Resort Evolution Along the Gulf of Mexico Littoral: Historical, Morphological, and Environmental Aspects.

Klaus J. Meyer-arendt
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RESORT EVOLUTION ALONG THE GULF OF MEXICO LITTORAL:
HISTORICAL, MORPHOLOGICAL, AND ENVIRONMENTAL ASPECTS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
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in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Geography and Anthropology

by

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August 1987
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TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................................................... ii

LIST OF FIGURES .................................................................................... x

LIST OF TABLES ..................................................................................... xii

LIST OF PLATES .................................................................................... xiii

ABSTRACT ............................................................................................. xiv

CHAPTER I. INTRODUCTION ................................................................ 1
  Statement of Problem ....................................................................... 1
  Objectives and Methods of Study ...................................................... 2

CHAPTER II. RELEVANT GEOGRAPHICAL RESEARCH ................... 5
  Origins of Seaside Recreation ............................................................ 6
  Conceptual Models of Tourism Evolution ......................................... 13
  Models of Resort Morphology ............................................................ 21
  Recreational Development and the Physical Environment .............. 28

CHAPTER III. THE SETTING: THE GULF OF MEXICO ..................... 35
  Location .......................................................................................... 35
  Climate ........................................................................................... 36
  Geology ........................................................................................... 44
  Vegetation ....................................................................................... 51
  Coastal Settlement .......................................................................... 51

CHAPTER IV. GRAND ISLE, LOUISIANA ........................................... 56
  Location ........................................................................................... 58
  Physical Environment ..................................................................... 59
  Pre-Recreation Settlement ................................................................. 61
  Exploration and Initial Recreational Development ................................ 62
  Development of Recreational Infrastructure ..................................... 65
  Settlement Expansion ....................................................................... 66
  Landuse Intensification .................................................................... 69
  Morphologic Aspects of Resort Development ................................... 70
  Human Interaction with the Physical Environment ......................... 73
  Future Trends .................................................................................... 77
Morphologic Aspects of Resort Development..............................225
Human Interaction with the Physical Environment.....................229
Future Trends.............................................................................232

CHAPTER XII. SUMMARY AND CONCLUSIONS ............................234
  Summary of Case Studies.......................................................234
  Variables of Resort Development.........................................239
  A Conceptual Model of Resort Evolution...............................244
  A Resort Morphology Model.................................................252
  Environmental Aspects of Resort Development.......................256
  Government Involvement in Resort Evolution........................261
  Limits to Growth....................................................................265

BIBLIOGRAPHY .......................................................................267
  Literature Cited......................................................................267
  Maps and Aerial Photographs Utilized....................................296

APPENDIX: THE SAFFIR-SIMPSON SCALE ..................................301

VITA ...........................................................................................305
LIST OF FIGURES

1. Gulf of Mexico beach resorts selected for study ......................................... 4
2. Profiles, social characteristics, and typical destinations of travelers ... 16
3. Hypothetical evolution of a tourist area ..................................................... 19
4. The Ellis curve ............................................................................................. 21
5. Theoretical accommodation zones in a seaside resort .............................. 23
6. RBD vs. CBD in Atlantic City, New Jersey ............................................... 24
7. Schematic of a typical seaside resort in Britain .......................................... 25
8. Types of "fronts de mer" ............................................................................ 25
9. Development of a coastal recreational landscape ...................................... 26
10. A model of tourism landscape evolution on a Caribbean island ............. 27
11. Profile of a Gulf of Mexico barrier island ................................................. 30
12. Regional setting of the Gulf of Mexico ...................................................... 34
13. Temperature characteristics of the Gulf of Mexico ................................. 37
14. Precipitation and hurricane tracks in the Gulf of Mexico ...................... 41
15. Regional geologic-oceanographic classification of the Gulf of Mexico coast............................................................................................... 45
16. Geologic features along the Gulf of Mexico shoreline ............................. 46
17. Wave energy and shore conditions along the Gulf of Mexico littoral ....... 47
18. Schematic model of hurricane effects on the Texas coast ......................... 50
19. Vegetative associations surrounding the Gulf of Mexico ....................... 52
20. Urbanization along the exposed coast of the Gulf of Mexico ................... 56
21. Regional setting of Grand Isle .................................................................... 58
22. Physical setting of Grand Isle ..................................................................... 59
23. Shoreline changes on Grand Isle, 1677-1976 ........................................... 61
24. Settlement evolution on Grand Isle, 1877-1983 ....................................... 63
25. Change in resident population of Grand Isle, 1810-1980 ....................... 67
26. Regional setting of Galveston Island .......................................................... 79
27. Physical environments of Galveston Island .............................................. 81
28. Settlement evolution on Galveston Island, 1850-1984 ............................ 84
29. Generalized urban morphology of Galveston Island ................................ 93
30. Revenues from hotel/motel taxes, Galveston ......................................... 102
31. Value of building permits, Galveston ....................................................... 103
32. Regional setting of South Padre Island .................................................... 104
33. Settlement evolution and physical characteristics, South Padre Island ... 111
34. Recorded crossings, Queen Isabella causeway, 1969-1985 .................... 115
36. Regional setting of Estero Island, Florida .............................................. 126
37. The physical setting of Estero Island .............................................127
38. Settlement evolution on Estero Island, 1910-1984 ........................130
40. Resident population of Estero Island, 1910 to 2000 ...................136
41. The urban morphology of Fort Myers Beach .................................137
42. Regional setting of Pensacola Beach ...........................................146
43. Physical setting of Pensacola Beach ...........................................146
44. Settlement evolution at Pensacola Beach, 1932-1986 .....................153
45. Housing unit construction at Pensacola Beach, 1952-1986 .............155
46. Santa Rosa Sound bridge crossings, 1955-1985 ............................164
47. Regional setting of Dauphin Island, Alabama ...............................165
48. Physical setting of Dauphin Island .............................................167
49. Settlement evolution on Dauphin Island, 1894-1986 .......................172
50. Washover channels on Dauphin Island following Hurricane Frederic, 1979.................................................................186
51. Urbanization along Alabama's Gulf Coast, 1983......................................188
52. Regional setting of Progreso and Yucatan's barrier coast .............190
53. Landuse changes in Progreso and vicinity, 1946-1978 ....................198
54. Landuse at Chelem .......................................................................201
55. Schematicized landuse at Progreso and vicinity ............................203
56. Schematicized evolution of the north Yucatan recreational coastal landscape.................................................................204
57. Regional setting of Tecolutia, Veracruz ........................................213
58. Physical setting of the lower Rio Tecolutia ....................................215
59. Landuse changes at Tecolutia, 1951-1985 ....................................221
60. Number of hotel rooms in Tecolutia, 1948-1986 ............................223
61. Schematicized settlement evolution of Tecolutia ............................226
63. A theoretical model of resort evolution ........................................245
64. Stage of resort development at the study sites ..............................251
65. A model of morphologic evolution of a seaside resort ....................253
66. Matrix of cultural-historical and physical aspects of resort development at the Gulf of Mexico study sites..............................257
67. A model of environmental modifications at a seaside resort ..........259
LIST OF TABLES

1. Chronology of recreational usage of the Gulf study sites ..................57
2. Saffir-Simpson damage-potential scale ranges ................................304
## LIST OF PLATES

1. The west half of Grand Isle, 1984 .............................................................. 72
2. Grand Isle beach in 1983 ........................................................................ 76
3. Grand Isle shorefront after construction of artificial dune, 1985 ............... 77
4. Jamaica Beach, west end of Galveston Island ........................................ 90
5. The core of Galveston’s RBD .................................................................... 94
6. Anthropogenic dunes and sand-fencing as efforts to extend the vegetation line seaward following Hurricane Alicia ......................... 100
7. South end of South Padre Island .............................................................. 107
8. Condominium development along lagoon shore of South Padre Island .................................................. 117
9. Crumbling seawall functioning as breakwater ........................................ 121
10. Dunes left in situ for erosion protection ................................................ 122
11. Concrete bulkhead fronted by coquina riprap ....................................... 134
12. The condominium “frontier” at Fort Myers Beach ................................. 137
13. The recreational business district of Fort Myers Beach ........................ 138
14. Beach access road utilized as bathing beach ....................................... 143
15. The recreational business district of Pensacola Beach .......................... 156
16. Condominiums and dune preserves at Pensacola Beach’s west end .......... 159
17. Backbarrier fingerfill development on Dauphin Island ........................ 175
18. Dauphin Island’s recreational business district, 1986 ........................... 179
19. Fort Gaines and groin field at Dauphin Island’s east end, 1986 ............. 182
20. Dauphin Island’s washover-prone west end, 1986 ................................. 185
21. Downtown Progreso ................................................................................ 195
22. Recreational development in coastal zone east of Chicxulub ................. 200
23. Rock-and-timber groins of Yucatan ..................................................... 207
24. Groins fronting Chelem, 1984 ............................................................... 208
25. Chelem beachfront, 1987 ...................................................................... 210
26. Tecolutla in 1948 ................................................................................... 219
27. Tecolutla’s RBD .................................................................................... 227
28. Tecolutla in 1985 ................................................................................... 229
29. The Tecolutla spit, exhibiting beachfront accretion and riverbank erosion ................................................................. 231

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*With exception of Plate 26, all plates are from photographic slides taken by author.*
ABSTRACT

The development histories of eight coastal resorts along the Gulf of Mexico littoral (Fort Myers Beach, Pensacola Beach, Dauphin Island, Grand Isle, Galveston Island, South Padre Island, Tecolutla, and Progreso) are documented to evaluate variability of temporal, spatial, and environmental aspects of resort development.

Temporally, a modified S-curve model of resort evolution is offered to describe the historical development of seaside resorts, and stages of exploration, infrastructural development, and settlement expansion precede each resort's levelling off stage. The upper level of development, or level of maturation, varies among the sites, primarily as a function of demand. Resorts in high demand undergo an additional development stage prior to reaching maturation—landuse intensification. In this stage, a resort becomes characterized by high-density landuse and corollary high levels of visitation and seasonal occupancy. After a resort reaches its level of maturation, it declines in terms of attractiveness to new recreationists and tourists.

Spatially, a resort's morphology reflects its stage of development. The initial locus of development at the resort site generally evolves into the recreational core area, or recreational business district, and subsequent growth fans outward from this core. While any pre-existing settlement in the area avoided the exposed beachfront as a locus of construction, recreational development proceeds by a pattern of linear shorefront urbanization and subsequent urban infilling of zones removed...
from the waterfront. At resorts subject to landuse intensification, high-density development initially takes place at more distal zones within the bounds of the site, but eventually 'redevelopment' of older properties transforms the beachfront into a highrise landscape.

Environmentally, greater variability in degree of human modification is noted. Generally, environmental changes become more widespread with successive stages of development. Dune disturbance, shoreline armoring, and wetlands dredging are extensive during the settlement expansion stage, but preservation efforts are often made as a resort matures. If shoreline erosion constitutes a serious problem for continued resort development, human efforts at stabilization by either 'hard' or 'soft' methods may only propel a resort into an early maturation stage. Hurricanes were found to stimulate progression through the development stages, primarily by facilitating landuse intensification via 'redevelopment'.
CHAPTER I. INTRODUCTION

Statement of Problem

Many coastlines of the world are experiencing high rates of urbanization as a result of demand for recreation and tourism opportunities. Attributed to increases in wealth, leisure time, mobility, and popularization of water-based activities among an ever greater segment of society, seaside recreational settlements have proliferated since sea-bathing first became popular in the early 1700s. The demand for beachfront resort property has steadily increased over time, and the 1970s and 1980s have been marked by unprecedented high rates of coastal construction.

Recent high rates of coastal urbanization have led to increased concern by a variety of disparate interest groups, ranging from environmentalists to government officials. Points of concern include: 1) interference with barrier dynamics, 2) destruction of sensitive natural habitats such as wetlands, 3) pollution of rivers, estuaries, and nearshore waters, 4) reduced accessibility to public beaches, and 5) escalation of federal subsidies in the form of erosion protection and post-storm reconstruction. In the United States, environmental legislation of the 1960s and 1970s was accompanied by coastal management guidebooks designed to help policy-makers guide and perhaps limit seaside urbanization, but the attraction to the coast was hardly curtailed. With the availability of government-subsidized insurance against storm damages, land developers and property buyers felt less risk in building in such dynamic settings.
Also, the U.S. Army Corps of Engineers, whose cost-benefit policies tended to favor erosion control projects at sites that were more highly developed, could be counted on to provide protection against the encroachment of the sea. In 1962, the Coastal Barrier Resources Act, a strategy for federal disinvolved in continued subsidization of development on barrier islands and beaches, was passed (USDI 1962). As a result of the various governmental policies, the future shaping of the coastal cultural landscape may well become even more a function of regulatory legislation than of "spontaneous" cultural processes.

In spite of much recent research into coastal and estuarine processes, including human impacts upon those processes, we know little about the cultural-historical aspects of coastal settlement. There has been a notable lack of comprehensive geographic studies addressing the temporal and spatial aspects of recreational settlement evolution. Likewise, the changing relationships between humans and their coastal habitat have not been comprehensively examined within a systematic framework that incorporates time, space, culture, and environment.

**Objectives and Methods of Study**

The purpose of this study is to investigate the cultural-historical aspects of coastal resort evolution in terms of time, space, and corollary levels of environmental impacts. If the development of a resort over time represents an ongoing process of conversion of a physical landscape to a cultural landscape, then both the form (i.e. morphology) of the resort and the degree of environmental modification should theoretically depend upon the stage of evolution. The intent of this thesis is to test the
applicability of this dictum in several coastal resorts set in similar physical environments and subject to similar physical processes. Application of a three-pronged research framework--focused upon resort evolution (time), resort morphology (space), and corollary interactions between humans and the coastal environment--is intended to highlight similarity or variability among the study sites and to provide a descriptive model of the time-dependent morphologic patterns and environmental aspects of coastal development.

The Gulf of Mexico was selected as a regional setting, and eight seaside resorts were chosen for analysis, six in the United States and two in Mexico (Figure 1). Physically, all of the sites are similarly beach-oriented and susceptible to the onslaught of severe storms. With two exceptions, the sites are characterized by shoreline erosion, although local geology, wave energy, climate, and vegetation vary among the sites. Culturally, they represent varying ages and levels of development.

The methodology is primarily historical. By analysis of historic maps, photographs, and literary sources, complemented by field surveys and interviews, documentation of resort evolution is provided. Development processes, resultant settlement forms, and corollary environmental impacts extending up to the present-day are examined within a "resort cycle" framework. The physical environment and pre-existing settlements (if any) are briefly described, and human interactions with the environment (including response to storms and shore processes and environmental modifications) are discussed. The summary chapter provides a comparative analysis that forms the basis for descriptive models of coastal
recreational development processes, evolving patterns of settlement morphology, and corollary environmental modifications.

Figure 1. Gulf of Mexico beach resorts selected for study.
CHAPTER II. RELEVANT GEOGRAPHICAL RESEARCH

A review of the literature relevant to the themes inherent in this study necessitates the exclusion of a wide array of information which may have only a peripheral bearing upon the subject matter. The literature of the geography of tourism and recreation is summarized in several recent works (Mathieson and Wall 1982; Pearce 1981; Smith 1982; and Smith 1983) which offer good starting points for further research. Coastal management texts (Armstrong et al. 1974; Clark 1974; Ducik 1974; and Ketchum 1972) provide good overall descriptions of environmental aspects of coastal development. More detailed research into physical impacts of recreational development may be culled from books and journals of the various academic disciplines.

The basic terminology used in the literature of recreation and tourism often varies in meaning according to the preferences of the authors. Within this study, leisure is considered as an element of time, i.e. the residual time left over after work, day-to-day chores, and necessary travel time (Patmore 1983). Recreation, simple relaxation in its most basic form (i.e. re-creation, or refreshment of the strength and spirits after toil), generally encompasses all activities performed in one's leisure time. Although recreation can take place in or about one's home, it may also include short distance travel to a locale popular for specific recreational activity. Tourism entails travelling either for the sake of travelling (i.e. to constantly be exposed to new places) or to reach a distant location in which to pursue forms of recreation. There is confusion between what constitutes a recreationist (a practitioner of recreation) and
what constitutes a tourist (a practitioner of tourism). Recreation implies recurrence of activity, whereas tourism implies a “new experience”. A vacation home owner and seasonal resident at a Florida seaside resort engages in the same recreational activities whether he is from Ohio or a nearby urban area, yet one may be classed as a tourist and one as a recreationist. A resort is a popular place of entertainment or recreation at which public overnight accommodations are available. However, if a community is functionally recreational and no lodging facilities are available, properly it would not be considered a resort. The term recreational settlement is used herein to include communities both with and without overnight facilities.

This chapter is divided into four sections—1) origins of seaside recreation, 2) conceptual models of tourism evolution, 3) models of resort morphology, and 4) cultural/physical interactions—which summarize investigations into the historical background of coastal recreation as well as the three major research themes germane to this thesis.

Origin of Seaside Recreation

Seaside recreation is considered to be a direct outgrowth of hydrotherapy, first popularized by the Romans and "rediscovered" by elitist Europe following the Middle Ages (Lowenthal 1962). The "taking of the waters" for improvement of health at mineral and hot springs traditionally entailed drinking and bathing, although "thermalists" could also "irrigate, inhale, gargle, apply hot packs, or take mud baths" (Lowenthal 1962). The idea of a therapeutic "spa experience" was exported throughout the Roman Empire, and one of the more famous spas
was Bath, England. Following the Middle Ages, during which hydrotherapy had become all but abandoned, aristocratic Europeans (on the continent as well as Great Britain) revived the practice, and health resorts came to "provide an element of stability that helped social life to flourish" (Lowenthal 1962). Thermal resorts evolved into pleasure resorts, characterized by much dancing, gambling, and drinking. By the late 1500s, Europe boasted of an estimated fourteen spas, of which two were in Britain (Lavery 1971). During the seventeenth and eighteenth centuries, more springs were discovered, and the medicinal attributes of the thermal waters increasingly popularized the spa experience. The world's first seaside resort is said to be Scarborough, which attained that honor primarily by having a mineral spring that emerged at the base of a cliff directly onto the beach (Stansfield 1970). When the practice of sea-bathing became generally accepted in the 1700s, the resort infrastructure at Scarborough enabled an easy shift from spa to seaside resort. Swimming in the ocean for therapeutic, and social, purposes was popular at Scarborough by the 1730s (Gilbert 1939).

A trend of widespread coastal resort development in Britain was begun in 1752 when a Dr. Richard Russell, a resident of the incipient seaside resort of Brighton, issued his Dissertation on the Use of Sea-water in the Diseases of the Glands. In addition to bathing, Dr. Russell recommended drinking "half a pint of sea water every morning at five of the clock" (cited in Gilbert 1939). Although sea-water had been prescribed for certain ailments (especially melancholia) for centuries, Russell's prescription for all-around health improvement at a time that sea-bathing was being "discovered" led to a decline in spa attendance and
a corollary increase in seaside resort attendance (Gilbert 1939). With Russell's thalassotherapeutic proclamations reaffirmed by numerous other physicians, Brighton soon rivalled Bath as England's premier health resort (Gilbert 1949). More resorts sprung up at different points along the coast in response to demand, and the health function was eventually replaced by the pleasure function.

The early seaside resorts of Britain were of two main types: pre-existing port or fishing towns that became converted to resorts and new towns that were founded with a resort function clearly in mind (Gilbert 1939). The first type was common along the south coast, where former mercantile towns such as Brighton, Scarborough, Weymouth, Hastings, and Margate had almost died out as ports by 1700, but remained as minor fishing towns until the onset of seaside recreation. The second type, which includes Bournemouth, Blackpool, Southport, and Southend, developed as a consequence of someone establishing a hotel, summer home, or other facility with seaside enjoyment as the primary goal (Gilbert 1939). These two types later became identified along the North American coast as well (Stansfield 1970).

Although the origins of seaside recreation date to the 1700s, significant increases in the number and size of coastal resorts did not occur until onset of the Railroad Era in the 1800s. Some resorts, such as Brighton and Margate, were situated close enough to London to develop in spite of poor transport which entailed either carriage or boat travel. The introduction of railroads not only provided easier access to the beaches for the established resort clientele, but also facilitated a "filtering down" of seaside recreation opportunities to a growing middle class. Like the steam
engine, this social stratum was a product of the Industrial Revolution, and increases in wealth and leisure time among a new class of workers were accompanied by emulation of social traditions previously the exclusive domain of nobility and landed gentry. The Census of 1851 listed eleven major seaside resorts and four major inland spas in England, with a total permanent population of 278,000—an increase of 254 percent in fifty years (Gilbert 1939).

The resort tradition in the United States is an import from Europe, specifically the British Isles. By the 1740s there were less than a handful of springs used for medicine and pleasure in Britain's American colonies, but by the 1820s the number had risen substantially and a "seaside resort region" had come to characterize the Atlantic coast from Nahant, just north of Boston, to Cape May, at the southern tip of New Jersey (Lawrence 1983). Rival claims to being the oldest seaside resort in America are made by Long Branch and Cape May, in northern and southern New Jersey, respectively. Long Branch, which catered to the New York City urban area, documents a hotel with bath houses as early as 1792, although references to sea-bathing for health purposes at Cape May, which primarily served a Philadelphia hinterland, date to 1766 (Stansfield 1975). Newport, Rhode Island, an enclave of fancy seaside summer homes, served as a retreat for wealthy southern planters as early as the 1730s (Demars 1981) and is often regarded as the original beach resort in America. Public accommodations did not become available until the first hotels were built in the 1830s, however, and resort status must be traced to that time (Amory 1952).
As in England, the boom in coastal resort development in the New World is directly attributed to improvements in transportation coupled with greater participation in leisure activities by a broader societal cross section. Initial access by steamboat and horse-drawn carriage, e.g. the "Jersey wagons" across the pine barrens in the early 1800s, gave way to the railroads in the 1850s. Cape May and Atlantic City, especially, developed rapidly as a result of railway connection to the interior, and by the close of the century, rail-induced coastal development had practically created a ribbon-like seaside megalopolis (Stansfield 1975). The most dramatic impact of rail accessibility can be seen at Coney Island, which, as a result of its proximity to New York City, evolved from an isolated coastal retreat for the wealthy to the largest mass recreation seaside amusement center in the United States (Kasson 1976; and Snow and Wright 1976).

From a Middle Atlantic/New England hearth, seaside resorts diffused throughout the United States during the nineteenth century. The South initially lagged behind the North in seaside resort development, in part because wealthy Southern plantation owners often migrated to the more hospitable climes of places such as Newport, Nahant, and Cape May during the sultry summer months (Franklin 1976; and Lawrence 1983). Although the "Southern spa" tradition was well established by 1850 (Lawrence 1983), and some sheltered Gulf Coast shores, as along the Mississippi coast and the eastern shore of Mobile Bay, had evolved into resort areas prior to this period, it was not until the increasing socio-political friction between the North and the South that Southern seaside resort development was greatly stimulated. (An example of this mid-century trend is Louisiana's infamous Last Island, an incipient barrier
island resort for wealthy sugar planters, many of which previously vacationed in the North. The island resort was prematurely destroyed, with over 200 fatalities, in an 1856 hurricane.) By the Civil War, resorts had evolved within several hours of steamboat and/or railroad travel of most major Atlantic Seaboard cities (Demars 1981), and were rapidly appearing along the Gulf Coast as well. Seaside resort development also accompanied settlement along the Pacific Coast. Northwest resorts, notably along the Oregon coast, date to the 1860s, and the grander resorts of southern California date to the 1880s (Demars 1981). Semi-tropical Florida was also discovered by Northern recreationists during this period, and resort development there was stimulated by steady southward expansion of the railroads along both the Atlantic and Gulf Coasts (Nolan 1984).

In terms of social function, three general categories of seaside resorts have been identified as existing in the United States by 1900: "elitist", "democratic" (i.e. popular), and religious (Demars 1981). Prior to the Civil War, resorts were primarily of the elitist variety, to which members of high society seasonally migrated, along with their servants and numerous household belongings, to bask in more favorable climes (Colten 1978). Summer resorts were places at which to escape the heat, and winter resorts places at which in which to escape the cold. The therapeutic aspect of the resort, be it a spa, highland, or seaside resort, was often secondary to the opportunity to socialize with one's peers.

In the early history of resort development, only the wealthy could afford both the time and money to partake in leisure activities. With improvements in transportation and greater affluence among the middle
classes, resorts became more democratic in patronage, and the pursuit of health and pleasure began to appeal to the "masses". As seaside resorts began to cater more to the middle classes, the upper classes sought out mechanisms of preserving their elitist domain. This entailed both the creation of new resorts located at more peripheral (i.e. more inaccessible) locations, such as Bar Harbor, Maine, and also the establishment of "social discriminators" such as price structuring or membership restrictions, as at Newport or Palm Beach (Demars 1980). The initial peripheral elitist resorts, in the absence of social discriminators, often became more democratic through time (i.e. "mass follows class"), and much of the history of Atlantic coastal resorts--from Coney Island to Miami Beach--can be described in such terms.

Another form of social discriminator is religious affiliation, and denominational "retreats" at coastal settings led to the establishment of the religious seaside resorts (Demars 1981). Although many of these persist to the present day (e.g. the Methodist encampment on Cape Cod), others were more ephemeral and either lost their religious underpinnings and evolved into popular resorts or completely disappeared (e.g. numerous West Florida resorts such as Cromanton near Panama City). Today, the democratic, or popular, seaside resort is by far the most common.

Along with the twin factors of increased wealth and increased leisure time, increased mobility provided by technological advances in transportation led to the growing popularity of coastal recreation. The automobile has perhaps contributed most to the evolution of coastal resorts, because of the increase in potential accessibility. Although the
use of a motor car for leisure activities was confined to the upper classes during the first decade of the twentieth century, by the 1910s (and the introduction of cheaper, mass-produced cars such as the Model T), automobile ownership had filtered down to the middle classes (Hugill 1985). Motor-touring became increasingly popular, and "tin-can tourists" soon ventured throughout the country in large numbers, especially to well-publicized destinations such as California and Florida (Nolan 1984). The automobile age was accompanied by much highway construction, and as coastal access was provided, opportunities for resort development increased. While early 1900s coastal resorts were spatially compact entities, situated at railway or highway beach termini and consisting of hotels, summer homes, and usually a central, beachfront touristic core, later resort development came to be characterized by shorefront sprawl. Undoubtedly, the private automobile played a pivotal role in the development of the modern urbanized coastal landscape, which today may consist of a shorefront commercial strip, residential subdivisions, condominiums, and self-contained resort complexes. Access, or improvement thereof, is generally considered to be the major direct stimulus to coastal recreational urbanization (Dunbar 1958; and Sheaffer and Roland, Inc. 1981).

Conceptual Models of Tourism Evolution

Coastal resorts, like other centers of tourism and recreation, are highly dynamic places. According to the whims of recreationists, a resort may be "in vogue" or old-fashioned and out of style. Thus a resort may undergo phases of development, characterized by areal growth and landuse intensification, or phases of decline, characterized by
abandonment of facilities and general deterioration. During the progression through various phases, both the "character" of the resort, and also the "character" of the tourist or recreationist that frequents the resort, changes. Observers have noted that a process of "resort evolution" can be theoretically outlined, based upon analysis of either the characteristics of the resort (i.e. the tourist destination) or of the persons that frequent the resort.

During the 1950s and early 1960s, several geographers recognized an evolutionary sequence in resort development. E.W. Gilbert, who had been studying the origins and urban morphologies of English seaside and spa resorts since the 1930s (Gilbert 1939; and 1949), discussed a "resort cycle" concept in his landmark study of Brighton, Britain's largest coastal resort (Gilbert 1954). R.I. Wolfe, a pioneer of geographical analyses of recreational travel and summer cottage development, noted a pattern of rise-and-fall in popularity among Ontario lakefront cottage resorts (Wolfe 1952; and 1962). But the best early description of a tourist "cycle" was provided by W. Christaller, who, in later life, had turned his attention from central places (quantifiable in terms of locational analysis theory) to peripheral places, the "polar counterparts" to central places and not easily adapted to statistical theorization (Christaller 1966). Christaller's tourist cycle descriptions first appeared in German geographical journals (Christaller 1955), but it was the following description in English that is most often cited in discussions of resort cyclicity:

The typical course of development has the following pattern. Painters search out untouched unusual places to paint. Step by step the place develops as a so-called artist colony. Soon a cluster of poets follows, kindred to the painters; then cinema people, gourmets, and the
...jénnesse dorée. The place becomes fashionable and the entrepreneur takes note. The fisherman's cottage, the shelter-huts become converted into boarding houses and hotels come on the scene. Meanwhile the painters have fled and sought out another periphery—periphery as related to space, and metaphorically, as "forgotten" places and landscapes. Only the painters with a commercial inclination who like to do well in business remain; they capitalize on the good name of this former painter's corner and on the gullibility of tourists. More and more townsmen choose this place, now en vogue and advertised in the newspapers. Subsequently the gourmets, and all those who seek real recreation, stay away. At last the tourist agencies come with their package rate travelling parties; now, the indulged public avoids such places. At the same time, in other places the same cycle occurs again; more and more places come into fashion, change their type, turn into everybody's tourist haunt. (Christaller 1963)

As the changing character of the tourists at a given location was held at least partly accountable for the changing character of the resort, research concerning the nature of tourists was pursued by several psychologists and sociologists in the 1970s, and a number of "tourist typologies" resulted.

In 1972, Plog first identified a continuum of travelers ranging from allocentrics, who prefer adventure and individual exploration, to psychocentrics, who travel in automobiles or in organized tour groups and prefer a familiar environment (Plog 1974). Most tourists, Plog felt, were mid-centrics who fell in the middle of the continuum, and they would venture to places in which facilities had been established and which had a growing reputation. Transitional tourist types included near-allocentrics and near-psychocentrics rounded out Plog's
continuum. According to his theory, a tourist destination would be successively frequented by the five tourist types--from allocentric to psychocentric--and the "viability" of the resort will depend on which segment of the continuum is attracted to it. Once the appeal is toward the psychocentric end of the continuum (e.g. Coney Island), the resort will lapse into a decline phase. Professionals in the travel industry have utilized Plog's descriptions in their understanding of tourist behavior and tourism development (Figure 2).

Figure 2. Profiles, social characteristics, and typical destinations of travelers. (Slattery 1983)
Cohen (1972) devised a similar typology of tourists. He proposed two categories of travelers, each of which could be further subdivided into two classes: non-institutionalized travelers comprised "drifters" and "explorers", and institutionalized travelers comprised individual mass tourists and mass tourists organized in tour groups. Like Plog, Cohen saw the character of the tourist destination as a reflection of the demands of the class of travelers attracted to it. Smith (1977) expanded Cohen's typology to end up with seven tourist types: explorer, elite, off-beat, unusual, incipient mass, mass, and charter. Although the "continuum" could also be used to analyze corollary settlement impacts within the tourist destinations, Smith, a cultural anthropologist, used the typology to demonstrate the inverse relationship between the touristic impact upon a culture and that culture's perception of the visitors.

Noronha, summarizing the sociological literature for the World Bank, suggested that, for a given location, tourism develops in three stages: 1) discovery, 2) local response and initiative, and 3) institutionalized tourism. As the nature of the tourist differs in each of the stages, so does the level of the existing touristic infrastructure at the destination (Noronha 1976).

A renewed focus on the tourist destination, rather than on the tourist, revived the concept of a "resort cycle" as a research approach. Snow and Wright (1976) examined of the rise and decline of Coney Island in terms of technologic phases, and a few years later, Stansfield (1978) noted a pattern of cyclicity in his study of Atlantic City. Stansfield identified three distinct phases in resort evolution--discovery, democratization, and abandonment--with the possibility of a fourth
phase—revitalization—when concerted efforts, such as providing an architectural facelift or introducing casino gambling, are adopted (Stansfield 1976). In the touristic discovery phase, the attraction of fresh, uncrowded recreation resources (in this case, the beach) lures the trend-setters, and soon the site is characterized by intensive real estate speculation, provision of access, and a rapidly expanding infrastructure. The resort becomes more democratized as more and lower income recreationists arrive, and the attractions become more “mechanized”, by amusement facilities, for example. In time, the “pioneering” social classes go elsewhere for their recreational pursuits, the initial infrastructure deteriorates, and the resort slumps into an abandonment phase.

Perhaps the best recent theoretical model of resort evolution is that offered by Butler (1980). By application of the 'product life cycle' concept employed by marketing analysts, in which sales of a newly introduced product can be expected to proceed according to phases of growth, maturity, and decline, Butler outlined a 6-stage “tourism area cycle of evolution” (Figure 3). From an initial exploration stage, characterized by few, adventurous tourists visiting sites with no public facilities, an involvement stage is entered. Here, limited involvement with tourism by local residents leads to provision of basic services and perhaps advertising thereof, and a definable pattern of seasonal visitation and recreational hinterland (i.e. market area) begins to emerge. The development stage is marked by more facilities, more advertising, increasing control of the tourist trade by outsiders, an excess of tourists over locals at peak periods, and increasing antagonism by the latter toward the former. In the consolidation stage, tourism has become a
major—if not the major—part of the local economy, but growth rates have begun to level off. A well delineated recreational business district (RBD) has taken shape, some of the older, deteriorating facilities are perceived as second-rate, and local efforts are made to extend the tourist season. The stagnation stage witnesses peak numbers of tourists as capacity levels are reached. Although the resort now has a well established image, it is no longer in fashion and property turnover rates are high. The original physical attraction of the site may be buried under the cultural overlay, which, in the words of R. Wolfe, represents the "divorce from the geographic environment" (Wolfe 1952). As the tourist market wanes, the decline stage is entered. However, countermeasures such as redirected foci of tourist attraction, beautification/urban renewal projects, beach

Fig. 3. Hypothetical evolution of a tourist area. (Butler 1980)
nourishment, or even legalization of gambling may offset the decline and stimulate varying degrees of rejuvenation (Butler 1980).

Butler's S-curve model has been applied, often in slightly modified form, by geographers examining various aspects of tourism. Hovinen (1982) used the framework to document tourism trends and make planning decisions in Pennsylvania's Lancaster County; Young (1983) made frequent comparison to Butler's model in his own proposed model of urban change (touristization) in Maltese villages; Meyer-Arendt (1985) employed the model to evaluate environmental changes at Grand Isle; Keller (1986) focused on large-scale tourism development planning in Canada's Northwest Territories; and Weaver (1986) applied the framework in modelling the economic role of tourism and the morphologic expression on the landscape of a Caribbean island.

Wolfe, in a recent (1982) re-evaluation of his earlier (1966) research into recreational travel, proposed a descriptive model of resort evolution that incorporates the environmental component. In his model, "a normative typology of tourist destinations" (Figure 4), the vertical axis represents the level of economic impact (from positive to negative) and the horizontal axis measures relative environmental impacts. When tracing the course of development of a resort such as Torremolinos, Spain along the Ellis curve (named after an associate), one notes an initial benefit in economic and environmental terms, the latter because initially attention is paid to aesthetics of landscape in order to attract the tourist. Also, an initially low number of visitors do not detract significantly from the environmental setting. In time, however, environmental degradation becomes dominant, and even the economic benefits, while still positive,
decrease as more profits are pocketed by outside investors and developers. Local residents, too, are forced to pay higher prices for land and other goods and services. Finally, the resort exceeds the point where

![Diagram of the Ellis Curve (Volfs 1983)](image)

net economic benefits are no longer being realized. If management decisions are not implemented at that stage, economic and environmental decline will continue.

Except for isolated applications of proposed resort cycle models to specific sites (e.g., Young 1983; Meyer-Arendt 1985; and Weaver 1986), correlations between theoretical models of resort evolution and resultant spatial patterns (i.e., resort morphology) inherent in seaside resort development have not yet been critically addressed in the literature.

**Models of Resort Morphology**

Resort morphology is the description of the spatial form of recreational urbanization. Although this definition describes the form of
the overall urban overlay within a given physical environment, it also usually implies a breakdown of the urban overlay into various landuse components such as central business district, residential sector, commercial strip, etc. Technically, description of a resort's morphology is restricted to a specific "time slice". But as resorts have been shown to be highly dynamic, it follows that the morphology of the resort changes as well. A tourist destination in a growth phase may exhibit an evolving resort morphology that reflects: 1) areal expansion of the whole resort or parts thereof, 2) addition of new urban components, or 3) both.

It has been long recognized that resort settlements develop a unique form because of their specialized touristic functions (Jones 1933). Studies of coastal resort morphology date to the 1930s, when Gilbert (1939) first examined the phenomenon of coastal urbanization in Great Britain. Gilbert's epic works on Brighton (Gilbert 1949; and 1954) thoroughly documented the morphologic patterns of the resort's development.

Wolfe (1952), in his study of a lakefront cottage resort in Ontario, employed a similar historical approach in his examination of the various functional landuse zones that had come to characterize the resort. Wolfe identified a honky-tonk section of town in addition to discrete zones of housing and accommodation facilities.

The first systematic analysis and modelling of landuse zonation in coastal resorts was undertaken by Barrett (1958) in a doctoral dissertation. By applying a historical-morphological research approach at eighty seaside resorts in the United Kingdom, Barrett proposed several
generalizations concerning the evolutionary and functional patterns of the settlements. In his model of "theoretical accommodation zones" (Figure 5), a zone of hotels and other "frontal amenities" faced the beach directly seaward of a downtown core. With distance from the beach, the type of lodging facilities became simpler (boarding houses and bed-and-breakfast places), and the intensity of tourism-related activities decreased concentrically away from the beachfront.

Recreation geographers in the U.S. coined the term recreational business district (or RBD) to apply to the zone of "frontal amenities", which was easily distinguishable from the central business district (CBD) (Stansfield and Rickert 1970). The RBD, a highly-specialized business district composed of hotels, tourist-oriented shops, and amusement facilities, catered especially to short-term vacationers, many of workingclass background (Figure 6). Stansfield (1971), in a comparison of British and Northeast U.S. resorts, identified RBDs as prime urban components in both countries, although variability in components of the

Figure 5. Theoretical accommodation zones in a seaside resort. (after Barrett 1958)
RBD and in morphologic expression was noted. American resorts were more linear (reflective of a barrier environment setting) and street networks followed a grid pattern (reflective of newer, more ordered concepts in town planning). Fishing piers, amusement piers, and beachfront promenades were British inventions readily adopted in American resorts, although the promenade became modified into a boardwalk, a low wooden platform for strolling above the sand. Originating in Atlantic City, the boardwalk was characterized by RBD development along its inland flank (Stansfield 1971).

![Resort Morphology of Atlantic City](image)

**Figure 6. RBD vs. CBD in Atlantic City, New Jersey. (Stansfield 1971)**

The RBD concept was quickly adopted by many tourism and recreation researchers. This is seen in the schematic of a typical seaside resort developed by Lavery (1971) for Britain (Figure 7). The CBD and RBD, although functionally separated, are adjacent to each other, respectively wedged between the train depot and the fishing pier. Dense commercial development lines the main streets of the core areas. The hotel zone fronts the beach (site of the highest land values), and the more modest lodging facilities lie farther from the beach. Case studies of resorts
in South Africa (Taylor 1975) and Australia (Pigram 1977) support the idea of distinguishing recreational functions from other urban functions in landuse analyses.

![Figure 7. Schematic of a typical seaside resort in Britain. (Lavery 1971)](image)

Urban beachfront morphology along the French Riviera was examined by Pearce (1976), who delineated three major types of *fronts de mer* (Figure 8). The simplest type (A) consists of low-density development flanking a coastal highway, and housing separates the beach area from the road. Types B and C respectively consist of medium- and high-density development, although it is restricted to the landward side of...
the highway. Most European beachfronts exhibit the latter patterns, but the American pattern, regardless of density, is generally of Type A.

Resort models that take the historical component into account are either quite spatially generalized or restricted to site-specific case studies. An attempt to understand the evolution of "touristic space" is provided by Miossec (1976; discussed in English by Pearce 1981), who utilized location analysis theory to devise his general model. Similar generalized models of recreational landscape change (Figure 9), although more descriptive than theoretical, were developed by Russian geographers (Preobrazhensky and

Figure 9. Development of a coastal recreational landscape. (after Preobrazhensky and Krivshelyev 1982)
While these models provide useful overviews of regional landscape expressions of recreation and tourism, the more site-specific models provide more insights into the details of recreational landscape evolution. Weaver (1986) has recently proposed a morphologic model of resort evolution for a hypothetical Caribbean island (Figure 10).

His model is based in part on a modification of the Butler (1980) resort cycle model, augmented by field research on the island of Antigua.
Previous models have generally downplayed the role of the physical environment, except for perhaps noting that a once pristine natural landscape has been replaced by a less-than-pristine cultural one.

**Recreational Development and the Physical Environment**

Human interaction with the physical environment can take a variety of forms, ranging from minimal modification to extensive modification. Of the literature which addresses the environmental aspects of recreation and tourism development, most emphasis is placed on extensive modification that results from such development. Roy Wolfe, in his pioneering work on lakeside resorts, observed a direct inverse relationship between recreational urbanization and environmental quality. As the Ontario lakeside cottage resorts became more urbanized and commercialized, they increasingly became "divorced from their geographic environment" (Wolfe 1952). Although environmental degradation is, in fact, generally related to increases in recreational usage (Cohen 1976), there is argument not only as to the linearity of this inverse relationship but also as to the necessity of the inverse relationship itself. Wolfe later recognized that the degree of touristic impact was dependent upon the stage of resort evolution when he presented his previously discussed "Ellis curve" (Wolfe 1982). This integration of the physical component into models of tourism development, both theoretical and spatial, has not been attempted by many. Cohen (1978), in summarizing literature addressing the environmental impacts of tourism, identified four major factors which contributed to decline in environmental quality: 1) intensity of tourism, 2) resiliency of the ecosystem to tourism (i.e. the more fragile systems are the first to collapse), 3) the time perspective of the developer (i.e.
economic incentives and tax policies favor quick monetary gain at the expense of environmental conservation), and 4) the transformational character of recreational development (i.e. during the course of resort evolution, the type of tourist attracted to that particular resort changes, as may well the recreational resource). Since the highest levels of environmental deterioration have accompanied tourism development that is neither properly designed or managed, landscape architects and planners have argued that, with proper design and management, a co-existence or even "symbiosis" between tourism and environment is possible (Budowski 1976; Gunn 1972; and Pigram 1980).

The theme of man as an agent of coastal landscape change is not a new one. At a 1956 symposium addressing "Man's Role in Changing the Face of the Earth", Davis (1956) summarized the various human impacts upon the shoreline ranging from shell midden creation to the construction of seawalls. Many of the recent shoreline impacts, Davis noted, could be attributed to the increasing attractiveness of coasts as sites for recreation. The development of motels and vacation homes not only modified the strand environment, but mangrove swamps and tidal marshes as well (Davis 1956). As the world's shorelines are becoming increasingly urbanized, in large part due to the phenomena of recreation and tourism, they are being correspondingly structurally modified. High levels of modification have led some coastal scientists to include an "anthropogenic" category in their coastal classifications (Walker 1981; and 1984).

When discussing human modifications of a coastal barrier environment, as is characteristic of the Gulf of Mexico study sites, one can focus upon either the type of human activity responsible for environmental
modification, or one can evaluate the modification within subcategories of the physical environment. Both geomorphic and ecologic impacts need to be evaluated for proper assessment of overall human impacts upon the ecosystem. For all intents and purposes of this study, the level of human impact was examined within the context of several key impacts: 1) modification of the shorefront, including dunes, beaches, and the nearshore, 2) modification of the wetlands and waterbodies on the sheltered inland side (backbarrier) of the dune ridges of a barrier island or barrier beach, 3) response to hurricanes and severe storms (Figure 11).

![Figure 11. Profile of a Gulf of Mexico barrier island.](image)

The shorefront of a coastal barrier is a geologically dynamic environment in many aspects. Geologically, the dune, beach, and nearshore zones comprise the sand system where the energy of incoming waves is expended, and there can be a constantly changing shorefront morphology in response to variation in wave energy. Dunes, although genetically aeolian features, are integrated with the beach during abnormal storm events. Storm wave energy may erode sands from the vegetatively-stabilized dunes, only to restore them during post-storm
recovery phases. In essence, dunes can absorb higher-than-normal wave energy, thereby minimizing expenditure of that energy inland of the dune line. Modification of the beach/dune system by recreationists can take various forms, including advertent and inadvertent removal of sand and vegetation cover, building too close to the seaward edge of dunes, and constructing a beach access road through the dunes. These actions eventually disrupt the pre-existing balance between natural processes and coastal geomorphology (Carter 1980; Leathermann 1981; Nordstrom and Allen 1978; Psuty 1987; and Usher et al. 1974). Where natural or human-induced changes have occurred, restoration can often be accelerated by a variety of mechanisms, including sand-fencing and artificial planting of dune vegetation.

The position of the barrier shoreline can also vary in response to changes in sea level, supply of sand to the beach, and wave energy. As sea level is generally rising throughout the Gulf of Mexico (USDI 1985), the shoreline is retreating inland in response. If, in addition, the landmass is locally subsiding, "relative" sea level rise becomes even higher, and the base for shoreline erosion does also. Where beach/dune sand is being lost to the backbay (via storm overwash, for example) or to the offshore, and no new sand is brought in by longshore currents to replace that which has been lost, shoreline retreat will accelerate. Finally, during storm events, abnormally high rates of shoreline retreat (and vegetation line retreat) may occur. To respond to such shoreline dynamics, resort communities begin to "armor" their shorelines, either on a piecemeal basis or comprehensively. The construction of jetties at tidal inlets (to minimize longshore sediments from shoaling a navigation channel), groins (to intercept
longshore sediments for the purpose of building out a beach), offshore breakwaters (to reduce wave energy at the shoreline), revetments, seawalls, and bulkheads (to "stabilize" the shoreline and protect private property) has been found to be at best a short-term solution. Often, the effect of structural emplacement is an acceleration of erosion rather than the prevention of it (El-Ashry 1971; FitzGerald et al. 1981; Komar 1984; and Morton 1982).

Ecologically, the most important subenvironment of a barrier island is the lower-elevation backbarrier zone, usually comprised of wetland vegetative species such as tidal marshes and mangroves that are adapted to frequent inundation (Day et al. 1973; and Lugo and Snedaker 1974). This wetland zone comprises the source of nutrients for adjacent estuarine waters, which support biologically and commercially valuable populations of fish and shellfish. It is estimated that over 90% of the U.S. commercial catch in the Gulf of Mexico is comprised of estuarine-dependent species (USDI 1985). Tidal marshes are especially important as suppliers or organic nutrients to the estuaries. High rates of biomass production are accompanied by corresponding high rates of organic decomposition, and the rich detrital matter becomes flushed into the bays with tidal activity. As the acreage of nutrient-contributing wetlands diminishes as a result of either natural or human-induced processes, the biological productivity of the estuary declines. A direct relationship between the acreage of tidal wetlands and commercial shrimp yields has been noted (Turner 1977). In addition, free tidal exchange of detritus between the marshes and the backbay must be maintained (USDI 1985). If the interface between wetland and water becomes a barrier to exchange, as a result of erecting a
bulkhead, for example, then the value of the wetlands to the estuarine system is likewise diminished.

The impacts of recreational urbanization upon backbarrier wetlands are numerous. The most obvious impacts include direct removal by either dredging or filling. By combining dredging with filling, a developer can provide an access canal while raising adjacent land to a sufficient elevation to provide a foundation home construction and to minimize tidal flooding (Darnell et al. 1976). Dredging and filling of shallow backbay waters to create land for development is a similarly environmentally-damaging process. Often referred to a “fingerfill” because of the finger-like shapes of the created land, this type of construction impact was invented in Florida early this century (Notan 1964), and was widely adopted in shallow bay environments there until the 1960s (Lewis 1976; Sykes 1971; and Taylor and Saloman 1966). Less obvious, although still damaging, impacts include hydrologic modifications such as drainage or impoundment, and also the spraying of chemicals (to reduce the mosquito population, for example). Additional impacts include seepage of sewage from septic tanks into wetlands and backbays. Although wetlands have a relatively high pollutant-filtering capability, excessive introduction of pollutants can “overload” the system and cause contamination and mortality of estuarine dependent species (USDI 1985). A comprehensive examination of construction activities in U.S. wetlands (Darnell et al. 1976) summarizes most conceivable human impacts, and references to cases of wetland degradation abound in the literature of various disciplines.

A final theme to be addressed is the interaction between humans and severe storms, particularly hurricanes. Hurricane impacts upon the
physical environment include shoreline and vegetation line retreat, dune erosion, washover channel and washover fan development (McGowen et al. 1970). Human structures are subject to damage and destruction by winds and waves. In spite of human recognition of the potential impacts of hurricanes, coastal settlements are still growing and increasing in number. Several questions thus become raised: 1) to what extent has human modification influenced the physical impacts of hurricanes?, 2) what human modifications have been adopted in response to hurricane onslaught?, 3) how is resort evolution affected by hurricanes?, and 4) how is a resort’s morphology influenced by hurricanes? Except for the second point, the existing literature does not address these questions. In the 1960s, following a devastating 1962 U.S. East Coast storm, natural hazards research became an important field of study (Burton and Kates 1964). Several investigations of coastal hazards have subsequently appeared (Davenport 1970; and Mitchell 1974). But, although the role of humans as geomorphic agents was cited, the emphasis of these studies was upon predominantly sociological aspects rather than (urban) morphological ones. Little research into the role of hurricanes as modifiers of growth patterns or urban morphology has been conducted.
CHAPTER III. THE SETTING—GULF OF MEXICO

Location

The Gulf of Mexico is a subtropical sea approximately 600,000 square miles (1,600,000 km²) in area (Figure 12). Latitudinally, the Gulf extends from approximately 18°N to over 30°N and is bisected by the Tropic of Cancer. Politically it is bounded by the U.S.A. (between the Rio Grande and the Florida Keys, including the coasts of Texas, Louisiana, Mississippi, Alabama, and western peninsular Florida), Mexico (between the Rio Grande and Cabo Catoche, including the coasts of Tamaulipas, Veracruz, Tabasco, Campeche, Yucatan, Quintana Roo, and Campeche, Veracruz, Tabasco, and Campeche, respectively). Figure 12 shows the regional setting of the Gulf of Mexico.

Figure 12. Regional setting of the Gulf of Mexico.
Veracruz, Tabasco, Campeche, Yucatan, and northern Quintana Roo), and northwestern Cuba (between Cabo San Antonio and a point where the 83°W longitude line intersects the Cuban coast west of Havana and south of the Dry Tortugas) (DeVorsey 1982). The Gulf of Mexico is connected to the Atlantic Ocean by two water passages: the Straits of Florida (between the Florida Keys and Cuba) which link the Gulf with the Atlantic directly, and the Yucatan Channel (between the Yucatan Peninsula and Cuba) which link it with the Caribbean Sea. For purposes of investigation the Cuban segment and the Florida Keys were omitted from the study; Cuba for political considerations, and the Florida Keys because they technically front on the Straits of Florida. Although the Gulf of Mexico coastline totals 15,500 miles (25,000 km) in length counting estuarine and lagoonal shores (Reinhardt et al. 1996), the Gulf littoral proper--not including inland waters or the Florida Keys--encompasses about 3,100 miles (4,960 km). Of this total, the U.S. share is 53.2% (1,650 miles, or 2,670 km), the Mexican share is 40.3% (1,250 miles, or 2,000 km), and the Cuban share is 6.5% (200 miles or 370 km).

**Climate**

Based upon analysis of climate data from twenty weather stations around the Gulf of Mexico (from Progreso, Yucatan clockwise to Key West, Florida), generalizations about climate, temperature, and precipitation were made. In terms of the Köppen climate classification system, the Gulf of Mexico region exhibits a transition from a humid temperate climate (Cf) to a humid tropical climate (Am), with a short segment of dry climate (B) along the northwest coast of of Yucatan (Figure 13A). The northern Gulf Coast, from the Rio Grande to Tampa Bay, is characterized by a relative
abundance of rainfall in all months and by winter months with average temperatures of under 64.4°F (18°C)—hence the Cf climate. A temperate (semi-tropical) wet-and-dry climate (Cwa), characterized by a pronounced winter dry season, extends from the Rio Grande to south of Tampico along the western Gulf rim and from Tampa Bay to near Naples along the eastern rim. As average temperatures increase equatorward, a tropical

---

**Figure 13. Temperature characteristics of the Gulf of Mexico:**

savanna climate (Aw) with a distinctive late-summer rainy season is entered. Southernmost Florida, the southwest Gulf Coast (roughly from Tuxpan to Veracruz), and much of the Yucatan Peninsula fall within the Aw classification. Only the northwest littoral of the Yucatan Peninsula qualifies as a BS, or steppe, climate (Trewartha 1981). The northern limit of the tradewind belt coincides approximately with the Aw/Cwa boundary during the winter months (West and Augelli 1976), and orographic interception of the southwestward-moving, moisture-laden airmasses largely accounts for the distribution of the monsoon (Am) belt in the southern Gulf. The northward shift of the tradewind belt during the summer months, to slightly north of the Cwa/Cfa boundary, partly accounts for the summer precipitation in the Cwa zone of Mexico.

Mean annual temperatures around the perimeter of the Gulf of Mexico range from less than 68°F (20°C) along the northeastern Gulf to over 80°F (26.7°C) at Campeche (Figure 13B). The data indicate that colder temperatures extend much further south along the western rim of the Gulf than along the eastern rim. This pattern reflects the greater southward thermal influence of continental airmasses, specifically wintertime polar outbreaks, or nortes. These airmasses, which sweep southward over the Great Plains and the Mexican Plateau, are not ameliorated by waterbodies along the western littoral as they are by the time they reach southwest Florida or Yucatan.

This latitudinal thermal imbalance is especially apparent during winter when polar outbreaks are most frequent. A temperature map for January (Figure 13C) reflects the annual pattern (Figure 13B), but variation in temperature is greater across the Gulf. From about 53°F
(12.2°C) along the northern Gulf Coast, average temperatures increase to over 74°F (23.3°C) at Campeche. The temperature range is even more compressed along the Florida coast, where mean temperatures increase from 60°F (15.6°C) at Tarpon Springs to over 70°F (21.1°C) at Key West. Key West's January mean temperature is slightly higher than that of Veracruz, in spite of its latitudinal setting 5° further north. The mean January temperatures provide some clues as to what constitutes (or at least formerly constituted) the "winter recreation belt" for temperate climate inhabitants. The 60°F (15.6°C) mean January temperature of Tarpon Springs, Florida, which approximately marks the northern limit of the traditional winter recreation belt in southwest Florida, corresponds with the mean January temperature of Brownsville, Texas. Perhaps it is no coincidence that the only winter recreation area in Texas is the Lower Rio Grande Valley!

Although the winter climate of the Gulf of Mexico littoral is influenced by continental polar airmasses, especially along the northern Gulf rim, the summer climate is characterized by balmy, tropical maritime weather around the entire Gulf. Mean July temperatures display a regional variation of only 4°F (2.2°C) from 81°F (27.2°C) to 85°F (29.4°C), and the highest temperatures occur along the south Texas/northern Mexico coast because of seasonally drier conditions.

Sea surface temperatures, like air temperatures, reflect the influences of seasonal weather changes (Liepper 1954b). During the month of August, for example, the surface temperatures throughout the Gulf are almost uniformly 84°F (29°C). During January, however, there is a distinct temperature gradient from northwest to southeast (Figure 13D).
With the notable exceptions of the U.S.A./Mexico border area and the north Yucatan coast, the Gulf of Mexico littoral is subject to high humidity levels throughout the year—commonly above 90% at night (Fekete 1962). The coupling a high relative humidity with high temperatures during the summer months has led bioclimatologists to classify this environment as "sultry and uncomfortable" (Rudloff 1981). In spite of the widely-perceived moderating effects at coastal sites, such as "cooling breezes" during summer months, comparison of temperature data for coastal stations and nearby inland weather stations (e.g. Dauphin Island vs. Mobile, Alabama) revealed no significant differences in temperatures during summer months (USDC 1980). A previous study of recreational development along the southwest Florida coast similarly noted this lack of temperature difference between inland sites and coastal sites (Fekete 1962).

Precipitation around the Gulf of Mexico also varies considerably, ranging from a low of 13.11 in/yr (330 mm/yr) at Progreso, Yucatan to a high of 112.15 in/yr (2850 mm/yr) at Coatzacoalcos, Veracruz (Figure 14A). The northern Gulf Coast receives an average of over 60 in/yr (1500 mm/yr), and most of the Florida coast receives over 50 in/yr (1250 mm/yr). The western rim of the Gulf, between Galveston and Tampico, is subhumid, and annual precipitation is in the 20 to 40 in/yr (500 to 1000 mm/yr) range. The southern Gulf, specifically along the rim of the Bay of Campeche, displays marked variability in precipitation totals due to both local orography because of interception of tradewind-borne moisture-laden airmasses and also because of proximity to the summertime position of the Inter-Tropical Convergence Zone (ITCZ) (West and Augelli 1976).
Precipitation is also more unevenly seasonally distributed on the southern rim of the Gulf than on the northern rim. The northern Gulf receives abundant rainfall in all months because of onshore airflow and convectional activity during summer months and mid-latitude cyclonic (i.e. frontal) activity during winter months. In the tropics, southward of the mid-latitude cyclone belt, winter is relatively rainfree (with the notable exception of norte passages across the Gulf) while late summer and early fall constitute the rainy season. This wet period is brought on by intensification of the low pressure cell over the Mexican interior, the poleward shift of the ITCZ, and consequent onset of the summer "monsoon" season (Vivó 1964). Thundershower occurrence along the Gulf Coast is most pronounced along the southeast Louisiana coast and the Florida coast from Cape San Blas to south of Naples, where an average of over seventy summer days experience thunderstorm activity (Vivó 1964).
Of special significance within the Gulf of Mexico is the occurrence of tropical cyclones, or hurricanes (*hurricanes*). About 80% of hurricanes appearing in the Gulf of Mexico form outside of the Gulf, generally in the tropical Atlantic between 5° and 15°N latitude, and enter via the Yucatan Channel and Florida peninsula (Liepper 1954a; and Nummedal 1984). Approximately 15% form in the northern Gulf, and 5% form in the southwestern Gulf (Liepper 1954a). The initial disturbance is generally found within the ITCZ, and as this band moves north into the latitude belt where adequate Coriolis inertial force and sea temperatures above 80°F (26.7°C) exist, conditions for hurricane formation become more favorable (Nummedal 1984).

The primary months of hurricane landfall are August, September, and October, and along the U.S. Gulf Coast there is marked eastward temporal lag in probability of hurricane landfall (Nummedal 1984). The Texas coast has the highest probability of an August hurricane landfall, whereas for the Florida Gulf Coast the high peak occurs in October (Nummedal 1984). Because of the geometry of the Gulf of Mexico and its orientation to the source area of the majority of hurricanes, direct landfalls are largely confined to the U.S. and northern Mexico. Hurricanes entering the Gulf via the Yucatan Strait tend to travel in a relatively straight path or "bend" to the north and east (Figure 14B). This refraction results from the hurricane entering the westerlies wind belt which is furthest south both early and late in the hurricane season (Simpson and Riehl 1981). The occurrence of land-based high pressure systems also tend to modify the path of the hurricane as it nears land.
Based on the historical evidence, numerous authors have delineated the rim of the Gulf of Mexico in terms of frequency of hurricane probability, primarily for the U.S. segment of the Gulf Coast (Nummedal 1984; Reinhardt et al. 1986; and Simpson and Riehl 1981). Whether past frequency is a valid measure of future frequency is subject to debate, especially in view of the discrepancies in the results. Statistically, however, over 80% of all hurricanes that enter or form in the Gulf make landfall in the U.S. portion of the Gulf Coast (Tannehill 1938). The southern rim of the Gulf has been least affected by hurricanes, in part because few hurricanes curve southward upon entering the Gulf. Also, coastal areas affected by hurricanes crossing the Yucatan peninsula from the south and east are in a lee situation and are generally spared the storm surges that accompany onshore-moving storms.

Hurricanes vary in both spatial dimension (100 to 500 mile, or 160 to 800 km, diameters are common) and intensity (in terms of barometric pressure and wind speeds primarily). This degree of intensity, in turn, partly determines the severity of the storm surge, the amount of tornadic activity, and the overall impact of the hurricane upon the physical and cultural environment (Simpson and Riehl 1981). A continuum—the Saffir-Simpson scale—has become established to measure the intensity of hurricanes (Appendix). By this scale, all hurricanes are divided into five levels of power (Force 5 being the highest) on the basis of barometric pressure, windspeed, and storm surge height. A qualitative indication of the type of damage that can be expected from the respective hurricane is also listed (see Appendix).
Geology

The Gulf of Mexico dates to the time of the break-up of the protocontinent Pangaea during the late Triassic about 200 million years ago (Freeland and Dietz 1971). The evolution of the Gulf is related to tectonic processes that took place at former plate junctions between North America, South America, and Africa as the Americas drifted westward. Formation of the Gulf was essentially complete by the late Jurassic about 150 million years ago (Freeland and Dietz 1971), but ongoing tectonic, orogenic, carbonate-building, and sedimentary processes have substantially modified the shape of the Gulf of Mexico. Many of the modern geologic features around the rim of the Gulf have been formed during the past 7000 years, when sea level approximately reached its present level, by fluvial, tidal, and marine processes (Walker and Coleman 1987).

According to Price (1954b), the regional coastal geology of the Gulf of Mexico can be categorized into 4 major types (Figure 15): 1) young orogenic coasts, such as the Mexican coast from Tampico to Coatzacoalcos, where active diastrophic and volcanic mountain building is on and near the shore, 2) alluvial shorelines, such as from the Rio Grande delta to the Apalachicola delta along the northern Gulf and the Usumacinta/Grijalva delta in the southern Gulf, both areas characterized by broad coastal plains and extensive offshore sedimentation, 3) limestone coastal plains, such as subaerial and drowned segments of the Yucatan and Florida peninsulas, and 4) biogenous environments, including the extensive carbonate platforms off of Yucatan and Florida, localized carbonate reefs off of Louisiana, Texas, and Veracruz, and the marsh/swamp environments of Louisiana, southwest Florida, and north-
east Campeche. Except for along the emergent orogenic coast of the southwest Gulf, the Gulf of Mexico is characterized by a wide continental shelf which has resulted from both sedimentary deposition and carbonate reef growth (Murray 1961).

Figure 15. Regional geologic-oceanographic classification of the Gulf of Mexico coast. Key: 1. Alluvial coasts. 2. Drowned limestone plateaus. 3. Young orogenic coasts. 4. Biogenous (organic) development on various coasts. (after Price 1954b)

Because of marine processes such as waves and tides acting upon the coastline of the Gulf, both during rising sea level of the Holocene as well as present, the shores of the Gulf have become considerably "smoothed" (Price 1954a). Where wave energy is present at the coast, sandy shorelines have generally formed, both by offshore bar emergence
and also by wave reworking and redistribution of sediments eroded from headlands. Sandy beaches and barrier islands are found throughout most of the Gulf, with notable exceptions of: 1) the active delta of the Mississippi River, 2) the “zero-energy” coasts of northwest Florida (Cape San Bias to Tarpon Springs), extreme southwest Florida, and northeast Campeche, all of which occupy lee locations where incoming wave energy is dampened by broad, gently sloping continental shelves, and 3) the volcanic salients of Veracruz (Figure 16, see also Figure 12).

Figure 16. Geologic features along the Gulf of Mexico shoreline. (Price 1954b)
Comprehensive wave energy studies have not been conducted along the entirety of the Gulf shoreline, and the isolated visual surf observations conducted along the northern Gulf during the 1950s were inconsistent in quality (Mossa 1964). Price (1954a) classified the Gulf shoreline in terms of "smoothness" which reflected a combination of pre-existing geology, fluvio-deltaic processes, and wave energy (Figure 17). Wave energy at

Gulf of Mexico

<table>
<thead>
<tr>
<th>SHORE CONDITIONS</th>
<th>RELATIVE WAVE ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>smoothed</td>
<td>O = zero</td>
</tr>
<tr>
<td>partly smoothed</td>
<td>L = low</td>
</tr>
<tr>
<td>not smoothed</td>
<td>M = medium</td>
</tr>
<tr>
<td></td>
<td>H = high</td>
</tr>
</tbody>
</table>

Figure 17. Wave energy and shore conditions along the Gulf of Mexico littoral. (after Price 1954a; and Tanner 1960)
the shoreline was inversely related to distance across the continental shelf, although additional dampening was attributed to obstacles, such as reefs, on the shelf (Price 1954a). For the most part, the shoreline of the Gulf fell into the "smoothed" category which consists primarily of sandy barrier islands and beaches. Exceptions include the "zero-energy" coasts of Florida, the active Mississippi River delta, the reef coast of central Louisiana, rocky outcrops along the Veracruz and Campeche coasts, and a sand-deficient stretch of northern Yucatan.

The genesis of the barrier islands and sandy beaches varies considerably along the Gulf of Mexico littoral. The Yucatan and Florida barrier beaches have been produced by sediments derived from the carbonate/limestone platforms, and a high shell content is evident in the beach sands. Also, coquina, an aggregate of shell deposits used as construction material, frequently crops out at the shoreline (Kwon 1969). Most of the remaining barrier beaches originated from reworking and longshore transport of sediments associated with various fluvio-deltaic systems (e.g. Mississippi River, Brazos/Colorado Rivers, Rio Grande, Rio Panuco, Rio Tecolutla, Rio Nautla, Rio Papaloapan, Rio Grijalva/Usumacinta), each of which contains a different mineral assemblage and different set of beach sand characteristics (in terms of abundance, grain size, and color). The whitest, coarsest beaches are associated with erosion and redistribution of Pleistocene terrace sediments, as along the panhandle of Florida (Kwon 1969).

The sedimentary characteristics of most of the Gulf shoreline makes it quite vulnerable to modification by hurricanes. Although hurricanes vary in size and intensity, their impacts are further affected by 1) bottom
slope and profile of the inner shelf and shoreface, 2) existing sea level conditions, in turn dependent on astronomical tidal stage and meteorological conditions, 3) characteristics, shape and orientation of the coastline, 4) direction of hurricane approach. A generalized model of hurricane impacts was prepared for the Texas coast (Figure 18) (McGowen et al. 1970), but the outlined stages may well be applied to most other parts of the Gulf of Mexico littoral also.

As the storm approaches the coast, winds and water levels increase (Figure 18B). The storm surge is greater the longer the storm remains offshore in the Gulf. Funnel-like shore configuration will also increase the surge levels, to as high as 25 feet (8 m) above sea level. The storm surge modifies the barrier islands considerably by reworking nearshore shelf sands, flattening and eroding dunes, and redistributing sands to the nearshore, the backshore, and to the alongshore. In Texas, strong south-westward longshore currents result from the counter-clockwise circulation associated with the hurricane.

As the hurricane crosses the coastline, the storm circulation pattern generates strong onshore winds and currents to the right of the "eye", or storm center, and corresponding offshore winds and outflow to the left of the eye (Figure 18C). As the storm moves inland, nearshore currents switch abruptly to the northeast.

The storm cell becomes weak and diffused, although tornadoes are often spawned along its margins (Figure 18D). Water that had become stacked up in bays and river valleys drains back to the gulf through passes and washover channels that may have been opened by the
Figure 18. Schematic model of hurricane effects on the Texas coast. A) physical features of the Texas coast. B) pre-landfall hurricane effects. C) impacts of hurricane landfall. D) aftermath effects of hurricanes (after McGowan et al. 1970)
hurricane. Heavy rains persist inland, and extensive flooding is possible (McGowen et al. 1970).

Vegetation

The vegetation found around the Gulf of Mexico littoral reflects local environmental conditions, particularly climate, geology (bedrock, soils, topography), and tidal regime. Within a narrow coastal band of the Gulf, a variety of temperate-to-tropical and arid-to-humid vegetation types are identified (Figure 19). The approximate northern limits of red mangroves (Rhizophora mangle) and coconut palms (Cocos nucifera), commonly perceived as "tropical" by winter recreationists, are indicated.

Because of many coastal "micro-environments", general vegetative association maps are not good indicators of local vegetation. Due to the low elevations along the Gulf, and a high number of barrier-lagoon-estuarine systems, extensive wetlands occur. Where warm and wet conditions are found (southern Mexico, southern Florida), mangroves comprise the dominant wetlands species. Northward of the mangrove zones, in areas of abundant precipitation, marshes of varying salinities predominate. Areas with low precipitation exhibit proportionally less expanses of marsh or mangrove, although small, salt-tolerant species may occur (Deegan et al. 1986).

Coastal Settlement

Prior to the popularization of beach recreation, direct settlement on the exposed coast of the Gulf of Mexico was uncommon, particularly along the more hurricane-prone northern rim. Aboriginal populations, although
utilizing the abundant food resources of the shore zone, generally maintained their bases of settlement some distance inland of the exposed
coast. The first Europeans also placed their coastal outposts at sheltered locations, such as bayshores or riverbanks, where accessibility by ship was possible.

In Mexico, only two major settlements—Veracruz and Campeche—were directly situated on the shoreline during the Spanish colonial period, and both occupied locations relatively protected from the ravages of hurricanes. Campeche, facing west, was located in an area rarely struck head-on by hurricanes, and Veracruz was protected by offshore reefs. The two coastal cities, the only two official ports during the colonial period, were also fortified by walls which functioned not only to repel pirates and other invaders but also to minimize storm damages. Campeche served as the sole port for the entire Yucatan peninsula, and Veracruz served a similar role for Mexico City and the rest of the interior. Other important coastal cities, such as Matamoros, Tampico, Tuxpan, Frontera, and Champotón, occupied riverine locations short distances away from the open coast. The remainder of coastal settlements consisted primarily of tiny fishing and salt-gathering villages. In the modern era, the only significant change to this pattern has been the growth of additional port and industrial centers, such as Coatzacoalcos, Ciudad del Carmen, and Progreso, and the development of coastal resorts.

In the United States, the Spanish avoided exposed coastal settlement in Texas and Florida, with the notable exception of Pensacola. This outpost was destroyed three times by hurricanes before being relocated to approximately its present sheltered bayshore site. The French, in their initial explorations of the Lower Mississippi Valley, also selected an exposed site for a temporary capital—Dauphin Island—but
here too, destruction by hurricane forced resettlement to the shores of Mobile Bay. The coastal settlement patterns of the United States in the early-to-mid-nineteenth century reflected a continuing avoidance of the shoreline, with the major exceptions of Galveston and Cedar Key (Florida), both of which were important entrepôt towns. Other major U.S. Gulf Coast cities were located, like their Mexican counterparts, on bayshore or riverine sites. Even these locations were not spared from hurricane destruction, as the major port for immigration into Texas—Indianola—was destroyed in 1886.

The beginnings of recreational urbanization along coasts directly exposed to the waves of the Gulf may be traced to at least two paths of evolution. First, the gulf beaches began to attract more recreationists from nearby urban areas, primarily during the hot summer months. Secondly, the beaches began to attract tourists from the Northeastern and Midwestern states, primarily during the winter months. Both trends became important in the latter nineteenth century and reflect the increasing international popularity of sea-bathing for health and/or pleasure. As transport to beaches became facilitated by railroads and steamboats, coastal visitation and urbanization increased even more.

By the 1880s, a pattern of local summer beach recreation had evolved along the exposed Gulf shoreline near Mérida (Yucatan), the Rio Grande Valley, Corpus Christi, Houston/Galveston, New Orleans, Mobile, Pensacola, Panama City, Tampa/St. Petersburg, and numerous smaller urban centers. The "well-to-do" of coastal Veracruz, however, retreated to the cooler highlands during summer months (Arreola 1980). During the same time period, railroads were penetrating southward into Florida along
both the Atlantic and Gulf Coasts, and the railroad companies actively built hotels and promoted tourism. An American equivalent of the French Riviera had been discovered, and wealthy residents of the northern states began to frequent Florida during the cold winter months (Nolan 1964).

Urbanization along the exposed shoreline still did not become widespread around the Gulf of Mexico until after 1900, or about at the onset of automobile age. With greater mobility, greater affluence, and a rapidly expanding highway system, human colonization of the Gulf shores began to increase. This pattern was especially pronounced during economic boom times such as the Roaring Twenties, the immediate post-World War II era, and the 1970s and 1980s. Florida has continued to be the most intensely recreationally developed section of the Gulf Coast, in large part because of massive permanent and seasonal in-migration of residents of the northern United States.

The distribution of recreational development along exposed shores of the Gulf of Mexico reveals distinctive physical and cultural patterns (Figure 20). Physically, virtually all shorefront urbanization is found at sandy beaches. Culturally, the developed shorelines reflect the destinations of either winter recreationists (southern Florida) or summer recreationists from proximate urban centers.

Based on field reconnaissance of the entire Gulf shoreline, the eight coastal resorts were selected as representative examples of beachfront development. Recreational development associated with large coastal cities such as St. Petersburg or Veracruz was not examined because beachfront urbanization could be reflective of suburban, rather than
recreational development. Also, modern self-contained resort complexes not associated with specific settlements were omitted from examination. In Florida, shorefront development is most pronounced along the southwest barrier islands and along the northwest barrier coast, and Fort Myers Beach (Estero Island) and Pensacola Beach were chosen as respective representative examples of each. The Alabama coast is recreationally developed both east and west of Mobile Bay. Because Gulf Shores, east of the bay, is similar to the northwest Florida resorts, Dauphin Island was selected for analysis. The Mississippi coast, although it is one of the earliest sites of summer home development in the South and presently highly urbanized, is sheltered from the open Gulf by a chain of
offshore barrier islands and is therefore omitted from this study. In
Louisiana, only Grand Isle qualifies as a significant seaside resort.
Galveston and South Padre Island were selected for the Texas coast,
although Port Aransas (Mustang Island) and the Bolivar Peninsula are old
beach resort destinations. For the Mexico coast, two of the three major
zones of beach recreation—Tecolutla and the north Yucatan coast—were
selected as study areas.

The order of presentation of the following study site analyses was
rationalized on the basis of a combination of chronology and chorology
(Table 1). The earliest documented beach usage was along the northern
Gulf Coast, so Grand Isle and Galveston are discussed first. The remainder
of the U.S. resorts are analyzed next (in the order of the list on Table 1),
and the two Mexican resorts follow.

<table>
<thead>
<tr>
<th>resort</th>
<th>1st documented beach recreation</th>
<th>1st beachfront homes</th>
<th>1st hotel</th>
<th>1st highway or railway access</th>
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<td>ca. 1855</td>
<td>1866</td>
<td>1932</td>
</tr>
<tr>
<td>Galveston</td>
<td>1836</td>
<td>ca. 1875</td>
<td>1882</td>
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<td>1926</td>
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<td>1911</td>
<td>1912</td>
<td>1921</td>
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<tr>
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<td>ca. 1870</td>
<td>1950</td>
<td>1908</td>
<td>1931</td>
</tr>
<tr>
<td>Dauphin Island</td>
<td>ca. 1890</td>
<td>1954</td>
<td>1955</td>
<td>1955</td>
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<td>1861</td>
<td>1857</td>
<td>1941</td>
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</tr>
<tr>
<td>Tecolutla</td>
<td>?</td>
<td>ca. 1945</td>
<td>1949</td>
<td>1944</td>
</tr>
</tbody>
</table>

Table 1. Chronology of recreational usage of the Gulf study sites.
CHAPTER IV. GRAND ISLE, LOUISIANA

Location

Grand Isle is a recreationally developed barrier island situated 50 miles (80 km) due south of New Orleans (Figure 21). Presently one of few seaside resorts in Louisiana, Grand Isle was among the earliest recreational sites to become established directly facing the Gulf of Mexico. Settled since the late 1700s, the island first became touristically

Figure 21. Regional setting of Grand Isle.
developed following the Civil War, and the recreational hinterland was primarily New Orleans. Access was by boat until a highway along Bayou Lafourche was extended to the island in 1932. Today Grand Isle is a popular fishing destination for residents of southeastern Louisiana.

**Physical Environment**

Grand Isle is a 7 mile (11 km) long and 0.5 mile (0.8 km) wide barrier island, flanked on both ends by deep tidal passes (Figure 22). The

![Figure 22. Physical setting of Grand Isle. (1932 base)](image-url)
greater portion of the island consists of a beach ridge plain, backed by frequently inundated saline marshes along the backbarrier. The highest ridges, locally known as cheniers (oak ridges), in the central part of the island, reach 7 feet (2 m) above mean sea level (msl) and are vegetatively stabilized by live oak (*Quercus virginiana*) trees. The southwest end of the island, with elevations of about one to 2 ft (30 to 60 cm) above msl, has historically been subject to extensive overwash activity, and marsh-colonized sand deposits extend across the entire width of the island.

The recurvature of the beach ridges coupled with changes in island position as shown on historic coastal charts indicate that the island has grown from west to east (Conatser 1969), and this has been attributed largely to erosion of a relict deltaic (Bayou Lafourche) headland to the west and subsequent eastward longshore sediment transport (Penland and Boyd 1981). Historically, the highest shoreline erosion rates have been along the western end of Grand Isle, while the eastern end has experienced shoreline accretion. The site of the original settlement is approximately at the nodal point between the erosionary and accretionary shoreline (Figure 23). Longterm rates of about -12 ft/yr (-3.6 m/yr) on the west end) and +12 ft/yr (+3.6 m/yr) on the east end mask shorter term variations in erosion and accretion. Erosion rates may well increase in the future because of higher relative sea level rise (subsidence plus sea level rise) rates, currently estimated to be about 0.5 in/yr, or 1.3 cm/yr (Baumann 1980; and Nummedal 1983).
Pre-Recreation Settlement

The initial Spanish land concessions on Grand Isle and adjacent coastal areas date to the 1760s, and by 1800 small settlements existed on Grand Isle, Cheniere Caminada, and Grand Terre, where the privateer Jean Lafitte made his headquarters (Evans et al. 1979). The local economy of Grand Isle was initially based upon fishing and smuggling, but plantation agriculture (sugarcane) was introduced early in the nineteenth century. In spite of back-levee construction and forced drainage west of the settlement, salinization of groundwater and the periodic ravages by hurricanes soon ended the viability of sugar production. Sea-island cotton supplanted sugarcane as a plantation crop, but by the 1850s, continued
salinization and inundation during storms precluded successful continuation of plantation agriculture.

**Exploration and Initial Recreational Development.**

Summer tourism on Grand Isle dates to the early nineteenth century. Wealthy New Orleanians seeking to escape the sultry, disease- and crime-ridden city at that time generally migrated to the shores of Lake Pontchartrain (particularly the pine-shaded North Shore, where several springs were located), to Shell Beach on Lake Borgne, or to the nearby Mississippi coast. The few visitors to Grand Isle arrived by private vessel and boarded as guests of the local plantation bourgeoisie. By the 1850s, several summer homes had been built, and a small boarding house opened at the larger nearby fishing community of Cheniere Caminada (Evans et al. 1979).

The first hotel on Grand Isle appeared after the Civil War. In 1866, the defunct Barataria Plantation was converted to a tourist facility, with the main sugarhouse becoming the Grand Isle Hotel, and thirty-eight slave shacks transformed into guest cottages (Fig. 24A). Streetcar tracks were laid, and a mule-drawn tram transported visitors from the bayside dock to the hotel and on to the beach, where bathhouses were erected (Evans et al. 1979). Steamship excursions from New Orleans were actively promoted, and twice-weekly service (eight hours of travel each way) was soon available. Several nationally-known writers popularized the island in novels and feature articles (e.g. Cable 1884; Chopin 1899; Hearn 1884; and Hearn 1889), and the late nineteenth century Gilded Age witnessed a
Figure 24. Settlement evolution on Grand Isle, 1877-1983.

significant increase in demand for seashore tourism at Grand Isle (Stielow 1982).

By the early 1890s, travel time from New Orleans to Grand Isle had been halved—to four hours—by construction of the New Orleans, Grand
Isle, and Fort Jackson railroad along the banks of the lower Mississippi River. Summer recreationists were able to travel by train to Myrtle Grove and then transfer to a waiting steamer, which completed the journey. By 1893, two more large hotels had been constructed on the island—including the elaborate 417 ft (127 m) long Ocean View Hotel complete with sixty beachfront changing cabins. Built two blocks from the beach, the contractors for the 160-suite, two-story hotel insisted that "nothing could blow it away" (Evans et al. 1979). At least one other major hotel was under construction, and numerous smaller boarding houses were available for recreationists within the village. Hotel development was also planned for nearby Cheniere Caminada and Grand Terre, site of Fort Livingston and Jean Lafitte’s former headquarters (Stielow 1977).

This phase of initial recreational settlement and rapid development quickly ended with the onslaught of the infamous October 1, 1893 hurricane, which made landfall at Cheniere Caminada. Considered one of the worst hurricanes in U.S. history in terms of loss of life, the Cheniere Caminada storm—ranked as Force 3 on the Saffir-Simpson scale—destroyed that community, taking the lives of 700 inhabitants and leaving only four of 400 structures standing. The storm, which passed on into Mississippi and Alabama, left a total of 2,000 dead (Tannehill 1936). At Grand Isle, however, in spite of a 10 ft (3 m) storm surge, almost all damage was to tourist facilities. All beachfront structures and hotels were destroyed or severely damaged, and twelve hotel employees lost their lives. The village, sheltered by the oak-covered beach ridges, allegedly experienced no deaths and only minor damage (Falls 1893; and Forrest 1893).
Development of Recreational Infrastructure

The legacy of the 1893 hurricane was to postpone major touristic redevelopment of Grand Isle for three decades. Two of the hotels heavily damaged in the 1893 storm reopened within a few years, and entrepreneurs concocted various schemes for promoting the recreational potential of the island in the early twentieth century. These included plans for a monorail to New Orleans, a massive seawall similar to one built at Galveston, and various other beach "improvements" (i.e. protection structures). New Orleans recreationists for the most part stayed away from Grand Isle during this period, however, and virtually no shorefront development took place. Major hurricanes in 1909 and 1915 struck Grand Isle and destroyed the two hotels surviving from the pre-1893 era. The prevailing negative image of Grand Isle among New Orleanians was reinforced by these two storms (Stielow 1977).

By the 1920s, economic boom years for America as a whole, the stigma of the hurricane had lifted, and Grand Isle experienced a resurgence of recreation. The first beachfront cottages since the 1890s were built, gambling was widespread in numerous clubs, and in 1926 the Grand Isle Tarpon Rodeo (allegedly America's oldest organized fishing tournament) was established. The Roaring Twenties saw Grand Isle headed for rapid expansion of tourism, but the stock market crash of 1929 and ensuring economic depression curtailed this second incipient boom.

In spite of a temporary setback, the Depression proved to be the catalyst for future development. First, the depressed economy forced many islanders to sell their landholdings to real estate developers, some
of whom were envisioning a new Palm Springs or French Riviera. Fifteen hundred acres (610 ha) flanking the village were subdivided and a crude street network laid out (Figure 24B). Second, two beachfront hotels were constructed in the early 1930s: the Oleander Hotel fronting the village core and the Grand Isle Inn at the east end near the main dock where tourists disembarked. Third, a highway to the island was completed in 1932. This facilitated beach access and expanded the recreational hinterland, which presently conforms to predictive recreational gravity models (Fournier 1984). Beachfront cottage construction began again on Grand Isle, and even Cheniere Caminada—virtually abandoned since the 1893 storm—was rejuvenated as a settlement. The depressed 1930s and a world war delayed an anticipated summer home construction boom until the mid-1940s.

**Settlement Expansion**

Rapid development of a recreational landscape occurred following World War II. Half of the prewar subdivided lots were developed by 1950 (Stielow 1977), and three hotels and numerous rental cabins comprised the extent of the lodging facilities. A Grand Isle information center was set up in New Orleans' French Quarter, the remaining free-ranging cattle were removed from the island, and lobbying for a state park began. Summer homes, ranging from elegant stilt houses to shacks, soon proliferated along the beachfront and in the western half (between the access highway and the village core), and an offshore oil industry support base was established in the eastern backbarrier wetlands (Fig. 24C). A strip of tourism-related businesses appeared along the main coastal highway, especially fronting the town core, and this incipient RBD
became the focus of recreational activity. Tourism on Grand Isle was at its peak as weekend visitors numbered as high as 10,000 (Stielow 1977). Although a large proportion of the recreational development was by seasonal or weekend residents, the permanent population of Grand Isle also increased rapidly in the postwar years, to over 2,000 by 1960 (Figure 25).

Figure 25. Change in resident population of Grand Isle, 1810-1980.

By about 1960, the postwar development boom showed signs of slowing. This is attributed to several factors, including the increasingly ramshackle appearance of recreational housing on the island (due mainly to an absence of zoning restrictions), accelerated beachfront deterioration resulting from a combination of storm passages and futile efforts at shoreline stabilization, and improved access to the more attractive beaches of Mississippi, Alabama, and the Florida panhandle (Hubbert
Although camp construction remained popular with fishing enthusiasts, the beach recreationists shifted their attentions elsewhere. Following incorporation in 1959 and water and gas hookups a few years later, a comprehensive landuse plan was commissioned (Carter-Horan and Chapin 1962-3). Extensive landuse controls and implementation of a comprehensive erosion control program were recommended to maintain the viability of tourism. But little came of these suggestions, and as the beach continued to shrink, piecemeal beach renourishing and private bulkheading along the shorefront continued.

In 1965, Hurricane Betsy (Force 3) struck the Louisiana coast, making landfall at Grand Isle. Accompanied by a 9 ft (2.7 m) storm surge, the hurricane caused destruction estimated at 85% island-wide (100% at the washover-prone west end) and left 750 residents homeless (USACE 1966). The beach was eroded as far inland as the coastal highway, and the RBD was effectively destroyed. Although many residents moved "up the bayou" after Betsy, the hurricane provided the "facelift" necessary to revitalize the resort and stimulated lobbying for federal involvement in erosion control efforts (Cook 1966). The RBD was redeveloped in situ with modern motels and stores, fancier summer homes were built with subsidized disaster-relief loans, and the beach was renourished with sand that had accreted against a recently-completed east jetty. The following summer witnessed record tourism (Conaway 1966).

By the early 1970s, however, the post-Betsy boom had passed. The 1970 census showed a slight gain in population, but the rate of growth did not approach the projections made by the planners (Carter-Horan and Chapin 1962-3). The post-storm landuse upgrading was only partly
realized, as many mobile homes that were introduced as temporary relief shelters quickly became permanent fixtures (many elevated upon stilts). Minimal zoning guidelines encouraged a wide spectrum of summer homes, from primitive to fancy, to be built. In face of continued erosion, beach stabilization efforts proved shortlived, and the aesthetic deterioration of the beachfront continued.

From about 1970 until the early 1980s, Grand Isle slipped into a "recreational stagnation" phase. The beachfront continued to seriously erode, and numerous homes fell as victims to the sea. Growth slowed dramatically—the permanent population was decreasing as were rates of summer home construction. Fishing remained a strong drawing card for the island, however, and camp construction continued, mainly at the west end (Figure 24D). Records from the Grand Isle State Park at the east end also indicated a gradual decline in visitors since the mid-1970s (Office of State Parks 1984).

**Landuse Intensification**

Unlike other Gulf Coast resorts, Grand Isle has not been subjected to extensive construction of multi-unit recreational housing. In addition to one condominium/marina complex (twenty units) constructed adjacent to the U.S. Coast Guard station at the east end in 1980, an existing east end motel was converted to a condominium in 1985. Empty "dry" land for new development still exists on the island, although much of it is owned by various industries located at the east end. Plans have also been drawn up to convert the remaining backbarrier wetlands, including the site of the former Grand Isle Hotel, into a major 150 acre (61 ha) development
project complete with hotels, multi-unit townhouses, and residential canal subdivisions. At present it appears doubtful that the requisite wetlands impact permits can be obtained.

**Morphologic Aspects of Resort Development**

The morphologic evolution of Grand Isle as a recreational settlement has been somewhat skewed because of: 1) a pre-existing settlement in the center of the island, 2) a devastating 1693 hurricane, 3) changing loci of tourist arrivals, and 4) reduced recreational demand resulting from deterioration of the physical resource base. The original settlement was nestled among the oak-covered beach ridges and access was via the tidal channels in the backbay. With the onset of tourism, the beach and surf zone became the major attractions, but initial post-Civil War recreational development was confined to the core and flanks of the central village. Except for bathhouses, major construction along the shorefront did not take place until the early 1890s, when recreational development was in full swing.

The late nineteenth century settlement patterns reflected a shift away from the village proper, toward the beachfront and the adjacent non-forested beach ridge plain. The first hotel (the Grand Isle Hotel) was situated almost 0.5 miles (0.8 km) from the beach, at a site in both visual and olfactory contact with the seashore. The later hotels were built increasingly closer to the shorefront, as were the bathhouses and several summer cottages. In a sense, an awareness of storm surge potential persisted during this era, as hotels and beach cottages were occupied only during the summer season. The tourist season ended on about September
1, a date which according to popular perception marked the onset of hurricane season (Evans et al. 1979). Even the 1893 hurricane, which put a halt to incipient Gilded Age recreational development, made landfall on October 1, and no recreationists were known to be on the island at the time (Evans et al. 1979).

The second phase of infrastructural development began in the latter 1920s, and the Grand Isle Inn was built close to the main boat landing at the east end. Limited summer home construction, both fronting the village and between the village and the boat landing, took place in the years just prior to highway opening. When the road reached Grand Isle in the early 1930s, via Cheniere Caminada, the locus of recreational settlement shifted toward the west side of the village. The core of the RBD remained closest to the center of town, however. With the availability of lots in beach subdivisions on both sides of the town, the recreational infrastructure was essentially complete. As the lots were bought and developed, the patterns of recreational settlement consisted of: 1) a line of summer homes along the beachfront, 2) developing beach subdivisions at the west end of the island, and 3) sparse settlement at the east end (a pattern that became reinforced after the oil industry acquired much of the east end in the mid-1950s).

The present pattern of land use essentially represents an infilling of a settlement infrastructure laid out over fifty years ago coupled with the industrial zone established over thirty years ago (see Figure 24D). Single-family residential sectors include the higher-elevation original town core and the lower-elevation west end beach subdivisions (Plate 1). At the
east end, most land is industrially-owned although most development has been on the backbarrier, along the dredged navigation channel. Public land consists of municipal government properties plus the two spits which are state property. The accreted spit on the east end is the site of the Grand Isle State Park, inland of which is where recent modern condominium, marina, and other residential development has taken place. Vacant lands include the central and western backbarrier marshes, some of are impounded and formerly contained commercial turtle ponds. The non-impounded marshes and low beach ridges west of the original village comprise the area for which development plans have been drawn up, although federal permits for wetlands modification may not be granted.
**Human Interaction with the Physical Environment**

The original pattern of settlement at Grand Isle reflected human adjustment to periodic storms and shoreline erosion. The village was sited amidst the higher beach ridges, and most of the few dispersed plantations were situated away from the beach. The protection value of the ridges was recognized, and not only was it forbidden to cut the oaks that grew on them, but also seedlings were actively planted (Stielow 1977). Houses were built with shipped-in cypress, and floor elevations were 2 to 3 ft (60-90 cm) above ground level. (These levels gradually rose with successive storms.) Driftwood was left in situ on the beach as an erosion retardant, and only small amounts were gathered to meet basic fuel requirements. The outward focus of the village and plantations was toward the back bay, where the boat docks were located and levees and drainage ditches were constructed to minimize bayside flooding (Evans et al. 1979). Even severe storms, such as the 1893 Cheniere Caminada hurricane, caused relatively little damage within the central village on Grand Isle.

Once recreational development began on Grand Isle, human interactions with the physical environment began to change. The first infrastructural development took place outside of the oak-sheltered village and was thus more exposed to wind and high waves. Initially, proximity to the shore was avoided except for day use purposes, and the Grand Isle Hotel was situated away from the shoreline. The protection value of the beach ridges and driftwood was still recognized, although increasing amounts of driftwood were gathered to supply the hotels' rising fuel needs (Cole 1892). Also, the summer tourism season ended prior to
onset of the hurricane season. By 1893, recreational development had moved closer to the beach, as epitomized by the grandiose Ocean View Hotel, which was in business for only one summer season. All development that had taken place outside of the village proper on Grand Isle—exclusively recreational development—was effectively destroyed by the 1893 storm. In spite of promoters' plans for armoring the shoreline, tourists avoided Grand Isle for the next three decades, and recreational development levels remained low.

The post-1932 resurgence of tourism on Grand Isle was accompanied by a renewed focus upon the shorefront and empty lands flanking the village, where lots were now available. The now-unsightly driftwood was piled up and burned. In the interests of tourism, "beach maintenance" subsequently became a town responsibility. Beach ridges in the recreational subdivisions were levelled to provide more homesites and also a better view of the sea (Conatser 1969). It was soon noticed that shoreline erosion was increasingly severe, and lobbying for erosion protection began. A survey by the federal Beach Erosion Board (1937) concluded that only a seawall would insure total protection, but even the fallback choice—a groin field—was deemed not economically justifiable.

As shoreline erosion rates increased beginning in the 1930s, at least partly as a result of driftwood removal, federal and state engineers were more frequently called upon to provide solutions. In 1951, as the coastal highway began to be threatened by an advancing gulf, the state authorized construction of two sets of wooden groins: four groins 500 feet (150 m) long near the western end and ten groins, four of 500 ft (150 m) lengths and six of 250 ft (75 m) lengths, near the central part of the island.
(see Figure 24C). The net effect of the groin emplacement was an increase in downdrift erosion, especially at the western groin field, where retreat rates approached 100 ft/yr (30 m/yr) (Kohlmann 1955). To restore the eroding beach, 1,150,000 yds³ (867,000 m³) of fill material was dredged from the bays north of Grand Isle, but a third of this was rapidly lost to the offshore (USACE 1972). Between the incompatible grain sizes and passage of Hurricane Flossy in 1956, the nourishment material was scoured out. Flossy, only a Force 2 storm but the first major hurricane since 1915, destroyed the Grand Isle Inn and numerous summer homes (USACE 1972). A fifteenth groin was constructed east of the central groin field by Humble Oil Company after the storm, but it too was ineffective in trapping significant amounts of sand. To provide a ready source of fill material as well as to (hopefully) offset the beach erosion trend, a 935 ft (284 m) long jetty, later extended seaward by 400 feet (122 m) was constructed at the extreme east end of the island beginning in 1957 (Myers 1959). This proved to be successful in regard to the first objective, as over 1,000,000 yd³ (754,000 m³) of sand accreted within four years. Much of the accreted sand was excavated to nourish Grand Isle’s beaches following Hurricane Betsy in 1965, and in the early 1970s, the state park was established at the site. The benefits of accretion did not extend to the eastern or central portions of the island, however, and various erosion control measures, such as sand-filled tubes placed in the shallow nearshore zone, were experimented with during the mid-1970s (Dement 1977) (Plate 2).

In the late 1970s, a fifteen million dollar U.S. Army Corps of Engineers project to construct an 11.5 ft (3.5 m) high, vegetatively-stabilized
artificial dune, fronted by a graded 225 ft (68 m) wide beach was authorized (USACE 1978), but various delays postponed onset of construction until 1984. The project, finished in late 1984, utilized sand dredged from offshore, provided storm protection to the island and also created a beach attractive to recreationists (Plate 3).

Unfortunately, 1985 saw the arrival of three hurricanes (all essentially Force 1 hurricanes along the Louisiana coast), which removed much of the newly-placed beach fill. Hurricane Juan, with a storm surge sustained for almost one week, removed about 2 miles (3 km) of the sand levee as well. Although serious damage to structures on the island was averted, the expected rejuvenation of Grand Isle as a tourist resort was
put on hold. The U.S. Army Corps of Engineers plans to rebuild the
damaged sand levee and restore the beach during the summer of 1987,
utilizing sand excavated from the accreting spit east of the jetty.

Plate 3. Grand Isle shorefront after construction of artificial dune,
1985. (location approximately same as Plate 2)

Future Trends

In view of Grand Isle's precarious location in a rapidly-subsiding
transgressive deltaic environment and its poor accessibility from Louisi­
ana's major urban areas, it is doubtful that significant future recreational
development will occur. Although the new protection levee minimized
damages to private property during the hurricane season of 1985, the
longterm effectiveness of such a project remains questionable. Aesthetic
degradation of the shorefront, caused in part by structural modifications
(e.g. groins), has caused a diversion of beach recreationists to the less-damaged, cleaner, coarser, and whiter beaches of Alabama and Florida. In spite of the environmental degradation, however, the fishing remains good, and Grand Isle will undoubtably persevere as one of the top fishing resorts of the Gulf Coast.
CHAPTER V. GALVESTON ISLAND, TEXAS

Location

Galveston Island is a 30 mile (48 km) long barrier island situated 50 miles (80 km) south of downtown Houston (Figure 26). Permanently
settled since the 1830s, the island has been connected to the mainland since 1853. Although the city of Galveston was established as a commercial port, its location on the Gulf made it attractive as a recreation destination. Since the 1880s, Galveston has been a seaside resort, and this role has been maintained into the present-day as a result of the island's proximity to Houston, to which it is now linked by an interstate expressway. Highways extend the length of the island, and a toll bridge over San Luis Pass connects Galveston with Follett's Island. A ferry links Galveston with Bolivar Peninsula, location of numerous recreational settlements such as Crystal Beach, which serves as the primary beach destination for a recreational hinterland comprising Beaumont, Orange, and Port Arthur. Galveston's recreational hinterland is dominantly metropolitan Houston.

**Physical Environment**

Galveston Island is a regressive Holocene barrier island (Bernard et al. 1970). A transect across the island (Figure 27) crosses four major zones: the beach, a beach ridge zone comprised ridges often separated by marshy swales, a barren wind-tidal flat, and a backbarrier marsh. Primary sand dunes (or foredunes) are found inland and adjacent to the beaches, which average between 100 and 200 feet (30 and 60 m) wide. Dunes formerly ranged in height from 12 feet (3.6 m) at the eastern end of the island to between 5 and 8 feet (1.5 and 2.4 m) along the central and western portions. The zone of beach ridges is widest and highest (about 10 feet [3 m] above sea level) at the central and eastern portions of the island, and live oak trees (*Quercus virginiana*) colonize the higher ridges. The western half of the island has few beach ridges, and the far western segment is characterized by vegetated washover fans. Along much of the
island, a narrow wind-tidal flat represents a transition between the higher-elevation beach ridge/barrier flat zone and the frequently inundated marsh wetlands. This "flat" is also periodically inundated, primarily during winter cold fronts, and during extended dry periods a salt crust forms at the surface. The shallow waters of West Bay contain numerous patches of submerged grasses and many natural oyster reefs.

In conjunction with the seaward growth of Galveston Island, longshore sediment drift has accounted for a westward growth of the island (Bernard et al. 1970). Longshore currents trend northeast-to-southwest along Galveston, with localized reversal noted in the vicinity of
Bolivar Roads, the tidal channel. Longshore sediment transport has been estimated as averaging 50,000 yd$^3$/yr (36,000 m$^3$/yr) (USACE 1985). During most of the nineteenth century, the east end of the island was characterized by steady erosion, although this trend has been reversed since jetty construction began in the late 1800s (Morton 1974). The western half of the island has experienced a net longterm erosion, on the order of one to 2 ft/yr (30 to 60 cm/yr) between 1851 and 1973 (Morton and Paine 1985). Locally, however, there has been great variability in shoreline changes, and the highest rates presently are found west of the Galveston seawall and at the west end adjacent to San Luis Pass (Benton and Bolleter 1984).

Pre-Recreation Settlement

In 1528, Cabeza de Vaca, reconnoitering the Gulf of Mexico for Spain, was shipwrecked on a Texas island he named Isla Malhado, or "Isle of Misfortune", which is presumed to have been Galveston Island. De Vaca wrote of hostile Indians he had encountered, most likely the allegedly cannibalistic Karankawas. Archeological evidence bears out the aboriginal usage of the island, but no evidence of permanent habitation was found (McComb 1986). Following its initial discovery, the island soon collected a variety of names, including San Luis, Isla de Aranjuez (a royal resort in Spain), and Isla de las Culebras. A 1785-86 survey named the large bay Galvez, a name which in 1836 became applied to the island (WPA 1940). Galveston Island was first settled by the privateer Louis Aury in 1816 who claimed "Snake Island" for the fledgling republic of Mexico. The tiny pirate settlement was located on a beach ridge on the bay side of the northwest tip of the island, near a navigable tidal channel. The following
year, Jean Lafitte established his own pirate settlement of Campeche (anglicized to Campeachy) on the site abandoned by Aury, who had gone off to Mexico. This slave trade settlement, numbering up to 1,000 inhabitants at its peak, was soon destroyed by a hurricane in 1818. Although rebuilt, Campeachy was ordered burned by the departing Lafitte following a confrontation with U.S. authorities in 1821 (WPA 1940). In 1825, the island was designated a Mexican port of entry, and a custom-house was established in 1830. The Texas War of Independence quickly ended Mexican sovereignty in the area, however (McComb 1986).

Just prior to relinquishment of its Texas claims, Mexico had awarded a land grant of "a league and labor of land" (about 4,605 acres, or 1,872 hectares) to Michel Menard. The 1833 land grant was accepted as proper title by the Republic of Texas in 1836, and Menard and his associates, operating as the Galveston City Company, proceeded to survey and subdivide the land into lots. Although the entire tract was platted (Groesbeeck 1836), the core of settlement was slightly east of the old Campeachy (renamed Saccarappa by immigrants from Maine), at a site where the tidal channel directly bordered on the beach ridge plain (i.e. a backbarrier strand) (Figure 26A). Except for a few homesteaders, the remainder of Galveston Island remained uninhabited. A small cotton-press settlement--San Luis--developed on nearby Follett's Island in 183, but a hurricane in 1837 and subsequent shoaling of San Luis Pass forced the abandonment of this settlement, the remaining structures of which were removed to Galveston (Hayes 1879).

The port of Galveston soon boomed as the major commercial entrepôt for Texas, and the first railroad bridge to the mainland was
Figure 28. Settlement evolution.
completed in 1860. Galveston became a major cotton-pressing and cotton-shipping port, a role that persisted into the early twentieth century, by which time the rival Houston had surpassed the island city. Numerous books (e.g. Hayes 1879; and McComb 1966) detail the fascinating history of Galveston, but because of the peripheral importance of much of this history, only aspects relevant to this study are included herein.

**Exploration and Initial Recreational Development**

Although the primary function of Galveston was commerce, a secondary, latent role was that of seaside resort. The original plat of the city (Groesbeeck 1836) shows a Bath Avenue extending from the downtown courthouse south to the Gulf beach. However, no road was built until after the Civil War, when sea-bathing became increasingly popular. By 1877, as urban development was slowly expanding toward the Gulf, a streetcar line was extended to the beach (McComb 1966). A major dance pavilion was built on the beach by the trolley company in 1881 (only to burn in 1883), and a three-story, 200-room Beach Hotel was constructed in 1883. Restaurants soon began to "cluster about the Beach Hotel like flies about a barrel of New Orleans sugar" (anon. 1896), and bathhouses were built on stilts extending out over the water. The hotel was apparently only profitable when the railroads offered cut-rate fares, and in 1898 it burned to the ground under mysterious circumstances (McComb 1966). Nonetheless, a recreational business district developed along the beachfront, at the site first outlined in the original 1838 city plan.

Galveston Island west of the city had been settled by homesteaders since the late 1830s (Figure 28A). The first "beach restaurant" was a
homestead located slightly more than halfway from the city to San Luis Pass. Stagecoaches travelling the beach enroute to points west stopped at this "Halfway House" for lunch during the 1850s (Grover 1950). A ferry was operative at San Luis Pass during the stagecoach period, and in 1879 a U.S. Coast Guard life saving station was built nearby (Grover 1950). The station monitored at-sea disasters, however, and no beach recreation was noted here. In 1883, construction was begun on a narrow-gauge railroad that was to run the length of the island, but only 13 miles (21 km) of track were laid. The tracks ended at Lafitte's Grove, a clump of oaks where Jean Lafitte allegedly fought and won a battle with Karankawa Indians. Near the railroad terminus, a planned settlement—South Galveston—was platted in 1889 (Figure 26B). A second settlement—Nottingham—was planned around a factory that produced lace from Texas cotton. The factory operated for several years, but the settlement venture failed (Grover 1950). The only profit the railroad made was from transporting picnickers to Lafitte's Grove, which became a major excursion destination, and hauling sand back to the city for fill purposes (McComb 1986).

In September 1900, Galveston was struck by a Force 3 (almost Force 4) hurricane characterized by 120 mph (192 kph) winds and a storm surge of 14.5 ft (4.4 m) (USACE 1979). Of a population of 38,000, 12,000 fled the island and thousands more sought shelter in the center of the city (USACE 1979). Still, over 6,000 lost their lives (Weems 1957). All structures within 0.5 miles (0.8 km) of the beach were completely demolished, and destruction would have been even worse had it not been for a "debris line" of timber planks that afforded protection to the rest of
the city. Beach erosion approached 300 feet (90 m) at the easternmost corner of the city, and about 150 feet (45 m) in the vicinity of the former Beach Hotel. Unlike at Grand Isle, where the 1893 storm effectively ended incipient recreational development for three decades, a commitment was made to preserve the commercial vitality of Galveston by building a seawall and raising the grade of the city. By 1905, 4.25 miles (6.8 km) of a 17 ft (5.2 m) high seawall had been completed (USACE 1981) (Figure 26B).

**Development of Recreational Infrastructure**

With the construction of the seawall, grade-raising of most of the city, reconstruction of the causeway to the mainland, and the onset of the automobile age, Galveston was again ready to resume its status as a beach resort. The new seawall not only afforded the city protection from storms, but it also provided a beach promenade, similar in style to the European resorts. A strip quickly became re-established, and bathhouses and fishing piers were soon built out over the Gulf in front of the seawall. A beach of perhaps 150 ft (45 m) width remained in front of the seawall, although this was to rapidly decrease in ensuing years. In 1911, a seawall drive was opened to automobiles, and a second beachfront hotel—the 200-room Galvez—was built in the RBD. When a new causeway to the mainland finally opened in 1912, a recreation boom began, one that lasted throughout the Roaring Twenties.

**Settlement Expansion**

From the RBD nucleus, recreational development spread laterally along the seawall. Recreational development consisted primarily of
beach-oriented commercial development (amusements, restaurants, lodging facilities, etc.), and except for fishing piers and bathhouses, this development remained confined to behind the seawall. Beach cottages, however, were uncharacteristic of recreational development on the island. In front of the seawall, the beach gradually narrowed, especially following the 1915 hurricane, and the seawall-fronting beaches became more intensively recreationally utilized. East Beach, steadily accreting because of the jetty, became the most frequented bathing beach, particularly the nearest section (Stewart Beach) where a secondary RBD evolved. West Beach became popular for beach driving, and ramps were built to allow access from the seawall boulevard.

Beginning in the 1920s, the urbanized area of Galveston began filling in within the city limits and expansion toward the west also began. Although most of this growth reflected non-recreational urban expansion, the beachfront west of the seawall became occupied by tourist courts and restaurants. By 1930, several extensions to the original seawall had been made (Figure 28C). The first, completed in 1926, extended the seawall eastward to the jetty to minimize any chance for island breaching and a second extension, finished in 1927, pushed the western terminus past Fort Crockett to just beyond the city limits (USACE 1981a). By 1933, a commercial strip extended laterally along the seawall, with an RBD centered at the Gulf terminus of the old Bath Avenue (25th Street). Two other large beachfront hotels had joined the Galvez by 1933, and a sand-trapping groin, a bathhouse, and a fishing pier all protruded into the Gulf at the RBD (see Figure 28C).
Prior to the 1930s, little summer home construction characterized recreational development on Galveston Island. Numerous isolated homesteads dotted the island west of the city, some of which were used as seasonal residences, and a road had replaced the pre-1900 railroad that ran to Lafitte’s Grove. This road extended 13 miles (21 km) west of city limits and ended on the beach, from whence one could drive on the beach to San Luis Pass or back to town. Motor-touring became popular, but although several roadhouses were built to serve meals to motorists (Grover 1950), beach cottage construction was relatively insignificant.

Summer home subdivisions, although promoted as early as the 1930s, were not developed until the latter 1950s. In 1932, partly in anticipation of completion of the “Hug-the-Coast Highway” from Louisiana to Mexico, a West Beach Addition was advertising 30 by 80 ft (9 by 24 m) “campsite” lots for thirty dollars (anon. 1932). One camp was constructed, but the Depression postponed this incipient trend. Twenty years later, a group of Houston speculators reintroduced the beach subdivision concept (anon. 1970b), and by 1956 (Figure 28D), two subdivisions (Bay Harbor and Sea Isle) were under construction. A line of homes occupied the beachfront of the old Nottingham property, and this development was later absorbed within the Bermuda Beach subdivision (Johnston 1963).

When Hurricane Carla struck the island in 1961, four beach subdivisions with a total of about 200 vacation homes occupied western Galveston Island (the West End). Although severe beach erosion resulted from the storm and several homes were destroyed, the storm stimulated a major development boom (Feinman 1986, pers. comm.). Reasons for this boom include: 1) public perception that another 100-year hurricane won’t
strike for a while, 2) publicity generated by the storm focused attention upon the incipient recreational development on Galveston Island, and 3) in spite of the severity of the storm, summer homes, especially those away from the shoreline, weathered the hurricane relatively well. By 1963, over 300 additional vacation homes had been built, and six subdivisions existed (Johnston 1963). Two more subdivisions began construction the following year, and by 1969, a total of fifteen subdivisions—covering 6200 acres (2520 ha) were optioned or under construction (anon. 1969). Many of these subdivisions stretched from Gulf to backbay, and the ones that were developed in the 1960s commonly consisted of a combination of beach-focused housing and residential canal waterfront lots in the backbarrier marsh zone (Plate 4).

Plate 4. Jamaica Beach, west end of Galveston Island.
Many of the properties bought for subdivision in the 1960s were bought on speculation and in many cases did not begin development until the late 1970s and early 1980s. The 1960s summer home boom slowed in the early 1970s, but an upsurge in construction began in the late 1970s and early 1980s (Feinman 1966, pers. comm.). This upsurge is attributed to a combination of a booming oil-based Houston economy, which stimulated recreational demand as well as investment opportunities, and various local, state, and federal development incentives. In 1975, the remainder of the island was annexed by the city of Galveston (save for a few previously incorporated subdivisions such as Jamaica Beach), which subsequently initiated a "long-range development plan" that included comprehensive sewage treatment facilities for all West End subdivisions (Carter and Burgess 1986). Between 1956 and 1984, several summer home subdivisions were built in West Galveston (Figure 28E).

**Landuse Intensification**

The intensification of recreational landuse on Galveston has entailed both condominium and hotel development along the city's beachfront, behind the seawall and in front of it. In response to post-World War II westward urban expansion, the U.S. Army Corps of Engineers authorized extension of the seawall 3 miles (4.8 km) beyond 61st Street. Completed in 1963, this extension presently protects the area of most intensive condominium and hotel construction on the island. In 1984, one condominium complex was constructed immediately downdrift of the seawall terminus, site of the highest shoreline erosion rates on the island! East of, and contiguous to, this locus of multi-unit construction, is the former Ft. Crockett property, which became partly filled in with
condominiums and high-rise hotels in the early 1980s. A second major locus of hotel/condominium construction is East Beach, the zone of accretion in front of the seawall. Three major structures presently line the beachfront, and plans call for development of the entire area (Carter and Burgess 1986). The west end of Galveston, site of numerous single-family home subdivisions, contains only one condominium complex at present, although further multi-unit development is planned.

**Morphologic Aspects of Resort Development**

Galveston Island's resort morphology reflects the influence of a large, backbay-focused commercial port. The initial locus of settlement in the 1830s and 1840s had become transformed into a central business district (CBD) by the 1860s, and residential neighborhoods surrounded this urban core on three sides. An industrial zone, comprised of both port and railroad infrastructure, soon flanked The Strand along the backbay littoral. The highest-elevation beach ridge, about 8 feet (2.4 m) above sea level and approximately halfway between the backbay and the Gulf) was platted as Broadway, the elite residential corridor of the island. In spite of the rapid growth of the city, no development took place directly on the coast until the 1870s (Hayes 1879).

In addition to Broadway as a major east-west corridor through the city, Bath Avenue (25th St. or Rosenberg Blvd.) took on the function of the major north-south corridor that connected the CBD with the beach. A four or five block stretch at the gulf terminus of Bath Avenue became Galveston's recreational business district (RBD) in the 1880s, stimulated in large part by a local railway's construction of both a trolley line to the
beach and also the Electric Pavilion, an immense dance hall and Texas' first electrified structure (McComb 1986). This beachfront zone became the locus of bathhouse and beach hotel construction and has remained the heart of Galveston's RBD ever since (Figure 29, and Plate 5).

With erosion of the natural recreational resource base (the beach fronting the seawall), the locus of sea-bathing shifted to the next closest beach—the accreting East Beach about fifteen blocks away. Since the late 1910s and early 1920s, this area (Stewart Beach) has developed into a secondary RBD, replete with amusement facilities and eating/drinking establishments. Behind the seawall, less ostentatious lodging facilities (initially tourist courts, later motels) were constructed.
A tourism-oriented commercial strip today lines the Galveston seawall from 61st Street, the closest beach access point upon arrival from Houston, eastward to Stewart Beach. The densest development is still closest to the original recreational core, but lateral expansion has led to the evolution of an RBD strip. With a promenade on the waterfront side of Seawall Blvd. and commercial businesses confined to the inland side, the morphology of the RBD is similar to many European beach resorts (Pearce 1978, and Stansfield 1971).

Recreational development along the seawall is confined to within one block of Seawall Blvd. Beyond that lies the non-recreational, urban
area of Galveston. This pattern of a narrow recreational corridor along the beachfront has remained in place up to the present-day, with the notable exception of the West End. When Galveston’s urban growth began a westward expansion following World War II, the beachfront west of the seawall was characterized by low-density recreational development. With completion of the western seawall extension in 1963, a large area of prime shorefront property became valuable for development, and this has become the prime condominium zone of the island today. East Beach, east of Stewart Beach, is a secondary zone of condominium/hotel development, in spite of its exposed location seaward of the seawall.

Although summer estates of the wealthy have dotted both the city and the West End of Galveston since settlement began (Hayes 1879), the summer home subdivision phenomenon is only thirty years old on the island. Beach subdivisions are confined to Galveston’s West End, where they are gradually displacing the remaining cattle ranch homesteads.

**Human Interaction with the Physical Environment**

The primary impacts that humans have had upon the physical environment of Galveston and vicinity are best summarized under five basic categories: 1) harbor and navigation channel improvements, 2) landfilling of low-lying areas, 3) shoreline erosion control, including seawall construction and grade-raising in response to the 1900 hurricane, 4) enlargement and maintenance of the seawall, 5) recreational impacts, including residential canal development and beachfront modifications.

Harbor and navigation channel improvements include reclamation of tidal flats out to the tidal channels, construction of the jetty system, and
continuous maintenance dredging of the navigation channel. The tidal flats were sold as "wharf privileges" by the Galveston City Company as early as the 1840s, but the modern harbor morphology was not completely in place until the early 1900s (McComb 1986). The use of jetties to deepen the channel depth over the ebb-tidal delta (i.e. the "sandbar") has existed at Galveston since 1871, when rows of cedar piles were driven into shallow water off of the eastern point. Within two years, water depth over the bar had increased from 8 to 12 feet (2.4 to 3.6 m) and 500 acres (200 ha) of sand had accreted at the east end (McComb 1986). The desired bar depth increased with time, and more elaborate jetties were constructed. Sand-filled gabions (cylindrical, cage-like structures of woven wicker, covered inside and out with hydraulic cement) were used for channel training in the mid-1870s, but they did not withstand severe storms (Alperin 1977). The accreted sand at the east end soon eroded away. Construction of the modern jetties was begun in 1880 and finally completed in 1910, and by the 1890s, the trend of east end beach erosion had again reversed to accretion (Morton 1974). The entire area known as the East End Flats, seaward of the present seawall, has accreted since the 2.5 mile (4 km) long South Jetty was built. (This accreted land, originally public property, was auctioned off to private individuals, and is presently slated for extensive recreational development.) Additional harbor and navigation modifications include: 1) filling of the old military property (Ft. San Jacinto) behind the seawall with dredge spoil, and 2) the creation of Pelican Island by the construction of a retaining "channel dike" (see Figure 28B) and subsequent dredge spoil disposal behind it.
Land-filling of low-lying city property was an ongoing process from the time of the city's foundation until the Great Hurricane of 1900. Following inundation of the settlement during an 1837 hurricane, it was recommended that a rail line be constructed down Bath Ave. to the Gulf to bring in sand and shell to fill low areas of town (Hayes 1879). Although the rail line was not built, sand was brought in to raise the level of the Strand by 6 to 8 feet (1.8 to 2.4 m) (Hayes 1879). The use of sand from the beach and dunes to fill the city occurred throughout the nineteenth century. Whereas dunes 10 to 12 ft (3 to 3.6 m) high once protected the city, by 1875 the dunes had been "fairly well leveled" (McComb 1986). When the 1875 hurricane destroyed most of the poorer neighborhoods at the east end of the city (Hayes 1879), the city prohibited the practice of dune removal, and sand-trapping salt cedars were planted to rebuild the dunes (McComb 1986). By the 1880s, in spite of a trend of steady erosion (Washington 1938), the idea of mining of dunes for fill was revived (anon. 1887a). As an alternate source of sand, the beach ridges west of the city were mined, and this was facilitated by the construction of the railroad to Lafitte's Grove (Grover 1950).

Concern over shoreline erosion dates to the 1875 hurricane. Not only was the value of sand dunes recognized as a consequence of this storm, but this was also the time that the beaches were increasingly used by bathers. By 1890, some private bulkheads had been constructed, and four 300 ft (91 m) long rock-and-timber groins were built by the city in 1892 and 1893 (Washington 1938). Their effectiveness was questionable, however, and at the Beach Hotel, erosion was measured at 25 ft/yr (7.6 m/yr) between 1893 and 1899 (Washington 1938). The Beach Hotel
erected bulkheads around its property in an attempt to minimize beach loss (anon. 1897). The navigation jetties, while acknowledged as having reversed erosion east of about 6th St., were also blamed on increasing erosion west of that point (anon. 1897). Nineteenth century concerns with beach erosion came to an end with the 1900 hurricane.

After the disastrous storm, which caused shoreline retreat of between 150 and 300 feet (45 and 90 m), the commitment was made to substantially defend the city against future "overflows", and 4.25 miles (6.8 km) of a 17 ft (5.2 m) high seawall was completed by 1905. To strengthen the wall and provide for better drainage, it was decided to raise the grade of the city to slope from the height of the seawall to the backbay. Completed in 1910, this task required the dredging of a canal throughout the city to enable a hopper dredge to bring in 11,000,000 yds$^3$ (8,300,000 m$^3$) of sand to be piped underneath the jacked-up houses (McComb 1986). Approximately 3,000,000 yds$^3$ (2,300,000 m$^3$) of sand were excavated from a borrow pit in the East End flats, and the remainder was dredged from Bolivar Roads (USACE 1981a). During the 1915 hurricane, one as severe as the 1900 hurricane with a 14 ft (4.3 m) high storm surge, the seawall survived the storm quite well and kept deaths and destruction in the city to a minimum. Minor modifications to the seawall crest were made, and in the following decades, several extensions were made, notably east to the South Jetty through the borrow pit of the East End flats by 1926, west to 61st Street by 1927, and 3 miles (4.8 km) beyond 61st Street by 1963 (USACE 1981a). Over 10 miles (16 km) of seawall were constructed.
Within four years of completion of the seawall, the beach fronting it rapidly eroded. The city constructed thirty-two 300 ft (91 m) long wood groins, spaced between 600 and 900 feet (182 and 274 m) apart, to offset this trend so damaging to the tourist trade (Washington 1936). Poorly engineered, the groins were quickly battered by waves, and totally destroyed in 1915. In 1922, a recurved timber pile groin was built immediately west of the main bathhouse in the RBD, and a short beach temporarily built up. Overall, the erosion trend continued, and by 1939, a total of thirteen 500 ft (153 m) long timber-piling-and-sheet-steel groins were constructed to protect the toe of the seawall (USACE 1981a). These gradually crumbled away, but were rehabilitated in the form of rubble-mound groins. With the loss of two of the original groins and the incorporation of four former fishing piers, fifteen rubble mound groins capped with evenly-placed cover stones for the benefit of recreationists were completed by 1970 (Alperin 1977) (see Plate 5). Practically no sand remains between the groins, although future beach nourishment, derived from the accreting spit beyond South Jetty, has been found to be feasible (USACE 1985).

West of the seawall, shoreline changes have historically fluctuated between erosion and accretion (Morton 1974). The county made an effort to build up the dunes during the 1930s by planting 9 miles (14.4 km) of salt cedars westward from city limits. Successfully restoring the dunes to a height of 5 or 6 feet (1.5 to 1.8 m), the county completed planting west to San Luis Pass in 1937 (Washington 1938). The longterm success of this planting is not known, but the next efforts at shore protection came in response to recreational settlement, particularly following hurricane-
induced erosion. Bulkheading of property has taken place in several of the West End beach subdivisions since Hurricane Carla in 1961 (Morton 1974). Hurricanes Carla and Alicia (1983) respectively caused an average of 164 and 78 feet (50 and 24 m) of vegetation line retreat. Although post-Carla dune recovery brought the vegetation line back to its pre-storm position along a small portion of West Beach, in most places both the shoreline and the vegetation line had been set back (Morton and Paine 1985). When Hurricane Alicia again caused a vegetation line setback, the State of Texas claimed the new beach as public land and refused to allow the rehabilitation of structures more than 50% destroyed. More fortunate beachfront seasonal residents quickly attempted to re-establish the vegetation line in its previous position, by use of rubble, timber, sand fences, old tires, etc. (Plate 6). Lawsuits were filed by beachfront property

Plate 6. Anthropogenic dunes and sand-fencing as efforts to extend the vegetation line seaward following Hurricane Alicia (1983).
owners and, in spite of court rulings in favor of the state (upheld twice), the case is presently still on appeal. At the condominium complex built west of the seawall terminus in 1984, a sand-filled fabric bag revetment was installed at the base of the dunes. Whether this protection will withstand a new storm is questionable, however (USACE 1985). New development on the West End must now adhere to a "ten-year erosion setback" behind the dune line, based upon ten times the rate of average annual short-term dune erosion (Carter and Burgess 1986).

The bayshore of the West End was little modified by humans until the 1960s, except for a linear shore-hugging fishing camp settlement at 8 Mile Road. During the 1960s, many of the recreational subdivisions dredged extensive canal networks to produce numerous waterfront lots. Dredge-and-fill activity has been responsible for the loss of 3,100 acres (1,255 ha) of wetlands since 1956 (Carter and Burgess 1986). Seepage from septic tanks and poor flushing through the canals has forced frequent closure of the West Bay oyster reefs to harvesting (Carter and Burgess 1986). Dredge-and-fill permits have become much more difficult to obtain since the mid-1970s, and rates of canal dredging have been reduced. Several of the subdivisions currently under construction are developing only the barrier plain portions of their property.

Future Trends

Due to the proximity of Houston, it is anticipated that longterm growth in recreational demand will result in continued recreational development on Galveston Island. While the rapid touristic growth of the 1970s oil boom years may have reached a temporary peak (Figure 30),
the longterm outlook calls for steady growth (Garcia 1984). In response to rising demand for recreational facilities, Galveston Island experienced a construction boom beginning in the early 1980s. Galveston’s beachfront

![Figure 30. Revenues from hotel/motel taxes, Galveston. (data courtesy of Galveston Visitors Bureau)](image)

witnessed an explosion of condominium/hotel development, with over 2,100 units added between 1984 and 1986 (GCC 1986). On the West End of Galveston, development has been approved for 4,405 multi-family housing units and 3,047 single-family housing units since 1980 (Carter and Burgess 1986). Much of this development has been facilitated by the Texas Tax Increment Financing Act of 1981, which provides tax incentives to developers willing to “improve” blighted or undeveloped urban areas (anon. 1984). Much of undeveloped Galveston qualified as “undeveloped urban”, and seven of the nine “tax reinvestment zones” are recreational development projects (Carter and Burgess 1986).

Primarily because of the virtual collapse of the oil industry in 1982, the incipient construction boom has been checked. As building permit
data indicate (Figure 31), the 1980s boom has slowed, and several development ventures have recently filed for bankruptcy.

![Graph showing cumulative value of building permits in Galveston](image)

**Figure 31. Value of building permits, Galveston. (anon. 1984)**

As growth continues on Galveston, especially along the West End, pressures for increased shoreline protection will surely increase. The U.S. Army Corps of Engineers is already investigating the feasibility of beach nourishment on West Galveston (USACE 1985), and although the thirty million dollar price tag presently yields a low benefit-cost ratio, this may well change with further recreational development.
Chapter VI. South Padre Island, Texas

Location

South Padre Island is a seaside resort situated on the southernmost 6 miles (9.6 km) of the 110 mile (176 km) long Padre Island (Figure 32).

It is located approximately 26 miles (42 km) from the border cities of Brownsville/Matamoros and 2 miles (3.2 km) from Port Isabel across Laguna Madre. Connected by causeway with that historic port and recrea-
tional fishing outpost since 1954, South Padre Island is today the only developed resort in South Texas, although beach access is also provided at Boca Chica, near which a former resort—Del Mar—was located. Traditionally, these beaches attracted recreationists primarily from the Lower Rio Grande Valley (including a small proportion from Mexico), although today the recreational hinterland has expanded to include most of Texas during the summer season and much of the U.S. Midwest during the winter season. A minor beach resort—Playa Lauro Villar (formerly Playa Washington)—is located south of the Rio Grande mouth, but it functions almost exclusively as a local resort for residents of Matamoros.

**Physical Environment.**

Padre Island, the longest barrier island in the United States, formed by a combination of shoal emergence (Fisk 1959) and longshore transport of sediments eroded from deltaic headlands (Morton and McGowen 1980). The origin of South Padre Island is attributed to the abandonment and subsequent transgression of the northernmost subdelta of the Rio Grande, and corollary northward littoral transport of sediments by nearshore currents, about 2,000 years ago (Morton and McGowen 1980). A tidal pass cut through the emerging barrier island to connect the Gulf with Laguna Madre. Because of the relatively dry climate and little freshwater inflow into the lagoon, Brazos Santiago Pass (which separates Padre Island from Brazos Island) is one of the few outlets to the gulf.

Physiographically, South Padre Island consists of a wide, sandy beach backed by a discontinuous line of 10 to 15 ft (3 to 4.5 m) high dunes. Between foredune segments are low washover channels, within
which sand is transported to the backbarrier during frequent storms and hurricanes. Much of the backbarrier consists of a washover terrace and sand flats which grade lagoonward into periodically inundated algal and mud flats. The role of storms in modifying South Padre Island's geomorphology is evidenced not only by the washover channels between the foredunes and the washover terrace along the backbarrier, but also by the irregular, often serrated, lagoonal shoreline attributed to overwash events. Although various species of dune vegetation temporarily stabilize the foredunes, storm waves and high winds easily reshape the sand deposits. Some smaller sand dunes are found along the lagoonal shore, and their origin is attributed to destabilization of foredunes by overgrazing (by sheep and cattle in the late 1800s) and subsequent wind transport toward the lagoon (Price and Gunter 1943). Marsh wetlands are rare along the backbarrier and the few patches on South Padre Island exist because of human creation of habitat (e.g. spoil deposition and sewage outfall).

Shoreline erosion rates along the southern portion of Padre Island are among the highest on the island, averaging between 10 and 15 ft/yr (3 and 4.5 m/yr) (Morton and Pieper 1975). Construction of jetties at Brazos Santiago Pass beginning in the late 1920s has caused a localized reversal of that trend, however (Plate 7). Between 1933 and 1962, the resort shorefront has experienced accretion at the south end (over 17 ft/yr, or 5 m/yr, near the jetties) and erosion at the north end (about 7 ft/yr, or 2 m/yr, near the beach access at Andy Bowie Park). Beach widths reflect the shoreline change trend, with 300 to 400 ft (90 to 120 m) widths typical of the southern sections and 100 ft (30 m) widths characteristic of the northern end of the resort (McGrail et al. 1985).
Pre-Recreation Settlement

No major settlements have been known to exist at South Padre Island prior to recreational colonization. Several aboriginal Indian sites have been uncovered on North Padre Island, but South Padre has remained archeologically barren (Garza 1980). Early Spanish accounts described Padre and Brazos Islands as "Negro Islands" after the inhabitants, which were allegedly a mixture of hurricane-wrecked slaves and Coahuiltecan Indians that were temporarily living there (WRT 1950). In the late 1700s, the island was conveyed to Padre Balli, after whom the island was named, as a Spanish land grant (Ferguson 1976). He and a nephew (whose children later inherited the island) introduced cattle and horses to the island. Their ranch residence was located about 24 miles (38 km) north of Brazo Santiago Pass, and not until the late 1840s was the southern tip of the island settled by a shipwrecked family (the Singers)
who stayed and later bought the Balli ranch. The Singers were evicted from Padre Island during the Civil War, at which time a military garrison occupied northern Brazos Island, and Port Isabel (then named Point Isabel) became an important outpost. Following the Civil War, the island came into possession of Pat Dunn, who continued the ranching tradition, primarily grazing cattle and sheep (Garza 1980).

**Exploration and Initial Recreational Development**

Although Brazos Island has been described as being one of the oldest beach resorts in the United States because Spanish ranchers of the Lower Rio Grande Valley frequented the area during summer months as early as the 1780s (WPA 1940), the beginnings of modern recreational utilization of South Padre Island can be traced to the initial facilitation of access to Port Isabel. Much of the development of the Lower Rio Grande was based upon commerce, and when a military railroad from Brazos Island to a transhipment point on the Rio Grande (White’s Ranch) was destroyed during an 1867 hurricane, merchants from Brownsville and Port Isabel cooperatively built a narrow-gauge railway linking the two cities. Train service began in 1871, and although freight shipping was the primary function, weekend and summer excursions carried bathers and fishermen to the booming port of Point Isabel (TPWD 1984). Bathers would sail across to South Padre, spend the day on the beach, and then return to Brownsville at night. A similar pattern characterized northern Padre Island, and Pat Dunn tried hard to discourage recreationists from trespassing on his island (Garza 1980).
The pattern of passive recreational usage of South Padre prevailed until the latter 1920s. Point Isabel, in spite of several economic downturns, continued to attract tourists, and in 1904, the first hotel (the Queen Isabella) opened. The Gulf beaches were a major drawing card for the recreationists, and in 1908 a Padre Island Development Co. filed a proposed subdivision plat for the southern tip of the island. The subdivision (the first on record in Cameron County) was named Tarpon Beach, after an early vernacular name given to the beach adjacent to Brazos Santiago Pass. However, the proposed development never materialized (Garza 1980).

**Development of Recreational Infrastructure**

The boom years of the 1920s were felt at both Port Isabel (the name was changed from Point Isabel in 1928) and South Padre Island. With the advent of the automobile age, the road to Port Isabel was improved, and a recreational boom ensued. Hotels and tourist courts were built, the town was modernized by means of a new street layout, and dredging and filling began to create waterfront lots (TPWD 1964). The number of visitors boating across to the beaches steadily increased. In 1926, pressures of tourism encroachment led Pat Dunn to sell the island to developer Sam Robertson, whose aim was "to make Padre Island into another Miami Beach" (Garza 1980; and WRT 1950). Robertson built a causeway to North Padre Island and a bridge from Padre to Mustang Island, and ferry service to South Padre Island was begun. Plans for a South Padre causeway in 1927 were not approved by officials (WRT 1950). Two hotels were built on South Padre Island: the Twenty-Five Mile Hotel 25 miles (40 km) from the south tip and the Sportsman Hotel
(also known as the "casino") at Tarpon Beach. Four houses and a plank road from the ferry landing to the beach were also built (Figure 33A) (Garza 1960). Robertson had grandiose plans for a road along the whole length of the island, and 12 miles (19 km) of pavement were actually laid in the vicinity of the Twenty-Five Mile Hotel (WRT 1950). Despite all of Robertson's infrastructural improvements and efforts to promote tourism, the hotels were not successful. Following the stock market crash of 1929, he sold his interests to the Ocean Beach Drive Corporation. Later, in the 1930s, Robertson developed the successful Del Mar resort, replete with a handful of restaurants, fishermen's supply houses, and tourist lodges, on highway-accessible Brazos Island (WPA 1940).

On Padre Island, the Ocean Beach Drive Corporation embarked on continuation of Robertson’s original plans to build an island highway. The first official survey by the Texas Highway Department was made in 1933, the same year that a Force 3 hurricane made landfall on the island. The September storm, which produced 11 ft (3.3 m) storm surge levels at Port Isabel, destroyed Robertson's structures and the North Padre causeway, and left little doubt that a beach highway was unfeasible (WRT 1950). Between 1933 and 1949, no further attempts at development of South Padre Island were made. Dayuse recreation and overnight camping continued, however, and the surviving lower story of the "casino" was used as a de facto bathhouse during that period.

The modern resort infrastructure became established after 1949 when a Corpus Christi developer (John Tompkins) bought 5 miles (8 km) of South Padre Island (Ditton et al. 1979). To entice the county to build a
I'll 5-foot contour

washover locations

Main Road

reclaimed for development

levee

Fiesta

Andy Bowie Park

limits of Padre Beach subdivision

post-Beulah washover locations

City limits (1973)

fishing pier

post-Beulah Resort Hotel

Sedimentation and physical characteristics, South Padre Island.
causeway to his property, Tompkins deeded the southernmost 149 acres (60 ha) and northernmost 226 acres (91.5 ha) to the county as public parks (Isla Blanca and Andy Bowie Parks, respectively) in addition to a highway right-of-way (Myers and Hodges 1983). The central 2.5 miles (4 km) of his property was platted as the Padre Beach subdivision, composed of eleven grid plan subdivision units plus one unit (Fiesta Isles) to be developed as an exclusive subdivision complete with residential canals on the lagoon side (Figure 33B). For the rest of the subdivision, the low-elevation sand flats along the lagoon side were leveed and filled to an elevation of 7.5 feet (2.3 m) (Garza 1980) to provide a suitable foundation for housing. Cameron County began developing park facilities at Isla Blanca Park in the early 1950s, and in 1954, the Queen Isabella Causeway from Port Isabel was opened. Several owners of smaller parcels of property also subdivided their holdings into residential lots. The first motel was opened in 1955, and a topographic map of the same year showed very few structures but an expansive street network awaiting infilling by vacation home development.

Settlement Expansion

Although the provision of access to South Padre beaches was popular with day users who came to frequent the county parks from a largely local Rio Grande Valley hinterland, structural recreational development of South Padre Island proceeded slowly during the 1950s and early 1960s (Ditton et al. 1979). Reasons for this include: awareness of hurricane danger, lack of availability of insurance against potential hurricane destruction, and a highly-saline water supply piped in from the mainland (Sheaffer & Roland, Inc. 1981). In 1961, Hurricane Carla, a Force 4 hurri-
cane but less powerful along the south Texas coast; destroyed one motel at the northern end of the resort and caused extensive damage to summer homes. When the federal Padre Island National Seashore was authorized along the central portions of the island in 1962, some observers noted a depression in land prices as plans for a continuous Padre Island highway were dropped (Sheaffer & Roland, Inc. 1981). However, another account suggested the storm triggered a boom, and South Padre was described as a "Little Miami Beach" with fifteen resort hotels by 1964 (cited by Garza 1980). While this description may well have over-exaggerated the status of South Padre, the beachfront of the resort was steadily being developed by a combination of summer homes and modest motels. The leveed lagoon shore of Padre Beach also proved to be a popular settlement site. In 1966, a newer, less saline source of water was found, and one obstacle to development was thus removed (Sheaffer & Roland, Inc. 1981).

Recreational development at South Padre Island increased following the landfall of Hurricane Beulah in September 1967 (Garza 1980). Condominium had just recently been introduced to the island, and when it was seen how well South Padre withstood Beulah, a Force 3 hurricane quite reminiscent of the 1933 hurricane, a building boom began. This boom was reinforced by passage of the National Flood Insurance Act of 1968 and a state Catastrophe Pool Act (CATPOOL) of 1971 which made flood and wind insurance available at subsidized rates. Aerial photographs from 1968 (Figure 33C) show that the southernmost 3 miles (4.8 km) of the resort, where about 85% of all development was concentrated, was less impacted by the hurricane (which produced a 7 ft [2 m] storm surge on the island) than the northern 3 miles (4.8 km), where much washover activity had
occurred. Nonetheless, post-storm development by private summer homes and multi-unit structures took place at all segments of the resort. An oft-cited example of poor planning are the Tiki condominiums built shortly after Beulah in the center of a washover channel at the northern limits of the resort (Morton and Pieper 1975).

**Landuse Intensification**

Beginning in the late 1960s, South Padre Island began to be characterized by multi-unit development more than by single-family home development. Although this pattern generally prevailed throughout the entire Gulf Coast, South Padre Island differed somewhat in that local summer home development had not been as extensive as elsewhere, perhaps because of a less populous—and economically more depressed—recreational hinterland. In about 1970, South Padre Island’s status began to change from a local recreational beach to a national and international beach resort.

Although the first condominiums date to 1965, not until after Hurricane Beulah did rampant growth of multi-unit and commercial structures begin. In 1973, the Town of South Padre Island incorporated, and in 1974, a new federally-funded, four-lane, high-span, and toll-free Queen Isabella Causeway was opened. A comprehensive sewage treatment program was begun in the mid-1970s, and the water supply system was upgraded in 1977 (Sheaffer and Roland, Inc. 1981). Visitation on the island increased steadily during the 1970s primarily because of greater publicity throughout the rest of Texas (especially Dallas) but also because of substantial Mexican visitation. Causeway crossings steadily increased.
from 1969 until the devaluation of the Mexican peso in 1982 (Figure 34). Accompanying the rise in visitation was increased investment, and the proliferation of condominium hotels reflected market demand. It has been estimated that of the total investment on South Padre Island, 25% is from Mexican nationals, 25% is from Rio Grande Valley (U.S.) residents, 25% is from the rest of Texas, and 25% is from the rest of the U.S. (Hockaday 1986, pers. comm.).

The building boom climaxed in 1982 as the oil boom busted and the Mexican peso was devalued (Figure 35). As of 1986, South Padre Island counted 2,447 condominium units, 1,987 hotel/motel units, 656 residential units, and a total of 506 mobile home spaces and 18 bungalows in Isla Blanca Park (Tallman 1986). The 1982 map (Figure 33D) shows that growth has taken place primarily by infilling rather than by expansion. The beachfront has proven to be the most popular location for
hotel and condominium development, but a secondary zone has also developed along the lagoon shore (Plate 8).

Hurricane Allen in 1980 produced a 10 ft (3 m) storm surge at Padre Island and re-activated the dormant washover channels (Morton et al. 1983). In spite of dune erosion and damage to structures in and adjacent to washover channels, the rapid development on the island was stimulated even more by Allen. The peak years of development were 1980, 1981, and 1982 (see Figure 35).

**Morphologic Aspects of Resort Development**

South Padre Island differs somewhat from the other study sites in that no distinctive beachfront recreational business district has evolved. Historically, recreationists congregated at Tarpon Beach, and construction of the Sportsman’s Hotel in 1926 created a central focal point. When the
Queen Isabella Causeway opened in 1934, the RBD functions became divided among the two county parks, both of which attracted fishermen, bathers, and campers, and the incipient beachfront motel strip. Support businesses were established along the main highway in the center of the island.

Plate 8. Condominium development along lagoon shore of South Padre Island. (note sparse development in interior)

Thirty years later, the pattern of multiple RBDs remains. The county parks remain the prime attractions for day use recreationists. At Isla Blanca Park, public facilities (e.g. picnic shelters, bungalows, and camper hook-ups) have been augmented by commercial establishments, both within the park (via lease arrangements) and at the entrance to the park. The lack of admission fee (until late 1986, when a one dollar per vehicle
charge was instituted) made the park quite popular. At the north end, the undeveloped Andy Bowie Park is popular because there is vehicular access to the beach, which is passable as far as Mansfield Pass, 30 miles (48 km) to the north. A fishing pier was a popular attraction until its destruction by Hurricane Allen. In addition to the two parks, the numerous resort hotels function as mini-RBDs in themselves, and tourists have little need to stray far from them. The lagoon side of South Padre, zoned "resort", contains a mixture of commercial and residential development. As guided by zoning, most businesses on the island flank the main highway, and this commercial landuse setback from the beach represents an anomaly in resort development patterns.

The primary zone of condominiums and resort hotels is along the beachfront, with a secondary focus upon the lagoon. In spite of much available vacant land within the interior of the island, the demand for beachfront property has led to much replacement of the earlier 1950s and 1960s summer homes with highrise structures in this zone. (The only area actually zoned single-family is the residential canal subdivision of Fiesta Isles and a narrow sliver of housing extending to the beach, where a seawall was built.) Since the early 1970s, several condominiums with access by private boats have been built along the lagoon shore, and access channels were dredged through the shallow Laguna Madre. This trend has been slowed by increasingly strict permit requirements.

Single-family homes, now essentially displaced from the beachfront, occupy the interior and lagoonal portions of the resort. Compared to the 4,500 condominium and hotel units, the 656 individual homes represent but a small proportion of the total recreational development on the island.
As over half of these homes are occupied by permanent residents (Myers and Hodges 1963), the summer home trend must be considered to be relatively insignificant on South Padre Island.

**Human Interaction with the Physical Environment**

Prior to construction of the 1954 causeway, human efforts at coastal settlement were periodically thwarted by hurricanes. Brazos Island was the site of a small port (Brazos Santiago) as early as the 1820s (Ferguson 1976), and from the 1840s until its destruction in the 1867 hurricane, a military garrison was headquartered there. At the mouth of the Rio Grande, a town known as Boca del Rio (population of 2,000 during the 1820s) served as port of entry until its destruction by hurricane in 1829 (Ferguson 1976). Later, the Confederate outpost of Bagdad ("Sodom of the Rio Grande") developed on the same site, but the 1867 hurricane ended the remains of that metropolis. Similar fates befell smaller coastal settlement ventures, including the initial recreational development on South Padre Island.

When the post-causeway development began, little attention was paid to the existing geomorphology which reflected the impacts of storm processes. The 2.5 mile (4 km) stretch of island platted as Padre Beach spanned at least three major washover channels, demarcated by wide gaps in the foredunes. The street grid was platted with no regard for the channels, and the exclusive Fiesta Isles was sited in the center of one of the largest washovers (see Figure 33B). North of the Padre Beach subdivision, an extremely broad washover zone was deeded as a county park, perhaps in recognition of its low development potential. Periodic
inundation of the backbarrier was also noted, and this sector of Padre Beach was leveed and filled prior to causeway opening.

In terms of response to shoreline changes, development at South Padre Island has benefitted from the existence of the Brazos Santiago navigation channel jetties in that erosionary trends have been replaced by accretionary ones in the immediate vicinity. Isla Blanca Park has witnessed steady increases in the width of the beach, and during the summer of 1986, a major construction project was underway in which picnic shelters and other park facilities were being rebuilt on the beach, closer to the water's edge. Three miles north of the jetties (approximately at the zone where the washover channels begin), the trend of shoreline change switches to one of erosion. Along the beachfront of Fiesta Isles, a concrete seawall was built by Tompkins in the latter 1950s to protect the exclusive subdivision. During Hurricane Carla in 1961, the storm surge overtopped the wall and severely damaged his beachfront home. In 1962, a larger seawall was built, 20 feet (6 m) inland from the old one and 200 feet (60 m) from high tide line, only to be severely damaged by Hurricane Beulah in 1967 (Garza 1960). Twenty-five years later, the home stands in semi‐ruins on the beach, and the crumbling seawall stands in the breaker zone, partly attached to the beach by a tombolo (Plate 9). Although little else has been done to attempt to offset the erosionary patterns, city officials and researchers at the Pan American University Marine Laboratory are now actively monitoring shoreline changes and recommending that beach nourishment, in the form of dredged material removed from Brazos Santiago Pass, be implemented (Hockaday 1986, pers. comm.)
Practically all multi-unit structures along the South Padre beach-front have concrete "seawalls" at their base. These range from 3 to 10 feet (1 to 3 m) in height above ground, and are presumably anchored at least a similar depth in the sand. A U.S. Army Corps of Engineers report (1979) felt that no additional shore protection was needed at South Padre because of the existing proper structural engineering. In spite of the apparently adequate foundation protection, a 1986 field survey found that of fifty-one multi-unit beachfront structures, all but seven had removed the sand dunes from their fronting beaches (Plate 10).

The destruction of sand dunes on South Padre Island has been facilitated by the exemption granted the island from the Sand Dune...
Protection Act of 1973 (Morton et al. 1983). Although disturbance of sand dunes is generally prohibited in Texas, the South Padre Island barrier was considered to be "an area of irregular dunes, unstable, and migratory; and that such dunes do not afford significant protection to persons and property inland from this area" (cited by Morton et al. 1983). As a result of the exemption, dune disturbance due to construction practices or dune buggy riding has been widespread. Within the resort, the only significant dune areas are at the extreme ends, where they are essentially protected within the county parks. The value of the dunes as storm wave buffers is slowly being realized, however. In addition to several resort complexes intentionally leaving their fronting dunes in place, the city beach cleanup machines have been depositing their scrapings in front of the public right-
of-ways, which has initiated new dune formation. Also, active local environmentalists are lobbying to remove the exemption from Texas law (Campbell 1986, pers. comm.).

Additional modifications to the environment include substantial spoil deposition in the vicinity of the causeway approach, navigation channel dredging to provide access to lagoonside waterfront lots and condominium complexes, creation of marsh via the discharge of sewage treatment effluent into the lagoon, and the conversion of numerous narrow hurricane “cuts” along the lagoon shore to residential canals (see Figure 33C).

**Future Trends**

Padre Island is the type of seaside resort where recreational development has not taken place in response to consumer demand but rather where speculative overbuilding has led to extensive publicizing of the resort in the hopes of realizing a return on investment, both from overnight tourism and condominium sales. Today, almost all available beachfront property within the city limits is lined with resort hotels and condominium complexes, some in excess of twenty-eight stories high. The interior of the island, laterally transected by the busy commercial strip, is dotted with single-family houses. Though zoned for multi-family structures, this area is least desirable for high-density recreational development and as a consequence has remained sparsely urbanized (see Photo 8). Hotel/condominium development has been popular on the lagoon side, but increasing difficulties in obtaining permits to modify tidal flats and dredge nearshore waters is restricting development there.
In addition to infilling of the interior, future resort development can only expand northward into a highly washover-prone segment of the island. At present, development plans include the construction of a residential canal subdivision on a low washover fan (lagoonward of the infamous Tiki, constructed in the washover channel) and the construction of a golf course and convention center in Andy Bowie Park (Wells 1985). North of the city limits, the South Padre Island Investment Company subdivided much of the area and sold residential lots in the early 1970s. A right-of-way was deeded to extend the main island road 30 miles (48 km) to Mansfield Pass. When this venture went bankrupt in 1977 (Garza 1980), title passed to American General Investment Corp. of Houston (operating under a subsidiary, Padre Island Land Company), which then owned 21,000 acres (8,500 ha) of South Padre Island (Gordon 1984). About 7.5 miles (12 km) of highway was paved through this property in about 1980. When the undeveloped land between Mansfield Pass and the Town of South Padre was being proposed as a barrier island unit under the Coastal Barrier Resources Act of 1982, extensive lobbying by American General and other Padre Island property owners (aided by Sen. John Tower) was successful (Gordon 1984). Essentially, in spite of unsuitable land in terms of shoreline erosion and washover potential, 7.5 miles (12 km) can be annexed by the Town of South Padre Island in the future, thus extending the existing pattern of resort development northward.

The presently poor economy in both Texas and Mexico has caused a levelling off of development rates on the island. Local realtors optimistically feel that this is merely a lull before the next boom, and if the recent
discovery of South Padre Island as a Spring Break destination is any indication, perhaps another boom is indeed coming. In spite of less investment in the mid-1980s (following a frenzy of over-speculation in the early 1980s), visitation, as measured by causeway crossings or hotel occupancy tax receipts (see Figure 34), has been steadily increasing. If the existing resort infrastructure is indeed extended northward, and demand keeps pace with speculative construction, considerable growth can still be realized before a carrying capacity level is reached. A resort morphology consisting of a strip RBD flanked by resort hotels and condominiums on the beach side is possible, provided sufficient additional water (supply) rights can be secured. Regulations may limit lagoon side construction, and Gulf setbacks of at least 300 feet (90 m) should be required if foundation erosion is to be minimized.
CHAPTER VII. ESTERO ISLAND (FORT MYERS BEACH), FLORIDA

Location

Situated near the southern limits of the southwest Florida barrier island chain (which contains at least thirty-four seaside settlements from Tarpon Springs to Marco Island), Estero Island is 15 miles (24 km) south of Fort Myers, near the mouth of the Caloosahatchee River estuary (Figure 36). Primary access to the island is through Fort Myers, although a secon-

Figure 36. Regional setting of Estero Island, Florida.
Primary approach is via Bonita Beach and Bonita Springs to the south. Although subject to less intensive levels of tourism and recreation than the islands near St. Petersburg/Tampa area, Fort Myers Beach (as the settlement on the island became known) is important both as a summer resort for Fort Myers residents and also a winter resort for snowbirds from U.S. Northern and Midwestern states. Nearby Cape Coral is a large retirement community first developed in the 1950s.

**Physical Environment**

Physically, Estero Island consists largely of a low beach ridge plain which grades into mangrove wetlands in its backbarrier zone (Figure 37).

![Figure 37. The physical setting of Estero Island. (1944 base)](image)

The highest elevations range between 5 and 6 feet (1.5 and 2.4 m) above msl and are found at the crests of the primary dunes. The vegetation of the better-drained sections originally consisted of native pines (e.g. *Pinus*...
palustris), but these have now been replaced largely by ornamentals such as coconut palms (Cocos nucifera) and Australian pines (Casuarina equisetifolia). The backbarrier lowlands consisted of a mangrove/palmetto association, most of which has now been converted to residential canal subdivisions. Between the coastal barriers and the low elevation coastal plain of the mainland lies an expanse of shallow bays, marshes, and mangrove swamps dotted with numerous shell middens left by the aboriginal Calusa Indians (Clark 1976). At least three shell middens existed on Estero Island, but only the westernmost one remains today, the rest having been mined for fill material.

Geologic formation of the island has been attributed to onshore sediment transport during the Holocene (Winton et al. 1981), although recent evidence suggests that headland erosion combined with longshore drift may have been more dominant processes (Nummedal 1984). Longshore drift is presently bidirectional, although a net drift rate of 22,000 yd$^3$ (16,600 m$^3$) to the northwest has been estimated (USACE 1969). Sand spits recurve into deep tidal passes (Matanzas Pass and Big Carlos Pass) at both ends of the island, and the crescentic shape of the island is attributed to tidal hydraulics and wave refraction around the respective ebb tidal deltas. The spits have undergone alternating phases of shoreline erosion and accretion, but the central section of the crescent-shaped island has been characterized by slow erosion. Longterm erosion rates have averaged 1 to 2 ft/yr (30 to 60 cm/yr), but much temporal and spatial variation has been evident (Walton 1980). During the 1957-1967 period, erosion rates as high as 20 to 25 ft/yr (6 to 7.6 m/yr) were recorded near both ends of the island (USACE 1969). Historically, storm events and inlet
changes have accounted for most of the erosion, and seemingly higher erosion rates of the storm-free 1970s and 1980s may reflect eustatic sea level rise.

**Pre-Recreation Settlement**

Initial settlement in the vicinity dates to the 1850s when pioneers, originally assigned to nearby frontier military posts (e.g. Fort Myers), spread out across the region. In the frequently inundated coastal zone, the shell mounds were the first sites to become settled, and squatters occupied the main Estero Island shell mound as early as the 1870s (Schell 1962). The first land titles under the Homestead Act were granted in 1898 and 1899 (Figure 38A), and during the successive twenty years, the remainder of the island was parceled out to various claimants, some of whom had arrived in Florida as members of the Koreshan Unity, a quasi-Christian cult headquartered on the mainland nearby (Schell 1980). The initial homestead period was characterized by a scattering of individual homesteads along the length of the island, and homesites occupied the shell mound and the higher, more protected beach ridges. The local economy consisted of truck-farming and fishing, and products were shipped to the growing mainland cities by coastal schooner. Tomatoes, guavas, and limes were among the important early cash crops. Both ends of the island were initially U.S. Government property, reserved for future use as lighthouse sites, but the southern tip of the island was acquired by the Koreshans, who established a sawmill there in 1894 and cleared the native pines over the successive two decades. The first post office on the island was located at that site (Schell 1980).
Figure 36. Settlement evolution on Estero Island, 1910-1984.
Exploration and Initial Recreational Settlement

In the early 1900s, before all of the homestead claims even had been filed, residents of nearby Fort Myers began to frequent Estero Island during the summer months to escape the sultry weather. The Gilbert Homestead was bought and subdivided by Harold Case in 1911 (Figure 38B). A windmill pump and elevated cypress tank comprised the island’s first water supply system, eventually serving twenty-five homes. In 1912, the first beachfront hotel was constructed by a Dr. Winkler, a firm believer in the curative powers of the sea and sea air. A second homestead was subdivided in 1915 (the Hill subdivision), and beachfront lots were the first to be sold. Backbarrier property was offered in 10 acre (4 ha) parcels, and two residential canals were soon dredged to provide boat access to the lots, but this land remained less desirable. In spite of only crude ferry service across Matanzas Pass, Crescent Beach (as the incipient settlement was called) became increasingly popular.

Development of Recreational Infrastructure

The first boom in development began in 1921 as a result of two important stimuli. First, post-World War I affluence, combined with the increasing affordability of mass-produced automobiles, was leading up to the Great Florida Land Boom. Second, as a result of the incipient development, local interests raised bond money to construct a bridge from the mainland to the island. Hundreds of motorists soon crossed the bridge on weekend days. Casinos and fishing piers were built on the beachfront, a recreational business district took shape at the nearest point where the access highway reached the beach, and further subdivision of the initial
subdivisions took place. A 1921 hurricane destroyed much of the beach-front development, but rebuilding was rapid and the impact upon the community was (apparently) minor. A third subdivision was carved out of San Carlos Island, but slow initial land sales confined development to the bridge terminus area. The 1920s land boom accounted for much speculation in real estate and property values soared. Although a small beachfront-oriented recreational community had developed by the time the first accurate map of the island was made in 1927 (see Figure 38B), only a small portion of this "paper boom" resulted in actual construction. Boom soon gave way to bust and between the Hurricane of 1926, which caused a 10 ft (3 m) storm surge and destroyed the bridge, and the stock market crash of 1929, a temporary phase of low growth set in.

Settlement Expansion

Not until the late 1930s, and especially after 1945, did Crescent Beach (now dubbed Fort Myers Beach by the local press) begin to boom again. Many Americans, especially Midwesterners "discovered" the island as a result of being stationed at nearby military bases during World War II. Gradually Estero Island's function as a summer resort became overshadowed by a new "winter resort" status, a status characteristic of most southern Florida beach communities today. The addition of a fishing pier restaurant and extensive planting of coconut palms increased the attractiveness of the island for postwar recreationists, many of whom decided to construct second homes. The first aerial photos of the island (1944) show growth proceeding in a southeasterly direction along the beachfront, accompanied by isolated forays into the mosquito-ridden mangroves where limited residential canal waterfront lot development
took place (Figure 36C). San Carlos Island also experienced greater development, although mainly as a base for an expanding shrimp fleet. A severe hurricane in 1944 inundated Fort Myers Beach with 3 to 6 feet (1 to 2 m) of water, but again recovery was rapid (USACE 1969).

Following the war, the rate of residential expansion increased and significant environmental modification accompanied this rapid growth. By 1949, the U.S. Government had sold the lighthouse reserve at the north end of the island and rapid subdivision took place (Figure 36D). The highway along the island axis was also extended to the southern tip, thus opening the entire island to development. (The causeway to Bonita Beach was not built until the early 1960s, however.) As demand for housing continued, dredge-and-fill activity in the mangrove swamps became more prevalent, and more subdivisions came to occupy that zone. Even prior to dredging and filling, mangroves were often "ditched" to retard mosquito breeding activity (Russell 1985, pers. comm). Also, the 1950s and 1960s witnessed many structural efforts to retard shoreline erosion—in the form of groins, revetments, seawalls, and bulkheads, often constructed of coquina aggregate (Plate 11). Both the shorefront and the backbarrier were perceived as popular residential sites during this period.

Landuse Intensification

By 1970, very little beachfront property remained available for development (Figure 36E). High demand for land increased real estate values to the point where summer cottage construction extended beyond the financial means of the middle-class recreationist. The first condominiums appeared on the island in 1967, initially near the southeast end
where the remaining parcels of available beachfront property were located. The period up until the early 1980s was characterized by a proliferation of multi-unit structures, mostly at the southern end where still today over half of all condominium units are located (Figure 39). As the beachfront rapidly filled with highrise structures, the bayshore became a secondary locus of condominium development. Condominium complexes were also built in dredge-and-fill subdivisions, again primarily at the southeastern end. Also, by replacement of decaying summer homes (owners of which could no longer afford the escalating property taxes) and conversion of existing resort facilities, a "redevelopment" trend began, and condominiums now line central stretches of the island as well as the flanks of the recreational business district.
Development pressures led to rampant clearing of the remaining mangroves on the island (Figure 38F), although increasingly strict legislation all but halted this trend by 1980. Only one of the few remaining parcels of mangroves is a true preserve (Matanzas Pass Wilderness Preserve), and the rest are parcels spared from developers' dredges and bulldozers by environmental legislation. Several unfinished residential canals stand as testimony to this pattern (Plate 12).

**Morphologic Aspects of Resort Development**

The patterns of condominium growth (Figure 39) and resident population growth (Figure 40) show that Estero Island has evolved according to the S-curve resort model. During the pre-1921 stage of recreational exploration, an incipient RBD formed at the Beach Hotel, and a small summer home subdivision developed nearby. After provision of highway
access, the primary RBD locus shifted to the closest beach access, adjoining the boundaries of the lighthouse reserve. Between this primary RBD and a now secondary focal point at the hotel, where a popular fishing pier had been built, a recreational core area of the future resort of Fort Myers Beach developed.

The present urban morphologic patterns (Figure 41) reflect the chronology of development on Estero Island. The beachfront zone closest to the point of access from the mainland contains the recreational business district, which consists of a county fishing pier, a county beach park, and numerous tourist-oriented business establishments (Plate 13). The prime commercial zone on the island, including most motels and hotels, flanks the original access highway (now bypassed as a result of high-span bridge construction in 1980) and the beach highway for about one mile (1.6 km) on either side of the RBD. Historically, the backbarrier and distal sections of the island were characterized by single-family residential development.
Figure 41. The urban morphology of Fort Myers Beach.

Plate 12. The condominium "frontier" at Fort Myers Beach. (A. Spit growth sheltering beachfront highrises, B. Bayshore and canal-front condominiums, and C. Active canalization halted by wetlands legislation)

development interrupted by an occasional beachfront motel or trailer park. The distribution of condominiums reflects both the infilling of remaining vacant lands (until this process was stopped by wetlands legis-
lation) and the redevelopment of older properties in the vicinity of the RBD and along the central beachfront.

Fort Myers Beach has reached a plateau of development considered 'saturation level' on the Butler (1980) model. The 1980 census count of 6,000 inhabitants greatly underestimates the seasonal winter population, which allegedly exceeds 25,000. Population projections by Lee County officials (Ahlert et al. 1982) foresaw the population of Estero Island peaking by 1985 and gradually declining in subsequent decades. This projected decline is based on both lack of available developable land and new (1980) zoning laws which lowered allowable densities from 35 to 14 housing units per acre (86 to 35 units/ha). The present number of condominium units (3,700) may still increase, primarily via the mechanism of

Plate 13. The recreational business district of Fort Myers Beach. (Note the pre-causeway access highway at left)
"redevelopment" of older properties, and this process may gradually intensify land use and increase population density.

**Human Interaction with the Physical Environment**

Estero Island has been substantially modified as a result of human settlement. Initially, settlement was confined to the shell midden and the more suitable beach ridge complex that comprises the "backbone" of the island. With the post-World War II boom, increasing conversion of back-barrier wetlands to residential canal subdivisions took place. Vegetative changes accompanied this dispersal of settlement: the native upland pines had been cleared by lumber interests, and "touristically attractive" species such as coconut palms and Australian pines, first planted in the 1920s, soon became dominant (Schell 1960). The mangroves almost completely disappeared from the island as a result of development. Erosion of the shorefront accompanied the onslaught of hurricanes, and the shoreline has become armored as a result of efforts to retard the loss of beachfront property.

Estero Island has borne the brunt of several damaging hurricanes. During a severe (Force 4?) 1873 hurricane, the nearby cattle shipping port and fishing resort of Punta Rassa was inundated by a 14 ft (4.3 m) storm surge and totally destroyed (USACE 1969). However, Estero Island was virtually uninhabited at the time. The next significant hurricane (Force 3) arrived in 1910. Estero Island was still in a pre-recreation stage, but early homesteaders noted that it marked the first time they "had to batten down" (Schell 1980). Although 4 to 6 feet (1.2 to 1.8 m) of flooding were recorded (USACE 1969), damage estimates are lacking. Another
Force 3 hurricane hit the island in 1921, the same year the first bridge opened, and water levels of 11 feet (3.3 m) above msl were recorded at Punta Rassa (anon. 1970a). The vegetation line retreated about 100 feet (30 m) on Estero Island, and one gambling casino, one bathhouse, and numerous summer cottages were destroyed (Schell 1960). Apparently there was little negative response to this, and all structures were rebuilt and the beach was "repaired". This was a period of economic boom throughout Florida, including Estero Island, and promotional films of the "new" beach were shown throughout the northeastern United States to promote tourism on the island (Schell 1980). In 1926, a Force 4 Hurricane brushed the coast, and this time the impact was severe. Water levels of 12 feet (3.6 m) above msl were recorded at Punta Rassa, and damage at Estero Island was extensive. The access bridge was destroyed, as were a major casino and numerous summer homes. The 1924 Florida Land Boom was rapidly heading for a major bust, and on Estero Island, the 1926 storm is said to have "burst the Boom's bubble" (Grismer 1949). On nearby Sanibel Island, new recreational beach subdivisions were totally destroyed (Dormer 1975). Nonetheless, on Estero Island most summer homes were repaired and a new bridge was opened by 1928.

Human modification of the shoreline dates to the 1930s on Estero Island, but was most common in the 1950s and 1960s. Reynolds (1982), in his examination of shoreline structures as "cultural artifacts", noted that although Naples, Florida (20 miles [32 km] south of Ft. Myers Beach) had wooden seawalls as early as the 1920s, the construction of groins (still ubiquitous along the Naples beachfront) could be correlated with rapid recreational development between the late 1940s and about 1970. At
Fort Myers Beach, the 1950s and 1960s also represented the period of extensive groin building, and longtime residents attributed this phase to human response to erosion caused by storm activity. Hurricanes were most numerous in this period, especially in the 1940s and 1960s, and the resultant beach erosion prompted shorefront property owners to attempt protective strategies. Also, groins and seawalls were popular during this period, and this may partly account for their widespread adoption.

Only one significant hurricane was felt during the 1930s: a 1935 Force 5 hurricane which damaged the Florida Keys extensively but only caused 2 to 3 feet (60 to 90 cm) of flooding on Estero Island. A damaging Force 3 hurricane made landfall near the island in 1944, causing severe damage to property, including removal of the Beach Hotel fishing pier. Meteorological records list additional hurricanes in 1946 and 1947 (USACE 1969), but local residents observed practically “one hurricane per year over the next decade” (following the 1944 storm) (Schell 1980). Many groins and seawalls were constructed along the beachfront as a result of this storm-prone period, which coincided with a phase of rapid growth. Although the 1950s were relatively storm-free, in 1960 Hurricane Donna (a Force 4 hurricane, the worst since 1926) hit Fort Myers Beach, inundating the resort with recorded water levels of 10.41 feet (3.16 m) (Miller and Benson 1976). Again, although beach erosion and shorefront property damage were extensive, the island was rebuilt and more “protective” structures were put into place. Informants stated that many longtime residents sold out after the 1960 hurricane, but new recreationists moved in and growth rates actually accelerated (Reckwerdt 1985, pers. comm.). In 1967, an estimated 93 groins (87 of stone, 4 of timber, and 2 of both
stone and timber) and 3,800 feet (1,155 m) of concrete seawall were inventoried on Estero Island (USACE 1969). A 1970 travel guide, while promoting the tourism potential of the island, noted that "shore erosion is a real problem...watch for damaged seawalls and groins" (Ford 1970). Additional hurricanes have caused minor damage at Fort Myers Beach, including Betsy (1965), Gladys (1968), Agnes (1972), a June 1974 storm, and the "no-name storm" of 1982 (anon. 1982). Shoreline erosion resulting from these storms varied considerably along the length of island, but additional armoring continuously took place, although at a slower rate in recent years. Much of the damage to beachfront cottages resulting from minor storms is presently attributed to updrift seawalls and groins which have upset the sediment balance (anon. 1982), and legally no new shorefront structures may be built. By 1984, the lengths of seawall and rock revetment were noted to be over 6,000 feet (1820 m) (Doyle et al. 1984). At many locations, very little beach remains in front of the structures (see Plate 11), and as a result, several beach access roads have evolved into de facto bathing beaches (Plate 14).

In addition to the private efforts at shoreline armoring, limited nourishment of beaches has been undertaken. Matanzas Pass is maintained for navigation, and periodic maintenance dredging has freed up spoil material for placement on the island. In 1966, 40,000 yds$^3$ (30,000 m$^3$) of dredged material were discharged onto the beach fronting the RBD (USACE 1969), and a similar amount was placed in the same area in 1972. In 1980, 130,000 yds$^3$ (98,000 m$^3$) were placed both along the northern one mile (1.6 km) of beach and upon an upland disposal site on the northern spit (Doyle et al. 1984). The spit now exhibits the highest
elevations on the island (over 20 feet, or 6 m, above msl) and speculation over future condominium development atop this spoil abounds. (This undeveloped spoil heap has been classified as an undeveloped barrier unit under the 1982 CBRA legislation, but eventual private development of the site is nonetheless anticipated.) The U.S. Army Corps of Engineers (1969) has recommended more extensive beach nourishment and construction of a sand-trapping terminal groin at the north end, but it is doubtful if these recommendations will be implemented.

The south end of the island, where condominium construction has been most intense, has historically exhibited highly variable erosion and accretion rates as a result of the changing morphology of Big Carlos Pass. Since about 1980, a nearshore bar (Little Estero Island) has emerged
subaerially and now offers a modicum of protection to the multi-unit structures lining the formerly exposed beachfront (refer to Plate 12). Human modification in the form of beach grading, cutting of colonizing Australian pines and topping of colonizing mangroves (both of which obstruct the view from the main beach) were observed on and near Little Estero Island in 1985.

The post-World War II popularity of backbarrier development, in the form of residential canal subdivisions, would have claimed all of the mangroves had it not been for establishment of the Matanzas Preserve and rigid enforcement of wetlands protection laws beginning in about 1980. Many tales of clandestine dredging were heard during the course of fieldwork in 1985, but federal officials have forced developers to undo their illegal work in recent cases. As mentioned, several unfinished canals and rectangular parcels of mangroves stand as testimony to the stricter enforcement policies of the 1980s.

In spite of the many hurricanes and subsequent emplacement of groins, seawalls, etc. which led to an aesthetic deterioration of the beach, few negative attitudes toward storms and erosion were noted during the field study. Even historically, hurricanes and other storms were seen as minor inconveniences rather than causes for alarm. Rebuilding and shore armoring were perceived as costs one had to pay to live "on the beach". And although the modern trend is toward more "natural" methods of erosion control, i.e. beach nourishment, many property owners feel that only the traditional "hard" structures will hold back shoreline encroachment.
**Future Trends**

The future landscape of Estero Island will be determined by a combination of economic conditions and regulatory guidelines. Lee County and the State of Florida now have strict regulations regarding development both along the shorefront and in backbarrier wetlands. Redevelopment along the shorefront in the event of removal by storms is being restricted by legislation enacted in 1965, as is continued erosion control in the form of seawalls, groins, and riprap. Although natural forces could cleanse the shorefront of older housing structures, stricter state legislation will limit post-storm landuse upgrading (i.e. redevelopment). Highrise condominium expansion has already been curtailed by the new density requirements, wetlands legislation, and other factors. However, inflated property values and taxes are forcing many residents to sell out. As individual properties may subsequently be consolidated by major developers, the island landuse, especially along the desirable beachfront, may well intensify. This action may only push Fort Myers Beach closer to a theoretical "carrying capacity" and cause many tourists to move on to less spoiled recreational beaches.
CHAPTER VIII. PENSACOLA BEACH, FLORIDA

Location

Pensacola Beach is a 6 mile (10 km) long resort located near the western end of northwest Florida's 52 mile (83 km) long Santa Rosa Island. Originally a summer resort for nearby Pensacola, 6 miles (10 km) distant via two causeways (Figure 42), Pensacola Beach's recreational...
hinterland presently includes Georgia, Alabama, and the urban centers of Louisiana (New Orleans is approximately 200 miles [320 km] distant). Although the first local highway access to the beach was at Gulf Beach on Perdido Key, completion of the causeways and the 100 mi (160 km) long coastal highway ("the Miracle Strip") between Pensacola and Panama City in the early 1930s led to the emergence of Pensacola Beach as a major seaside resort in western Florida. Potential for further urban expansion is presently limited by the adjoining Gulf Islands National Seashore, and also local concerns about overdevelopment.

**Physical Environment**

Santa Rosa Island is an example of a dune, dune flat, and washover barrier island, where beach ridges are poorly defined and occur only at the spits (Stapor 1975). The island is considered to have formed primarily by longshore drift processes (Kwon 1969), and sediment transport is dominantly to the west. The coarse, white 100% quartz sand is traced to a source in the Appalachians (Shepard and Wanless 1971), and transport to the coast was via the Apalachicola River system and perhaps also several smaller river systems. A Pleistocene barrier ridge is identified in certain segments, including the Gulf Breeze area presently separated from the modern barrier by Santa Rosa Sound (Figure 43). Much of the sand being supplied to western Santa Rosa Island today is due to updrift erosion of Pleistocene deposits (Kwon 1969). Wave energy is relatively high along this coast because of a steep nearshore, but a steady sand supply has kept shoreline erosion to almost zero during the historical period. Longshore sediment drift has been conservatively esti-
Figure 43. Physical setting of Pensacola Beach.
mated at 180,000 yds\(^3\)/yr (135,000 m\(^3\)/yr) (Stapor 1975). Although a maximum shoreline erosion rate of 4.3 ft/yr (1.3 m/yr) was reported for westernmost Santa Rosa Island (6 or 7 miles [10 km] west of Pensacola Beach) for the 1934-1965 period (Stapor 1975), no significant erosion was noted at the resort. Post-storm shoreline re-establishment is also rapid: beach profiles at Pensacola Beach show that from erosion incurred during Hurricane Elena in 1985, recovery took place within one year (Morgan 1986, pers. comm.). The narrow shore segment occupied by Pensacola Beach exhibits no distinctive beach ridge but only dunes (several over 25 feet, or 7.6 m, high), dune flats, and washovers. Several small pockets of marsh wetlands border the sound side.

**Pre-Recreation Settlement**

Pensacola is one of the oldest cities in the United States. Originally established near its present location in 1559, the Spanish outpost rapidly failed, primarily due to Indian aggressions. Although re-established at its original mainland site in 1696 (Bliss 1898), the settlement of Pensacola was soon shifted to Santa Rosa Island in the early 1700s. Although the hurricane hazard at this site was quickly noted, optimal defense against an expanding French colonial empire nearby (headquartered at Mobile at that time) necessitated a barrier island settlement location (Muir 1983). Hurricanes in 1722 and 1736 destroyed the outpost, but it was rebuilt after each storm. When a 1752 hurricane again destroyed the settlement, it became relocated to near its original site on the mainland (Muir 1983).

Upon American acquisition following the war of 1812, Santa Rosa Island became federal property, for use as a military and lighthouse
reserve. In the 1840s, Fort Pickens was built at the western spit to guard the entrance to Pensacola Bay, and during the Civil War, a Union force occupied the fort (Bliss 1898). The fort was abandoned following the war.

**Exploration and Initial Recreational Development.**

In the latter nineteenth century, western Santa Rosa Island became a summer playground for residents of Pensacola. The idea of sea bathing had become popular in Pensacola in the 1850s, and several bathhouses were built on pilings extending out over Pensacola Bay. The Gulf beaches were soon quite popular also (Chipley 1877). By the 1880s, small boats carried urban passengers to the beaches of Santa Rosa Island for the day, and a U.S. Coast Guard life-saving station (designed to keep vigil for ship disasters at sea) became the focal point for recreational activities. Fort Pickens became popular because of Civil War artifact hunting, and during the Indian rebel Geronimo’s incarceration there in the late 1880s, tourism increased. Excursions from New Orleans were even organized (Ellsworth and Ellsworth 1982). Photographs from the 1890s show many hundreds of bathers frolicking in the surf near the Coast Guard station. In 1906 a hurricane destroyed the Coast Guard station, but within two years a hotel was built on the beach nearby. The beach hotel was a popular attraction until the next major hurricane, in 1916, destroyed it. No more recreational development took place until the 1930s.

**Development of Recreational Infrastructure.**

In the early 1920s, at the onset of the Florida land boom and an economically healthy Roaring Twenties nationwide, Pensacola businessmen and Midwestern investors foresaw a big boom in waterfront develop-
ment (McGovern 1976). Although most speculation and development were focused on Pensacola Bay and tributary rivers, the beaches were also seen a major drawing cards for Northern tourists. The easiest coast access was to Gulf Beach, and the Gulf Beach Highway was one the earliest highways completed as part of an active highway-building program that began in the early 1920s. The first seaside hotel—the million-dollar Gulf Beach Hotel—began construction in 1925, but this project became abandoned following the bust of the Florida Boom and the hurricane of 1926 (McGovern 1976). (The hotel foundation is still visible today.)

In spite of hurricanes and economic setbacks, the highway program continued, and a tourism boom was still anticipated (McGovern 1976). Between 1926 and 1931, roads were built in all directions from Pensacola. A Pensacola Bridge Corporation was awarded the rights to build a causeway across Pensacola Bay and subsequently across Santa Rosa Sound. To recoup its investment, the corporation obtained a lease of 2.5 miles (4 km) of Santa Rosa Island from Escambia County (which in 1929 had bought the island from the federal government for ten thousand dollars) to develop a resort which would stimulate travel over its toll bridge (McGovern 1976). Additional rights-of-way were obtained to extend the highway system through to Panama City via a Gulf Coast Highway (soon promoted as the "Miracle Strip"). The causeway to Santa Rosa Island and the resort, soon dubbed Pensacola Beach, opened in 1931. The complex consisted of an amusement facility (known as the Casino) replete with bathhouse facilities for 500, a dining room for 300, a dance hall, and a 1,200 ft (365 m) long fishing pier (McGovern 1976). A license plate survey of beach users in 1931 revealed that Florida, Alabama, Louisiana,
Georgia, and Illinois were most represented, and on Labor Day 1932, a total of 7,000 people visited the resort (Loftin 1971). In spite of the 2.5 (4 km) mile lease, no lateral roads were built and the only development consisted of the casino complex (Figure 44A). In terms of resort morphology, Pensacola Beach had become an RBD without a surrounding settlement.

Infrastructural recreational development did not begin in earnest until the early 1950s. In 1938, the county gave up its claim to Santa Rosa Island, which was returned to the federal government for proposed establishment of a national seashore (Lenox 1973). But World War II interrupted these plans and several military installations were built at the eastern end of the island. Following the war, the western 17.5 miles (28 km) were deeded back to Escambia County, with the stipulation that any development thereon be “in the public interest” (Lenox 1973). A county Santa Rosa Island Authority was created in 1947 to regulate leasing of beach land and to oversee island development. A new bridge was constructed, the casino lease was bought from the Pensacola Bridge Corporation, a development plan was outlined, a road network was laid out, low marshes were filled, a water and sewage system was installed, and by 1950 the first summer homes and motels were built (Lenox 1973).

**Settlement Expansion**

Under the auspices of the Santa Rosa Island Authority, a Pensacola Beach master plan was designed to promote orderly development of a resort. Initially, a commercial district was zoned for the area closest to the Casino, and residential subdivisions were to be created to the east. A
Figure 44. Settlement evolution.
SANTA ROSA SOUND

GULF OF MEXICO

1932

1958

1969

1986

Commercial
Single-Family Residential
Preserved/Public

Condominiums
Under Development

Villa Primera

Development at Pensacola Beach, 1932-1986.
community began to take shape in 1951, and within six years the commercial area was totally leased, mainly to motels, beach cottage complexes, and other recreation-oriented businesses. Lots in the first residential subdivision—Villa Primera—were quickly bought and developed, and summer homes were rapidly colonizing the shorefronts of the second subdivision (Figure 44B).

The year 1960 witnessed the beginnings of a westward expansion to balance the landuse zonation east of the RBD. A Spanish Village exhibit was constructed to commemorate the 400th anniversary of the founding of Pensacola and a Villa Sabine subdivision was created nearby. By the late 1960s, the popular RBD—centered on the Casino and fishing pier, the family-oriented Quietwater Beach on the protected Sound side, and the adjacent commercial district—was flanked by residential subdivisions, and land for further development remained available at both ends of the community (Figure 44C). Much of this remaining land was leased in large blocks by speculators anticipating future development, and in 1970 the Santa Rosa Island Authority put a halt to further leasing. However, most of the resort property had either been leased or optioned by that time.

**Landuse Intensification**

Like other parts of Gulf Coast, Pensacola Beach became swept up by a construction boom beginning in the late 1960s (SRIA 1957-1985). This boom was stimulated by a number of factors including: 1) availability of federal flood insurance, which took the risk out of building expensive homes (earlier homes were generally simple cinder-block houses), 2) establishment of the Gulf Islands National Seashore on much of the island,
which limited the amount of remaining developable land and increased the black market value of leases, and 3) increasing popularity of condominium units, which required less financial investment and maintenance (Gordon 1985) (Figure 45).

![Figure 45. Housing unit construction at Pensacola Beach, 1952-1986. (data from SRIA 1957-1985)](image)

As at Fort Myers Beach, the last remaining parcels of empty land became the loci of this increasingly highrise construction. The zone between the RBD and the entrance to the Gulf Islands National Seashore (the former Fort Pickens State Park) was especially popular with developers. Public recreational facilities and dune preserves were quickly established to prevent total highrise encroachment. The few remaining parcels today are already slated for development (Figure 44D). The east end also witnessed condominium and residential growth during the 1970s,
but by the early 1980s, environmentalists succeeded in setting aside much land for preservation and public usage and limiting future development to 61 acres (25 ha). Construction on the first 10 acres (4 ha) began in 1986, but a poor economy in Louisiana (the major market area for Pensacola Beach) has temporarily halted building activity.

As Pensacola Beach is nearing its areal limits to growth, pressures for redevelopment within the RBD are intensifying (Plate 15). Several older motels have been razed and replaced with highrise condominium complexes, and several others have been converted to a condominium form of ownership. Although the island authority stands to benefit financially from continued highrise development, the present trend,
coupled with a proposal to expand the "core area" (i.e. RBD) into the older residential sectors, has stimulated a public outcry (Hall 1985). Wallace, Roberts, and Todd, a Miami-based environmental planning firm best known for its Sanibel Report (Clark 1976), has been commissioned to give proper direction to development, and until a final comprehensive plan is presented and approved, a moratorium on RBD redevelopment remains in effect.

**Morphologic Aspects of Resort Development.**

Pensacola Beach is somewhat unique among Gulf Coast resorts in that much of the town's development has been guided by landuse plans and lease arrangements, which monitored residential and commercial growth. However, since the onset of the condominium era in about 1970, there has been a trend of diversion away from a pattern of discrete landuse zonation. In 1986, this has culminated in the moratorium on construction in the core area of the resort.

Although attempts at permanent development on Santa Rosa Island have been made since the initial Spanish discovery of the area, not until the provision of highway access was any semblance of development sustained for a time span greater than fifteen years. Upon initial highway access in 1931, the casino complex was built and this served as the RBD for day use recreationists for two decades. Although a sizable 2.5 mi (4 km) reach of the island had been leased by the Pensacola Bridge Corporation, no efforts at development or road construction were made.

From the RBD core, the planned settlement of Pensacola Beach grew toward the east during the early 1950s. The newly-created island
authority laid out a commercial area adjacent to the Casino, and a subdivision containing about 172 lots was platted east of that. The lots in this subdivision were rapidly leased, and a second subdivision was platted. Figure 44B shows the incipient pattern of home construction in Villa Segunda, and initial housing fronted the Gulf beach as well as the soundside beach. In subsequent years, the less desirable interior lots were also filled in with summer homes.

The western flank remained undeveloped in spite of the opening of a new road to Fort Pickens in the early 1950s. Much of the land had been leased in large blocks, by speculators hoping for future profits by selling their leases on a thriving black market. After a replica of the original settlement of Pensacola (Spanish Village) was built along the sound west of the casino in 1959, a third subdivision (Villa Sabine) was platted nearby. In terms of landuse zonation, this created a more morphologically-balanced resort (Figure 44C). The vacant west side beachfront also slowly began to be developed, initially with motels in the mid-1960s and with condominiums beginning in the late 1960s. When flood insurance became available in 1970, the condominium boom began in earnest and the western zone extending to the entrance to Fort Pickens State Park (now the Gulf Islands National Seashore) became the primary locus of this construction (Plate 16). This trend has continued to the present day.

Beyond the single-family subdivisions east of the RBD, leases had been issued for large blocks of land, and as the condominium boom began west of the RBD, a secondary condominium zone became located in this area. The future growth of Pensacola Beach seemed to be headed eastward in the late 1970s and early 1980s, but local opposition to the
rampant growth resulted in the setting aside of several hundred acres for "unimproved recreational" (i.e. undeveloped) use. Only 61 acres (25 ha) remain available for further development.

In terms of resort morphology, Pensacola Beach has essentially reached its areal limits to growth, and presently there exists a conflict between those residents in favor of limiting growth and developers favoring landuse intensification (i.e. redevelopment in the form of highrise condominiums) within the commercial core.

**Human Interaction with the Physical Environment.**

Although the pre-recreation settlement history of Santa Rosa Island was greatly influenced by hurricanes, the modern recreational community
has rebounded quickly from damaging storms. Because of an abundant supply of sediments, shoreline erosion has not been a detriment to beachfront settlement, and even following storms, the shoreline rapidly became adjusted to its pre-storm position. However, storms have rearranged the abundant sand deposits on the island, and dune erosion and overwash have historically been common. Naturally, stabilizing vegetation on the sandy island has been sparse, and geomorphic rearrangement has thus been facilitated. In response, one of the major human adjustments to the physical environment has been both the protection and the introduction of stabilizing vegetation, especially on the dunes. The soundside of the barrier island is exposed to strong north winds during winter cold fronts, and since this area has been popular for summer home development, considerable erosion of soundside beaches has occurred.

Because of the situation of Pensacola Beach, near the receiving end of a steady sediment transport system yet sufficiently updrift of the more unstable western spit, shoreline erosion has not been a problem on the Gulf side. Short-term erosion has accompanied hurricane landfalls, but recovery of the beach profile has always been quite rapid. The greatest impact of hurricanes has been the rearrangement of the sand deposits, especially the primary dunes. The first major hurricane to affect the fledging resort—Hurricane Flossy in 1956—was accompanied by 88 mph (141 kph) winds. Although the resort was evacuated, no major structural damage was incurred, but sand fencing was installed along the beachfront where dune flattening and dune retreat had taken place (SRIA 1957). Because of the paucity of stabilizing vegetation, Christmas trees were laid down in a major dune building effort several years later (SRIA 1962).
Subsequent hurricanes, including Betsy (1965), Camille (1969), Eloise (1975), Frederic (1979), and Elena (1985), also caused dune damage, including dune blowouts, and sand fencing has proven popular both as a means to restore damaged dunes and also to induce dune building in front of beachfront structures. Additional damage to the low primary dunes and the higher dunes was caused by recreationists by means of trampling and dune buggy riding, and a need for preserving dunes was called for as early as 1960 (SRIA 1960). When the condominium boom began in the 1970s, several dune preserves were quickly established to prevent not only loss of the dunes to new development but also destruction of the vegetation by recreationists. Most recently, the "Sugarbowl" at the east end of town (see Figure 43) was set aside as a preserve in 1983 to protect it from development.

Although the Gulf beaches recovered quickly following short-term hurricane-induced erosion, the Santa Rosa Sound side of the resort did not benefit from a natural sand replenishment system. Much of the soundside was naturally characterized by a narrow sand beach fronted by sandy tidal flats. During winter cold fronts, sustained north winds generated sufficient wave action to cause erosion along the island's lee side. By 1960, soundside property lessees called for combative measures to minimize erosion of their homes and lots (SRIA 1960). In 1961, 75,000 yd$^3$ (56,600 m$^3$) of fill, dredged from nearshore sand flats, was placed along the backshore of the (then) two residential subdivisions. This nourishment material slowly eroded, however, and many property lessees bulkheaded their property and installed various types of revetments (e.g. rocks, old tires, etc.). These measures tended to reduce the width of the
beach, thereby lessening the recreational value. Cold fronts and occasional hurricanes, which caused elevation of water levels in the sound, continued the pattern of soundside erosion, and this has remained a problem for the settlement up to the present day. A 1979 survey by Dr. James Morgan, geologist-in-residence, determined average rates of shore retreat to be 1.86 ft/yr (57 cm/yr), although locally rates as high as 3 ft/yr (90 cm/yr) were reported (anon. 1983). In 1984, the Santa Rosa Island Authority adopted the Olsen Report (prepared by a consulting engineer) which divided the soundside into four categories and recommended structural modification along those reaches designated as critically eroding.

Aside from the widespread dune restoration measures, human modifications to the beachfront have been minimal. Unlike many of the other Gulf resorts, the absence of erosion has precluded structural armoring of the shoreline, although the washing up of seaweed and other debris has led to various beach cleanup programs throughout the years. In the early 1960s, however, a cut across the island was proposed so that recreational fishing at the resort would be stimulated. The exchange of water between sound and Gulf via a "fish pass" was a popular idea around the Gulf Coast during that period. Although the proposed pass was never implemented, a cut was made at Navarre Beach, east of Pensacola Beach on Santa Rosa Island, in 1965. This pass quickly became sealed by longshore sedimentation, attributed by many to passage of Hurricane Betsy that same year. Plans to re-open the pass were finally dropped in 1983 because of the potential environmental damage to the ecology of Santa Rosa Sound (Alexander 1983).
Wetland impacts have been minor because of the virtual absence of wetlands on Santa Rosa Island. Several pockets of backbarrier marshes formerly were located at the site of Pensacola Beach, but these were filled when the resort was platted in 1950 (Lenox 1973). Several marsh areas remain east of the settlement, and these are presently under legislative protection.

**Future Trends**

Pensacola Beach is presently in an economic slump because of the oil recession affecting Louisiana, the source of a high proportion of tourists visiting the resort. Pensacola Beach has been considered "Louisiana's beach", and several hotels and realty agencies estimate that 60% to 70% of their clientele hail from Louisiana (Hubbert 1963). Since the 1982 drop in world oil prices, the flow of Louisiana tourists has dropped, and a glut of empty condominium units has resulted. Although the housing unit data show high rates of growth through 1986 (see Figure 45), several of the condominium complexes have delayed onset of construction. This economic downturn has helped the cause of the preservationists, who favor a reduction in continued highrise condominium development. The recession may be a short-term event, however, and recreational usage of the Santa Rosa Island beaches is expected to escalate. Visitation at Pensacola Beach has steadily increased since causeway crossings were first recorded, with only a minor drop in 1979 when Hurricane Frederic struck the Alabama coast (Figure 46). While the temporal patterns of recreational usage may be projected on the basis of past trends, the morphologic expressions of future recreational development will be guided to a great extent by the upcoming comprehensive landuse plan.
Figure 46. Santa Rosa Sound bridge crossings, 1953-1985.
(data from SRIA 1957-1985)
CHAPTER IX. DAUPHIN ISLAND, ALABAMA

Location

Dauphin Island is a 15 mile (24 km) long barrier island on the western flank of the entrance channel to Mobile Bay, approximately 30 miles (48 km) due south of Mobile (Figure 47). Prior to causeway access

Figure 47. Regional setting of Dauphin Island, Alabama.
in 1953, a small fishing village was located on the sheltered soundside, and presently much of the eastern 7 miles (11 km) of the island is recreationally developed. Formerly attracting swimmers and sportsfishermen primarily from Mobile, Dauphin Island today caters to recreationists from interior Alabama, Mississippi, and Louisiana. Highways approach the high-span island causeway from the west and north, and since 1984 an automobile ferry has linked Dauphin Island with the Fort Morgan peninsula, gateway to Gulf Shores, the largest seaside resort in Alabama.

**Physical Environment.**

Geologically, Dauphin Island is a combination of Pleistocene terrace outlier and barrier island. The Pleistocene core of the island is about 4 miles (6.4 km) long (east to west) and 1.5 miles (2.4 km) wide and elevations range between 5 and 10 feet (1.5 and 3 m) above msl (Figure 46). The pine-forested core is fronted by an extensive dune system which reaches elevations of 45 feet (14 m) above msl. An 11 mile (18 km) long Holocene barrier spit, with elevations of about 6 or 7 feet (2 m) above msl and widths as narrow as 700 feet (210 m), trails westward from the edge of the island core. A second spit is Little Dauphin Island, which trends southeast-northwest from the eastern tip of the island. Extensive oyster beds are scattered throughout the shallow waters of adjacent Mississippi Sound.

There is debate as to the exact geologic origin of the island. Some feel that the emergence theory of barrier island formation best explains the chain of barrier islands from Mobile Bay westward through Mississippi (Otvos 1982). In addition to a proposed offshore source of
Figure 48. Physical setting of Dauphin Island.
barrier island sediments, sources of sand include: in situ erosion of the Pleistocene deposits, longshore sediment transport from the Gulf Shores area (via the ebb tidal delta shoals at the entrance to Mobile Bay), and sediment flushing through Mobile Bay. The tidal shoals south of Dauphin Island (including the subaerial Pelican Island and Sand Island) shelter the core of island by breaking incoming high waves. The waves are refracted and subsequently focused on the narrow western spit, which is subject to frequent breaching and overwash during storms (Hardin et al. 1976; and Nummedal et al. 1980). A relationship between the offshore shoals and the massive barrier dune complex is inferred, as the total sand volume appears to have increased during this century. Dune encroachment of more than 500 feet (150 m) into the pine forest was recorded for the 1917-1942 period, while shoreline erosion along that reach was relatively insignificant (Hardin et al 1976). Average island-wide shoreline erosion rates of 6.34 ft/yr (1.93 m/yr) characterized the 1917-1942 period, but rates up to 12 ft/yr (3.6 m/yr) were noted at the west end for the 1917-1974 period (Hardin et al. 1976). The western spit has grown 1.8 miles (2.9 km) during the same period, indicating considerable longshore sediment drift. The best estimates of drift rates are based on dredging records: since 1957, an average of 264,000 yd³ (199,000 m³) were removed from the 42 ft (12.8 m) deep navigation channel annually (Hardin et al. 1976).

Hurricanes have historically caused much breaching of the western spit, near the point where it trails off of the Pleistocene core. A 1917 map shows the western spit separated by as much as 5 miles (8 km) from the forested portion (Hardin et al. 1976). By 1942, the breach had healed, but
in a 1948 hurricane it was reopened. Subsequent hurricanes, notably Camille (1969), Frederic (1979), and Elena (1985), have caused short-term breaching and extensive overwash in this zone.

Vegetatively, Dauphin Island consists of poorly-drained pine flatwoods within the core of the island, behind the dunes. Well-drained upland species, including live oaks (*Quercus virginiana*) and eastern red cedars (*Juniperus virginiana*) were confined to an aboriginal shell midden and a few well-drained pockets of high ground near the edge of the sound. A fringe of marsh occupied the soundside prior to extensive modification by dredging and filling. The dunes, including both the high dunes and the low primary dunes, are sparsely vegetated and highly unstable. The narrow barrier spits, at the western end and at Little Dauphin Island, are characterized by salt marsh (*Spartina alterniflora*) along their backbarrier fringes.

**Pre-Recreation Settlement**

Dauphin Island, long settled by Indians, was first discovered by the French in 1699. Within two years, a small settlement was established on the Gulf side of the island, facing what are today the Pelican Island shoals. The beachfront settlement by 1706 consisted of a fort and a row of eighteen to twenty houses. A 1717 hurricane silted up the entrance to the harbor and destroyed the settlement, forcing several of the survivors to rebuild on the shell mound on the island's soundside (Hamilton 1898). Port Dauphin, considered to be the "cradle of French Louisiana", was finally abandoned as the French focused their settlement plans upon Mobile, Biloxi, and New Orleans (Holmes 1967), although several persons
are reported to have remained on the island (Hamilton 1898). It is likely that individual settlers remained on Dauphin Island throughout the eighteenth century.

As at Pensacola Bay, fortifications were built at the entrance to Mobile Bay in the 1820s. Fort Gaines was built at the eastern tip of Dauphin Island (East Point or Pelican Point). By the mid-1830s, the building of a resort hotel near the fort was proposed (Ingraham 1835), but these plans were never realized. Following a flurry of Civil War activity (Admiral Farragut landed 1,500 troops during an amphibious assault in 1864), the feasibility of extending a railroad to the island was studied (McNeely 1974). Although foundation strength appeared to be an engineering problem, railroad proposals surfaced again in 1887 (anon. 1887b) and in the late 1910s (McNeely 1974).

By the latter nineteenth century, a small fishing settlement occupied the soundside of the island (Figure 49A). Houses dotted the shell mound and a small area of forested uplands near the marshy edge of the island. A population of about one hundred was noted in 1887 (anon. 1887b), and paths ran along the island to Fort Gaines. Cattle, goats, and hogs roamed throughout the island and fruit and vegetable gardens were common. Oranges and grapefruits were popular truck crops sold on the mainland (Smith 1968). By 1915, the island had a hotel and a dance pavilion, and soldiers from Fort Gaines (where as many as 1,800 were stationed in 1918) occasionally rode into town for weekend dances (Smith 1968). As late as 1947, the village, by then with an estimated population of about 285, was still relatively untouched by tourism.
Exploration and Initial Recreational Development

The idea of building a resort hotel on Dauphin Island was first proposed in the 1830s (Ingraham 1835), and all subsequent proposals for rail linkages to the island included references to potential beach hotel development. During the mid-nineteenth century, several popular bay-front recreational communities catered to uppercrust Mobilians: the high-elevation (over 100 feet, or 30 m, above msl) eastern shore of Mobile Bay (site of the recently restored Grand Hotel), and the Coden/Sans Souci Beach/Bayou la Batre shorefront across the sound from Dauphin Island. In all likelihood, Dauphin Island was visited by recreationists during this period, but no regular boat service other than mail delivery to the island existed.

Perhaps in conjunction with the proposed Mobile & Ohio Railroad extension to the island, a Birmingham company (Gulf Properties Corporation) acquired title to most of the island in 1912 (anon. 1946). Minor efforts were made to recreationally improve the island. According to one long-term resident, a bathhouse stood on the Gulf side of the island by about 1920 (Patronas 1986, pers. comm.). Visitors would come to the island to bathe, and some would stay at the small village hotel. USCGS survey charts of 1916 and 1921 show that a road was constructed across the island between those years, although no beach structures are shown on the maps. The bathhouse was allegedly destroyed during the infamous 1926 hurricane, and a second bathhouse was constructed in the late 1920s near the western end of the dune field, approximately at the site of the present Bienville Beach county park (Patronas 1986, pers. comm.). In 1929, the Dauphin Island Deep Sea Rodeo (allegedly the second oldest
fishing tournament in the U.S., after the Grand Isle Tarpon Rodeo) was begun, and Fort Gaines served as base of operations. The first topographic map (USGS 1943) reveals little recreational development since 1894, but
the island village had grown and become extended laterally along the
soundside (Figure 49B).

**Development of Recreational Infrastructure**

Not until after World War II was the infrastructure laid out that
would transform Dauphin Island into a recreational landscape. Following
the war, local business interests in Mobile—members of the Mobile
Chamber of Commerce—proposed a bridge span to the island to encourage
recreational usage and development. To pay the estimated three million
dollar cost of building a bridge, a one-cent-a-gallon county gasoline tax
was proposed. However, this plan was soundly defeated by voters at the
polls in 1948, and the issue was temporarily laid to rest (McNeely 1974).

In 1953, the Mobile Chamber of Commerce decided that the best
way to fund a bridge would be to buy Dauphin Island, subdivide it into
homesites, and use the proceeds from lot sales to finance the initial
purchase as well as the bridge (McNeely 1974). An offer of one million
dollars was made to Gulf Properties Corporation for purchase of the island.
For this price, the corporation agreed to sell 5 miles (8 km) of island (as
measured westward from Fort Gaines), with an extra mile of the western
spit thrown in if a road were completed all the way through the property.
The remaining 7 miles (11 km) were to be kept by the Birmingham
interests. A Dauphin Island Land Sales Corporation was set up to sell the
lots, and proceeds were to be distributed in the following fashion: 50% to
the Chamber of Commerce to pay off development fees, 35% to a Dauphin
Island Property Owners Association for island improvements and
maintenance, and 15% to a Dauphin Island Park and Beach Board to
oversee public facilities on the island. An estimated 1,500 lots were considered minimum to raise the necessary funds, so roads were cleared and 1,500 lots surveyed and marked for inspection by prospective buyers. In November 1953, the lots went on sale, and buyers from Alabama, Mississippi, and Louisiana put down money for 1,800 lots in the first three days of sales. Substantial discounts were given for cash payment, and when 80% of all sales were in cash, the Chamber’s cash flow problems were readily resolved (McNeely 1974).

Although the pre-sales land plat map of Dauphin Island showed the settlement infrastructure as occupying the higher-elevation portions of the island and a 2 mile (3.2 km) portion of the western spit, the unforeseen high demand for lots required the addition of at least 500 extra lots. The Chamber of Commerce decided that even more than 500 lots could be added if Florida-style fingerfill development were added along the entire soundside of the island and lots were extended westward along the narrow spit (McNeely 1974). By law, all tidal lands inland of a Harbor Line artificially delineated by the Alabama State Docks in 1938 had passed on to Dauphin Island Land Sales Corporation as part of the Gulf Properties Corporation island sale (Pearson 1970). The tidal lands were turned over to the Alabama State Docks for the purpose of officially revising the Harbor Line with the intention of development, and for the fee of one dollar, the property was re-conveyed to the Dauphin Island Land Sales Corporation (Pearson 1970). Fingerfill development contractors were brought in from St. Petersburg, Florida, and during two phases of construction (1954 and 1959), 422 acres (171 ha) of the soundside of the island was dredged, bulkheaded, and filled (Plate 17 and Figure 49C).
(Rhode 1980-81). By 1959, when the Dauphin Island Land Sales Corporation finally shut its doors, 2,800 lots had been sold, and six million dollars had been made in sales (McNeely 1974).

As the island infrastructure was being completed in anticipation of a recreational boom, negotiations were being made to construct the bridge and lay the electric and phone cables. The bridge construction had been authorized by Alabama Governor Gordon Persons in the late 1940s, if two million dollars were contributed by the Mobile Chamber of Commerce to help defray the then-estimated three million dollar cost. The bridge construction contract was let on December 31, 1953, the last full day of the governor's term of office.
In July 1953, the Gordon Persons Overseas Highway was completed, replete with strategically placed recreational fishing platforms. On the island, the Sand Dunes Casino was under construction fronting the one mile (1.6 km) long public Bienville Beach, and a 300 ft (90 m) fishing pier extended seaward from the facility. A dancehall/restaurant/lounge (the Fort Gaines Club) was created out of one of the old military buildings. An Isle Dauphine Country Club began construction in the high dunes near the center of the island. Near Fort Gaines, fairways were laid out for a golf course. Although this was never completed because of the illegality of operating a public, racially discriminating golf course, later a private golf course was built on the country club property in the high dune field.

**Settlement Expansion**

Following the opening of the causeway and provision of the basic infrastructure, commercial and residential development ensued. The Sand Dunes Casino became a prime attraction for beach recreationists and a commercial zone developed in that area. A 100-room beach hotel (later sold to Holiday Inn) was built next to the Bienville Beach county park in 1956, and within a few years, two more motels were built.

Since most of the residential lots were already sold by the time the causeway opened, settlement expansion took the form of lot infilling. By 1956, a total of about 60 vacation homes had been built, and they were distributed throughout the island. This summer home building phase waned, however, and by the mid-1960s only another 140 homes had been added (Sheaffer and Roland, Inc. 1981).
In addition to the lots sold through the Chamber of Commerce, much of the initiative in development is ascribed to several New Mexico investors. These speculators acquired Little Dauphin Island with plans for development, bought 4,000 feet (1,216 m) of beach frontage east of the country club for motel construction, developed the aforementioned resort hotel, and were instrumental in getting an airstrip constructed. The New Mexico interests also made plans for a major medical complex to be built on the island, and Little Dauphin Island was to be converted into residential and commercial property. These plans did not materialize, however.

By the late 1960s, many of the recreational facilities had fallen into disrepair or become vandalized, the beach had not been maintained properly, and the whiter sand beaches of Gulf Shores on the eastern side of Mobile Bay were attracting ever more recreational development. The original Dauphin Island fishing pier had rotted away, and the second was soon due for replacement. The Mobile Chamber of Commerce was accused of not living up to its promises of maintaining facilities (Sweatt 1971).

As at other Gulf Coast resorts, an upsurge in construction began in the late 1960s and 1970s, in part due to passage of the National Flood Insurance Act. Most of this growth was in the form of vacation home infilling. Construction increased especially along the vulnerable western spit, and by 1975, an estimated 850 structures stood on the island (Harrison 1975). With increased growth, the septic tank method of sewage disposal was no longer adequate. When high levels of fecal coliforms appeared in the soil in 1971, a moratorium on new septic tank installation was issued for the island core (Rhode 1980-81). However, above-ground septic holding tanks were still (temporarily) permitted on
the western spit. By 1979, a total of 1,000 residential structures was reported (USACE 1981b), and the population consisted of 680 permanent residents and 2,215 seasonal residents. Visitation at this time was estimated at 3,450 daily during the peak summer season (Jordan, Jones, and Goulding, Inc. 1980).

Settlement expansion on Dauphin Island was set back severely by passage of Hurricane Frederic in 1979. This storm, barely a Force 4 on the Saffir-Simpson scale, battered the island with sustained 130 mph (206 kph) winds and water levels as high as 13.5 feet (4.1 m) (Rhode 1960-61). The destructive winds, dominantly out of the northeast caused much damage along the soundside of the island and also destroyed the causeway (USACE 1981b). The storm surge mostly affected the low, narrow western spit in the form of extensive overwash activity and breaching at two locations (Nummedal et al. 1980). Of the 1,000 residential structures on Dauphin Island, 144 were totally destroyed, and 656 received extensive damage. Further analysis of those figures indicates that of the 676 homes behind the high dune ridge, only 17 (2.5%) were totally destroyed, whereas of the 332 homes along the western spit, 127 (38.3%) were totally destroyed (Rhode 1980-81). The three beachfront motels west of the county park were also completely destroyed (Plate 16).

**Landuse Intensification**

Dauphin Island entered the condominium era at the time the trend was becoming popular throughout the Gulf Coast, but low recreational demand precluded extensive high-density construction. The first
Plate 18. Dauphin Island's recreational business district, 1986. (Note concrete foundation of motel destroyed by Hurricane Frederic)

Condominiums on the Alabama coast were built at Dauphin Island in 1969, overlooking the Gulf from the high dunes (Figure 49D). Waterfront condominium units were built along the island's soundside in 1976, and a second beachfront condominium was completed in the mid-1980s. The relative paucity of high-density housing reflects low levels of demand, which in turn are attributed to physical, infrastructural, and social factors. Physical deterrents include more sediment-laden nearshore waters and less attractive beaches than east of Mobile Bay. Infrastructurally, Dauphin Island has a building code which limits heights of multi-unit structures to three stories. Socially, Dauphin Island has earned a reputation as a place for quiet family recreation, unlike the party reputation that Gulf Shores has acquired. Also, after destruction of the causeway as a result of
Hurricane Frederic in 1979, no road access to the island existed for three years. During that period, Gulf Shores experienced a major touristic boom characterized by extensive landuse intensification. When a new, thirty-eight million dollar high-span bridge linking Dauphin Island to the mainland opened in 1982, the anticipated resurgence of recreational development was less than expected.

**Morphologic Aspects of Resort Development**

Prior to the acquisition of the island by the Mobile Chamber of Commerce and the opening of the causeway, several patterns of a future resort morphology had already become established. The small commercial district originally catering to the local community grew because of its strategic position at the terminus of the causeway, and a distinctive central business district (CBD) can now be identified. Two pre-causeway recreational foci existed: fishermen flocked to the Fort Gaines area (then site of the annual Deep Sea Rodeo), and bathers congregated at Bienville Beach, site of the best bathing beach on the island.

When the initial development plan for Dauphin Island appeared in 1953, these recreational foci became incorporated into the plan. Both Fort Gaines and Bienville Beach were designated parks, and at Bienville Beach, a commercial zone of motels and businesses (RBD) was platted along the main road (see Plate 18). A soundside sand beach existed between the old Shell Mound (renamed Indian Mound Park) and the causeway terminus, and a third locus of recreational development was envisioned for this area (e.g. boat landing, marina). Most of the original 1,500 lots were platted on high ground, protected behind the high dunes. Only limited surveying of
the western spit was completed, although the expansion potential into this zone was noted on a 1953 subdivision map. Lot owners were to have access to a private one mile (1.6 km) beach (Dauphin Beach) fronting the Isle Dauphine country club east of the public Bienville Beach. Between the country club and the designated Fort Gaines Park, one mile (1.6 km) of beach and dune property was set aside for hotels and multi-unit housing.

The initial subdivision plan for the island has remained essentially intact, except for the fact that the high demand for lots led to doubling of the total number of lots. As discussed earlier, this doubling was achieved both by extensive, quasi-legal dredge-and-fill operations along the soundside and also by an extension of subdivision plats westward along the beach spit, including into the last mile (1.6 km) of optioned land.

Human Interaction with the Physical Environment

Until the recreational development of Dauphin Island in the 1950s, human interactions with the physical environment consisted of adjustment to physical processes and a minimum of environmental modification. Except for during the initial, aborted flirtation with exposed Gulf settlement in the early eighteenth century, island inhabitants maintained their residences in sheltered portions of the island and above the backbarrier wetlands. The highly dynamic barrier spits (Little Dauphin Island and the western spit of Dauphin Island) were avoided as settlement sites, and the breaching of the western spit in 1917 and 1946 reinforced this pre-recreational avoidance (Rhode 1980-81). Although a hurricane in 1906 (a Force 3 hurricane) caused three deaths and allegedly stimulated an exodus from the island (Rhode 1980-81), other historic hurricanes (e.g.
1916, 1926) apparently had little impact upon settlement at Dauphin Island. Pre-recreational human modification of the physical environment included the dredging of a navigation channel to the village in the early 1900s and shore protection measures at Fort Gaines (Smith 1968).

The greatest modification along the exposed Gulf Shore has been in the vicinity of Fort Gaines, where erosion of the eastern point threatened to undermine the fort. During the 1920s and 1930s a groin field, containing seventeen groins and one jetty at the entrance of a boat slip, was built around the whole east tip of the island (Plate 19). In addition, sand (presumably brought in from outside the immediate area) was piled up against the fort to act as a buffer during storm events. When the Dauphin Island Land Sales Corporation "improved" the island to make it saleable, the sand covering was removed from the fort and placed back.
between the groins, along with a considerable amount of rubble (McNeely 1974). The westernmost groins have been severed from the beach with successive storms, especially Frederic (1979) and Elena (1985).

Once the island became recreationally developed in the mid-1950s, more significant environmental modifications resulted. The creation of 422 acres (171 ha) of fingerfill land from marshland to meet the demand for lots is the greatest impact in areal terms. Navigation channel dredging to provide boat access to the created lots accompanied the reclamation activities. Pass Drury through Little Dauphin Island was also dredged to provide direct access from Mobile Bay (McNeely 1974), even though the history of the pass had been characterized by alternating states of being open and being sealed. Other negative environmental impacts included using sand from the high dunes as fill for low residential lots, a process still sporadically ongoing (illegally) in 1986. Also, when the golf course was laid out in the high dunes on the country club property, a suitable soil for the grass fairways was necessary, so one of the freshwater lakes (Alligator Pond, shown on Figure 48) was drained and the clay excavated and transported by truck to the golf course site (McNeely 1974). Dune buggy destruction of dune vegetation was also noted in the 1960s and 1970s, and efforts were made by local citizens to replant damaged dunes and to close off vehicle accessways to the dunes (Baxley 1974).

With the exception of the groin field at Fort Gaines, few efforts at shoreline erosion control were made until after the passage of Hurricane Frederic in 1979. As at Pensacola Beach, sand fences were installed by property owners along the unstable western spit to maintain primary dunes. When shoreline erosion threatened the Isle Dauphine Country Club
in the mid-1970s, unsuccessful experiments with cement blocks ("sand-grabbers") placed in the nearshore were conducted.

The greatest recent impact upon development at Dauphin Island has been Hurricane Frederic, and details of the physical and geomorphic impacts are described in several publications (Nummedal et al. 1980; Schramm et al. 1980; and USACE 1981b). The storm caused considerable erosion along Little Dauphin Island, the east end of Dauphin Island (where the sand had been removed from between the rock groins), the Pelican Island/Sand Island shoals, and especially the west end, where up to 130 feet (40 m) of shore retreat was noted (Nummedal et al. 1980) (Plate 20). Not only was damage to housing most severe at the west end, but shore-normal roads and backbarrier canals also helped to determine the location of washover channel tracks (Schramm et al. 1980). Inspection of post-storm photography of the westernmost residential housing reveals that "feeder roads" from beach to main highway tended to function as washover channels (Figure 50). Whether this increased storm damage to adjacent summer homes has not been determined, however.

Restoration of the beachfront became a high priority item following Hurricane Frederic. Stabilization of the high dunes was attempted by aerial seeding of sea oats. Sand fencing and hand planting of dune vegetation was implemented by west end property owners who had witnessed the vegetation line shift inland. By Alabama law, all new coastal construction must be no less than 40 feet (12 m) inland of the primary dune crest (normally indicated by the presence of vegetation), although the state leniently ignored these guidelines during post-Frederic
reconstruction (Canis et al. 1985). The concept of beach nourishment was brought up following the storm, primarily as a mechanism to offer protection to storm-vulnerable structures on both the east and west ends (Breland 1982). The U.S. Army Corps of Engineers had previously decided that the only feasible form of beach nourishment would entail deposition of dredged material derived from channel maintenance dredging onto the seaward-sloping face of the offshore Pelican Island/Sand Island shoals.
This deposition would create a "submerged berm" available for transport by longshore currents to the beaches of the western spit. After various delays, this nourishment technique was to have been implemented during the fall of 1966 (Burdin 1986, pers. comm.).

Figure 30. Washover channels on Dauphin Island following Hurricane Frederic, 1979. (housing data from October 1983 field survey)

**Future Trends**

Dauphin Island is today a quiet resort and prospects are likely that it will remain that way. Development has been hampered by a variety of factors, including: 1) lack of county maintenance of facilities in the 1970s, 2) lack of sufficient recreational infrastructure and public facilities, 3) zoning ordinances against highrise construction, 4) septic tank installation moratorium since 1976, 5) periodic excess demand upon the water supply system, which is fed from local aquifers, 6) Hurricane Frederic, which destroyed most commercial development and left the island without road...
access for three years, and 7) corollary high recreational growth at Gulf Shores, which appears to have diverted beach demand away from Dauphin Island.

The causeway has been rebuilt, a sewage treatment plant installed, the few public facilities cleaned up, ferry service begun to Fort Morgan, and most of the destroyed buildings removed, but no post-hurricane boom has been felt at Dauphin Island. A development plan commissioned after the storm predicted steady increases in visitation and seasonal population, but cautioned that problems with sewage disposal and provision of drinking water may result if summer populations of 10,000 become realized (Jordan, Jones, and Goulding, Inc. 1980). More public facilities were recommended, including a campground which has since been opened at Fort Gaines. Statistical data on recreational usage at Dauphin Island are difficult to obtain, but post-storm growth has been relatively slow. Hotel and motel rooms are practically non-existent, but there is a thriving seasonal market in cottage rentals. Recreationists are mainly families, attracted to the island because it exhibits less of a "beach party" atmosphere than do Gulf Shores or Pensacola Beach.

Gulf Shores, on the other hand, has benefitted economically from a hurricane that removed beach structures from an earlier era (1950s and 1960s) and allowed beach structures of the 1980s (highrise condominiums and resort hotels) to take their place. Coupled with a major publicity campaign which included changing the local beach nickname from "Red-neck Riviera" to "Pleasure Island" and advertising heavily in Midwestern states (beyond the traditional hinterland of the Alabama coast) and four-laning of the access highway from Mobile, construction rates at Gulf
Figure 51. Urbanization along Alabama's Gulf Coast, 1963.
Shores were perhaps the highest along the entire Gulf Coast in the early-to-mid-1980s. Much of the Alabama coast is presently urbanized (Figure 51), and the Gulf Shores area from the Fort Morgan peninsula to Perdido Key has been most affected by recent construction activity.

The federal Coastal Barrier Resources Act may also play a small role in limiting the future development on Dauphin Island. The western spit beyond the existing settlement is presently owned by the West Dauphin Corporation, which has expressed interest in developing the property. These plans are currently on hold, in large part because of a presently poor economy. Also, as the property is entirely within a CBRA unit, and no federal funds may be expended in the development and maintenance of recreational infrastructure. Little Dauphin Island, too, has been proposed for future development in spite of the lashing it received from Frederic. The island has been included in the updated 1985 CBRA legislation, which was formally adopted by Congress in March 1987. With the two tracts of lands set aside for preservation, the developable area of Dauphin Island will essentially include only what is presently developed or platted for development. In view of the slow pace of growth, one would expect much time to elapse before all stages of a resort cycle are completed and a dense landuse pattern is produced.
CHAPTER I. PROGRESO AND VICINITY, YUCATAN

Location

The north coast of Yucatan is a recreationally developed barrier coast situated 22 miles (35 km) north of Mérida, the capital of Yucatan (estimated 1985 population: 500,000) (Figure 52). The closest beaches to Mérida are at the port town of Progreso, where seaside recreation has been practiced for over a century. With the provision of road linkages, the smaller coastal towns have also become engulfed by a recreational landscape. As the majority of beach recreationists are residents of Mérida, the primary beach access is via the four-lane highway to Progreso, where the intensity of recreational development has remained greatest.
**Physical Environment**

Characterized by multiple beach ridges, indicative of a past history of accretion, the North Yucatan coastal barrier is locally fronted by vegetatively stabilized dunes up to 10 feet (3 m) high (e.g. at Chuburná). The beaches are composed of carbonate materials on a wave-cut surface developed in limestone (Tanner 1975). The shoreline is generally long and straight, except where interrupted by small "headlands", formed by limestone outliers (Sapper 1945). Some of these rock outliers are in the nearshore, where they function as natural breakwaters and reduce wave energy and locally produce tombolos. The barrier is separated from the limestone mainland by an extensive mangrove-fringed lagoon system, referred to as La Ciénaga (locally known as Estero Yucalpetén). This shallow lagoon system extends eastward across most of the north Yucatan coast, and two natural outlets of the lagoon are found 7.5 miles (12 km) south of Celestún (a fishing port due west of Mérida) and 4 miles (6.4 km) east of Dzilam de Bravo (Edwards 1954; and Wilson 1980). The lagoon is noted for its variety of waterfowl, and fishing and salt-gathering (in small salinas, or impoundments) are locally important economic activities (Wilson 1980).

The north Yucatan coast is characterized by variable rates of shoreline erosion. Retreat rates of 5.9 ft/yr (1.8 m/yr) over a 110 year period have been reported (Gutierrez 1963), but comparison of 1946 and 1978 aerial photographs reveals rates on the order of 1 to 2 ft/yr (30 to 60 cm/yr) for the Progreso area. The greatest shoreline erosion has taken place along the coastal reach west (downdrift) of the jettied harbor entrance at Yucalpetén, where rates of 3 ft/yr (90 cm/yr) were measured.
East of Progreso, shore erosion has been reported to exhibit a high degree of cliffing of beach ridges (Tanner 1975).

**Pre-Recreation Settlement**

In the pre-colonial era the region was part of the Mayan province of Cehpech. Several early habitation sites dotted the north coast, ranging from a major village at Chuburná Puerto to small shell middens along much of the lagoon (Eaton 1978). Salt production and fishing were the primary aboriginal economic activities.

Under Spanish colonialism, fishing and salt production remained important in the many small hamlets of the Gulf of Mexico coast of Yucatan. Salt production was the major economic activity at several locales, including Las Coloradas and Telchac Puerto east of modern Progreso, although salt was also produced at Chuburná Puerto and Chicxulub Puerto. Chelem was not settled prior to arrival of the Spanish, although it served as a fishing encampment during the colonial era (Eaton 1978).

The port for Yucatan during most of the colonial period was Campeche, located 125 miles (200 km) southwest of Mérida. In 1810, during the final years of colonial rule, successful petitioning by Yucatecan commercial interests led to a shift of the official port to Sisal, a fishing settlement about 30 miles (50 km) northwest of Mérida (Moseley and Terry 1980). By the 1830s, as the export of **henequén** (for binder twine) began to increase, it became apparent that a new port closer to Mérida was needed to replace Sisal, which frequently was inaccessible during the rainy season. (Henequén had become known as **sisal**, because of stamp imprinted on the bales of fiber at the point of export.) In 1840, a scouting
expedition determined that the stretch of coast closest to Mérida, between the vigias (coastal lookout points) of Chicxulub and Chuburná, would be suitable. In 1856, after various studies and legal investigations, authority was granted to construct a port settlement, named Progreso de Castro, at the selected site, and within a year the first houses were built. By 1861, a crude road from Mérida to the new settlement had been constructed (Ferrer 1945). The first wharf was completed in 1870, and in 1871 the customs authority was formally transferred from Sisal to the newly-opened port of Progreso. Train service between Mérida and Progreso began in 1881 as Yucatan was entering its "Golden Age" because of high worldwide demand for henequén (Moseley and Terry 1960). A second rail line (narrow-gauge) from Chicxulub Pueblo reached the new port in 1886, and Progreso experienced an economic boom.

**Exploration and Initial Recreational Settlement**

Although the main function of the railroad was the shipment of cargo (mainly the export of henequén), passenger service was also available to transport Mérida residents to the coast. Many Méridans soon traveled to the beaches as day users, and wealthier families began to build summer residences at Progreso during the 1880s and 1890s (Frias 1985, pers. comm.). One of the first references to beach recreation along the north Yucatan coast is contained in a report of a 1903 hurricane, which caused extensive roof damage to homes, tossed boats upon the beach, and toppled trees in town (Frias and Frías 1984). Many seasonal residents, in town for the summer months, returned to their Mérida homes early. By 1907, three hotels existed in Progreso, although these mainly served ship passengers in transit to other parts of Mexico or
overseas. The same year a large beachfront recreational facility (with game rooms, dance hall, etc.) was constructed by North American interests, and a special excursion train from Mérida brought celebrants to the grand opening (Frias and Frías 1984). By 1912, Progreso had established a reputation as a popular vacation destination for Mérida residents.

**Development of Recreational Infrastructure**

In 1928, the Mérida-Progreso highway was paved, and the shorefront of Progreso was recreationally improved. A malecón, or concrete beachfront promenade, was constructed east (updrift) of the port facility, and restaurants and dance clubs located along the landscaped beachfront drive. Increasing numbers of opulent summer homes came to line the Progreso shorefront, behind the malecón and along the beach toward the east. Tourism became an important tertiary component of Progreso's economy, after fishing and port-related functions (Plate 21).

At the same time the recreational infrastructure was expanding during the late 1920s and 1930s, Progreso's port facilities were gradually deteriorating in response to reduced export of henequén (Frias and Frías 1976). The two wooden wharves didn't offer enough docking space to keep up with demand. Small cargo carriers of the "mosquito fleet" were often diverted to the ports of Chicxulub and Chelem, and at the former a wooden pier was constructed in the 1940s. Chelem, only an "official" settlement since 1905 when a town plan was laid out (Frias and Frías 1976), became a "backup port". Although no dock was ever constructed at Chelem, a now-abandoned port administration building still stands on the
beachfront. The port functions of Chicxulub and Chelem declined after a 1.25 mi (2 km) long concrete wharf at Progreso (in planning stages since 1936) was completed in 1947.

Plate 21. Downtown Progreso. (Note malecón and beach at left)

Although the only paved road during the 1930s was the Mérida-Progreso highway, graded local coastal roads extended toward Chicxulub Puerto in the east and Chelem in the west. Unimproved sand roads were extended as far eastward as Dzilam de Bravo and as far westward as Chuburná Puerto. Roads across the extensive coastal lagoon system at various locations were improved during this period, and many inland towns were provided with closer port access. This facilitation of access (during a period of growing usage of buses and private automobiles)
expanded the potential for coastal recreation. By 1945, Chicxulub and Telchac Puerto were described as **playas de veraneo** (summer beaches), and many of the small fishing and salt-producing settlements along the north coast between Progreso and Dzilam de Bravo were considered **lugares de recreo** (recreation spots) (Ferrer 1945). The recreation pattern was primarily one of day use, although the construction of vacation homes was just beginning to expand beyond Progreso. Mérida, with a 1945 population of almost 100,000, provided the majority of recreationists to the north coast, but smaller, more distant recreational beaches such as Telchac Puerto and adjacent Miramar Beach also drew from closer, secondary urban centers such as Motul (population: 5,450 in 1945) and Temax (2,900 in 1945). In 1945, the only major coastal town was the port of Progreso with a population of 13,785, while smaller villages included Chicxulub (376), Chelem (352), Telchac Puerto (332), Dzilam de Bravo (300), and Chuburná (245) (Martínez 1945).

**Settlement Expansion**

The first major areal expansion of the recreational landscape began in the 1940s. Chicxulub, practically contiguous with a laterally expanding Progreso, became the site of scattered summer residence construction in the early 1940s and Mérida buyers actively acquired beachfront property from the local residents (Figueroa 1985, pers. comm). Maps generated from 1948 aerial photographs illustrate the incipient nature of recreational beachfront development (Figure 53A). Progreso and Chicxulub are in the process of rapidly welding together as a summer home landscape develops along the beachfront between them. Expansion is also taking place along the beachfront immediately east of Chicxulub,
and isolated summer homes are colonizing the coconut groves (cocoales) and barren beach ridges as far as 4 miles (6.4 km) to the east. If Progreso can be regarded as the core area of beach recreation in Yucatan, this zone east of Chicxulub represents a "recreational frontier" in which summer homes are built in advance of the availability of utilities and services.

Throughout the 1940s, the beaches closest to Progreso remained most popular for summer home construction because of the availability of utilities and proximity to Mérida. After Progreso's beachfront filled in with summer homes during the 1950s, Chicxulub became the primary locus of recreational development (Fernandez 1985, pers. comm). A secondary direction of expansion, in the latter 1950s, was toward Chelem. Chelem allegedly attracted a slightly lower social stratum of Mérida society, because of its location downdrift of the port (and corollary lower land values). Initial recreational development took place in the village proper, but during the 1960s summer homes began to line the previously empty coastal stretch between Progreso and Chelem. The local ejidos (cooperatives) which owned most of the uninhabited land between settlements soon recognized an easy source of revenue and began subdividing their own lands for sale to seasonal residents from Mérida.

A 1964 tourist guide to the north coast (Ellis 1964) noted the growing importance of the Progreso area as a "summer home center" and listed paved roads extending to Chicxulub and Chelem. A graded road connected Chelem with Chuburná, and only sand roads continued beyond Chuburná and Chicxulub. The only fancy beach hotel on the north coast, however, was the newly built Hotel Los Cocoteros between Progreso and Chicxulub (which in 1980 was converted to a private club).
Figure 39. Landuse change
no changes in Progress and vicinity, 1948-1978.
Chuburná, west of Chelem, received water and electric connections in about 1960, and dayuse tourism began soon thereafter. However, because of closer and more easily accessible available beachfront property, Chuburná was slower to experience the recreational landuse transformations that characterized Chicxulub or Chelem during the 1960s. The local ejido at Chuburná sold the first beachfront lots in 1971, but not until 1975 were the first summer homes built (Castro 1985, pers. comm.)

The 1978 map of Progreso and vicinity shows the extent to which development has transformed the once sparsely inhabited landscape (Figure 53B). Progreso and Chicxulub have essentially merged into one contiguous urban area, and considerable recreational development has occurred to the east of Chicxulub. Many former cocalos have become subdivided and developed with seasonal housing, and the recreational frontier of 1948 has shifted eastward (Plate 22).

A pattern of contiguous beachfront urbanization also characterized the western flank of Progreso. The port of Yucalpetén, a safe harbor for the Progreso fishing fleet which opened in 1968, has forced a relocation of the main coastal highway, and the channel entrance now separates the residential areas of the port city from the recreational landscape that extends almost continuously from the jetties to Chuburná. A 1982 study listed almost 4,000 casas veraniegas (summer homes) in the municipio of Progreso, which includes Chuburná, Chelem, and Chicxulub (Castillo 1982). Perhaps a few hundred more private summer homes and several bainearios ("bathing resorts" with changing quarters, a restaurant, and usually a bar) are located between Chicxulub and Dzilam de Bravo.
Chelem typifies a traditional fishing village which has evolved into a beach resort town. Morphologically, the village has grown both to the east and west, and primarily along the shorefront (Figure 54). The core of the old village is characterized by contiguous housing, while newer, recreational development is dominantly single-family housing. The fishing function of the village remains amidst the recreational overlay, and both the Gulf and the lagoon are actively fished. Tourism has created a larger local market for freshly caught fish, as attested to by numerous restaurants and "pescado por kilo" outlets (at which fish is fried and then sold on a per kilogram basis). Physically, the Chelem shoreline has been much modified by groin construction, which appears to have accelerated
beachfront deterioration. Most recently, Hurricane Juan in October 1985 caused considerable destruction of waterfront property.

![Map of Chelem](image)

**Figure 54. Landuse at Chelem. (map not to scale)**

**Landuse Intensification**

The recreational development along the north Yucatan coast is presently still dominantly characterized by single-family summer homes. Landuse intensification, in the form of hotels or condominiums, began in the early 1960s, however. In 1965, the municipio of Progreso contained fourteen hotels—eight in the city of Progreso (with a total of 116 units), one in Yucaletén (76 units), two in Chelem (14 units), and three in Chicxulub (28 units). The only first-class resort hotel in the area opened in 1982, adjacent to the public balneario at Yucaletén. The hotel is administered by ISSTEY, the federal social security administration. Ironically, due to the hotel’s policy of preference to federal employees and social security recipients, international tourists rarely can receive a room during the summer tourist season. One small condominium project—"Los
Doctores”, colloquially named after the professions of the owners—was completed in the mid-1980s in the recreational frontier zone east of Chicxulub, and a major hotel is under construction (in early 1987) adjacent to the Progreso yacht club in the Yucalpetén harbor. Indications are that the pattern of landuse intensification will slowly continue, although not because of lack of space.

**Morphologic Aspects of Resort Development**

The morphologic patterns of resort growth along the north Yucatan coast reflect an overriding attraction with the beachfront. From Chuburná eastward to past Chicxulub, the entire shorefront is presently developed. With minor exceptions, practically all of this development is recreational, and dominantly in the form of private summer homes.

Since the first rail connections linked Mérida with the coast in 1881, the beaches of Progreso have been the locus of recreational activity and the site of the primary RBD in north Yucatan. The first summer homes also became established in this area soon afterward. In 1928, the recreational function of the Progreso shorefront became reinforced by the building of the malecón, and the RBD expanded (eastward) as dance clubs and restaurants came to line the landscaped tourism corridor.

Because of continued growth of Mérida’s middle class and popularization of the automobile, recreational beach usage spread beyond Progreso. By the 1940s, nearby Chicxulub had become a popular beach resort, and summer home construction began to characterize its landuse. Smaller coastal settlements east of Chicxulub also developed into nuclei for beach recreation, and summer homes began to cluster where utilities
(particularly electricity) were available. Chelem and Chuburná, west of Progreso, also became engulfed by a recreational cultural overlay. Both of these settlements were traditionally compact and oriented more toward the lagoon than the Gulf. With the advent of recreation, summer housing came to occupy the beachfront portions of these settlements. Today, the pattern is one of a swath of about two or three belts of vacation home property, each about 260 feet (80 m) in width, occupying the entire beachfront of the study area. Unlike U.S. resorts, no backbarrier development has yet occurred, because of a low proportion of private pleasure boats. A few pleasure craft are docked at the yacht club marina in the Yucalpetén safe harbor, however. Much vacant land remains on the inland half of the coastal barrier (Figure 55).

![Figure 55. Schematicized landuse at Progreso and vicinity.](image)

Progreso, being the closest beach to Mérida and having the longest history of recreational usage, continues to be the site of the dominant RBD along the north coast. The restaurants and clubs along the malecón are
crowded during summer holidays, and the eight nearby hotels fill up. However, the high recreational growth around the smaller settlements has led to the development of secondary recreational commercial districts. Chicxulub, Chelem, Yucalpetén, and to a lesser extent Chuburná contain hotels, restaurants, and even dance clubs catering to both dayuse recreationists and seasonal residents. In a sense, secondary RBDs have developed in each of these recreational loci.

Today, a recreational landscape has developed along a once sparsely inhabited coastal barrier (Figure 36). The process of development has consisted of three stages: 1) primary recreation nodes became established where access arteries from the mainland reached pre-existing
coastal settlements, 2) an initial pattern of day use recreation became followed by second home construction at and adjacent to these nodes, and 3) the vacation home landscape expanded outward from the primary nodes, both by means of contiguous lateral expansion as well as "hopscotching" to nearby pre-existing settlements, which were transformed into secondary recreational nodes. Urban infilling between the nodes followed. Although these stages can be seen along the entire north coast, they are best exemplified in greater Progreso. From a core area in Progreso originally sited at the railroad terminus in the 1880s, secondary recreational nodes became established at Chicxulub, Chelem, Yucalpetén, and Chuburná. Subsequent beachfront infilling has created one contiguous urban area (see Figure 53B), and recreational frontiers are found at both flanks of this recreational urbanization.

**Human Interaction with the Physical Environment**

Human modification of the physical environment of coastal Yucatan dates to the aboriginal impoundment of lagoonal waters for purposes of salt production, but the extent of modification has been much greater in recent times. Since the late nineteenth century, the extensive port modifications at Progreso, from the original wooden docks to the modern 1.25 mi (2 km) long concrete wharf (presently being extended to 2.5 miles [4 km] in length) and to the Yucalpetén safe harbor, have all caused accelerated downdrift shoreline erosion because of interruptions to longshore drift patterns. Shore erosion, although naturally characteristic of the Yucatan coast, has been locally accelerated even more by groin emplacement, a practice begun as a result of recreational development. Extensive modification of wetlands and the lagoon system has also taken
place in the Progreso area, specifically in the form of channel dredging through the barrier ridge, impoundment due to causeway construction, and active reclamation in backbarrier wetlands. The stimulus for these actions has been industrial and residential development rather than recreational development, however.

Periodic inundation of the settlement of Progreso, because of lagoonal flooding, stimulated modification of the environment beginning early in the twentieth century. Following a 1903 hurricane, federal officials proposed draining the lagoon, to minimize danger from backflooding and disease outbreaks, and also building a seawall along the whole shoreline to "impede the invasion of water" (Frias and Frias 1964). These proposals were not acted upon, however. In 1916, high waters in the lagoon again threatened to cause serious flooding in Progreso, and a zanja (emergency ditch) was cut through town to drain the lagoon waters into the Gulf. This ditch allegedly served a useful drainage function for several years (Frias and Frias 1964). A 1944 hurricane caused significant shore erosion west of the dock in Progreso, and half a residential block was damaged. A second ditch was dug through the barrier west of town to drain out high lagoonal waters (Frias 1987, pers. comm.).

The first human responses to shore erosion were efforts to improve the beaches for recreationists. In 1964, a series of rock-and-timber groins (espolones or escolleras), designed by government engineers, was installed along the Progreso shorefront (Plate 23) (Fernandez 1963, pers. comm.). The espolones proved to be relatively successful in trapping sand and widening the beach fronting the malecón.
Armoring of the recreational shorefront intensified following the opening of the safe harbor (puerto de abrigo) at Yucalpetén in 1968. Although the storm-protected safe harbor has provided a suitable base for the Progreso fishing fleet, a naval base, and a growing seafood processing industry, the dredging of a channel through the barrier island has led to many negative environmental consequences, including accelerated
shoreline erosion downdrift of the jettied entrance. In response to the high rates of erosion (Figure 53B shows retreat of over 90 feet [30 m] since the jetties were built in 1968), widespread unauthorized espolón construction began. The groins, extending from the jetties to beyond Chelem, were not properly engineered (Plate 24), unlike the earlier groin

Plate 24. Groins fronting Chelem, 1984. (view toward east)
field at Progreso. Beachfront lot owners individually made decisions to build espolones, and although construction permits were legally required, these were not obtained. Approximately 75% of the vacation home properties west of the Yucalpetén jetties presently encroach to within the 82 ft (25 m) wide federal beach easement (de la Cruz 1985, pers. comm), and many seasonal landowners perceive groins as a means of saving their property. However, groin construction has increased local downdrift erosion and, between 1968 and 1985, the leading edge of espolón construction has slowly shifted westward in response. During a 1984 aerial survey, 176 espolones were noted along the 5.5 mi (8.8 km) stretch from Yucalpetén to Chuburná Puerto, an average of one every 163 feet (50 m). Their concentration is highest between the jetties and Chelem. As a consequence of the groin construction, the attractiveness (and widths) of the beaches diminished (Plate 25). In the early 1980s, Chuburná officials formally complained that groin construction had accelerated shoreline erosion within their jurisdiction, and by April 1985 the ban on espolón construction became actively enforced (Villet 1987, pers. comm.). Several groins have been removed from the Chuburná ejido beachfront since 1985.

In addition to deterioration of the shorefront, the lagoonal environment became highly stressed as a result of saltwater intrusion through the Yucalpetén navigation channel. Many of the mangrove wetlands were quickly killed off by sustained high inundation levels. The waterfowl habitat has been substantially degraded, although lagoon fishing has allegedly improved due to the introduction of saltwater species.
Reclamation into the wetlands immediately inland of the barrier has been associated both with construction of the industrial park at Yucalpetén and with residential encroachment at Progreso, the latter primarily in the form of poor squatters. In 1986, a major project, jointly sponsored by the federal and Yucatan governments, was begun to reclaim a large portion of the dying mangrove zone immediately south of Progreso for the purpose of low-income residential housing construction. A gravel causeway was constructed across a healthy stand of mangroves to enable trucks to transport the fill material from dockside at Yucalpetén to the project site. None of this reclamation, either past or present, can be attributed directly to recreational development, which is focused almost exclusively upon the seafront.
Although the traditional pattern of recreation along the north Yucatan coast has been one of local usage, characterized by day use and second home construction by Mérida residents, a new phase of recreational development may be in the making. In addition to areal expansion of the existing summer home landscape, intensification of recreational development has recently begun. Completion of the resort hotel at Yucalpetén in 1962 introduced first-rate facilities to the north coast, and recently a small condominium complex has appeared east of Chicxulub, near the recreational frontier zone. Also, a resort hotel is presently (1987) under construction at the Yucalpetén yacht club. Immediately west of Yucalpetén, groin construction has perhaps lowered the potential for beachfront tourism intensification, but west of Chuburná (beyond the zone of espolones), a former hacienda has been subdivided and condominiums are planned.

Plans also entail the expansion of the recreational hinterland to beyond Mérida. The Chuburná hacienda subdivision is being advertised in Mexico City, and envoys from the Secretaria de Desarrollo y Turismo are being sent to the U.S., the U.S.S.R., and Europe to promote coastal tourism in Yucatan. The Progreso dock, already the longest in the world, is presently being extended to 2.5 miles (4 km) to accommodate deep-draft vessels, including cruiseships. Cruiseship passengers will initially presumably be whisked to Mérida and inland archeological sites, but the potential for local tourism infrastructural expansion may be capitalized upon. The government has already proposed a long-range Isla Chelem project, in which 4,000 residential villas and multi-family housing totaling 2,000 dwelling units will front on two large artificial lakes. The idea of the
project is to copy retirement communities in Florida and Arizona and attract U.S. retirees and winter visitors (Castillo 1982). Whether this project materializes remains to be seen, but the development of a continuous recreational landscape along the entire north Yucatan coast is a realistic future scenario.
CHAPTER XI. TECOLUTLA, VERACRUZ

Location

Tecolutla, Veracruz is a small fishing village-transformed into a seaside resort-situated at the confluence of the Tecolutla River and the Gulf of Mexico. Tecolutla is located about 36 miles (60 km) from the oil boom center of Poza Rica (200,000 inhabitants) and 225 miles (360 km), or five to six hours by road) from Mexico City (circa 18,000,000 inhabitants). In terms of distance, Tecolutla is the closest beach to the federal capital, lying at the northern end of a recreational beach strip that extends south to Nautla (Figure 57).

Figure 57. Regional setting of Tecolutla, Veracruz.
Located just north of a scrubby, volcanic stretch of coast, the Tecolutla-Nautla strip is easily accessible from the population centers of the interior highlands via Poza Rica (to Mexico City) and via Martinez de la Torre (to Puebla). The densely-settled highlands constitute the primary sources of visitors to the Gulf beaches. Initial recreational development began in the 1940s at existing coastal settlements such as Tecolutla, but more recent hotel and summer home construction has taken place at previously undeveloped sites along the coast highway, including Playa Paraiso and Playa Oriente. Tecolutla today has been somewhat isolated from the recreational strip which extends south to Nautla by the rerouting of the coastal highway to a bridge at Gutierrez Zamora in 1970.

Physical Environment.

This segment of the Veracruz coast consists of a wide coastal plain at the base of the Sierra Madre Oriental. Several major rivers drain these highlands, and sedimentation associated with these rivers has created an agriculturally fertile coastal plain. In the Tecolutla area, the Rio Tecolutla and Rio Nautla are major conduits of sediment transport. The shoreline consists of sandy beaches, and an analysis of beach sediments confirmed the major source areas as being the nearest rivers (Self 1977). At the river mouths, extensive accretionary beach ridge plains have developed, but away from the rivers (e.g. halfway between the Rio Tecolutla and the Rio Nautla), erosion into older coastal plain deposits is common. Waves and longshore currents are responsible for local shoreline smoothing, and much annual variation has been noted. Winds and waves are dominantly from the east-southeast during spring and summer, and from the northeast during fall and winter (Tamayo 1962). Longshore currents and
longshore sediment drift shift accordingly on an annual basis. Self (1977) notes a net dominance of northward littoral drift (on the basis of beach spit and bar morphology) south of Nautla, but for the Tecolutla coast, the author infers a net dominance of southward drift based on the same criteria.

The landscape at the lower Rio Tecolutla reflects the interaction of fluvial and marine processes. The Rio Tecolutla is flanked by wide natural levees which grade into wetlands, mainly mangrove forest south of the river and a mixture of marsh grasses and mangroves north of the river (Figure 56). Both tidal and distributary channels are evident along the

![Figure 56. Physical setting of the lower Rio Tecolutla. (1956 base)](image)

lower Tecolutla River. The tidal channels (e.g. Estero Naranjos) are part of an extensive wetland drainage network that connects with the river near
its confluence with the sea, and the distributaries, identified by natural levee ridges, represent overflow channels cut during flood events. A wide beach ridge plain, composed of multiple beach ridges (not mapped) characterizes the Gulf littoral. Historical evidence attests to a trend of accretion along both sides of the river mouth, in spite of a marked shoreline offset. The beach ridges immediately north, or updrift, of the Rio Tecolutla mouth have provided a site for human settlement for over one thousand years.

**Pre-Contact Settlement**

Tecolutla falls within the territory of the aboriginal Totonac culture, the major city of which was El Tajín, near Papantla. The partially excavated El Tajín is one of the major archeological sites along the Mexican Gulf Coast, and also a popular tourist attraction. Although the Totonac culture was centered in the foothills of the Sierra Madre Oriental, the coastal plain was settled by hunters and gatherers as early as 4000 B.C. and by agriculturalists by about 1000 B.C. (Wilkerson 1980). Between 300 and 1000 A.D., an elaborate irrigation agricultural system was in place only immediately upriver from Tecolutla (Wilkerson 1980). Fishing settlements were established along the river mouths as well, and Tecolutla was one such site. Although the archeological evidence is inconclusive, settlement at Tecolutla (Nahuatl for "settlement where owls are found") dates to between the sixth and ninth centuries A.D. (Ramirez 1961). Early Spanish accounts noted Tecolutla as an important supplier of fish and salt to the interior settlement of Papantla, and this economic role was apparently maintained well into the post-colonial period. Nineteenth century
reports omitted mention of salt, but fishing and subsistence agriculture were noted at Tecolutia (Ramirez 1981).

The friction between Mexico and the United States in the 1840s may have been the initial stimulus for development in the Tecolutia area. When U.S. forces blockaded the port of Veracruz (the only official East Coast port in Mexico, other than Campeche) in 1846, several smaller Gulf Coast settlements—including Tecolutia—were designated as secondary official commercial ports. Military outposts were established and minor commercial development began. A few years later, major growth had not materialized, but a thriving contraband trade was reported at Tecolutia (Ramirez 1981).

Land tenure in the Tecolutia region consisted largely of absentee ownership, and landowners resided in the more temperate highlands. A program of coastal plain colonization was begun in the 1850s, and several Italian families were settled along the lower Rio Tecolutla (Ramirez 1981). Further south, many French families settled along the Rio Nautla (Wilkerson 1980). This immigration continued until the late nineteenth century, and much of the arable land was brought under cultivation during this period. A railroad, constructed between Tecolutia and Gutierrez Zamora in 1910, facilitated export of agricultural products (vanilla, citrus) and cattle through the port facility at the latter city (Wilkerson 1985, pers. comm.). Government efforts to develop a fishing industry as well as a coconut industry during this period also encouraged further growth at Tecolutia, which had almost 400 residents in 1909 (Ramirez 1981). The town’s first restaurant (La China, still operating) opened in 1915.
Exploration and Initial Recreational Development

The beginnings of coastal recreation along the Veracruz coast, and specifically at Tecolutla, are difficult to ascertain. The coastal plain had been stigmatized as hot, humid, and malarial for most of the colonial and post-colonial period. Several towns, such as Jalapa, capital of Veracruz state, were located about 3,000 feet (1,000 m) above sea level on the slopes of the Sierra Madre Oriental and functioned as "hill stations" with ideal climates to which both the coastal elite and highland elite fled from the heat. The port city of Veracruz, gateway to Mexico, functioned as an entrepôt town through which travellers passed. Although several hotels were located in Veracruz, these served the transient passengers, few of whom had much good to say about the place (Arreola 1960). In the aftermath of worldwide economic boom of the Roaring Twenties, the first true beach hotel was constructed near Veracruz in the early 1930s—the Hotel Mocambo a short distance south of the city.

Recreational development at Tecolutla was stimulated in large part because of improved transportation links with the rest of Mexico. In 1924, a graded road between Papantla and Tecolutla was opened, from whence connection by ferry could be made to the coastal settlements as far south as Nautla and up the Rio Nautla to Martinez de la Torre (Ramirez 1981). In the early 1940s, this mode of transportation was replaced by a highway, while at the same time a highway connecting Poza Rica with the highlands was opened. With these latter developments, Tecolutla became not only an important ferry crossing link on a new coastal highway, but it also became the closest road-accessible beach to Mexico City.
Although the first hotel in Tecolutla (the Hotel Roma on the central plaza, now a private residence) dates to the 1930s, it was allegedly built to accommodate fishermen (mainly Cuban) who came to the area during the jumbo shrimp boom of that period (de la Luna 1985, pers. comm.). The first beach hotels were not built until the provision of road access and the subsequent onset of tourism in 1944.

**Development of Recreational Infrastructure**

Following provision of highway access to the coast, recreational construction along the Tecolutla beachfront ensued (Plate 26). Most of

Plate 26. Tecolutla in 1948. (Original photograph hanging in lobby of Hotel Marsol, shown under construction at right center)

this construction was in the form of three large hotels (Hotel Tecolutla with 72 rooms, Hotel Marsol with 52, and Hotel Playa with 24), all of
which were completed in 1948 (Ramirez 1981). It has been stated that completion of the highway to Tecolutla was actually contingent upon construction of the hotels (Wilkerson 1985, pers. comm.). In any case, virtually overnight Tecolutla was transformed into the major resort along Mexico's Gulf Coast. The speculative investors hoped to copy the success of Acapulco on Mexico's Pacific coast, where completion of a 250 mile (400 km) long graded road from Mexico City stimulated that resort's first tourism boom in 1927. However, the trip to Acapulco from the capital city took twenty-four hours on the primitive highway (Cerruti 1964). By providing a shorter route to the beach both in terms of distance and especially travel time (six to seven hours), speculators anticipated a similar boom at Tecolutla.

In addition to the three major hotels, limited summer home construction began at Tecolutla after 1944. The oldest summer homes date to the late 1940s, and all were beachfront-oriented, flanking the hotel zone (Fig. 59A). In 1950, a fraccionamiento (beach subdivision) was platted northwest of the town, partly within a former coconut grove (cocal). A sand road network was laid out, and the earliest airphotos of Tecolutla (1951) show a few houses constructed, several within the cocal and several seaward of it. A short stretch of beachfront road was designated for commercial recreational development (i.e. a secondary RBD).

The anticipated boom at Tecolutla never materialized. This is attributed to a variety of reasons, of which climate may be the most important. Winter months are characterized by frequent nortes and extensive cloud cover, and summer months are characterized by much convectional rainfall and the threat of hurricanes. In spite of much initial
Figure 59. Landuse changes at Tecolutla, 1951–1985.
advertising in Mexico City (the Hotel Tecolutla’s logo is still “la playa de la capital”), few tourists came to the Gulf Coast beaches. The premature overbuilding of hotel rooms quickly became apparent, and several investors sold out their shares in the hotels. In 1952, a devaluation of the Mexican peso put Tecolutla into further hibernation (Wilkerson 1985, pers. comm.). At about the same time, the developer of the fraccionamiento died and promotion of lots was halted. While Tecolutla was stagnating in the mid-1950s, so soon after its initial infrastructural development, Acapulco was entering its second major boom phase, stimulated because of construction of a new highway which cut travel time to five or six hours) (Cerruti 1964).

**Settlement Expansion**

In spite of Tecolutla’s rapid initial overdevelopment, recreational usage of the resort eventually became elevated to its capacity. Tecolutla’s location on the coastal highway and its role as point of ferry crossing insured at least a captive highway clientele during the 1950s and 1960s. At the point of ferry embarkation (see Figure 59B), a cluster of small seafood restaurants sprang up to serve travelers waiting for the ferry. This source of tourists was perhaps more important than the beach recreationists during this period, although usage of the main beach hotels also steadily increased at the same time (Guevara 1985, pers. comm).

In 1962, the coastal highway southward from Tecolutla was completed to the city of Veracruz, and automobile traffic and recreationists increased (Wilkerson 1985, pers. comm.) By the mid-1960s, it became evident that a bridge across the Rio Tecolutla was needed, and
the city of Gutierrez Zamora 6 miles (10 km) upriver from Tecolutla was selected as the crossing site. Tourism interests in Tecolutla did not enjoy the prospect of seeing the fledging resort return to a former status as an end-of-the-road backwater, and allegedly bribes were paid to delay completion and opening of the new bridge. When an overloaded ferry sank at Tecolutla in 1970, the bridge was hastily opened, however (Wilkerson 1985, pers. comm.).

In the mid-1970s, the popularity of Tecolutla as a seaside resort destination increased. Summer home construction, mostly within the fraccionamiento, was revived for the first time in over two decades. Hotel occupancy began increasing at greater rates, and several new lodging facilities were opened (Figure 60). This trend has continued into the

![Figure 60. Number of hotel rooms in Tecolutla, 1940-1986.](image)
1980s, as evidenced by the number of new hotel rooms added. During peak tourism season, primarily Holy Week and summer vacation, the three original hotels are booked to capacity, and entrepreneurs are opening small hostels to cater to the tourist overflow. Tecolutla, with a 1980 population of 5,000, listed forty-seven eating establishments in 1985 (Manzano 1985, pers. comm.). The recent boom in tourism at Tecolutla is attributed to: 1) expansion of Mexico City's middle class, e.g. skilled, high-paid blue-collar workers, 2) disenchantment with Acapulco's high price structure caused by expansion of international tourism, and 3) increasing interest in the less publicized Gulf Coast, where attractions include the El Tajín ruins and excellent seafood.

**Landuse Intensification**

Tecolutla has not yet experienced any intensification of landuse. Recreational development is centered around the three original beachfront hotels and associated resort infrastructure (restaurants, bars, changing quarters, etc.), and vacation housing consists of single-family dwellings located in the subdivision northwest of town. Although the core of Tecolutla's resort landscape is almost forty years old, the hotels are relatively well maintained, and no plans for redevelopment exist at present. Sufficient space is available for areal expansion of existing landuse without intensification or encroachment into backbarrier wetlands. This expansion may take the form of infilling between the town core and the fraccionamiento or northwestward expansion into the zone beyond the subdivision presently utilized for coconut-growing and cattle grazing (see Figure 59B).
Although Tecolutla is the most developed resort along this portion of the Veracruz coast, newer beachfront construction is taking place along the stretch of coast, between La Guadalupe and Casitas, where the main highway parallels the shoreline. This coastal strip is characterized by large private summer estates, camping facilities, and hotels. Accommodations are available in all but one of the small towns within this strip, and large, modern hotels are found in El Palmar, La Vigueta, Playa Paraíso, and Playa Oriente (see Figure 57). As Tecolutla is deficient in terms of modern, highrise beachfront hotels, the previously undeveloped beachfront flanking the highway now is the locus of such construction.

**Morphologic Aspects of Resort Development**

Comparison of the 1951 and 1985 maps (see Figure 59) reveals that areal growth has accompanied the evolution of Tecolutla as a seaside resort. This growth has taken the form of expansion from a core area centered upon the plaza toward the river, toward the beachfront, along the beachfront toward the cocal zone, and along the highway (Figure 61).

The pre-tourism cultural landscape at the mouth of the Rio Tecolutla contained a small, compact fishing village nestled in the higher beach ridges equidistant from river and beach. Although the beach was utilized for surf fishing, the focus of the village was toward the river where docking facilities housed a small fishing fleet that exploited local fish and shellfish resources. This river focus became strengthened, first by the jumbo shrimp boom in the 1930s which brought in foreign shrimpers, and then by the 1944 coastal highway opening which made Tecolutla a ferry crossing point. Vendors and small restauranteurs
specializing in seafood created a minor commercial district catering to highway travellers and the few tourists who came to Tecolutla as a destination. Although the ferry has not operated since 1970, a landscaped boulevard runs to the river's edge from the core of the town. At the road terminus, a bustling commercial area of seafood restaurants attracts tourists looking for inexpensive meals. Contemporaneous with the provi-
vision of highway access was the hotel boom that focused attention upon the beachfront. The three hotels, plus a sprinkling of summer homes, were built close to the core of the town and up to the vegetation line fronting the beach, including out to the spit. This created a second focus for visitors, as a small RBD—with restaurants, bars, and beach supply stores—developed at the terminus of the street leading to the beach from the plaza (Plate 27). This pattern, which initially developed in the 1940s, has changed little except for expansion of commercial infrastructure along the beachfront and greater urban infilling behind it.

A second beachfront zone was the summer home subdivision that was partially carved out of a cocal northwest of town. This vacation home colony had separate access leading to it and was envisioned as a quiet
beach getaway, separate from the town of Tecolutla. However, not until the 1970s did summer home construction increase significantly. By that time, road links with Tecolutla along the beachfront had been established, and the community was expanding in the direction of the fraccionamiento. That zone between the town and the beach subdivision is presently being filled in, and home owners are a mixture of the wealthier local residents plus seasonal recreationists, mainly from Mexico City. (The local residents primarily build away from direct exposure to the beach while the recreationists prefer the sensory linkage to the sea.) The fraccionamiento has today become a distal residential zone of Tecolutla (Plate 28), although its residents are dominantly seasonal. A secondary RBD, composed of several seafood restaurants and changing quarters, has developed along its beachfront, and overnight accommodations are now available in this zone as well. Much new growth was seen during the 1985 field survey.

The combination of tourism and local population growth accounts for the evolution of the present settlement morphology of Tecolutla. Tecolutla's beachfront expansion has resulted largely from emplacement of tourism infrastructure, e.g. the fraccionamiento, and subsequent urban infilling (see Figure 61). The secondary recreational focus upon the riverfront, site of the small port facility and base of the fishing fleet, developed during the ferry crossing years of 1944 to 1970. With increased tourism came increased opportunity for employment in the hotel, service, and fishing sectors. Much of the settlement's growth, especially toward the river, is attributed to growth in permanent population. Growth related directly to tourism includes the commercial and summer home development situated primarily along the beachfront.
Human Interaction with the Physical Environment

Situated between river and the sea, the settlement of Tecolutla has been shaped by processes associated with each. In terms of shore processes, recreational development has benefitted from shoreline accretion. The initial late 1940s beachfront construction took place immediately behind the vegetation line, and since that time the shoreline and the
vegetation line have moved seaward. Based on aerial photographs from 1951 and 1985, shoreline accretion of 400 feet (120 m), or 11.8 ft/yr (3.6 m/yr), was measured in front of the Hotel Tecolutla (near the spit), and 240 feet (73 m), or 7.1 ft/yr (2.2 m/yr), was measured in front of the beach subdivision. The vegetation line advanced seaward at the same rate at the latter location, although at the Hotel Tecolutla a total advance of 290 feet (88 m), or 8.5 ft/yr (2.6 m/yr), was noted. This discrepancy reflects a pattern of beach accretion near the spit, which is attributed to Tecolutla's location at a river mouth and at the receiving end of a longshore sediment supply system. In the late 1960s, a jetty was constructed at the river entrance to minimize shoaling and reduce maintenance dredging of the navigation channel. As a result, the jetty accelerated the accretion of sand on Tecolutla's beaches, enlarged the recreational resource base, and allowed beachfront infrastructure to expand seaward with an advancing vegetation line.

Tecolutla's riverbank, on the other hand, has experienced considerable bank erosion which has destroyed much property since 1951. Two types of erosion are noted: 1) a general trend of riverbank erosion perhaps related to shifts in flow distribution, and 2) localized bank erosion directly upriver of the beach spit that recures into the river. Much of the recurved spit has been planed off partly because of the channel training effect induced by the jetty, and high rates of riverbank erosion are evident in the lee of the spit (Plate 29) (Hoffman 1985, pers. comm.). One summer home is presently threatened by river undermining, and extensive concreting around the house's foundation is prolonging the inevitable. Most of the other damage incurred by bank erosion has been
to shanties of local fishermen and modest commercial structures at the former ferry landing.

Plate 29. The Tecolutla spit, exhibiting beachfront accretion (fronting Hotel Tecolutla at lower right) and riverbank erosion (upper left).

Although Tecolutla is subject to occasional hurricane landfall, past damage has been primarily attributed to floodwaters encroaching into the town from the river. Most serious hurricanes occurred prior to the settlement's transformation into a seaside resort. Tannehill (1938) cited a major nineteenth century hurricane ("the great Cuban cyclone of 1888") as making landfall near the city of Veracruz. Several hurricanes struck near Veracruz in the early 1930s, one with recorded wind speeds of 95 mph (152 kph) (Tannehill 1938), and a hurricane in 1944 caused much flooding at Tecolutla (Wilkerson 1985, pers. comm.). A 1955 hurricane caused extensive rainfall and flooding north of Tecolutla (Murray 1961),
and local residents reported occasional inundations from the river side, due both to tropical storms and to flood events on the Rio Tecolutla. Allegedly, no major beach damage has resulted from hurricanes, although dune flattening and vegetation removal were remembered (Manzano 1985, pers. comm.). During field inspection in November 1985, shortly after passage of Hurricane Juan, much planting of coconut palms (*Cocos nucifera*) and Australian pines (*Casuarina equisetifolia*) was observed amidst denuded sand dunes.

The marshes and mangroves behind the barrier ridge of Tecolutla have hardly been affected by recreational development. Near the main road to Gutierrez Zamora, several residential shanties have been built at the edge of wetlands, but this encroachment has so far been insignificant.

**Future Trends**

Tecolutla is today realizing the recreational potential that was envisioned in the late 1940s. The hotels are booked up during Semana Santa (Holy Week) and summer holidays, and new modest lodging facilities are being built to accommodate the growing crowds. In excess of 100,000 visitors have been estimated for the Semana Santa holidays (Manzano 1985, pers. comm). The permanent population of both the town and municipio of Tecolutla has also increased at higher rates in recent years (Figure 62), largely in response to recreational development and corollary opportunities for employment. These higher growth rates may continue, depending upon the stability of Mexico’s economy. In terms of future expansion, sufficient space exists for infilling amidst existing tourist facilities, and lateral beachfront expansion beyond the fraccionamiento is
a possibility. In spite of the growth trend, Tecolutla still represents a minor seaside resort when compared with any of the tourist destinations along Mexico's Pacific Coast.

Figure 62. Population change at Tecolutla, 1910-1980. (Ramirez 1981)
CHAPTER XII. SUMMARY AND CONCLUSIONS

Summary of Case Studies

In spite of variations in settlement age, degree of development, levels of recreational demand, and physical characteristics among the eight study sites, certain common patterns of recreational development were observed throughout the Gulf. These patterns are described according to the three major underlying themes of this study: time, space, and environment.

The historical record of seaside recreation along the Gulf of Mexico shows certain temporal trends of both initial establishment and subsequent development. Between the 1620s and the 1850s, the upper classes of many U.S. Gulf Coast urban areas developed a pattern of establishing summer residences or frequenting lodging facilities at distance waterfront locations. Mississippi Sound and Lake Pontchartrain were favored by New Orleanians, Mobile Bay by Mobilians, and Galveston Bay by Houstonians, for example. However, the exposed coast of the Gulf of Mexico was generally avoided by recreationists during this period.

Between the 1860s and the 1880s, the Gulf littoral nearest established urban centers became increasingly favored for beach recreation, and this trend was facilitated by the improvement of transportation, primarily rail and/or regular boat service. Grand Isle (1866), Galveston (1870s), South Padre Island (1870s), Progreso (1881), and several of the southwest Florida barrier islands (early 1880s) experienced the foundations of recreational development in this period.
From the 1880s until 1920, the fledgling resorts either grew slowly or failed, depending upon the impacts of hurricanes and human response to them. Construction of the Galveston seawall after the 1900 hurricane coupled with rapid economic growth of Galveston as a commercial port led to development of a beachfront resort infrastructure during this period, but recreational development was slow or non-existent at the other sites.

The economic boom years of the 1920s were accompanied by a renewed interest in the shorefront, and the established resorts of Galveston and Progreso witnessed much growth during these years. Grand Isle, South Padre Island, and Estero Island also experienced recreational infrastructural development in this period, and pleasure excursions to the beach became popular at Pensacola Beach, Dauphin Island, and Veracruz. The 1930s, a period of economic depression, were characterized by extensive road-building activity, and highways were built to the beaches at Grand Isle, Estero Island, Pensacola Beach, and (in 1944) Tecolutla. Although the provision of highway access was accompanied by limited hotel/motel and summer home construction, the next boom was postponed until a period of economic affluence after World War II.

All eight sites underwent growth phases in the 1950s, including the two resorts (South Padre Island and Dauphin Island) that did not have highway access until the mid-1950s. Postwar growth rates generally slowed during the 1960s, a notable exception being Galveston Island, the west end of which was characterized by much beach subdivision development following Hurricane Carla in 1961. The most recent development boom throughout the Gulf began about 1970 and lasted until
the early 1980s when a reduction in world oil prices depressed the economies of the U.S. Gulf Coast states and Mexico and led to reduced demand and lowered real estate values.

The temporal patterns of resort development at the eight study sites reflect underlying social, economic, political, and environmental factors. Socio-economic factors included more leisure time, more disposable income, and popularization of swimming and other recreational activities. Historic environmental factors included unhealthful conditions (e.g. yellow fever outbreaks) at the site of permanent residence, which led to increased perception of the shore as a healthful and rejuvenating environment. The attraction of the seashore became reinforced by infrastructural development such as access highways, fishing piers, and beach hotels (i.e. supply) as long as disposable time and income levels (i.e. demand) remained high. The initial period of resort development in the 1870s and early 1880s was a period of affluence for a select social stratum in the booming commercial ports of New Orleans, Galveston, Houston, Brownsville, Pensacola, and Mérida. Semi-tropical Florida was also being discovered by northern U.S. members of this same elite social stratum during this period. As beach recreation became more popularized beginning in the early twentieth century, especially in the industrialized United States, subsequent booms and busts of recreational development increasingly reflected regional or national economic conditions. The 1970s boom in U.S. resort development, however, reflected not only a period of general affluence and economic inflation but also a reduction in risk made possible by the availability of government-subsidized flood and wind insurance and erosion control.
Spatial aspects of resort development also exhibited much similarity among the eight sites, although components of the resort morphology varied in accordance with the period of resort establishment. Settlements that experienced resort development in the nineteenth century, such as Grand Isle and Galveston, were characterized by large, often opulent, beach hotels, near which other tourism-related businesses tended to locate. This recreational business district (RBD) was usually situated at the point of beach access closest to the source of recreationists. A major beach hotel (in some cases, two) was a dominant landscape feature at the seaside resorts well into the 1940s, although the twentieth century versions were generally smaller and less opulent than the earlier versions. Examples of twentieth century beach hotels were noted at Estero Island (1911), Galveston (1911, 1928), South Padre Island (1926), Grand Isle (1932), and Tecolutla (1949), and several of these remain in business. Motels replaced hotels as the primary lodging facilities in the 1950s and 1960s (the 1970s at Tecolutla), and the modern, post-1970 resort hotels evident at Galveston, South Padre Island, Estero Island, Pensacola Beach, and Progreso are in many aspects reminiscent of an earlier beach hotel era. A recreational business district is present at all eight sites, and, with the exception of South Padre Island, is concentrated along the beachfront at the point of closest access. Summer homes, lavish structures of the elite classes in the nineteenth century (notably at Progreso, but also at Grand Isle and Galveston), gave way to simpler beachfront and beach subdivision structures in the 1920s. Residential subdivisions, dating to the 1910s at Estero Island, remain characteristic of beach resorts today, and individual homes have become more elaborate since the provision of flood insurance.
Environmental aspects of resort development around the Gulf of Mexico, in terms of both human adaptations to and human modifications of the environment, were much more variable. Human responses to hurricanes and shoreline erosion, the two major adverse physical characteristics of seaside resorts along the Gulf of Mexico littoral, varied considerably. Both Grand Isle and Galveston were struck by major hurricanes in the last decade of the nineteenth century. At Grand Isle, the destruction wrought by the 1893 storm postponed recreational rejuvenation of the resort for over thirty years. Galveston, however, elected to rebuild and armor its shoreline following the 1900 storm, thereby offering protection to renewed recreational development. Similarly, the 1926 storm in south Florida was followed by rebuilding on Estero Island, yet the 1933 storm at South Padre Island delayed renewed growth until a causeway was built two decades later. Later storms were generally followed by development booms, partially because of insurance payoffs, disaster relief funds, much turnover of property, and extensive publicity generated by the storms.

Shoreline erosion, too, was met with varied responses. All of the resorts except Pensacola Beach and Tecolutla are characterized by eroding shorelines. In at least one case (Grand Isle), residents had been aware of the protection value of beach debris, and no efforts at beach cleanup predated recreational development. At Galveston, nineteenth century mining of beach sand was quickly noted as causing increased erosion, and dune preservation measures were instituted well before the 1900 hurricane. Armoring of the shoreline with groins, riprap, and private seawalls (i.e. beachfront bulkheads) became popular in the United States
between the 1930s and the 1950s and in Mexico in the 1960s and 1970s, but little correlation could be made between rate of erosion and amount of modification. In addition to the massive shore defense system in place at Galveston, structural erosion control methods were experimented with at Grand Isle, Estero Island, and the Progreso area. None of the hard structural measures proved to be very effective, however, and soft measures (i.e. beach nourishment) have become more popular since the 1960s. Beaches have been nourished at Grand Isle, Galveston (in front of the seawall), Estero Island, Pensacola Beach (soundside), and Dauphin Island (offshore dredge disposal in late 1966). Beach nourishment is also proposed for Grand Isle (to repair the storm-damaged erosion control project), Galveston Island (west end), South Padre Island, Estero Island, and the Progreso area. Other modifications of the environment, such as conversion of wetlands to fingerfill and residential canal subdivisions, also varied considerably and are summarized in a later section.

**Variables of Resort Development**

In addition to factors of surplus leisure time and disposable income which are indicative of overall socio-economic conditions, certain variables are important in determining the actual levels of resort development that may characterize a specific site. These variables include: perception of physical environment, availability and types of access, social infrastructure, and opportunities for financial gain.

The notion that the shoreline is recreationally attractive is rooted in human perception of sea air and seawater being of value for health of mind and body. From origins in ancient Rome, the perceived therapeutic
benefits of mineral springs became widely accepted by post-Middle Ages Europe. When a "pleasure" aspect became integrated with the "health" aspect and "hydrotherapy" became augmented by "thalsasotherapy" at Scarborough in the early 1700s, the seashore became a popular destination.

Following its "discovery" by the British aristocracy, the concept of beach recreation as a combination health/social event was diffused culturally, spatially, and socially. Culturally, beach recreation was adopted primarily by Europeans, not only in the British Isles and the European mainland, but also in overseas colonies. Non-European cultures did not readily adopt this Western "fad", however, and even Arab inhabitants of the Mediterranean littoral did not become recreationally interested in their beaches until the mid-twentieth century (Ritter 1975). Spatially, the seaside resort concept spread throughout the Europeanized world, including North America and Latin America. Socially, beach recreation became diffused downward through the social strata as increasing wealth and leisure time became available to an ever-increasing proportion of the population. This held particularly true in countries benefitting from the Industrial Revolution, such as northern European nations and the United States, where a "peasant" class became rapidly supplanted with a "worker" class. The large social segment now generically labelled "middle class" has tended to emulate social trends established by the upper classes ("mass follows class"). In European countries and colonies (or ex-colonies) not greatly benefitting from the Industrial Revolution and social reforms of the nineteenth century, the social class structure is comprised of a proportionately much larger "peasant" class, for whom leisure time and
financial resources are generally too meager to generate high levels of demand for beach recreation opportunities. Such is the case in Mexico, where beach recreation demand is much lower than in the United States in proportion to total population.

Physical factors influencing levels of recreational development include shoreline characteristics (rocky, marshy, muddy, sandy), beach quality (color and coarseness of sand, width of beach, cleanliness), water quality (cleanliness, clarity), wave climate, presence of mosquitoes, fishing potential, and aesthetic considerations in general. The ideal location for resort development would exhibit: 1) a wide, clean beach composed of white, coarse-grained (yet relatively shell-free) sand, 2) clear, clean nearshore water, 3) a wave climate of 2 to 3 ft (60 to 90 cm) high waves, high enough to make swimming exciting, yet not too high for children to enjoy or for strong undertows to develop, 4) steady sea breezes which provide an illusion of "cooling" and also keep mosquito populations down, 5) a visually pleasing environment, preferably with shade vegetation such as coconut palms, and 6) good fishing. A resort may well develop at a site which exhibits only some of these attributes, but if an alternative recreational site with more of these attributes were located within a reasonable distance, that latter site may experience greater levels of development. A resident of Mobile, facing a choice between forty-five minutes travel time to the darker sand beaches and sediment-laden nearshore waters of Dauphin Island and one hour travel time to the cleaner, whiter beaches and blue-green water of Gulf Shores usually selects the latter. Likewise, a New Orleans beach enthusiast, only two hours from Grand Isle, will generally elect to travel an extra hour to get to
more aesthetic beaches in Alabama or Florida. If the primary leisure attraction is good fishing, however, then the aesthetics of the beach will be less of an influential factor.

Availability and ease of access are also factors contributing to a resort's development. At beaches proximate to centers of population, demand for beach recreation generally preceded provision of public access. As demand for beach usage increased, entrepreneurs quickly stepped in to provide at least a rudimentary access infrastructure, perhaps a small shuttle boat ferrying recreationists back and forth across a bay to the beach. This pattern was noted at Grand Isle, South Padre Island, and Pensacola Beach.

Railroad companies became major promoters of coastal recreation in Europe and the northeastern United States during the early 1800s, and by the latter nineteenth century railroads had reached Florida and southern California. Trains were recreationally important until the early twentieth century at Grand Isle (to Myrtle Grove), Galveston, South Padre Island (to Port Isabel), and Progreso, although transport of recreationists was a secondary function at these locations. Nonetheless, trains were important stimuli of recreational development.

Patterns changed with the onset of the automobile age. Initial access bridges and causeways were constructed by local developers, often in conjunction with local governments, and a resort boom generally followed. When these initial bridges, usually timber pile draw- or swing-bridges, decayed or were destroyed by hurricanes, newer and wider concrete span bridges (funded by state and federal funds) replaced them.
The improved access usually stimulated tourism and recreational activity, although Dauphin Island appears to be an exception to this trend. The improvement of mainland highways, especially the completion of the interstate system in the United States, facilitated a more rapid transport of recreationists to the various coastal access points. Likewise, where tourism, i.e. travel of over 100 miles (160 km) to a vacation destination, is important, more airline routes and lower airfares have facilitated the transport of tourists.

The social infrastructure of a given seaside resort also influenced the degree of development. Recreationists tend to congregate with their peers, and particular resorts attract a given type of recreationist. Grand Isle caters especially to a fishing contingent, Dauphin Island attracts primarily family recreationists, and Pensacola Beach and nearby Fort Walton Beach have acquired reputations as "party beach resorts" popular with single college-age recreationists, especially during annual Spring Breaks. Some resorts attract retirees and older winter recreationists ("snowbirds"), and places such as Fort Myers Beach are attractive to different sets of recreationists at different times of the year. Where opportunities of social segregation of beach resorts are precluded by an absence of easily accessible multiple destination choices, such as Galveston catering to a Houston hinterland, a variety of beach "zones" may evolve, each catering to specific social groups.

A final major factor accounting for resort development, particularly in the affluent United States, is the opportunity for financial gain. This can take several forms, a major one being investment in a summer, or winter, residence. A beach residential unit can be used: 1) as a tax
shelter via offsetting income by deduction of expenses and interest costs and also by depreciation, 2) for generation of rental income when not in use by the owner, 3) for speculation in the real estate market. The investment opportunities are often a major consideration by recreationists who like to enjoy the seaside amenities and make a profit besides. At a higher level, many development corporations, including banks and insurance companies, invest in beach resorts to both take advantage of favorable tax-sheltering provisions in the United States Tax Code (USDI 1985) and also to speculate in sales and rentals of properties for profit. These corporate resort developers, in conjunction with local Chambers of Commerce and tourism boards, actively publicize their resources in more distant market areas, thereby expanding the recreational hinterlands and stimulating demand.

**A Conceptual Model of Resort Evolution**

The transformation of a pristine stretch of shoreline into a highly developed coastal resort can be described in terms of a "resort cycle" model, similar to the S-curve model proposed by Butler (1980). Inherent in such a model is the concept of carrying capacity which delineates a theoretical upper limit to growth. The determination of exactly what levels of density, in terms of either population or recreational development, constitute carrying capacity has remained an elusive goal of recreational geographers and other social scientists for many years (Mathieson and Wall 1982), and in view of the many existent temporal and spatial variables inherent in such a theoretical threshold, a definitive quantification of carrying capacity is undoubtedly not soon forthcoming. In a more qualitative sense, however, the carrying capacity concept is
valid, and an S-curve resort evolution model provides a good framework for documenting both temporal and spatial trends of coastal resort development. Based on the results of this study, a variation of the S-curve model is proposed (Figure 63).

Figure 63. A theoretical model of resort evolution.

For a resort to evolve from a state of zero recreational usage to one of extensive recreational development, an overall S-curve path is followed until a "level of maturation" is reached. A minimum of four evolutionary stages are identified, with the potential of a fifth if levels of recreational demand remain high. Progression through all five stages also implies that the maximum developable land area has become developed. The model
applies to coastal areas that were either uninhabited or already populated at the onset of the recreational transformation.

The first stage in the evolution of a resort is one of exploration, accompanied perhaps by isolated settlement. Tourists or recreationists become drawn to the coast for purposes of health or pleasure, usually in response to a greater national or international trend of popularization of sea-bathing. Access is initially difficult, and means of transport must be individually secured. If the coastal site becomes known among the local population that comprises an incipient recreational hinterland, a small-scale entrepreneur may invest in a boat and begin ferrying recreationists to the site. Some of these recreationists may build a modest structure to retreat to on a seasonal or perhaps permanent basis (as at Fort Myers Beach and Grand Isle). If access to the beach by land or small boat is a fairly straightforward undertaking (as it was from Pensacola, Galveston, and Port Isabel), little or no structural development may take place as a sense of "remoteness" may already be lacking.

The second stage is characterized by the development of recreational infrastructure. This entails both access infrastructure (i.e. railroad or highway access via a bridge or causeway) and also commercial or real estate infrastructure at the destination. Generally, the former precedes the latter, although simultaneous infrastructural provision is common. A bridge, a restaurant/lounge, a lodging facility, or house lots for sale all will trigger demand for recreational usage of the incipient resort. This stage is usually stimulated by one or more entrepreneurs, who foresee a potential for profit. A typical pattern is for the entrepreneur to acquire a large chunk of real estate, construct a commercial
enterprise such as a combination hotel/restaurant (often with bathhouses) and perhaps sell lots for vacation home development. A focal point on the beach—a recreational business district—becomes created by the commercial facility, and future development clusters around the RBD, with less intensive land uses (e.g. vacation homes) flanking the RBD. This initial provision of infrastructure may be due to the efforts of a single individual (as at South Padre Island), a handful of entrepreneurs (as at Grand Isle, Fort Myers Beach, and Tecolutla), corporations (e.g. the Electric Pavilion at Galveston and the Casino at Pensacola Beach), or even local governmental jurisdictions (the Mobile Chamber of Commerce at Dauphin Island and the rural ejidos in the Progreso area).

Once the seeds of infrastructure have been planted, settlement expansion can take place. This stage of the model is most important in regard to the extent of transformation of a physical environment to a cultural one. The resort area at the beginning of the stage is still relatively pristine, i.e. little impacted by recreational development, but towards the end of the stage a recreational landscape has become dominant and little room for further expansion is available. Because the slope of the graph (rate of growth per time) varies within this stage, it should technically be further subdivided into three components: incipient expansion, “take-off”, and levelling off (see Figure 63). (Insufficient growth rate data were available for most of the study sites to easily delineate these subphases, however.) During the settlement expansion phase, property perceived to be most desirable becomes developed first. Normally this property is along the beachfront, and construction takes place as close to the beach as possible, usually behind the vegetation line.
The next most desirable property is on the higher beach-ridge plain (or barrier flat), provided that a visual and olfactory link to the sea is maintained. If wetlands comprise the backbarrier zone, then perception of them as valuable is usually linked to demand for residential canal lots where private pleasure boat can be docked. All landuse zones experience growth during the expansion phase, particularly the RBD, other commercial areas, and the residential zones.

Residential development in resorts dating to the 1960s or before consisted almost exclusively of single-family units, but since about 1970 multi-unit structures, including townhouses and condominiums, have become more prevalent. If, during the settlement expansion phase, a more intense form of landuse becomes adopted (e.g. a condominium complex with a high number of units per acre), the recreational carrying capacity limit becomes raised. Due to increased density of housing units, the number of potential housing units will correspondingly increase. This stage of landuse intensification is not a requisite stage of resort evolution, but it is characteristic of resorts high in recreational demand. One measure of level of demand is real estate values. At Fort Myers Beach, a forty year old wooden beach cottage on a 0.25 acre (0.1 ha) lot may sell for over $300,000 (in 1985). Consequently, a new condominium unit that may be bought for $100,000 or $120,000 (or about $2,000/week under interval ownership arrangements) becomes more attractive.

Landuse intensification can occur by means of two main mechanisms. The first entails the introduction of higher density forms of landuse during the active settlement expansion phase. This has the effect of both raising the upper limit of potential recreational development, as
measured either by number of recreationists/tourists or by number of housing units, and also prolonging the settlement expansion stage and thereby delaying onset of the (final) maturation stage. The second mechanism of landuse intensification, euphemistically referred to as 'redevelopment', is one whereby a pre-existing form of landuse is replaced by a more intense, i.e. higher-density, form of landuse. Landuse intensification often entails a land developer buying and removing older, decaying structures located on what is perceived as prime real estate, and replacing them with a hotel or condominium. This action can occur after a resort has reached the maturation stage (i.e. no vacant land remains available for development) or during the stage of settlement expansion. Landuse intensification can also be stimulated by a destructive hurricane which instantly removes older, low-density forms of landuse (e.g. beach cottages) and subsequently facilitates the transfer of property to developers who, in turn, erect high-density hotels and condominiums. The net result is that a severe storm has increased levels of recreational development rather than decreased them, as intuition might lead one to believe. Hurricane Frederic in 1979 stimulated such redevelopment at Gulf Shores, Alabama, for example.

In the proposed final stage of resort evolution, a level of maturation is reached. All potentially developable land has been developed, either low-density or high-density, and equilibrium conditions have been reached. No new construction is taking place, except perhaps replacement construction, and levels of visitation by recreationists and tourists have stabilized. The level of maturation varies considerably and is a function of a combination of market demand, landuse regulation, and environmental
regulation. Assuming a constant market demand, areal expansion will continue until political or physical growth boundaries are reached. Even less suitable micro-environments such as wetlands and unstable shorelines bordering tidal inlets are subject to development if sufficient demand exists and no prohibitive laws have yet been implemented. A low-demand resort such as Grand Isle has reached the maturation stage prior to extensive wetland modification or landuse intensification, while Fort Myers Beach has reached that level prematurely because wetlands and landuse zoning legislation halted ongoing reclamation and intensification processes. A hurricane, striking a mature resort and removing many beachfront structures, will temporarily upset the state of "equilibrium". This equilibrium will subsequently be restored following post-storm construction, most often in a higher-density form.

The individual stages of recreational development characteristic of the eight study sites can be placed into perspective by use of the resort cycle model (Figure 64). Although rates of development at the sites reflect prevailing economic conditions, four resorts are clearly experiencing active expansion. Tecolutla, not having grown much since infrastructural development in the 1940s, is now slowly and steadily growing, although via a low-density landuse pattern. The Progreso area, characterized by multiple nodes of recreational development (some of which, such as Chelem, appear to be at a maturation level), is also steadily expanding and recent intense forms of landuse reflected continued demand by the Mérida recreational hinterland. In Texas, both South Padre Island and Galveston are expanding, although the former is characterized by greater high-density construction. At both sites, much space
for expansion remains. Grand Isle, plagued by a poor image and an adverse environmental setting, has reached maturation level with only minimal wetlands modification or landuse intensification. Dauphin Island, also suffering from a negative image, is approaching a levelling off stage in spite of much vacant, less desirable land. Pensacola Beach is presently at a maturation level, although further expansion to a higher level may take place if redevelopment and landuse intensification is recommended by the forthcoming landuse plan. Fort Myers Beach is near its limits to
growth and further wetlands disturbance and landuse intensification is limited by local, state, and federal legislation.

**A Resort Morphology Model**

The morphology, or form, of a coastal resort is highly variable. Greater proximity to a large urban area may account for higher levels of commercial development than might characterize a resort distant from sources of day users. The time period of resort establishment is important as prevailing patterns and prevailing architecture of the period become adopted. These may persist at a resort for many decades in spite of changes in trends and patterns. Also, a resort’s morphology is highly dependent upon stage of development. On the basis of the conceptual model of resort evolution, a time-dependent resort morphology model is presented (Figure 65). A barrier island, characterized by natural boundaries to developable space, is used as the setting for the model.

During the exploration stage, little development characterizes the incipient resort. Generally, one small reach along the backbay becomes the prime landing area for arriving tourists, that reach being determined on the basis of proximity to point of departure or proximity to a point of attraction on the island. Perhaps a rudimentary dock is constructed. A path evolves between the landing site and the closest beach. Recreationists will tend to cluster at that point, and the intensity of beach usage decreases with distance from that point. The few structures (cottages) that are built in this early stage of evolution reflect the established patterns of day use: a small cluster of structures at the closest beach access point may be complemented by isolated, outlying structures. Dev-
Development is restricted to the beachfront and perhaps the point of arrival on the island.

During the stage of infrastructural development, the patterns established in the first stage become reinforced by greater levels of usage.
and more structural development. Businesses and lodging facilities catering to tourists and recreationists become established, and bridge or causeway linkages to the mainland are built. A recreational business district, often including a fishing pier, develops at the point of closest beach access, and much shorefront development flanks the RBD. Other commercial establishments may begin to line the approach to the beach. Land developers foresee demand for summer home construction, and subdivisions (of variable magnitudes) become platted. Development remains relatively concentrated however, and the distal ends of the island (often subject to variations in shoreline position due to tidal hydraulics) and the backbarrier wetlands remain relatively unmodified by humans.

In the settlement expansion stage, characterized by increasing numbers of visitors and seasonal residents, the beachfront and upland portions of the island become extensively developed, and even wetlands are perceived as potential waterfront lot sites. Along the beachfront, the RBD zone expands laterally from its original core as more hotels, motels, and recreation-oriented businesses are constructed. The remainder of the beachfront, save perhaps for less stable inlet-flanking beaches, becomes occupied by summer homes. The better-drained central portion of the island, site of the initial beach subdivisions, becomes subject to extensive subdivision development and vacation home construction. Residential canal subdivisions are carved out of the backbarrier wetlands, especially if demand for lots with private boat docking space exists. The dredging and filling of wetlands increases especially if little property remains available for development in other zones of the island. Very discrete zones of landuse characterize this stage of evolution: 1) the RBD is the
zone of concentration of most recreation businesses and lodging facilities, 2) additional commercial development flanks the approach highway, the distal ends of the RBD, and perhaps isolated spots along the beach highway (not shown), and 3) vacation housing comprises the remainder of resort development.

In the landuse intensification stage, high values of real estate lead to the introduction of multi-unit structures, particularly hotels and condominiums (the latter attracting seasonal residents as opposed to temporary recreationists and tourists). The trend of higher-rise construction became popular during the late 1960s, especially at resorts high in recreational demand. In terms of areal expansion, this class of resort housing first occupies the beachfront zone near the inlets and subsequently many of the remaining undeveloped wetland parcels. Although state and federal legislation in the United States placed increasing restrictions on development in wetlands beginning in the 1970s, condominium developers nonetheless were able to placate environmental agencies by various means (e.g. leaving a strip of wetlands at the land-water interface, providing habitat for threatened floral and faunal species, or mitigating wetland destruction by creating wetlands elsewhere) until the early 1980s. Contemporaneous with the multi-unit construction in the most fragile environmental sectors of the island, pressures for redevelopment of older portions of the resort settlement mount. Older commercial enterprises in the RBD and older beachfront cottages become replaced by highrise hotels and condominiums. Hurricanes can act as agents of change, stimulating this highrise trend if older beachfront development becomes damaged beyond repair.
The pattern of landuse intensification continues until a maturation stage is reached. At this time, most of the original beachfront development has been replaced by newer, multi-unit housing, and only relict pieces of an earlier recreational landscape remain. Along the backbarrier, development continues until enforcement of wetlands protection legislation, combined with local preservation efforts, saves a few pristine parcels of marsh or mangrove forest. Theoretically the process of redevelopment may continue until only multi-unit structures occupy the island, but increasing public opposition to destruction of an earlier, less-dense resort landscape generally results in landuse legislation limiting the amount of further development. In essence an arbitrary “carrying capacity” for that specific resort has thus become defined.

**Environmental Aspects of Resort Development**

Environmental impacts of recreation exhibit greater variability than cultural-historical aspects of resort development at the eight study sites (Figure 66), largely as a reflection of differing physical conditions and non-recreational demands upon the environment.

In a generalized model of environmental modification on a recreationally developing and slightly eroding barrier island (Figure 67), an initial exploration stage is characterized by relatively few human impacts except perhaps for limited dune disturbance in the zone where an access corridor reaches the beach. Removal of large amounts of dune sand was noted only at Galveston, however, where demand for fill material in a rapidly growing (non-recreational) urban area was high (see Figure 66).
### Figure 66. Matrix of cultural-historical and physical aspects of resort development at the Gulf of Mexico study sites.

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<tr>
<th>Study Sites</th>
<th>Physical Aspects</th>
<th>Cultural-Historical Aspects</th>
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<td>Time Line (days)</td>
<td>Stages of Development</td>
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<td>Environmental Impacts</td>
<td>Landscape Features</td>
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<td>Tecolutla</td>
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**STUDY SITES**

1. Preventing development (on land only)
2. Tourist development (on land only)
3. Permanent residential development
4. Permanent non-residential development
5. Waterfront development only
6. Commercial development
7. Airport or airfield
8. Large multi-family housing
9. Small multi-family housing
10. Small single-family housing
11. Recreational development
12. Commercial development
13. Farming or ranching
14. Ranching
15. Other (please specify)
By the infrastructural development stage, landscaping of the platted beach subdivisions often is accompanied by levelling of the beach ridges and replacement of native upland vegetation with introduced plant species. Certain vegetation types (e.g. palms, palmettos, Australian pines, and oleanders) exude an aura of the tropics that many recreationists, especially seasonal refugees from northern climes, find appealing. This pattern of vegetation replacement was noted especially at Grand Isle, Galveston, Fort Myers Beach, and South Padre Island (see Figure 66). In conjunction with settlement landscaping, the beach often becomes “aesthetically improved” by the removal of driftwood, debris, and perhaps even dunes.

In the settlement expansion stage, environmental modifications rapidly increase in response to more extensive recreational development. To make the beach subdivisions more appealing, wetlands are ditched and drained and/or filled to both minimize mosquito outbreaks and provide homesites suitable for development. All sites exhibited this pattern to some degree, although in Mexico it was associated mainly with non-recreational development (see Figure 66). Modification of wetlands via dredge-and-fill soon follows, in order to provide boat access to private lots. The resulting dead-end residential canals often exhibit poor natural water circulation. This lack of natural flushing, combined with sewage inflow from septic tank seepage, causes anaerobic conditions characterized by algal blooms and fish kills. The environmental degradation easily becomes exported into the backbay, which may well now be criss-crossed with dredged navigation channels, and overall levels of bioproductivity—including commercial fish and shellfish harvests—are reduced. Along the
Figure 67. A model of environmental modifications at a seaside resort.
shorefront, previous modifications of the dune system have perhaps led to accelerated shoreline erosion, particularly during storm events, and human response is to combat this new "problem". This was the case at Grand Isle, South Padre Island, Estero Island, and Progreso (see Figure 66). The previous negative impacts of dune removal are recognized and active dune restoration measures, such as sand-fencing or placement of Christmas trees, are begun (as took place at most of the sites). Additional shoreline erosion control devices such as groins, seawalls, revetments, offshore breakwaters, and beach nourishment, are implemented if funds are available. Private property owners often construct bulkheads at the seaward margins of their beachfront lots.

The environmental modifications implemented during the settlement expansion stage continue into the landuse intensification stage. Residential canal subdivision construction continues, and more shorefront structures are emplaced in an effort to offset an erosionary trend often locally accelerated by the initial structures. Grand Isle, Galveston, and Estero Island displayed this pattern (see Figure 66). Sand loss may be replenished by beach nourishment if an easily accessible sediment source is nearby. Increasingly, however, a small contingent of local residents recognizes that human efforts are destroying the natural setting, and opposition to further wetland destruction and shorefront modification is voiced. Often a higher governmental authority (county, state, or federal) is called upon to institute (and enforce) landuse legislation.

By the maturation stage, the degradation caused by human action is recognized both by local residents and by governmental agencies. Increasing controls are placed on sewage disposal, dune and dune vegetation
removal, placement of structures along the beachfront, wetlands removal, dredging-and-filling, and related hydrologically and environmentally damaging activities. Setback requirements may be instituted for new beachfront development, both to maintain the physical integrity of the beach-dune complex and also to minimize federally-subsidized insurance payoffs following destructive storms. If beach erosion remains a critical problem, restoration measures such as comprehensive beach nourishment may be implemented.

Environmental modification has been least at those resorts in early stages of development (Tecolutla, Progreso) or at low-intensity levels of maturation (Dauphin Island) (see Figures 64 and 66). The Mexican resorts are expected to gradually become more recreationally developed, and more environmental modifications are anticipated.

Government Involvement in Resort Evolution

The above models of resort evolution are derived from recreational coastal settlements that have developed "spontaneously", i.e. development processes, settlement forms, and environmental impacts have resulted from unregulated, unrestricted human activities. In the United States, now highly urbanized along the coast, new development is subject to extensive construction guidelines and restrictive legislation. Within the framework of the proposed resort cycle model, most of this legislation became adopted during the landuse intensification stage, in response to environmental degradation associated with the settlement expansion stage. Resort development is today influenced as much by legislative and landuse guidelines as by private infrastructural developers.
In the United States, government involvement with coastal settlement dates to the economic boom years of the 1920s when the first significant recreational movement to the shore began. As erosion was soon perceived as a problem rather than a process, the Beach Erosion Board was created to offer erosion control advice to states and communities. With passage of the Flood Control Act of 1936, the United States Army Corps of Engineers was given the role of protecting settlements from coastal flooding in addition to river flooding (Moore and Moore 1983). Federally-subsidized disaster insurance became available in the early 1950s (Emmer 1977), and federally-subsidized flood insurance was made widely available to residents of floodprone riverine and coastal environments following the National Flood Insurance Act of 1968 (Alperin 1977). Additional government involvement in coastal urbanization resulted from the National Environmental Policy Act (NEPA) of 1969, by which the Environmental Protection Agency was given jurisdiction over coastal development to insure “a balance between population and resource use which will permit high standards of living and a wide sharing of life’s amenities” (Graber 1981). In 1972, the Federal Water Pollution Control Act (Clean Water Act) gave the Corps of Engineers power to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters” (Graber 1981). Dredge-and-fill activity became closely monitored as a result of this legislation. Related federal legislation (in 1977) included Executive Orders 11968 (Floodplain Management) and 11990 (Protection of Wetlands) which mandated federal agencies to evaluate alternatives to construction in floodplains and wetlands prior to issuance of permits (USDI 1985).
In 1972, the federal Coastal Zone Management Act (CZMA) was passed, and coastal states were given incentives to prepare coastal management programs, which would outline development guidelines and monitor development practices (Graber 1981). The development guidelines imposed by the individual states that elected to partake in the federal program varied considerably in terms of strictness and levels of development and enforcement, however.

Although the various guidelines and legislation were intended to minimize development of coastal areas and preserve and conserve the natural resources, development has increased substantially since the laws were first enacted. First, the "restrictive" governmental policies were not very effective due to both loose interpretation and lack of enforcement, and second, the federal flood insurance program stimulated new and more elaborate development because the risk of financial loss due to natural disaster was removed. Various other federal programs were providing direct supports in the form of highway funds, sewer improvement funds, and other infrastructural assistance.

In 1982, Congress passed the Coastal Barrier Resources Act (CBRA) which effectively withholds federal monies from any development on designated undeveloped barrier islands of the Gulf and Atlantic Coasts. A 1985 proposed amendment to the act, adding existing protected land and nearshore water bottoms to the previously designated barriers, became adopted in March 1987. Although the federal government could not legally prevent development of privately-owned land, it could perhaps lower the rate of development by withholding federal subsidies and passing on risks and higher costs to the private sector. Preliminary
results show that the CBRA legislation is indeed slowing rates of development at some of the designated CBRA barrier units (Godschalk 1984), but land use is becoming more intensified (e.g. condominiums) because only major developers can afford to take the added financial risks.

When the Coastal Barrier Resources Act was passed in 1982, the settled or incorporated portions of the study sites were exempt from the legislation. Estero Island, Pensacola Beach, Grand Isle, and Galveston Island had incorporated by 1982. Dauphin Island (unincorporated) still offered potentially developable land, however, especially at the western spit. The spit and Little Dauphin Island were subsequently adopted as CBRA units. South Padre Island, although incorporated, could also potentially expand northward, and a CBRA unit designation was proposed for all empty land north of the resort. However, extensive lobbying led to the exclusion of the southernmost 6 miles (9.6 km) of this reach, and the washover-prone barrier is eligible for federally-subsidized development (Gordon 1984).

Although the CBRA legislation may appear to directly affect only two of the sites, the preclusion of recreational development from presently undeveloped CBRA units will likely increase demand at existing resorts. This will be the pattern more at resorts in the earlier stages of resort development than in ones near or at maturation level. At sites in a land use intensification stage, housing demand may continue until an arbitrary maturation level, based upon a mutually acceptable density level, is set. The intensification of recreational housing is presently anticipated at North Carolina CBRA units (Godschalk 1984).
The two Mexican sites have not yet reached the levels of development of the American resorts. Tecolutla is still in a settlement expansion stage, and the Progreso area is beginning to enter a landuse intensification stage. The official position of the Mexican government is that tourism is economically beneficial, and, except for the recent establishment of national parks and preserves, few restrictions are placed on recreational development. Spontaneous coastal development is still characteristic of the Mexican sites, and government involvement is usually pro-development (e.g. the current wetlands reclamation project at Progreso).

Limits to Growth

According to the proposed resort evolution model (see Figure 65), growth will continue until a high density level of maturation is reached, and the physical environment at the resort site has been completely buried under the cultural overlay. A resort area such as Miami Beach or the Costa del Sol might be representative of this "end product" of recreational development. (Miami Beach was in fact in a decline stage until a major beach nourishment project rejuvenated the resort in 1980.) High demand resort areas, such as in southern Florida, Hawaii, and the Mediterranean, will reach this advanced stage in the absence of landuse guidelines. Low demand resort areas, exhibiting less attractive physical attributes (e.g. Grand Isle, Dauphin Island), may reach low density levels of maturation.

Coastal development will likely continue at any given site as long as space permits. The rate of growth, the price of lots, and the intensity of development, will reflect levels of demand. If arbitrary limits on the
developable land are set, such as by constraints on wetlands or beachfront construction or establishment of preserves, then the area of development will be restricted. Likewise, if costs and risks of development are raised by the withdrawal of governmental subsidies, as in delineated CBRA units, then the area of development will be at least partly restricted (dependent upon local demand). In either case, the forced constriction of developable land may result in higher density landuse in the available areas.

The models of resort evolution presented herein are offered to summarize the historical, morphological, and environmental patterns of recreational settlement growth (see Figures 63, 65, 66, and 67). Seaside resorts appear to be following a classic S-curve growth pattern. In spite of less 'spontaneity' and more government regulation of resort growth, urban morphologic patterns of seaside resorts are still generally evolving according to the models in both the United States and Mexico. Levels of environmental impacts can also be roughly correlated with stages of resort evolution, in spite of varying physical conditions and intensity of recreational demands. In conclusion, the models of resort evolution are offered as means of recognizing patterns in the process of transformation of a physical landscape to a cultural landscape along recreationally popular coastlines.
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1985  Poza Rica, Veracruz (F14-12), 1:250,000.
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Golman Associates
1986  Real estate map of South Padre Island, Brownsville.

Groesbeeck, D.
1538  Map of the City of Galveston, Bradford and CPs Lithograph, Boston.

McGill, J.T.
1958  Coastal Landforms of the World, 1:25,000,000, American Geographical Society, New York.

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1975  Grand Isle, color infrared aerial photographs, 1:24,000, Flights 78-143 to 78-148, October, U.S. Environmental Protection Agency, Las Vegas.
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Padre Island Development Co.
1908  Map of Tarpon Beach, 1:12,720 [approximate], on file at Cameron County courthouse, Brownsville.

Real Estate Data Inc. (REDI)

Texas General Land Office
1982  South Padre Island, color infrared aerial photographs, 1:24,000, July, Austin.
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1968 South Padre Island, black-and-white aerial photographs, 1:24,000, July, Austin.

Tobin Research, Inc.
1956 Galveston Island, black-and-white aerial photographs, 1:24,000, August, San Antonio.

United States Army Corps of Engineers (USACE)
1979 Dauphin Island, black-and-white aerial photographs, 1:4,800, September, Mobile District.

United States Coast and Geodetic Survey (USCGS)
1932 Caminada Bay, Hackberry Bay to Grand Isle (T-5302), 1:20,000.
1892 Entrance to Mobile Bay (T-1042), 1:10,000.
1850 Galveston Harbor and City (T-282), 1:20,000.
1851 Galveston Island, central section (T-328), 1:20,000.
1852 Galveston Island, west section (T-374), 1:20,000.
1932 Grand Isle to Cheniere Ronquille (T-5311), 1:20,000.
1927 Little Hickory Pass to Estero Island (T-4389), 1:20,000.
1877 Lower Part of Barataria Bay and Vicinity (T-1468a), 1:20,000.
1821 Mississippi Sound and Approaches (chart no. 1267), 1:80,000.
1894 Mobile Bay and Approaches (chart no. 188), 1:80,000.
1916 Mobile Bay and Approaches (chart no. 188), 1:80,000.
1921 Mobile Bay and Approaches (chart no. 1266), 1:80,000.
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1927 West Shore of Estero Island (T-4289), 1:20,000.

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1958 Dauphin Island, black-and-white aerial photographs, 1:20,000.
1944 Estero Island, black-and-white aerial photographs (DCT-2C-167, DCT-3C-12 to 13, 60 to 67), April, 1:20,000.
1953 Estero Island, black-and-white aerial photographs (DCT-3H-38 to 39, 41 to 44, 95 to 96, 98), February, 1:20,000.
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1983 Grand Isle, color infrared aerial photographs, 1:25,000, November, National High Altitude Program, EROS Data Center, Sioux Falls, South Dakota.

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1969 Brownsville, Texas, 1:250,000.
1943 Cedar Point, Alabama, 15 minute, 1:62,500.
1943 Fort Morgan, Alabama, 15 minute, 1:62,500.
1958 Fort Morgan, Alabama, 7.5 minute, 1:24,000.
1982 Fort Morgan, Alabama (photorevised), 7.5 minute, 1:24,000.
1958 Fort Morgan NW, Alabama, 7.5 minute, 1:24,000.
1982 Fort Morgan NW, Ala. (photorevised), 7.5 minute, 1:24,000.
1958 Fort Myers Beach, Florida, 7.5 minute, 1:24,000.
1972 Fort Myers Beach, Florida (photorevised), 7.5 minute, 1:24,000.
1933 Galveston, Texas, 7.5 minute, 1:31,680.
1954 Galveston, Texas, 7.5 minute, 1:24,000.
1969 Gulf Breeze, Florida, 7.5 minute, 1:24,000.
1958 Heron Bay, Alabama, 7.5 minute, 1:24,000.
1982 Heron Bay, Alabama (photorevised), 7.5 minute, 1:24,000.
1968 Houston, Texas, 1:250,000.
1933 Karankawa Lake, Texas, 7.5 minute, 1:31,680.
1933 Lake Como, Texas, 7.5 minute, 1:31,680.
1954 Lake Como, Texas, 7.5 minute, 1:24,000.
1958 Little Dauphin Island, Alabama, 7.5 minute, 1:24,000.
1982 Little Dauphin Island, Al. (photorevised), 7.5 minute, 1:24,000.
1962 Mobile, Alabama, 1:250,000.
1969 Oriole Beach, Florida, 7.5 minute, 1:24,000.
1935 Padre Island No. 1, Texas, 7.5 minute, 1:31,680.
1966 Pensacola, Florida, 1:250,000.
1958 Petit Bois Pass, Alabama, 7.5 minute, 1:24,000.
1982 Petit Bois Pass, Ala. (photorevised), 7.5 minute, 1:24,000.
1934 Port Isabel, Texas, 7.5 minute, 1:31,680.
1955 Port Isabel, Texas, 7.5 minute, 1:24,000.
1970 Port Isabel, Texas (photorevised), 7.5 minute, 1:24,000.
1983 Port Isabel, Texas (photorevised), 7.5 minute, 1:24,000.
1955 Port Isabel NW, Texas, 7.5 minute, 1:24,000.
1970 Port Isabel NW, Texas (photorevised), 7.5 minute, 1:24,000.
1983 Port Isabel NW, Texas (photorevised), 7.5 minute, 1:24,000.
1933 San Luis Pass, Texas, 7.5 minute, 1:31,680.
1954 San Luis Pass, Texas, 7.5 minute, 1:24,000.
United States Geological Survey (USGS) [topographic maps]
1954  Sea Isle, Texas, 7.5 minute, 1:24,000.
1964  Tampa, Florida, 1:250,000.
1933  The Jetties, Texas, 7.5 minute, 1:31,660.
1954  The Jetties, Texas, 7.5 minute, 1:24,000.
1932  Virginia Point, Texas, 7.5 minute, 1:31,660.
1954  Virginia Point, Texas, 7.5 minute, 1:24,000.
1963  West Palm Beach, Florida, 1:250,000.

Wells, C.G.
1904  Map of City of Galveston, Texas. Sandusky Special Surveys, Galveston.
APPENDIX: THE SAFFIR-SIMPSON SCALE

The Saffir/Simpson Damage-Potential Scale is used by the National Weather Service to give public-safety officials a continuing assessment of the potential for wind and storm-surge damage from a hurricane in progress. Scale numbers are made available to public-safety officials when a hurricane is within seventy-two hours of landfall.

Scale numbers range from 1 to 5. Scale No. 1 begins with hurricanes in which the maximum sustained winds are at least 74 mph (119 kph) or which will produce a storm surge 4 to 5 feet (1.5 m) above normal water level. Scale No. 5 applies to those in which the maximum sustained winds are 155 mph (249 kph) or more, or which have the potential of producing a storm surge more than 18 feet (5.5 m) above normal. Atmospheric-pressure ranges have been adapted to this scale, and pressure ranges associated with each are listed in Table 2.

The scale numbers are not forecasts but are based on observed conditions at a given time in a hurricane’s lifespan. They represent an estimate of what the storm would do to a coastal area if it were to strike without change in size or strength. Scale assessments are revised regularly as new observations are made, and public-safety organizations are kept informed of the hurricane’s disaster potential.

The damage-potential scale indicates probable property damage and evacuation recommendations as listed below:

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*Appendix C of Simpson and Riehl 1981*
1. Winds of 74 to 95 mph (119-153 kph). Damage primarily to shrubbery, trees, foliage and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. And/or storm surge 4 to 5 feet (1.5 m) above normal. Low-lying coastal roads inundated, minor pier damage, some small craft torn from moorings in exposed anchorage.

2. Winds of 96 to 110 mph (154 to 178 kph). Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. And/or storm surge 6 to 8 feet (2 to 2.5 m) above normal. Coastal roads and low-lying escape routes inland cut by rising water two to four hours before arrival of hurricane center. Considerable damage to piers; marinas flooded. Small craft torn from moorings in unprotected anchorages. Evacuation of some shoreline residences and low-lying island areas required.

3. Winds of 111 to 130 mph (179 to 209 kph). Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. And/or storm surge 9 to 12 feet (2.6 to 3.9 m) above normal. Serious flooding at coast; many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Flat terrain 5 feet (1.5 m) or less
above sea level flooded inland 8 miles (13 km) or more. Evacuation of
low-lying residences within several blocks of shoreline possibly required.

4. Winds of 131 to 155 mph (211 to 249 kph). Shrubs and trees blown
down; all signs down. Extensive damage to roofing materials, windows,
and doors. Complete failure of roofs on many small residences. Complete
destruction of mobile homes. And/or storm surge 13 to 18 feet (4 to 5.5
m) above normal. Flat terrain 10 feet (3 m) or less above sea level
flooded inland as far as 6 miles (10 km). Major damage to lower floors of
structures near shore due to flooding and battering by waves and floating
debris. Low-lying escape routes inland cut by rising water three to five
hours before hurricane center arrives. Major erosion of beaches. Massive
evacuation of all residences within 500 yards (455 m) of shore possibly
required, and evacuation of single-story residences on low ground within
2 miles (3 km) of shore required.

5. Winds greater than 155 mph (249 kph). Shrubs and trees blown
down; considerable damage to roofs of buildings; all signs down. Very
severe and extensive damage to windows and doors. Complete failure of
roofs on many residences and industrial buildings; extensive shattering of
glass in windows and doors. Some complete building failures. Small
buildings overturned or blown away. Complete destruction of mobile
homes. And/or storm surge greater than 18 feet (5.5 m) above normal.
Major damage to lower floors of all structures less than 15 feet (4.5 m)
above sea level within 500 yards (455 m) of shore. Low-lying escape
routes inland cut by rising water three to five hours before hurricane
center arrives. Massive evacuation of residential areas on low ground
within 5 to 10 miles (8 to 16 km) of shore possibly required.
<table>
<thead>
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<th>Scale No.</th>
<th>Central Air Pressure (category)</th>
<th>Winds mph</th>
<th>kph</th>
<th>Surge ft</th>
<th>m</th>
<th>Damage</th>
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<td>1</td>
<td>&gt;28.93</td>
<td>74-95</td>
<td>118-152</td>
<td>4-5</td>
<td>1.2-1.5</td>
<td>minimal</td>
</tr>
<tr>
<td>2</td>
<td>28.50-28.92</td>
<td>96-110</td>
<td>153-176</td>
<td>6-8</td>
<td>1.8-2.4</td>
<td>moderate</td>
</tr>
<tr>
<td>3</td>
<td>27.90-28.49</td>
<td>111-130</td>
<td>177-208</td>
<td>9-12</td>
<td>2.7-3.6</td>
<td>extensive</td>
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<tr>
<td>4</td>
<td>27.17-27.89</td>
<td>131-155</td>
<td>209-248</td>
<td>13-18</td>
<td>4.0-5.5</td>
<td>extreme</td>
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<tr>
<td>5</td>
<td>&lt;27.17</td>
<td>&lt;920</td>
<td>&gt;155</td>
<td>&gt;248</td>
<td>&gt;18</td>
<td>&gt;5.5</td>
</tr>
</tbody>
</table>

Table 2. Saffir/Simpson damage-potential scale ranges. (Hebert and Taylor 1975, cited in Simpson and Riehl 1981)
VITA

Klaus J. Meyer-Arendt was born in Hamburg, West Germany on November 6, 1950 and raised in Germany, Brazil, Ohio, Utah, Colorado, and Oregon. Following extensive travels throughout Europe, North Africa, North America, and South America in the early 1970s, Klaus enrolled at Portland State University where in 1975 he received a B.A. degree in Geography and a Certificate of Latin American Studies. Enrolling in Louisiana State University in 1976 to pursue his research interests in the cultural-historical geography of Latin America, Klaus focused on a guava-producing region in the Colombian Andes as a thesis topic, and an M.A. degree in Geography was conferred in 1979. A secondary interest in the Louisiana coastal zone led to employment with a Louisiana environmental consulting firm, where between 1979 and 1983 he specialized in coastal/deltaic geomorphology and management of coastal resources. A desire to incorporate the human component into coastal research led Klaus into the subfield of recreational geography and back to Louisiana State for his Ph.D. studies in early 1983. His topical interests include the geography of tourism and recreation, coastal processes, coastal resource management, cultural-historical geography, and settlement geography. Regional specialties include North America and Latin America. In August 1987, Klaus joined the Department of Geology and Geography at Mississippi State University as assistant professor of geography.
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Title of Dissertation: RESORT EVOLUTION ALONG THE GULF OF MEXICO LITTORAL: HISTORICAL, MORPHOLOGICAL, AND ENVIRONMENTAL ASPECTS

Approved:

[Signatures]

Major Professor and Chairman
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

May 18, 1987