The Florida Society of Geographers was chartered in 1964 as a non-profit organization for the purpose of furthering professionalism in geography through application of geographic techniques in all areas of education, government, and business.

The Society supports these objectives by promoting acquaintance and discussion among its members and with scholars and practitioners in related fields by stimulating research and field investigation, by encouraging publication of scholarly studies, and by performing services to aid the advancement of its members and the field of geography in Florida.

Since 1996 the Florida Geographical Alliance, whose mission is to support geographical education in grades K through 12, has helped pay for the publication and distribution of *The Florida Geographer*. All members of the Alliance receive the journal, and articles related to geographical education are enthusiastically encouraged.

The Society holds meetings once a year. At this meeting, papers are presented and matters of mutual concern are discussed. Meetings are held in different parts of the state always include field trips to allow participants to gain first-hand knowledge through field experience. This year's conference will be held **February 9-11, 2007** in **Jacksonville, Florida**.

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Managing Editor: Kris Bezdecny, M.A.

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From the Editor

The Florida Geographer is the official publication of the Florida Society of Geographers and is distributed free to members of the society. It is a statewide journal with coverage of social and physical geographical topics. Most articles are related to the state, or feature Florida figures as an important component.

Papers are welcomed from all who feel they have research worthy of dissemination. Authors should not be dissuaded from submitting articles for review because of format considerations. It is requested that authors follow the following guidelines when submitting their manuscripts:

- All manuscripts should be sent in electronic form. Text should be submitted as a Microsoft Word document (*.doc) or as a rich text file (*.rtf). Authors should submit the final copy on an IBM compatible disk, a CD, or emailed to the editor.
- Figures and maps, if submitted separately from the text, should be sent as a JPEG (*.jpg) or graphical image file (*.gif). Tables may also be submitted in Excel or Quattro Pro format. Please note that all images will be printed in black and white, and as such should be sent as either black and white or gray-scale images. Please include the figure (table) number, title, and source .
- It is the author's responsibility to ensure that none of the materials used in the paper are copyright-protected.
- Headings, paragraphs, and references should be consistent in their style.
- Please use in-text citations; footnotes will not be accepted. Endnotes should only be used sparingly.

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Note to Readers

It is with pleasure that I present the latest edition of the Florida Geographer. The diversity of the papers exhibits a continuing interest on the part of the readership in ensuring a quality publication. I appreciate that and also those who have given of their time to review the manuscripts as they have come in. The journal could not proceed without such effort.

Once again I make a call for manuscripts. We have a vibrant Society here in Florida and this, its flagship journal, should be considered an excellent outlet for research undertaken by its members, including K-12 teachers and students at all levels. Each manuscript will be reviewed and authors will be well-informed about the whole process from manuscript to final publication. The editors are enthusiastic about your work and are here to enable it to see the light of day in the form of this journal. Please do not hesitate to send it our way. As I mentioned in my last note, this work can include pedagogical notes, field-based observations, and other work not necessarily of research manuscript form. I believe the journal should be used as a forum for any information deemed important to our readers on a Statewide basis.

One possibility for this latter might be surveys or formal reviews of the latest books or articles of pertinence to researchers and others in the State. For example, our past editor, Dr. Morton D. Winsburg, has just published an important book: *Atlas of Race, Ancestry, and Religion in 21st-Century Florida* with the University of Florida Press. Much like his well-known *Atlas of Florida* and *Florida Weather* books, this latest edition of Winsburg's research promises to be an integral addition to the libraries of all those undertaking geographic studies of Florida. I hereby invite those who may wish to review this book for the journal to send me a note of interest. Similarly, a recent book by Gary R. Mormino: *Land of Sunshine, State of Dreams: A Social History of Modern Florida*, has also recently been published by the same press. This book is over-flowing with important information that would be of use to those interested in the recent past of the State. Finally, a more popularly-targeted recent book by Diane Roberts: *Dream State: Eight Generations of Swamp Lawyers, Conquistadors, Confederate Daughters, Banana Republicans, and Other Florida Wildlife*, published by the Free Press, simply cries out to be read thoroughly, if only to get a sense of the popular geographic imaging of our State. Again, drop me a line if you would like to comment on these books or others that you think need to be brought to the attention of our readers.

Finally, thanks once again to my Managing Editor, Kris Bezdecny, now on the faculty of the Center for Urban Transportation Research here at the University of South Florida and continuing Ph.D. student, for making sure this journal gets published. Without her, I would be lost in the sea of details she charts so well.

Kevin Archer, Ph.D.

Political Economy of the Palm Beach County Biotechnology Research Park

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Florida State University

Among the most rapidly growing and technologically dynamic industries in the U.S. today, biotechnology has captured the imagination of entrepreneurial politicians and investors alike. With a reputation for generating high-wage jobs and highly profitable outputs, particularly pharmaceuticals, this sector has become central to the competitive designs of many states, counties, and cities throughout the United States, and indeed, much of the economically developed world. While there is a rich and insightful literature in geography on "high technology" industries, particularly in light of theories of post-Fordism and flexible production, geographical treatments of biotechnology are sparse (cf. Delaney 1993). As biotechnology has grown economically and diversified geographically, this issue has acquired new significance, particularly in light of the attempts of many Southern states to diversify their economies.

This paper focuses on the economic and spatial dynamics of this industry, using the proposed Palm Beach County Biotechnology Research Park in Florida as a case study. It opens with an overview of locational clustering and regional competitiveness, including the importance of tacit knowledge in the formation of agglomerative complexes. Second, it turns to the geography of the U.S. biotechnology industry, focusing on its critically important relations with the venture capital industry and public policy. Third, the paper examines the biotechnology sector in Florida, emphasizing the catalytic role of universities. Fourth, it delves into the specifics of the proposed biotechnology park in Palm Beach county, site of heated political controversy. The conclusion appraises the competitive viability of new complexes of biotechnology in the face of heated competition from older, existing ones, a theme used to demonstrate the contingency inherent within economic landscapes.

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Locational Clustering and Regional Competitiveness

A long tradition in economic geography, stretching as far back as Alfred Marshall in the 1890s (Harrison 1992), has recognized the tendency of many types of industries to form dense clusters of inter-related activities. An interdisciplinary body of research concludes that dynamic, internationally competitive industries tend to concentrate geographically in distinct agglomerations or clusters of firms (Antonelli 2000; Porter 1990, 2000). Clusters arise from the numerous inter-connections of people, goods, services, and information that suture individual entrepreneurs, firms, their supplier networks, ancillary services, as well as government agencies and offices, public/private partnerships, trade associations, universities, legal services and patent attorneys, accounting firms, specialized advertising firms, and related ancillary services.

Multiple factors contribute to the generation of regional clusters, but arguably the most important is access to skilled pools of labor, including in particular technical and engineering talent. Highly competitive industries tend to be knowledge-intensive, embodying large quantities of human capital in the production process. Thus, most industrial clusters include well known universities, which play important roles as partners in development initiatives, including the expansion of human capital, technology transfer, and outreach programs. Traditional product-cycle models hold that innovative firms tend to cluster in metropolitan areas, where firms rely extensively upon urban agglomeration economies (Audretsch and Feldman 1996b). Agglomeration economies refer to the lowering of costs that occurs when firms are concentrated together, and take the forms of a shared infrastructure, low transport costs for backward and forward linkages, a common pool of labor, and specialized circuits of information. By clustering and entering into networks of reciprocal relations, firms lower costs and raise productivity.

The process of innovation generally occurs within so-called "knowledge regions" in which innovation is a continuous and sustained phenomenon (Howells 2000; Maskell 2001). Proximity of firms that are both rivalrous and cooperative is essential to the generation of an entrepreneurial and creative dynamic. The process of

discovery and innovation is closely related to collaborative relationships, networking, and tight spatial linkages among firms and individuals (Antonelli 2000; Freel 2003). The formation of knowledge spillovers relies on frequent, repeated, and sustained interactions among individuals and firms in a given local milieu (Grossman and Helpman 1991). An important outcome of this process is the creation of synergies, i.e., interactions that generate benefits that would not be possible if actors operate in isolation of one another. The synergistic benefits of agglomeration are often labeled "positive external economies of scale" in that they lower production costs in ways that would not be possible if firms and workers were geographically dispersed (Stigler 1952). In short, in order for individuals and industries to generate positive externalities and synergistic interactions, they must be grouped in close proximity to one another.

Formal and informal linkages among individuals are key to the creation and sustenance of knowledge spillovers (Saxenian 1996). A critical part of this process is the creation of trust among actors through repeated personal ties, often in informal settings (Gertler 1995). In order for personnel in competitive, dynamic, knowledge-intensive sectors to be productive and creative, they must be engaged in frequent, collegial interaction with one another and develop interpersonal bonds. This requirement arises in large part from the sheer complexity of the production process in high technology sectors, in which large, difficult problems are addressed by teams of people working together. Many observers link such "untraded dependencies" to the local cultural context: drawing upon Granovetter's (1985, 1991) notion of embeddedness, this line of thought emphasizes cultural factors as being equally important to putatively "economic" factors in the formation of economic regions (Storper 1997).

Two types of knowledge play an important role in economic activity, particularly innovation (Polanyi 1967; Howells 2000). Explicit knowledge refers to written, standardized forms of information that are easily transmitted from one person to another, including quantitative data, publicly known rules and standards, and orderly records. Tacit knowledge, on the other hand, includes information

ity is the acquisition and development of a 9 acre piece of land in Mayport currently owned by the city of Jacksonville but no longer being used and in great condition. Possible future use of this parcel could result in Beaches Habitat building 40 duplexes providing homes to 80 families.

Conclusions

Identifying and selecting sites for construction of low income housing in areas close to the waterfront in Florida is a difficult task. The site selection process used by Beaches Habitat—a non-profit faith-based organization—used a GIS database provided by the city of Jacksonville to identify, screen, and select land parcels which are available for purchase, are affordable, and correctly zoned for residential development. Several parcels were selected in three beaches communities in Duval County and further negotiations between land owner, non-profit organization and local city government set the stage for the eventual purchase of land and construction of affordable housing for low-income residents close to the beach.

The effects of substandard housing and homelessness is becoming an unfortunate reality for an increasing number of people in the Jacksonville Beaches area, but through the use of GIS to find land, and organizations such as Beaches Habitat for Humanity and the Beaches Housing Coalition, affordable housing is becoming a welcome reality in an area known for high-end condominium developments and expensive ocean-front living.

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The Mayport beaches area (figure 2) and the Atlantic Beach region (figure 3) have the most selected parcels with the Jacksonville Beach area (figure 4) having the least. Mayport is the site of a large Navy port and airfield and Jacksonville Beach is closest to the exclusive resort communities of Ponte Vedra Beach and Sawgrass in neighboring St. Johns County to the south.

Once potential sites are identified, there are still many challenges left in the process of acquiring the land. There are obvious reasons why much of this land has not been bought yet and one of the biggest problems is lack of urban infrastructure. For example, one of the areas being targeted by Beaches Habitat is located off Mayport and Dutton Island Road (see figure 2). This area has over 16 acres of available and mostly affordable land. Unfortunately, the area lacks access to water, sewage, electricity and roads that meet city standards. Lack of urban infrastructure makes the assessed value of the land affordable for Beaches Habitat; however, once bought, the cost of utility and road construction is prohibitive. Furthermore, according to Kennedy (2006), another problem occurs in persuading private owners to sell land for construction of a Habitat house.

Following the public-private community development process documented by Harris (2004), representatives from Beaches Habitat have participated in many meetings with city officials and politicians from Duval County to establish a City-Beaches Habitat partnership. If the city commits to providing infrastructure, Beaches Habitat will receive assurance that it needs to pursue land acquisition. Also, if the city will sell the available land that it owns at a low cost, this will in turn free up more funds to buy privately owned land. So far, the city has responded positively to these ideas looking at the work Beaches Habitat does as a service to the community as a whole. Another idea introduced in these meeting is to put an inclusionary zoning policy in place which will require developers to set aside 10% of their land for low-income housing.

Initial success includes receiving the support of the city of Atlantic Beach which has decided to spend $50,000 of its Community Development Block Grant to help a Beaches Habitat development just outside of its city limits (Minton, 2006). Another possibil-

that is generally unwritten, unstandardized, changes rapidly, is heavily context-dependent, and subject to informal rules of organization that make it difficult to transmit from one situation to another, and is critical for innovation to take place. The production and exchange of tacit knowledge frequently occurs through dense interpersonal networks with a narrow spatial range in which face-to-face contact is critical; often such contacts are formed through personal ties such as friendships, i.e., interactions “off the job” as well as on the job.

Locational Dynamics of the U.S. Biotechnology Industry

Biotechnology may be defined as the application of molecular and cellular processes to solve problems, develop products and services, or modify living organisms to carry desired traits. Arising in the 1970s, particularly after the discovery in 1973 of recombinant DNA, biotechnology has been a rapidly growing industry worldwide, with extensive linkages to agriculture, health care, energy, and environmental sciences. In 2003, the U.S. biotech industry consisted of 1,473 firms that employed 406,000 people, generated $64 billion in output, and spent $17.9 billion in research and development. There is a wide range in the size of firms in this industry, including single proprietorships and firms of more than 500 employees; the average firm has 275 employees; the mean national annual salary in the industry is $62,500, which makes it pay well above average. Pharmaceutical firms, which tend to be much larger than biotechnology companies, form the major market for biotechnology products. Other applications are found in agriculture, industry, and veterinary medicine.

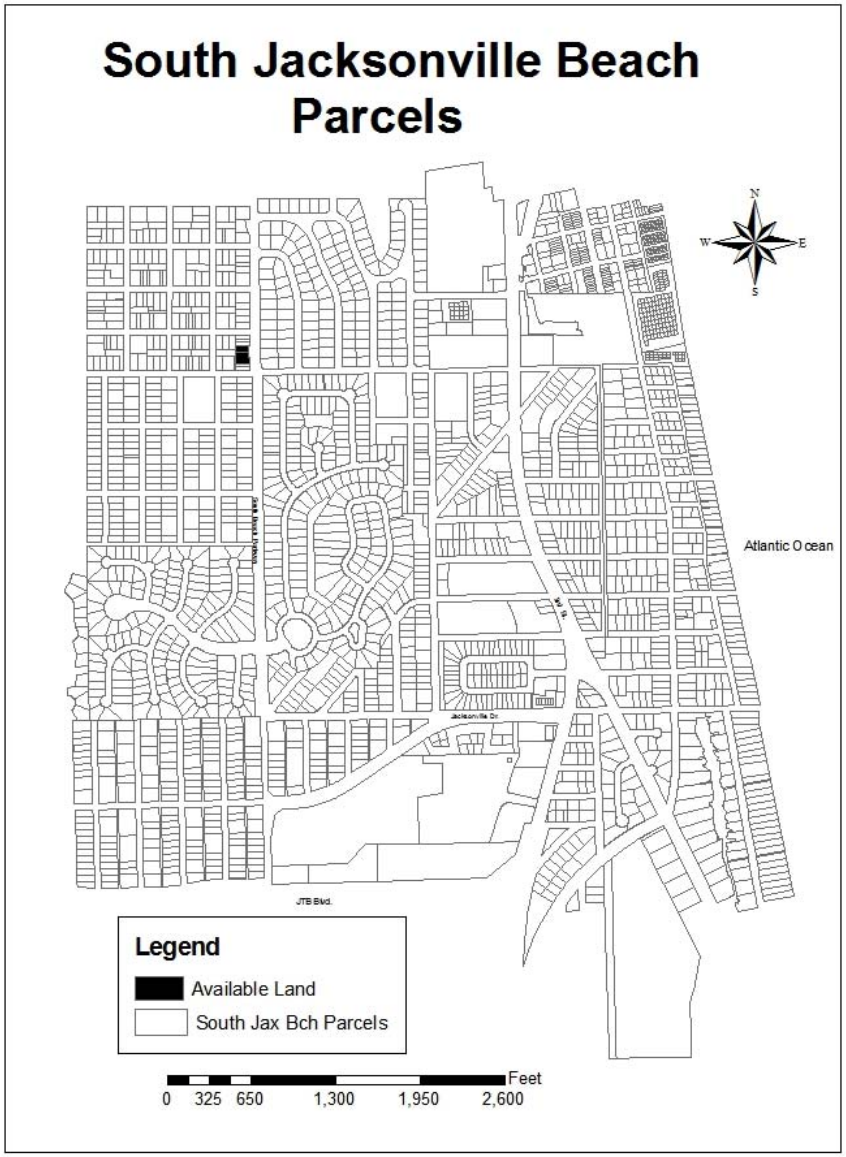
Venture capital is critical to making basic research in biotechnology commercially viable. Most small biotech firms lose money, given the high costs and enormous amounts of research necessary to generate their output and the long lag between R&D and commercial deployment. Only 1 in 1,000 patented biotechnology innovations leads to a successful commercial product, and it may take 15 years and as much as $800 million to reach that point (Somers 2004). The vast majority of start-ups go bankrupt within a few years as venture capital runs out, indicating the need for a constant supply of new business ventures to keep the cluster vibrant. In 2003, the biotech

industry attracted $3.33 billion in venture capital, which comprised 20% of all venture capital in the nation; the bulk of these funds both originated in and went to established firms in California and Boston. Venture capitalists may invest in many biotech firms, and one biotech firm may receive funding from several venture capitalists. Venture capitalists look for an experienced management team when deciding in which companies they are willing to invest. Venture capitalists provide advice and professional contacts, and serve on the boards of directors of young biotech firms (Jaffe et al. 1993; Zucker et al. 1998). As a biotech firm survives and prospers, venture capitalists gradually withdraw from day-to-day direct management. Many investors sell their stocks when the firm offers its Initial Public Offering.

There has been extensive public involvement in establishing biotechnology complexes since the industry began. The survival and success of biotechnology firms is heavily affected by federal research funds, primarily through institutions such as the National Science Foundation and National Institute of Health as well as the Small Business Technology Transfer, Small Business Innovation Research, Environmental Protection Agency, and the Food and Drug Administration. Federal policies regarding patents and intellectual property rights, subsidies for medical research, and national health care programs are all important. State level determinants are also critical, including regulatory policies, educational systems, taxation, and subsidies.

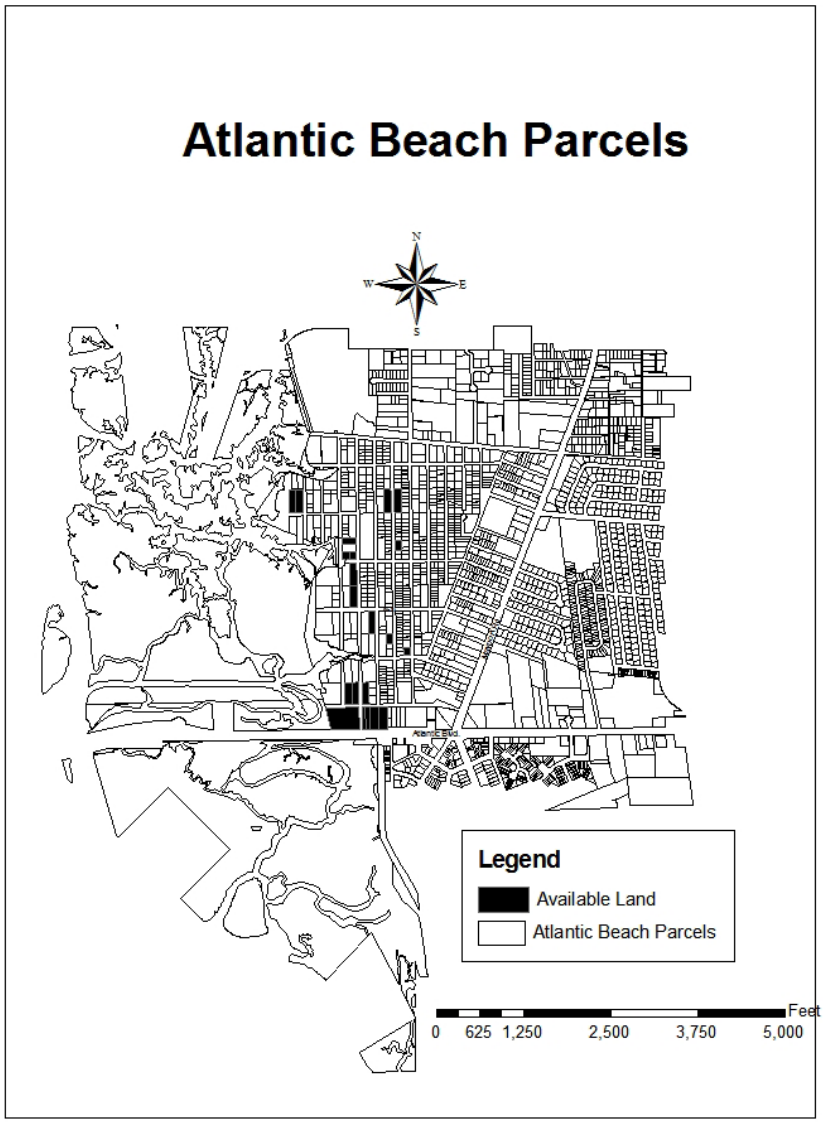
Biotechnology firms commonly tend to cluster in distinct districts, and place-based characteristics are essential for the industry's success in innovation (Bagchi-Sen and Scully 2004). Europe, for example, hosts the BioValley Network situated between France, Germany, and Switzerland (Claassens 2004). In Britain, Cambridge has assumed this role (Smith 2004). Similarly, Denmark and Sweden formed Medicon Valley (Coenen et al. 2004). Geographically, the U.S. biotechnology industry is dominated by a small handful of cities, particularly Boston, San Diego, Los Angeles, San Francisco, New York, Philadelphia, Seattle, Raleigh-Durham, and Washington, DC, which together account for ¾ of the nation's biotech firms and

Figure 4: Selected Jacksonville Beach Parcels .



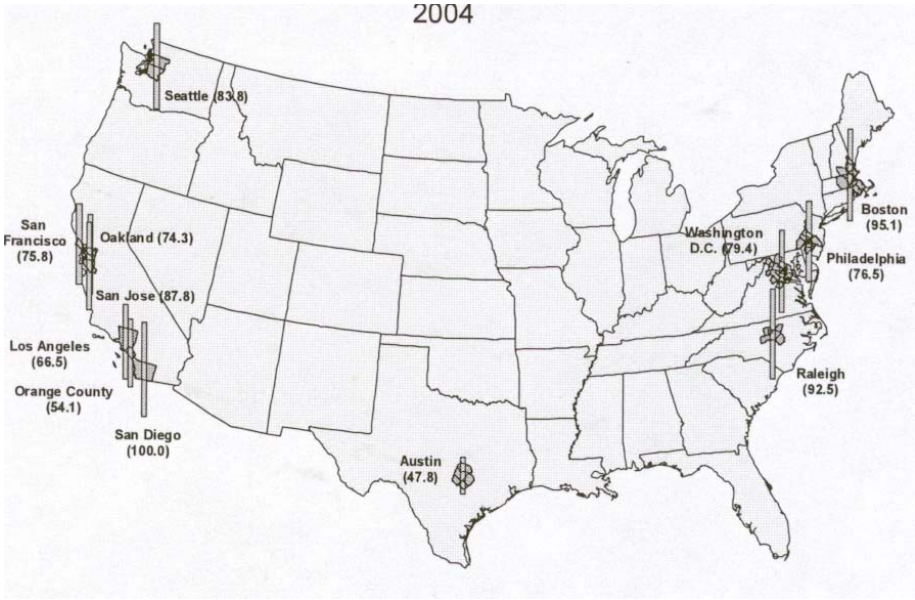
take approximately 70 acres of land to completely wipe out substandard housing in the area.

Figure 3: Selected Atlantic Beach Parcels .



cause of wetlands designation were dropped from the initial selection list and a final group of possible sites was defined to include 78 acres of land (see figures 2,3,4). Beaches Habitat estimates that it would

Figure 1: Major U.S. Clusters of Biotechnology, 2004.



Source: DeVol et al. 2004.

employment (Figure 1). These cities have excellent universities with medical schools, state-of-the-art infrastructures (particularly fiber optics, airports), and offer an array of social and recreational environments.

Biotechnology firms agglomerate for several reasons. In a highly competitive environment in which the key to success is the rate of new product formation, and in which patent protections lead to a "winner take all" scenario, the success of biotechnology firms is closely related to their strategic alliances with universities and pharmaceutical firms (Delaney 1993; Deeds and Hill 1996). Although many biotechnology firms engage in long-distance partnering, these tend to be complementary, not substitutes for, co-location in clusters where tacit knowledge is produced and circulated face-to-face, both on and off the job (Mytelka 2004). Because pools of specialized skills and a scientifically talented workforce are essential to the long process of research and development in biotechnology, an essential element defining the locational needs of biotech firms is the location

of research universities and institutions and the associated supply of research scientists (Zucker et al. 1998). Most founders of biotech companies are research scientists with university positions. Because knowledge is generated and shared most efficiently within close loops of contact, the creation of localized pools of technical knowledge is highly dependent upon the detailed divisions of labor and constant interactions of colleagues in different and related firms (DeVol et al. 2004). Successful biotechnology firms often revolve around the presence of highly accomplished academic or scientific "stars" with the requisite technical and scientific skills but also the vision and personality to market it.

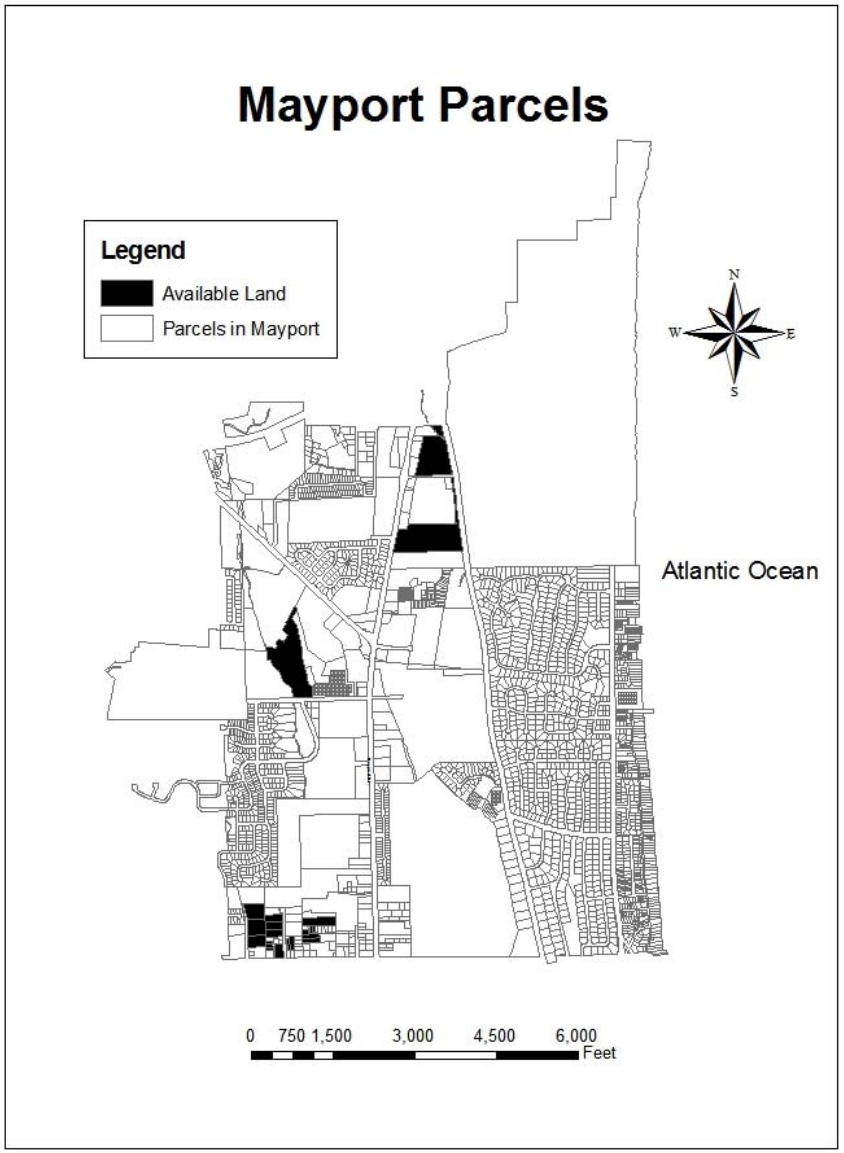
Work in the biotech industry is characterized by a high degree of uncertainty (Eaton and Bailyn 1999), and its employees often work long hours. Formal linkages among biotechnology employees may occur over long distances, e.g., using the Internet, but the informal ones essential to the creation of synergistic economies of scale necessitate geographic proximity (Audretsch and Stephan 1996). Thus, issues of employment in biotechnology cannot be considered separately from those of housing and lifestyle. For a well-educated labor pool in a rapidly growing industry with considerable locational mobility, quality-of-life issues cannot be divorced from those pertaining to work and productivity.

Florida's Biotechnology Sector

In 2004, Florida was host to roughly 33,000 companies in the broad domains of biotechnology, medical devices, pharmaceuticals, and health care, which together employ more than 600,000 people. Within the specific sector of biotechnology, however (i.e., excluding health care and medical device companies), Florida is relatively small compared to other states. The state hosted 53 biotechnology firms in 2004 (although other biotech workers may be in hospitals or universities).

Florida has targeted biotechnology as a priority growth sector in several ways. Enterprise Florida, the state's public and private partnership for economic development, lists life sciences as one of five "strategic technology sectors." The state established a $150 mil-

Figure 2: Selected Mayport Parcels.



The parcels which were sold and subsequently developed after the GIS parcel database was constructed, or which were unsuitable be-

mation system, suitable sites for construction of Beaches Habitat houses are analyzed and selected. The utility of a geographic information system (GIS) is well documented:

> GIS is a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth (Dueker and Kjerne, 1989).

GIS has broad applicability and can be used as a spatial tool of analysis for many disciplines. Using GIS for real estate and housing analyses is common (Barnett and Okoruwa, 1993; Sultana, 2003; Fung, et al., 1995; Webber, 2001).

This project used the city of Jacksonville's GIS database to find available land. The database encompasses Duval County and can be used to view every land parcel in the county, in either plain or aerial view, and is capable of zooming in to see the land and structures occupied on each parcel. A wealth of information is also tied to specific parcel location such as: zoning, number of acres, owner, assessed value, and number of improvements. Thus, all parcels in the three specified areas (see figure 1) were observed from the aerial view and each parcel which appeared to be vacant was analyzed further based on zoning, assessed value, acreage, and ownership characteristics using accompanying attribute data.

For land to be available for Beaches Habitat to purchase, certain criteria have to be met: land has to be vacant, assessed at $100,000 per acre or less to be affordable, and zoned as residential. All the parcels that met these conditions were selected, compiled into a spreadsheet, identified by specific beaches community, and classified by owner type: 'private', 'city', or 'developer'. The parcels chosen as possible sites for Beaches Habitat were also displayed in maps of the three areas that were constructed using ArcMap (ESRI). Spatial analysis using GIS had the goal of finding as much available land as possible at the Beaches.

The next step in the process was to ground truth the land which involved driving to every property on the list making sure it was still vacant; checking to see if there were wetlands on it; and looking at the surrounding urban and transportation infrastructure.

lion biomedical research trust fund, which includes $30 million for a Technology Development Fund that created two centers of excellence in three universities; two of these are biotechnology-related, including the Center of Excellence in Regenerative Health Biotechnology at the University of Florida in Gainesville, established to facilitate technology transfer in biotechnology, and the Center of Excellence in Biomedical and Marine Biotechnology at FAU at Boca Raton, designed to facilitate the commercialization of new medicines from marine resources.

Florida's universities play a major role, including research centers and developing the infrastructure to generate the requisite human capital that would make the state attractive to biotechnology start-ups. All major universities in the state have created technology transfer offices. The University of Florida has been instrumental to Gainesville's growing status in regenerative health biotechnology. Progress Corporate Park in Gainesville, now privately owned, started via the University of Florida and now hosts the Sid Martin Biotechnology Development Incubator, including the McKnight Brain Institute, and the Gainesville Technology Enterprise Center. This complex has generated 28 biotech spin-offs since it was founded in 1995. Similarly, Florida State University developed the cancer-fighting drug Taxol, a venture that generated the spin-off company Taxalog in 1997. Similarly, research parks with bioscience orientations are located at the University of South Florida, Florida State University, the University of Central Florida, and Florida Atlantic University. The University of South Florida is building a $40 million Center for Biological Defense. NASA funding, matched by the State of Florida, has created a Space Life Sciences Laboratory at the Kennedy Space Center in Cape Canaveral. Florida Atlantic University offers a Certificate in Biotechnology, funding by a $2.3 million grant from the Department of Labor, which graduates about 100 students annually, while FAU's College of Engineering offers the nation's first Bioengineering Graduate Certificate Program. UCF and USF offer a $1 million annual Industry Matching Research Program in this field. Several community colleges have started associate degree programs in biotechnology laboratory technology and bioinformatics. Florida's

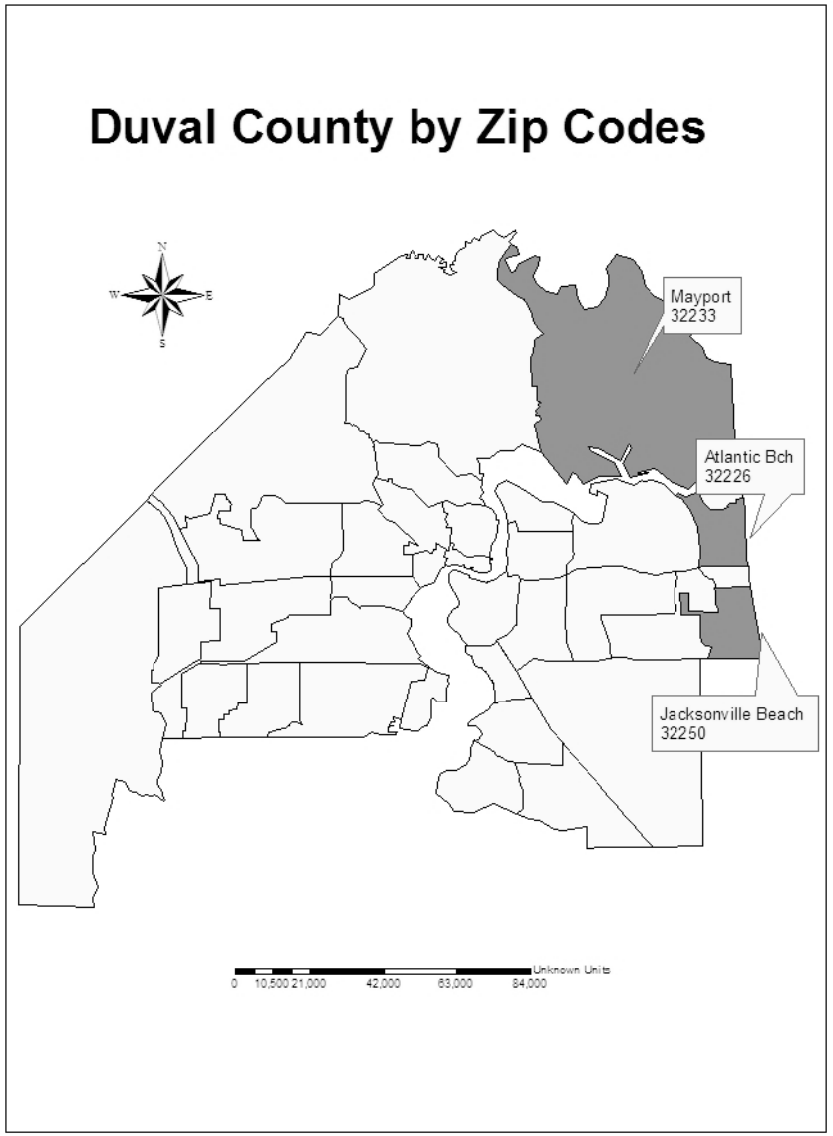
health care facilities offer research centers pertinent to biotechnology, including the Cleveland Clinic, Florida (Weston and Naples), H. Lee Moffitt Cancer Center and Research Institute at USF, Mayo Clinic (Jacksonville), M.D. Anderson Cancer Center and Walt Disney Memorial Cancer Center (Orlando), Shands HealthCare (Gainesville), and the University of Miami Jackson Memorial Hospital (Miami).

In 2004, Florida attracted $364 million in venture capital (up from $230 million in 2003), which funded 57 firms (new and existing). Of these, 15 were start-ups, one-half of which were in biotechnology. Venture capital is highly mobile geographically, but Florida does have significant numbers of local venture capitalists with experience in biotechnology, such as the Tampa investment bank Athena Capital Partners, Draper SI Ventures, in Fort Myers, and Inflexion Partners, which will invest $250,000 to $1 million each in 10 to 12 Florida biotech start-ups over the next three years (*Florida Trend* 2003). BioFlorida, the biotech trade association, plays an important role in fostering venture capital for the industry.

The Palm Beach County Biotechnology Research Park Project Plan

The Palm Beach County Biotechnology Research Park plan reflects many facets of how to achieve the synergistic effects of agglomeration. The project site is planned to comprise approximately 1,919 acres that include a variety of land uses related to biotechnology and biomedical research. Palm Beach County will act as the master developer, and The Scripps Research Institute will be the primary initial tenant. The project will include: The Scripps satellite university campus, with 28 faculty and 2,000 graduate students; a biomedical science research and development district with offices and laboratories; a town center district of commercial, retail, office, and residential uses; and a neighborhood center district with housing, parks, and community-serving commercial uses. It may also include a magnet high school for 2,500 students and a 90-acre pedestrian mall, and public open space. Palm Beach County had 2,782 biotechnology workers in 2002 (Pounds 2003). Direct employment at the Palm Beach Scripps facility will be 545 after seven years, the entire park's employment is expected to rise to 6,466 after 15 years

Figure 1: Location of Study Areas in Duval County.



close to, current poverty levels.

Finding additional land for low-income housing in the Beaches communities has become crucial. Using a geographic infor-

Table 1: Florida Low-income Housing Indicators

	RENTER # h'holds	RENTER % < poverty level	RENTER % very low income	OWNER # h'holds	OWNER % < poverty level
Florida	1,896,218	22.7	35.4	4,441,711	7.1
Jacksonville MSA	139,121	32.7	34.3	286,463	6.2
Duval County	112,025	36.9	35.3	191,722	6.5

Source: Adapted from Pelletiere (2006).

five. Future renovation of one apartment complex and the impending sale of a mobile home park is creating an affordable housing crisis at the beaches (Beaches Housing Coalition, 2006). Former residents of these low-income areas are being forced out of the community, likely into inadequate housing elsewhere, or into homelessness. Those that are employed, work in the low-wage, low-skill services sector in stores, restaurants and hotels so loss of local affordable housing choices will hurt the local Beaches' economy as well as the individual low-wage earner. Businesses will have to pay higher wages to attract more employees if low-income earners are forced out of the area, resulting in higher consumer prices for these services (*ibid*).

Founded in 1976, Habitat for Humanity is an international Christian non-profit organization devoted to eliminating poverty and substandard housing around the world. Beaches Habitat for Humanity is one of over 2100 affiliates of Habitat for Humanity International. It was founded in 1992 and has since built over 150 houses for low-income clients at the beach (www.beacheshabitat.com). Construction of Habitat houses is made possible by volunteer labor and the use of tax-deductible donations of materials and money. Excluding land, the cost to build a Beaches Habitat house is approximately $45,000. HUD fair market rent in the Beaches area for a 3 bedroom/2 bathroom house is $800 per month whereas mortgage for a Habitat home is about $425 per month including taxes and insurance (*ibid*). Houses are sold at no profit using no-interest loans and new homeowner 'sweat equity' making the price affordable for those at, or

(Hopkins 2003). Thus, the proposed park will roughly triple the county's employment in biotechnology.

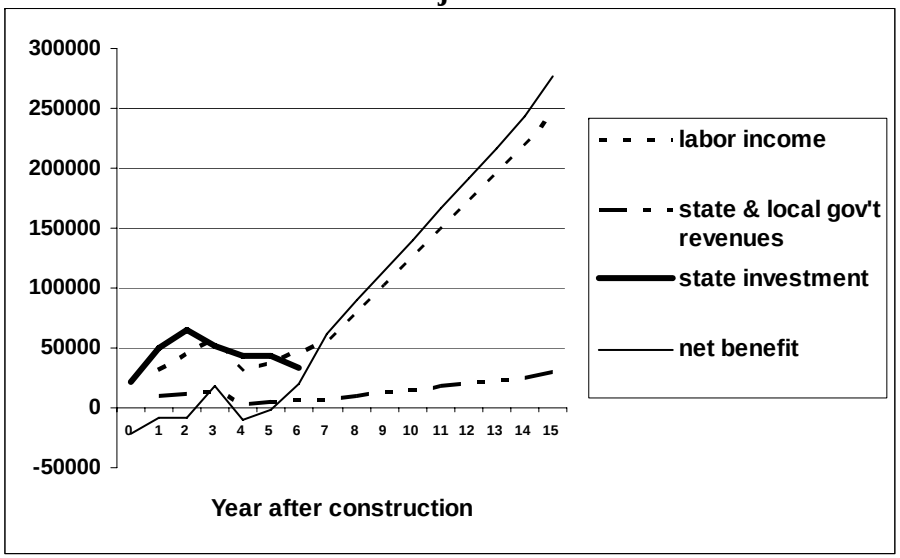
The Washington Economics Group (Hopkins 2003) estimates that in the 15 years after construction begins, and including its multiplier effects (indirect and induced), the facility will attract 499 firms with an average of 88 employees, and will generate a total of 44,300 jobs, $396 million in wages and salaries, and add $594 million annually to the state's gross output. The 15-year time horizon is consistent with the broader observation that biotechnology firms have a long start-up period and that biotech complexes do not emerge instantaneously. Average salaries for jobs there will be well above the state's relatively low average ($54,000 v. $31,000 state-wide in 2003). Figure 2 portrays the distribution of the project's projected costs and benefits over time, indicating that although the net economic benefits are negative for the first five to eight years, following this period it will generate a steady positive flow of labor income and state and local government revenues. Over the first 15 years, the project will generate approximately $6 billion in labor income, $536 million in state and local revenues, and $8.9 billion in gross state product.

Palm Beach County has provided Scripps Florida with $137 million (exclusive of land improvements) for two laboratories and one office building totaling 364,000 square feet. The State of Florida's $310 million economic stimulus package includes $50 million in start-up equipment. Operating costs in Palm Beach county are lower than those faced by equivalent biotechnology centers elsewhere (CB Richard Ellis Consulting 2004). The average annual cost to operate a firm there is estimated to be $9.9 million, including $2 million leasing expense (Pounds 2004a).

Given what is known about the locational dynamics of the biotechnology industry, to what degree will a Florida campus of the Scripps Research Institute in Mecca Farms succeed as the nucleus of a successful biotechnology cluster? Several factors contribute to the research park's potential success.

Infrastructure: Like most high technology industries, biotechnology is very information-intensive, and high capacity fiber op-

Figure 2: Temporal Distribution of Palm Beach Biotechnology Park State Investments and Projected Benefits.



Source: compiled by author from Hopkins 2003.

tic lines are essential. West Palm Beach is well endowed with a fiber optic network. The Palm Beach and Ft. Lauderdale-Hollywood International Airports provide adequate air access, and the site is close to highways such as I-95 and the Florida Turnpike. The design of the Mecca site indicates a substantial internal capture of trips, which minimizes demands placed on the neighboring road network, unlike the typical low-density sprawl often found in such areas.

Universities: The significance of universities to the biotechnology industry is abundantly evident. Palm Beach County universities include Northwood University and Palm Beach Atlantic College, while nearby Boca Raton hosts Florida Atlantic University, and its Center of Excellence in Biomedical and Marine Biotechnology. FAU, with 200 doctoral students in life sciences, is creating a new doctoral program in integrated biology (Pounds 2003); FAU already has 20 students enrolled in a Certificate in Biotechnology program, funded by a $2.3 million grant from the Department of Labor. Scripps Florida is currently occupying temporary lab space on the

the U.S. is provided by the low income housing tax credit program (LIHTC) which:

> offers market quality housing at rents that are affordable to low-income residents whose available income is constrained. Affordability standards are based on HUD median incomes. . . . . The principal motivation for the investor is a tax credit that can be used to offset federal income tax obligations directly. (Polton, 2005, p. 40)

An increasingly important role in the provision of a 'safety-net' for those of below average income is being played by the private sector—specifically by non-profit faith-based organizations (Wuthnow, 2004). The next section will analyze a case-study of one such organization—Habijax—and its role in locating suitable land parcels for the creation of affordable housing in the beaches communities of Duval County, (Jacksonville) Florida.

The Habijax Case

"There is no more land at the beach," is a common misconception of those living in the Jacksonville area. A small number of land parcels are available in the beaches communities however, and according to Kennedy (2006): "I am floored at the amount of available land at the Beaches." An increasing trend in the Jacksonville beaches communities though, is to see low income trailer-park housing developments torn down and replaced with high-end exclusive condominium and apartment complexes just blocks away from the ocean (Burmeister, 2006). Table 1 shows low-income housing indicators for the state of Florida, Jacksonville Metropolitan Statistical Area (Clay, Duval, Nassau and St. Johns counties) and Duval County (City of Jacksonville). The smallest geographic unit (Duval County) has the highest percentage of low-income renters (36.9% below poverty level) and the highest percentage of owner-occupiers below poverty level in the region (6.5%).

In the Jacksonville Beaches area (see figure 1), five low-income developments have been sold since 2005, comprising 594 homes and over 2000 beaches residents. A year ago, sixteen low-income developments existed but that number has now dwindled to

overactive hurricane season of 2004-2005 and severely impacted in the south of the state toward the end of the 2005-2006 hurricane season.

Inadequate housing poses many health hazards to families and barriers to education for students. Poor housing is often accompanied by dangerous building structures containing lead-based paint or lead water pipes which can cause lead poisoning; faulty wiring allowing the potential for electrocution; and leaks permitting mold and dampness increasing the propensity for allergic reactions or respiratory illness. Housing sites may also be hazardous, often located in subprime areas such as floodplains, or near to industrial activity, or solid waste dumps. Sites may also lack adequate sanitation and access to clean water resulting in more serious health issues (Dodd and von Schirnding, 2006).

Emotional health problems also accompany substandard housing. An unsafe house and the possibility of being evicted can cause much insecurity. The threat of homelessness can cause depression, alcohol and drug abuse, domestic abuse, and crime (Thornton, 2005). Lack of affordable housing and threat of homelessness also impacts student educational achievement. Student socialization, which is an important element of student success, may be hindered by perception of inequality with peers and lack of a sense of belonging with fellow classmates. Inadequate living conditions can stimulate feelings of anger, fear, and hostility all of which impede learning. Without a good education, the cycle of poverty and low academic performance will continue (Hodson and Pelallo-Willis, 2006). The lack of affordable housing combined with limited employment opportunities, limited educational achievement, and lack of basic conditions of shelter can result in an increasing gap between those who can afford to live in urban areas and those who can not (Slater, 2004).

Several initiatives exist however, with the aim of mitigating the affordable housing crisis. Neo-liberal policies with minimal public intervention show some success (Jones, et al., 2003). In the U.S., government intervention provides some stability when housing crises develop (Harris, 2004; Journal of Property Management, 2004). Perhaps the most pervasive and successful affordable housing support in

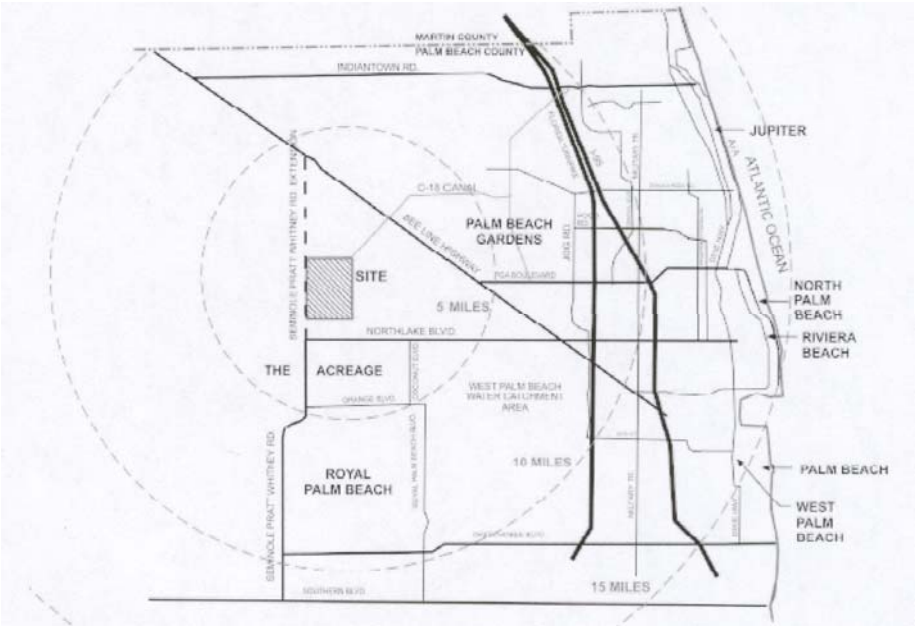
Jupiter campus of FAU. Scripps Florida will establish a Ph.D. program with 28 full-time faculty members, which includes opportunities for students to study at Oxford University through a partnership program. Finally, the hospital and university at the Mecca site will offer training on-site.

Venture Capital: The ability of the Palm Beach Biotechnology Park to attract venture capital will test and illustrate the validity of the principle "Build it and they will come." Dyadic International, a 25-year old biotech firm in Jupiter, raised $6.7 million in 2003 from Bioform, a new biotech venture fund started by Stephen Warner, founder of West Palm Beach's CrossBow Ventures (Singer and Pounds 2004). Similarly, FAU professor Russell Kerr and collaborators founded Tequesta Marine Biosciences in 2004, which creates medicines from marine life and is the first firm to come out of FAU's Center of Excellence in Biomedical and Marine Biotechnology. Other venture capital firms that have explicitly demonstrated interest in the Scripps Palm Beach County plan include: Noro-Moseley Partners in Atlanta; MB Venture Partners in Memphis; 5AM Ventures in San Francisco; Cardinal Partners in Princeton; and Three Arch Partners in Portola Valley, California.

Amenities: Florida's warm climate, the relative proximity of beaches and the oceans, and Palm Beach County's positive public reputation all contribute to the facility's likely success in this regard, phenomena that played a role in the formation of San Diego's biotechnology complex and the ability to recruit skilled talent. The campus-like atmosphere will be attractive to skilled professionals and offer short commutes. The City of West Palm Beach is relatively close and offers abundant golf and tennis as well as galleries and theaters within a 20-mile radius (Figure 3). Within a 20-minute drive there live roughly 120,000 people, and within a 30-minute drive, about 430,000. Proximity to the Everglades may be attractive to scientists working within the biological sciences. The proposed site thus offers a unique blend of rural and urban amenities.

Housing: A distinctive feature of the Mecca Farms project plan is the integration of residential units in the complex. Housing proximate to the laboratories and offices will minimize commuting

Figure 3: Location of Mecca Farms Site Relative to West Palm Beach Metro Area.



Source: CB Richard Ellis Consulting 2004, p. 30.

times and impacts on the regional transportation system, and include non-automobile alternatives. As Eaton and Bailyn (1999) note, professionals in biotechnology tend to favor residences relatively close to work, an aspect of the Mecca project plan. The presence of a range of affordable housing units, in a county in which the 2004 median housing price was $235,000, is significant in order to attract workers of modest financial means, including post-doctoral fellows and graduate students who often occupy entry-level niches in the academic scientific world or semi-skilled technicians.

Networking Possibilities: Local development initiatives include an aggressive technology transfer program designed to maximize interactions among Scripps personnel and other institutions, including universities. In addition to such formal channels, there is an infrastructure to facilitate informal ones. The Mecca site, designed as a multiple land use facility in which scientists, technicians, students,

Affordable Housing and Market Pressure

> There is not a single jurisdiction in the country where a person working 40 hours a week, 52 weeks a year at the prevailing minimum wage can afford a one bedroom apartment (National Low Income Housing Coalition, 2006).
>
> Analysis of data from the 2003 American Housing Survey (AHS) shows there were 7.7 million extremely low income (ELI) renter households and just over 6.0 million rental units affordable at or below the ELI threshold. The result was an *absolute deficit* of affordable rental housing for these households of just fewer than 1.7 million units (Pelletiere, 2006).

Lack of affordable housing is not confined to the U.S. (Planning, 2006; Musterd and Andersson, 2005), however, in the U.S., overall housing affordability fell consistently in 2005 when measured by the National Association of Home Builders/Wells Fargo Housing Opportunity Index (Journal of Property Management, 2006). The provision of affordable housing stock, whether owner-occupied or rental, is an area of concern for all communities in the United States, but is a critical problem for the state of Florida. Florida is one of the fastest growing states in the U.S. with an estimated 2004 population of 17,397,161. The Census bureau estimates that the state has a higher than average rate of population increase with 4.7% change from 2003 to 2004 compared to 3.8% for the U.S. as a whole (www.fluspop.org, 2006). Popular media describe the fact that one thousand people per day stream into Florida.

Population growth and population pressure in Florida create a lack of availability of housing stock in general (www.census.gov). Market pressures on available land parcels create spiraling real estate prices and effectively shut out lower income families from the chance to locate affordable housing. Florida also has to contend with environmental challenges posed by location, physical geography, and a cyclical increase in tropical storm activity (see, for example, Tobin, et al., 2004). Housing stock was depleted throughout out the state in the

Affordable Housing and Competition for Land: Searching for Sites at the Beach

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Introduction

In the United States, affordable housing start-ups are lagging demand (Thornton, 2005; Heavens, 2006). In Florida, and particularly in beaches communities throughout the state, the provision of affordable housing is becoming more problematic as market pressures on available land makes acquisition of property largely beyond the reach of lower-income families (Journal of Property Management, 2005).

This paper explores the efforts made by a community improvement organization in north Florida to locate suitable land-parcels in areas close (but not adjacent) to the Atlantic Ocean with the goal of increasing the stock of affordable housing. Parcel analysis using a geographic information system identified several potential sites for consideration.

The next section will consider previous contributions to the literature addressing affordable housing, local market pressures and local community improvement organizations. Section III presents a case-study analysis of the role played by Beaches Habijax—a non-profit faith-based organization in Duval County, Florida—in identifying and procuring suitable parcels of land in order to provide affordable housing in areas where market pressures are forcing low-income families to leave. The last section will offer conclusions and suggestions for further research.

and other personnel will work and live in relatively close proximity to one another, lays the groundwork for the repeated, fortuitous, face-to-face encounters that lie at the heart of competitive regions and synergistic spin-off effects. The site plan offers a critical mass of research facilities. The presence of housing, as well as supporting commercial and retail functions, at the Mecca site is conducive to the formation of informal relations and the exchange of tacit knowledge that is key to the creation of regional synergies.

Conclusions

Biotechnology epitomizes the entrepreneurial, knowledge-intensive, and networked firm that characterizes much of the American economy today. Critical variables that underpin the location of biotech firms include skilled scientific labor and access to venture capital. Biotechnology firms are currently concentrated in a handful of metropolitan regions that offer ready access to pools of skilled labor, specialized services, and venture capital. Geographic proximity, both on the job and off, is important to the generation of knowledge spillovers and the synergistic effects that these complexes generate. Because many of the contacts among scientists, researchers, and other workers are informal, a mixed land-use facility that includes both housing and recreational facilities as well as labs and offices necessary to the generation of the creative synergies that lie at the heart of successful biotechnology complexes.

Regions without an established advantage in biotechnology must be exceptionally entrepreneurial in order to gain a foothold in this sector. Florida has aggressively targeted the industry for growth, laying the groundwork for a skilled regional supply of scientific labor, including community college programs and university Centers for Excellence, which have already generated spin-off firms. While venture capital is difficult to predict, experience to date indicates that the potential exists to attract local and national investors. Unlike existing centers of biotechnology, which emerged without a conceptual plan to integrate the essential components for optimal economic growth and minimal side effects, the Palm Beach complex would be planned from the beginning, allowing it to draw upon the lessons

learned elsewhere and to minimize many of the market failures and negative externalities that accompany unchecked growth in existing regions (e.g., traffic congestion, unaffordable housing). Moreover, the current mix of land uses is designed to maximize possibilities for collaborative interactions that lie at the heart of the creation of synergies and external economies of scale.

The Mecca site, which is situated within striking distance of the city of West Palm and greater Miami, offers the locational prerequisites to build a successful biotech complex. The Mecca site offers access to the necessary infrastructure, universities and human capital, venture capital, and cultural environment that lead to synergistic interactions. The very presence of Scripps at the Mecca site as a large, successful, and experienced anchor tenant will validate the location in the eyes of other biotech entrepreneurs and venture capitalists. The site offers access to universities such as FAU that have tailored their curriculum to meet the needs of the industry. The on-site housing of the Mecca site is a unique feature and presents the milieu that leads to formal as well as informal interactions among firms and employees.

With so many states pursuing biotechnology firms, can Palm Beach County successfully compete? Three other factors are worthy of consideration. First, established centers, such as Boston and San Diego, suffer from the problems of earlier rounds of growth, including expensive housing, congested transport networks, and long commuting times that already are encouraging some biotech companies to examine alternative locations. Second, Florida offers amenities not available to many other competing locations, including an attractive climate and low tax rates. Florida's government has been unusually aggressive in pursuing this industry, and the state's educational infrastructure has changed to accommodate the biotech industry's human capital requirements. Third, the biotech industry is widely projected to enjoy rapid growth in the future. The industry has been energized by the human genome project and the potential of stem cell research, and may well be one of the nation's driving catalyst industries of the 21st century. Employment in the industry rose 12% annually over the last decade. Biotechnology revenues have tripled since 1995, and there is little reason to expect that future earnings will not be sus-

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tained at similar rates of growth. This growth must go somewhere, and there is no *a priori* reason that new clusters can not attract the venture capital and skilled labor that underpin local growth. Historically, clusters have emerged and disintegrated over time; there is no iron law of economics that maintains that only successful regions will succeed in the future.

The strategic implications of the Palm Beach biotech park for the state are significant. Florida's economy is dominated by relatively low-wage, low skilled industries and occupations such as tourism, and the presence of a biotechnology cluster would help to diversify the state economy with relatively skilled, high paying jobs. Florida has seen other major centers dot its landscape over the years, including Disney World and the NASA Kennedy Space Center; thus, the formation of a Palm Beach biotechnology park would not be the first time the state has witnessed the rise of a new industry with significant propulsive effects on the state.

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2005). A historical geographic approach to this problem would call for an analysis of wetland losses in specific places and finding ways to determine if visible impacts are a result of wetland losses—or simply coincident with them.

Conclusion

Florida remains fertile terrain for historical geographers, particularly those interested in the consequences of significant population and economic growth over relatively short periods of time. Although one could make a case for examining Florida's geographies of the more distant past, I think a stronger case can be made for seeking to understand the state's human and physical geographies since 1900. Rapid development in Florida, especially over the past 60 years, has provided many benefits but it has created several problems as well. We need to abandon the blanket assumption that additional growth and development will always produce benefits in excess of problems and more thoroughly analyze what all these changes mean for people.

Meanwhile, although environmentalists frequently decry the loss of wetlands, increasing air and water pollution, increasing scarcity of water resources, and the relative decline in the quality of Florida's environment—all too often they do so in general, non-specific terms. Indeed, there has been no systematic and statewide attempt to carefully measure many of the environmental consequences of rapid population growth in Florida since 1900. It is my contention that we desperately need such an effort and environmentally oriented historical geography is, as Colten and Dilsaver (1992) suggested more than a decade ago, well suited to undertake such a task. The state's attractive environment is what draws people to Florida in the first place. Are we in danger of literally loving the state to death—or can we draw attention to the specific impacts of rapid population growth in time to foster more sustainable environmental management? Only time will tell.

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documented impacts of coastal development to plant and animal species—as well as to people who once made a living on the coast, but who can no longer afford to live there. Finally, federal, state, and local governments subsidize property insurance against floods, hurricanes and other hazards, and they support beach nourishment programs, further encouraging the notion of "risk-free" development. Florida may be a subtropical paradise, but as the 2004 and 2005 hurricane seasons (and resulting property insurance crisis) remind us, our state periodically experiences extreme natural events. Moreover, now that the state is home to nearly 18 million people, natural hazards are now more likely than ever to impact large numbers of people, and the price tag for coping with such disasters is mounting. A historical geographical analysis of natural hazards and property insurance in Florida would help put the current property insurance crisis into perspective.

If freshwater represents Florida's life-blood and coastal waters are Florida's heart, wetlands (the third context of water in Florida) are the state's "kidneys." Dahl (1990) estimates that in the 1780s (long before virtually any wetland drainage took place), just over 20 million acres of Florida's 34+ million acres of land area (almost 59%) was wetland. And in spite of the fact that people have converted roughly 9 million acres of Florida wetlands to farmland or urban uses, and although Florida contains thousands of miles of streams and thousands of lakes, "wetlands are [still] the largest component of the state's surface waters in terms of total land area" (Fernald & Purdum 1998, p.77).

Wetlands are widely believed to provide a host of valuable services to people. According to Fernald & Patton (1984, p.249), "Loss of wetlands has been a major factor in the degradation of water quality, the decline of fishing and hunting, the reduction of water supply, and the increase in potential for flood damage experienced in many parts of the state." These generalizations seem reasonable, but can we identify specific impacts of wetland loss in certain places? This is a crucial issue because this is where many environmentalists' arguments fall apart; these impacts may be real, but they are generalizations that sometimes do not hold up to scrutiny in all cases (Meindl

sources of water to meet the increasing demand—costs that are passed along to all residents in an area (whether they benefit from continued growth or not).

Continued population growth impacts Florida's fresh water resources in a variety of ways. For example, salt-water intrusion into coastal zone aquifers (due to excessive demands placed on coastal area groundwater supplies) was long ago documented in Miami and St. Petersburg (among other places). It is one thing for relatively wealthy coastal residents to have to pay more to import fresh water—but entirely another when the movement of large quantities of water from inland areas toward the coast may create impacts for inland areas (such as additional sinkholes; see Rand 2003). The impacts associated with the movement of large quantities of water across county lines cries out for more attention. Furthermore, although water quality problems in the Everglades have been much publicized, the decline (and in a few cases, recovery) of water quality in the rest of Florida has not been given the historical geographic attention it deserves. In addition, we need to better document the relative impacts of drought over time. One might be tempted to suggest that population growth in Florida has made drought far more problematic than it was in the past, but this has not been thoroughly analyzed. Finally, impacts of growth to Florida's fabled springs are slowly becoming manifest. Many of the state's smaller springs have long since gone dry due to increased groundwater pumping. Historical geographers might well attempt to trace impacts to Florida's remaining springs, recognizing that such work is complicated by the fact that many springs in one watershed depend on water that originates in another watershed.

The second context in which one could examine water in Florida is that of coastal waters (and to a lesser extent, lakes and rivers). Coasts, rivers and lakeshores represent Florida's "heart" and they have attracted the lion's share of the state's residents and tourists. Although most of north Florida's coastal salt marshes have until recently escaped the developer's bull dozer, many of south and central Florida's salt marshes and mangrove forests have long been converted to waterfront housing—as has much of Florida's beachfront property. Surely historical geographers can synthesize the many

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Spatial Variations in Urbanization in Former French Africa, 1885-2004

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Despite sharing a similar colonial government and gaining independence in 1960, the former French colonies of Sub-Saharan West and Central Africa have experienced varying trends of urbanization. Landlocked nations Burkina Faso, Niger, and Chad currently range from 18 to 39 percent urbanized while coastal nations Mauritania and Gabon are 38 to 73 percent urbanized. These trends towards coastal development show a reversal from pre-colonial growth in which many kingdoms (Ashanti and Sokoto) and cities (Kano and Timbuktu) developed further inland. What has caused this reversal in urbanization and spatial demographics?

This paper examines how changes in French administrative policies and colonial goals resulted in differing focal points of development in Africa. As French interests shifted between the interior and coastal sections of West and Equatorial Africa, resources and capital for development followed. While administrative policies from Paris shifted the spatial focus of the colonial government, it also resulted in localized economic and agricultural practices which contributed to rural-urban migration, increased urban unemployment and poverty, and deepened the economic crisis experienced throughout most of the region (Hope, 1998). This paper will examine the various phases of French colonial administrative policy, how these policies impacted regional economic practices and populations, and to what extent these policies impacted urban growth and demographics.

French activity in Africa

French activity in Africa can be divided into three periods; the pre-war period from the late 1800s to 1914, the inter-war period from 1915-1939, and the pre-independence period from 1940-1960. French goals in colonial Africa changed very little during these peri-

man modifications such as wetland drainage, air conditioning and mosquito control), Florida's historically inexpensive housing (now a quickly fading dream!), no state income tax, and tourist attractions—all of these have all combined to attract large numbers of people who have both added to and reduced the quality of life that attracts people to Florida in the first place. From the brewing housing affordability crisis to awful traffic in urban areas, to all manner of environmental degradation—continued economic growth appears to be making many of these problems worse. At the same time, I remain painfully aware of Earle's (1992, p.53-54) warning to avoid the overly simplistic claims that "capitalism has mindlessly destroyed the landscape" and that "environmentalism will set things straight." Earle observes that such a dichotomy buries capitalism's occasional positive contributions under the environmental problems it may have helped create. For example, Earle (1992, p.54) found much "counterevidence of environmental wisdom and sensitivity" in late 19th and early 20th century residents of the U.S. South's Cotton Belt who apparently cared much more for their land than conventional wisdom suggests. Similarly, in 20th century Florida, one could start with the fact that wetland drainage—for all its negative attributes—contributed to an environment worth settling in the first place. Although destroying additional wetlands for development may not make much sense today—previous wetland drainage laid the foundation for many positive developments in Florida.

Of course, one could not address Florida's environmental historical geography without focusing on water, arguably the state's most attractive feature. This can be done in three contexts. First, fresh water for agricultural, industrial and domestic use, is the life- blood of the state. Roughly half of all the fresh water used in Florida comes from surface sources and the other half is drawn from the ground. Water shortages are becoming increasingly common despite the fact that the state averages over 50 inches of rain per year (Fernald and Purdum, 1998). The era of limitless and inexpensive ground and surface water appears to be nearing an end. Continued population growth in central and south Florida is now beginning to impose higher water costs because utilities must now tap more expensive

Conceptual Issues and Major Themes

The development of a historical geography of Florida requires confronting at least a few conceptual issues and themes. To begin with, although there are certainly historical geographical issues of interest prior to 1900 in many parts of Florida, the majority of physical and human geographical changes in the Sunshine State have taken place since 1900. To wit, Key West remained Florida's largest city until the state's census of 1895, and as late as 1900, scarcely more than a half million people inhabited the entire state (with more than half of those living along a string of north Florida counties between Jacksonville and Pensacola). Although there was some important late 19th century economic development in Florida (such as the railroad and hotel development by Henry Flagler and Henry Plant, as well as Hamilton Disston's drainage work), focus on the period since 1900 is appropriate.

In addition, we would almost certainly have to cope in some way with the economic consequences of massive population growth. For example, the explosion of tourism is widely touted as a positive development for Florida partly because it provides many jobs, and partly because it generates so much tax revenue that Florida remains one of a few states able to avoid adopting a state income tax. Yet for all of tourism's benefits, the related impacts of large numbers of poorly paid workers, and the fact that the state's tax revenue has not come close to providing the revenue necessary to support adequate transportation, education and other infrastructure suggests that the state is in some ways choking on its own growth. Indeed, it might prove fruitful to investigate the 20th century experience of other states for comparison to the Florida experience. For example, perhaps we can investigate the economic and environmental impacts of rapid growth in states like Hawaii or California and compare this with the consequences of slower growth in states such as West Virginia and North Dakota? Such comparisons would have to be handled with care, but they might help put the Florida experience into perspective.

Tackling the environmental consequences of the state's phenomenal population growth is equally important. Florida has been caught in a vicious circle: a pleasant natural environment (after hu-

ods. France concentrated on appropriating, exploiting, and developing vast areas of land and resources in their colonies (Martin & O'Meara, 1995). France implemented various policies to accomplish this objective including programs of land tenure, developing transportation networks, and investing in or adjusting administrative centers. However, policy implementation varied between coastal and interior colonies. Also, policies enacted in one location often affected people in other places.

Methods

The initial phase of this research included identifying the major urban centers of former French Africa. These were identified by their reference as an administrative capital or governing center. The major urban centers of today with populations greater than 100,000 were identified with reports from the United Nations Statistics Division and listed in a table with collected population figures. Once these figures were collected, they were graphed as a scatter plot. This allowed for an analysis of population patterns and trends.

The second phase of this project involved researching the policies of the French colonial government, identifying colonial policies, and overlaying these with the population statistics of African urban centers. This resulted in an analysis of the growth of urban centers with the implementation of governing policies.

Data Sources

This research paper uses findings from annual French-colonial statistical reports, national censuses, statistics from the United Nations, and references in historical documents. Annual statistical reports include findings from censuses conducted by administrators in the territories of French Africa. In years when no census was taken, surveys and guesses of population figures were taken by colonial administrators and local chiefs. Often, the exact number of the European population in an urban center was given, while African populations were rounded off and estimated based on the number of houses found. These figures were found in statistical reports such as *Annuaire Statistique de L'Afrique Occidentale Francaise* and *Memento*

Statistique de L'Economie Africaine. The population charts of African urban centers are based on these findings and figures. Data for French administrative, economic and urban development policies have been compiled from historical documents and references including direct quotes and passages from administrators.

Results

Fourteen nations in sub-Saharan Africa experienced French colonial administrative policies prior to their independence. Nine of these nations, including Senegal, Mali (French Soudan), Niger, Guinea, Cote d'Ivoire, Togo, Benin (Dahomey), Burkina Faso (Upper Volta), and Mauritania were members of the administrative unit French West Africa. Gabon, Central African Republic, Congo-Brazzaville, Chad, and Cameroon comprised the administrative unit of French Equatorial Africa (see Fig. 1).

French administrative policy altered the flow of rural migrants, seasonal workers, capital flow, and even the populations of entire villages. Populations and trade routes which had primarily involved interior areas were shifted towards the coast. Additionally, rural-urban migration is a self-perpetuating process. The vast majority of migrants are young adults with a high fertility rate (Hope, 1998). This facilitates faster birth rates in the urban centers while decreasing growth in rural areas and draining their potential workforce.

Pre-War Period Urbanization

Interior Colonies

In West Africa, the original economic plan involved modernizing traditional practices in the area. Subsistence farming would give way to modern plantation agriculture increasing production and revenue from the colonies. However, these efforts often failed as the labor force was too small and the idea of conscripting labor clashed with traditional practices of migrant laborers. Traditional economic practices often competed successfully with the French projects (Griffeth, 1985). As a result, the idea to modernize the local econ-

dealing with many aspects of Florida's past and present. A review of even the most important books in this series is beyond the scope of this paper, but quick mention of a handful of selected titles underscores the emergence of a literature devoted to an analysis of Florida's changing geographies.

David McCally's (1999) environmental history of the Everglades, Patsy West's (1998) treatment of Seminole Indians, and Mark Foster's (2000) book on Miami Beach developer Carl Fisher all illustrate the dramatic changes the have occurred in south Florida over the past century. Meanwhile, Gordon Patterson's (2004) analysis of Florida's war against mosquitoes, Faith Eidse's (2005) collection of interviews from people living near the Apalachicola River, and Bill Belleville's (2006) personal account of suburban sprawl's path across a chunk of central Florida all highlight environmental changes in other parts of Florida. Finally, Jack Davis and Raymond Arsenault (2005) edited a collection of essays attempting to examine selected aspects of Florida's environmental history while Gary Mormino (2005) produced a solid synthesis of late 20th century Florida social history that wonders aloud if the changes we are imposing on the state are truly sustainable over the long term.

Of course, there is an equally relevant and burgeoning literature that is NOT part of the *Florida History and Culture Series.* For example, Ary Lamme (1997) and Kevin Archer (1996a, 1996b, 1997a, 1997b, 1997c) have commented on growth and change in central Florida. Included among the more environmentally-oriented histories of at least a portion of Florida include Carter's (1975) now somewhat dated book on the development of Florida water policy, Nelson Blake's (1980) aptly named *Water into Land—Land into Water*, an examination of efforts to drain the Everglades and of the ill-fated attempt to create a cross Florida barge canal; and James Miller's 1998 *Environmental History of Northeast Florida*. To these we might add Belleville's (2000) discussion of the St. Johns River and Kathryn Ziewitz and June Wiaz's (2004) treatment of the transformation of Florida's largest landowner (St. Joe Company) from a forest products producer to real estate developer.

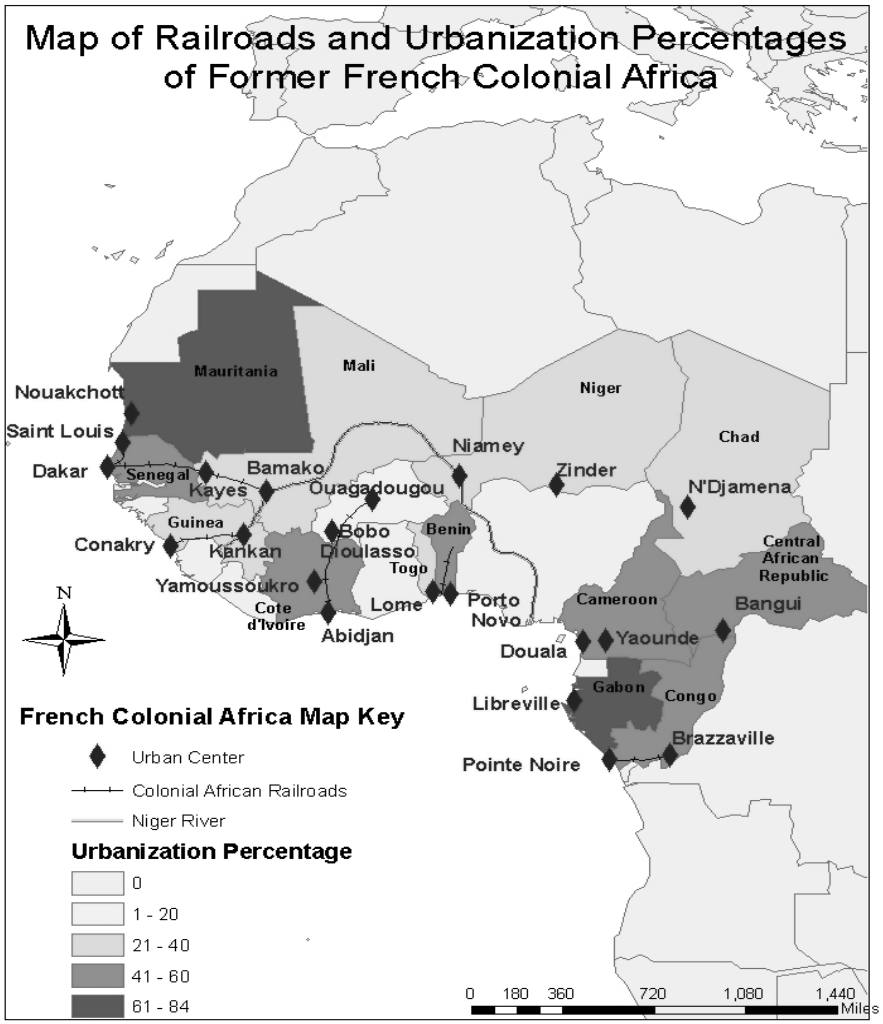
key themes evident in much recent work include: a more overtly theorized exploration of the material, political and symbolic dimensions of travel and exploration; imperialism and post-colonialism; nationhood and state formation; and ideas of nature and environmental change."

To be sure, there has been some top-notch work by physical geographers interested in past environments (see Trimble 1992; Phillips 1997), as well as by environmental historians (Cronon 1991; White 1995). Indeed, Colten (1998, p.iv) refers to environmental historians "constructive interlopers." Although Holdsworth (2002) initially contended that it is too early to tell if more modern perspectives in historical geography would completely erase traditional concerns of place, space, and environment—in a subsequent review of the field, Holdsworth (2004) acknowledges some fine environmental historical geography by a variety of scholars such as Walker (2001), Colten (2002), and Gandy (2002) among others. In fact, Dilsaver and Colten's earlier fears that environmental issues appeared to be taking a back seat in historical geography proved premature. Writing the historical geography chapter in the massive *Geography in America* published in 2003, Colten et al. (p.153) contend "Without a doubt, the 1990s was a surging, successful decade for scholars with environmental interests." To this we might add Dilsaver's (2004) work on the Cumberland Island National Seashore or Colten's (2005) *Unnatural Metropolis*, a timely discussion of New Orleans' continuing struggle with their low lying environment, published just months before Hurricane Katrina devastated the northern Gulf coast.

Focus on Florida

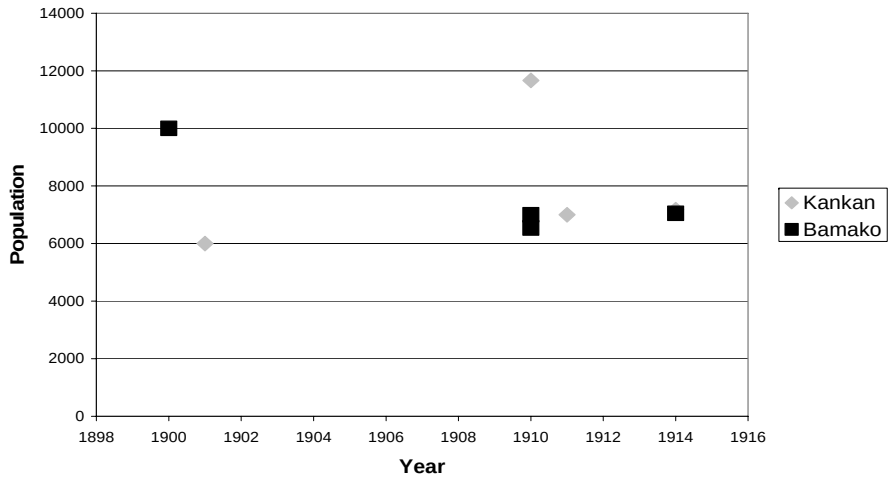
Students of Florida's past have written much about the state's changing demographic patterns and developing collage of ethnic groups (Winsberg 1993; Lamme and Meindl 2002; and Mormino 2005) and some occasionally tip their hat to environmental issues (see Ganon 1996 and especially Tebeau 1980). Indeed, Ray Aresenault and Gary Mormino launched the University Press of Florida's *Florida History and Culture Series* almost ten years ago and have since overseen the publication of almost 40 volumes (and counting)

Figure 1: French Colonial Urban Centers, Urbanization Percentages, and Major Railways.



omy changed to a policy of economic accommodation. From these successes, French policy was altered to increase a worker's individual production. A large population of laborers developed as a response to increased benefits through an agricultural lifestyle. It was profit-

Figure 2: Pre-War Interior Urban Center Populations



able for rural farmers of interior colonies to produce cash crops such as cocoa, coffee, cotton, peanuts, and palm oil for European markets (Martin & O'Meara, 1995).

In French Equatorial Africa, the economic policy of land appropriation to concession companies was less accommodating, harmful to the population, and only profitable through exploitation. According to an inspector in 1913, the powerful Compagnie Forestiere Sangha-Oubangui systematically neglected everything except collecting rubber (Vidrovitch-Coquery, 1986). To foster the collection of resources on these lands, all who lived in its bounds were used as laborers.

Throughout French Africa, growth of interior urban centers and the overall population was minimal if not declining. Interior urban centers in Guinea and Mali experienced declines in population. Bamako and Kankan (see Fig. 2) likely decreased in population as seasonal migrant workers left for Senegal to cultivate cash crops (Vidrovitch-Coquery, 1985).

Coastal Colonies

The pre-war period saw the initiation of several principal rail-

(1997) concludes that it matters not whether our interpretations of the past are objective. He argues that we should confess we cannot possibly be entirely objective in our discussion of the past so that we may open "the possibility for many legitimate interpretations of the past" (Wishart 1997, p.117).

Although McQuillen (1995, p.279) wanted to be supportive of environmentally oriented studies in his 1995 review of historical geography, he found little work worthy of comment: "Historical geographers have always been interested in aspects of environmental change over time, but they have rarely contributed to the developing literature on environmental history over the last two decades." McQuillen (1995, p.280) did cite Dilsaver and Colten's (1992) edited collection of essays entitled *The American Environment: Interpretations of Past Geographies*, but he contends that "These essays also underscore a weakness in the contribution of historical geographers to environmental history: a tendency to describe environmental change rather than to measure it . . ." Yet even if there has been an emphasis upon simply recreating and describing past environments, environmental change in Florida has been so extensive and so rapid that we would do well to begin with relatively simple descriptions of what the landscape used to look like just a half century ago—and then combine this with measuring the nature of changes in the environment since then.

In the early 1990s, Colten and Dilsaver (1992) lamented the fact that at that time, relatively few historical geographers appeared to be taking up discipline's storied human-environment interaction tradition. They feared that environmental perspectives in historical geography were being greatly outnumbered by a variety of other concerns. In their review of the field, Graham and Nash (2000, p.3) report:

> "Recent work is moving in new directions. Many contemporary historical geographers informed by feminism, post-structuralism, anti-racism and post-colonial perspectives share concerns about power and meaning with other researchers more readily located within the traditional sub-disciplines of economic, cultural, political and social geography. . . . The

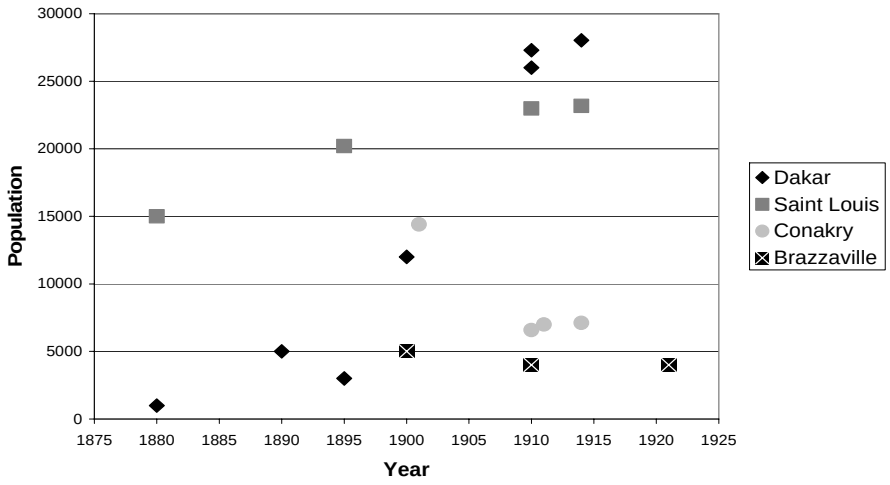
suggests "Within historical geography, as within history, there should be unrelenting criticism of all orthodoxies and conventional wisdoms, as well as unremitting awareness of discourses in cognate disciplines." Indeed, I submit that we ought to think more critically about the role of population and economic growth in reworking Florida's landscapes. Such growth has certainly provided many positive outcomes, but the conventional wisdom seems to be that growth always provides benefits in excess of problems—and I am not sure that is still true in many parts of Florida.

In any event, human-environment interaction is one of historical geography's most venerable traditions, and Colten and Dilsaver (1992, p.10) argue that "The slow moving manner of resource management policies and the incremental nature of human impacts demands historical treatment of these subjects, and historical geography offers an ideal framework for their examination." They add that we need more studies of the physical consequences of human impacts to the environment—and further treatment of the economic costs of environmental degradation and depletion of natural resources—all of which will hopefully lead us to greater emphasis upon environmental management.

Williams (1994) agrees that environmental historical geographers still have much to contribute to our understanding of 1) the transformation and modification of the earth, 2) the impacts of the spread of capitalism, 3) the place of people in nature, and 4) the interrelationships among habitat, economy, and society. Yet he warns against oversimplifying complex behavior patterns and depending too much upon ecology to explain how natural systems "should work." While he concedes that the notion of objectivity in history and in science has been subject to increasing skepticism, he maintains that we would do well to use more curiosity and waste less time trying to develop sharper logic.

Although Demeritt (1994) questions the heavy dependence upon science (especially ecology) as a way to frame stories about past environments, Cronon (1994, p.42) suggests that "Without some faith that our descriptions of reality bear at least tangential relationship to that reality, it makes little sense to worry about reality at all." Wishart

Figure 3: Pre-War Coastal Urban Center Populations



ways. The Senegal-Niger line of 1905, linking Dakar to Kayes; the Conakry to Kankan line in Guinea, completed in 1914; the Abidjan to Bouake line in Cote d'Ivoire, and the Cotonou line to Save in Dahomey, both completed in 1912 (see Fig. 1), all caused a realignment of economic axes, causing populations to regroup (Vidrovitch-Coquery, 1986).

This altered the orientation of commerce toward the coast through the port cities established as colonial administrative centers. For the majority of landlocked peoples living in French West Africa, inland expansion of transportation systems altered their attention toward the coast and away from Saharan caravan routes (Griffeth, 1985). New patterns of trade helped colonial authorities attract populations and secure labor resources from the interior toward areas favored for development (Pheffer, 1985). This created new urban centers while selectively draining older centers.

When examining the coastal urban centers of Dakar and St. Louis, we can see initial stages of urban growth (see Fig. 3). Dakar's population doubled from 1900 to 1914. This growth is expected with the emphasis of development placed on Dakar. Completion of Dakar's port in 1910 and railroad junctions centralized colonial adminis-

trative and economic activities to the city (Pheffer, 1985). While Saint-Louis displays growth, it is not as pronounced reflecting the emphasis placed on Dakar. In 1902, Dakar replaced Saint-Louis as the administrative capital of French West Africa. Not all coastal urban centers grew during this time period however. Population decreases in Conakry and Brazzaville, both port cities and administrative capitals, typify decreases in the overall populations of colonial Africa due to disease, conscription, labor recruitment, and relocation (see Fig. 3).

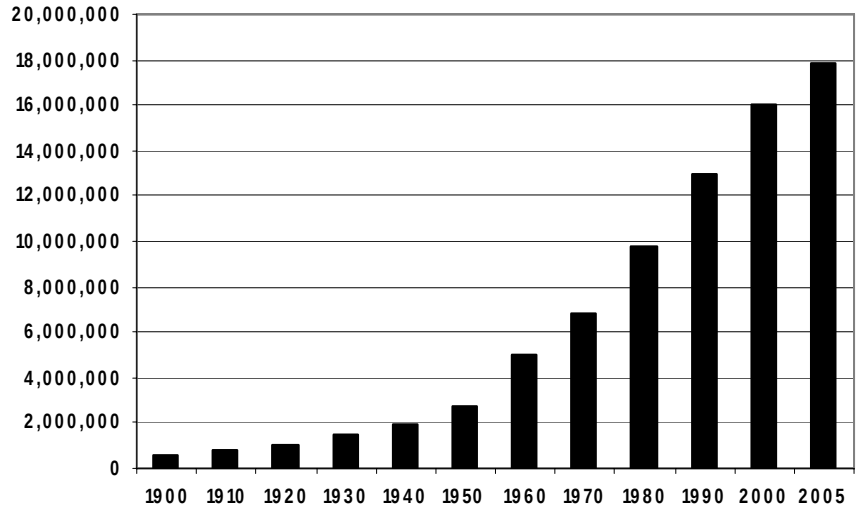
Inter-War Period Urbanization

Interior Colonies

The end of the war exposed the deplorable health conditions many Africans experienced. This was due to policies of relocation to new regions, troop recruitment, disease outbreaks, and natural hazards which magnified difficult living conditions. In many areas, the normal rhythm of social and economic life was disrupted by labor recruitment. Population densities fell below the level needed to maintain self-sufficiency (Vidrovitch-Coquery, 1986). By the early 1920s, officials noted declines in population. A fifteen percent decline was observed in Cameroon and thirty percent declines in Congo and Central African Republic. In 1923, Albert Sarraut, the minister of colonies, noted that "Our policy must be to preserve the African people. Thus there is a need for a far reaching programme of metropolitan investment, for health and education services to improve African welfare and thus productivity" (Vidrovitch-Coquery, 1986).

In the years following World War I, Paris enacted a strategy to spur economic revival. France encouraged colonies to maximize production, support the war effort, and aid in post-war economic reconstruction (Vidrovitch-Coquery, 1986). Increased economic production was based on the availability of labor. In West Africa, this policy coincided with efforts to regroup thinly spread populations. In Upper Volta, Mali and Niger, cotton production increased from 189 tons prior to the War to 3500 tons in 1925. However, increased demands drove many in the region to flee. In the course of a decade, an

Figure 1: Florida's Population Since 1900.



Historical Geography

It is instructive to take a moment to review some relevant literature from the often-neglected field of historical geography because such a review helps situate this call for historical geographic work on Florida. By way of introduction, Baker (2003, p.3-4) differentiates between geography and history by reminding us that "historical geographers tell us stories about how *places* have been created in the past by people in their own image, while historians tell us different stories about how *periods* have been created in the past by people in their own image." Colten et al. (2003, p.154) add that unlike historians, historical geographers "often bring to bear a richer, more scientific understanding of the natural world." Baker admits that social theory perspectives have begun to challenge the once dominant empirical emphasis in historical geography. To be sure, much early 20th century work in the field was stuffed with a mind-numbing volume of facts, but it is also true that deeply theoretical work without empirical grounding is not very useful either. In summary, Baker (2003, p.213)

Toward a Historical Geography of Florida: Assessing the Consequences of Massive Population Growth

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Introduction

A historical geography of Florida? What a strange idea that must be to many contemporary central Floridians who half-heartedly assume that A.D. means "After Disney," the opening of Walt Disney World on the outskirts of Orlando in 1971—or for many historical geographers who think in terms of examining geographies of the more distant past. In spite of the fact that Florida is home to St. Augustine, "The Nation's Oldest City" (if we pretend ancient Native American communities don't count), not until well after 1900 did the state begin to show signs of being transformed from a wetland wilderness into a series of sprawling cities, strip malls, and tourist attractions. And although wetland drainage and other landscape changes were well under way by the middle of the 20th century, Florida had only 2.7 million people in 1950—on its way to nearly 18 million in 2005—and counting (Figure 1; U.S. Census). Can a historical geographic perspective possibly add anything to our understanding of this collection of places so recently (but substantially) shaped by people? I think so and indeed, Kearns built his 1992 review of historical geography around the theme of contemporary history. Moreover, although using states as units of analysis does not seem to be much in vogue among geographers these days (see Wyckoff 1999 for a rare exception), historians appear to have no such qualms (see Gannon 1996 and 2003; Mormino 2005; Davis and Arsenault 2005). I argue that because Florida is changing so fast, we need solid historical geographic work on the Sunshine State that carefully assesses the state's previous human and physical geographic patterns and processes; in this way, we can develop a clearer picture of the ways the state's population and economic growth over the past century has in some ways improved quality of life, while in other ways causing declining quality of life.

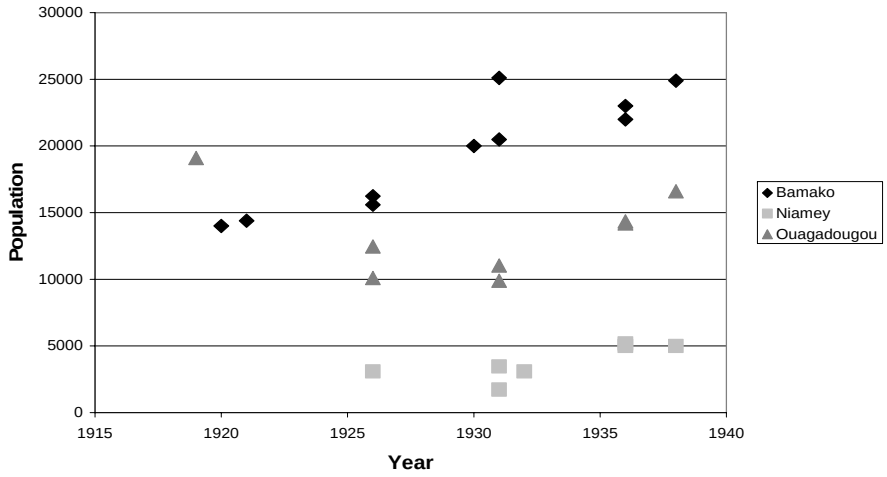
estimated 100,000 Mossi fled Upper Volta (Cordell & Gregory, 1982).

As economic production increased and France experienced a revived economy, the situation for African workers hardly improved. Wages did not increase consistently, leading to a growth of non-contracted migrant laborers traveling between colonies looking for better wages. Nearly 50,000 workers annually left Burkina Faso and Guinea to harvest groundnuts in Senegal. While wages did not increase with economic successes in the colonies, taxes did, rising from five francs before the war to twenty-five in 1930 and seventy-five in the prosperous economic zones (Vidrovitch-Coquery, 1986).

Often, individuals increased production to pay off debts and taxes. By the 1930s, the combination of taxes and deflated commodity prices was too much for many farmers to tolerate. In most colonies, people paid more in cash than they earned. This compounded crises, such as demands for labor, food-production shortages from the exodus of young people, plagues, and famines. By 1936, traditional farmers abandoned hope of surviving off the land and fled to urban and administrative centers (Vidrovitch-Coquery, 1986).

During the years of World War I, colonial urban centers changed little in population, if they did not decline from conscription and out-migration. With immediate post-war policies promoting increased production and improved living conditions, colonial urban centers reversed their declines. However, as long as citizens living in rural areas survived with an agrarian lifestyle, there would be few reasons to migrate. Overall, interior urban centers demonstrated slower population growth than coastal centers. In Niger, transferring the colonial capital from Zinder to Niamey (see Fig. 4) caused only slight population growth (Njoh, 2004). In Mali, population growth at Bamako (see Fig. 4) was steady and likely augmented with farmers fleeing from interior sections of the colony. In Upper Volta, Ouagadougou (see Fig. 4) likely experienced population decline due to the use of the Mossi and other peoples as an "indispensable labour source for Senegal and the Ivory Coast" (Cordell & Gregory, 1982).

Figure 4: Inter-War Populations: Interior Urban Centers



Coastal Colonies

France exploited its colonies by extracting human capital in the form of conscripted soldiers. Because of numerical inferiority to Germany, the French adopted a policy treating the African territories as a troop reservoir (Martin & O'Meara, 1995). However, conscription was not limited to World War I. From 1919 to 1939, conscription caused a number of young Africans to flee to nearby English colonies which did not retain this policy.

During World War I, numerous soldiers were recruited from Africa impacting demographics, altering economic practices, and disrupting family organizational schemes. French Africa supplied over 200,000 troops for World War I with tens of thousands dying on the battlefield (Martin & O'Meara, 1995). The recruitment process was alarming for most Africans. To counter resistance to recruitment, policy makers created bonus schemes including exemption from future labor taxes or conscriptions. Despite these, Africans fled into the bush, left the country or deserted. Thirty-five thousand Senegalese took refuge in the Gambia and Guinea-Bissau. In Guinea, one of every five recruited fled to nearby Liberia and Sierra Leone. Whole districts in Guinea were emptied and others were reduced to half their

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ined together to determine the effects of enhanced friction and convergence at the coastline. Acquisition of data for all Florida stations receiving rainfall for each TC will facilitate a calculation of the area over each TC produces rainfall, and the amount of TC-produced rainfall received each year.

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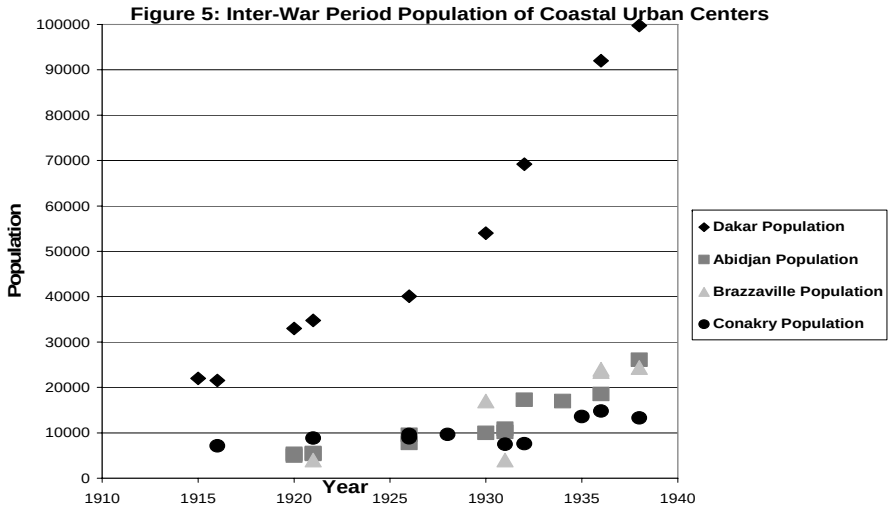


numbers (Vidrovitch-Coquery, 1986).

In Senegal, the local populations were strained by soldier recruitment. As a result, production of millet fell by a half and groundnuts by a quarter. In Cote d'Ivoire, there was less of a strain by recruitment and the colony received migrant laborers from neighboring colonies. Subsequently, maize production increased eightfold and cotton production by a factor of fifteen (Vidrovitch-Coquery, 1986). In Equatorial Africa, a similar program was launched in 1915. Rather than producing for France, every village was required to provide for troops stationed in Cameroon. In the end, only a quarter of all produce was left for local village consumption.

France enacted policies to increase colonial economic production. To accommodate these demands, forced labor was legalized. In 1912, work-taxes were enacted in Equatorial Africa ranging from eight to twelve days a year In 1925 the policy was extended to fifteen days. In this region, recruiting campaigns were used for projects planned in areas far away from the main population. Between 1921 and 1932, nearly 130,000 men were recruited to work on the Congo-Ocean railway which often amounted to a death-sentence from poor health and working conditions (Vidrovitch-Coquery, 1986).

As many farmers from interior colonies fled regions with high taxation and production demands, coastal urban centers experienced increases in population. From 1931 to 1936, Dakar and Abidjan combined to grow 71% and Conakry doubled. However, few of these people were employed. In 1936, there were only 167,000 wage earners in West Africa, barely one percent of the population (Vidrovitch-Coquery, 1986).

When examining the inter-war population figures for Dakar and Abidjan (see Fig. 5), an increase can be seen after 1930. Both centers grew slowly during the years of conscription and also show only slight growth during the economic boom years between 1920 and 1930. A spike can be seen in Abidjan's population after 1934 when the city succeeded Bingerville as the colonial capital (OTAL, 2005). When examining population figures for Conakry (see Fig. 5), the population doubles between 1932 and 1936. Coastal urban centers in Equatorial Africa also demonstrate population growth following 1930. In Brazzaville (see Fig. 5), an influx of tens of thousands of workers was received during construction of the Congo-Ocean railway (The Dupuy Institute, 2000).

Pre-Independence Period Urbanization

Interior and Coastal Urban Centers

Following World War II, politicians in Paris re-examined colonial policies in Africa. An emphasis was placed on reform and development of urban and administrative centers. Reform occurred as economic and financial management. During the inter-war period, the colonies were expected to provide and assist France economically. After World War II, this was reversed. Emphasis on investment and development in urban centers became more pronounced and did not focus exclusively on coastal urban centers over those in interior regions. In 1946, politicians in France's 4th Republic reversed the traditional ruling that the colonies should finance development from production based revenue and policies were made to abolish forced labor and improve general welfare. Goals to reform overall welfare of the African population involved investing in and relocating

rain rates away from the storm center would correspond to decreasing rainfall totals away from the storm center.

Conclusions and Future Research

This study examined the location receiving the maximum storm total rainfall amount within Florida for TCs that occurred during 1980-2005. Seventy-one TCs produced an inch (25.4 mm) or more of rainfall within Florida during this period, with an average maximum rainfall total of 254 mm (10.6 in). The locations of these Florida rainfall maxima were compared to the landfall location of each TC, and the TC's closest position to the point of rainfall maxima to determine the range of distances over which Florida residents should be on alert for the potential of TC-produced rainfall. TCs making landfall as far away as Texas have tracked eastward to produce rainfall in Florida, and six TCs affected Florida without making a U.S. landfall. This finding suggests that people in Florida should prepare for the possibility of TC-produced rainfall even when a TC is forecast to come ashore in other states.

More than half of the TCs examined produced their Florida maximum rainfall within 100 km of either side of the storm track. Yet, 20 percent of the LMFR were located more than 300 km from the storm track, suggesting that Florida residents need to stay informed about potential rainfall hazards even if the TC is not forecast to track directly through their area. Although intensity does not appear to influence the maximum amount of rainfall received, an inverse relationship was found between hurricane rainfall totals and distance from the storm track. The key factors proposed by this study to enhance rainfall for storms tracking through Florida are interactions with the atmosphere which affect the speed of motion and moisture availability, and frictional convergence along the coastline.

Future research will further investigate the atmospheric and land surface physical forcing mechanisms responsible for TC rainfall production in Florida. TCs whose tracks were influenced by similar atmospheric conditions will be grouped to identify similarities in rainfall patterns resulting from atmospheric physical forcing mechanisms. TCs making landfall along coastlines of similar shape, and TCs of similar intensity and radius of maximum winds will be exam-

Table 3: Correlation Values for Maximum Rainfall Amounts and the Distance from the Storm Track at Which They Occurred

Type	All Data	Hurricanes	Tropical Storms	Tropical Depressions
Correlation	-0.42*	-0.72*	-0.36	-0.34
No. Cases	69	19	29	21

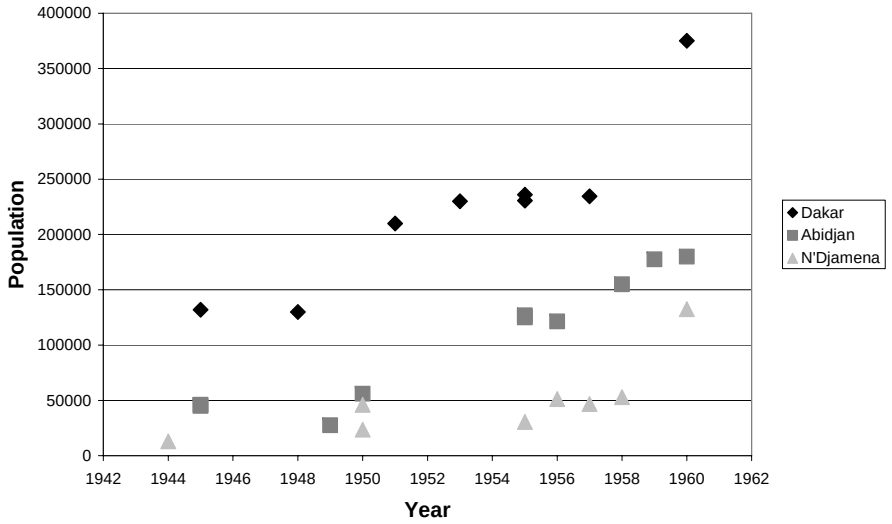
** denotes significance at the 0.01 level*

storm. For example, strong vertical wind shear inhibits rainfall from occurring on the upshear side of the storm (Corbosiero and Molinari 2003). In other words, if the wind shear is from the west, most rainfall will occur on the east side of the storm. If a storm experiencing westerly wind shear is moving towards the east, the rain shield will be displaced ahead of the storm, and locations on either side of the storm track could experience heavy precipitation. Strong wind shear causing a displaced rain shield could account for the large distances between some LMFRs and the TC circulation centers.

As stated previously, the majority of LMFRs occurred within 100 km of the storm track. Pearson correlation coefficients were calculated to determine if a relationship existed between the rainfall total and the proximity of the storm track for the 69 TCs producing at least 75 mm of rainfall (Table 3). All TCs were analyzed together and then were stratified by intensity. The storm's intensity was defined using its maximum sustained wind speed when first entering or at its nearest position to Florida.

Results suggest that hurricanes produce higher storm total rainfall amounts close to their storm track. Marks et al. (2002) found through an examination of 245 TCs that high rain rates for hurricanes were located closer to the storm center than for tropical storms, which supports the correlation coefficients calculated in the current study. In the Marks et al. (2002) study, peak hurricane rainfall rates exceeded 7 mm/hr at a distance 25 – 50 km away from the storm center. Rainfall rates decreased to 4 mm/hr 125-150 km away from the storm center, and 1 mm/hr 250-300 km away from storm center. This decrease in

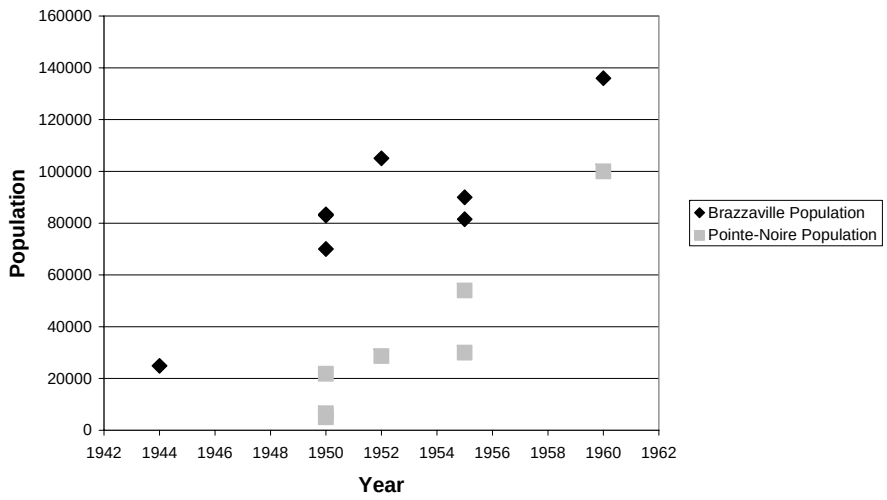
Figure 6: Pre-Independence Population: Coastal Urban Centers



administrative centers. In 1946, Cameroon's administrative functions were relocated from Douala to Yaounde, while in 1947 the same transfer occurred in Burkina Faso from Bobo-Dioulasso to Ouagadougou (Njoh, 2004). In most instances of relocation, the welfare of the colonial administrator took priority. The moves in Cameroon and Niger situated administrators in a more favorable climate. In 1950, the Vridi Canal was completed linking Abidjan to the Atlantic Ocean (OTAL, 2005). This established Abidjan as the major port handling all goods coming in to West Africa. In 1957, Nouakchott was established as the capital of Mauritania with a population goal of 15,000 (BBC News, 2005).

In 1943, regulation of urban development in France was broadened to cover similar activities in the colonies. In 1945, law was passed requiring territories to create urban development plans. Urban centers from Dakar to Brazzaville implemented this plan (Njoh, 2004). Architects in Paris designed city plans while workers and departments in the colonies implemented them. While most plans were drawn up in the 1940s and 1950s, they were not implemented until after independence in 1960 (Njoh, 2004).

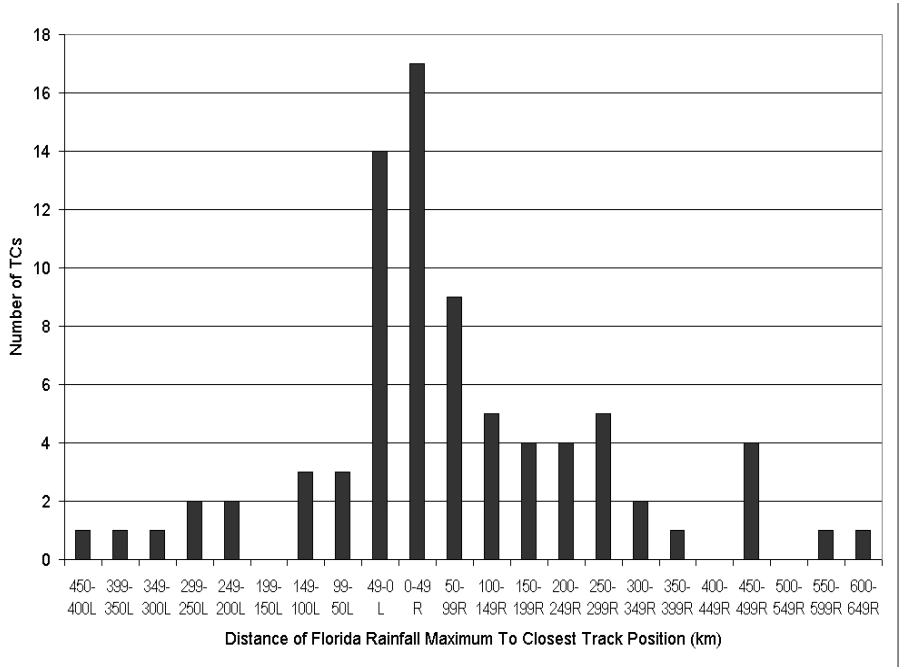
Figure 7: Brazzaville/Pointe-Noire Population Comparison: Pre-Independence Period



Following World War II, colonial investment focused on the colonial urban centers and the capitals and territorial headquarters, especially Dakar, Abidjan, and Brazzaville. The interior populations continued serving as a reservoir of labor. Now, they were needed in the booming economies of the coastal areas (Njoh, 2004). Facilities such as schools, colleges, hospitals, and religious institutions were constructed. These required an initial labor force for construction and fulltime employees afterwards (Njoh, 2004). Urban centers with job opportunities and institutions facilitating economic advancement attracted rural migrants.

Urban centers throughout West and Equatorial Africa experienced tremendous population growth. In Dakar the population nearly tripled, in Abidjan the population quadrupled, and in N'Djamena the population increased tenfold (see Fig. 6). Even when colonial administrators relocated operation, both cities demonstrated growth. Brazzaville and Pointe-Noire (See Fig. 7) both grew, although Pointe-Noire grew faster with the completion of the Congo-Ocean Railway, its port, and its brief tenure as capital of the French-Congo (Adloff, Decalo, and Thompson, 1996). In Cameroon, Douala and Yaounde

Figure 4: Distance of Location of Florida Rainfall Maximum from the Closest Approach of the Tropical Cyclone's Circulation Center



strated that the shape and orientation of the coastline can affect where this enhanced rainfall is produced within the storm. Faster tangential winds and/or a smaller radius of maximum winds would allow moisture to circulate about the storm before precipitating out (Li et al. 1997), which could produce a rainfall maximum on the left side of the storm. Due to the relatively narrow shape of Florida's peninsula, it is possible for onshore winds to occur on the coastline opposite from where the storm center makes landfall. Therefore, a TC making landfall on the west coast of Florida could produce a rainfall maximum on the east coast of Florida on the left side of the storm. This process could also account for increased rainfall amounts to the left of the storm track.

TC interactions with the atmosphere can also cause a TC's rain shield to become displaced from the circulation center of the

Both the atmosphere and the land surface can affect a TC's track. When experiencing high wind shear, Ueno (2003) found that the differing wind speeds and directions throughout the vertical column of the troposphere can cause a variety of TC tracks. Modeling work by Dengler (1997) showed that the orientation of the coastline could deflect the track of a landfalling TC. In the absence of these features, the storm's inertia carries it towards the northwest in the northern hemisphere. Given the complex interactions between a TC and its environment, Florida residents must exercise caution throughout the hurricane season, and prepare for the possibility that a storm making landfall in Texas could move eastward and produce heavy rainfall in northern Florida, or that a TC moving through the Florida Straights may not make landfall, but could still produce heavy rainfall in the southern portion of the state.

Position of Maximum Florida Rainfall Relative to the Storm Track

The TCs examined in this study produced their Florida rainfall maxima at distances ranging from the storm's circulation center out to 610 km from the circulation center (Figure 4). More than half (40 percent) of the LMFRs were less than 100 km (50 km) from the storm track, suggesting that locations closer to the storm track are more likely to experience high rainfall totals. The side of the storm track where the LMFR occurred was also examined. The LMFR occurred on the left side of the storm track in 34 percent of the cases examined, while 18 percent of TCs produced rainfall maxima on both sides of the storm track. To better understand how rainfall can be produced ahead of and/or to either side of the storm track at varying distances, it is important to understand the physical forcing mechanisms that control rainfall production with the TC.

The movement of winds from the relatively smooth ocean surface to the rougher land surface can also enhance rainfall production in certain portions of the storm. The onshore winds converge as they slow, which enhances uplift and precipitation generation (Parrish et al. 1982). In a TC making landfall at a perpendicular angle to a straight coastline, this enhanced uplift occurs on the right side of the storm in the northern hemisphere. Rogers and Davis (1993) demon-

Figure 8: Douala/Yaounde Population Comparison, Pre-Independence Period

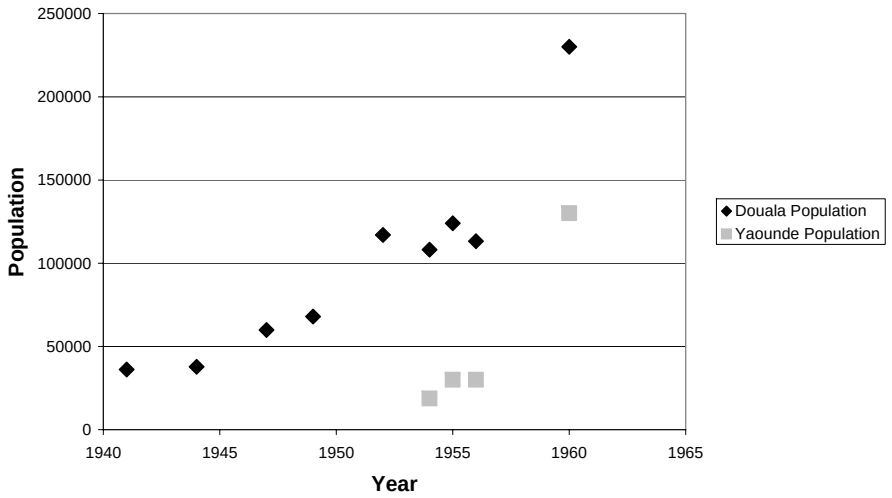


Figure 9: Bobo Dioulasso/Ouagadougou Population Comparison Pre-Independence Period

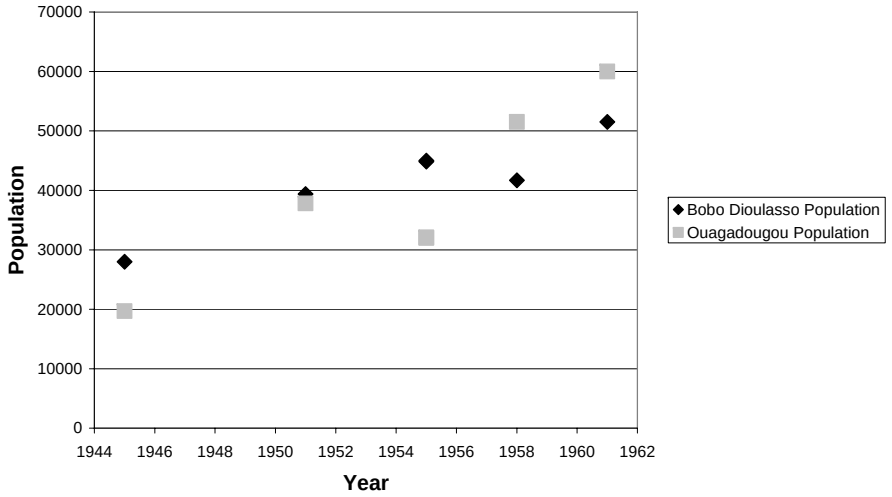
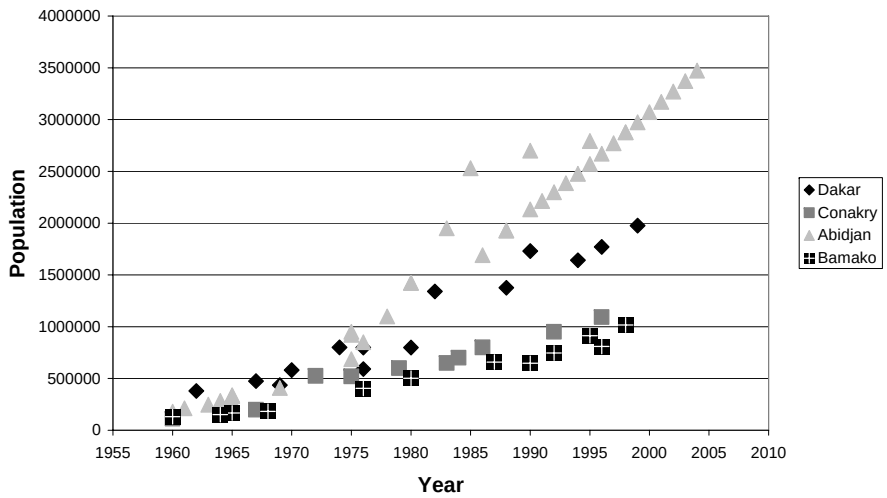


Figure 11: Post-Independence Population: Dakar, Conakry, Abidjan, and Bamako



In Figure 11, population statistics for Abidjan were collected from estimates given by the Institut National De La Statistique Du Republique De Cote D'Ivoire (http://www.ins.ci/) for 1990 through 2005. These estimates give Abidjan the appearance of linear growth which is not a typical way in which a city grows.

(See Fig. 8) grew following an administrative transfer, as did Bobo Dioulasso and Ouagadougou (See Fig. 9) in Burkina Faso.

Post Independence Urbanization

Following independence, growth in African urban centers increased rapidly. Newly independent nations in Africa retained the same policies implemented during the 1940s and 1950s. The urban center remained the focal point of government and private sector investment (Hope, 1998). In some instances, the continuation of colonial policy resulted in the relocation of national capitals. In 1983, Yamoussoukro (see Fig. 10) was designated Ivory Coast's new national capital replacing Abidjan (Scaruffi, 2005).

In these urban centers, the populations have increased to such a degree that famines, diseases, droughts, and small-scale wars have not impacted their growth. Only full scale civil war temporarily stops

The highest amount of rainfall within Florida during 1980-2005 occurred during Hurricane Georges (1998) (Table 2). Like Allison, Georges did not make landfall within Florida. However, the circulation center of Georges did pass through northern Florida the day following its landfall near Biloxi, Mississippi (Pasch, Avila, and Guiney 2001). Munson, Florida, located 225 km east from Biloxi, received 978 mm (38.46 in) of rainfall from Georges. Several rain gauges approximately 75 km west of Munson and 150 km east from Biloxi, recorded rainfall totals between 635-765 mm, indicating that Georges produced heavy rainfall in multiple locations. Even though Georges made landfall as a Category 2 hurricane on the Saffir-Simpson scale (Simpson and Rhiel 1981), the effects of its heavy rainfall were much more wide-spread than from its fast winds, as hurricane-force winds only extended an average of 51 km outward from its circulation center.

Allison and Georges are two examples of TCs that produced heavy rainfall within the state of Florida, although neither storm made landfall within the state. The second highest total rainfall amount for Florida since 1980 was produced by Tropical Storm Dennis (1981) (Table 2), a storm that did make landfall in Florida (Lawrence and Pelissier 1982). Homestead received 390 mm of rainfall within 24 hours as Dennis made landfall in Monroe County and tracked north, entering the Atlantic Ocean near Daytona Beach. The LMFR for Dennis occurred 65 km from its point of landfall. Lawrence and Pelissier (1982) estimated that over $25 million in damage was caused by the rainfall of Dennis in southern Florida.

As a TC making landfall over 1000 km west of Florida can still produce heavy rainfall within the state, it is important to determine which features of the atmosphere influence TC tracks. Plotting storm tracks for TCs that have produced rainfall within Florida illustrates several different trajectories taken by these 65 TCs (Figure 3). Large-scale circulation patterns usually determine the track of a particular TC (Wu and Wang 2004). Variations in the storm tracks of North Atlantic Basin TCs can be attributed to the positions of the polar jet stream over North America and the subtropical high in the North Atlantic Ocean (Elsner, Liu, and Kocher 2000).

Figure 3: Tracks for Tropical Cyclones Producing Over 75 mm of Rainfall in Florida during: a) 1980-1985, b) 1986-1990, c) 1991-1995, d) 1996-2000, e) 2001-2005, f) legend

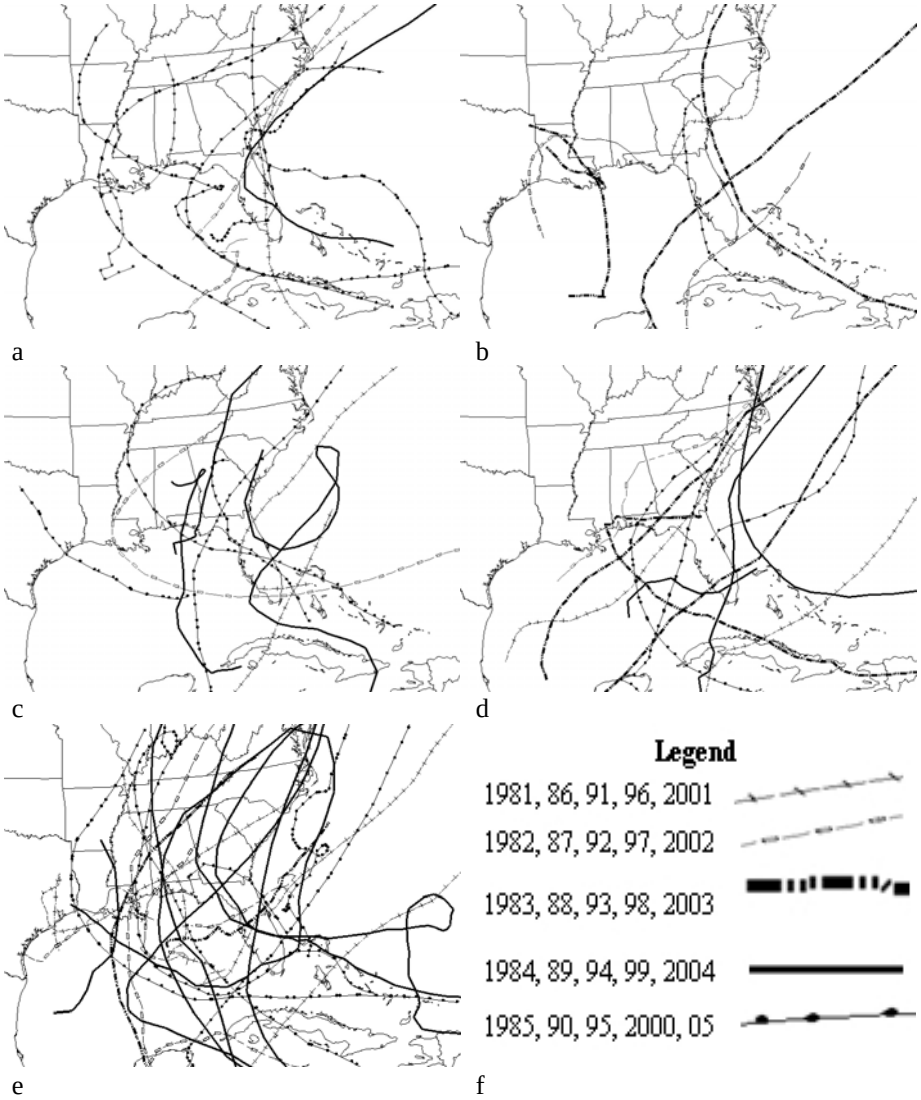
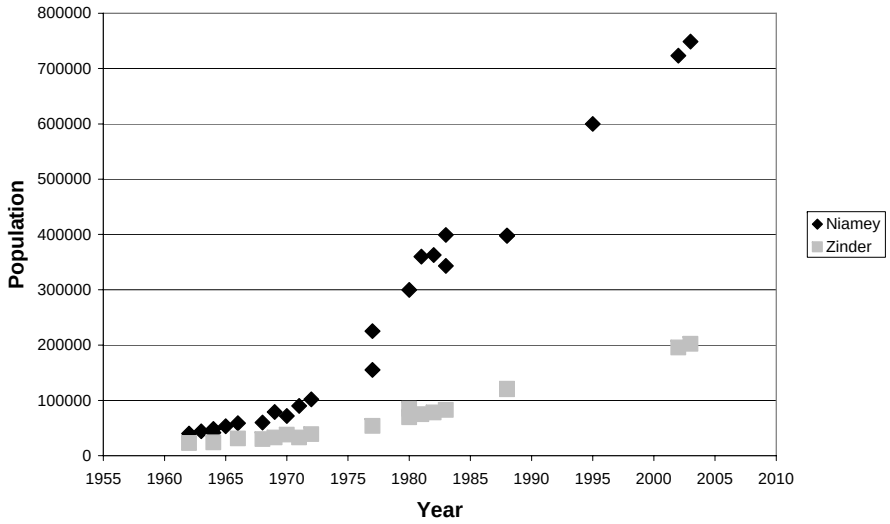


Figure 12: Niamey/Zinder-Post Independence Population Comparison

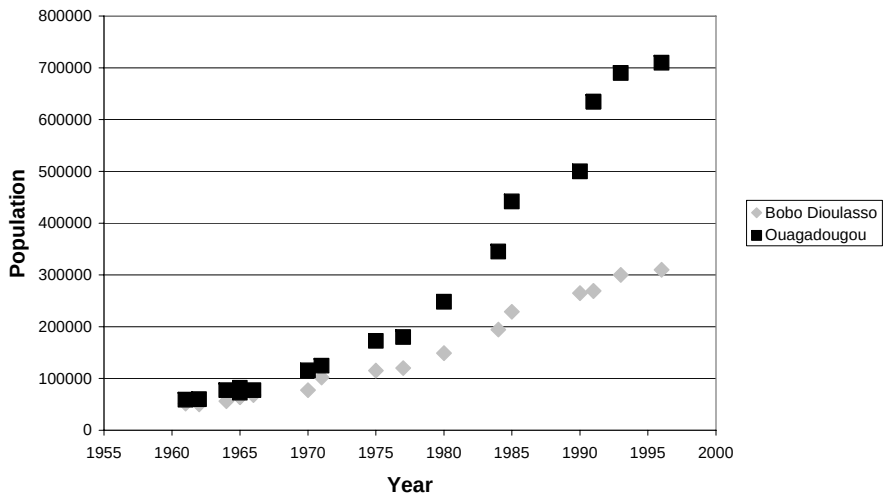


population growth as seen in N'Djamena, (see Fig. 10) in which an estimated ninety percent of the population abandoned the city in 1982 (Decalo, 1997). Overall, urban centers have grown rapidly reflecting an instilled belief that economic opportunity is found at the urban center. Cities such as Dakar, Conakry, Abidjan*, and Bamako (See Fig. 11) have all experienced population growth. In situations where the colonial administrators moved their operating location, the new capital grew quicker than the former. Niamey is three times the size of the old capital Zinder (See Fig. 12), Ouagadougou is twice as large as Bobo Dioulasso (See Fig. 13), and Nouakchott has surpassed its intended population goal of 15,000 (See Fig. 10).

Conclusions

While very rapid increases in urban populations in Africa are a relatively recent phenomenon, the economic and demographic focus has been shifting from rural to urban since the late 19th century (Hope, 1998). Many residents of interior colonies and cities have migrated to coastal urban centers identifying economic opportunities along the coast and hardships amongst the interior regions. This re-

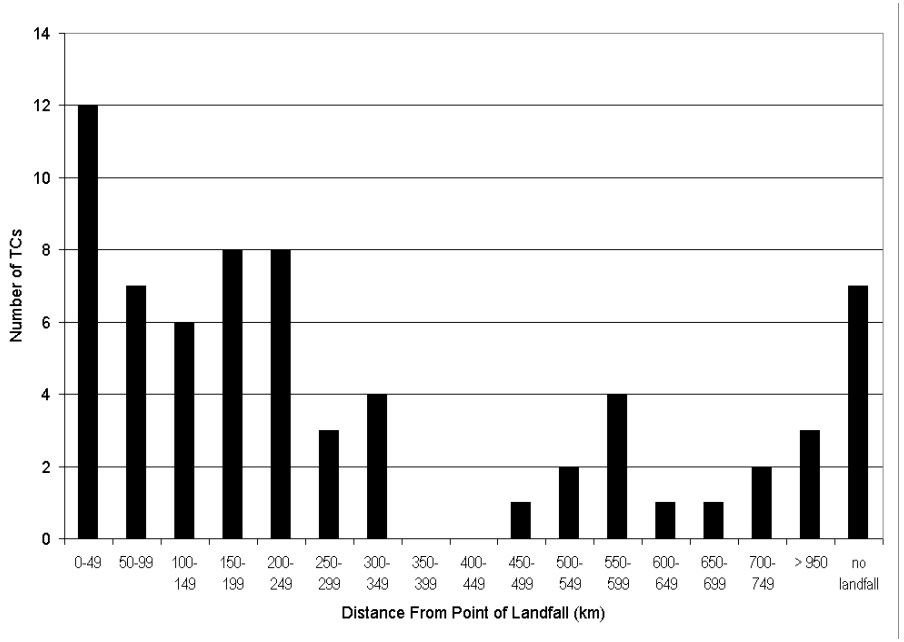
Figure 13: Ouagadougou/Bobo Dioulasso Post-Independence Population Comparison



orientation of the economic axis developed with the initial French colonial policy of developing transportation networks to the interior and extracting labor and resources towards the coast, and continued with increased production demands and burdens of taxation on interior agricultural areas following World War I. Following World War II, France invested heavily in coastal urban centers to attract skilled laborers, other Europeans, and potential colonial administrators. When colonial rule was replaced by national governments, policies favoring coastal development at the expense of interior regions were continued.

This type of study can benefit future urban planners dealing with population issues in large urban centers. One problem is that rural-urban migration is a self-perpetuating process. The vast majority of migrants are young adults with higher fertility than the urban population as a whole. The long-term contribution of rural-urban migration becomes much greater, as does the loss experienced by the rural population (Hope, 1998). Equatorial Africa appears to have a more stable situation. The nations of French Equatorial Africa currently have a larger portion of the population urbanized than their

Figure 2: Distance Between the Landfall Location and the Florida City Receiving the Maximum Rainfall Amount



occurred. Most (70% of) TCs tend to produce their highest rainfall amounts in Florida when they make landfall within 50 km (300 km) of the LMFR (Figure 2). However, as witnessed during Tropical Storm Allison (2001), heavy rainfall can also occur in Florida up to 1050 km from the point of landfall (Figure 1). Jefferson County, Texas received 1033 mm (40.68 in) of rainfall in total, the highest amount produced by a TC in the U.S. during 1980-2005 (Table 1). Six days after the initial landfall over Freeport, Texas, Allison produced 257 mm of rainfall over Tallahassee, Florida. Subtropical ridges located on either side of Allison were responsible for its slow forward velocity and eventual northeast track. Over half of the 41 deaths caused by Allison were due to fresh water flooding; eight people died in Florida (Beven et al. 2003). This example illustrates that Florida residents need to exercise caution even after a TC has made landfall and even though landfall may have occurred several states away.

Table 2: Top Ten Maximum Rainfall Amounts Produced by Tropical Cyclones in Florida 1980-2005

Rank	Max. Rain (mm)	Tropical Cyclone (year)	Int. [a]	LMFR [b]	Distance to track (km) [c]	Distance from landfall (km)
1	978	Georges (1998)	TD	Munson	5 R, L	225
2	650	Dennis (1981)	TS	Homestead	65 R	65
3	635	TD #1 (1992)	TD	Arcadia Tower	75 R	75
4	546	Bob (1985)	TS	Everglades City	40 R	55
5	508	Alberto (1994)	TS	Niceville	15 R, L	10
6	508	Erin (1995)	H	DeFuniak Springs	0	0
7	445	Leslie (2000)	TD	South Miami	255 R	No landfall
8	443	Irene (1999)	H	Boynton Beach	75 R	210
9	427	Jerry (1995)	TS	Golden Gate	140 L	210
10	419	Alberto (1982)	TD	Tavernier	225 R	No landfall

[a] Int is the intensity of the TC when it affected Florida (H - Hurricane, TS - Tropical Storm, TD - Tropical Depression)
[b] Location of Maximum Florida Rainfall
[c] Distance to track includes whether the gauge was located to the left (L) or right (R) of the storm track

Distance from Landfall Point

It is important to determine the distance over which a TC can travel from its landfall point to produce heavy rainfall within Florida so that people will remain aware of conditions even after landfall has

West African counterparts (See Fig.1). While the fastest growth and urbanization rates are found in West Africa, Equatorial Africa appears to have reached a stable situation.

Despite receiving less funding for urban economic development, it appears that many in French Equatorial Africa fled rural areas as a response to harsh exploitation by concessionaires. A consistent stream of migrants flowed into urban centers like Bangui and Brazzaville. This, coupled with the population decline in Equatorial Africa in the early 1900s may explain differences in urbanization percentages. Subsistence survival would have been extremely difficult in these areas. Equatorial Africa subsequently started a rural-urban migration sooner than West Africa.

Even though urban centers throughout Africa are growing at a rapid pace, those closer to the coast are larger. Attempts to relocate administrative urban centers from the coast to the interior as seen in Cote d'Ivoire and Cameroon have not been able to reverse the trends of population and funding moving to the coastal urban centers. The French had a lasting impact on the populations of West and Equatorial Africa. Ports, administrative centers, and economic opportunities were invested in and developed faster along the coast under French rule. This trend was carried over following independence by various African nations. As a result, migrating families continue to follow the trail to economic opportunity which leads to the urban centers along the coast.

Acknowledgements
The author would like to express gratitude towards Dr. Joshua Comenetz of the University of Florida for his guidance while conducting this research.

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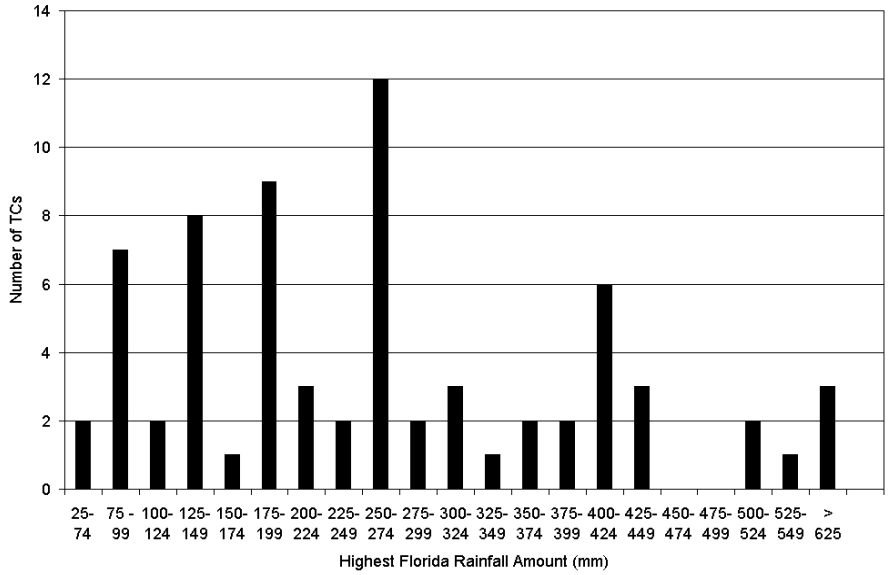
Figure 1: Maximum Rainfall Amounts Produced by Tropical Cyclones in Florida 1980-2005



riod. These figures demonstrate that in addition to the effects of fast winds and storm surge associated with a direct landfall, Florida is also susceptible to the effects of TC rainfall, which can occur without a direct landfall.

The average rainfall maximum for the 71 TCs producing 25.4 mm or greater rainfall totals was 270 mm (10.6 in) (Figure 1). Six TCs produced over 500 mm (20 in) of rainfall, and these rainfall amounts occurred within 75 km of the TC's circulation center (Table 2), suggesting that TCs produce their highest rainfall totals close to the storm's center. However, not all of these rainfall totals were produced near the point of landfall. Hurricane Georges (1998) made landfall over 200 km from its LMFR, demonstrating that TCs making landfall in other states can still produce heavy rainfall within Florida. The following two sections discuss the landfall locations of TCs producing rainfall in Florida, and the distribution of the LMFR about the storm track to ascertain the range of distances over which TC rainfall has affected Florida.

closest to the LMFR is measured to determine whether locations close to the storm track receive the highest rainfall totals. Several physical forcing mechanisms that affect TC rainfall production are discussed to explain variations in TC rainfall patterns over Florida.

Data and Methods

A list of the highest storm total rainfall amount produced by each U.S. landfalling TC and the location receiving this rainfall is available from the Hydrometeorological Prediction Center website (http://www.hpc.ncep.noaa.gov/tropical/rain/tcmaxima.html). This information was utilized to create Table 1 and identify which TCs produced their highest rainfall totals in Florida. Selected rainfall totals reported in the National Hurricane Center best track dataset, or rainfall totals listed in the storm summary for TCs where individual observations were not listed, were utilized to determine the rainfall amounts received in Florida for all other TCs in the current study. Although these data are the official storm total rainfall amounts recorded by rain gauges at each station, it should be noted that these data may underestimate the actual rainfall amounts that occurred with each storm (Nystuen 1999).

A Geographic Information System (GIS) was utilized to calculate the distance between the LMFR and the landfall location, and between the closest point along the storm track to the LMFR and the LMFR. Storm track coordinates were obtained from the National Oceanic and Atmospheric Administration Coastal Services Division, where storm track data have been converted into a GIS-compatible format (http://hurricane.csc.noaa.gov/hurricanes/download.html). Data utilized to determine the intensity of the storm when the TC was closest to Florida are also contained within this dataset.

Results

Of the 335 TCs that formed within the Atlantic Basin during 1980-2005, 71 (61) produced at least 25.4 mm (125 mm) of rainfall within Florida. Forty Atlantic Basin TCs produced their highest rainfall amounts within Florida, nearly twice the amount of Texas, which had the second highest number of TC rainfall maxima during this pe-

Rapid Growth and Development at Lehigh Acres, Florida Despite Faulty Layout and Design

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Introduction

The selling of rural real estate mushroomed into a multi-billion dollar industry during the 1950s and 1960s as land developers capitalized on the desire of millions of American to own a parcel of land. Unfortunately, many of the lots that were sold are in large pre-platted subdivisions, projects that sold raw land as rapidly as possible and largely ignored many important aspects of land development.

Pre-platted subdivisions (often referred to as platted lands) create a complex set of problems that depend on the location and size of the development, the nature of the land that has been platted, the character of the lots, and the availability of basic services. Some platted lands are a problem because the lots in the subdivision are too small to meet minimum lot size requirements for on-site waste-water treatment facilities (septic tanks, for example). Others are a problem because of poor drainage or because the land on which they are located is underwater for all or much of the year. Some are a problem because no improvements have been made and they are subdivisions in name only or are "paper subdivisions." Regardless of the reason, the platted lands problem involves literally millions of platted vacant lots and looms as one of the most significant stumbling blocks for orderly growth and development in Florida (Stroud and Spikowski, 1999).

Lot Sales Activity in Florida

Significant platting* of lots began in Florida around the turn of the century by entrepreneurs like Henry Flagler who recognized the State's potential for tourism. Subdividing and selling small lots was used as a way to open the State to hundreds of thousands of visitors. Interest in land was strong enough to create the first boom in

Table 1: Top Ten Rainfall Amounts Produced Within the U.S. by Named Atlantic Basin Tropical Cyclones During 1980-2005

Rank	Highest Rainfall (mm)	Tropical Cyclone (Year)	State of Landfall	State Receiving Highest Rainfall	Florida Storm Track [a]	Maximum Florida Rainfall (mm)
1	1034	Allison (2001)	TX, LA	TX	N	257
2	978	Georges (1998)	MS	FL	Y	978
3	932	Danny (1997)	LA, AL	AL	Y	178
4	711	Alberto (1994)	FL	GA	Y	508
5	653	Allison (1989)	TX	LA	N	127
6	650	Dennis (1981)	FL, NC	FL	Y	650
7	612	Floyd (1999)	NC	NC	N	76
8	599	Frances (2004)	FL, FL	NC	Y	381
9	569	Frances (1998)	TX	LA	N	0
10	546	Bob (1985)	FL, SC	FL	Y	546

[a] Y (N) indicates that the TC's circulation center did (not) pass over Florida
Data complied from the Hydrometeorological Prediction Center

rainfall totals for Atlantic Basin storms in the U.S. since 1980 shows that Florida experienced three of these ten high rainfall totals (Table 1). Three additional TCs on this list tracked through Florida even though they produced their highest rainfall total in other states. Thus, in addition to a high risk of a direct hurricane strike, Florida is also vulnerable to high rainfall amounts produced by TCs that may or may not make landfall within the state.

This study examines TC rainfall totals produced in Florida during the 1980-2005 Atlantic Basin hurricane seasons, and their relationship to the position of the storm. Distances between the location of maximum Florida rainfall (LMFR) for each TC and the landfall of each TC are discussed to demonstrate that TCs do not have to make landfall in Florida to produce heavy rainfall within the state, and to determine the distance over which a TC can travel from landfall and still produce rainfall within Florida. To examine the spatial distribution of heavy rainfall amounts around the storm's track, the distance between the LMFR and the location along the storm's track that is

Florida Tropical Cyclone Rainfall Totals as Related to Storm Location and Intensity

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Introduction

As recently witnessed during the 2004 and 2005 Atlantic Basin hurricane seasons, Florida is highly susceptible to the effects of tropical cyclones (TCs). Its elongated shape and location within the subtropics means that TCs forming in the Gulf of Mexico, Caribbean Sea, and the Atlantic Ocean can affect Florida (Vega and Binkley 1993). According to the National Hurricane Center's best track data, 475 named TCs have formed during the past 48 Atlantic Basin hurricane seasons. Forty percent of the 164 TCs that have made a U.S. landfall have come ashore over Florida, which is more than any other state. When calculating return periods for hurricane landfalls in all U.S. coastal counties, Elsner and Kara (1999) found that Monroe County, Florida, experiences the highest frequency of hurricane landfalls, with a return period of four years. Dade and Broward counties have return periods of five years. These facts suggest that Florida is more subject to a direct hurricane strike than any other state along the U.S. Gulf of Mexico or East Coast.

TCs can cause damage through fast winds, storm surge, tornadoes, and heavy rainfall. Although fast winds and storm surge are of concern during a direct hurricane strike, Rappaport (2000) found that nearly 60% of U.S. TC-related deaths during 1970-1999 were due to fresh water flooding. Depending upon the forward speed of the storm (Corbosiero and Molinari 2003), moisture availability (Chan et al. 2004), and interactions with the atmosphere and land surface (Gilbert and LaSeur 1957), heavy rainfall from TCs can commence prior to the circulation center's landfall, continue for days after the storm has tracked inland, and can even occur when a TC does not make landfall. Thus, the effects of TC rainfall can be more widespread than those from fast winds and storm surge. A ranking of the top ten TC

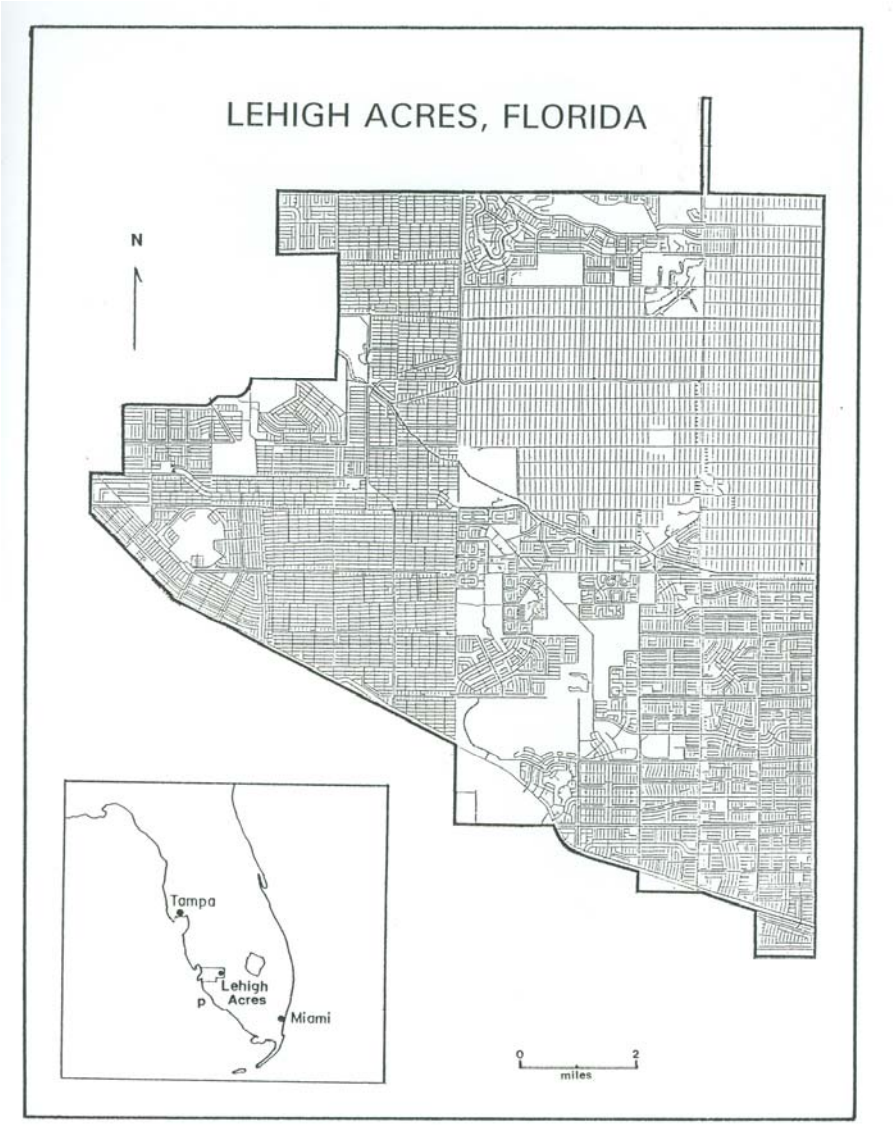
recreational real estate; a lot-selling frenzy that ended with the 1929 stock market crash. As impressive as the lot sales numbers are for the 1920's era, they are not nearly as significant as the number of vacant platted lots that were created during the rebirth of lot sale programs during the 1950s and 1960s. The period, often referred to as "the golden age of land scams" in Florida, created a number of vacant lots that is almost beyond comprehension. Developers of large subdivisions within the three counties of Sarasota, Charlotte, and Lee, located along Florida's southern Gulf coast, created nearly 900,000 lots during this period. The subdivision activity included such projects as Port Charlotte, Cape Coral, and Lehigh Acres (Schnidman and Baker, 1983). While it is extremely difficult to determine the full extent of the platted lands problem, based on the Office of Interstate Land Sales data and extensive field work, this problem is widespread and particularly significant in several locations (Stroud, 1983 and 1995).

Based on findings from the Office of Interstate Land Sales Catalogue Report, Florida alone has over 2.1 million lots extending across 1.6 million acres of land (Stroud, 1995). Although almost all of Florida's 67 counties have experienced subdivision activity, it is strongly concentrated in central Florida near Orlando and Disney World and in several southern Gulf Coast counties including Charlotte, Lee, and Collier. Lee County alone has over 350,000 platted lots, 250,000 of which remain vacant. Many of these vacant lots are clustered within two mammoth subdivisions, Cape Coral and Lehigh Acres (Stroud, 1984 and 1995).

Platted Lands Problems at Lehigh Acres

Lehigh Acres (Figure 1), the focus of this research, is not only one of the largest pre-platted subdivisions in Florida but one of the largest in the United States. Its more than 60,000 acres have been subdivided into approximately 130,000 lots, over 100,000 of which remain vacant and represent future homesites for a build out population that will far exceed the ability of local government to provide even the most basic services (Fleming, 2005). Problems are intensified since lot owners think that they have an irrevocable right to build a home on their property. This belief often conflicts with established

Figure 1: Map Depicting Dense Network of Roads within Lehigh Acres, Florida.



public policy and complicates an already vexing problem of how to deal with "vested communities."

Since Lehigh Acres and many other pre-platted subdivisions

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Notes

[*]*The "platting" of land is the formal procedure taken by landowners to officially record maps of land subdivision. Recording of plats consists of filing the appropriate survey maps with the municipality involved and showing that all existing requirements have been fulfilled. The filing of a plat is necessary before lots can be legally and effectively marketed. After the plat is accepted, land development can begin*.

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were approved years ago at a time when few regulations existed, many ill-conceived land developments were created. The magnitude of the problems and the potential for rapid population growth combine to make platted lands the sleeping giant of Florida's growth management problems. More research is needed to find ways or options for dealing with a problem that is particularly troubling for many local governments in Florida.

Platted lands problems are indeed significant at Lehigh Acres since the original developers, skilled at marketing real estate, knew little or nothing about proper land development techniques (Faulkner, 1994). These developers emphasized the selling of unimproved lots and virtually ignored planning and careful site selection practices. This approach created numerous problems including a rigid grid-iron pattern of roads (see Figure 1) and canals superimposed over the entire site, an absence of even the most basic services such as water and sewer to lots, an inadequately designed road network with few arterial streets, no provisions for reserving parcels of land needed for schools, fire stations and parks, an absence of employment opportunities, and an inadequate provision for commercial land use. As the community continues to grow and as the population becomes younger, there is an ever increasing need for basic services including adequate and properly designed commercial land (Spikowski, 2005). Options for improving current deficits in commercial land are discussed in the latter portion of this paper.

Most, if not all, of the problems cited above were created because Lehigh Acres and most pre-platted subdivisions were developed for the purpose of building a lot inventory rather than for the development of new communities designed to meet the needs of a growing population (O’Connor and Sajgo, 1994). Problems have been compounded because of the adversarial relationship that existed between Lee County and the original developers for more than 30 years. Since Lehigh officials were uncooperative and disinterested in assistance, the county largely ignored Lehigh Acres for more than three decades. This relationship changed dramatically in 1992, however, after the old Lehigh Corporation was purchased by Minnesota Power, a company eager to resolve land use planning problems and to

develop Lehigh as a community rather than as a lot sales subdivision (Sajgo, 1994 and O'Connor, 2005).

Possible Solutions

Although several options are available for dealing with platted lands problems including community redevelopment, plat vacation, subdivision redesign, lot consolidation, transferable development rights (TDRs), mandatory lot pooling, lot acquisition, special assessments, and tax delinquent lot purchase, the key is finding solutions that are appropriate for a given situation or that are feasible under existing monetary and legal constraints. In view of these and other limitations, most of the options mentioned above are of little value in resolving platted lands problems at Lehigh Acres. Commitments made by state and local officials concerning property rights and inadequate financial resources to implement lot purchase and reassembly techniques preclude the use of many possible solutions to the problem. Since platted lands problems are so complex and since feasible solutions are indeed limited, there is much frustration over how to improve the quality of life at many pre-platted subdivisions including Lehigh Acres. In 1994, officials with the "new" Lehigh Corporation (Minnesota Power), influential citizens at Lehigh Acres, and politicians representing eastern Lee County collectively confronted county officials and argued that Lehigh Acres had been ignored for the past 30 years and asked the county to assist them in resolving problems. Shortly after the request for assistance was made, the Board of County Commissioners' agreed to include Lehigh Acres in the community redevelopment plan. Lehigh Acres became one of several redevelopment areas in Lee County. The approval of an area as a CRA was contingent upon the presence of one or more conditions of blight as defined in the Florida Community Development Act. Based on the definitions used in the statutes, conditions of blight are easy to find at Lehigh Acres since it was allowed to evolve in a manner that was the most convenient for the developer rather than according to a master plan. Lehigh Acres' predominance of defective and inadequate street layout and design, faulty lot layout, and unsanitary or unsafe conditions including such things as poor street lighting,

Commissioners have decided not to divest anyone's property rights, have refused to place a moratorium on growth, and are not going to commit vast sums of money to acquire property in pre-platted subdivisions (Parker, 1994). In addition, the County terminated the CRA and has largely ignored the recommendations made in the Spikowski study. As a result, much of the land that Spikowski had suggested for commercial use is now been converted to other uses. It has been purchased by developers and is being designed to accommodate high density residential uses rather than meet commercial and other land use needs (Fleming, 2005).

The longstanding approach used by Lee County government in the past has been to ignore the problem and hope that it goes away. In the case of Lehigh Acres, not only did the problem not go away, it continued to become progressively worse. The problem is intensifying because land continues to be platted and sold, even today. Since most of the lots were originally purchased by out-of-state owners for investment purposes, many local officials assumed that the impact would be minimal. While this has been the case with some pre-platted subdivisions, many developments such as Lehigh Acres have grown substantially and now represent large, rapidly growing communities with the potential to exceed 300,000 people within the next 50 years or so. Because of this unanticipated growth, the platted lands problem is now looming larger than ever before with no immediate solution in sight. Lee County's initial support of the Lehigh Acres Commercial Land Use Study was a step in the right direction. Since the County failed to implement the suggestions in the commercial land use study, potential commercial sites are now being committed to uses that will not provide the mix of land uses necessary to establish a sustainable community. Unfortunately, those trying to resolve the problem must work with complex ownership patterns, limited resources, many legal restraints, reluctant or hesitant local officials, and a land use pattern dominated by residential uses. For these and other reasons, Lee County must learn to cope with problems created by very costly mistakes of the past.

1. giving priority to suitable parcels that remain in single (unified) ownership;
2. reconfiguring or redesigning existing commercial strips; and
3. enabling or working to establish neighborhood-scale commercial uses.

Since areas where the land remains in single ownership are indeed limited at Lehigh Acres, it is important that any unplatted tracts or platted tracts with lots that have never been sold be recognized and seriously considered as possibilities for commercial land or as suitable places for schools, parks, multifamily housing or other community-based needs. Certainly many of these tracts would not have been chosen for commercial development if today's lot ownership patterns did not already exist. Since the current pattern was established years ago and the community is now "vested," some of the single ownership sites have the potential of providing large and very useful locations for commercial, educational, or other important uses (Spikowski Planning Associates, 1995).

A second option is to redesign existing commercial strips so that they would be suitable as shopping center sites or for other commercial uses. Existing commercial strips that are located near a future major intersection, for example, could be deepened to provide adequate space for a neighborhood or community shopping center. For other commercial strips with less favorable locations, variances might be given to allow multifamily use (Spikowski Planning Associates, 1995).

The third possibility is to take the necessary steps to allow neighborhood-scale commercial uses on some sites. This alternative would help in resolving the commercial land deficiency but would be only supplemental to the other approaches that have been suggested (Spikowski Planning Associates, 1995).

Conclusion

Unfortunately, uncontrolled, ill-conceived land developments have created very troublesome land use problems. While local officials would very much like to resolve these problems, Lee County

dangerous road design, and lack of pedestrian crosswalks and road shoulders were used by the local redevelopment agency as conditions of blight (Simpher, 1994).

The Lee County Community Redevelopment Agency (CRA) formulated strategies that were to help resolve some of the problems at Lehigh Acres. Strategies were based on the goals and objectives identified by the Local Redevelopment Planning Committee (LRPC). The committee's goals and objectives were directed toward specific community needs that, if implemented, would provide immediate results. They included the provision of a community bike path and sidewalk system, greater police protection, bus shelters, the widening of roads, increased street lighting, commercial zoning, and the installation of community signs (Lee County Community Redevelopment Agency, 1994). In addition to establishing these objectives, the community redevelopment agency has provided part of the funding for a commercial land use study that was completed in 1995 by Spikowski Planning Associates (see, for example, Spikowski, 1995).

Traditionally, CRA's are used to redevelop small inner-city neighborhoods or small rundown portions of a city. CRA's are given condemnation power that can be used to allow private sector developers to redevelop a three or four block area. This approach contrasts sharply with the use of a CRA for a sprawling 96 square mile community that many would argue has no blight at all. While this unconventional use of a CRA could assist in the provision of services and CRA initiated studies may enhance the understanding of platted lands problems, it is a poor substitute for incorporation or for some other more effective method of city management (Jones, 1994).

Lehigh Acres grew from what originally was to be a small retirement community with little or no demand for commercial land uses. Since the installment lot sales program was surprisingly strong, developers expanded to the north (Faulkner, 1994). The result is today's northern Lehigh Acres, a landscape of unending half-acre residential lots, still with virtually no commercial land and little or no land for parks and open space or other public needs.

On a positive note, the large inventory of vacant lots at Lehigh Acres served as a source of relatively inexpensive lots for many

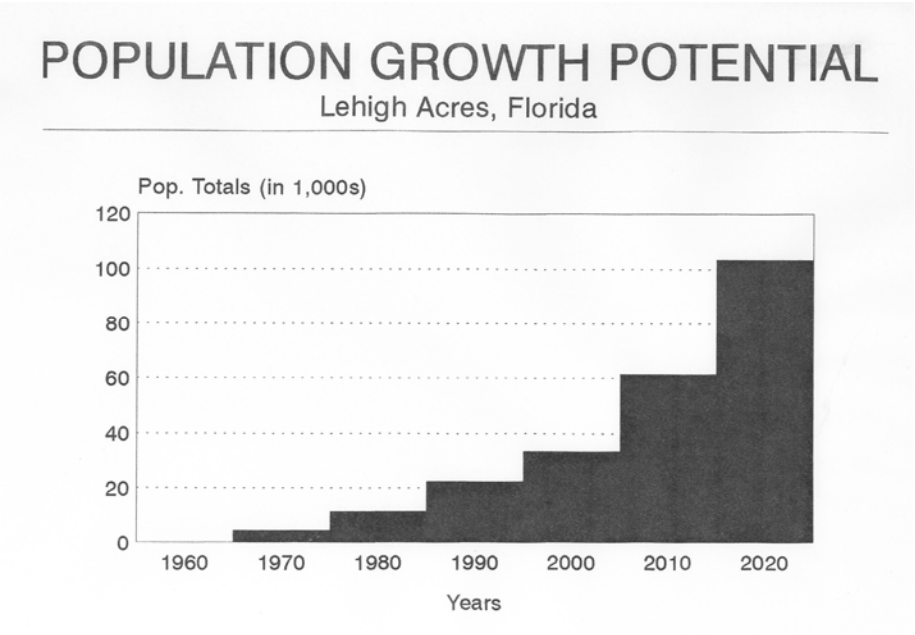
years. It was a place where young couples could purchase an affordable lot and build a moderately priced home. This opportunity to obtain an affordable house and lot was an important stimulus for growth despite the numerous problems cited above. In 1970, for example, Lehigh's total population was only 4,394 but by 2000 the population had grown to more than 33,000 (Figure 2). According to the Bureau of the Census, only 19.7 percent of the population was 65 years or older in 2000. These statistics support the notion that Lehigh Acres is no longer a retirement community.

The relatively recent interest in Lehigh Acres has caused and incredible increase in lot prices; an unfortunate turn of events for those seeking affordable housing. Lots that were selling for only around $2,000 a few years ago, if they sold at all, are now selling for $40,000 to $50,000. This almost unbelievable escalation in price is an indication of the demand for homesites in Lee County and has eliminated Lehigh Acres as a place with "affordable lots"(Fleming, 2005).

The large inventory of lots is also creating an incredibly large potential for population growth. In a recent study of Lehigh Acres by Van Buskirk, Ryffel, and Associates, it was found that the population total is expected to exceed 100,000 by 2020 (see Figure 2) and the build out population is projected to exceed 300,000 people sometime after the year 2060 (see, for example, Van Buskirk, Ryffel, and Associates, Inc., 2004). Apparently, growth is going to continue on faulty, substandard lots that were created years ago by the original developer who had no idea that he was creating a "sleeping giant" that would become a "boom town."

After waiting until almost all of the most suitable land for commercial uses had been subdivided and sold, developers finally began to realize the need for commercial uses and designated a few commercial strips of land here and there. These strips remained unplatted for several years. As lot sales continued, developers platted and sold portions of(and in some cases all) these commercial strips as residential property. The commercial land that remained had many shortcomings. First, the commercial land was highly fragmented. It was platted into small lots and sold to individuals instead of being

Figure 2: Population Growth Potential at Lehigh Acres, Florida.



held intact. This resulted in the premature commitment of commercial land to fragmented parcels. These fragmented parcels are not suitable for large shopping centers or other commercial uses that require large parcels of land. Second, most of the vacant commercial land is located along major roads in shallow strips or ribbons and is thereby undesirable as prime locations for most businesses.

In an attempt to rectify some of these problems, Lee County and the Community Redevelopment Agency hired Spikowski Planning Associates to study commercial land use at Lehigh Acres and to make recommendations for improvement. The result was a report entitled Lehigh Acres Commercial Land Use Study that provided several specific recommendations for improving land for commercial uses at Lehigh Acres (Spikowski Planning Associates, 1995). Spikowski's recommendations included the following: