

# **The Virginia Coast Reserve LTER 1996-1997 Annual Report**

**1 August 1997**

## **VCR LTER Highlights**

**UNDERGRADUATES AND LTER RESEARCH** -- We have buildt a new database and data and information delivery system for site biodiversity data. This project was a joint effort between VCR LTER PIs and undergraduate students at the University of Virginia. The biodiversity data base was designed in the Fall of 1996 by a team of 6 students and three PIs. The system was programmed and filled with data on all taxa in the spring of 1997. 33 undergraduate students were involved in the filling of this system from published data. Nearly 6000 species observations were put in the system by the students. This data base and the system display of data for the user are ON-LINE.

**NEW THEORETICAL CONSTRUCT OF MARSH AND LAGOON SYSTEMS** -- A new morphometric analysis of coastal watersheds and lagoons provides a detailed understanding of the extent and complexity of coastal marshes. The model has special application for the prediction of changes in estuarine marshes resulting from sea level change.

**1969 ATLANTIC COAST WIDE EROSION REVERSAL** -- Shoreline change rates at the VCR reversed their direction of change (erosion and accretion) in 1969. We have established that this reversal of pattern of coastal erosion applies to the Atlantic Coast from Florida to Cape Cod. This past year we identified a similar reversal in the boundary between the beach and inland vegetation (an ecotone) followed, in time, the change in shoreline erosion. These changes are due to changes in storm climates.

## **Other Important findings at the VCR LTER**

### **Nutrient Dynamics**

**HEDGE ROWS AND GROUNDWATER NUTRIENT FLUXES** -- Control on agricultural nutrients flows into tidal creeks by means of groundwater pathways. We established even a narrow hedgerow of trees was sufficient to shut-down this pathway of nutrients in to tidal creeks.

**FRANKIA DISPERSAL PRECEDES SHRUB INVASION** -- The nitrogen fixer Frankia (on roots of the coastal shrug Myrica) disperses in fresh new sand deposits within 5 years. Shrub colonization is this not limited by a lack of the bacterium and may account for the extreme rapidity of expansion of coastal shrublands.

## Microbial Communities

*IN SITU* MICROBIAL COMMUNITY CLASSIFICATION -- Naturally occurring microbial communities can be classified on the basis of metabolic use patterns of 100 standard carbon sources. The classes found are stable from place to place and from season to season.

## Marsh Dynamics

LEGACY SUPPORTS NEW MARSHES -- The rate and course of salt marsh initiation and development are a function of the subsurface flow of fresh ground water from adjacent uplands. We have also established that incipient marshes built on beach sands that use nitrate as a nitrogen source lag by two decades over marshes established on buried mudflats that use ammonia as a nitrogen source. This will aid in understanding the progress of wetland restoration in coastal areas.

HYPERSALINE PLUME UNDER ISLANDS -- Hypersaline (140 ppt) pore water on VCR barrier island salt flats sinks as a plume into the island sands to a depth of at least 9 meters. The fate of these high saline solutions are not yet established.

## Ecosystems, Storms and Sealevel

SEDIMENTATION AND SEALEVEL RISE -- Marsh sedimentation, essential for marsh growth upward to keep up with sealevel rise, only occurs during a 2 hour window at high tide (>1 m) when there is a wind tide from the Northeast. As coastal storm produces such wind tides. Marsh upward growth is subject to long term trends in storm climate. In addition, we established that the stems of marsh plants lower to tidal flow velocities below 1 cm/s and permit deposition if other conditions are present.

COASTAL STORM CLIMATE CHANGE -- Coastal storm in the VCR region reached a low frequency in the first decade of this century and a high frequency in the 1960s. The amplitude of this change is 2-fold in number. This climate change drives coastal erosion patterns and apparently the health and vigor of marshes at the VCR.

STORMS AND PREDATION -- High storm flooding frequency and increased avian and mammalian predation of colonial gull-billed terns has reduced per nesting survivorship to fewer than one bird per nest. This is below the population replacement. While based on the 1994-1997 period, population structure changes could result from a continuation of this circumstance.

KEEPING UP WITH SEALEVEL -- Experiments at the VCR indicate that increased flooding (as in sealevel rise) and storm deposited wrack both have the effect of reducing respiration and thus decomposition. These adjustments may contribute to the organic matter accumulation in marshes and the capacity to keep up with sealevel rise.

## Information Management:

NEW SOFTWARE --Software designed for creation of annual LTER research reports using a WWW-form has had much wider use than originally anticipated. The software makes it possible to rapidly create an automated system for receiving and displaying information over the WWW. Data from the WWW form is pasted into a template document to create a new WWW page. An automatic table of contents for submitted entries is then generated. This VCR software was also used to obtain community input on LTER/LMER consolidation, develop the LTER Network Regionalization document and even for processing of abstracts for the ERS/SEERS meeting.

NEW VCR-WWW SYSTEM SOFTWARE -- The VCR/LTER Information Management System was moved to a WWW interface. Although the system has used the WWW for display and access since it came online in 1993, input to the system was via database software that was not WWW accessible. The new system allows investigators at seven institutions in four states to directly input and edit information about new datasets and to update information on older datasets without intervention by the site information manager. Changes in the database immediately show up in queries by data users. The system uses a forms-based interface to a SQL relational database (Mini-SQL). The data model for the system is hierarchical. PROJECTS may have one or more DATASETS each of which has one or more VARIABLES which may have zero or more CODES. The database has links to an existing personnel database, so an that investigator's address information is automatically updated. The system has been enthusiastically received by investigators and graduate students. Additional training on using the system is planned for the fall of 1997.

## **Activities in the next funding year (1997-1998).**

In 1997-1998 we will install 30 sediment platforms at the VCR in conjunction with a world-wide effort to measure sediment deposition in marshes. With this measurement system we will be able to directly record from year-to-year and over decades the rate of rise of marsh elevations. Indirect evidence indicates a loss of marsh of 11% since 1850. However we do not know the shortfall in marsh rise that results in such marsh-area loss.

With the acquisition of a GPS-coordinated, digital fathometer new bathymetric surveys of Hog Island Bay will be initiated next spring. From these analyses we will, for the first time, be able to estimate tidal volumes and test a new hypsometric theory (Oertel) at several of our marsh study sites.

With our new motion-stabilized digital video camera will map bottom attached macroalgae in our lagoons and establish a series of permanent plots to record macroalgal standing stock. It is common lore in the region that the lagoon bottoms of the VCR are seeing a increase in attached macroalgae. As such changes might give rise to increases and water clarity, it is essential that we measure these changes.

The VCR LTER is building new Field Station at Oyster, VA. A grant from the University of Virginia (450K) and from a graduate of the University of Virginia (\$1M) are being used to purchase and construct phase one of a new field station for research. PIs of the VCR LTER have worked over the last 3 years to reach this point and we expect construction to begin in the Fall of 1997.

We expect to link our biodiversity database with the Man and Biosphere initiative and data share. The VCR is a Man and the Biosphere site and we have begun talks to accomplish a data link.

## **Information about Data Management**

### Progress and New Developments

1. We have developed WWW based tools for field data entry directly into our electronic data bases. Once the PI has established the metadata fields, the process from data input to dynamically generated webpages of data will be automatic to ON-LINE status.
2. We have built a new database and data and information delivery system for site biodiversity data. This project was a joint effort between VCR LTER PIs and undergraduate students at the University of Virginia. The biodiversity data base was designed in the Fall of 1996 by a team of 6 students and three PIs. The system was programmed and filled with data on all taxa in the spring of 1997. 33 undergraduate students were involved in the filling of this system from published data. Nearly 6000 species observations were put in the system by the students. This data base and the system display of data for the user are ON-LINE.

VCR Datasets ON-LINE on WWW (<http://www.vcrlter.virginia.edu/data.html>)

As of 2 July 1997 the VCR LTER had 66 Science-data Datasets on line and 17 Science VCR Site Management Datasets. These datasets are listed below

#### Physical Data

- Weather data and graphs from VCR weather stations
- Tides data and graphs from VCR tidal stations
- Water Quality and Nutrient Data from VCR monitoring sites
- Description of VCR LTER Climate and long-term data on temperature and precipitation from LTERNET climate documents
- Climate Data (from NOAA)
- Waves (from NOAA)
- Tides (from NOAA, for Wachapreague)
- Climate Data for Painter VA
- Overwash disturbance probabilities on Hog Island

Storm Frequency 1885-1996  
Barrier Islands, Lagoons and Marshes morphology (Fla. to Cape Cod)

#### Biological Data

VCR LTER Biodiversity Database

A free standing interactive information system (all taxa included)  
6000 species observations included.

Small Mammal Survey - 1975/77

Small Mammal Photos

VCR Bird Database

VCR Fish Database

Aquatic Invertebrate Species List

Vegetation Database

Field Key to VCR Plant Species

Vegetation Species Codes

Island Vegetation Maps - 1974

Spartina alterniflora Leaf & NPP Measurements - A

Spartina alterniflora Leaf & NPP Measurements - B

Decomposition Data for the VCR from the LIDET project.

Parramore Island Permanent Vegetation Monitoring Plots: 1992-93 Baseline Data

#### Images and Geographical Data

Atlas of Aerial Photos and Satellite Images (raw images stored offline on optical disk)

GIS Maps and Figures

Draft ARC/INFO coverages and metadata

VCR Global Positioning System Network

Ongoing GPS projects from Randy Carlson

Atlas of Topographic Surveys

Research Site Coordinates

Interactive UTM & Lat./Long. coordinate Locater

Photographic Images of Events, Places, Equipment and more

Northampton County, VA GIS

NASA MODIS Imagery (July 1993)

#### Models

Animation of model by Shao et. al.

#### Project Management Electronic Data and Information Sets

Personnel Database

Electronic Copies of Proposals, Annual Reports

Project Descriptions

Site Coordinate Database

Publications Database

Annual Progress Report Database

Investigator Annual Report Database

### **Outreach Activities (media, training, REU, etc.)**

Undergraduate Student Outreach -- The VCR LTER has 3 to 5 NSF REU students each summer and out of project funds we augment these REUs with 2 to 3 undergraduate

students. In the Fall of 1996 we offered instruction to 6 students on building a biodiversity information system for the Delmarva Peninsula (Porter and Hayden). In the Spring semester (1997) 33 students were added to the biodiversity information system project and nearly 6000 species observations were entered into the system (Porter and Hayden). The class will be offered in the Fall of 1997 (Porter and Smith).

State and local community outreach of VCR PIs are 1) Shared GIS layers with - Northampton County and with Cape Charles USF&W Station (Porter and Hayden), 2) Public School Field Trips at the LTER Site (Carlson), 3) Participated in Economic Impacts of Research Study for Northampton County (Hayden, Oertel, Blum and Mills), 4) Natural Resource Values and Vulnerabilities. The second Virginia Eastern Shore Natural Resources Symposium. (Hayden, Oertel, Blum and Mills), 5) Participant in the Eastern Shore Birding Festival (Hayden), 6) Virginia Professional Wetlands Delineation Workshop (Hayden and Oertel), and 7) Eastern Shore Water Quality Monitoring Program (Blum)

The VCR LTER program extends beyond the University of Virginia and includes scientists from East Carolina University, Virginia Commonwealth University, Old Dominion University, Utah State University, Bucknell University, William and Mary (VIMS), Virginia Tech. In addition we have affiliations with The Nature Conservancy, Virginia Museum of Natural History, and The Man & Biosphere Program

National Outreach activities of the VCR include the White House National FRAMEWORK Workshops (Hayden), will lead the ESA / GSA Penrose Conference Field Trip in 1998, leadership in ESA Long-term Studies Section (Porter), Statistical Ecology Studies Section (Porter), and SBI Programs (Hayden)

International Outreach (in addition to ILTER programs) include 1994 Intecol Data Management Demonstration (Porter), 1998 Intecol Organizing Committee (Christian and Hayden), and IGBP participation -- GCTE and BAHC: (Shugart and Hayden)

**Non-NSF LTER-Connected Grants Currently in Force**

(unless specified the funds apply only to the 1996-1997 Academic Year)

Linda K. Blum -- Comparison of the importance of microbially-based food chains in autotrophic and heterotrophic estuaries. Virginia Graduate Marine Sciences Consortium \$59,590.

Frank P. Day -- Belowground plant responses to carbon dioxide enrichment..  
Smithsonian Environmental Research Center (DOE) \$46,000

Mark M. Brinson -- Donald R. Cahoon. Southern Science Center, National Biological Service, USGS Associated. Installation of 30 Sediment Tables at the VCR. \$15,000

Robert R. Christian -- via Pierluigi Viaroli, University of Parma, Parma, Italy Associated. Research and Travel Grant \$8,000.

Robert R. Christian -- via Daniel Baird, University of Port Elizabeth, Port Elizabeth, Republic of South Africa Travel Grant \$11,000.

Donald R. Young -- Interacting biotic mechanisms that control shrub establishment on Atlantic Coast barrier islands. Jeffress Memorial Trust \$9,410

Donald R. Young -- Revegetation of coastal spoils in Swash Bay Virginia Department of Environmental Quality \$27,000

R. Michael Erwin -- Experimental augmentation of nesting habitat for terns in coastal Virginia U.S. Fish and Wildlife Service \$8000

R. Michael Erwin -- NBS (U.S. Fish and Wildlife Service) appointment to the University of Virginia and the VCR LTER program. \$140,000

J. Zieman -- Field Station Development Gift by Private Giver (P.T. Jones) \$1,000,000 (1996-2001).

Bruce P. Hayden & David Smith -- Field Station Land Purchase Grant Arts & Sciences at the University of Virginia \$450,000

Bruce P. Hayden & David Smith -- Gift of the Vessel Nema a 32 ft. Trawler  
Mr. George Seward \$170,000

Bruce P. Hayden & David Smith -- Bannon Student Support Grant  
Mr. Bannon \$2500 per year.

Bruce P. Hayden & David Smith -- William E. Odum Research Grant from  
Odum Endowment \$2500

Bruce P. Hayden & David Smith -- The Moore Research Award from the Moore Endowment \$5000

Bruce P. Hayden & David Smith -- Three Faculty Gifts to the LTER Program Anon. \$11,600

Aaron Mills -- Factors Affecting the Transport of Bacterial Cells (DOE years 2 and 3 only)\*. \$307,884

VCR LTER PIs -- Student support from the University of Virginia in the form of teaching assistantships, fellowships and tuition differential \$36,100

R. Craig Kochel -- Grant to Nicole Bailey (Bucknell Summer Research Fellowship) \$3000

John Albertson and Pat Wiberg -- Source areas considerations of soil moisture dynamics. USGS \$46,980 1997-1999.

John Albertson and Pat Wiberg -- Source areas considerations of soil moisture dynamics. State of Virginia companion funding \$10,000. 1997-1999.

John Porter -- Local validation of Global Estimates of Biosphere Properties NASA \$40,000

Macko, S. -- The Effects of Anthropogenic Disturbance on Nitrogen Cycling Dynamics in Forest Systems: Stable isotopes.(USDA, Foreign Agricultural Service, International \$14,000

Iris Anderson -- The Effects of Anthropogenic Disturbance on Nitrogen Cycling Dynamics in Forest Systems.(USDA, Foreign Agricultural Service, International Cooperation and Development, Research and Scientific Exchanges, Div. \$20,000.

Total \$2,427,080

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\*DOE has invested about \$3,000,000 in the LTER Site of which about 1/3 has come to VCR PIs and their students. The remaining \$2,000,000 is not included in the Total above.

## **Publications**

### Journal Articles



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Brinson, M.M. and R.Rheinhardt. 1996. The role of reference wetlands in functional assessment and mitigation. Ecological Applications 6:69-76.

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Christian, R. R., and B. P. Hayden. 1995. Long-term ecological research in the United States, an international initiative and implications for Italy. Bollettino della Societa italiana di Ecologia 16:60-63.

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Fenster, M.S. and B.P. Hayden. in press. 1997. Ecotone displacement trends on a highly dynamic barrier island: Hog Island, Virginia. *Ecological Applications* .

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Foyle, A.M. and Oertel, G.F. 1997. Transgressive systems tract development and incised valley fills within a Quaternary Estuary-Shelf System: Virginia Inner Shelf, USA. *Journal of Marine Geology* 137:227-249.

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- Semones, S.W. and D.R. Young. 1996. Possible VAM association in the actinorhizal shrub *Myrica cerifera* on a Virginia, USA barrier island. *Mycorrhiza* and the citation is 5: 423-429.
- Shao, G., D.R. Young, J.H. Porter and B.P. Hayden. In Press 1997. An integration of remote sensing and GIS to examine the response of shrub thicket distributions to shoreline changes on Virginia barrier islands. *Journal of Coastal Research*
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- Wu, K. W. and L. K. Blum. In Review. 1997. Estuarine bacteria: important links to higher trophic levels. *Estuaries*

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- Christian, R. R. and D. G. Capone. 1996. Overview of issues in aquatic microbial ecology. Pages 245-251. in C.J. Hurst, G. R. Knudsen, M. J. McInerney, L. D. Stetzenbach, M. V. Walter. *Manual of Environmental Microbiology*. ASM Press, Washington, DC.

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### **Network, Cross-site and International Activities (1994-1997) by PI**

Iris Anderson -- 1) Eastern US LTER delegation member, 2) A nitrogen cycling study in forested watersheds impacted by high atmospheric N deposition. at ILTER site in the Shumava Mountains of southern Czech Republic(supported by USDA), 3) US LTER Host for visit by scientists of the Czech Republic to the Coweeta LTER site, 4) VCR Tragnet contributing member, and 5) Ecosystem metabolism study in Brazilian Cerrado following a burn event. (with Universidade of Brasilia).

Linda K. Blum -- 1) Long Term Ecological Research Network Workshop on Biodiversity. National Center for Ecological Research Synthesis, September, 2) 1996, Santa Barbara, CA. , 3) Hungarian - USA LTER workshop: May 1994, 4) Hungarian - USA LTER workshop: December 1994, 5) Hungarian - USA LTER workshop: March 1995. , 6) US/Hungarian grant proposal - Biodiversity of open water trophic levels: inter-lake comparisons with J. Magnuson (NTL) to NSF, 7) International Programs by June 30, 1995, 8) Long Term Ecological Research Network Workshop on Litter Decomposition. March 1996. Sevilleta LTER, NM.

Frank P. Day -- 1) Intersite graduate student (Rett Weber) dissertation project at VCR and Konza, 2) LTER Workshop on Soil Methods - March 1996 at Sevilleta; developed book on standard soil methods to be published by Oxford University Press..

Robert R. Christian -- 1) Initiated an LTER program in Italy, 2) coauthored a paper in the bulletin of the Italian Society of Ecology on starting an Italian LTER program, 3) LTER Workshop on Soil Methods - March 1996 at Sevilleta., 3) with Jim Gosz and Bruce Hayden, organized a session at the upcoming INTECOL meeting (Florence, Italy, summer 1998), Member of the LTER Portugal/Spain ILTER delegation (Spring 1996).

Bruce P. Hayden -- 1) LTER Coordinating Committee (1990 - 1997), 2) LTER Executive Committee (1994-1997), 3) LTER Publications Committee Chair (1995-1997), 4) LTER Climate Committee (1988-1997), 5) LTER Regionalization Committee (1993-1997), 6) LTER Network Office Renewal Proposal Committee (1995-1997), 7) Luquillo LTER Site Advisory Committee (1995-1997), 8) LTER White House Framework Representative, 9) ILTER Hungary Delegation, 10) ILTER Spain & Portugal Delegation, 11) ILTER 1998 INTECOL Organizing Committee, 12) Contributor to the Konza LTER Synthesis Volume (2 Chapters), 13) CED [Climate-Ecosystem Dynamics] is a monthly network e-mail publication produced by Bruce Hayden and distributed to more than, 14) 200 scientists across the LTER Network. The publication addresses research on the interactions between climate and vegetation and on related topics like climate change.

15) Tornadoes as dispersal agents of fish with J. Magnuson NTL. Joint work with UW graduate student., 16) Ran workshop on LTER publication needs at the 1995 ESA meeting., 17) Negotiated LTER book contracted with Oxford Press., 18) Submitted proposal to hold LMER/LTER workshop in program merger which funded and held July 18,19 & 20, 1996), 19) LTER contributing member to the ESA-ASA planning group for the SBI workshop on detecting long term trends in ecological data, 20) Established an LTER regionalization WEB page for the July 96, 21) LTER representative to the Mid-Atlantic FRAMEWORK workshop initiated by the White House Science Office, and 22) US LTER Host for visit by scientist the Portugal ILTER site.

Stephen Macko -- 1) Member of the LTER Eastern Europe ILTER delegation (Spring 1996). 2) A nitrogen cycling study in forested watersheds impacted by high N deposition at ILTER site in the Shumava Mountains of Czech Republic. 3) Host to CZECH scientists on a visit to the Hubbard Brook LTER.

John H. Porter -- 1) Training Workshop for Information Managers from Czech Republic and Hungary at Sevilleta LTER. September 1996, 2) Collaboration on developing databases for tropical field stations with Jorge A. Jimenez from Costa Rica. Hosted informal 2-day training session on metadata for Ted Hope information manager from the Organization of Tropical Studies, 3) Maintain home page for MODLERS group which involves representatives from 14 LTER sites., 4) Developed WWW-page for MODLERS activities. Spring 1996., 5) Developed automatic Personal Web Page in use at several sites. Data committee member, 6) Advisory Panel for the Luquillo LTER site., 7) Developed regionalization web page., 8) Developed WWW-page for MODLERS activities. Spring 1996, 9) Developed automatic Personal Web Page in use at several sites. Data committee member, 10) Data Bits is written by John Porter as a network service in conjunction with the data management committee, 11) Developed prototype tools for LTER Network Information System catalog with James Brunt from SEV LTER, 12) Two presentations (poster and talk) in LTER sessions at the Eco-Inforna 96 meeting on site and national LTER information management, 13) Poster at Ecological Society of America



1996 meeting on software tools and data availability in the LTER Network., 14) Host Personnel Database for Konza LTER., 15) Provided on-site assistance for WWW development for LUQ LTER site., 16) ILTER: Visit to Smithsonian Tropical Research Institute (STRI) in Panama, 17) Data Management Training at Organization of Tropical Studies (OTS) in Costa Rica, 18) LTER Information Managers Workshop: Participant. Summer 1995, 19) LTER DataTask: Member 1995-1996., 20) NSF Site Visits: ARC and BNZ site reviews. Summer 1995., 21) NASA: Participated in MODLERS workshop, 22) X-Roots Workshop: Participated in a workshop aimed at integrating., 23) LTER Climate Data into advanced relational databases, and, 24) Developed automatic Personal Web Page in use at several sites. Data committee member.

Guofan Shao -- 1) Presentation: Plant functional types for global ecosystem modelling, Oct. 25-30, 1994, Potsdam, Germany, 2) Presentation: The application of patch models of vegetation dynamics to global change issues, March 28-April 1, 1994, Netherlands, 3) Joint Project: Evaluation of forest cover types in Changbai Biosphere Reserve using TM data, cooperated with Prof. S. Zhao of CERN, China. IES

