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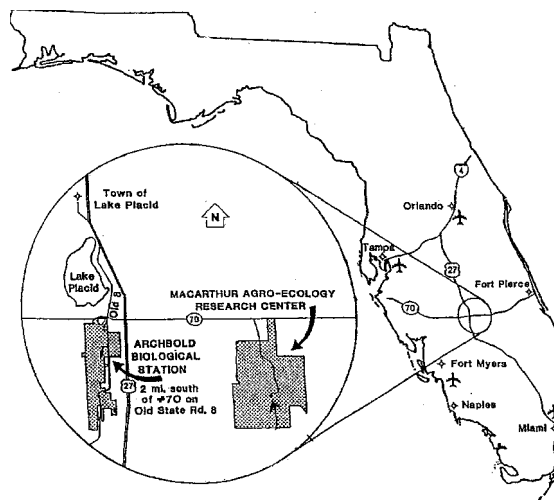
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Preface

The MacArthur Agro-Ecology Research Center (MAERC) located on Buck Island Ranch near Lake Placid, Florida, is the site of on-going cooperative research administered through a Memorandum of Understanding (MOU). In 1991, Archbold Biological Station, South Florida Water Management District (SFWMD), the University of Florida Institute of Food and Agricultural Science (UF/IFAS), and the Florida Cattleman's Association established the project. The 10,300-acre Buck Island Ranch, obtained in 1988, is managed by the Archbold Biological Station under a long-term lease from the John D. and Katherine T. MacArthur Foundation. It is operated as a working cattle ranch and citrus grove as well as a long term agro-ecology research project.



The purpose of the project is to research the relationships between cattle ranching, citrus production, and Florida's native ecosystems. By obtaining further information on the complex issues that surround natural resource management in an agricultural environment, program participants aim to develop strategies to protect Florida's natural resources while still maintaining economically viable and compatible agricultural industries within the state. A particularly important issue is understanding how cattle and citrus production affect water quality and soil nutrients, and how these factors affect invertebrate and wildlife populations.

Specific objectives of the agro-ecology research, extension, and education initiative include:

- Developing a comprehensive understanding of the ranch ecosystem and landscape of central Florida, including nutrient flow, water movement, wetland dynamics, and population biology of native species.
- Measuring the effects of selected low-input agricultural practices on long-term health and sustainability of the ranch ecosystem, and the economic implications of implementing these practices.
- Fostering dialogue between all community stakeholders to promote natural resource conservation and wildlife enhancement within the context of a viable agricultural economy.

Each participating group has an important role in the MAERC project. IFAS's role is to develop research and extension programs that focus on the relationship between natural resource management and agricultural systems. Archbold Biological Station provides logistical support for all research activities that take place on the Ranch. The Water Management District formulates water management priorities and incorporates research findings into regional policies and practices. The Florida Cattleman's Association reviews the projects and brings in the expertise of the producers. MAERC projects are supervised by the MOU Steering Committee composed of representatives of each MOU signatory.



Research

Research

The Research Group

This report highlights the research and extension activities conducted by UF/IFAS. However, it is important to understand the history of the formation of the research group and to mention the other research partners.

During 1994, three organizations (IFAS, MAERC, SFWMD) created a cooperative group to outline a series of research programs examining the relationships between management practices, environmental issues, and economic sustainability of beef cow-calf operations in central Florida. A 1994 Memorandum of Understanding (MOU) initiated the program. These partners have committed considerable resources to the program. In 1996, the Florida Cattleman's Association joined the MOU Advisory Committee and the U.S. Natural Resources Conservation Service is becoming involved in site characterization. The expanded partnership ensures a comprehensive research program.

The **University of Florida's Institute of Food and Agricultural Sciences (IFAS)** is organized into 21 Departments and 13 Research and Education Centers to develop and support environmentally and economically sustainable agriculture in Florida. IFAS faculty brings a wide range of expertise in range sciences, agricultural engineering and economics, soil and water chemistry, wildlife biology, and animal science to the effort. To find out more, visit their web site at <http://www.imok.ufl.edu/buck/index.html>.

Archbold Biological Station's MacArthur Agro-ecology Research Center (MAERC) is committed to conducting and stimulating long-term research on the relationship between cattle ranching, citrus production, and the native ecological systems of central Florida. MAERC operates the 10,300-acre Buck Island Ranch as a commercial beef cow-calf operation and citrus grove. To find out more, visit their web site <http://www.archbold-station.org>.

The **South Florida Water Management District (SFWMD)** is the agency with responsibility for water supply, flood protection, water quality, and environmental protection for the interconnected Kissimmee/Lake Okeechobee/Everglades/Florida Bay Ecosystem. The District has a large research program, and conducts environmental research and modeling within the system. To find out more, visit their web site at <http://www.sfwmd.gov>.

The **Florida Cattlemen's Association (FCA)** is an organization of over 4,000 members concerned with various aspects of beef production in Florida. They provide important and realistic insights for the research program because FCA members are the actual owners and managers of cattle ranches.

The **U.S. Natural Resources Conservation Service (NRCS)** is the U.S. Department of Agriculture agency responsible for helping people conserve, improve, and sustain our natural resources. For over 60 years, the agency (formerly the Soil Conservation Service) has provided science-based technical assistance to Florida ranchers and encouraged them to adopt voluntary approaches to range management. The NRCS brings expertise on range management/soil dynamics to the research group. To find out more, visit their web site at <http://www.ncg.nrcs.usda.gov>.

UF/IFAS Researchers at Buck Island Ranch

Name of Researcher	Project Duration	Project Title
Alva, Ashok K.	1992-1999	Best management practices for Ridge Citrus ground-water nitrate study;
Babbitt, Kimberly J.	1994-1997	Animal and plant monitoring for surface water quality study; microhabitat and predator-prey relationships
Campbell, Kenneth L.	1994-ongoing 1994-1997	Decision support system for beef cattle production Hydrology and water quality investigations at Buck Island
Capece, John C.	1994-1997 1995-1997	Pasture water quality projects World Wide Web home page for MAERC & tech. coordination
Christman, Steven	1992-1997	Base animal population monitoring for grazing cattle management study
Fanning, Michael	1992-1997	Cow-calf performance as affected by stacking density
Fraisse, Clyde W.	1992-1997	Decision support system for beef cattle production
Gibbs, E. Paul (UF/Col. Vet. Medicine)	1994-1997 1994-1997	Feral swine transmission of Pseudorabies Virus (PRV) Sentinel herd for Bluetongue studies
Graetz, Donald A.	1994-ongoing 1992-1997	Hydrology and water quality investigations at Buck Island Decision support system for beef cattle production
Graham, Wendy D.	1992-1999	Best management practices for Ridge Citrus ground-water nitrate study
Greiner, Ellis C. (UF/Col. Vet. Medicine)	1994-1997	Sentinel herd for Bluetongue studies
Humphrey, Stephen R.	1992-ongoing	Reproductive ecology and habitat associations of Audubon's crested caracara in South-Central Florida
McGehee, Steven M.	1992-ongoing	Reproductive ecology and habitat associations of Audubon's crested caracara in South-Central Florida
McSorley, Robert	1994-1997 1992-1997	Nematode population dynamics, succession, and community structure Cow-calf performance as affected by stacking density
Meade, Paul N.	1992-1997	Feral swine transmission of Pseudorabies Virus (PRV)
Morrison, Joan L.	1992-ongoing	Reproductive ecology and habitat associations of Audubon's crested caracara in South-Central Florida
Mozaffari, Morteza	1994-1997 1994-1997	Review Standardized Performance Analysis (SPA) for the evaluation of cattle production and finance performance World Wide Web home page for MAERC & tech. coordination
Mullahey, J. Jeffrey	1992-1997	Vegetation sampling of pasture water monitoring sites
Portier, Kenneth M.	1992-1997	Statistical modeling of agro-ecosystem indicators
Roka, Fritz M.	1992-1997	Economic aspects of agro-ecosystem indicators
Romero, Carlos H.	1994-1997	Feral swine transmission of Pseudorabies Virus (PRV)
Still, H. Max	1992-1997	Best management practices for Ridge Citrus ground-water nitrate study
Tanner, George W.	1992-1997	Animal and plant monitoring for surface water quality study; microhabitat and predator-prey relationships

Research Summary Reports
Projects Supported by the Center for Natural Resources

**Water Quality Research Component of the MAERC Cattle Stocking Rate
Experiment**

Project Director: *J. C. Capece (IFAS)*

1997-1998 Progress Summary

The water quality component of the MAERC cattle stocking rate optimization study includes an ambitious data collection program at 16 pasture plots, each instrumented with sophisticated flow and water quality monitoring systems. Construction and instrumentation of the flow and water quality measurement systems was completed in May 1998. Data collection began at the winter pasture array in late 1997 and at the summer pastures in mid 1998.

Little flow and water quality data was collected from March to July of 1998 because of the dry conditions on the pastures. No significant runoff events have occurred during this period. During the 1998 rainy season several runoff events have occurred and runoff data have been collected.

The project is currently in the “equilibration phase” during which water quality effects of the ditch and flume construction are being allowed to diminish prior to implementation of the stocking rate treatments in November 1998. Water quality data collected during the early part of the project (during construction and soon after installation of the flumes) exhibited high total phosphorus concentrations, but these levels have decreased dramatically after the initial months of the project as shown in the water quality data tables below.

Summary Tables for Water Quality Results

Full period of record:

Mean Concentration, mg/L				
Station	NH3	NOx	TKN	TP
W1	0.12	0.01	5.1	0.34
W2	0.14	0.01	3.8	0.14
W3	0.04	0.01	4.0	0.10
W4	0.13	0.01	3.3	0.10
W5	0.47	0.00	14.4	0.71
W6	0.06	0.01	2.9	0.05
W7	0.11	0.00	3.5	0.15
W8	0.12	0.01	3.6	0.19

Post-stabilization period of record:

Mean Concentration, mg/L				
Station	NH3	NOx	TKN	TP
W1	0.03	0.01	2.40	0.06
W2	0.07	0.01	3.40	0.10
W3	0.04	0.01	3.50	0.09
W4	0.06	0.01	2.80	0.05
W5	0.04	0.01	2.60	0.04
W6	0.06	0.00	2.70	0.05
W7	0.19	0.01	3.30	0.06
W8	0.08	0.01	2.60	0.05

The project web page includes all primary project documents (statement of work, CompQAP, QAPP, and reports). The site, located at www.imok.ufl.edu/buck, is being continually expanded to include additional site images and reports.

A new addition to this website is a page dedicated to the stocking rate project and the associated Florida DEP grant at <http://www.imok.ufl.edu/buck/stocking>. Included on this website is the standard operating procedure (SOP) developed for the automated water quality sampling system and for the manual grab sampling task. This SOP is posted on the project web page along with the database entry form for samples collected by the ISCO units.

1998-1999 Priorities

Experiment Implementation

The equilibration phase will continue through November, 1998 at which time the winter pastures will be stocking according to the planned treatment rates. A meeting of project participants will be held to further discuss this issue and decide on a specific schedule for implementation of the treatments and system measurements.

Field Instrumentation

The software currently used to collect the flow data and control the automatic samplers is functional, but is undergoing review and upgrades to better address our project needs. The primary upgrade sought for the system is the addition of automatic telemetry and Internet-based data retrieval, inspection and processing. Another primary goal for enhanced field instrumentation is the addition of water table monitoring wells. Ground water wells are essential for complete water budget calculations and accurate rainfall-runoff modeling.

Standard Operating Procedures

Additional SOPs will be developed to instruct field maintenance and data collection personnel on the proper servicing and data extraction procedures for the data logger systems. The water quality sampling SOP will also be improved and revised.

Data Processing

Previously-collected runoff data will be adjusted to reflect offset adjustments recorded in the field notes. Automated systems for data processing will be developed using SAS, SQL, HTML, and JAVA software environments.

Agro-Ecosystems Indicators of Sustainability as Affected by Cattle Density in Ranch Management Systems

Principal Investigators: *K.L. Campbell, J.C. Capece, J.J. Mullahey, M.D. Fanning, D.A. Graetz, J. Holt, R. McSorley, R.M. Muchovej, K.M. Portier, F.M. Roka, A.D. Steinman, and G.W. Tanner (IFAS)*

Specific Aims

The objectives of this multidisciplinary project are to:

1. investigate the effect of cattle stocking rate on the following indicators of cattle ranching system sustainability:
 - C animal performance,
 - C seasonal forage biomass production and quality in summer and winter pastures,
 - C changes in soil test P, soil P sorption capacity over time, and their implications for P transport,
 - C avian community structure and biodiversity, and
 - C nematode community structure and biodiversity.
2. develop an economic simulation model that will:
 - C track the economic performance of cow-calf operations in south Florida for a given set of agronomic and animal performances relationships, and
 - C improve our understanding of ranching systems by identifying the agronomic and animal management decisions that have important economic consequences.

Results

Installation of water measurement flumes and hydrologic instrumentation was completed and the remainder of the year served as an equilibration period to remove the effects of construction disturbance and establish consistent measurement performance and procedures. Stocking rate treatments were established for the winter and summer pastures. During the winter season (November-April) cattle stocking rates are 0, 2.3, 4.0, and 5.3 acres per cow. In the summer season (April-November) cattle stocking rates are 0, 1.4, 2.5, and 3.3 acres per cow. One hundred forty Brahman-cross, pregnant cows (4-9 years of age) were stratified by age and body condition (5-7; scale 1-9) and randomly allotted to the stocking density treatments in preparation for placement in the winter pastures. Winter pastures will be burned in early November and approximately 60 days after the burn, cattle will begin grazing. Summer pastures were mowed (October) and are targeted for burning after the first frost event. Forage samples were collected from each pasture to determine standing biomass and forage quality prior to burning. Burning during the winter grazing period was unexpected and will interrupt the winter grazing period.

This year was devoted to background data collection to determine the chemical and biological status of the pastures before any treatments were imposed. Soil samples were taken from the winter and summer pastures arrays prior to cattle placement to provide pre-treatment soil P characterization. Analyses have been completed for the winter pasture array. Average water-soluble P concentrations were 19, 4.5, 1.0, and 0.3 mg kg⁻¹ for the 0-5, 5-10, 10-20, and 20-30 cm depth increments, respectively. Soil samples for nematode analysis were collected from the pastures in February, May, and early October. Analyses of these samples and data are pending. In addition to establishing background levels of nematodes in each of the pastures in the experiment, these samples will be examined for seasonal trends in nematode populations and analyzed for any differences in nematode populations and community structure between winter pastures (which tend to be wetter overall) and summer pastures (which tend to be somewhat

drier). Typically, the soil nematode community contains a great variety of different kinds of nematodes, many of which are involved in decomposition, others which feed directly on the roots of growing plants, and some which feed as predators or omnivores. Previous work indicates that population levels of different kinds of nematodes may respond to inputs of organic matter, fertilizers, and other sources of nutrients. Therefore it is anticipated that cattle populations and their associated inputs may have some impact on the soil nematode community as well. Bird census data collected in spring and late summer provide background data to reflect the general avian community associations that typically occur on south Florida pasture lands. These pastures have ephemeral wetlands and some forest islands. These habitat features provide for a mixture of wetland, upland forest and grassland associated bird species.

Work on the ranch economic simulation model during this first year of the project consisted of refining the initial spreadsheet model. University faculty in the animal science and range science departments were consulted about the overall structure of the model and specifically reviewed default values describing animal nutritional requirements and forage production coefficients. Several research papers were identified and work is ongoing to incorporate those findings into the model. Preliminary results, using data from two commercial ranches, indicate the model's ability to accurately track revenues and expenses and to estimate after-tax returns.

Plans for the Coming Year

Experimental treatments with cows placed on the pastures at assigned stocking rates will be in progress throughout the coming year. Cow body condition, herd health, calf weights, and cow pregnancy rate will be monitored for all stocking density treatments. Forage production and quality will be measured during the remainder of the winter grazing season and during the summer grazing period. Soil sampling will continue on a 4-6 month interval on all pastures. In addition, soils and standing water in localized areas will be sampled periodically to determine if nutrients are being accumulated in swales and ditches. Soil samples for nematode analysis will be collected in May and November from each of the 16 pastures. Bird censuses will continue on a quarterly time frame. These samples will allow for censuses to be taken during migration periods and when resident bird species are nesting. Vegetation structure also is monitored during bird census periods to test if any association exists between bird usage and structural aspects of the vegetation. Priorities in continuing the refinement of the economic simulation model will include: 1) loading financial information from MacArthur Agro-ecology Research Center at Buck Island Ranch and analyzing production/financial trends, 2) writing a user's guide for the simulation model, and 3) conducting ranch interviews in conjunction with county extension faculty to identify and solicit cooperation from commercial ranches in south Florida. The objective is to configure the simulation model for each ranch. The specific data collected from ranches will be used to develop and refine model relationships. Hydrologic/water quality data will be measured continuously throughout the year from all 16 experimental pastures with support from a Florida Department of Environmental Protection/EPA Section 319 grant.

Products

Additional information regarding this project and other related activities at this location are available for review on the project web pages at the following URL address:

<http://www.imok.ufl.edu/buck/index.html>

Information available at this location includes project status, summary data, progress reports, work plans, meeting notes, experimental plot layouts, and other similar information.

McSorley, R. 1997. Correlation of nematode densities and rainfall in a Florida pasture. *Soil and Crop Sci. Soc. of Florida Proc.* 56:55-57.

Landscape, Land Use, & Water Quality

Project Directors: *Kenneth L. Campbell, Donald A. Graetz (UF/IFAS)*

Research Assistant: *Lisa M. Collins (MAERC)*

The cycling of nutrients within native and managed ecosystems is a major controlling factor in determining the productivity and composition of these communities. In central Florida, much of what was once native, subtropical wet prairie is now managed for grazing. In many areas of the world, and in Florida in particular, pastures and rangeland represent a substantial component of the landscape. These lands exert enormous influence upon nutrient cycling within regional ecosystems. To maintain or restore the ecosystem functions of subtropical prairies requires:

- better understanding of their nutrient and hydrologic processes
- recommendations for management practices which better mimic the traditional ecosystem processes of native landscapes.

The Landscape Design

Automated surface water sampling sites were established in 1994 on four pasture types (wetland, native prairie, semi-improved, improved pasture) at Buck Island Ranch. The wetland pasture is a mosaic of wetland communities, including sawgrass and broad-leaf marsh species. The native prairie pasture is dominated by native grasses. The semi-improved pasture has been planted extensively in Bahia grasses (an exotic) but still contains substantial wetlands. The improved pasture, dominated by Bahia grass, is gridded with shallow ditches. Each site is equipped with automated equipment to measure rainfall and surface water flow and to collect water samples based upon flow volumes. Water samples are analyzed for nitrogen and phosphorus forms. Two sites have complete weather stations.

Water Quality (1995-1996)

Total Kjeldahl nitrogen (TKN) concentrations in the runoff were similar across all land-uses and ranged from 3.7 to 5.5 mg/L (Table 3, page 14). Most of the nitrogen was in the organic form as indicated by low concentrations of ammonium-N and nitrate-N. Phosphorus concentrations were more responsive to land-use than nitrogen concentrations and ranged from 0.36 to 0.78 mg/L. Lowest phosphorus concentrations were observed in runoff from the marsh while highest concentrations were found in improved pasture runoff. In contrast to nitrogen, over 50% of phosphorus was in inorganic form. (Note: The 1997 water quality data is currently being processed.)

Future Plans

Analyzing relationships between nutrient concentrations, runoff volume, rainfall, and land-use activity will give a better perspective on the role of each of these in the nutrient dynamics. Runoff hydrograph characteristics vary considerably across these four land-uses. Improved land-use generate sharper-peaked hydrographs with a more rapid decrease in flow due to the enhanced surface drainage. The marsh site generates more runoff with a prolonged low flow rate due to saturated conditions and standing water during much of the year. These flow and nutrient data will be helpful in the development of models that will permit ranchers and managers to ask "what if?" questions on alternative ways of managing the land. This integrative approach offers the greatest possibilities for solutions to the surface water nutrient problems of central Florida.

Table 3: Surface Water Runoff Nutrient Concentration (1995-1996)

Pasture Type	TKN (mg/L)	TP (mg/L)
Marsh	5.5	0.36
Native Prairie	4.1	0.52
Semi-improved	3.7	0.40
Improved	4.2	0.78

Cow-calf Performance as Affected by Stocking Density

Project Director: *Michael D. Fanning, (IFAS)*

Assistant Professor and Extension Beef Cattle Specialist, UF/IFAS

Southwest Florida Research and Education Center - Immokalee

Cattle have been identified, ear tagged for individual identification, and assigned to one of four stocking densities (Table 1). The four stocking densities are replicated in eight winter array 80-acre pastures and 8 summer array 50-acre pastures (Table 2). The animals assigned to a specific stocking density will remain in the particular stocking density when moved between winter and summer arrays. Tables 1 and 2 are located on the Southwest Florida Research and Education Center's web site. The address is <http://www.imok.ufl.edu/buck/stocking/design.html>.

A cow-calf herd management calendar has been developed. The calendar covers all aspects of cow-calf management practices. Vaccinations, breeding soundness exam of bulls, start and ending of the breeding season, deworming of cattle, implanting calves with growth promotants, castration of male calves, palpation to determine pregnancy, and shipping of calves are all items included on the herd management calendar for Buck Island Ranch (Table 3). Table 3 are located on the Southwest Florida Research and Education Center's web site. The address is http://www.imok.ufl.edu/animal_sci/research/buck/table3.html.

Animal performance data collection will begin when the experiment starts in the Fall of 1998 with the introduction of the cows into the winter array pastures.

Table 1. Cow-calf stocking density for winter and summer array pastures.

Treatment Code	Description (cow-calf pairs per plot)	Winter (Acre/cow-calf pair)	Summer (Acre/Cow-calf pair)
C	control (no cow-calf pairs)	0	0
15	low rate (15 cow-calf pairs)	5.3	3.3
20	moderate rate (20 cow-calf pairs)	4.0	2.5
35	high rate (35 cow-calf pairs)	2.3	1.4

Table 2. Random allotment of cow-calf pairs (treatments) to winter and summer array pastures.

Plot Number	1	2	3	4	5	6	7	8
Winter Array (80 acres/plot)	C	20	35	15	35	15	C	20
Summer Array (50 acres/plot)	C	20	35	15	35	15	20	C

Table 3. Herd health and working schedule for all cattle on Buck Island Ranch (all dates are approximate).

Nov. 01	Vibrio/Lepto/Trich all early breeding cattle this includes retain opens and first time breeding heifers.
Nov.	Bleed bulls, semen test, tick check, etc. (Bull Management)
Dec. 01	Put Bulls with early breeding females
Jan. 01	Vibrio/Lepto/Tick booster cow herds Work early bred cows calves deworm, external parasites, bleed Castrate calves, implant, deworm, weigh calves
Jan 15	Put bulls with all cows
Feb. 15	Pull Bulls from open breeders from prior year 75 days
March	Work all other calves deworm, implant, castrate, weigh calves Tick/vibrio/lepto replacement heifers
Mid-March	Pull Bulls from two year old breeders 95 days
April	Shipping shots early bred calves; IBR, BVD, PI3, plus Lepto, 8-Way Blackleg, Deworm, weigh calves, 2 nd Tick shot for replacement heifers
May	Ship Early calves, Pull bulls from all cows May 17 Put Bulls with replacement heifers
June	Shipping Shots to all other calves, weigh calves
July	Pregnancy check all early bred cattle Give fall shots to bred cows Pull bulls from yearlings
Aug.	Ship calves
Sept.	Pregnancy check all cows Deworm, Defluke, 8-Way blackleg, Vit. A-D, 3Way/lepto, external parasite control all cows 2 nd round of shots to weaned retained calves
Oct.	Pregnancy check Yearling cattle Start cycle over again

Surface Water Quality and Cattle Operations: An Experimental Approach

Project Directors: *Multiple Principal Investigators from Archbold, UF/IFAS, SFWMD*

The objective of this research program is to obtain a better understanding of the factors in cow-calf operations that affect surface water quality in the Lake Okeechobee Watershed. Phosphorus loads to Lake Okeechobee are still substantially above target levels set by Florida's Surface Water Improvement and Management (SWIM) legislation. Reducing the total amount of phosphorus entering Lake Okeechobee is a major environmental goal. Although the concentrations of phosphorus in the surface waters leaving individual ranches are not high, the extensive acreage of cattle ranches in the watershed means that ranches are, cumulatively, a major contributor of these nutrients to Lake Okeechobee. Viable solutions will depend upon having credible data addressing various management issues. Finding economically sustainable ways to further reduce phosphorus and nitrogen loading to Lake Okeechobee is important.

The Experimental Design

In 1995, two large experimental pasture arrays at Buck Island Ranch were designed to examine the effects of stocking rates on water quality. MAERC constructed (1996-97) eight pastures in each of two arrays. Summer pastures (50 acres each) are planted in Bahia grass and fertilized annually. Winter pastures (80 acres) are dominated by native grasses. Modification to our 'Surface Water Permit' from the Florida Department of Environmental Protection and a 'Wetlands Modification Permit' from the U.S. Army Corps of Engineers were obtained.

Each of the 16 experimental pastures are isolated hydrologically from surface flow by small berms and collection ditches. Flumes for measuring surface water flow are at the outflow point of each pasture. Each flume will be equipped with an automatic water sampler. Water samples will be collected based upon timing and volume of surface water runoff. Samples will be analyzed for phosphorus and nitrogen content and other important parameters. The nutrient information, in combination with flow volumes, will help determine loading rates for both phosphorus and nitrogen relative to stocking rates. Weather data from the summer and winter arrays will provide information to estimate evapotranspiration and to calculate a water budget for the treatment area.

The experiment will examine the effects of stocking rates on nutrient content in pasture runoff. Each study animal will be assigned to a high, medium, or low stocking rate herd at the beginning of the study and will remain with the same herd through the life of the project. The 140 "Braford" cows (4-9 yrs. old) required for this study will be selected randomly from one of the commercial herds at Buck Island Ranch. During the study, replacement females will be selected from the same herd. Test herds will use the winter pastures during November-April/May and the summer pastures during May-November.

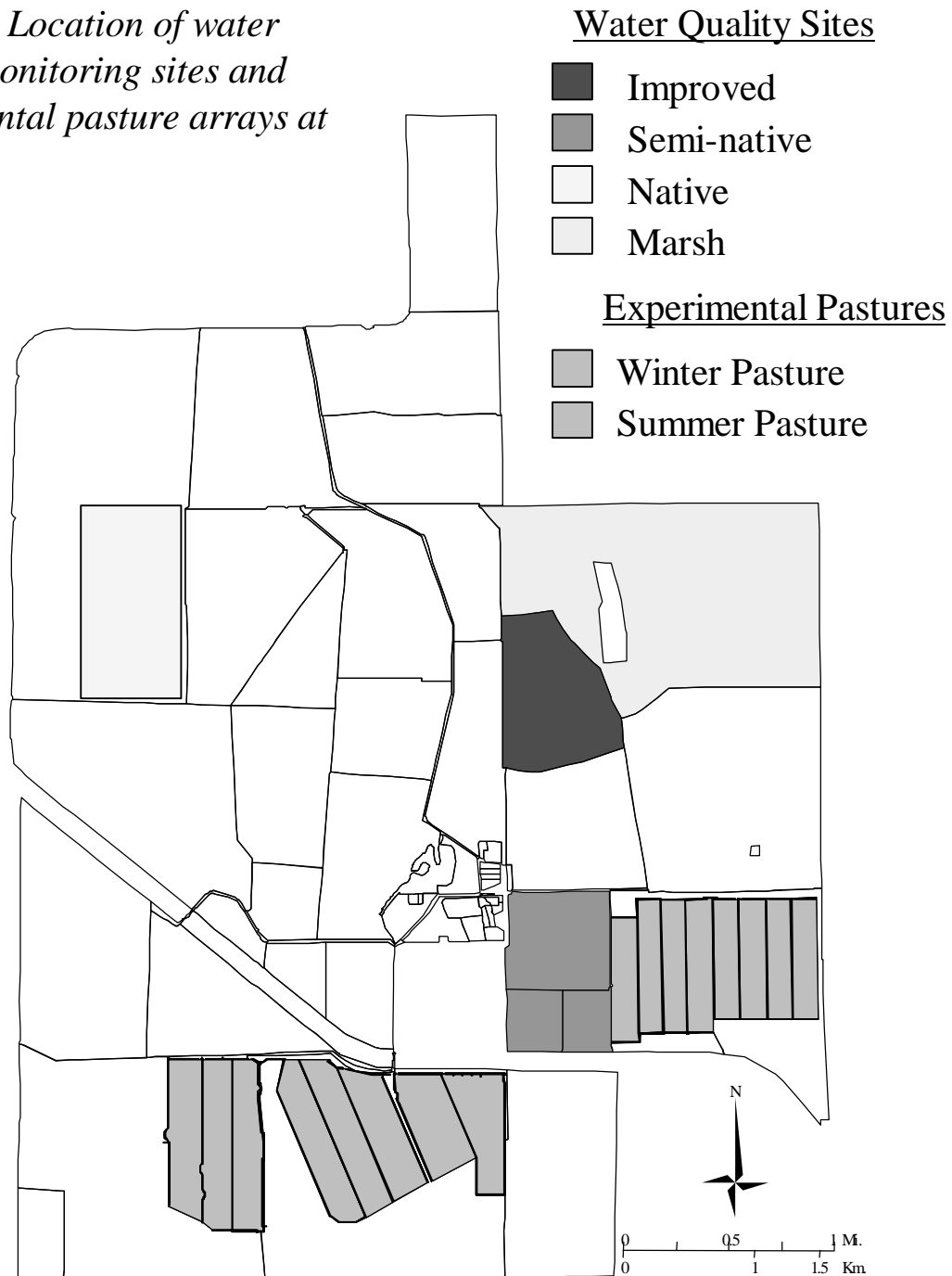
Economics of Decisions

Having information on the economic implications of alternative management scenarios is essential to the development of programs that improve water quality while maintaining the economic sustainability of ranches. Cow conception rates, weaning percentages, and weaning weights are three variables that have a major influence on the income of a cow-calf operation. Alternative stocking rates may cause cows to consume more or less winter supplement or minerals. Similarly, the condition of a breeding female may affect her long-term viability to the rancher. These critical production variables will be monitored by MAERC during the experiment and used to evaluate the economic consequences of different stocking rates.

Future Plans

Over the course of this experiment, we should gain an understanding of the influence of stocking rates on the quality and quantity of water leaving summer and winter pastures. Additionally, production information for cattle will provide economic evaluation of alternative management practices. This work will help develop management practices that are both economically sound for the cattle industry and environmentally sustainable.

Figure 2. Location of water quality monitoring sites and experimental pasture arrays at MAERC



Selected Research Summary Reports
Projects Not Supported by the Center for Natural Resources

Decision Support System for Beef Cattle Production

Project Directors: *Kenneth L. Campbell, Clyde W. Fraisse (IFAS)*

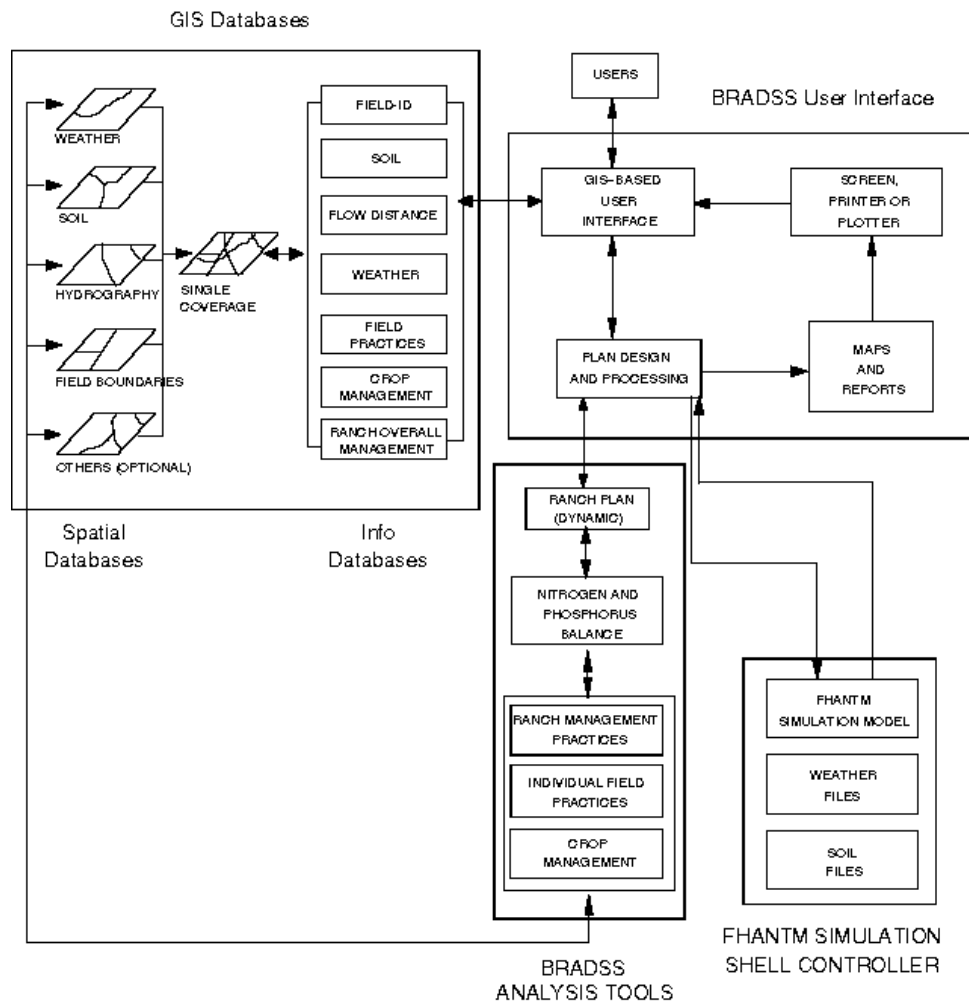
Regional Issues

Florida is a major beef cattle producing state in the eastern United States with production centered around cow-calf production. In Florida, over 75% of the nutrients required to maintain a cow and produce a calf come from forages on native prairie (3.8 million ha) and on pastures planted with exotic grasses (1.2 million ha). These regional land resources contain numerous environmentally-sensitive seasonal wetlands, and many other distinctive native habitats. Growing interest in maintaining the integrity of natural ecosystems has stimulated concern over the impact of cattle production practices on water quality and the environment. Ranchers in the region must adjust management (grazing, fertilization, etc.) to comply with state regulations that limit phosphorus in surface water runoff from pasture and native prairie. Also, grazing and roller chopping of wetlands are being scrutinized statewide with respect to water quality issues and habitat destruction.

Decision Support System

This project is a component of Florida's regional management goal to develop environmentally and economically sustainable cow-calf practices within the Lake Okeechobee Basin. The System seeks to determine relationships between agricultural practices and water quality, quantity, hydroperiod, and economic sustainability. FHANTM (**F**ield **H**ydrologic **A**nd **N**utrient **T**ransport **M**odel) is a field-scale model which simulates water and phosphorus movement from individual pastures. It was recently modified and enhanced by adding complete phosphorus and nitrogen simulation components to develop a new version, FHANTM 2.0. This new model was tested using existing data from an earlier study in Okeechobee County, Florida. Initial results show a good agreement between simulated and observed values. FHANTM 2.0 was used with a Geographic Information System (GIS) to develop BRADSS (**B**eef **R**anch **D**ecision **S**upport **S**ystem), a tool for evaluating water and phosphorus losses from individual ranches under various management practices. It was designed for flexibility and easy use in a generalized cattle ranch application. Time-series graphing allows viewing selected input and output variables in paired graphs. This provides a visual display of daily water and nutrient responses as a function of time. The System also provides maps and tabular reports of average annual responses. BRADSS includes algorithms to model the attenuation of phosphorus in flowing water from field-edge to the ranch outlet and allows decision-makers to simulate the impact of beef cow-calf operations on water quality. BRADSS provides a summary table for use in ranch production management and economic analysis. Development of the model and the decision support system is nearly complete, but calibration, verification, and sensitivity analysis will require field data, such as hydrology and water quality, from experiments initiated at Buck Island Ranch in 1997. Additional information that may be required includes linking pasture management practices to carrying capacity and production costs.

Figure 1: BRADDS Model Schematic



Ridge Citrus Water Quality Project

Principal Investigators: *Wendy D. Graham, Ashok K. Alva (UF/IFAS)*

Research Assistant: *Lisa M. Collins (MAERC)*

Project Manager: *Marlene Czerniak (FDACS)*

In Florida, a multi-agency Nitrate Study Committee has recommended a long-term research project to evaluate the effects of alternative citrus fertilizer and irrigation practices on groundwater quality in the vulnerable sandy soils of the ridge citrus region (the Lake Wales Ridge, and other near-by ridges) of central Florida. The objectives of this project are: 1) generate baseline groundwater quality data from commercial groves in the ridge citrus region to correlate current groundwater quality data with existing and historic management practices; 2) develop recommendations for alternative nutrient and water management practices to reduce off-site water quality impacts associated with citrus production; and 3) assess the impacts of alternative management practices on groundwater quality, fruit yield, and juice quality.

Because nitrates in drinking water can cause health problems for infants and the elderly, the Environmental Protection Agency has set a maximum concentration level (MCL) of 10 mg/L (milligrams/liter) for drinking wells.

Buck Island Ranch

The Buck Island Ranch (MAERC site) citrus grove is one of six study sites established in 1993 in Highlands County, Florida. The Ranch grove is important in evaluating differences in ground water contamination between ridge and off-ridge groves. MAERC contributes to this project by water sample collection through mid-1996 and continues to provide rainfall data and site management information. The baseline monitoring data show that groves managed at sites with shallow groundwater tables (3-6 feet), as at the Ranch, do not show groundwater nitrate levels above the EPA MCL. However, mature groves managed at sites with groundwater tables \$10 feet below ground level, as on the Lake Wales Ridge, often show nitrate concentration above the MCL. Data from the native-vegetation ridge at Archbold Biological Station show no nitrate.

Preliminary Analysis

After baseline groundwater quality data were established at each grove, site specific fertilization and irrigation best management practices (BMPs) were implemented in December 1994. A preliminary analysis of post-BMP monitoring data suggests that all sites show statistically significant downward trends of nitrate concentration in groundwater over time. The downward trends range from 0.5 mg/L/yr to 5.7 mg/L/yr, and are greatest for the fertigation/foliar spray BMP. If the current rate of decrease continues, all sites will be in compliance with the nitrate MCL within two to four years. Testing of leaf nutritional status shows that leaves at all groves have remained either very close or slightly above the optimal range of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) concentrations. No significant changes in fruit weight or juice quality that can be attributed to the prescribed changes in management practices have been observed.

Water quality monitoring and horticultural response of the citrus groves will continue through 1999 to examine long-term impacts of the recommended citrus management practices. The Buck Island Ranch site has been reduced to quarterly monitoring as the nitrate levels continue to be below the EPA MCL.

Reproductive Ecology and Habitat Associations of Audubon's Crested Caracara in South-Central Florida

Project Director: *Joan L. Morrison (IFAS)*

Research Assistant/Intern: *Steven M. McGehee, L. Danielle Todd (IFAS)*

Because of their role as top predators, birds of prey are valuable indicators of ecosystem health. They are also important component of biodiversity. The crested caracara, a distinctive raptor/scavenger, is a species of concern in Florida because it occurs as an isolated population remote from the nearest populations in Cuba and southern Texas. In Florida much of the caracara's original habitat, native prairie, has either been converted to intensive monocultural agriculture or occupied for urban use. The Florida population is suspected to be in a long-term decline and is listed as Threatened by both Federal and State governments. Today, the caracara is found almost exclusively on Florida's cattle ranches, which contain much of the remaining native and semi-native grassland habitats.

The goals of this project were:

- furnish a comprehensive picture of the caracara's population biology in Florida;
- document habitats used for nesting and foraging;
- provide information useful for developing management guidelines that addresses the population's long-term persistence.

The research focused on understanding the caracara's use of cattle ranches.

During 1995-97, the MacArthur Agro-ecology Research Center served as research headquarters for this regional project. At Buck Island Ranch, nesting activity was regularly monitored to determine reproductive success and productivity for seven caracara territories and for two on an adjacent ranch. Adults and chicks from these nine families foraged regularly on the Ranch. In 1995, five of these nine pairs produced independent young, and in 1996 all nine pairs produced independent young. This density of 1 pair per 550 ha suggests high-quality habitat exist for caracaras at Buck Island Ranch. In 1995, all juveniles from these nine families were banded and five juveniles and three adults were radio-tagged. In 1996, 13 juveniles and 3 adults were radio-tagged. As of 1996, we obtained home range data, via radio-telemetry, for one adult from each of the nine territories. Radio-telemetry of the juveniles provided data on their survivorship and movement patterns. In 1997, monitoring of the banded adults from eight of the nine families continued. It was suspected that the ninth family was on a neighboring ranch.

Data from this research have focused attention on the importance of cattle ranches for native wildlife and on the need for habitat conservation plans to consider private lands. Many local ranchers supported this research by permitting access to their lands, and results to date indicate that caracaras seem to be doing particularly well on cattle ranches.

Proceedings

Agro-ecology Research to Develop Sustainable Cattle Production Practices for Florida*
By J.C. Capece and M. Mozaffari

*Please see Appendix III for entire copy of the document.

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Extension and Education

Overview of Extension/Education Programs

Communicating the results of research to ranchers, environmentalists, policy makers, regulators, and the general public is critical to the success of the MAERC Agro-ecology Project.. UF/IFAS faculty and MAERC staff made numerous presentations to groups across the state and at the Buck Island Ranch. During recent years over 50 agricultural, environmental, and educational groups have toured the Ranch.

General Tours and Groups

Several groups visited the Ranch in 1997 for tours and presentations on the MAERC activities and research. These include agricultural groups such as Florida Cattlemen's Association, various environmental groups, numerous regulatory agency representatives, and educational groups ranging from elementary school students to college classes. Presentations include a slide show focusing on the mission of MAERC, the agricultural operations, and the various research projects. MAERC staff take groups on a Ranch tour that highlights the cow-calf operation, water quality research, and wildlife projects. Tours are often organized to focus on interests of the specific group. These presentations are critical to promoting the mission of the MAERC and improving interactions between various agricultural, environmental, and educational groups.

4-H Youth Programs

Each year the Ranch is host to a Livestock Judging Workshop for 4-H groups from the region's counties. Groups learn from a practice judging competition and interaction with other teams, extension agents, and MAERC staff. An annual Livestock Judging Competition for 4-H and Future Farmers of America groups is held at the Buck Island Ranch. Approximately 200 members of these youth groups participate in the day-long competition. Teams judge classes of steers, heifers, and bulls and awards are given for teams and high scoring individuals. The Highlands County's 4-H Camp visits MAERC each year. Campers are given a tour of the Ranch and learn about the agricultural operations and research at MAERC.

Extension Projects

Title: *Nematodes in Pastures Are Not at All Bad*

Contact Name: Robert McSorely

Description: Florida growers and gardeners are familiar with plant-parasitic nematodes and the damage which these worms cause to vegetables, grass and other types of plants. Nematodes are microscopic in size, they often go unnoticed but several thousand can be present in a pint of soil. Nematodes occur in all soils which support plant growth, regardless of the type of plant. Although much research has been done on the control of plant-parasitic nematodes, very little is known about the habit or even the occurrence of beneficial nematodes in Florida soil. UF-IFAS and the Archbold Biological Station, since 1994 have been collecting soil samples on a regular basis at the MacArthur Agro-ecology Research Center to determine what kinds of nematodes normally present in a health Bahia grass pasture. There have been significant findings in the samples collected.

Title: *Effective management for Frogs and Toads on Florida's Ranches*

Contact Name: George W. Tanner

Description: Most people know that frogs depend on water for breeding. Thus, the practice of ditching land to drain it for cattle grazing may seem incompatible with frog conservation. However, because of varying requirements of the different species, many species of frogs and toads can successfully coexist in a landscape modified for cattle ranching.

Media Coverage

Articles*

“Buck Island: Research at Archbold a key to future,” Ric Liljenberg, *The News-Sun*, 10 July 1996.

“Cut not, want not,” Becky Mills, *Beef Today*, April 1997.

“Good news is a rare bird,” Becky Mills, *Beef Today*, October 1997.

“They’re different yet the same,” Diane Mercado, *Highlands Today*, 1 November 1997.

Television Coverage

Cable News Network, CNN, Charles Tsai and Janice McDonald, 25 March 1997

Web Pages*

Buck Island Ranch Project, Southwest FL Research and Education Center. Revised 1999.

<http://www.imok.ufl.edu/animal_sci/research/buck/buck.html>.

Title: *Learn About the MacArthur Agro-Ecology Research Center on the Internet*

Contact Name(s): John C. Capece and Morteza Mozaffari (UF/IFAS)

Description: New tool for learning about MacArthur project and the information becoming available as the result of that research. Thanks to funding from the Center for Natural Resources (CNR) at the UF-IFAS. MacArthur Agro-ecology project has a *world wide web homepage* on the Internet. The homepage is housed on the computer system at the Southwest Florida Research and Education Center (SWREC) in Immokalee, Florida. Advantages for using the homepage: 1) a very large amount of information can be stored on the homepage, 2) ranchers can access the information whenever their schedule permits and 3) information can be viewed and retrieved using any computer with Internet access.

Internet address: <http://www.imok.ufl.edu/buck/index.html>

There are 8 sections to the MacArthur homepage:

- Introduction
- Research and Extension
- Aerial Photo and GIS Images
- Sustainable Agriculture
- Participant Directory
- Project Governing Documents
- E-mail Exchange and Archive
- Location Map and Upcoming Events

* Copies of these articles and web pages can be found in Appendices I and II.

Other Relevant Websites:

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Image of Summer Plots <<http://www.agen.ufl.edu/~maerc/stocking/summer.gif>> .

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<<http://www.archbold-station.org/maerc/bamacarthu.htm>>.

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Capece, J.C., M. Mozaffari, G.T. Bancroft, K.L. Campbell, and D.A. Graetz. Developing cattle production practice for restoration and protection of south Florida ecosystems. International Conference on Ecological Restoration and Regional Conservation Strategies, Society for Ecology Restoration. Miami, Florida.

Capece, J.C., M. Mozaffari, G.T. Bancroft. The MacArthur Agro-ecology Research Center an integrated research program to develop sustainable cattle production systems for Florida. 61st Annual Meeting of Florida Academy of Science.

Capece, J.C., M. Mozaffari, and G.T. Bancroft. Agro-ecology research for protection of subtropical prairie ecosystems of Florida. 24th Annual Conference on Ecosystems Restoration and Creation. 15-16 May.

Capece, J.C., M. Mozaffari, K.L. Campbell, and D.A. Graetz. A holistic approach to developing sustainable cattle production practices for Florida. Soil and Water Conservation Soc. of America Conference on Interactions: Investigating ecosystem dynamics at a watershed level. Athens, Georgia. 13-16 April.

Graetz, D.A., M. Mozaffari, J.C. Capece, K.M. Portier, and K.L. Campbell. Phosphorus availability and sorption in soils of Buck Island Ranch. Ecosystems Symposium, University of Florida, Gainesville, Florida.

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MAERC Presentations Sponsored by Center for Natural Resources, IFAS

Swain, H.M. The MacArthur Agro-ecology Research Center; exploring the relationship between agriculture and ecology in Florida. Center for Natural Resources, IFAS, University of Florida, Gainesville, FL. 26 Sept.

Swain, H.M.. The MacArthur Agro-ecology Research Center; exploring the relationship between agriculture and ecology in Florida. Keynote Address at the First Annual Agro-ecology Conference, Center for Environmental Studies, Tampa, FL. 13-14 Nov.

Appendices

Articles

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Internet Sites

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MOU Meeting Agenda