtney Doyle, Rolling Hills; Mark Moran and Susan Sweeney, Cheyenne.

Call for Candidates: A 2009 nomination committee will be established to fill WNPS positions. Interested? Contact Lynn Moore (lmflora@alluretech.net; or 307-259-6971).

Treasurer's Report: Balance as of 1 Sept 2009 - General Fund: $1,611.67; Markow Scholarship Fund: $1,116.00. Total Funds: $2,727.67.

Contributors to this Issue: Ann Boelter, C. Alex Buerkle, Eva Crane, Bonnie Heidel, Brittany Jenkins.

2010 Markow Scholarship: Online and next issue

Wyoming Native Plant Society
P.O. Box 2500
Laramie, WY 82073

Online Database for Plants of the Black Hills and Western South Dakota

By Grace Kostel, Black Hills State University

In June 2009, Black Hills State University Herbarium (BHSC) work came to fruition with the posting of specimen information for large segments of the Northern Great Plains as housed in herbaria throughout the region. The BHSC web site is open and ready for your use and enjoyment. This is a free resource for plant enthusiasts, educators, and research professionals everywhere. We welcome you to access the site at:www.herbarium.bhsu.edu.

The BHSC web site covers a geographic area that includes Crook and Weston counties, Wyoming and all South Dakota counties west of the Missouri River, based on collections at 16 herbaria (including the Rocky Mountain Herbarium).

The project started in 2004, initially funded by the National Fish & Wildlife Foundation, databased all regional species of the family Poaceae, and placed these online in 2005. The BHSC used computerized procedures to maintain the database for grasses for several years before launching a second exciting and more ambitious project in 2006 funded by the National Science Foundation (NSF) to create a database for *all vascular plants* of the region. This database is now online and is a capable research tool for many activities such as producing checklists for the relatively unknown flora of the Northern Great Plains region, tracking the historical and recent appearance of invasive plant species, and for learning about the plants and plant resources that are our natural heritage.

Watch for updates and improvements in the near future!

If you haven't tried visiting herbaria vicariously on the internet, it is simpler than ever to do from home, office or library. In addition to the new online data services at Black Hills State University Herbarium and Rocky Mountain Herbarium (this issue), online databases are also posted for Colorado State University, University of Colorado, and University of Montana.

Rocky Mountain Herbarium At Your Fingertips

One of the greatest herbarium facilities in the Rocky Mountains just got greater. The Rocky Mountain Herbarium (RM) web site (www.rmh.uwyo.edu/) now includes direct access to nearly 700,000 specimen records through a new search interface (330,000 specimens in Wyoming alone). This makes it easy to access specimen data when you need it.

Features of the new interface include: searching for specimens by family, genus, species or variety (Figure 1); searching for specimens by collector, year, or location like county, national forest, or place name; or searching by drawing an arbitrary polygon around an area of interest on a map and searching for all species or a taxonomic group (Figure 2). Links are provided for viewing the distribution of a species over Google Maps with an associated listing of specimen records, the ability to click on a dot on the map to get the list of specimens collected at that site, or click on a specimen to view its location on the map, the ability to down-load data GIS files, excel files or text files, and more.

The web site includes data from 44 major floristic Masters thesis projects as well as more than 24 other projects by RM staff and associates, for a total of 550,000 numbered collections. Thirty two of the studies were conducted in part or in full in Wyoming, plus ten other states in or adjacent to the Rocky Mountains (all georeferenced). Detailed information for nearly all floristic inventories conducted at RM are available under the Research tab, including:

- Maps of projects for each state (Figure 3)
- Maps showing individual project boundaries with dots representing collection sites (Figure 4)
- Short narrative describing the project and the primary results.
- Statistics, including:
  Project area (square miles)
  # of collections
  # of taxa
  # state records
  # sensitive taxa
  # exotic taxa
  # noxious weeds
- A full list of the taxa collected for each project. Taxa in the list can be clicked to show the collection locations of that taxon for the project as dots on a map, and each dot can be clicked to get the exact specimen data.

Data from unmounted specimens is included, except in cases of floristic projects and publications in progress. Addition of data from "historical" collections (150,000 specimens) is being incorporated. Location data are redacted from private lands and Threatened or Endangered taxa.

Figure 1. *Silene acaulis* collections and label data

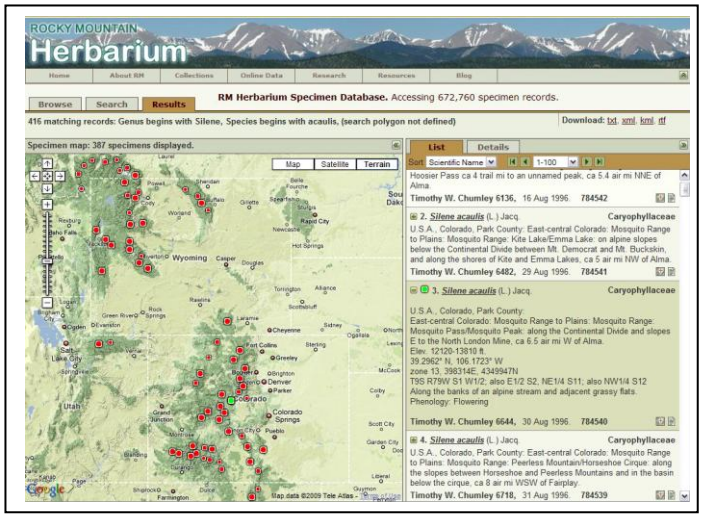
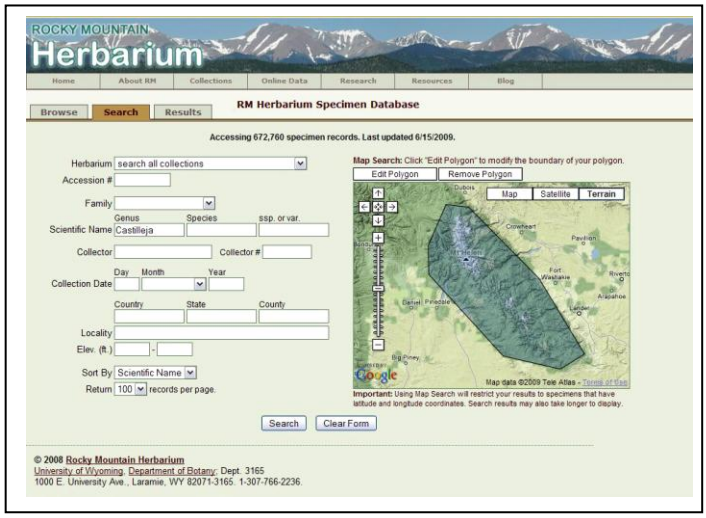


Figure 2. *Castilleja* collections in the Wind Rivers



Do you want to see the actual specimens? Virtual herbarium resources with high-resolution images are currently available through RM starting with the Grand Teton National Park Herbarium collections housed at the Park headquarters. RM has recently been awarded a grant from the Mellon Foundation to provide high-resolution images of type specimens online, which will become available in 2010. Plans are also underway to go through the entire RM collection and pull out several representative specimens of each taxon that occurs in Wyoming, scan each specimen, and make these images available online as a reference set for Wyoming's flora.

Ben Legler, University of Wyoming Masters student, totally rebuilt the database using MySQL and MS Access and created the new web interface. He was also responsible for the technical aspects of the portal for the Consortium of Pacific Northwest Herbaria (http://www.pnwherbaria.org) at the WTU Herbarium, University of Washington, on which the RM interface is modeled.

For further information, please contact Dr. Ron Hartman, Curator (rhartman@uwyo.edu), or B. E. Nelson, Manager (bnelsonn@uwyo.edu); 307-766-2236.

Figure 3. Wyoming floristic study areas of RM

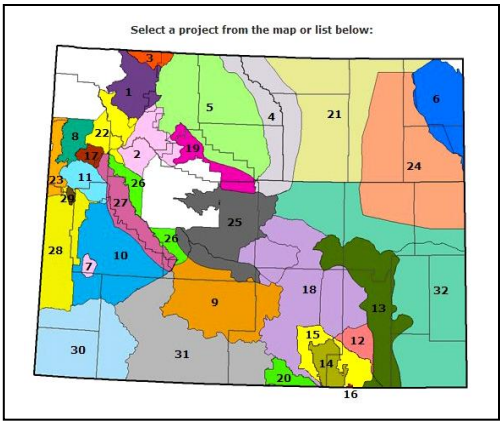
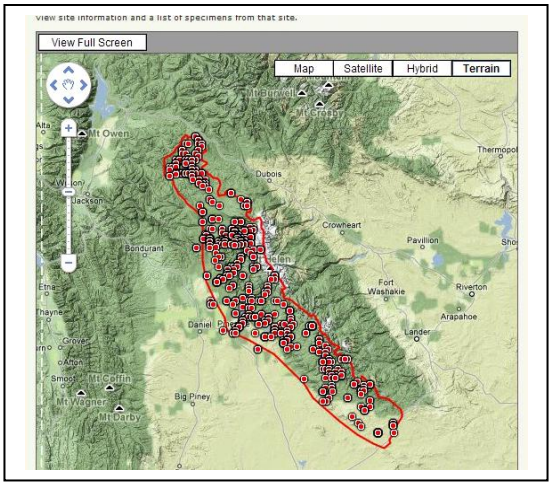


Figure 4. Collection sites in West Wind River Range Study Area (#27 in Figure 3) of W. Fertig



Announcement

Updated National Wetland Plant List

The U.S. Army Corps of Engineers, Wetland Regulatory Program announces the release of its new web site for updating the National Wetland Plant List (NWPL), a key component of its national wetland program. The NWPL, a cooperative effort of the Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the Natural Resources Conservation Service, lists the wetland ratings for plant species found throughout the U.S. and is used extensively in determining wetland boundaries, restoring wetlands, and conducting ecological research. The new web site will allow experts and interested parties to submit information and participate in the process of updating the NWPL. Of more general interest is the site's wealth of information on nearly 10,000 U.S. plants, including distribution maps and photographs. Search capabilities for geographic, habitat, and other attributes allow users to follow their interests locally, regionally, or nationally for information on plant families, genera, and species. This is the first time that such a range of detailed botanical information has been gathered and made easily available to the public. The address is https://rsgis.crrel.usace.army.mil/apex/f?p=703. (Non-Corps users may need to accept a web certificate the first time they visit the site. The site will be published in the Federal Register as part of the updating process, after which all visitors will be able to obtain an automated password.)

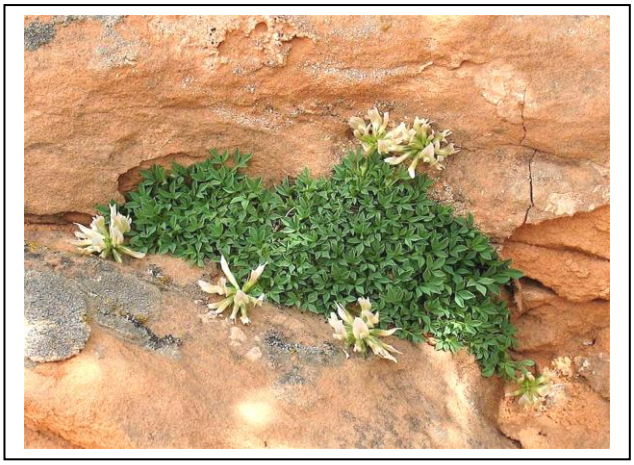
2009 Annual Meeting Highlights

The 2009 Wyoming Native Plant Society Annual Meeting, 30-31 May 2009, marked a grand slam of southwestern Wyoming state and regional endemics featuring Precocious milkvetch (*Astragalus proimanthus*), Nelson's milkvetch (*Astragalus nelsonianus*), Stemless beardtongue (*Penstemon acaulis*), Beaver Rim phlox (*Phlox pungens*), Rocky Mountain twinpod (*Physaria saximontana*), Green River greenthread (*Thelesperma caespitosum*), and Barneby's clover (*Trifolium barnebyi*). The event was also marked by equally rare weather usually only found in daydreams, and terrific company. Special thanks to Robert and Jane Dorn, Rita Faruki (The Nature Conservancy) and *everyone* who came!

Above: *Penstemon acaulis* in full bloom near McKinnon By B. Heidel.

Above: Robert Dorn recounts a tale of discovery at the spot he first came upon *Thelesperma caespitosum*, near Green River, 21 years ago. By B. Heidel.

Above: It is impossible to walk Red Canyon Rim in May without stopping to admire flowers. By Ann Boelter.



Above: *Trifolium barnebyi* in full bloom above Red Canyon. By Eva Crane.

References (cont. from page 1)

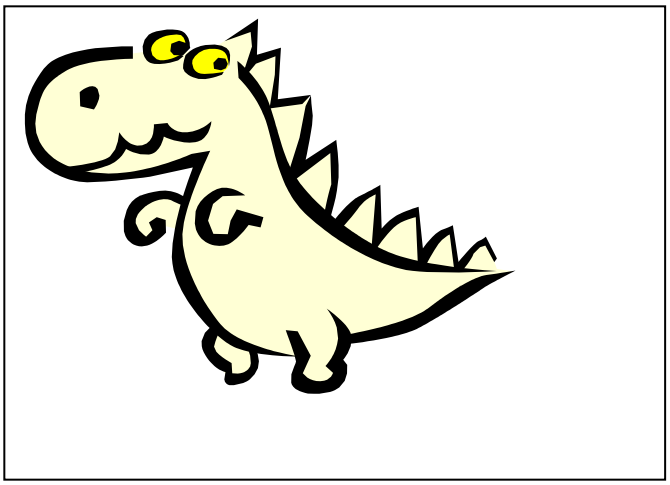
Evans, R.D., R.A. Black, S.O. Link. 1991. Reproductive growth during drought in *Artemisia tridentata* Nutt. Functional Ecology, Vol. 5 (5): 676-683.

Welch, B.L. 2005. Big sagebrush: a Sea Fragmented into Lakes, Ponds, and Puddles. Gen. Tech. Rep. RMRS-GTR-144. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station.

Is Botany As We Know It An Endangered Profession?

By Dennis W. Woodland, Ph.D.
Professor of Botany, Andrews University
Berrien Springs, MI 49104 USA

(*Editor's note: The following is excerpted from a speech given at the 2009 Colorado Native Plant Society Annual Meeting, Sept. 12, in Loveland, CO. For a full transcript, contact the speaker or the Castilleja editor.)*



…It was the summer of 2000 when the Biology Department Office Manager called me to the office. A man was there with some biological problems. … "Can you identify these organisms for me and tell me something about each?" he asked. "Why yes, I think I can," I told him. He informed me he was from a small city about 100 km away located half way between my university and Chicago. He had been first to the university near his home, then to an elite private one, next to one of the most prestigious universities in the U.S., a city university, and then to my institution. "I visited five universities today and you are the only ones who could help me. What type of biology do you teach students that is different?" A serious question; not a frivolous one.

This incident set me thinking, "How many field botanists were in a radius of 100 km of where I live and work?" Reflecting on this via a Web search, I could only come up with eight botanists…

At about this same time the *Chronicle of Higher Education*, a journal read by a high percentage of academics and academic administrators in the United States had an article entitled: "The Impending Extinction of Natural History?" (Wilcove & Eisner, 2000). The authors concluded that natural history is disappearing rapidly from the curriculum of North American universities. More recently… a marketing firm told the publisher of my text [Woodland, D.W. 2009, 4th ed. Contemporary Plant Systematics.[2]] that there are now less than 190 plant taxonomy or local flora courses taught in North American universities and colleges. This is not a very comforting thought to a person like myself who has spent almost a half-century practicing organismal botany, a segment of natural history--extinction of my professional gene pool!

Before I go further, we need to define natural history of which botany is a component. …Peter Grant (2000) felt the modern naturalist was "an explorer and tester of evolutionary and ecological ideas that are developed to reveal and explain regularities in nature." We botanists attempt to explain the plants we find in nature and to ask questions and seek answers wherever they may be found (e.g. field and lab experimentation, ultra-structure, DNA, etc.).

Perhaps the best definition is a combination of Grant's words with that of the founding President of Stanford University, David Starr Jordan, an ichthyologist who in 1916 defined natural history to mean: "the recognition or study of animals and plants as complete organisms, each greater than the sum of all the parts. It involves knowledge of names and of some degree of classification. It leads up to the origin of species, the affinities of forms, of the complex relations we call habits, the problems of geological distribution, the details of evolution and a balanced knowledge of things as they are, as actual through temporary stages in a university of change." Good natural history (botany) is a source of priceless information. It inspires new theories, as well as data and answers to broad problems in ecology, evolution, reproduction and conservation biology (Schmidly 2005)…

[2] This college textbook by Woodland is among the few that includes a "job opportunities" section in the epilogue, and a photo atlas CD to more fully represent the breadth of the subject matter.

I have some suggestions for… making classical botany [come] alive again.

1. Begin at home…
2. Get your students involved outside the laboratory…
3. Work hard to give botany students a broad botanical background. By this I mean encouraging students to see the interrelationships between genetics, reproduction, ecology, morphology, physiology, entomology and geology to name a few…
4. Emphasize plants on your own campus…
5. …It is good for us academics to get out of our 'ivory towers' and show the average person that plants can be cool and interesting…
6. …write botanical articles for your local news outlets on the interesting botanical information all around us.

Time does not permit me to expound *ad infinitum*. But, I want to say I'm guardedly optimistic. Optimistic provided [that] we all work together in many different ways to make the pendulum begin to swing back to where students and the public will once again … view botany as a viable occupation.

Selected References

Grant, P. R. 2000. What does it mean to be a naturalist at the end of the twentieth century? American Naturalist 155: 1-12.

Schmidly, D. J. 2005. What it means to be a naturalist and the future of natural history at American Universities. Journal of Mammalogy 86(3): 449-456.

Wilcove, D. S. and T. Eisner. 2000. The impending extinction of natural history. Chronicle of Higher Education 47(3): B24.

If Natural History means attentiveness to species-level subject matter, usually with the benefit of field observation, then wouldn't all life sciences benefit by reaffirming a Natural History alliance? The words themselves are sources of confusion, as though to compartmentalize "Nature" from everything else, with no relevance for the future. BH

New Native Plant Nursery Manual

The Rocky Mountain Research Station has the following publication available in single or multiple copies:

Dumroese, R. Kasten; Luna, Tara; Landis, Thomas D., editors. 2009. Nursery Manual for Native Plants: A Guide for Tribal Nurseries. Agriculture Handbook 730, Volume 1: Nursery Management. Washington, DC: Department of Agriculture, Forest Service. 302 p. Color.

This 17-chapter manual provides basic, easy-to-understand information for operating a native plant nursery. Intended for use by Native Americans, the manual is well illustrated with photos and line drawings, includes many case studies, and would be useful to anyone that is considering starting a native plant nursery, or refining their current operation. The first section, "Getting Started", discusses planning a native plant nursery, understanding the "target plant concept", and developing plant production protocols. The second section, "Developing Your Nursery", includes information on proper propagation environments, types of growing media, and container selection. The third section, "Growing Plants", is comprised of eight chapters that focus on collecting and processing seeds, seed germination, vegetative propagation, water quality and application, fertilization, hardening, plant storage and shipping, and application of beneficial microorganisms. The last section, "Problem Solving", addresses pest management, overall nursery management, and how to properly install trials to improve nursery performance.

There is NO charge for this publication. Single or multiple copies can be ordered by email, fax, phone, or mail:

Email: Richard Schneider - rschneider@fs.fed.us (include full mailing address)
FAX: (970) 498-1122
Phone: (970) 498-1392
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Genetic Consequences of Rarity in *Penstemon*

Brittany Jenkins[1,2] and C. Alex Buerkle[1]
[1] Department of Botany, University of Wyoming
[2] Department of Ecology and Evolutionary Biology, University of Colorado (present address)

The persistence of plants in small populations depends on chance to a greater extent than plants in large populations. Chance events that cause plant mortality and habitat disruption are likely to affect a larger fraction of a small, spatially restricted population than a larger, more widespread population. Similarly, random variation in reproduction in a small population will lead to the loss of genetic variation at a greater rate than in a large population. This loss of genetic diversity is referred to as genetic drift and is a simple consequence of chance variation in reproduction among individuals that harbor different genetic material. Whereas genetic drift must occur in any finite population, we lack data on the consequences of small population size and rarity on genetic diversity in several comparable plant populations and species. Because genetic diversity is the raw material of evolution and of adaption by natural selection, this gap in our knowledge means that it is difficult to evaluate the consequences of rarity on future evolution and persistence of plants in a changing environment.

Penstemon is an interesting genus in which to quantify the genetic consequences of rarity. The genus has approximately 271 different species with a range of geographic distributions and has its center of diversity in the western United States. As is the case for several North American plant genera, *Penstemon* contains many species that are very geographically restricted, occur on particular soils, and have relatively small population sizes. The genus also contains more widespread species, with very large population sizes. We sampled from this variation among the following species: 1) three extremely rare species, including two federally endangered species (*P. haydenii* and *P. penlandii*) and one species that is a candidate for listing (*P. debilis*), 2) two rare species that are narrow endemics (*P. gibbensii* and *P. absarokensis*), 3) two intermediate species with two subspecies of one (*P. laricifolius exifolius*, *P. laricifolius laricifolius*, and *P. eriantherus*), and 4) two widespread species (*P. angustifolius* and *P. grandiflorus*).

Above: Gibbens beardtongue (*Penstemon gibbensii*) is a narrow endemic included in the study. By Kay Thorne. From Fertig et al. 1994.

We quantified genetic variation in populations of these ten different *Penstemon* taxa. For each species, we (and very helpful field botanists from Wyoming and neighboring states) collected leaf material from at least 18 individuals in a single population. For several species we sampled multiple, independent populations. We used the leaf material as a source of DNA and used laboratory techniques to amplify and score six variable regions of the *Penstemon* genome. Our goal was to estimate diversity at each of these six loci, and to compare diversity among species and determine whether plant rarity led to a loss of genetic diversity.

Across the six genetic loci that we screened we found no association between rarity and diversity. Generally, the loci were highly variable within populations, regardless of the breadth of the species' geographic distribution. Evidently local population sizes of these species are sufficiently large or gene exchange among populations is great enough to support substantial genetic diversity within populations and to minimize loss of alleles due to genetic drift. This is true despite the very small geographic ranges of some of the species. This is the first study of this type to apply the same set of molecular markers to a range of species within the same genus. Previous studies have

usually compared pairs of species, with one common and one rare taxon, and have documented every possible pattern of differences between species.

The implications of this work are that, in the absence of other information, genetic diversity should not be a primary concern for the viability of rare species in the genus *Penstemon*. Instead the availability of suitable habitat is likely to be the primary concern. This work does not address the issue of variation at functional or ecologically important loci directly, but the set of six loci should serve as a good proxy for variation in the remainder of the genome. In terms of processes that might affect genetic diversity, factors other than rarity are likely to have greater effects, such as variation in mating system and pollination biology. Many members of the genus are thought to be primarily outcrossing; together with their perennial life history, this might provide an explanation for the maintenance of diversity in rare species in the genus. In other genera, with other life histories and mating systems, it is of course possible that rarity would lead to the erosion of genetic diversity, but this remains to be seen.

(Financial support for this research was provided in part by a WNPS Markow scholarship to Brittany Jenkins in 2008).

Listing Petition Update

Five Wyoming Plant Species to be Considered for Listing by U.S. Fish and Wildlife Service

A status review is being initiated by the U.S. Fish and Wildlife Service (Service) for five Wyoming vascular plant species, on the heels of an 18 August 2009 determination that listing them as threatened or endangered under the Endangered Species Act (ESA) may be warranted (Fed. Reg. 74(158):41649-41662). Comments are due 19 October 2009, concerning the status of the 29 species.

These five Wyoming plant species and their reported distribution information include:
-*Abronia ammophila* (Yellowstone sand verbena) – endemic to Yellowstone Lake
-*Agrostis rossiae* (Ross' bentgrass) – endemic to thermal basins in Yellowstone National Park
-*Astragalus proimanthus* (Precocious milkvetch) – endemic to bluffs of the Henry's Fork River, Sweetwater Co., WY
-*Boechera pusilla* (syn. *Arabis pusilla*; Small rockcress) – endemic to the southern Wind River Range, Fremont Co., WY
-*Penstemon gibbensii* (Gibbens' beardtongue) – endemic to substrates found in Carbon and Sweetwater cos., WY, in Moffatt Co., CO and immediately adjoining Daggett Co., UT

The original petition, filed by WildEarth Guardians on 24 July 2007, included 206 plant and animal species in the eight-state Mountains-Prairie Region (Region 6) of the Service that are ranked G1 or G1G2 by NatureServe and which are not listed or being considered as candidates for listing under the ESA. Status information and supporting references posted by NatureServe as of August 2007 were used in all later reviews by the Service.

The list was pared to 38 species by the Service in a determination published on 5 February 2009 (Fed. Reg. 74(23): 6122-6128) that the petition did not present substantial scientific information that listing of these species may be warranted. Four Wyoming plant species were dropped from further consideration in this set, including Barneby's clover (*Trifolium barnebyi*; see *Castilleja* 28(1)).

The list of 38 was trimmed to 29 species in the 18 August 2009 determination that the petition did not present substantial information that listing may be warranted for nine more species. All determinations are made based on five factors in Section 4(a)(1) of the ESA: 1. The present or threatened destruction, modification, or curtailment of its habitat or range; 2. Overutilization for commercial, recreational, scientific, or educational purposes; 3. Disease or predation; 4. The inadequacy of existing regulatory mechanisms; or 5. Other natural or manmade factors affecting its continued existence. Information can be submitted to the Service, due 19 October 2009, concerning the status of the 29 species. Information in writing should be sent to: Attn: FWS-R6-ES-2008-0131, Division of Policy and Directives Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Dr., Suite 222, Arlington, VA 22203. Information in electronic format should be sent to http://www.regulations.gov. The docket number is: FWS–R6–ES–2008–0131.

Calling All Girl Scout Leaders

Native Plants Patch for Girl Scouts

A new program encourages partnerships between Girl Scouts and local National Garden Clubs, intended for Girl Scouts of all ages.

To earn the Native Plants Patch, girls can learn what plants are native to their area and how to preserve and protect those native plants as well as what invasive species are in their area. Girls will learn about resources and partnerships offered by their local National Garden Clubs, and they may take on native plant projects such as native plant gardens. In addition, girls are encouraged to make contact with native plant societies, horticultural professionals, and county extension services to help in completing project requirements.

To learn more about this program, see: http://www.gardenclub.org/Youth/GirlScoutPatch.aspx , contact Patrice Lineberger, Girl Scout Liaison for the National Garden Clubs, Inc (PALtwinmom@alumni.Clemson.edu) or contact local chapters of Wyoming Federated Garden Clubs, Inc.

Wyoming Native Plant Society
P.O. Box 2500
Laramie, WY 82073

Wyoming Native Plant Society is a non-profit organization established in 1981, dedicated to encouraging the appreciation and conservation of the native flora and plant communities of Wyoming. The Society promotes education and research on native plants of the state through its newsletter, field trips, and annual student scholarship award. Membership is open to individuals, families, or organizations. To join or renew, return this form to:

Wyoming Native Plant Society
P.O. Box 2500, Laramie, WY 82073

Name: _____

Address: _____

_____

Email: _____

___ $7.50 Regular Membership
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($7.50 goes to the Markow Scholarship Fund)

Check one:

_____New member
_____Renewing member

__Renewing members, check here if this is an address change.