#2290 ✓

STUDENT INTERSITE COMPARISON

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Streamflow Hydrology at Five LTER Sites

Hydrology is a critical component of all ecosystems. Water moving through hillslopes and stream channels links terrestrial and aquatic ecosystems, drives nutrient cycling processes, and governs geomorphic and fluvial disturbance processes. Streamflow monitoring is a component of research at 11 of the 18 LTER research sites, and four sites have climate and streamflow records spanning more than 30 years. This article describes preliminary results—supported by a 1995 LTER Network Office graduate student travel award—from an ongoing comparative study of streamflow hydrology at four LTER sites: H.J. Andrews (AND), Coweeta (CWT), Hubbard Brook (HBR), and Luquillo (LUQ), as well as Caspar Creek (CC), a U.S. Forest Service Research Forest in California's Coast Range (see table at right). These sites were selected because they have contrasting hydrologic characteristics and well-documented long-term streamflow and climate records. It is hoped that approaches developed in this study will be extended to examine other sites' long-term streamflow records.

Figure A. Cumulative Annual Precipitation

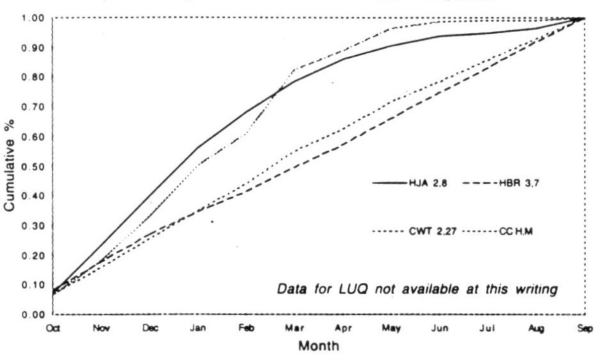
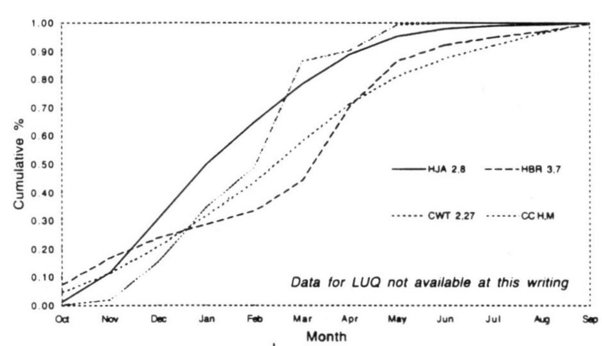


Figure B. Cumulative Annual Runoff



Above: Figure A. Cumulative annual precipitation *of AND, HBR, CWT, and CC. **Figure B.** Cumulative annual runoff of AND, HBR, CWT, and CC. Percentages represent averaged percentages of runoff produced at two control watersheds at each site.*

Streamflow patterns from undisturbed watersheds differ markedly among these five sites, reflecting differences in climate and vegetation (see table and figures). At CWT, HBR, and LUQ, precipitation is evenly distributed throughout the year, whereas precipitation at AND and CC occurs predominantly in winter (Figure A) (McKee and Bierlmaier 1987, Swift 1987, Ziemer and Albright 1987, Federer et al. 1990). This distinction produces relatively constant monthly streamflows at CWT and HBR, but much higher winter than summer streamflows at AND and CC (Figure B). AND and HBR also have a seasonal snowpack, whereas CWT only occasionally receives snow, and LUQ and CC lack snow. Melt of the seasonal snowpack contributes to prolonged high spring streamflows at AND and a rapid rise in spring streamflows at HBR compared to CWT and CC (Figure B). Forest canopies at CWT and HBR are dominated by deciduous broadleaf vegetation which transpires throughout the summer months, whereas forest canopies at AND and CC have evergreen coniferous vegetation which may transpire little during dry summer months. Potential evapotranspiration greatly exceeds precipitation in the summer at AND and CC (Bierlmaier and McKee 1989, Swift et al. 1975), whereas summer soil moisture deficits are smaller at CWT and HBR (Federer 1982).

The availability of these high-quality long-term streamflow data provide the opportunity to address a number of process-based hypotheses relating hydrology to ecology at long-term ecological research sites. For example, post-disturbance vegetation succession may differ among sites and produce contrasting post-disturbance streamflow patterns. Life history strategies of aquatic organisms and stream community structure may be related to streamflow variability at annual, seasonal, storm, or diurnal time scales. Nutrient fluxes may differ among sites according to the relative importance of rare, large precipitation and streamflow events. A two-year collaborative project is currently under way to further compare streamflow data among these five sites.

◆ *Reed Perkins, H.J. Andrews*

Climate and Vegetation Characteristics of Five Long-Term Streamflow Monitoring Sites

Site	*Location*	*Climate*	*Vegetation*
H.J. Andrews	Oregon	winter rain/snow, summer drought	old-growth Douglas-fir forests
Coweeta	North Carolina	winter rain, summer rain	oak hickory forests
Hubbard Brook	New Hampshire	winter snow, summer rain	northern hardwood forests
Caspar Creek	California	winter rain, summer drought	second-growth Douglas-fir, coastal redwood forests
Luquillo	Puerto Rico	`winter rain, summer rain	sub-tropical and lower montane forests

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STUDENT INTERSITE COMPARISONS

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Fall 1995 Travel Awards

In response to a 1994 request by the LTER Graduate Student Committee, the LTER Executive Committee approved the use of LTER Network Office funds to support student travel to LTER sites for intersite comparison work. Fall 1995 student proposals were reviewed by the Executive Committee and awarded February 1, 1996.

Cross-Site Comparisons of Two Important C_4 Perennial Grasses in North American Grasslands

TAMERA J. MINNICK
Ph.D. candidate, Colorado State University (Ecology)

Bouteloua gracilis and *Bouteloua eriopoda* are two important perennial grasses in North American grassland ecosystems. Both are C_4 perennial bunchgrasses that tolerate high temperature and low moisture regimes, yet their geographic distributions differ remarkably: *Bouteloua gracilis* is distributed throughout the central grasslands of Canada, the United States and Mexico and *B. eriopoda* is limited to the U.S. Southwest and Mexico. The LTER Network is the ideal system for comparing these species, since *B. gracilis* dominates the Central Plains Experimental Range (CPR), *B. eriopoda* dominates the remnant grassland portion of the Jornada, and both are found in abundance at the Sevilleta (SEV). The general objective of my doctoral research is to investigate effects of disturbance, environmental constraints, and competition on the distribution and abundance of these two important North American species. I will combine field experiments with simulation modeling to address site- and regional-level questions across an environmental gradient that includes these three LTER sites. I want to know how these patterns can explain the current and predict the future geographic distributions and abundances of the two species. I am also examining experimentally the role of competition at CPR and SEV to determine the influences of inter- and intraspecific competition, the physical environment and the interactions of these on the distributions and abundances of *B. eripoda* and *B. gracilis.* By using a variety of approaches at different spatial and temporal scales, my goal is to determine relative effects of disturbance, environmental constraints, and competition on the distribution and abundances of these two important North American perennial grasses.

Local Adaptation of Hymenolepis citelli *in Ground Squirrels*

L. DWIGHT FLOYD
Ph.D. candidate, Colorado State University (Zoology)

Ground squirrels (*Spermophilus spp.*) cover a wide range in western North America from the Arctic to northern Mexico. Across their range, the ground squirrels may vary in a number of ways, but particularly with respect to hibernation regimes. These differences may occur between species but also within species along latitudinal and altitudinal gradients. Despite these differences in life history, *Hymenolepis citelli* (a tapeworm) is found in all species of ground squirrel. The purpose of this study is to determine how H. citelli reacts to these differences in their ground squirrel hosts and how the ground squirrels react to different parasite populations. These differences should help to determine the extent of local adaptation in parasite and host populations. Ground squirrels of different species and different ranges will be captured and cross-infected with parasites of complementary geographical regions or species. Hibernation regimes may then be controlled by placing some animals in cold rooms. Host and parasite fitness will then be compared between experimental groups. ◆

NETWORK NEWS

Newsletter of the U.S. Long-Term Ecological Research Network Spring/Summer 1996, Issue 19

AN LTER PROFILE

Fifteen years old, the LTER model is showing its worth

Research that is long-term, large-scale, systemwide, across trophic levels, interdisciplinary, experimental, and synthetic is common to all LTER sites. LTER scientists engage in both prescribed research common to all sites and evolving, creative research unique to each site. Now that the LTER way of doing research is some 15 years mature, the LTER Coordinating Committee has taken a look at the numbers (see table below), and the numbers show that the LTER Program has met its promise.

Building a Research Community

The research scope at LTER sites necessitates a team approach with diverse scientific expertise. On average, the sites require 15 investigators from five to six different institutions to accomplish their research programs. Including annual supplements, the National Science Foundation awards LTER sites just under $600,000 per year. Of the 15 investigators funded, those who have earmarked portions of the site's annual budget (a fraction at each site) receive, on average, only $27,000 per year. These resources are used to cover summer stipend support for PIs, direct support of graduate students, or to meet specific field expenses not common to the site's research community.

Efficient Use of Resources

The institutional cost of doing research at LTER sites is modest. The effective overhead rate (the institutional rate adjusted for a university's matching contribution) averages, across all LTER sites, less than 25% of the NSF award. The sites spend 21% of their NSF awards to build research infrastructure to support current and future research. Each year, LTER sites become better equipped and better able to support the LTER research mission. Because they all run field stations, much of the research dollar—56% on average—is spent in the local community surrounding the field station.

Leveraging Science

LTER sites leverage resources to greatly expand their research enterprise. Across the Network, NSF awards, the large pool of scientific expertise, and the research infrastructure provide a powerful base from which to compete for additional research resources, leveraging an average 2.1 dollars from each NSF grant dollar. The scientific expertise is also leveraged in that an LTER site attracts, on average, 25 other research scientists to work at the site and collaborate with LTER scientists—in effect, each LTER scientist attracts two other scientists to the site. This leveraging of dollars, scientific expertise, and field station infrastructure directly supports and enhances education by attracting an average of 17 graduate and 15 undergraduate students each year, meaning that an LTER site supports on average a total of 73 research scientists. As a whole, the LTER community has grown to include nearly 1,400 scientists.

◆ *Bruce P. Hayden, LTER Executive Committee*

INSIDE:

HOW LTER SITES WORK

	AND	ARC	BNZ	CDR	CPR	CWT	HBR	HFR	JRN	KBS	KNZ	LUQ	MCM	NTL	NWT	PAL	SEV	VCR	AVG	per 100K
# of PIs at site	20	16	12	7	13	27	11	10	11	22	8	27	8	15	15	10	14	24	15	2.6
Avg $/PI (x1000)	38	16.6	27	48	10	22	40	56	22	10	40	10	60	19	12	38	10	12	27	4.9
# Institutions	4	9	4	4	3	7	6	6	7	3	9	15	8	4	4	5	4	8	6.1	
Effec. overhead (%)	31	46	37	0	15	26	28	8.5	24	0	27	10	20	11	26	26	8	21	20	20
% $ Infrastructure	30	40	12	30	51	23	10	11	10	20	10	33	8	15	30	23	28	25	21	21.2
% $ Local economy	100	16	80	88	100	25	35	70	70	70	100	8	0	25	100	0	100	30	56	56.3
# Grad students	45	20	19	23	13	19	9	12	10	21	11	19	12	20	12	12	15	40	17	3
# Undergrads	18	8	4	24	15	21	15	25	4	19	13	20	5	15	10	8	27	19	15	2.7
Other $/LTER $	4	2	2	0.7	1.8	2	2.5	3.8	1.1	2	3.2	2.3	0.5	2	2	0.3	3.9	2.1	2.1	212.6
Non-PI scientists	40	8	10	16	34	20	15	57	15	15	30	18	25	15	20	14	88	22	25	4.5

Notes: (1) The table provides averages across all 18 LTER sites as a measure of the attributes of an average site. (2) The table provides a normalized measure of site attributes. This normalization is on a per-$100,000 basis, so that comparisons between LTER and other kinds of science support can be made. (3) McMurdo Dry Valleys and Palmer Station in Antarctica and the Alaskan Tundra site have field stations with finite capacities and limits on the degree to which leveraging of award funds is possible.

Site abbreviations: AND=H.J. Andrews, ARC=Arctic Tundra, BNZ=Bonanza Creek, CDR=Cedar Creek, CPR=Central Plains, CWT=Coweeta, HBR=Hubbard Brook, HFR=Harvard Forest, JRN=Jornada, KBS=Kellogg, KNZ=Konza Prairie, LUQ=Luquillo, MCM=McMurdo, NTL=North Temperate Lakes, NWT=Niwot Ridge, PAL=Palmer Station, SEV=Sevilleta, VCR=Virginia Coast

Next U.S. LTER Coordinating Committee Meeting:

October 3-6, 1996 Harvard Forest

LTER

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CALENDAR

May 1996 ◆ November 1996

MAY 1-3 LTER-NASA MODLAND Workshop. H.J. Andrews Forest (Warren Cohen, H.J. Andrews LTER, 503/750-7322, *wCohen@LTERnet.edu*).

MAY 1 NSF Program Deadline: Biological Instrumentation & Resources. Multi-User Biological Equipment and Instrumentation Resources, Instrument Development for Biological Research (Karl A. Koehler, 703/306-1472 *kkoehler@nsf.gov)*

MAY 7 NSF-EPA Program Deadline. Joint Competition in Environmental Research (NSF: James Edwards, BIO, 703/306-1400, *jledward@nsf.gov*; EPA: Robert Menzer, 202/260-5779, *nabzer.robert@dpamail.epa.gov)*

MAY 30 - JUN 1 ILTER Connectivity Station. Puerto Rico (Rudolf Nottrott, LTER Network Office, 206/543-8492, *rNottrott@LTERnet.edu)*

JUN 1 NSF Program Deadline: Biological Instrumentation & Resources. Instrument Development for Biological Research (Karl A. Koehler, 703/306-1472 *kkoehler@nsf.gov)*

JUN 1 NSF Proposal Deadline: Education & Human Resources. Informal Science Education. (Hyman Field, 703/306-1616, *hfield@nsf.gov)*

JUN 15 NSF Target Date: Biological Sciences. Division of Environmental Biology, LTREB (Scott Collins, 703/306-1483, *sCollins@nsf.gov*). Systematic & Population Biology (James Rodman, 703/306-1481, *jrodman@nsf.gov;* B. Jane Harrington, 703/306-1481, *bharring@nsf.gov.* Ecological Studies (Michael Auerbach, 703/306-1479, *mauerbac@nsf.gov*; Taber D. Allison, 703/306-1479, *tallison@nsf.gov)*

JUL 15 NSF Program Deadline: Biological Sciences. Division of Environmental Biology, Long-Term Projects (Scott Collins, 703/306-1483, *sCollins@nsf.gov*). Research Collections in Systematics and Ecology (Scott Collins, 703/306-1483, *sCollins@nsf.gov)*

AUG 15 NSF Preliminary Proposal Deadline: Education & Human Resources. Informal Science Education. (Hyman Field, 703/306-1616, *hfield@nsf.gov)*

SEP 15 NSF Program Deadline: Biological Sciences. REU site proposals (James H. Brown, 703/306-1470, *jhbrown@nsf.gov)*

SEP 29 NSF Program Deadline: Biological Sciences, Special Competitions. Basic Research In Conservation and Restoration Biology (James H. Brown, 703/306-1470, *jhbrown@nsf.gov)*

OCT 1 NSF Program Deadline. Management of Technological Innovation (MOTI). (M. Christina Gabriel, Engineering, *cgabriel@nsf.gov*; Marietta Baba, Social Behavioral and Economic Sciences, *mbaba@nsf.gov)*

OCT 3-6 LTER Meetings: Executive and Coordinating Committees. Harvard Forest LTER, Petersham, MA. Field trip to Hubbard Brook LTER, NH. (Adrienne Whitener, Network Office, 206/543-4853, *aWhitener@LTERnet.edu)*

OCT 11 NSF Target Date: Biological Sciences, Special Competitions. Doctoral Dissertation Improvement Grants (James H. Brown, 703/306-1470, *jhbrown@nsf.gov)*

NOV 1 NSF Preproposal Deadline: Biological Instrumentation & Resources, Special Projects. Postdoctoral Research Fellowships in Biosciences Related to the Environment (James H. Brown, 703/306-1470, *jhbrown@nsf.gov)*

NOV 11 NSF Target Date: Biological Sciences. Division of Environmental Biology, Biotic Surveys and Inventories (Scott Collins, 703/306-1483 sCollins@nsf.gov)

NOV 11-16 International LTER (ILTER) Regional Meeting. Panama and Costa Rica. (Jerry Franklin, 206/543-4853, *jFranklin@LTERnet.edu*; Rudolf Nottrott, 206/543-8492, *rNottrott@LTERnet.edu)*

NOV 15 NSF Proposal Deadline: Education & Human Resources. Informal Science Education. (Hyman Field, 703/306-1616, *hfield@nsf.gov)*

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For more information on funding opportunities: NSF Science & Technology Information System (STIS), stis@nsf.gov, *703/306-0214, or* http://www.nsf.gov

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