# Castilleja

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Above: *Arnica mollis* (Hairy arnica) is one of 14 *Arnica* taxa in Wyoming. The *Arnica* genus has its center of distribution and diversity in the Rocky Mountains along with the *Castilleja* genus(Thorne 1993).

From: Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 3: 534. Courtesy of Kentucky Native Plant Society. Scanned by Omnitek Inc.

In this issue:



## *Where Are You?*
### (Floristically-speaking)

By Bonnie Heidel

Wyoming as a state is intersected by provinces, but they are nonpolitical floristic provinces. The blossoming of western North American floristic studies and of statistical packages in recent decades provided new resources for generating rigorous new interpretations useful for taking one's floristic bearing.

The classic floristic mapping of Cronquist (1982) is reprinted in the *Flora of North America* with discussion (Thorne 1993); and most recently revisited in a multi-faceted analysis by McLaughlin (2007). In the latter treatment, Wyoming has twice as many discrete floristic domains as before: the original Rocky Mountain and Great Plains domains plus the Colorado Plateau and Great Basin domains. The floristic composition of those floristic domains and classification among all on the continent are also greatly elucidated, e.g., uniting the Rocky Mountain Subprovince with subprovinces in boreal and arctic latitudes into a "Cordilleran-Arctic Province."

(*Floristic Maps, cont., p. 8*)

Two new posters with native bee-pollinated crops of the Americas and with native grasses are available while the supply lasts. For further information, see p. 7.

## WNPS News

By-Laws News: Between January-June, 2008, over 2/3 of the current WNPS membership cast their vote to pass three By-Laws amendments, as announced at the 2008 annual meeting. The WNPS membership year and Board position terms will begin with the calendar year starting in 2009. The month of joining/renewing will still be recorded – contact Ann Boelter if you have any questions. Current WNPS By-Laws copies are available on request.


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Contributors to this issue: Nancy Bockino, Luke Bruner, Ann Boelter, Bonnie Heidel, Susan Marsh, Lynn Moore, Steve Norton and Amy Taylor.

Contributions: Announcements, book reviews and ideas are welcome any time of year by mail or email. The next newsletter deadline is 28 Nov.

Treasurer's Report: Balance as of 4 October 2008 - General Fund: $1,600.51; Markow Scholarship Fund: $771.00. Total Funds: $2,371.51.

New Members: Please welcome the following new members to WNPS: Irene Beardsley, Moose; Carol Connors, Teton Village; Astrid Davis, Clearmont; Janet Dombrowski, Laramie; Maria Lisa Eastman, Hyattville; Ami Erickson, Story; and Annie LaGrange, Laramie.

Last Chance: Wyoming Native Plant Society t-shirts and tote bag are still available – purchase one as a gift for yourself, family and friends today. They cost $10 for the large canvas tote bag and $15 for the organic cotton t-shirt (Small and Large sizes only; NOT medium or extra-large). Contact Amy Taylor (ajrtaylor@hotmail.com; Teton Chapter) or Bonnie Heidel (bheidel@uwyo.edu; Laramie area) if you are local; or else mail an order to the WNPS address (please add $1.00 for shipping per item). We are pleased to report that all production expenses were cleared during sales at the 2008 annual meeting.


## Teton Chapter News

*Native Plant Slide Show*
Wednesday, November 12, 2008 @ 7:00 p.m.
WY Game & Fish Office, 420 North Cache St. in Jackson
Chapter members are invited to bring plant or landscape photos taken locally or beyond (bring them on a compact disc). There will also be photos from last summer's plant walks, garden-planting, and annual meeting. ?: Amy at 733-3776

*Holiday Potluck*
Thursday, December 11, 2008 @ 6:00 p.m.
Jean and Pete Jorgensen's home
Come celebrate the solstice season with other native plant lovers. Bring a dish to share and a beverage. Please RSVP to Jean by Tuesday, Dec. 9: jeanj@bresnan.net or 307-733-5625.

## 2008 Annual Meeting Highlights

The 2008 Wyoming Native Plant Society Annual Meeting, hosted July 11-13 by the Teton Chapter, offered three grand days for over 70 participants. Featured speakers were Robert & Jane Dorn. Field events were lead by Nancy Bockino, Meredith Campbell, Katy Duffy, Jean Jorgenson, Susan Marsh, Dave Scott, Kim Springer, and Klara Varga. Amy Taylor coordinated the tours and publicity with heroic help of the Teton Chapter. THANK YOU to everyone who came!

*Additional stunning photographs of plants-and-people from the event, taken by Susan Marsh, were used to update the Wyoming Native Plant Society homepage.*

Upper left: *Wyethia scabra* greeted 2008 attendees in full force, by Charmaine Delmatier
Upper right: Klara Varga and entourage plunge into pothole wetlands, by Susan Marsh
Right: Eva Crane captures the explosion of blooms in photographs, by Susan Marsh

Above: Dedication of the Markow-Murie Herbarium at the Teton Science School;
(back row, left): Lynn Moore, B.E. Nelson, Charmaine Delmatier, David Lester, RoseAnn Lester;
(front row, left): Bonnie Heidel, Klara Varga, Amy Taylor, Joy Handley, and Robert Markow

Below: Darby Klause practices use of her hand lens on flower friends, by Amy Taylor

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Copies of the Phelps Lake Hike Plants, July 12, 2008, are available by emailing WNPS or Curtis Haderlie (curtis@silverstar.com), based on notes taken by him, with additions by Katy Duffy. Scientific names are from Richard Shaw's *Vascular Plants of Grand Teton National Park and Teton County, An Annotated Checklist.*

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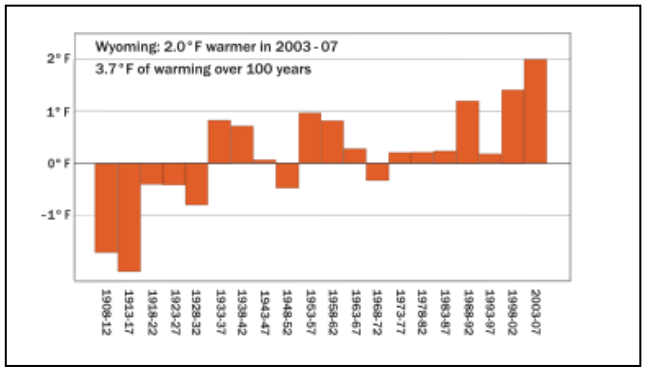
## Wyoming Plants and Climate Change

By Lynn Moore

Did you know that the average global temperature during the last glacial period (Pleistocene) was only 4-5° C different than the global temperature average of today? At first glance this may not seem like much, but in reality, a change in global temperature average of 4-5 degrees can have profound effects on regional climates. Most of us hear the daily weather report and feel our temperature in degrees Fahrenheit. One degree Celsius equals 1.8 degrees Fahrenheit. Most discussions today concerning climate change are presented to us in metric units. If we make the mental conversion, the change in temperature is significant indeed.

Figure 1. Wyoming temperature averages over five years, compared to Wyoming average temperature for 1901-2000. Data from National Oceanic and Atmospheric Administration's climate-division series (Saunders et al. 2008)




In March of 2008, Saunders and others of the Rocky Mountain Climate Organization and the Natural Resources Defense Council published a report on the West's changing climate. Wyoming's average temperature is 2.0° F higher (i.e., 3.6° C) when comparing the average annual temperatures of 2003-2007 to the prior 100-year average (Figure 1). This warming is prevalent throughout the West, and in fact the West is warming faster than the world as a whole. Between 2003 and 2007, eleven western states averaged 1.7° F warmer than the 20th Century average, a 70% greater warming then the global average. Additionally, the Intergovernmental Panel on Climate Change (Field et al. 2007) has identified the interior western United States as one of three areas predicted to experience future heat waves more frequently, more intense, and longer lasting.

So what does this mean for Wyoming's flora? We have already seen direct effects upon lodge pole forests. Bark beetle infestations have accelerated and in the absence of extreme cold winter temperatures paired with warm dry summers, millions of acres of lodge pole have already succumbed or will succumb to beetle kill in the immediate future. These dying forests are consequently susceptible to fire. Wildfires pose the greatest immediate threat to some of Wyoming's unique and interesting flora as a direct result of climate change (Saunders et al. 2008)

Some grasslands may become vulnerable to shrub encroachment. A recent study by Morgan et al. (2007) showed that increased levels of Carbon dioxide ($CO_2$) favored a sub-shrub, fringed sage (*Artemisia frigida*), in a Colorado short grass prairie. A strong growth response of the sage species to $CO_2$ was attributed to its C3 photosynthetic metabolism, and also its increased rooting depth, providing access to deeper water, and giving the small shrub a competitive advantage in the grassland environment. It was suggested the increase in shrub cover in many world grasslands over the last 200 years may have been accelerated by the increase in $CO_2$ following the increase in anthropogenic $CO_2$ emissions.

Wyoming has extensive grasslands mostly east of the continental divide consisting mostly of mixed grass prairies. Grasslands are significant carbon sinks throughout the world. Most of the carbon is held underground within the massive below-ground biomass. Thus the potential for mitigation through conservation of grasslands is an important issue related directly to Wyoming landscapes.

The High Plains Grassland Research Station in Cheyenne is home to an ongoing $CO_2$ enrichment study by the USDA Agricultural Research Station in collaboration with the University of Wyoming. This study is in its third year of a five-year investigation into the affects of increased carbon dioxide and/or increased temperatures upon the structure and function of northern mixed grass prairie. This research site is one of only a handful in the world doing both $CO_2$ enrichment and warming

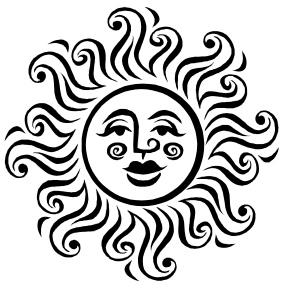
investigations. One preliminary finding suggests that increased $CO_2$ favors Eurasian introduced species. Increased temperatures did not favor the Eurasian introduced species, but a combined treatment of increased $CO_2$ plus increased temperatures showed an increase in the Eurasian introduced species. The take home message suggests that the increase in $CO_2$ may sometimes have more significant consequences than increased temperatures. Follow this link to learn more about this research:

www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=409130&showpars=true&fy=2007

Wyoming has extensive sand dunes. These ecosystems are unique and support interesting plants. Associated with sand dune ecosystems are interdunal wetlands that occur where the water table intersects with the ground (Winter 1986, Wurster et al. 2003). These interdunal wetlands are vulnerable to changes in water table elevation. An important study showed that the interactions between ground water and surface water are indeed connected in sand dune ecosystems. The Great Sand Dunes National Monument located in southern Colorado has experienced a loss of over 100 interdunal wetlands between 1937 and 1995. They found that it was the decrease in recharge, due to climatic change and the incision of an adjacent creek (likely due to flood events), which lowered the water table that was primarily responsible for the loss of wetlands in the sand dune system (Wurster et al. 2003)

Some of Wyoming's most unique and beautiful plants are those that occur at higher elevation. As temperatures continue to rise, plant populations that normally occur at lower elevations will move up in elevation in search of cooler conditions. Upward migration of plant communities provide for resilience and adaptation of most associations, except for the individuals that occur at the top. Plants occurring in alpine areas are limited in migration routes. Unless suitable microhabitat becomes available, these alpine dwellers will be at a competitive disadvantage as lower elevation species move in. Rare alpine species may experience catastrophic declines in population numbers.

Montane wildflowers may also be greatly affected by climate change. David Inouye (2008) recently published a study that documented increasingly early spring melts that triggered an earlier growing season, accompanied by higher frequency of frost. This initiation of the growing season stimulated an earlier flowering response, leaving the new buds vulnerable to frost kill. The three long-lived perennials studied in Rocky Mountain National Park in northern Colorado had drastic reductions in seed production under these conditions, a subtle change that may manifest itself decades later.



**Know Your Climate**

**State Climatologist**
www.wrds.uwyo.edu/sco/data/sco_monitor.html; includes the following statewide:
-Precipitation Update Maps
-Precipitation Charts and Data
-Temperature Charts and Data

**Western Regional Climate Center/ Natl. Oceanic and Atmospheric Admin.**
www.wrcc.dri.edu/summary/climsmwy.html ; includes the following for 174 weather monitoring locales in Wyoming:
-Monthly precipitation totals
-Mean monthly temperatures

The internet and media are flooded with information about climate change scenarios and a long list of do's and don'ts to help us reduce our carbon emissions. The Society for Range Management recently held a symposium in Cheyenne on climate change and western rangelands. The symposium provided information to land managers and ranchers about the possible effects of climate change upon rangelands. The discussion following the presentations focused upon including all participants in developing

solutions for better management. The seriousness of the climate issue requires parties to come together and work towards solutions. Hope lies in the ability of opposing views to find common ground and take steps in an incremental non-threatening way to find creative solutions for this serious problem.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Inouye, D. W. 2008. Effects of climate change on phenology, frost damage, and floral abundance of montane wildflowers. Ecology 89:353-362.

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Wurster, F. C., D. J. Cooper, and W. Sanford, E. 2003. Stream/aquifer interactions at Great Sand Dunes National Monument, Colorado: influences on interdunal wetland disappearance. Journal of Hydrology 274:77-100.


## Richard Shaw (1924-2008)

Richard (Dick) Joshua Shaw, 84, passed away April 21, 2008, in Logan, Utah. He was a professor of botany at Utah State University, author of "Plants of Yellowstone and Grand Teton National Parks", and Grand Teton National Park naturalist for over 30 years who conducted botany training for summer staff for at least another 15 years.

Seasonal and permanent naturalist staff of Grand Teton National Park looked forward to Dick's presentations each year as the highlight of training, drawing from a vast store of knowledge infused with insight and conservation reminders. Dick also gave presentations to the Teton Chapter of the Wyoming Native Plant Society in support of the Chapter and Society. Donations in his memory may be made to the Richard Shaw Memorial Fund, Grand Teton Association at PO Box 170, Moose, Wyo., 83012.

Above: Whitebark pine seedling, by Luke Bruner
(The poem below was handed out at the 2008 meeting)

**Whitebark Pine**

By Nancy Bockino & Steven Norton

*Whitebark grow in places high*
*With cones of purple mountain majesty*
*With needles grouped in clusters five*
*This is a keystone plant, you see.*

*On Whitebark so much else depends*
*Like water held for western rivers*
*Or food for Clark's nutcracker and*
*Clark's plants the tree, returns the favor.*

*The roof of Rocky Mountains grown*
*In climates harsh and comforts spare,*
*A broom-like crown is upward flown*
*With fatty seeds that feed the Grizzly bear.*

*Old, tenacious, grizzled, mature*
*Patient in its alpine zone*
*And yet the Whitebark must endure*
*Anxious threats in its mountain home.*

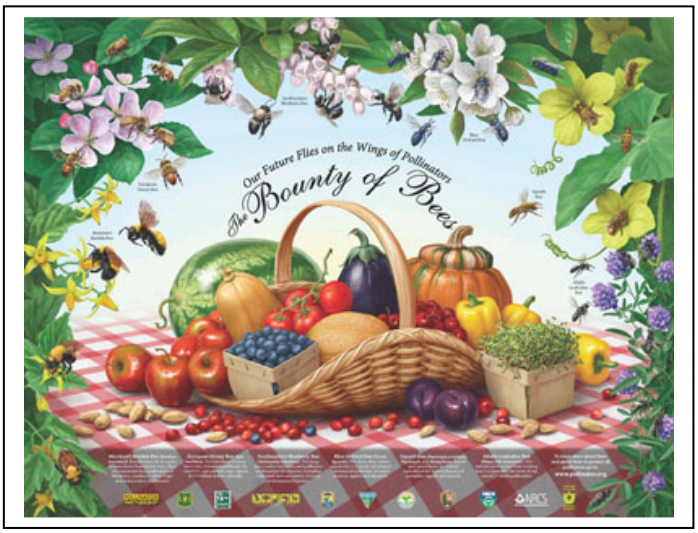
*Mountain Beetle, native born*
*So long tolerated here*
*Has with the climate numerous grown*
*And threatens Whitebark these warm years.*

*And Blister rust, invasive scourge*
*With cankers indicated thus*
*Chewing, swelling, pitch tubes, flags*
*Has weakened trees with quite a fuss*

*Not to despair! These hardy trees*
*Resilient with seed-banked earth*
*Shall persevere in legacy stands*
*Of trees of proud or humble girth*

*Our human days are blinking-short but time*
*Is long and so the lives of trees;*
*The forest and its citizens*
*Will stand long after you and me.*

*So who's to say that "such is good"*
*And "such is bad" we cannot say*
*All we can do is walk the woods*
*And do our best on this fine day*




**Thank a Bee**
**for Native Crops of the Americas**

A striking new poster is available that features agricultural crops native to the Americas and the native bees that pollinate them. As you carve your Halloween pumpkin or can your winter supply of apple sauce and tomato sauce, thank a bee.

Even in Wyoming,…"*that land of cool, dry summers and frigid winters"* there are over 600 species of wild, native bees among 3000-5000 in the United States", according to Vince Tepedino (1997). A recent international bee taxonomy blitz suggests that there are over 19,200 bees worldwide, more species than birds and mammals combined (American Museum of Natural History information posted at: http://www.amnh.org/science/papers/bee_080611.php).

The bee poster was published in a Pollinator Partnership among federal agencies, Plant Conservation Alliance, United States Botanic Garden, Xerces Society, and others. Wyoming Native Plant Society secured a set to distribute this year through the Bureau of Land Management (BLM), and copies are available free at the University of Wyoming – Department of Botany, the BLM-State Office in Cheyenne and the BLM-Rawlins Field Office, or else can be ordered by WNPS members who send in $3.00 per mailing to cover postage and a mailing tube, to the WNPS address: P.O. Box 2500, Laramie, WY 82073.

References
Tepedino, V. 1997. Wild bees and floral jewels. Wings 20(1): 8-11. Published by the Xerces Society.

**Grasses Galore**

Fourteen native Wyoming grasses and an appointed array of other native grasses from across the country are featured in a handsome new poster "Celebrating Our Native Grasses." The design and dimensions mirror the "Celebrating Wildflowers" poster released two years ago, created by the same artist.


The 14 species of Wyoming grasses are a drop in the bucket among the 275 grass species known in the state (Dorn 2001), but a visual reminder of their importance and diversity. The grass poster was published in a partnership among federal agencies and the Plant Conservation Alliance. Wyoming Native Plant Society secured a set to distribute this year through the U.S. Forest Service, and copies are available free at the University of Wyoming – Department of Botany, the Medicine Bow National Forest Office in Laramie, or else can be ordered by WNPS members who send in $3.00 per mailing to cover postage and a mailing tube, to the WNPS address: P.O. Box 2500, Laramie, WY 82073.

*Note: Copies of the original wildflower poster are still available while the supply lasts.*

Reference
Dorn, R.D. 2001, 3rd ed. Mountain West Publishing, Cheyenne, WY.

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(*Floristic Maps, continued from p. 1*)

The actual mapping is the least-refined aspect of phytogeography work to date. The final map in McNaughton (2007; Map 50) does not include state lines, and the remarks on Wyoming in this article are based on interpolation. But the floristic analysis is based on *bona fide* datasets such as Fertig (1992) and Marriott (1982) along with 243 others across the continent. It closes with acknowledgements to "…all those individuals who over the years have spent many long days in the field and herbarium, often under difficult conditions, collecting and identifying plants for floristic inventories. Their work is of lasting value."

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**The 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
___ $15.00 Scholarship Supporting Member
($7.50 goes to the Markow Scholarship Fund)

Check one:

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