CLIMAS Update

News from the Climate Assessment for the Southwest Project

Integrating science, policy, and community

The University of Arizona

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Climate variability affects decisions made by ranchers, home buyers

Learning more about how ranchers, homebuyers, and other stakeholders make resource decisions helps two CLIMAS researchers discover what types of climate services and information might prove useful in these endeavors.

Bonnie Colby and Dan Osgood, faculty members in the University of Arizona's Department of Agriculture and Resource Economics and members of the CLIMAS team, undertake their investigations on decision making with the additional goals of improving the design of public policies and developing incentives to encourage the better use of limited resources.

Two of their ongoing research projects explore how ranchers and home-buyers make tradeoffs among competing resource uses and values, and how climate affects these decisions. Specifically, Osgood's work provides an economic framework to understand how climate variability information can influence ranching decisions such as stocking and culling rates. Colby's research considers the role of climate variability in home values as generated by proximity to a riparian corridor such as a river or wash.

Ranching risk

Precipitation is crucial to successful ranching in the arid Southwest. Variability in precipitation affects the quantity and quality of forage, and whether watering tanks fill up enough to sustain the desired number of animals. A lack of precipitation may require ranchers to reduce their herd size, known as culling.

To consider how climate influences ranching decisions, Osgood and his students have developed a model that incorporates economic theory and climate variability information to influence rangeland management decisions. Ranchers, cattle, and precipitation are modeled as interactive resources that jointly determine the size of the herd given varying climate conditions, particularly as associated with El Niño and La Niña.

During El Niño years, the Southwest tends to benefit from higher than usual amounts of winter precipitation, whereas the opposite is true for La Niña years. The fluctuations from El Niño to La Niña and back, known as the El Niño/Southern Oscillation (ENSO), occur every two to seven years.

Oceanographers measure changes in El Niño by comparing tropical Pacific sea surface temperatures, while atmospheric scientists detect changes in the Southern Oscillation by monitoring variations in atmospheric pressure and related wind direction at sea level. Meanwhile, southwestern ranchers tend to notice the effects of these fluctuations by their associated, but not perfectly predictable, changes in vegetation abundance and nutritional value.

In a pilot project being developed by CLIMAS graduate research assistant Ryan Sohm, an economic model is applied to consider ranching decisions on the San Carlos Apache Reservation in the Superstition Mountains near Globe, Arizona. Because ranchers do not provide supplemental feed, cattle on the reservation depend upon forage as their source of sustenance. This serves as a natural experiment on how rainfall influences cattle weight.

With Osgood's guidance, Sohm collected data on cattle characteristics for a registered Hereford herd owned and maintained by the San Carlos Apache Tribe (Figure 1).

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Announcements

- The future of agricultural water use in Arizona will be the topic of a one-day conference on April 28 in Casa Grande. See http://ag.arizona.edu/AREC/dept/agwaterforum.html for more information.
- The American Geophysical Union is hosting a joint assembly with several other earth science groups in Montreal from May 17–21, and the Western Pacific Geophysics meeting in Honolulu from August 16–20. See http://www.agu.org/meetings/ for more information.
- The Arizona Hydrological Society's annual symposium will be held in Tucson from September 15–18. See http://www.azhydrosoc.org/Symposium.html.
- The Biodiversity and Management of Madrean Archipelago II conference will be held in Tucson from May 11–15. See http://www.madreanconference.com.

CLIMAS Mission

CLIMAS was established to assess the impacts of climate variability and longer-term climate change on human and natural systems in the Southwest. Our mission is to improve the ability of the region to respond sufficiently and appropriately to climatic events and climate changes.

What We've Been Up To…

Drought

CLIMAS Project Manager Gregg Garfin, also co-chair of the Arizona Governor's Drought Task Force drought monitoring committee, has been participating in a Western Governors' Association initiative to create a National Integrated Drought Information System. The system is a multi-agency effort associated with the National Drought Preparedness Act, a bill introduced to Congress by senators and congress members from Montana, New Mexico, and Florida. The proposed system is designed to help the nation prepare for and respond to drought—the most costly of all natural disasters in the United States. For more on these drought initiatives by the Western Governors' Association, see http://www.westgov.org.

CLIMAS drought researchers Jenna McPhee, Joe Abraham, Sean Downey, and Derek Eysenbach, all UA graduate students, recently provided preliminary research results to the Governor's Drought Task Force. McPhee's research, performed under the guidance of CLIMAS investigator Andrew Comrie, documents Arizona drought climatology. Abraham is studying drought vulnerability, while Downey is examining mitigation and adaptation to drought. Eysenbach's research will help the GDTF monitoring committee determine empirical triggers for drought response. Some of their research is supported by State of Arizona funding, through the Technology and Research Initiative.

Climate Variability and Change

CLIMAS principal investigator Jonathan Overpeck and researcher Kathy Jacobs testified before an Arizona Senate Natural Resources and Transportation Committee meeting on February 10. Their testimony helped convince the group to establish a study committee on climate change that would report back to the legislature with recommended actions to limit impacts. As of publication of this newsletter, the full Senate and the Arizona House of Representatives had yet to consider the bill, known as SB1227.

Barbara Morehouse gave a presentation in October at a Human Dimensions of Arctic Change (HARC) workshop in Seattle about conducting human dimensions research. As an advisory committee member for the HARC project, she also participated in the Study of Environmental Arctic Change meeting that immediately followed the workshop.

Morehouse and CLIMAS researchers Tim Finan and Kathy Jacobs participated in a November NOAA-Office of Global Programs sponsored workshop in Washington, D.C. The workshop explored the lessons learned from integrated assessment of vulnerability and adaptation to climate variability for adaptation to climate change.

Long-time CLIMAS investigator Diana Liverman is now directing the Environmental Change Institute at the University of Oxford. The institute hosts the U.K. Climate Impacts Programme (UKCIP), which seeks to provide climate information to stakeholders in the United Kingdom. Liverman, still a CLIMAS team member, was recently invited to a briefing for the Norwegian government in Oslo, where she described and compared the U.K. and U.S. approaches to regional climate assessment.

Water Resources and Hydrology

Barbara Morehouse, Holly Hartmann and Thomas Pagano contributed to "Assessing the impact of climate variability and change on regional water resources: the implications for stakeholders," published in late 2003 as a chapter in the American Geophysical Union Water Resources Monograph 16. The monograph also includes a chapter by Robert Varady and Morehouse on "Moving borders from the periphery to the center: river basins, political boundaries, and water management policy." Morehouse also contributed information about CLIMAS to a chapter on the Regional Integrated Sciences and Assessments, known as RISAs. CLIMAS is one of six RISAs supported by the National Oceanic and Atmospheric Administration (NOAA) to develop higher quality and more detailed climate assessments at the regional level.

CLIMAS Principal Investigator Bonnie Colby will co-chair a conference on New Mexico water supply vulnerability and planning to be held in Albuquerque in May. In March, she gave a presentation to the National Oceanic and Atmospheric Administration in Boulder, Colorado, on enhancing water supply variability for water providers.

University of Arizona graduate student Noah Molotch is the lead author of a publication prepared with CLIMAS researcher Roger Bales and two other authors on snowpack research that was partially supported by CLIMAS. The article, "Estimating the spatial distribution of snow water equivalent in an alpine basin using binary regression tree models: the impact of digital elevation data and independent variable selection, "will appear in the next issue of *Hydrological Processes* and is available online at http://www3.interscience.wiley.com/cgi-bin/jhome/4125.

CLIMAS research associate Melanie Lenart attended meetings in Sonora, Mexico, and in Arizona near the U.S.-Mexican border as part of a binational San Pedro watershed collaboration spearheaded by the Udall Center. In December, Lenart joined the Technology and Information Team, a subcommittee of about two dozen people from universities, agencies, and environmental organizations from both sides of the border. Graduate research assistants Carlos Rojas Salazar and Samual Sanford also are

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Submissions and Subscription Information

CLIMAS Update is published quarterly and welcomes the submission of items of interest. The editorial staff reserves the right to select and edit copy submitted for publication. All material in the newsletter may be reproduced, provided CLIMAS is acknowledged as the source. The newsletter is provided through the support of the National Oceanic and Atmospheric Administration (NOAA).

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Send to: Melanie Lenart at mlenart@email.arizona.edu
CLIMAS, Institute for the Study of Planet Earth,
The University of Arizona, PO Box 210156, Tucson, AZ 85721
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Economic Decisions *(continued from page 1)*

He included in the model an ENSO index based on modern instrumental records, as well as long-term records drawn from the 1,000-year tree-ring reconstruction of cool season precipitation for Arizona climate division 4.

These sources provide the model with the range of climate conditions that researchers and ranchers consider for rangeland and herd management.

Preliminary results suggest that an improvement in the ability to predict seasonal ENSO state would lead ranchers to make more confident stocking decisions in response to dry years (associated with La Niña) than to wet years. Forecasts may decrease ranch vulnerability and reduce environmental pressure on rangeland. Sohm plans to finish the modeling work this summer.

The project also included an outreach component. Researchers provided a series of climate risk-management classes to livestock managers on private lands and reservations as extension education courses. They used a mobile computer laboratory to present and discuss climate processes involving ENSO and other fluctuations related to climate in the past and present, and regional outlooks that could help predict future climate.

Ranchers worked through a "Planning for Profitability" exercise that explored how climate affects management decisions such as restocking, culling, and purchasing supplemental feed that in turn affects a ranch's financial viability. Ranchers also participated in the Right Risk computer exercise, addressing risk management for ranches. Typical decisions include the timing and sale of cattle and advance purchase of supplemental feed. The exercise includes several sources of uncertainty, ranging from prices to climate variability. Profits are calculated and ranchers compared their initial profits with the outcomes of others.

These workshops provided ranchers with climate-risk information and the tools to apply the information and to relate it to their existing knowledge base. These sessions have been well received. In a follow-up evaluation, 86 percent of respondents reported that the sessions had changed the way that they made ranch management decisions.

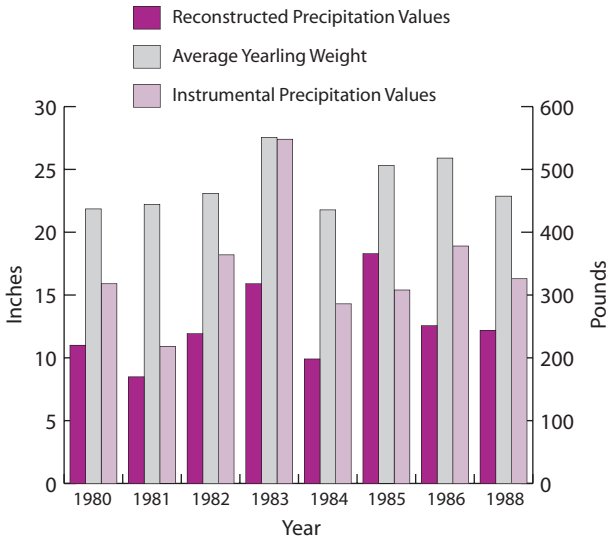

Figure 1. Data collected by graduate researcher Ryan Sohm on a registered Hereford herd owned and maintained by the San Carlos Apache Reservation illustrates how calves can grow fatter during years of higher precipitation. This is perhaps most evident when considering a flush year such as 1983.

Value of riparian corridors

Urban residents may seem to be more buffered than rural ranchers from the effects of climate variability on precipitation and water supplies. Nevertheless, there are important economic linkages between climate and economic values for urban residents. In another CLIMAS project led by Bonnie Colby, researchers measured the economic value of water-dependent riparian resources in Tucson using the hedonic valuation method.

The hedonic valuation method statistically links property values to a set of attributes that influence property values—for example, the number of bathrooms in a residence, total living area in square footage, inclusion in a preferred school district, and proximity to an amenity such as a river or a forest. By controlling for other factors that influence home values, the method identifies the approximate value homebuyers place on environmental amenities. This technique allows economists to place a monetary value on natural resources as they relate to real estate.

The team's preliminary research indicates that homebuyers were willing to pay up to a 6 percent premium for single-family residences located within a tenth of a mile of large riparian corridors.

The research team, which includes Colby, UA graduate student Rosalind Bark and faculty and students from Arizona State University, is now analyzing not only how proximity to a riparian zone impacts home prices, but also whether prices are statistically linked to the biological value of the riparian habitat. Fieldwork completed in their study area in late spring/early summer 2003 will allow comparisons among different qualities of riparian habitat, ranging from areas that are unusually lush for the Southwest to concrete-lined washes with no associated vegetation.

The statistical relationship between riparian habitat quality and economic values will be useful for understanding how climate variability affects this sector, as well as for considering policy issues such as limits on groundwater pumping near riparian areas and habitat conservation policies.

In addition to quantifying the link between habitat and economic values, the researchers are examining whether they can use satellite data to estimate riparian habitat quality. If remote-sensing indices such as the Normalized Difference Vegetation Index and the Soil-Adjusted Vegetation Index can approximate vegetation density or species richness, then future studies on climate variability, riparian habitat and economic values will require less labor-intensive fieldwork.

What We've Been Up To *(continued from page 2)*

assisting in the project, which includes a component on how climate variability affects water resources and the San Pedro River, and the stakeholders who live in the border region.

Roger Bales gave two presentations on CLIMAS activities in November in California, where he continues to be affiliated with CLIMAS in his new role as a founding faculty member of the University of California-Merced. Bales gave a presentation at Lawrence Berkeley National Laboratory, which is involved in a regional climate change assessment for California. Bales also gave a talk at Lawrence Livermore National Laboratory to foster collaborations between CLIMAS activities and the newly formed UC Institute for Research on Climate Change and its Societal Impacts (IRCCSI). In addition, he and UA graduate student Kevin Dressler have been meeting with a number of water decision makers in California's central valley to explore how new climate and hydrologic information could impact their decision making.

A temporary farewell

We bid a temporary farewell to Barbara Morehouse, deputy director of the Institute for the Study of Planet Earth and former CLIMAS project manager. She leaves for a three-month Fulbright fellowship at the University of the Aegean in Mytilene, Lesvos, Greece. She will be working with members of the Geography department on construction of decision support tools for fire management.

Welcome New Faces!

CLIMAS welcomes principal investigator Margaret Wilder, research associate Melanie Lenart, and assistant research scientist David McGinnis.

Wilder, an assistant professor with the Center for Latin American Studies and former University of Arizona associate dean, joins the CLIMAS team as a specialist in border issues. She has an interdisciplinary background in geography, political science and Latin American studies. Wilder's research interests include water, agriculture, environment, and development, with a particular regional focus on Mexico and the U.S.-Mexico border. One of her many projects focuses on the use of climate science information in Sonora, Mexico, and the integration of stakeholders in the decision-making processes involving the decentralization of water institutions in Mexico.

Lenart, who worked for more than a decade as a newspaper reporter and science writer before graduating from the UA in 2003 with a Ph.D. in renewable natural resources and global change, works in the core CLIMAS office on a number of projects integrating climate science and outreach. She writes for the Southwest Climate Outlook, CLIMAS' monthly newsletter and climate packet for stakeholders, and edits *CLIMAS Update*. Lenart is also helping to prepare papers for peer-reviewed publications on earlier CLIMAS outreach projects, including the END InSight Initiative. She is preparing to start a research project involving northern Arizona forests, which have been responding to climate variability and drought with pest outbreaks and catastrophic fires.

McGinnis, a geographer and the founder and director of the Western Institute for Sustainable Rural Environments at Idaho State University, brings strong skills in both research and outreach to his CLIMAS post. His 1994 Ph.D. dissertation at Pennsylvania State University won the prestigious Warren G. Nystrom award from the Association of American Geographers. It also set the stage for an illustrious research career on climate change and snowpack, an important source of water in the West. He has served as investigator or on more than $2.2 million in research projects since 1994. He is currently principle investigator on a major National Science Foundation biocomplexity grant investigating interactions between natural and human systems, in this case among wildlife (elk and wolf), vegetation, climate, and society in Yellowstone National Park. In addition, his earlier background as a secondary school teacher for some 15 years helps guide him in making climate information relevant at many levels of society.

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Institute for the Study of Planet Earth
The University of Arizona
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