MacArthur Agro-ecology Research Center
2001 Annual Report
for the
John D. and Catherine T. MacArthur Foundation

Prepared by
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and
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Letter from the Executive Director

Hilary M. Swain (Executive Director, Archbold Biological Station)

Archbold Biological Station welcomes this opportunity to outline our achievements at the MacArthur Agro-ecology Research Center (MAERC) in this 2001 Annual Report.

The Report gives an overview of the agricultural and ecological setting of this full-scale commercial cattle ranch, a description of beef cow-calf operations, and accounts of the multiple research activities. It summarizes projects investigating the relationship between water quality issues, endangered species, and native biodiversity and cattle ranching operations at Buck Island Ranch. Some of these individual research projects have been profiled in more detail in previous Reports.

Dr. Patrick Bohlen, Assistant Research Biologist at MAERC, leads an active research program at the ranch examining nutrient cycling in wetland ecosystems. As you will see, 2001 has seen the MAERC research partnership of Archbold Biological Station, the University of Florida Institute of Food and Agricultural Science (IFAS), the South Florida Water Management District (SFWMD), and the Florida Cattlemen's Association (FCA) continue to progress successfully.

In 2001 we hosted a site visit from the MacArthur Foundation including President Jonathon Fanton, Joshua Mintz, Vice President and General Counsel, and David A. Harris, Director of Florida Philanthropy. During this visit we discussed ongoing research programs, the proposed Wetland Reserve Program easement, agricultural operations with a focus on the difficulties in citrus operations, and long-term issues with the lease. A brief description of this visit is included (page 30).

We encourage the Foundation to explore the details of our ranch operational activities in this 2001 Report. We invite follow up on any aspects of the program in which there is interest. It would be our great pleasure to host further site visits for Foundation Staff or Board Members, to get a first hand view of all activities. One stipulation of our lease agreement (Section 6, Grant Program Investment Letter, dated November 15, 1988) is that an Executive Officer from Archbold makes a detailed formal presentation to the Foundation's Asset Management Committee on progress at MAERC at least once every five years. If requested, I would be delighted to give such a presentation in Chicago. We welcome continued Foundation support and interest in programs at the MacArthur Agro-ecology Research Center.

Hilary M. Swain,
Executive Director,
Archbold Biological Station

Mission

The primary mission of MAERC is to conduct and stimulate long-term research on the relationships among cattle ranching, citrus production, and the native ecological systems of central and southern Florida.

To achieve this goal, the staff of Archbold Biological Station and the MacArthur Agro-ecology Research Center, and the Board of Trustees of Archbold Expeditions are committed to maintaining the Buck Island Ranch as a full-scale, working ranch with a research infrastructure. Cattle herds and citrus groves are managed for research purposes at essentially full production levels. This provides both staff and visiting researchers an opportunity unique in Florida: to measure and monitor effects of alternative agricultural practices at real world scales of space and numbers. Through long-term monitoring and coordinated, large-scale experimental manipulations, research at MAERC is directed toward the following regional and global objectives:

- Develop a comprehensive understanding of the ranchland ecosystem and landscape of central Florida, including nutrient flow, surface and ground water movement, community dynamics, and population biology of native plant and animal species now largely dependent upon cattle ranches within this region.

- Document the effects on water quality and wildlife of pesticides, herbicides, fertilizers, and other chemical applications commonly used in cattle ranching and citrus production.

- Measure how certain "alternative" or low-input agricultural practices affect the long-term health and sustainability of the ranchland ecosystem, and what the economic trade-offs are in implementing these practices.

- Ensure the existence of impartially gathered and peer-reviewed ecological databases that can be used to fine-tune existing or new environmental regulations affecting agriculture in Florida.

- Develop means by which ranchers and citrus producers can conserve and foster natural resources and wildlife, in ways that do not require substantial economic sacrifice.

- Educate the public about the positive environmental roles that can be played by cattle ranches in protecting natural ecosystems of Florida.

The Beef Cow-Calf Operation in 2001

L. O'Gene Lollis (Ranch Manager, MAERC)

As a full-scale, working cattle ranch, Buck Island Ranch provides a unique opportunity to fulfill the mission of the MacArthur Agro-ecology Research Center. The 10,300-acre Ranch was managed in 2001 to support 3,213 units of breeding cows, bulls, and developing heifers. Three commercial herds of Brahman cross females and a small herd of heavy English cows made up the beef cow-calf operation. Brahman and Braford were used to sire replacement animals. Angus were used to produce terminal cross calves for sale. Calves are raised to approximately eight months of age and sold to stocker or feeder operations. The Ranch has a business plan that includes long-term management planning, flexibility, and re-evaluation as improved management practices are developed.

Management Factors

Herd Quality and Size. Maintaining the maximum sustainable herd size is critical to long-term economic viability. Long-term maintenance of breeding numbers requires managing the quantity and quality of breeding cows and replacement heifers. Extensive analysis of the quantity and quality of grass produced at the Ranch suggests that the Ranch should sustain a breeding herd of approximately 2,800 – 3,000 breeding cows. In 2001 we had 3,213 cows, bulls and developing heifers. Approximately 0.098% of the herd was culled in 2001 due to age, health, or performance. To maintain our breeding-herd level we retained 88 quality replacement heifers last year. Replacements are raised in a development herd and are now bred to calve for the first time as 2 - 3 year-olds. In 2001 we purchased 183 bred heifers, offsetting the lower numbers kept in 2000. We continually evaluate the economic feasibility of purchasing our replacements as bred heifers versus raising them ourselves to get the percentage of Brahman influence that is needed for our environmental conditions.

Health Program. In 2001 we spent an average of $25.56 per head on our herd's health program. The program includes parasite and disease prevention vaccinations, evaluation of reproductive measures, and calf health. Proper timing and annual review provides the opportunity to fine-tune our comprehensive herd health program. These inputs are essential in having a healthy productive herd.

Bulls. Bull type and quality are primary management factors that have a significant impact on maintaining the productive quality of the herd. In 2001 ten quality Braford bulls were kept from a small purebred herd and twenty Angus were purchased for the herd-breeding program. As we evaluate our heifer purchase program we may no longer need Braford or Brahman derivative sires to produce replacement heifers with Brahman influence, and we will move to a total terminal cross herd using Angus to produce English-type calves to sell at premium market prices.

Nutritional Program. Meeting the daily nutritional requirement of cattle is a management decision with significant impacts on production levels. Proper nutrition is critical to the breeding, calving, and lactation production phases

of cattle. Forage must meet the nutritional needs of cows that are pregnant and supporting a growing calf. Bahia is the primary forage available on our interior pastures used for spring grazing. The analysis of Bahia grass shows that our cattle require energy supplementation during November-March. Supplementation, using molasses, was provided based on the type of animal and the animal's production phase. In March, a single application of 52 lbs. of nitrogen fertilizer per acre was applied to enough Bahia pasture to support our cow-calf pairs. The benefits of maintaining the entire herd at the proper nutritional level, in better condition for improved production and health far outweighs the costs.

Marketing. Our calves were marketed for delivery in May and September. Calves are raised to an average age of seven to eight months and sold by the Ranch Manager directly to the stocker and feeder operations. We cannot control the price of beef, but we can plan for the seven-to-ten year cycle in beef prices that occurs. We subscribe to Cattle Fax, a source that provides projections on future production and prices in the cattle industry. Marketing tools, such as this, help us evaluate strategies regularly and maximize our marketing opportunities. In 2001 we retained around 104 steers and 54 heifers through the stocker phase. These were calves that were either lighter or slightly poorer in quality compared to the calves sold. In 2001 we retained 22 head of steer calves and sent them to the feed yards to feed them. This enables us to get the proper production data on how well our cattle are performing once we sell them. In years to come this will be a vital part of marketing calves.

Resource Management. Management of our native and semi-native resources is another important consideration at the Buck Island Ranch/MacArthur Agro-ecology Research Center. Factors such as burning and chopping pastures and maintenance of drainage ditches are evaluated and planned annually to maintain pasture quality. Our 2001 management plans were similar to that of 2000 to include renovation of some Bahia pastures by removal of existing sod, liming and reseeding. Our hopes are to increase sod production in the coming years to around 400 to 500 acres annually. In addition, our small game harvest lease brought in some revenue and allowed us to collect data on the distribution of game in a working agricultural landscape. Through research at MAERC, we are beginning to understand the wide range of wildlife supported by the variety of pastures and other interspersed habitats on the Ranch. Understanding the interaction between our landscape scale management of natural resources and wildlife responses is important in continuing to support economically and environmentally sustainable production agriculture.

Weather. Variations in weather have an impact on all management factors. Extremes in temperature or rainfall change the quality and quantity of forage produced. This can influence the quantity of supplemental feed or fertilization required in a certain year and can have significant impacts on production measures.

Operations Planning and Goals

Long-term planning, flexibility, and evaluation of improved practices are key management factors in operating Buck Island Ranch efficiently. Gene Lollis (Ranch Manager) and Sue Pettine (Controller) continually review and strategically plan all ranch operations on at least a quarterly basis.

The MacArthur Agro-ecology Research Center is committed to managing a full-scale working ranch. We aim to meet our goals of maintaining a sustainable agricultural enterprise and of providing typical cattle and citrus operations as a research infrastructure. This allows us to conduct research designed to examine environmentally and economically sustainable cow calf operations.

The Research Group

During 1994, three organizations (MAERC, IFAS, 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 FCA joined the MOU Advisory Committee and the Natural Resources Conservation Service (NRCS) is becoming involved in site characterization. The expanded partnership ensures a comprehensive research program.

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. http://www.archbold-station.org

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. http://www.agen.ufl.edu/~maerc/

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. 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. http://www.floridacattlemen.org/

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. http://www.ncg.nrcs.usda.gov

The Agricultural and Research Setting

Hilary M. Swain (Executive Director, Archbold) and Patrick J. Bohlen (Research Biologist, MAERC)

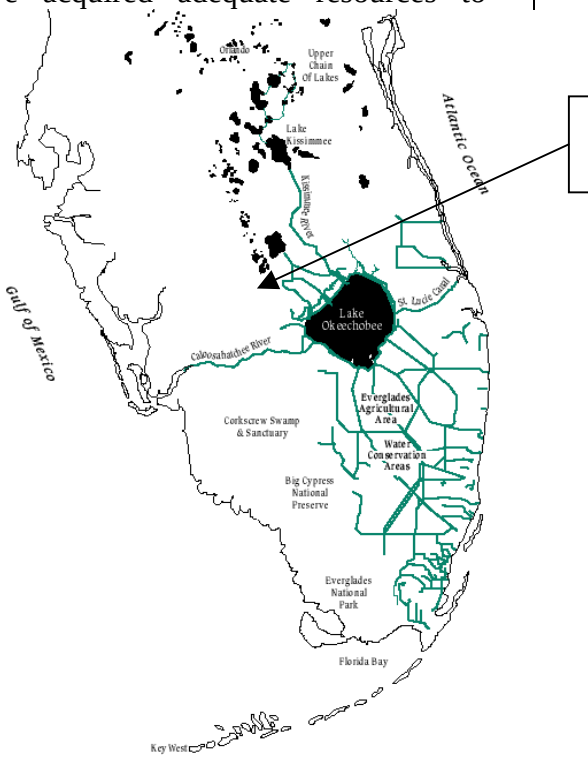
Grazing lands are complex agro-ecosystems involving large-scale manipulation of ecological processes, species, and the widespread modification of the spatial structure of the landscape (Vitousek et al. 1997). An economically and ecologically valuable component of the nation's grazing lands occur in Florida, where vast subtropical rangelands intersect with unique and environmentally sensitive native ecosystems. Florida is one of the leading cattle producers in the U.S., second only to Kentucky in beef production east of the Mississippi River (NRCS 1995). Over one million beef cow-calf units are supported on grazing lands in Florida, most of them privately owned. Much of what was once native subtropical wet prairie ecosystem in this region is now managed for grazing. Land use changes within this ecosystem have resulted in dramatic changes in the habitat characteristics and patterns of nutrient flow for upland, marshes and lakes. For example, total phosphorous concentration in Lake Okeechobee has almost doubled since 1970's and chlorophyll a level significantly increased between early 1970's and 1990. Runoff from this cattle production region feeds into Lake Okeechobee and the Florida Everglades.

The region supports many federally listed plants and animals making it a "national hotspot" for endangered species, including numerous federally listed threatened and endangered species that have regulatory protection on private lands under the Endangered Species Act. Several of these occur on working cattle ranches like Buck Island Ranch such as the Crested Caracara (*Caracara plancus audubonii)*, wading birds like Wood Storks *(Mycteria americana)*, and reptiles such as Indigo snakes (*Drymarchon corais couperi)*.

South-central Florida is one of the nation's most sensitive ecosystems, with one of the nation's fastest growing urban populations and rapid land use changes stemming from agricultural intensification (citrus, sod and sugar). New initiatives such as conservation easements, public land acquisition, wetland restoration and ecotourism are beginning to affect land use decisions in these agricultural lands. Familiar easement programs, such as NRCS-USDA Wetland Reserve Program, are being sought. In addition Florida has a well-funded ($300 million per annum) fee and less than fee conservation lands public acquisition program called Florida Forever (successor to Florida's P2000 program) and has recently acquired conservation easements over extensive areas of working cattle ranches in south-central Florida. Use of public lands for grazing in this watershed is an emerging issue. Florida cattle ranch eco-tourism programs are developing rapidly (http://www.ces.fau.edu/projects/agroecology/ecotourconf/.) Preservation and restoration of grazing lands within this unique ecosystem ranks among the top issues of our national environmental priority list.

Over the last 7 years a multi-institutional team (including Archbold Biological Station, University of Florida Institute of Food and Agricultural Sciences – IFAS, the South Florida Water Management District – SFWMD, the Florida Cattlemen's Association –

FCA, and the Natural Resources Conservation Service – NRCS) has built an exciting new partnership to understand the interaction among the environment, production, and socio-economic well-being of producers and the public in subtropical grazing lands of Florida. The partners have launched experimental and decision support system research at the MacArthur Agro-ecology Research Center (MAERC, see Figure 5-1) in south-central Florida to develop ecologically and economically sustainable cattle ranch management practices for Florida. Project partners have acquired adequate resources to implement the project's core components including data for forage analysis, soil fauna, soils processes, nutrient cycling, hydrological flows, wildlife populations, animal production and economic production and financial information. Linking environmental, economic, and agricultural practice data via modeling will allow us to examine the relationships among ecological, economic and physical patch structures. It will also provide the synthesis and integration necessary for effective communication of our findings to the end user community in Florida.



MacArthur Agro-ecology Research Center

Figure 5-1. Location of the MacArthur Agro-ecology Research Center in South-central Florida.

The MacArthur Agro-ecology Research Center (MAERC) examines ecological patterns and processes within this landscape to understand changes in the species and ecosystems of this region in response to human-alterations. The interdisciplinary teams at MAERC - encompassing ecologists, economists, range scientists, agricultural engineers, hydrologists, soil scientists, animal scientists, statisticians, and ranchers - have a variety of research aims including:

- increasing knowledge of the ecological functioning of grazing lands
- assessing the consequences of alternative management practices
- improving the capacity of decision-makers and the general public to understand the ecological role of grazing lands.

With access to the 10,300 acre Buck Island Ranch facility, MAERC approaches these research priorities at real-world agricultural scales, and with a day-to-day understanding of the economic realities of operating a cattle ranch. Using both observational and experimental approaches we address the very broad question: how are the ecological, economic, and physical factors involved in grazing lands related, and how do they change over time? In the last year we have continued to collect integrated data to determine the effects of agriculture on patterns of native biodiversity and fluxes of water and nutrients. Our research approach uses Buck Island Ranch to represent the range of conditions in the Okeechobee drainage basin. MAERC's work in 2001 is highlighted in the following series of research reports, which are representative of ongoing research this year. A complete listing of active research projects is given in Appendix B.

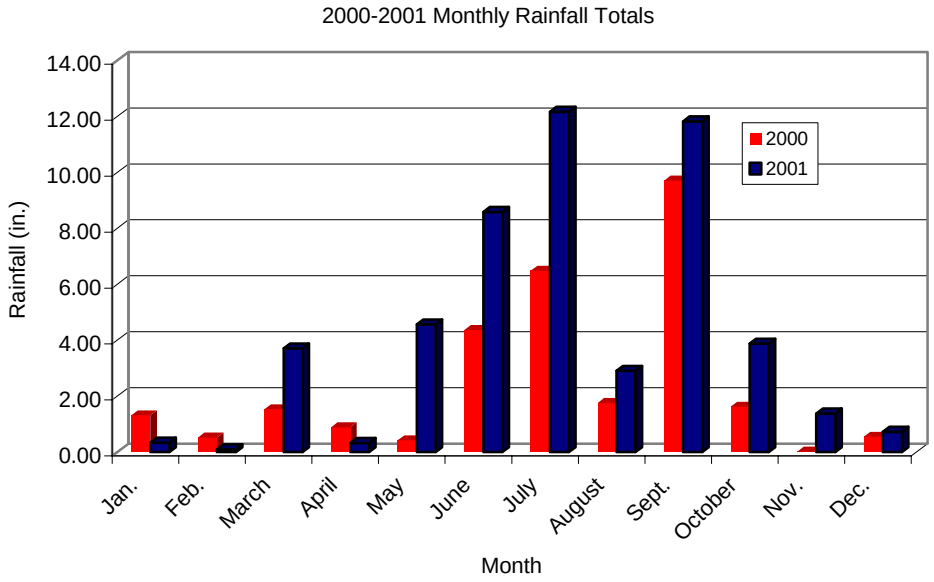
Meteorological Conditions

Patrick J. Bohlen (Research Biologist, MAERC)

Precipitation

Rainfall returned to near normal amounts in 2001 following the record drought of 2000. Rainfall amounts remained lower than average through April of 2001 but were much greater in 2001 than in 2000 during the rainy season (June-October). Total rainfall for 2001 was 50.5 inches compared to 29.2 inches in 2000. The greater precipitation during 2001 meant that the ranch experienced more typical flooded conditions in the rainy season than were encountered in 2000.

Figure 6-1.



Temperature

Air temperatures at MAERC in 2001 ranged from an average monthly minimum of 43.0° F in January to an average monthly maximum of 90.3 ° F in August. An unusually warm February followed a cold January. (Fig. 6-2)

Soils

Soil temperature probes were added to our weather station in 2000 to monitor soil temperatures, which together with moisture drives the rates of biological activity in the soil and influence patterns of productivity. The average monthly soil temperature in 2001 ranged from a low of 63° F in January to a high of 85.5°F in August. Soil temperature was slightly higher at the 5 cm depth than at the 10 cm depth from March through August, but was similar at the two soil depths from September through December. Soil temperature was particularly low in January due to cold air temperatures and were higher in February than in March due to warm air temperatures. (Fig. 6-3)

Figure 6-2

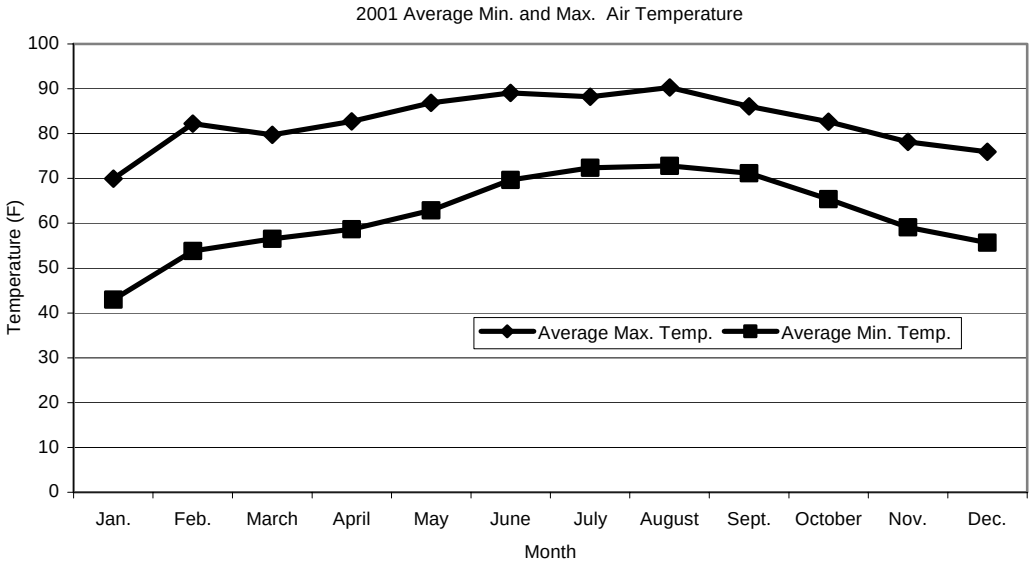
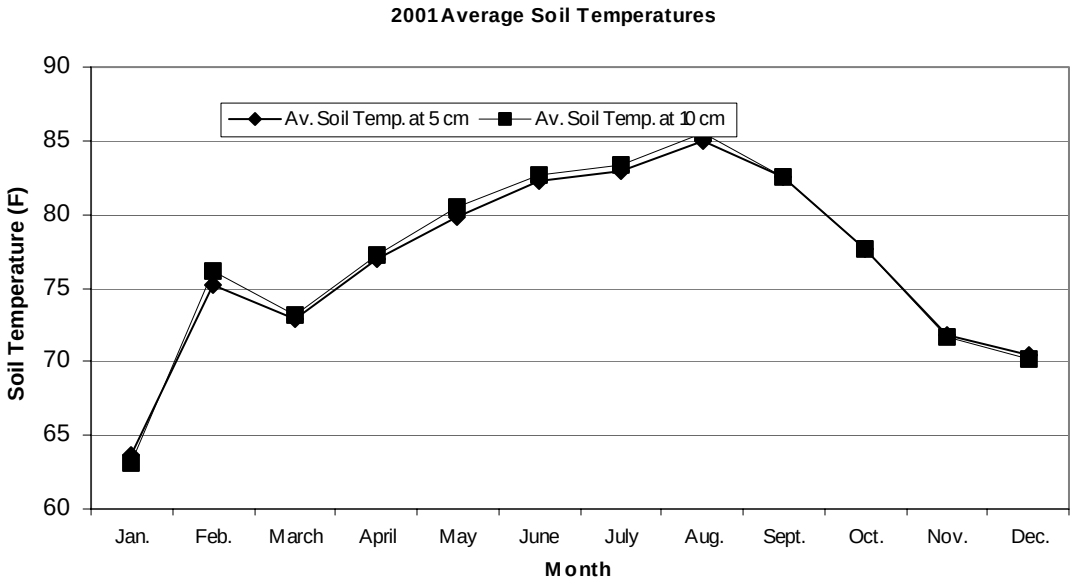


Figure 6-3



Agro-Ecosystem Indicators of Sustainability as Affected by Cattle Stocking Density in Ranch Management System

Patrick Bohlen, Ken Campbell (UF), John Capece (Southern DataStream), John Earman, J. Jeffrey Mullahey (IFAS), Don Graetz (UF), Robert McSorley (UF), Fritz Roka (IFAS), and George Tanner (UF)

Many details of this project are outlined at http://www.agen.ufl.edu/~maerc/stocking http://www.southerndatastream.com/

1. Forage ~ Jeff Mullahey (UF)

Decreasing cattle stocking densities is one practice that has been suggested to improve surface water quality runoff draining into Lake Okeechobee, Florida. The objective of this study was to determine the effects of stocking rate on forage production and quality, and forage utilization. Four stocking rate treatments were used on eight pastures (Buck Island Ranch, Highlands County) during both the summer (May-November) and winter (December-April) grazing seasons. Summer pastures consisted of established bahiagrass (8, 20.3 ha paddocks) whereas winter pastures (8, 32.4-ha paddocks) consisted of mostly native grasses. Stocking rate treatments on summer pastures were 0.58, 1.01, and 1.35 ha/cow for high, medium, and low rates, respectively. In the winter months, cattle stocking rates were 0.93, 1.62, and 2.16 ha/cow for high, medium, and low rates, respectively. A control without grazing was included for both winter and summer pastures.

To collect forage samples within the summer and winter pastures, summer pastures were divided into 10 blocks, and winter pastures into 16 blocks. Nine 1.5 m^2 grazing exclusion cages and associated paired-plots were randomly assigned in each pasture to a designated block to measure forage production and utilization. All forage was clipped at ground level, weighed to get a fresh weight, and then a sub sample was dried in a forced area oven to determine percent dry matter and for forage analysis.

Forage yield, utilization, and quality were not significantly affected by stocking rate. Forage yield in the winter pastures ranged from 2100-6300 kg/ha in both 1999 and 2000. In the summer pastures, forage yield ranged from 244-5580 kg/ha in both years. Forage yield data in this experiment was similar to yields observed by ranchers in south Florida. Forage utilization typically ranged from 19-30% for both summer and winter pastures. Higher utilization values were expected with the stocking rates used in this experiment. Forage utilization data suggested that forage production in the summer and winter pastures was adequate to support all of the stocking rates. Forage quality in the winter pastures varied across sampling dates for crude protein (5-8%), energy (25-32% IVOMD), and phosphorus (0.04-0.08%). In the summer pastures, forage quality values were higher compared to the winter pastures. Crude protein levels ranged from 5-12% , energy was 32-49%, and phosphorus ranged from 0.11.

2. Water Quality – 2001 Progress Report- Kenneth L. Campbell, John C. Capece and Patrick J. Bohlen

Rainfall at MAERC for the year 2001 was more than double that of the previous year (approximately 150 cm vs. 64 cm). Therefore, many more runoff events were recorded in the year 2001 by the 16 flume systems located on the MAERC summer and winter pastures. The summer pastures generated approximately ten discernable runoff hydrographs. Of these, two events generated peaks above 28 L/s on most of the summer pastures. The winter pastures generated a larger number of peaks but the hydrographs tended to be complex and not easily divided into distinct events. Most winter pastures generated at least two event peaks in excess of 56 L/s, some even higher. Figure 7-1 shows total runoff depths from each pasture for 1998 through 2001.

Figure 7-2 shows the mean annual total phosphorus (P) concentrations measured from each pasture for the years 1998 through 2001. Runoff concentrations of total P are consistently greater from the summer pastures than from the winter pastures, probably due mainly to historic land use. Note that P concentrations on the winter pastures were greater during the dry year 2000 than other years. Figure 7-3 shows the annual loads of total P from each pasture as determined from the measured runoff volumes and total P concentrations for each year. The dry year 2000 resulted in very small total P loads from the pastures even though total P concentrations were greater during that year, especially from the winter pastures. During 2001 the increased runoff volumes from all pastures resulted in the largest annual total P load for every pasture for the period of record. Similar data are available for ortho-P and forms of nitrogen. Figures 7-4 and 7-5 show examples of cumulative nutrient loads during 2001 from one summer pasture and one winter pasture. Note that significant reverse flow of nutrients into some pastures (primarily winter) occurred due to high water levels in Harney Pond Canal during dry periods.

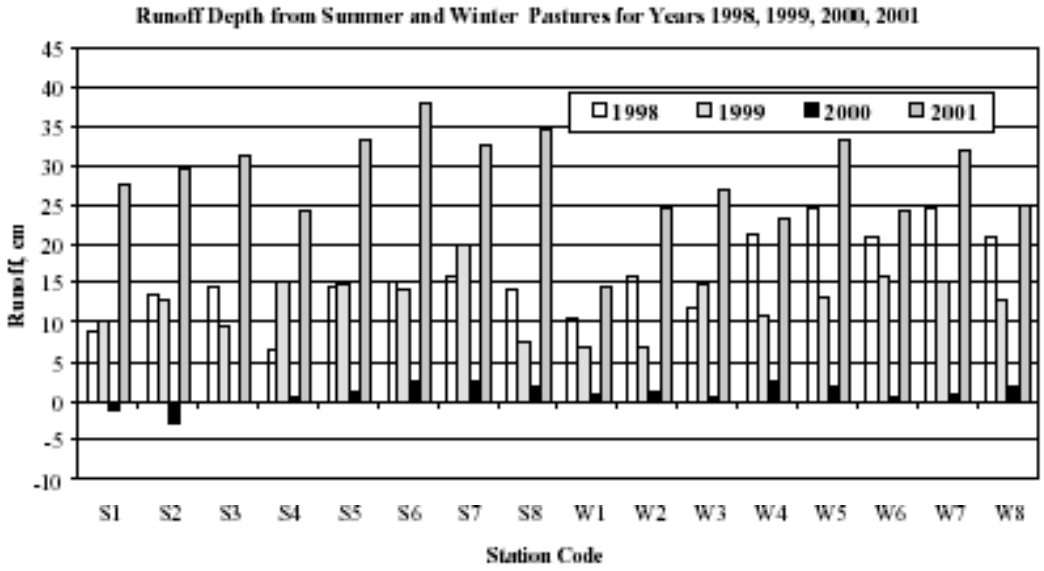


Figure7-1. Total runoff depth results calculated for summer and winter pastures blocks in the years 1998, 1999, 2000 and 2001.

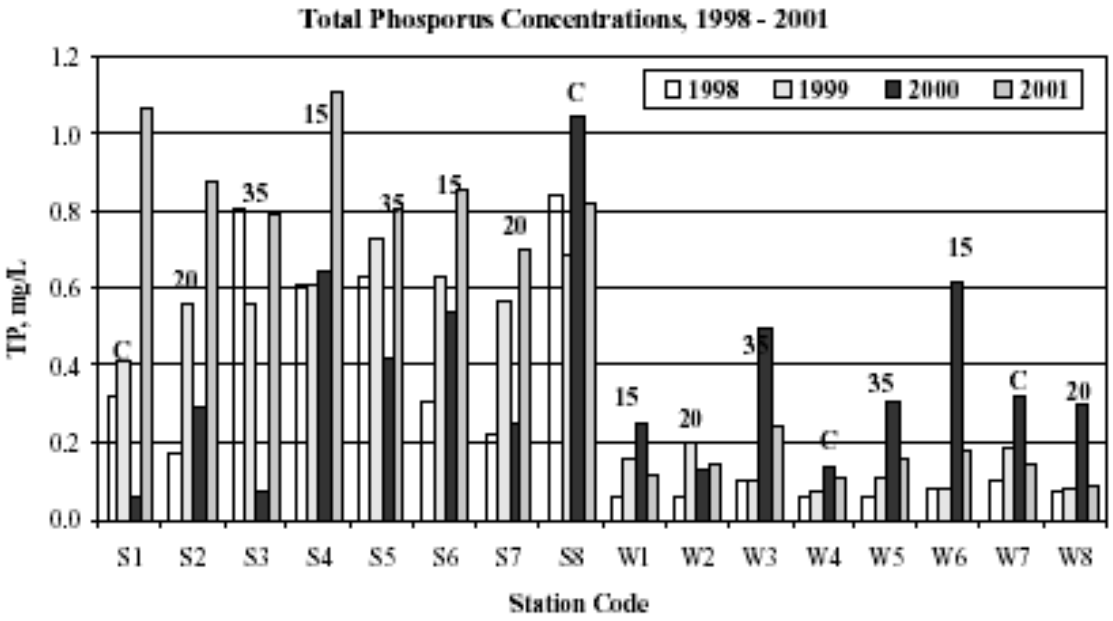


Figure 7-2. Total P in runoff from summer and winter pastures for the years 1998, 1999, 2000 and 2001 with mean phosphorus concentrations in mg/L (C represents the control plots).

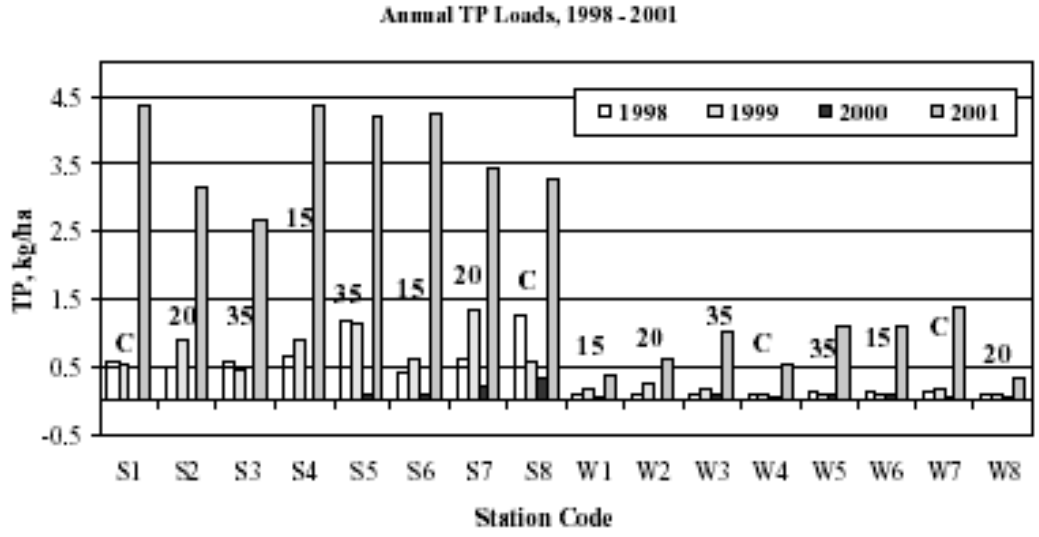


Figure 7-3. Comparison of nutrient loads in kg/ha calculated using TP concentrations collected from summer and winter pastures in the years 1998, 1999, 2000 and 2001.

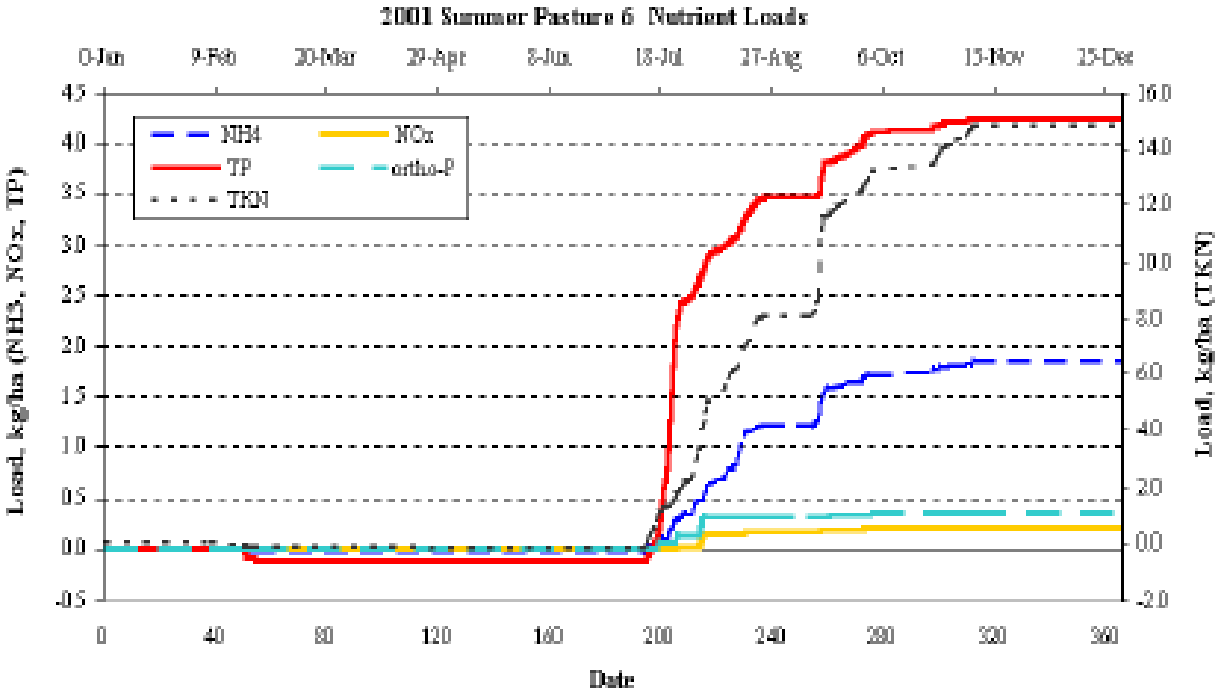


Figure 7-4. Cumulative nutrient load in kg/ha of elemental N and P as calculated for summer pasture 6 in the year 2001.

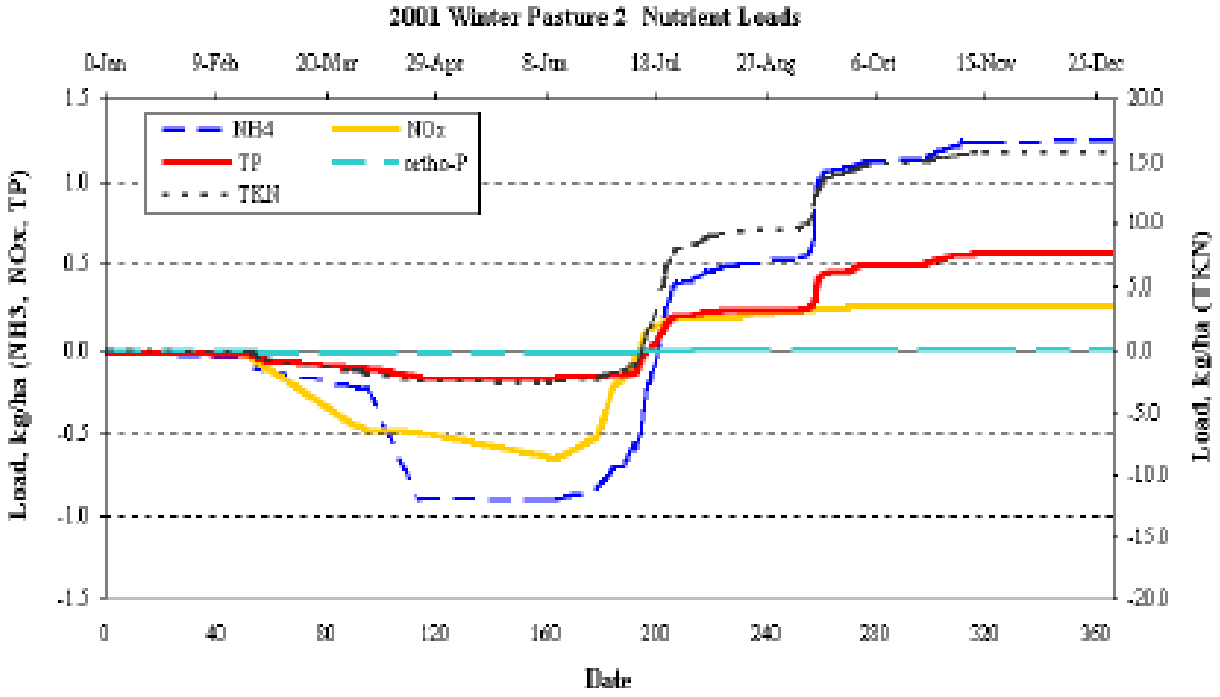


Figure 7-5. Cumulative nutrient load in kg/ha of elemental N and P as calculated for winter pasture 2 in the year 2001.

3. *Nematodes ~ Robert McSorley (UF)*

Ranch management practices aimed at cattle and pasture vegetation have the potential to impact other animals as well, including wildlife and other non-target organisms. Results of work conducted on impact of cattle stocking rates on non-target nematodes was summarized for two presentations, and compared with research conducted by G. W. Tanner on bird communities. Nematode and bird communities each represent very large and diverse animal groups, but also represent two very different levels of scale, varying greatly in size, habits, and structure. Results with both nematode and bird communities were similar, in that almost no effects due to cattle stocking rates were observed in either case, at least over the short term. Nematode populations showed strong seasonal responses, but effects from cattle density were minimal.

Work on nematode sampling has continued, in an effort to collect longer-term data to determine whether the trends observed thus far will be consistent over time. In addition, a new study has been initiated, with the intention of examining grazing effects on nematode communities on a very small local scale within pastures. The first samples for this study were collected from 20 different 1-m x 1-m plots in October 2001. These very small plots varied greatly in grazing intensity over the previous months, as determined by measurement of grass height. This design allows for detailed analysis of nematode communities and opportunities for correlation with grazing level or mineralization of organic matter. This study will determine whether grazing effects not apparent at the field level may be present on small local scales within fields.

4. Avian Community ~ George Tanner (UF)

No 2001 update available at time of MAERC report.

5. Soils ~ Don Graetz (UF)

No 2001 update available at time of MAERC report.

Nutrient Cycling in Seasonal Wetlands of Improved and Semi-improved Subtropical Pastures

Patrick Bohlen, Don Graetz (UF), and Stanley Gathumbi (Archbold Biological Station)

Wetlands in agricultural landscapes may help ameliorate water quality problems associated with farming and ranching operations by acting as nutrient buffers or sinks in the landscape. At Buck Island Ranch, there are numerous seasonal wetlands scattered throughout the landscape, and most of these wetlands are exposed to grazing cattle, fertilizer inputs and other agricultural operations. There have been several projects examining anuran (frog and toad) communities in the wetlands at MAERC, no previous research has examined nutrient dynamics in these wetlands. Such research is critical if we are to understand how these wetlands are influenced by the dominant land use in the region of south-central Florida and whether they can be managed or restored to improve the quality of surface waters in the region.

In the past year, Patrick Bohlen and his collaborators, Stanley Gathumbi, a postdoctoral research associate at MAERC, Don Graetz, faculty member at the University of Florida and Al Steinman, now Director of the Annis Water Resources Institute in Michigan continued their research on nutrient cycling in seasonal wetlands at MAERC. Following on last year's results in which we reported that levels of phosphorus (P) tended to be greater in sediments of wetlands in improved pastures than in those in areas of native prairie, we have analyzed nutrients in wetland vegetation. We also collected data on hydroperiod, vegetation composition, and water column nutrients.

Hydroperiod and water chemistry

Due to a severe La Nina event, 2000 was the driest year on record in South Florida with a total annual rainfall of ~30 inches in a region where ~55 inches is the annual average. As a consequence of this low rainfall, wetland hydroperiods were very short in 2000 (see Figure 8-1). Hydroperiods were much longer in 2001 than in 2000. Average water levels were always greater in the improved pasture wetlands than in the semi-native pasture wetlands, probably due to slightly higher elevations of the semi-native pastures.

Nutrient concentrations in the water column were much greater in wetlands in improved pastures than in those of semi-native pastures. Total phosphorus

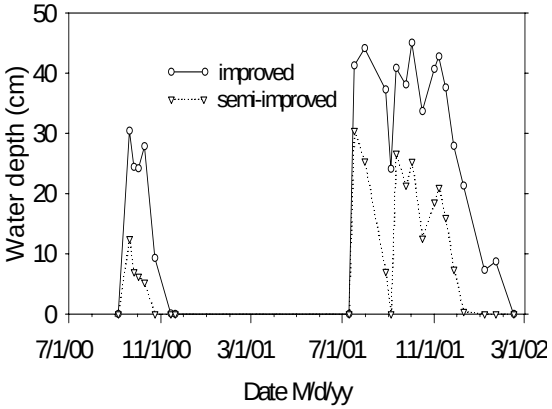


Fig. 8-1 Hydroperiod in wetlands in the experimental pasture in 2000 and 2001

concentrations were extremely high in improved pasture wetlands and a very high proportion (78%) of that P was biologically active ortho-P (see Table 8-1). Cattle stocking density treatments did not significantly affect water

chemistry in wetlands in the experimental pastures, possibly because even at the lowest stocking density wetlands in the improved pastures were exposed to significant cattle traffic. Thus, cattle impact may be more related to actual location of the cattle rather than pasture stocking density *per se*.

Pasture Type	Total P	Ortho-P	TKN	NH_4^+	NO_3^-
Improved	1.42 *	1.11*	6.02 *	0.35 *	0.007
Semi-native	0.19	0.08	3.93	0.12	0.007

Table 8-1.

We sampled other wetlands across Buck Island Ranch to assess whether the nutrient concentrations we encountered in our experimental pastures were representative of concentrations in wetlands throughout the ranch landscape. We selected 20 wetlands at different locations around the ranch, 10 each in native and improved areas of the ranch. Half of the wetlands in both native and improved areas were on one dominant soil type of the ranch (Spodosols) and half were on the other major soil type on the ranch (Alfisols) to account for any variability that might be introduced due to differences in soil type. Water samples from these wetlands were collected on two occasions in late summer in 2001 and analyzed for total phosphorus and the the more biological active form of P, soluble reactive phosphorus (ortho-P). Results from these samples showed that P concentration in the wetlands ranged over two orders of magnitude, and encompassed the range of concentrations in wetlands in the experimental pastures. Much higher P concentrations occurred in improved pasture wetlands than in native pasture wetlands, with a few exceptions (Figure 8-2). Some concentrations were exceptionally high (i.e. >3000 parts per billion) indicating that those wetlands were greatly enriched relative to the native condition. In general, wetlands with the highest P concentrations had signs of the greatest cattle traffic, indicating that cattle contributed high P concentrations, most likely due to stirring up the sediments

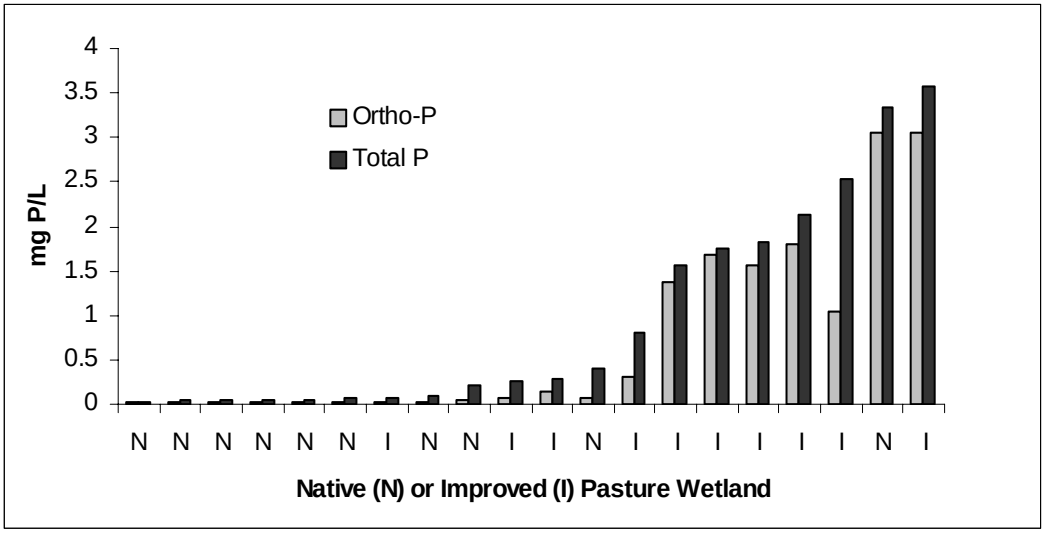


Fig. 8-2 This figure shows the range of phosphorus concentrations (total and ortho-P) in water from wetlands in native (N) and improved (I) pastures at various location throughout Buck Island Ranch.

and enhancing P release from nutrient laden sediments.

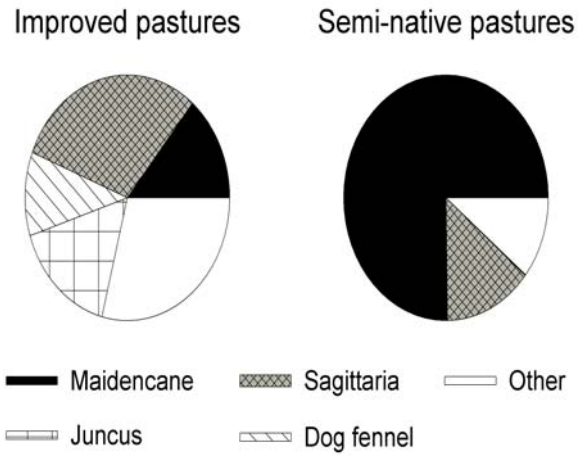
Effects of grazing on wetland plant communities

Patrick J. Bohlen (Research Biologist, MAERC) and Stanley Gathumbi (Archbold Biological Station)

There were large differences in wetland plant communities in the improved and semi-native pasture wetlands. Maidencane (*Panicum hemitomon*) dominated semi-native pasture wetlands, whereas a more diverse assemblage of species dominated improved pasture wetlands. The only wetlands in improved pastures that were dominated by Maidencane occurred in a control pasture with no cattle. Maidencane is a preferred forage and may have been grazed out by cattle from the improved pasture wetlands. Maidencane may persist in semi-native pastures because these areas are not grazed during the growing season. Furthermore, *Juncus effusus*, which is relatively unpalatable to cattle, dominates the edges and interior of many improved pasture wetlands but does not occur in the more native pastures throughout the ranch. These general patterns suggest that cattle have a stronger influence on wetland plant community structure in improved pasture wetlands, where they graze during the growing season (May-Oct.), than in semi-native pasture wetlands where they graze in the winter (Nov.-May).

Plant nutrient content and ratios

Nutrient ratios (C:N, N:P, and C:P) in live and dead plant material were significantly lower in wetlands surrounded by improved pastures than those surrounded by semi-native pastures, implying that vegetation was more enriched in N and P in improved pastures. These differences between the two pasture types in nutrient content of wetland vegetation were not due solely to differences in plant species composition, because even the improved pasture wetlands that had plant species composition similar to that of wetland in semi-native pastures had elevated nutrient content in the plant tissues. Higher nutrient enrichment of improved pasture wetlands is likely a cumulative affect of fertilizer use in the improved pastures, which are fertilized every year with N and were fertilized annually with P up until 1986; semi-native pastures have never been fertilized.



Species composition in percentage cover of wetland plants in improved and semi-native pastures in Sept., 2001.

Summary

Our results to date suggest that ranching operations in South Florida can greatly influence the ecology of seasonal freshwater wetlands embedded within the agricultural landscape, but that the degree of impact depends upon a variety of factors. These factors include, among other, fertilizer use, the timing and location of grazing, and the intensity of cattle traffic in the wetlands. Artificial drainage of the landscape also influences seasonal wetlands by decreasing the hydroperiod of the wetlands, which may lead to changes in wetland plant communities, altered productivity, and the population dynamics and community composition of other aquatic organisms. Fertilizer use, both past and present, clearly contributes to nutrient enrichment, resulting in greater nitrogen and phosphorus concentrations in wetland sediments and vegetation. Cattle may influence the relative abundance of plant species by selectively grazing certain species and avoiding others. We are currently addressing this question by setting up a series of grazing exclosures in five different improved pastures throughout the ranch, and monitoring changes that occur in plant communities inside and outside the exclosures over time. Cattle also apparently affect water column nutrient concentrations by stirring up sediments and causing release of phosphorus from nutrient-laden sediments into the water column. A better understanding of these interations may aid plans to restore wetlands on cattle ranches and will inform efforts to manage wetlands for improved water quality.

Tracing Fertilizer-Derived Uranium in Central Florida

Robert A. Zielinski and William H. Orem (US Geological Survey)

This continuing study started in May 2000 is a collaboration between researchers at the U.S. Geological Survey and MAERC. The project's objective is to test for the presence of fertilizer-derived uranium (U) in variably fertilized soils and in runoff waters at Buck Island Ranch. Such testing is aided by the unusually low natural background concentrations of uranium and by the contrast in isotopic composition (234U/238U ratio) between natural U and U in phosphate fertilizer. If fertilizer-derived U is detected it suggests that other fertilizer-derived constituents such as phosphorous (P) are present and are contributing to the P load in soils and surface waters.

In August 2001 MAERC personnel provided logistical support for a recollection of three soil profiles in support of a planned parallel study of fertilizer-derived sulfur. In addition, MAERC personnel collected and shipped runoff water samples from pasture plots S5 and W4 in July, September, and November. Data continues to be compiled for U, U isotopes, and nutrients in soils and runoff. Additional samples of locally available superphosphate were collected in August to better estimate the U isotopic composition of historically applied P-bearing fertilizer.

Apparent enrichments of U in uppermost soil from improved pasture S5 were reported last year. Quantitative calculations using the U isotopic composition of enriched S5 soil (3-6 cm interval), phosphate fertilizer, and uncontaminated native grassland indicate that the majority (82%) of the easily leachable U and at least 34% of the total U (1.4 ppm) in this enriched horizon is fertilizer-derived. The same horizon has elevated total P (525 ppm) compared to similar depths in profiles from semi-native pasture (342 ppm) and native grassland (126 ppm). Runoff from S5 contains very little dissolved U (<0.1 ppb) but is consistently higher in dissolved U, phosphate, and total dissolved solids than runoff from W4. Likewise the U isotopic composition of runoff from S5 is closer to that of fertilizer.

Influence of Spatial Distribution of Hammocks and Freshwater Wetlands on Use of Wetlands by Anurans

Kimberly Babbitt (University of New Hampshire)

Kim Babbitt, Matthew Baber, and Laura Brandt investigated the relationship between amphibian community structure (species richness and densities) and environmental factors at MAERC. The focal question of the study was whether proximity of wetlands to upland hammocks would have an important influence on amphibian tadpole assemblages. This study served as a continuation of dissertation research conducted on the ranch by Babbitt and Baber. Seventy-eight wetlands were sampled for larval anurans and the presence of predatory fish by dip netting during the 2001 wet season.

Hammock proximity did not influence species richness; however, assemblage composition differed between wetlands adjacent to large hammocks (hammock wetlands) and wetlands surrounded by pasture grasslands (pasture wetlands). In general, hammock wetlands contained more productive and diverse amphibian assemblages. Specifically, these wetlands often included the barking treefrog (*Hyla gratiosa*), pinewoods treefrog (*Hyla femoralis*) and the oak toad (*Bufo quercicus*), which were restricted to breeding in wetlands <20 m, <50 m, and <200 m from hammocks, respectively. This finding was attributed to the inability of these species to disperse across pasture grasslands, and several major environmental differences between hammock wetlands and pasture wetlands. Specifically, wetlands surrounded by hammocks had low pH, low conductivity, and were less likely to contain predatory fish than pasture wetlands. Moreover, pasture wetlands were more likely to be impacted by cattle (e.g., cow trampling, grazing, and nutrient enrichment from feces). This study also highlighted the importance of spatio-temporal variation in rainfall patterns, demonstrating that breeding efforts of some species may be less successful during wetter years due to fish presence in wetlands.

From a conservation standpoint, ranchlands in south-central Florida may benefit amphibian because agricultural modification has increased the number of temporary wetlands (which generally exhibit higher amphibian diversity than permanent wetlands). Nevertheless, the persistence of diverse amphibian assemblages on ranchlands in south-central Florida requires that many temporary wetlands and upland habitats (i.e., forested habitat) be retained in the landscape. Most importantly, some anuran species require these two habitats to be proximal to one another. This research was funded by the Florida Fish and Wildlife Conservation Commission.

Ecology of Audubon's Crested Caracara in South-Central Florida

Joan L. Morrison (Trinity College)

During 1994-2000, MAERC served as the home base for this region-wide research project, which focused on monitoring the distribution, reproductive success, and habitat associations for this threatened species in Florida. Because caracaras currently are found mostly on private lands, this project involved cooperation from many private landowners and local ranchers throughout an 8-county area. Over the years, we collected information on the breeding biology for caracaras nesting in over 50 breeding areas, including 10 breeding areas on MAERC. Since 2000, this project has focused on monitoring known territories throughout a more limited area, particularly the Kissimmee River Corridor, as well as on MAERC. As part of the Kissimmee River Restoration project, we continue to monitor nesting activity of pairs nesting in the corridor and to assess use of the corridor by non-breeding individuals (juveniles and sub-adults). Using capture techniques developed during the study at MAERC, we captured and radio tagged 2 juvenile caracaras in 2001. These individuals are currently being monitored for their activity and habitat use within the Kissimmee River corridor.

During the past year, we confirmed successful breeding by 3 pairs of caracaras at MAERC, although not all territories were monitored. We located nests of pairs along the Kissimmee River and confirmed breeding in 6 territories. Information on habitat was collected at 2 new nests found along the corridor. One pair moved its nest to a new site over 2.5 km away from the 1999 site, which we suspect is a consequence of the restoration project altering habitat near the previous site. During the past year we also continued with synthesis of the extensive dataset collected throughout this long-term study. Two reports were published by the Florida Fish and Wildlife Conservation Commission; these represent analyses of important aspects of the caracara's life history and management. "Age-specific survival and recruitment rates for Florida's Crested Caracaras" provided survival estimates for both adults and juveniles. These estimates will be used in upcoming population viability analysis modeling. "Recommended management practices and survey protocols for Audubon's Crested Caracara (*Caracara plancus audubonii*) in Florida," Technical Report No. 18 provides overall information on the caracara's biology as well as information for landowners and land managers interested in improving habitat for caracaras. Information in this technical report is also of particular value to consultants and land management agencies involved in surveying new areas for caracaras and in assessing potential impacts of land use projects on Florida's caracara population. Another manuscript, which presents the first information available on natal dispersal of the crested caracara in Florida, was recently accepted by the Journal of Raptor Research and will be published in June 2002.

Financial and Economic Factors - Standardized Performance Analysis

L. O'Gene Lollis (Ranch Manager, MAERC)

Research on the financial, economic and production impacts of alternative management practices is needed to assess the balance between environmental protection and production goals. Fundamental to the overall research program is the further development of financial and economic databases to track agricultural practices such as stocking density, fertilization, burning and chopping, and renovation, for all the pastures and the citrus grove at Buck Island Ranch.

Gene Lollis, Ranch Manager, and Lisa Collins have expanded the use of an economic analysis system at Buck Island Ranch, Standardized Performance Analysis (SPA), developed by the National Cattlemen's Association, to evaluate the production and financial performance of beef cow-calf operations. Assistance has been provided by agricultural economist Fritz Roka (IFAS). SPA provides a standardized tool that allows performance comparisons of an operation among years, producers, and regions. The SPA analysis is divided into two sections, production performance and financial and economic performance. The production analysis provides reproduction, production, grazing, and feed performance measures over a "production year." The financial portion of SPA provides financial and economic measures over the fiscal year. SPA results are used to evaluate trends in production and financial performance of a beef cow-calf operation. (Table 1, 1994-2001) shows four of the SPA production measures: Pregnancy Percentage (1a) indicator of percentage of females bred of those exposed, Pounds of calf weaned per exposed female (1b) provides an indicator of herd production, Calf Crop (1c) is an important indicator of the herd's breeding performance and Weighted Average per weaned calf (1d).

The financial analysis provides an appropriate measure for the entire beef cow-calf operation at the Ranch (Table 2, 1994-2001), but has limited capabilities for the individual pastures. However, specific financial measures, including pounds of weaned calf produced, and pounds of feed used, can be evaluated for individual pastures or herds. Evaluating SPA results over time allows MAERC staff to identify where production and financial costs are highest. Financial record systems at the Ranch are being revised to improve input data and, therefore, improve the accuracy of the SPA results. Utilizing SPA and other financial results over time allows us to evaluate what production and financial costs are in relation to physical and ecological factors, and can be included in decision support systems to allow us to ask "what if" questions.

Table 1. SPA Production Measures (1994 – 2001)

	1994	1995	1996	1997	1998	1999	2000	2001
Pregnancy Percentage Exposed Females	73.5	75.5	75	59	84	71	85	83
Pounds Weaned per Exposed Female	311	338	310	288	331	297	335	338
Calf Crop Based on Exposed Females	67	78	73	61	76	63	68	73
Weighted Avg. Payweight Prices (All Weaned Calves)	$74.05	$59.68	$50.09	$74.36	$71.35	$75.20	$94.44	$101.34

Table 2. SPA Financial Measures (1994 – 2001)

	1994	1995	1996	1997	1998	1999	2000	2001
Beginning Breeding Cow Inventory (hd)	3291	2856	2212	2494	2933	2865	3106	3213
Pretax Cost per Breeding Cow	$160	$171	$231	$180	$233	$235	$257	$287
Net Income per Breeding Cow	$73	$9.50	($40)	($24)	$20	$83	$161	$98
Financial Break-even Cost/cwt. of Weaned Calf Produced	$50	$58	$66	$67	$53	$61	$58	$72
Economic Break-even Cost/cwt. of Weaned Calf Produced	$78	$88	$79	$85	$64	$74	$68	$82

Proposed USDA – Wetland Reserve Program Conservation Easement

Hilary M. Swain (Executive Director, Archbold)

Over the year 2001 Archbold Biological Station continued to work closely with the John D. and Catherine T. MacArthur Foundation for a conservation easement award under the Wetland Reserve Program (WRP) of the US Department of Agriculture – Natu8ral Resource Conservation Service (USDA-NRCS).

Figure 16-1. WRP 2 and WRP 3 (yellow and light blue) were selected by USDA for the WRP.

History of WRP application.
MAERC submitted three potential sites to NRCS for consideration in 2000 (see Figure 16-1). In a regionally competitive ranking process two sites on the Ranch, the east marsh and the south marsh, approximately 750 acres, were approved. The MacArthur Foundation entered into negotiations with USDA for a conservation easement in perpetuity on these sites. We understand that the MacArthur Foundation has concluded an agreed upon price per acre for this easement with the USDA. A survey company has conducted site surveys. USDA will pay 100 percent of the costs of restoring the wetland (filling ditches, etc). We understand the USDA has expressed concerns as to whether there is sufficient access to MAERC for enrollment in the USDA-WRP; we continue to cooperate with Foundation staff to resolve this issue.

Archbold's main interest in the WRP program is that it provides an excellent opportunity for new research and outreach initiatives at the Ranch. A long-term research evaluation of the WRP program will position MAERC at the forefront of new initiatives in restoration ecology on agricultural lands, specifically to evaluate how to: (i) restore and protect aquatic and associated upland habitats; (ii) enhance biological diversity; (iii) improve water quality; (iv) increase carbon storage; and (v) examine economic sustainability of easement programs. In addition to research we would use these as demonstration sites to encourage other landowners to undertake wetland restoration. Such a research and outreach program would be in direct alignment with the original charitable purposes for which the MacArthur Foundation leased the Ranch to Archbold Biological Station. We submitted a conceptual research proposal in September 2000 ("Assessing the Effectiveness of

Wetland Restoration Programs in Subtropical Grazing Lands"). This original proposal presented a series of research activities at a range of funding levels.

In 2001 Archbold again respectfully requested that, if the sale of this easement goes through, Archbold (specifically the MacArthur Agro-ecology Research Center) receives, as some form of charitable donation, a substantial proportion of the funds generated by the sale of this easement. Our reasons for this request are threefold. First, Archbold staff will be involved in a significant amount of "on the ground" oversight for the actual wetland restoration process. Second, most WRP easements have restrictions on how the land is to be used subsequently for agriculture. The lost revenue stemming from these restrictions depends on the precise wording of the agreement in the easement, and varies from year to year, depending on market conditions. In addition there will be annual operational costs for the lands under conservation easements, again dependent on the wording of the easement. Third, Archbold is interested in pursuing this WRP easement as an opportunity to assess quantitatively the ecological and economic impact of restoration.

Archbold WRP activities in 2001 included:

- followed up with NRCS staff about the two potential WRP sites on Buck Island Ranch .
- arranged visits by appraisers and surveyors.
- On November 28th, 2001, in the meeting with the MacArthur Foundation officers (see page 36) we visited the WRP sites and had various discussions about the implications of the program. Archbold presented draft budgets to cover research and operations assuming total funding of just over $700,000. This included (i) to partially fund a research program and (ii) to offset the reduction in agricultural revenues and increases in operational costs as a result of enrolling in the WRP. These budgets were presented as a starting point for discussion.
- Provided material to assess access to MAERC property.

Our understanding is that as of the end of 2001 there was no decision yet as to funding for MAERC from an easement to the Foundation, but decisions will be reached based on final negotiations and other considerations. Archbold remains very committed to pursuing the WRP.

Initiatives such as conservation easements, wetland restoration and ecotourism have provided new options and funding for landowners interested in conservation and enhanced stewardship on private lands. Successfully implementing a WRP project at Buck Island Ranch would allow the Foundation to join with other leading Florida landowners in a voluntary program to protect, restore and enhance wetlands on their property. The WRP is only one of several new programs offering conservation easements to farmers and ranchers in Florida – there are likely to be further opportunities for wetland restoration and other conservation easements for the MacArthur Agro-ecology Research

Center. Participating in the WRP provides an opportunity for the Foundation to be recognized for efforts to promote healthy ecosystems in subtropical grazing lands in Florida, and worldwide.

MacArthur Foundation Site Visit

Hilary M. Swain (Executive Director, Archbold Biological Station)

Background

On November 28th, 2001 Jonathan F. Fanton, President, Joshua J. Mintz, Vice President and General Counsel, and David A. Harris, Director of Florida Philanthropy visited the MacArthur Agro-ecology Research Center. Details of this visit are provided in a Briefing Book that was supplied to participants, but brief highlights are presented here.

The agenda started with a field trip on the Ranch swamp buggy with Gene Lollis, Patrick Bohlen, Mary Hufty (President, Archbold Expeditions) and Hilary Swain via Main Drive, Triangle Road and East Marsh. This included a brief introduction to history of the Ranch and to the organizational structure of the MacArthur Agro-ecology Research Center as well as reviews of the agricultural operations – cattle, sod, etc. and a stop at the East Marsh - one of the proposed WRP sites.

At lunch Archbold Trustees Mrs. Frances Hufty (Chairman) and Mrs. Archie Leidy (Vice President for Investments) joined us for lunch. After lunch Patrick Bohlen gave an overview presentation of research programs at the Ranch followed by a second tour, viewing the main grounds and buildings, the citrus grove, and a stop at one of the flagship research locations where we met with research staff in the field.

The visit concluded with discussions on different scenarios for the Wetland Reserve Program. Also covered were other significant issues facing the Ranch including options for citrus operations and the long-term lease.

Appendix J includes some of the relevant handouts from this briefing. Archbold greatly appreciated the time the MacArthur Foundation officials committed for this visit to the MacArthur Agro-ecology Research Center. We look forward to hosting future visits.

Educational Outreach

Hilary M. Swain (Executive Director, Archbold) and Patrick Bohlen (Research Biologist, MAERC)

Communicating the results of research to ranchers, environmentalists, policy makers, regulators, and the general public is critical to the success of MAERC. Staff and collaborators made several presentations to groups across the state and at Buck Island Ranch.

Extension

MAERC staff has served on several local and state committees to provide input and promote economically and environmentally sustainable agriculture. MAERC staff has actively promoted outreach and education to the public through general tours and school groups, presentations, support of local youth groups, and participation in Archbold Biological Station's Ecology Summer Day Camp.

Ecotours

As a working cattle ranch and research station, MAERC is in the unique position of educating the public to the role of ranchlands. Our primary goal is education and tours discuss such topics as cattle breeding, grazing, prescribed burning, native American culture, water quality issues, wildlife, exotic and native plant communities, biological weed control, and recreation. Descriptions of MAERC research strengthens interest in these topics and adds to the overall experience.

A small number of ranches in Florida supplement income by offering tours of their agricultural operations and it was felt that that establishing such a program at MAERC would be an excellent way of augmenting the education and outreach program. Ranches with extensive marketing, like the Babcock Ranch, have as many as 40,000 visitors per year. We do not intend to have such a large number of visitors at MAERC, but there is clearly demand for eco-tours on ranches.

In 2000 we modified a swamp buggy to be a tour vehicle with a capacity of 25 passengers. In 2000 and early 2001, we established a tour route and ran several practice tours with various individuals and groups of wide-ranging interests and viewpoints. Throughout this comment period we modified the route as well as the scope of the educational message.

Figure 17-1. Swamp buggy.

In December 2001 we began to advertise the "**Indian Prairie Safari Educational Tours"** to the general public. One of the unique aspects of our tour is the research component of MAERC and the fact that actual researchers, who are knowledgeable about the research program and biology

of these subtropical ecosystems, as well as the cattle operation, lead the tours. We produced a tour brochure (Appendix I) and had 5000 copies printed. Brochures were hand delivered to businesses throughout Highlands County. An additional 10,000 copies of the brochure were recently printed. In addition to the brochures, a short article appeared in the local newspaper in mid-December. Interest was immediate and from late December 2001 through the end of April 2002 we completed an average of three tours per week. We currently charge $15 for adults and $10 for children 6-12 years old (children 5 and under are free) to cover the costs of the trips. We have discounts for large groups, including a special rate of $5 per head for school groups. The tour has not interfered with the overall research and operation activities at MAERC and has provided excellent outreach and education on the operation, ecological values and environmental aspects of cattle ranches in the region.

Additional tour information can be found at http://www.archbold-station.org/tour%20web%20site/home.htm .

MAERC Science Advisory Board

The Science Advisory Board for MAERC met in March 2002, and is included in the 2001 report as the report largely reviews prior activities. They met with Archbold staff, IFAS faculty and administrative staff, and staff from the South Florida Water Management District.

The MAERC Science Advisory Board includes representatives of the following disciplines: ecosystem ecology, agricultural watersheds/non-point source pollution, population/community ecology, and hydrology. The composition of the Board is intended to reflect the spectrum of disciplines represented in the Ranch research programs, although members may be drawn from related disciplines.

The MAERC Science Advisory Board Report is included in this report as Appendix A.

Figure 18-1. MAERC Science Advisory Board
From left:
Judith L. Meyer, Ph.D., University of Georgia
John M. Briggs, Ph.D., Arizona State University
R. Richard Lowrance, Ph.D., **(Chair).** USDA Southeast Watershed Research Laboratory
David Genereux, Ph.D., North Carolina State University

Appendices

Appendix A

MacARTHUR AGRO-ECOLOGY RESEARCH CENTER
SCIENCE ADVISORY BOARD REPORT
Report of Second Advisory Board Meeting 28-29th March, 2002

Members:

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Introduction

The Science Advisory Board (SAB) for the MacArthur Agroecology Research Center (MAERC) met at Buck Island Ranch (BIR) on March 28 and 29, 2002. On the afternoon of the 28th the SAB visited the one of the proposed wetland restoration sites on a short field tour. Most of the day on the 28th and the morning of the 29th, the SAB held a series of discussions with MAERC personnel including Dr. Patrick Bohlen, Agroecologist and MAERC Research Director; Dr. Hilary Swain, Archbold and MAERC Director; Gene Lollis, Ranch Manager, Drs. Richard Root and Peter Marks, Archbold Biological Station SAB members; MAERC technical staff; cooperators from University of Florida Institute of Food and Agricultural Sciences (IFAS); and cooperators from the South Florida Water Management District (SFWMD). The following report records the observations of the SAB and the suggestions (in Italics) based on those observations. Underlined sections were contained in the year 2000 SAB report and are included here to provide context for remarks and to reinforce areas that remain recommendations after the 2002 meeting. The major focus of the report is on the Research Programs with shorter sections on Research Administration, Information Management, and Education.

Research Programs

MAERC offers unique research opportunities. Buck Island Ranch has the ability to link in-depth ecological analyses of a working ranch with economic performance because the researcher has complete access to the financial records of BIR. It is a place where a scientifically rigorous experimental design has been brought to a working ranch representing an important part of the economy in Florida. This will enable establishment of cause/effect relationships between ranching practices and environmental concerns such as biodiversity and water quality and permit extrapolation of findings to the larger landscape of central Florida. The broad perspectives represented in the Memorandum of Understanding (MOU) group (MAERC, IFAS, Florida Cattleman's Association - FCA, SFWMD) leads to greater understanding of the perspectives and problems encountered by the different interest groups. There are substantial new research opportunities on the horizon with the Wetland Reserve Program (WRP) restorations being established, the possibility of cross-site comparisons with other grazing ecosystems, and the restoration ecology work that can be done in conjunction with operation of the McJunkin Ranch on the Lake Wales Ridge.

Dr. Bohlen continues to make good progress in his research program. He has continued the research program we observed in 2000 and has added the research associated with a USDA-NRI grant on wetland functions in a grazing environment. He has added a post-doc, Dr. Stanley Gathumbi, for this work. The ongoing research should result in a large number of publications on MAERC-related research over the next two years. Although his publication record is strong overall, it is weak in publications based on MAERC research. Patrick has also taken over coordination of the SFWMD funded water quality research program as was recommended by the SAB. Organization of a symposium on the Pasture Management Project for the Southern Agronomy meetings in February 2002 and the planned set of papers for Journal of Range Management show exceptional scientific leadership by Dr. Bohlen.

Because of the large number of exciting research opportunities at a site such as MAERC, Dr. Bohlen needs to guard against getting spread too thinly. At some point, Patrick may need to choose among competing research areas for himself. At this point his time is split among wetland research, pasture research, and continuing his work with invertebrates. It is critical that Patrick make significant progress on getting papers based on research at MAERC published in peer-reviewed journals.

Two research assistants (RAs-Lourdis Rojas and Greg Huey) will be leaving in the next 4-5 months to pursue graduate school and other scientific opportunities. They have done an excellent job carrying out the sampling, sample preparation, and instrumentation for the water quality/hydrology work.

Dr. Bohlen's decisions on new RAs are very important. It is crucial that he find people who are truly interested in the data they are collecting and who will "take ownership" of the data in the sense that they will be interested in doing some analysis and synthesis. It is also important that Patrick foster that in his dealing with them. Getting chemistry results at least quarterly rather than once per year will facilitate that effort. In addition, asking each RA to be responsible for synthesis and an annual summary report of the monitoring data for which they are responsible will help foster greater interest in the data. Patrick's idea of a regular discussion group where the RAs read papers (e.g. from sites collecting comparable data) would also foster greater RA interest in the projects. Additional training on electronic equipment and other aspects of their duties (e.g. from SFWMD) would be useful even if this means training at an outside lab.

The key members of the ranch and science management team (Hilary Swain, Patrick Bohlen, and Gene Lollis) continue to work together well. This is a strong team headed in the right direction. The SAB was again impressed with the competence, expertise, and dedication of Mr. Lollis, the BIR manager. The Ranch Operations Advisory Board, which has been established since 2000, is an excellent way to provide support and feedback for Gene. The WRP is of interest to ranchers in the area and the Ranch Operations Advisory Board has expressed an interest to Gene in having more information on maintaining water on the ranch in general. This is an idea that interests area ranchers because if ranchers can retain more water within existing ranch drainage patterns, then they can contribute to water resource management objectives in the Okeechobee basin.

Research on both the water resource and cattle resource effects of retaining more water on the ranch is worth pursuing. Water quality seems to be of great concern to the cattlemen in the region, so ranch research is very valuable to them. It is also important to use the Ranch Operations Advisory Board for feedback on issues that are important to ranch operator stakeholders in the region.

The South Florida Water Management District has renewed the contract with MAERC to continue the pasture water quality research through 2003. At this point the water quality research is well supported with outside funding through 2003. Technical and laboratory support for the soil ecology aspects of Dr. Bohlen's program are now being met. Dr. Bohlen now has a gas chromatograph for his denitrification work. The re-allocation of Mike McMillian's duties to support Dr. Bohlen's research has been successful and both are congratulated for making this possible. By all reports, Mike has done an excellent job in this position; however, his interest and expertise in ornithology and more organismal research suggest that this arrangement may not be viable over the long run.

Within the next two years MAERC and cooperators will need to develop a plan for experiments and funding for the future of the Pasture Management Project. Numerous options have been proposed: 1) rotational grazing; 2) boost cattle rates; 3)sod removal; 4) different treatments for winter vs summer pastures; 5) more intensive management. Input is needed from the Florida Cattlemen's Association and other stakeholders in the region. Ideally the research would tackle some challenging ecological questions as well as address questions of interest to the cattlemen.

There is a need to explore data on P content of soils on the ranch and more broadly in the region to understand how widely applicable will be the results from the experimental pasture study. Researchers expressed some concern that the soil type in the experimental plots is not representative of the ranch soils. How representative are these sites of soils elsewhere in the region? Understanding this is crucial to effective use of the information from the experiment in management. There is a need for a soil P map for the ranch. MAERC and IFAS cooperators should develop a P budget for the ranch. The first cut will not be perfect but it should be done and even if there are places where there are large uncertainties in the numbers, at least it will be started and perhaps it would aid researchers in making decisions on where to conduct research.

It appears that significant progress is being made in synthesis of the hydrologic and water quality data and that preliminary conclusions are possible relative to stocking density effects. *The 2001-2003 data are very important in understanding whether these preliminary conclusions hold.*

The MOU group established 3 priorities for research: water quality, threatened and endangered species, and native biodiversity. The SAB heard a great deal about water quality research but less about research on the other two. As the SW Florida landscape changes the proportion of land in sugarcane, citrus, sod and beef ranching, an assessment of the role of ranches in providing habitat for native species will be extremely valuable as land use decisions are made. MAERC and its collaborators have been collecting data on these questions. *These data (e.g. wading bird, raptor studies) need to be synthesized and published. The wading bird study appears to offer some opportunities to consider aspects of ditch design and maintenance that could enhance their value as habitat for wading birds of concern. The collaborators should also consider including an economist with skills in contingent valuation or valuation of non-market goods and services such as biodiversity and water quality. That will be an important component of integrating biodiversity and habitat for native species into the research program. The BIR would seem to be rich ground for research on invasive species, herpetological research and the role of crayfish in food webs.*

There appears to be little ongoing interaction among MAERC and Archbold scientists. We understand that current scientists at each site have well-established research programs and may have little time to undertake research at a very different site. The grazing lease on the new property will provide opportunities for further integrating MAERC and Archbold operations. The grazing lease will provide opportunities for Agroecology integrated with restoration ecology on the Lake Wales Ridge.

There is a continuing need for more effort in natural history/field biology at MAERC. One appropriate way to achieve this may be to combine a natural history position with an education position. This person could be heavily involved with ranch tours as well as continue and coordinate

natural history "surveys" of the ranch. These ideas are discussed in somewhat greater detail in the Education and Outreach section of this report.

With the new acquisition of the McJunkin Ranch and the plans for establishment of a wetland reserve area on MAERC, there is an expanded niche for restoration ecology at Archbold. The establishment of a restoration ecology position with responsibilities at both McJunkin and MAERC should be a priority for Archbold. Archbold should use the opportunity provided by the new land acquisition near the station and the wetlands reserve designation to establish parallel plots in Buck Island Ranch and the McJunkin Ranch for long term grazing exclosure, or other experiments. Restoration ecology seems to offer a means to better link interests of people at the station with the work at Buck Island.

Marketing the MAERC Research Opportunity

Attracting productive researchers to the ranch is a top priority. This will involve targeting individual scientists. MAERC should develop a brochure that highlights the unique research opportunities at the site. The SAB could provide feedback on what you have developed if that would be appreciated. We suggest that MAERC offer competitive summer research assistantships in particular areas that would be a way of getting major professors involved. To attract the best researchers, it is essential that ranch research gets published. Patrick has several papers that are in various states of completion and these need to get out. Hilary should consider hiring someone to work up the bird data so that it can be published. Both of these actions will help attract good researchers to the ranch.

MAERC is still in the process of creating an identity for the ranch in the research world. The recent efforts of both Patrick and Hilary to interact with other scientists in Range Ecology are a positive step in showing other researchers that BIR is a valuable resource for research. Although there are numerous publications from past ranch activities, they do not necessarily reflect the main research thrusts at the ranch today. It is critical that high quality publications come out to let researchers know what is going on there. This should be a top priority. This is the best way individuals will start to know about the ranch. The idea of setting up long-term experiments and/or plots with supporting data should be encouraged.

Information Management

Ken Portier and others have produced a report/system entitled ***MAERC/IFAS Agroecosystem Research Program Information System Development and Implementation***. This is an important step in synthesis for the project and is a valuable contribution from IFAS.

Data management has made great progress since last visit especially with regard to creating the ranch map with the pasture names, but unless the ranch and/or station commit a full time person to information management, continued progress will be slow and they will always be playing "catch-up".

<u>Some of the recommendations from 2000 are still relevant:</u>

1) *Request all users of the site to fill out a form that outlines where, how, who etc. the research will be carried out at BIR. This will allow records to be kept so as MAERC matures, others can know the history of past research efforts. In that form, a request for a copy of the data collected can be requested as well as all published manuscripts resulting from the study.*

2) *Establish meta data forms and provide new (and current) researchers a copy of these forms PRIOR to their data collection. In these forms, accepted names, date format, units, etc. can be established (encouraged!) that will aid any and all synthesis efforts. And of course, the very difficult item of data access should be addressed. Let investigators know up-front exactly what the policy will be at the BIR on the data they collected. Will there be a time-line? Will some data regardless of time always be available or restricted? Now is the time while MAERC is in the early stage of development to establish these difficult policies. A committee of scientists and users of the data should be established to explore the various options. Examples of these forms and guidelines can be obtained from most LTER sites or from Ecological Data: Design, Management and Processing by Michener and Brunt.*

3) *Keep a list of any and all data sets that MAERC knows about. This is true even if you don't have the data or meta data associated with it. At least MAERC will have a list. The goal would be to get all the data archived and documented. This might not ever happen, but it should be the goal. A list of those data sets that have meta data associated with them should be updated at least twice a year and should be posted on the WWW. This would allow potential new investigators to see what type of research is being conducted at BIR. In that list, a sub-group of on-going long-term monitoring data sets should be emphasized. To attract new investigators to the ranch, it would be helpful for the new investigators to know that their data could be tied into other data sets being collected at BIR. As part of the list of data sets, a careful assessment of historical data sets of the ranch should be conducted as soon as possible. A considerable amount of effort should be put into developing a historic land use record for BIR. At almost every site that conducts long-term research, eventually historical land use becomes an important driver in understanding ecological processes. Even word of mouth accounts of past land use might prove to be useful and if all possible, extensive analysis of historical aerial photographs should be encouraged.*

Research Administration

The key members of the ranch and science management team (Hilary Swain, Patrick Bohlen, and Gene Lollis) continue to work together well. This is a strong team headed in the right direction. *We support Dr. Bohlen's continued efforts to establish himself as a highly visible, involved leader of the technician/intern staff at the BIR. This staff has the potential to be an even more productive resource.*

Education & Public Outreach

The intern program has been quite successful.

It would be good to periodically recruit an intern with interest in ranch operations and agro-ecology. An agricultural school that has a strong research program in range management might be an excellent place to recruit from. This is important both for the types of studies that interns would do

in association with ranch personnel and for beginning to build a larger cadre of students and graduate students interested in agroecology and environmental effects of ranches.

The Indian Prairie ecotours are a welcome addition since our last visit. They are excellent public outreach, and the staff seems to enjoy doing them.

Using the success of these tours and the experience gained by the education Staff at the Station, we would encourage Hilary to write a proposal to fund an education person for the ranch. This person could continue the ecotours, develop a sustainable agriculture education program for schools involving tours and perhaps also web-based activities, as well as coordinating a volunteer program. This person could also be someone interested in natural history and help sustain interest in the natural history aspects of BIR.

Notes on SAB operation

The brief written statements on what had been done in response to the 2000 review were greatly appreciated. We would like to have a similar document for our next review. Future meetings of our committee will be left to the discretion of the MAERC research team, but a lot is happening and a meeting in two years seems appropriate. We would like some interim feedback from them. In a year, we would appreciate a BRIEF communication from them answering 3 questions:

a) What did the 2001 data for the experimental pastures show? Is TP loading unaffected by stocking density in a year of average rainfall?

b) What is being considered for future manipulations at the Experimental Pasture site?

c) What is being planned for experimental studies at the Wetland Reserve Program sites?

Appendix B

2001 Research Projects at the MacArthur Agro-ecology Research Center

Environmental Factors			

1. Nutrient Loading			
"Optimization of best management practices for beef cattle ranching in the Lake Okeechobee Basin." *Surface water flow (m^3s^{-1}) & nutrient loadings (NH4, TKN, TP, orthophosphate) from 16 experimental pastures with 4 cattle stocking rates*	SFWMD FL – DEP (EPA 319)	1998 – 2000 1999 – 2001	A Steinman J. Capece P. Bohlen H. Swain
"Long-term water quality trends in four representative agro-ecosystem land uses in a Florida cattle ranch"	IFAS Archbold	1993 – present	K. Campbell J. Capece
"Ridge citrus water quality project." *Reference site for regional evaluation of citrus effects on groundwater quality*	USDA	1993 – present	W. Graham A. Alva
"Patterns of N and P cycling in relation to cattle stocking density and grazing land use in subtropical rangelands."	Archbold	1999 – 2000	P. Bohlen
"Tracing fertilizer-derived Uranium in central Florida."	USGS	2001 – present	R. Zielinski W. Orem
2. Wetland Ecosystems			
"Algal productivity in wetlands on beef cattle ranches in the Okeechobee Basin."	SFWMD Archbold	1999 – 2000	A. Steinman P. Bohlen
3. Native Biodiversity			
3.1 Avian Ecology			
"Reproductive success, home range size and habitat use of the Red-shouldered Hawk and the Barred Owl on a working cattle ranch in the prairie region of south-central Florida."	Archbold	1995 – present	M. McMillian
"Prey selection of the Barred Owl (*Strix varia*) in south-central Florida based on pellet contents."	Archbold	1989 – 2000	M. McMillian
"American Kestrel/Eastern Phoebe winter surveys on a FL cattle ranch: the importance of open space for wintering birds."	Archbold	1995 – 2000	M. McMillian H. Swain
"Development of management methods to reduce Black Vulture predation on livestock."	USDA	2000	M. Avery
3.2 Wetland Biodiversity			
"Anuran community structure and predation rates on tadpoles in wetlands of Buck Island Ranch."	IFAS FFWCC	1993 – present	K. Babbitt
"Habitat and landscape influences on nestedness in an isolated wetland fish and amphibian assemblage."	FIU Archbold	1998 – present	M. Baber
"Importance of wetlands, ditches and canals in agricultural landscapes in south-central Florida for wading birds."	Archbold	1989 – 2000	H. Swain M. McMillian
3.3 Other Biodiversity Research			
"Agro-Ecosystems Indicators of Sustainability as Affected by Cattle Density in Ranch Management Systems (a) Forage biomass and nutrient analysis (b) Over-wintering & breeding bird census (c) Soil P analysis (d) nematode diversity (f) database management." *In 16 experimental pastures with 4 cattle stocking rates*	USDA	1998 – 2001	J. Mullahey G. Tanner R. McSorley K. Portier P. Bohlen
"Use of IKONOS satellite imagery for vegetation mapping at MAERC."	IFAS	2000 – present	M. Borengasser K. Townsend
4. Threatened and Endangered Species			
"Ecology of the Crested Caracara in South Florida."	IFAS SFWMD FFWCC	1992 – present	J. Morrison

5. Socio-Economic Factors			
Production – herd size/structure, conception, mortality (cow-calf, bull), weights at sale (steer and heifer)	Archbold	1989 – present	Background L. Lollis
Agricultural Operations Database. By pasture, stocking density, fertilizer nutrients inputs (minerals/molasses), labor, vet, pasture and ditch maintenance. Annual cattle operations expenses. Other revenue/expenses– citrus, sod, hunt lease, gators, palms, hogs, ecotours.	Archbold	1994 – present	Background L. Lollis
Standardized Performance Analysis annual financials (annual accrual) Pretax Cost/Cow, Net Income/Cow Economic Breakeven Cost/cwt of Weaned Calf Produced	Archbold	1994 – present	L Lollis J. Earman F Roka
"Agro-Ecosystems Indicators of Sustainability as Affected by Cattle Stocking Density in Ranch Management Systems." Production measures for herds in the 16 experimental pastures (a) production data (weights, conception rates etc) (b) financials (operating expenses/cow).	USDA	1998 – 2000	M. Fanning J. Holt F. M. Roka

Appendix C

2001 MAERC Intern Summary

Name	Position	Education or Affiliation	Research Project or Seminar Title (Date)
Nicola Clegg	Volunteer Intern	MSc Biology of Water Resource Management Napier Univeristy Edinburgh, Scotland	"Effect of intense fertilization in drainage ditches on micro-invertebrate communities in South Florida."
Julie Conklin	Undergraduate Intern	B.S. Natural Resources Management Rutgers University New Brunswick, New Jersey	"Comparing aquatic invertebrate communities in seasonal wetlands of subtropical cattle Pasters."
Christine Edwards	Undergraduate Intern	B.A. Environmental, Population, and Organismic Biology University of Colorado Boulder, Colorado	"The influence of microclimate on vascular epiphyte distributions in live oak hammocks."
Julie Golod	Undergraduate Intern	B.S. Environmental Biology and Zoology Michigan State University East Lansing, Michigan	"Impact of grazing intensity on denitrification in poorly drained, sandy soils."

Appendix D

2001 Contributions from MAERC

1. Lohrer, F.E. 1990. Winter bird population studies. 28. Mature citrus orchard. J. Field Ornithol. 61:20.

2. Lohrer, F.E. 1991. Winter bird population studies. 33. Mature citrus orchard. J. Field Ornithol. 62:26.

3. Lohrer, F.E. 1991. Breeding bird census. 98. Mature citrus orchard. J. Field Ornithol. 62:87.

4. Yosef, R., and F.E. Lohrer. 1992. A composite treadle/bal-chatri trap for loggerhead shrikes. Wildl. Soc. Bull. 20:294-300.

5. Yosef, R., and T.C. Grubb, Jr. 1992. Territory size influences nutritional condition in non-breeding loggerhead shrikes: a ptilochronology approach. Conserv. Biol. 6:447-449.

6. Yosef, R. 1992. Loggerhead shrikes eat crayfish. Fla. Field Nat. 20:75-76.

7. Yosef, R. 1992. Behavior of polygynous and monogamous loggerhead shrikes, and a comparison with northern shrikes. Wilson Bull. 104:747-749.

8. Yosef, R., and D. Yosef. 1992. Hunting behavior of Audubon's crested caracara. J. Raptor Res. 26:100-101.

9. Yosef, R., and D. Whitman. 1992. Predator exaptations and defensive adaptations in evolutionary balance: no defense is perfect. Evol. Ecol. 6:527-536.

10. Yosef, R., and T.C. Grubb, Jr. 1993. Effect of vegetation height on hunting behavior and diet of loggerhead shrikes. Condor 95:127-131.

11. Yosef, R. 1993. Prey transport by loggerhead shrikes. Condor 95:231-233.

12. Yosef, R. 1992. Territoriality, nutritional condition, and conservation in loggerhead shrikes (*Lanius ludovicianus*). Ph.D. Diss., Ohio State Univ.

13. Fitzpatrick, J.W. 1993. The ecology of food animal production: research needs for the Twenty-second Century. Pp. 81-87 *in* FAIR '95 Symposium on Food Animal Research Priorities. Federation of American Societies of Food Animal Sciences, Champaign, Illinois.

14. Yosef, R. 1994. The effects of fencelines on the reproductive success of loggerhead shrikes. Conserv. Biol. 8: 281-285.

15. Yosef, R., and M. Deyrup. 1994. Pellet analysis of burrowing owls in southcentral Florida. Fla. Field Nat. 22:78-80.

16. Yosef, R. 1994. Sex-related differences in distraction-displays by Florida sandhill cranes. Condor 96:222-224.

17. Layne, J.N. 1993. History of an introduction of elk in Florida. Fla. Field Nat. 21:77-80.

18. Yosef, R., J.N. Layne, and F.E. Lohrer. 1993. Trends in numbers of loggerhead shrikes on roadside censuses in peninsular Florida, 1974-1992. Fla. Sci. 56:92-97.

19. Champe, C. 1993. Bird communities in native and agricultural habitats in south-central Florida. Master's Thesis, Univ. Florida, 74 pp.

20. Yosef, R. 1994. Conservation commentary. An evaluation of the global decline in the true shrikes (Family Laniidae). Auk 111:228-233.

21. Yosef, R., and T.C. Grubb, Jr. 1994. Resource dependency and territory size in loggerhead shrikes (*Lanius ludovicianus)*. Auk 111:465-469.

22. Grubb, T.C., Jr., and R. Yosef. 1994. Habitat specific nutritional condition in loggerhead shrikes (*Lanius ludovicianus*): evidence from ptilochronology. Auk 111:756-759.

23. Yosef, R., and T.C. Grubb. 1995. Ptilochronology: A potential biomarker for assessing territory quality and habitat suitability in shrikes. Proc. West. Found. Vert. Zool. 6:276-279.

24. Yosef, R., and F. Lohrer. 1995. Loggerhead shrikes, red fire ants, and red herrings. Condor 97:1053-1056.

25. Babbit, K.J., and G.W. Tanner. 1997. Effects of cover and predator identity on predation of *Hyla squirella* tadpoles. J. Herpetol. 31:128-130.

26. Babbit, K.J. 1996. Tadpoles and predators: Patterns in space and time and the influence of habitat structural complexity on their interactions. Ph.D. Diss., Univ. Florida, 135 pp.

27. Morrison, J.L., and S.M. McGehee. 1996. Capture methods for crested caracaras. J. Field Ornithol. 67:630-636.

28. Morrison, J.L., M.A. McMillian, S.M. McGehee, and L.D. Todd. 1997. First record of a crested caracara nesting in a cypress. Fla. Field Nat. 25:51-53.

29. Morrison, J. L. 1996. Crested caracara (*Caracara plancus*). Birds of North America No. 249, 28 pp.

30. Yosef, R., J.E. Carrell, and T. Eisner. 1996. Contrasting reactions of loggerhead shrikes to two types of chemical defended insect prey. J. Chem. Ecol. 22: 173-181.

31. Meshaka, W.E. 1997. The herpetofauna of Buck Island Ranch: an altered wetland in south-central Florida. Fla. Sci. 60:1-7.

32. Capinera, J.L., C.W. Scherer, and J.B. Simkins. 1997. Habitat associations of grasshoppers at the MacArthur Agro-ecology Research Center, Lake Placid, Florida. Fla. Entomol. 80: 253-261.

33. Morrison, J.L. 1997. Reproductive ecology and habitat association of Florida’s crested caracara. Ph.D. Diss., Univ. Fla.

34. Foster, G.W., J.L. Morrison, C.S. Hartless, and D.J. Forrester. 1998. *Haemoproteus tinnunculi* in crested caracaras (*Caracara plancus audubonii*) from southcentral Florida. J Raptor Res. 32:159-162.

35. Pranty, B., and M.A. McMillian. 1997. Status of the white-tailed kite in northern and central Florida. Fla. Field. Nat. 25: 117-127.

36. McMillian, M.A., and B. Pranty. 1997. Recent nesting of the white-tailed kite in central Florida. Fla. Field Nat. 25:143-145.

37. Anderson, D., and B. Dugger. 1998. A conceptual basis for evaluation of restoration success. Trans. N. Amer. Wildl. Nat. Resources Conf. 63:111-121.

38. Yosef, R., and M. Deyrup. 1998. Effects of fertilizer-induced reduction of invertebrates on reproductive success of loggerhead shrikes (*Lanius ludovicianus*). J. f. Ornithol. 139:307-312.

39. McSorley, R. 1997. Relationship of crop and rainfall to soil nematode community structure in perennial agroecosystems. Appl. Soil. Ecol. 6:147-159.

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

41. Morrison, J.L. 1998. Effects of double brooding on productivity in crested caracaras. Auk 115:979-987.

42. Capece, J.C., and M. Mozaffari. 1997. Agro-ecology research to develop sustainable cattle production practices in Florida. Soil Crop Sci. Soc. Florida Proc. 56:131-135.

43. Steinman, A.D., K.E., Havens, N.G. Aumen, R.T. James, K.-R. Jin, J. Zhang, and B. Rosen. 1999. Phosphorus in Lake Okeechobee: sources, sinks, and strategies. Pp. 527-544 *in* Phosphorus Biogeochemistry of Subtropical Ecosystems: Florida as a Case Example (Reddy, K.R., G.A. O'Connor, and C.L. Schelske, Eds.). CRC/Lewis Publ., New York.

44. Morrison, J.L., and M. Maltbie. 1999. Methods of gender determination in crested caracaras. J. Raptor Res. 33:128-133.

45. Morrison, J.L. 1999. Breeding biology and productivity of Florida's crested caracaras. Condor 101:505-517.

46. Capece, J.C., M. Mozaffari, and G.T. Bancroft. 1998. Agroecology research for sustaining subtropical prairie ecosystems on beef cattle ranches of Florida. Proc. Annu. Conf. Ecosystems Restoration Creation 24:70-81.

47. Babbitt, K.J., and G.W. Tanner. 2000. Use of temporary wetlands by anurans in a hydrologically modified landscape. Wetlands 20:313-322.

48. Main, M.B., P.B. Walsh, K.M. Porter, and S. F. Coates. 1999. Monitoring the expanding range of coyotes in Florida: Results of the 1997-1998 statewide scent station surveys. Fla. Field. Nat. 27:150-162.

49. Pratt, S.C. 1997. The control of comb construction by honey bee colonies. Ph.D. Diss., Cornell Univ.

50. Pratt, S.C. 1998. Decentralized control of drone comb construction in honey bee colonies. Behav. Ecol. Sociobiol. 42:193-205.

51. Pratt, S.C. 1999. Optimal timing of comb construction by honey bee colonies: a dynamic programming model and experimental tests. Behav. Ecol. Sociobiol. 46:30-42.

52. Babbitt, K.J. 2001. Behaviour and growth of southern leopard frog (*Rana sphenocephala*) tadpoles: effects of food and predation risk. Canadian J. Zool. 78:809-814.

53. Morrison, J.L. 2001. Conservation value of private lands for crested caracara in Florida. Conservation Biol. 15:675-684.

54. Yosef, R. 2000. The Mayfield method for standarisation of shrike breeding studies: the case of the loggerhead shrike (*Lanius ludovicianus*) in southcentral Florida. The Ring 22:111-121.

55. McSorley, R., and J.J. Frederick. 2000. Short-term effects of cattle grazing on nematode communities in Florida pastures. Nematropica 30:211-221.

56. McMillian, M.A. 2002 (in press). Long-term trends in osprey nesting populations on Lake Istokpoga, Fla. Florida Field Nat. 30:.

57. Morrison, J.L. 2002 (in press). Natal dispersal of the crested caracara (*Caracara cheriway*) in Florida. J. Raptor Res. 36:.

58. Yosef, R. 2001. Nesting ecology of resident loggerhead shrikes in southcentral Florida. Wilson Bull. 113:279-284.

59. Clegg, N. 2001. The effect of land use on the macro-invertebrate community in the drainage ditches of ranchlands in south Florida. Master's Thesis, Napier Univ., Edinburg, Scotland.

60. Baber, M.J. 2001. Understanding anuran community structure in temporary wetlands: the interaction and importance of landscape and biotic processes. Ph.D. Diss., Florida International Univ.

61. Baber, M.J., D.L. Childers, K.J. Babbitt, and D.L. Anderson. 2002 (in press). Controls on fish distribution and structure in temporary wetlands. Can. J. Fish. Aquatic Sci. 59:.

62. Bogner, F., and T. Eisner. 1991. Chemical basis of egg cannibalism in a caterpillar (*Utetheisa ornatrix*). J. Chem. Ecol. 17:2063-2075.

Appendix E

2001 Educational Outreach

This appendix does not include the numerous off-site presentations by Archbold/MAERC staff and collaborating scientists given at scientific meetings, at agricultural conferences, to conservation organizations, and to the general public.

Educational/Informational Tours

Meetings Held at MAERC

OPS Advisory Board
MOU Pasture Project Meeting, 14 June
Grazing Lands Working Group Meeting, 6 June

Invited MAERC/Archbold Seminar Speakers

Patrick J. Bohlen (MacArthur Agro-ecology Research Center) – Legacy effects on nutrient dynamics of soil and water in Florida rangelands, 22 February.

Kyle G. Ashton (University of Colorado) – Bergmann's rule and tetrapod vertebrates, with special emphasis on body size variation of the western rattlesnake, 26 February.

Gilberto Pasinelli and Karin Schiegg (Virginia Polytechnic Institute and State University) – Conservation of woodpeckers: case studies from Europe and the U.S., 28 February.

Matthew Baber (Florida International University) – Understanding tadpole community dynamics in temporary wetlands: the interaction and importance of landscape processes and fish predation, 8 March.

Felicia Keesing (Bard College) – Cryptic consumers and the ecology of an African savanna, 29 March.

S. James Reynolds (University of Memphis) – Calcium availability and reproduction in birds, 5 April.

Peter Marks (Cornell University) – Forest fragmentation and biodiversity in central New York: 200 years of change, 12 April.

Sandy Andelman (National Center for Ecological Analysis and Synthesis) – How many, where and how much: quantitative approaches to setting conservation priorities, 19 April.

William J. Sutherland (University of East Anglia) – Linking behavior, ecology and conservation, 15 May.

R. David Evans (University of Arkansas) – Human impacts on the nitrogen cycle in arid ecosystems, 27 September.

Sidney A. Gauthreaux, Jr. (Clemson University) – Radar ornithology and the conservation of migratory birds, 16 October.

Susan Harrison (University of California, Davis) – Roles of patchiness, fire and grazing in shaping plant diversity on serpentine soils of California, 1 November.

Philip S. Ward (University of California, David) – Ants in plants: phylogeny and host-plant associations of pseudomyrmecine ants, 1 November.

Jan Leps (University of South Bohemia) – Multiple approaches to plant species coexistence and diversity in semi-natural meadows, 15 November.

Joyce Maschinski (The Arboretum at Flagstaff) – Rare plant conservation research in northern Arizona: restoration, roads, politics and promises, 29 November.

Torgrim Breiehagan (Stavanger University College) – Evolutionary aspects of the mating system in Pied Flycatchers and two *Calidris* species, 13 December.

4th Current Research Symposium at Archbold Biological Station, 11 – 12 January

11 January:

Warren Abrahamson (Bucknell University) -- Episodic reproduction in two fire-prone palms, *Serenoa repens* and *Sabal etonia*.

William Conner (Wake Forest University) -- Chemical ecology of the scarlet-bodied wasp moth, *Cosmosoma myrodora* (Lepidoptera, Arctiidae).

William Watts (Trinity College) -- Florida sinkholes and the Lake Wales Ridge.

Eric Grimm (Illinois State Museum) -- Late-glacial flora and climate recorded at Lake Annie and Lake Tulane, Florida.

Samuel Marshall (Hiram College) -- A molecular phylogeographic analysis of Florida's *Geolycosa* wolf spiders reveals new species and new patterns of divergence.

Curtis Adkisson (Virginia Tech) -- The behavioral ecology of Blue Jays in citrus groves: Is a supply of acorns the key to survival?

Jack P. Hailman (University of Wisconsin) -- Ecology meets psychology: what Florida Scrub-Jays understand about food objects.

Stephan Schoech (University of Memphis) -- Hormones and behavior in the cooperatively breeding Florida Scrub-Jay.

David Anderson (SFWMD), M. Baber, M. McMillian, and G. Aborn -- Composition and abundance of wading bird prey in drainage ditch wetlands at MAERC.

Olle Pellymr (Vanderbilt University) -- Reversal of pollination mutualism between yuccas and yucca moths: testing an Out of Florida hypothesis 12 January:

Christine V. Hawkes (University of California at Berkeley) -- Biological soil crusts and their interactions with four endangered herbs in rosemary scrub.

Rebecca Yahr (Duke University) -- Population-genetic community-level structure of Florida scrub lichens.

Robert McSorley (University of Florida) -- Nematode communities in Florida pastures.

Gayle vande Kerckove (University of Florida) -- Disease in pond populations of Edison's St. John's Wort.

Kevin Hogan (University of Florida) -- Comparison of ecophysiology and genetics in a rare and a widespread species of *Hypericum*.

Appendix F

2001 Financial Statements

MacArthur Agro-ecology Research Center
Statement of Financial Position
December 31, 2001

Assets

Cash	$	1,150
Property and Equipment (Net of Accumulated Depreciation of $1,615,097)		2,048,666
Prepaid and Deferred Expenses		61,972
Total Assets	**$**	**2,111,788**

Liabilities and Net Assets

Accounts Payable and Accruals	$	15,436
Net Assets		2,096,352
Total Liabilities and Net Assets	**$**	**2,111,788**

MacArthur Agro-ecology Research Center
Statement of Activities
for the Year Ended December 31, 2001

Revenues

Cattle Sales (Net of Cost of Sales)	$	1,111,661
Citrus Sales		69,698
Other Income		74,699
Total Revenues	**$**	**1,256,058**

Expenses		
Salaries	$	135,155
Employee Benefits		41,749
Professional Fees		2,954
Travel		1,705
Supplies		2,037
Agricultural Supplies		492,356
Rent		12,891
Repairs and Maintenance		109,206
Utilities, Telephone, and Water		7,050
Insurance and Other Expense		17,836
Special Events and Interest		578
Depreciation		226,659
Cost Allocated to Inventory		(82,375)
Total Expenses	**$**	**967,801**

Increase in Net Assets	$	288,257
Net Assets, Beginning of Year		1,808,095
Net Assets, End of Year	**$**	**2,096,352**

Appendix G

2001 Capital Purchases, Improvements, and Renovations

Continued construction of a new barn	$19,624
Housing improvements (air conditioning repair)	$2,185
Purchase of one cattle chute	$12,409
Purchase of 7 solar pumps	$25,522
Purchase of one F-150 pickup truck	$20,062
Purchase of 183 replacement heifers	$149,042
Purchase of 34 bulls	$63,140
Total	**$291,984**

Appendix H

2001 MAERC Staff

ADMINISTRATIVE STAFF

Bohlen, Patrick J., Ph.D., Director of Research

Lollis, L. O'Gene (Gene), B.S., Ranch Manager

RESEARCH STAFF

Anderson, David H., Ph.D., Post-Doctoral Research Associate

Bohlen, Patrick J., Ph.D., Assistant Research Biologist

Clark, Renee, Research Assistant I (Part-time)

Feree, Michelle A., B.S., Research Assistant III

Gathumbi, Stanley M., Ph.D., Post-Doctoral Research Associate

Huey, Gregory M., B.S., Research Assistant III

Knipps, Anna, B.S., Research Assistant II (Temporary)

McMillian, Michael A., M.S., Research Assistant IV

Rojas, Lourdes M., B.S., Research Assistant III

OPERATIONS STAFF

Addison, Jr., Lewis F., Ranchhand

Green, Jr., Mark W., Ranchhand

Hunter, Jerry M., Ranchhand

Lollis, L. O'Gene (Gene), B.S., Ranch Manager

Lollis, Terry M., Housekeeper

Mathes, John F., Ranchhand

Appendix I

Indian Prairie Safari – Brochure

Appendix J