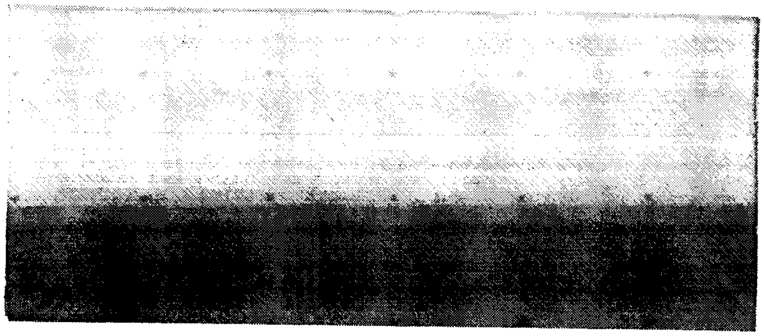
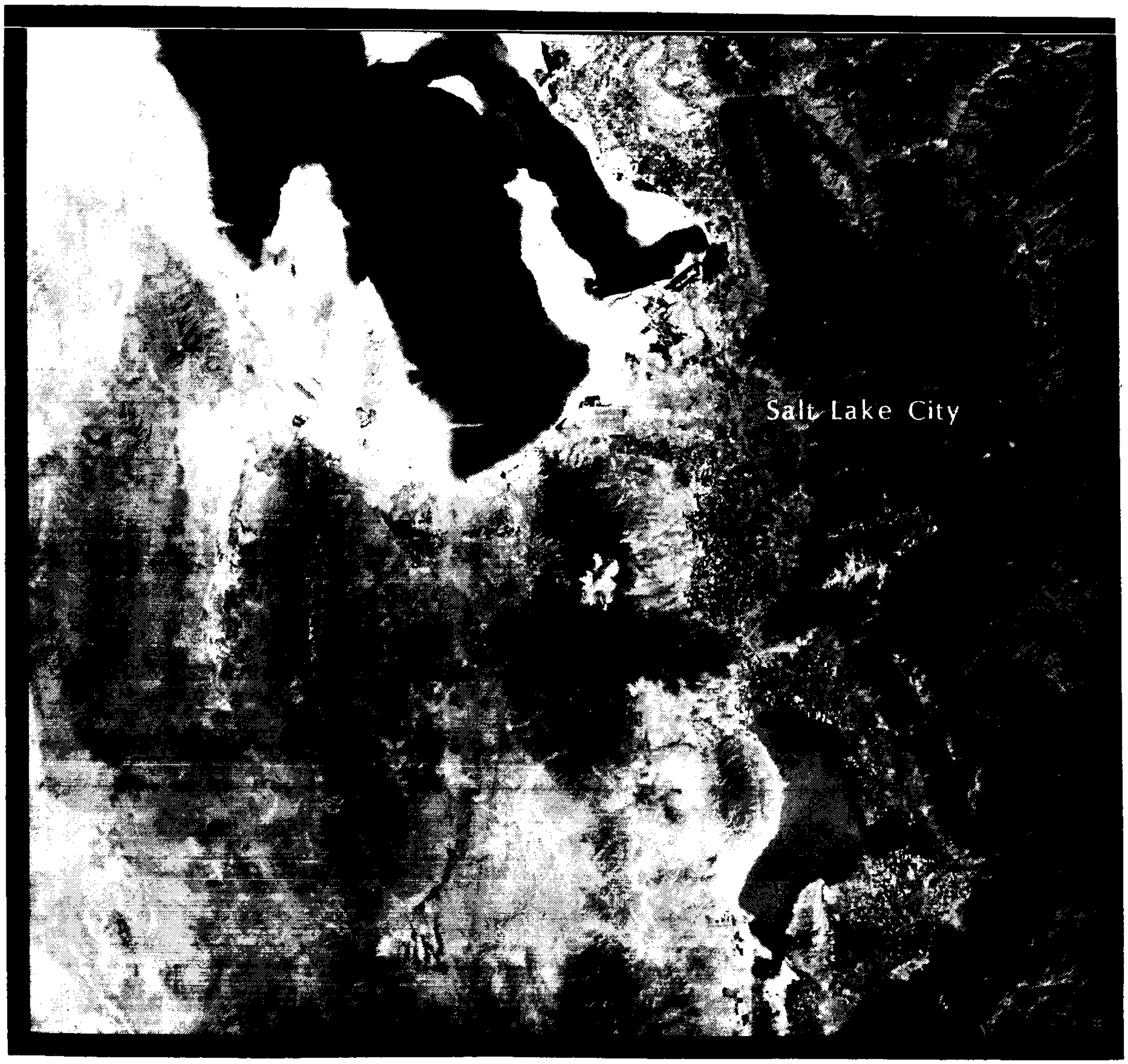
26 pages

CENTER FOR REMOTE SENSING AND CARTOGRAPHY





(NASA-CR-179703) FOLLOW-ON PROPOSAL IDENTIFYING ENVIRONMENTAL FEATURES FOR LAND MANAGEMENT DECISIONS (Utah Univ.) 26 p CSCL 08B

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UNIVERSITY OF UTAH RESEARCH INSTITUTE

Salt Lake City

FOLLOW-ON PROPOSAL

IDENTIFYING ENVIRONMENTAL FEATURES FOR

LAND MANAGEMENT DECISIONS

NASA Grant NAGW-95

For the Period

1 August 1986 to 31 July 1987

Center for Remote Sensing and Cartography
University of Utah Research Institute
391 Chipeta Way, Suite D
Salt Lake City, Utah 84108
801-524-3456

Phillip M. Wright
Principal Investigator
Technical Vice President

Merrill K. Ridd
Co-Principal Investigator
Director, CRSC

James J. Brophy
President, UURI

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INTRODUCTION

This is a request to the National Aeronautics and Space Administration for the final installment of funding under NASA Grant NAGW-95. This is a step-funded grant to the Center for Remote Sensing and Cartography (CRSC), with an anniversary date of 1 August. This proposal requests $34,000 in new funds beginning 1 August 1986 to augment funds already committed.

The following proposal is a scaled down version of the August 1985 to August 1986 proposal. All projects outlined within the last proposal are currently under way. Additional funding is needed to carry them to conclusion. The projects outlined herein cover the following subjects: urban ecosystem modeling, forest ecology, and arid land ecology.

I. URBAN ECOSYSTEMS

Although urban areas constitute a small percentage of the world's land surface, they have an inordinately large impact on energy and hydrologic budgets, and sources of atmospheric and water alteration. Furthermore, urban areas are expanding more rapidly than other land uses, as rural-to-urban migration takes place worldwide. No reliable data exist relative to actual land coverage by urban areas, but a high rate of urban populat-ion increase is observed on every continent (United Nations

1982), especially in the developing world. For the world as a whole, 41% of the population lives in urban areas, and by the year 2025, the number is projected to rise to over 65%. The rate of increase in percent urban population is greatest in Africa, Latin America, and Asia, while the greatest actual percentages estimated for 2025 are North America (89.9%), Oceania (87.6%), Europe (85.6%), Latin America (83.6%), and USSR (83.3%). Considering the increasing rate of urban expansion on the land and the increasing impact of urban/industrial processes on earth resources and environments, and considering that urban habitability directly affects the major share of the world's people, it seems urban ecosystem research should justifiably receive increased attention.

Satellite remote sensing technology is potentially an effective tool for providing standards for monitoring and predicting urban growth (Jensen 1981). It should also provide opportunities for greatly improving ecological knowledge of urban processes. At this point in time, there is little in the remote sensing literature that deals with the ecology of urban environments. The literature strongly emphasizes techniques of classification and mapping of urban features, without regard to understanding the functional interrelationships of urban systems -- natural or human -- as is very evident in the second edition of the Manual of Remote Sensing (Colwell 1983).

Objective and Scope

The objective of the urban ecosystem research proposed here is to develop and experiment with certain dimensions of an urban ecosystem research model. The urban ecosystems investigation team at CRSC suggests a general model that demonstrates the interrelationships between investigators' efforts. Figure 1 illustrates three areas of investigation focusing on urban ecosystems, which for convenience are called (1) urban morphology (an examination of spatial fabric and structure), (2) natural ecosystems (investigations emphasizing biophysical processes and patterns, and (3) human ecosystems (emphasizing socio-economic and engineering parameters). The three are not mutually exclusive, but do represent different emphases. At CRSC, researchers are at work on all three areas, providing a good deal of daily interaction and mutual development of tools, skills, and ecological understanding.

It is important to recognize that the several investigations are driven by a need to understand the total urban ecosystem, signified by the central box. Each investigator, contemplating the urban complex in the context of specific research interests, selects that combination of parameters relevant to the investigation objectives. Each investigation is designed to better understand the processes and/or patterns operating in some dimension of the ecosystem.

Having decided on study objectives and parameters, the investigator turns to existing documents (left box) and works

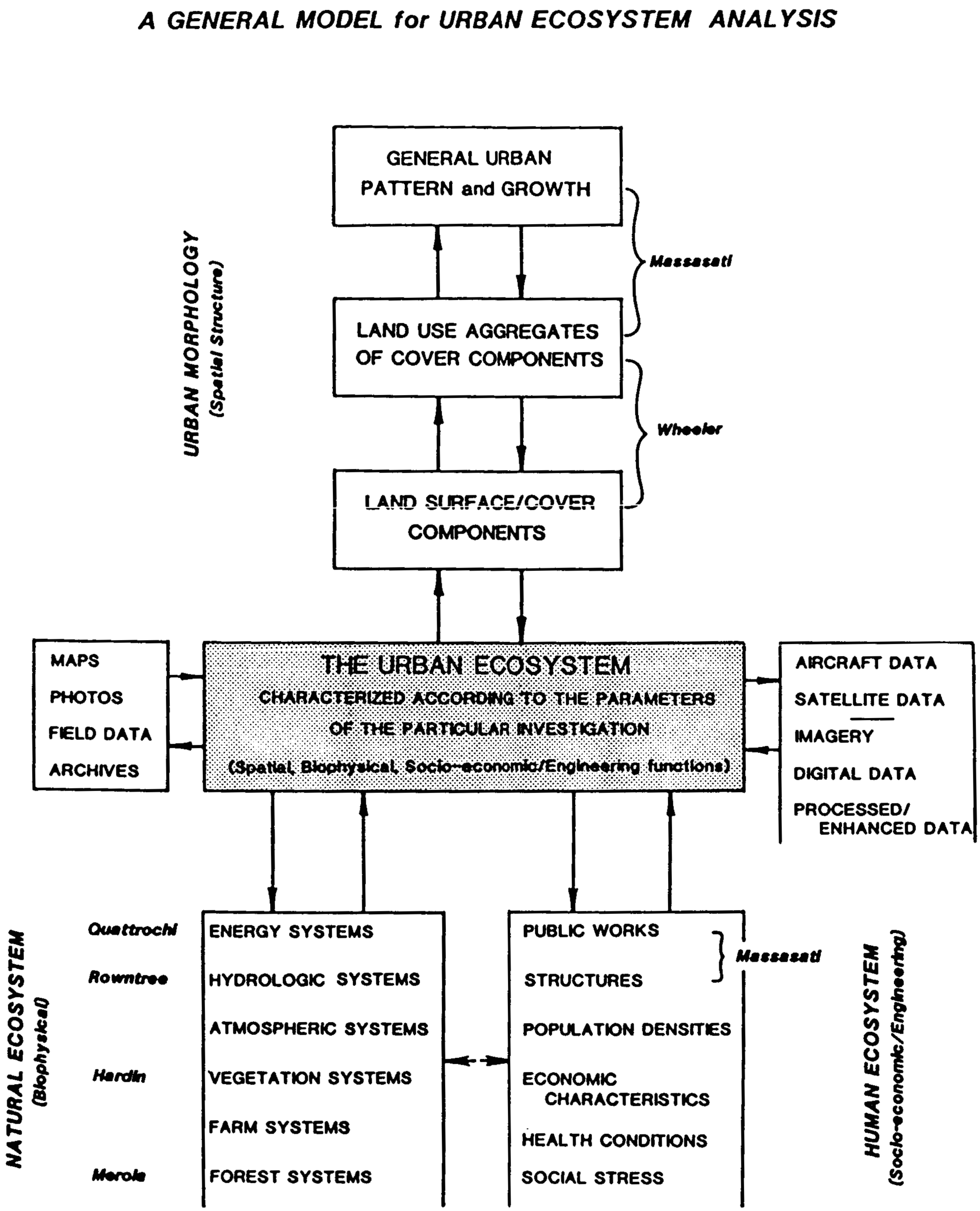

Figure 1. Several investigators at CRSC are working with various dimentions of urban ecosystem research.

out a research strategy to obtain the needed new information. To the extent that remotely sensed data may serve those needs, the investigator reaches out for such supporting data (right box) in such form as the investigation design is best served.

CRSC has become closely associated with Man and the Biosphere program Urban Ecosystems Directorate (MAB-11). Merrill Ridd and Dale Quattrochi, NASA scientist located at ERL, have both been appointed to the directorate. A recent directorate meeting in Salt Lake City with Dr. Roger Soles, executive director of the U. S. MAB program, has resulted in a direction of research that offers a new look at urban ecosystems with a strong remote sensing component. A basic assertion is that the urban ecosystem and its many components and subsystems, exhibit a strong visual character. Further, it is asserted that the visual components are to some degree, accurate surrogates for natural and man-made materials and processes occurring in somewhat distinctive patterns. It is anticipated that by observing those patterns, and by studying the ecological processes (natural and human) operating within those patterns, certain statements about ecological subsystems and conditions may be made.

The Salt Lake City metropolitan area has become a point of focus of research by the U.S. Forest Service, MAB, and NASA funding through CRSC and ERL. The potential for this integrated effort to pay off in modeling urban ecosystem research seems substantial. Upon further work here, it is anticipated that the techniques will be employed in Mexico City under funding from MAB and the Mexican government. CRSC has funding from MAB to do a pilot project in Mexico City and prepare a proposal. Furthermore, additional funding has been provided from MAB to stage a ten day workshop for Mexico city and federal leaders to introduce them to digital remote sensing. The workshop will take place in the fall of 1986 with five days in Salt Lake City and five additional days in Mexico City.

II. FOREST ECOLOGY

One project is proposed in forest ecology under this request: Modeling Transpiration in Aspen Stands.

Introduction

Forests of quaking aspen (*Populus tremuloides*, Michx.) are considered to be predominantly subclimax communities in the Rocky Mountain region (Bartos 1973, Mueggler 1976). Unless interrupted by fire or other disturbance, mature aspen forests are commonly replaced by evergreen conifers (esp. *Abies* spp. and *Picea* spp). More than 4.1 million acres of commercial aspen forest, and possibly another 1.5 million acres of non-commercial aspen lands, exist in the Rocky Mountains.

With evolving forest management built around fire suppression, vast acreages of mixed forest are undergoing unidirectional change from pioneer and seral species toward climax species. The effect of this transition is essentially unstudied on a regional or continental scale. Satellite remote sensing may be the link to such understanding.

The ecological significance of this unidirectional conversion of some 5.6 million acres of aspen forest in the Rocky Mountain region is far reaching, as shown by Ramsey and Harper (1983) and Wagstaff (1983). It has been shown that runoff decreases by some 7 to 18cm from aspen to spruce-fir forest, that wildlife habitat is reduced significantly, and livestock carrying capacity becomes a fraction of that in an aspen forest. Other impacts include increased fire suppression costs. The potential cumulative effect of regional conversion is enormous.

The effect at the local scale is beginning to be understood through hydrologic modeling. The weakest element of local modeling is the variable rate of water consumption in aspen communities (Gifford, Humphries, and Jaynes 1983). Due to variability in aspen phenology and community structure, investigators cite the need for increased attention to modeling the key hydrologic parameters in variable stands, especially transpiration rates. The proposed investigation begins at this level, and builds toward regional modeling dimensions. The key to quantifying the hydrologic impact is to improve the aspen component of the ASPCON (aspen-conifer hydrologic model).

Objective

The science objective of the proposed research is to improve the accuracy of the most critical variable, transpiration, in the ASPCON model, created by Jaynes (1978), describing the hydrology of aspen to conifer succession. Transpiration will be determined by a canopy transpiration model which estimates consumptive water use (CWU) for specific species (Kaufmann 1984) and a plant activity index (Gifford, et al. 1984). The remote sensing objectives are: (a) to provide data describing stand characteristics and environmental conditions, (b) to improve the efficiency of the model, and (c) to provide a spatial dimension to the model, so that local to regional applications can be made. These objectives are cast in a long-term, broad-scale ecological problem encompassing most of the forests of western United States and much of North America. Refinement of the local aspen-to-conifer hydrologic model will allow CRSC to build on its demonstrated ability to map successional stages (Merola, Jaynes, and Harniss 1982) and to create a regional model of succession dynamics and ecological impact.

The ultimate objective is to build a reliable and digitally efficient model to estimate the existing hydrology of aspen-conifer forest stands of the Rocky Mountain region, and to predict changes in runoff, and other significant impacts, of forest succession on a basin-by-basin and regional basis, using Landsat TM data and DEM terrain data. With such a model, various scenarios of alternative futures of Rocky Mountain forests can be employed. Future research will deal with rates of aspen-to-conifer succession to make it possible to place the regional conversion and impacts into a time frame.

Field data is being collected in the Big Cottonwood Canyon watershed in order associate transpiration differences between aspen clones and their respective spectral response.

III. ARID LAND ECOLOGY

The arid land project proposed to receive partial funding from this request, is a Pinyon-Juniper woodland erosion study.

Introduction

The pinyon-juniper (P-J) woodland occupies some 60 million acres of semiarid rangeland in the west and is expanding with each decade (Rodgers 1982). It is estimated that since the mid-1800's, land occupied by P-J has increased by 43% (West, et al. 1973).

The cause of P-J expansion is attributed variously to overgrazing, fire suppression, climatic change, etc. (West, et al. 1973 and Cottam 1947). Whatever the cause(s), the trend is toward xerification (desertification) of the landscape as woody forms overtake herbaceous understory, exposing soil and increasing erosion substantially. Efforts to detect and monitor soil degradation in arid lands by remote sensing have met with varying degrees of success. Robinove, et al. (1981) and Robinove, et al. (1982) employed albedo differencing from time 1 to time 2 on the assumption that increased albedo indicates a loss of vegetation and increased erosion. Experience in Mexico (Ridd, et al. 1983) indicates this is not always the case. The poorest range type among nine classes was characterized by heavy cactus and related woody shrubs, with little or no understory of grass or forbs and substantial erosion. These degrading land types are becoming increasingly xeric and unstable (with continued grazing), and yet they exhibit decreased albedo due to shadowing from shrub canopy. Experience with P-J woodland suggests a similar phenomenon, e.g. the worst erosion occurs where woody species, especially P-J, are most advanced. Figure 2 summarizes a succession of events that has thrown hundreds of thousands of acres of semiarid rangeland into varying stages of dynamic degradation. Once the protective understory of grasses and forbs is reduced, a chain of events continues to reduce the herbaceous understory and to give the competitive advantage to woody desert shrubs, until P-J totally dominates the area. Under such conditions, the threshold for natural recovery is crossed, and the land continues to deteriorate. The process, if left unattended, continues with an accelerating pace that eventually defies human efforts at restoring the land base or even arresting the

A DYNAMIC MODEL OF PINYON-JUNIPER WOODLAND
UNDERGOING DEGRADATION

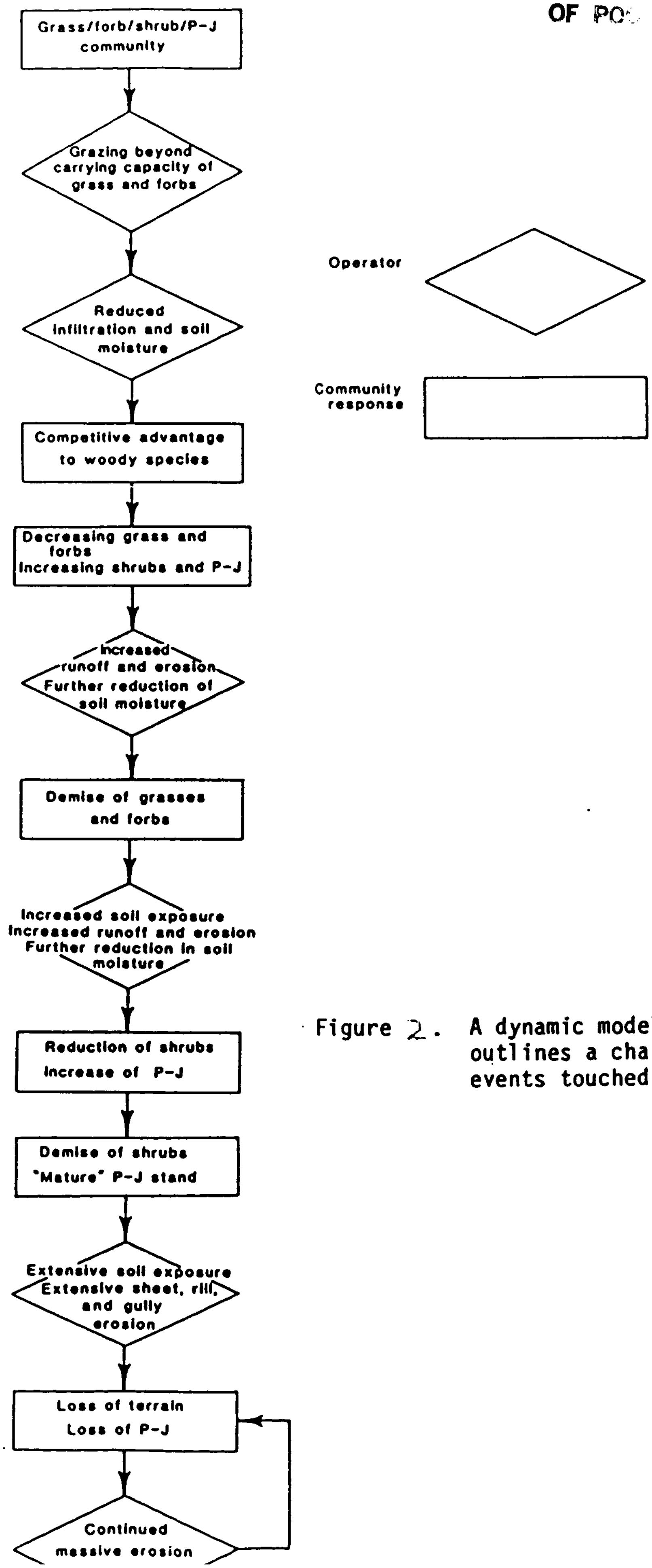

Figure 2. A dynamic model of a P-J woodland outlines a chain of degradation events touched off by overgrazing.

degradation. This downward spiral is also indicated with the positive feedback loop shown in the last two boxes of Figure 2.

This study focuses on Sanpete County Utah, where the SCS has a national emphasis on erosion analysis. This is a cooperative research agreement between SCS and CRSC. Research is nearly complete, using funding from SCS and funding from the current NASA grant to CRSC. Kevin Price, range scientist and PhD candidate, is the project leader.

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BUDGET

(10th Year of NASA NAGW-95)

Personnel:		
Salaries and Wages:		
Research Assistants	$2,780	
Secretary	$ 500	
Technicians	$ 300	
Employee Benefits:		
14.2% of salaries and wages (technicians)	$ 43	
42.8% of salaries and wages (RA's and Secretary)	$1,404	
Total Personnel:		$5,027
Consultants:		
Co-Principal Investigator	$11,630	
Travel*	$ 2,053	
Materials & Equipment*	$ 311	
Data Processing*	$ 980	
Total Non-Personnel:		$14,974
Total Direct Costs:		$20,001
Indirect Costs: (See attached Negotiated Agrement:EXHIBIT A)		
Overhead (48.4%)	$9,680	
General & Administrative (13.5%)	$2,700	
Total Indirect Costs (less fee)		$12,380
Total Budget (less fee)		$32,381
Fee (5.0%)		$ 1,619
Total Budget		$34,000
Total New Funds Requested		$34,000

Cost Sharing: Consistent with previous grants awarded to the University of Utah Research Institute, it is understood that there will be no cost-sharing under the proposed follow-on grant.

* See attached breakdown for details.

Travel

Two persons to JPL in Pasadena

Airfare, R/T to Pasadena from Salt Lake City $250 round trip for two persons	$ 500
Lodging at $50/day for 6 days	$ 300
Per diem at $21 for 6 days	$ 126
Ground transportation	$ 50
	$ 976

Two person trips to NSTL/ERL, Bay St. Louis, Miss.

Airfare, R/T to New Orleans from Salt Lake City	$ 500
Lodging at $60/day for 6 days	$ 360
per diem at $21 for 6 days	$ 126
Ground transportation	$ 100
	$1,086

Materials & Equipment:

Maps, orthophotoquads, film & processing, misc.	$ 300

Data Processing:

Prime 2655 super mini computer - 14 hrs. at $70 per hr.

Processing of digital data includes Landsat MSS, Landsat TM, and other digital data.

Total Data Processing	$ 980

RATE AGREEMENT
NONPROFIT ORGANIZATIONS

ORGANIZATION:
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

DATE: February 25, 1986

FILING REF.: The preceding Agreement was dated September 11, 1984

The rates approved in this Agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section II.

SECTION I: RATES

Type	Effective Period From	To	Rate	Locations		Applicable To
INDIRECT COST RATES*						
Final	10/1/83	9/30/84	13.5%	All	(2)	General and Administrative Rate
Final	10/1/83	9/30/84	76.7%	All	(2)	Utah Biomedical Test Lab
Final	10/1/83	9/30/84	48.4%	On-Site	(2)	Applied Technology Division
Final	10/1/83	9/30/84	6.8%	Off-Site	(2)	Applied Technology Division
Provisional	10/1/84	9/30/85	45.0%	All	(1)	Applied Technology Division
Provisional	10/1/84	9/30/85	14.5%	All	(1)	General and Administrative Rate
Fixed	10/1/84	9/30/85	39.0%	All	(3)	Fringe Benefit Rate Salaried Employees
Fixed	10/1/84	9/30/85	9.5%	All	(3)	Fringe Benefit Rate Hourly Employees
Provisional	10/1/85	Until Amended	48.4%	All	(1)	Applied Technology Division
Provisional	10/1/85	Until Amended	13.5%	All	(1)	General and Administrative Rate
Fixed	10/1/85	9/30/86	42.8%	All	(3)	Fringe Benefit Rate Salaried Employees
Fixed	10/1/85	9/30/86	14.2%	All	(3)	Fringe Benefit Rate Hourly Employees

SECTION I CONTINUED ON ATTACHED ADDENDUM.

SECTION II: GENERAL

A. LIMITATIONS: The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its indirect cost pool as finally accepted; such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as indirect costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate.

B. ACCOUNTING CHANGES: If a fixed or predetermined rate is in this Agreement, it is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from indirect to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES: If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the diference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES: The rates in this Agreement were approved in accordance with the authority in Office of Management and Budget Circular A-122, and should be applied to grants, contracts and other agreements covered by this Circular, subject to any limitations in A above. The organization may provide copies of this Agreement to other Federal Agencies to give them early notification of this Agreement.

AGREEMENT: February 25, 1986

E. SPECIAL REMARKS: NONE

BY THE ORGANIZATION:

UNIVERSITY OF UTAH
(ORGANIZATION)

(Signature)

James J. Brophy
(Name)

Vice President for Research
(Title)

10 March 1986
(Date)

BY THE COGNIZANT AGENCY
ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES
(Agency)

(Signature)

Henry J. Bomba
(Name)

Director
Division of Cost Allocation/RASC
(Title)

February 25, 1986
(Date)

HHS Representative: Frank T. McKune

Telephone: (303)844-5566

ADDENDUM TO RATE AGREEMENT
NONPROFIT INSTITUTIONS

February 25, 1986
Agreement Reference Date

University of Utah Research Institute
Organization

391 Chipeta Way, Suite C
Address

Salt Lake City, Utah 84108

SECTION I: (Cont'd)

* Base: (1) Total direct costs less individual items of equipment in excess of $1,000, subcontracts and subgrants in excess of the first $25,000 for each award, and alterations and renovations.

(2) Total direct costs less individual items of equipment in excess of $1,000, subcontracts and subgrants in excess of $5,000, and alterations and renovations.

(3) Direct salaries and wages excluding fringe benefits.

Treatment of fringe benefits: This organization uses a fringe benefit rate for both budgeting and charging purposes. The following fringe benefits are included in the fringe benefit rate for salaried employees:

1. FICA
2. State Unemployment Insurance
3. Health and Disability Insurance
4. Retirement - State and TIAA/CREF
5. Workmen's Compensation Insurance
6. Vacation Pay
7. Holiday Pay
8. Sick Leave and other paid absences
9. Life and Accident Insurance

The following fringe benefits are included in the fringe benefit rate for hourly employees:

1. FICA
2. Workmen's Compensation Insurance
3. Unemployment Insurance

Off-Site is defined as those activities conducted in facilities not owned by the Institute or serviced by its physical plant facilities.