MODELING ENVIRONMENTAL IMPACTS OF TOURISM
DEVELOPMENT ALONG THE GULF COAST

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ABSTRACT

Coastal resort development is attributed to a complex interplay of social, economic, and technologic factors. Social scientists have proposed S-curve or bell-curve models to better understand resort evolution. Such models have proved useful in both documenting the social history of resorts as well as in planning for future tourism. Even trends in the evolving urban morphology of resorts are comprehended more easily by resort models. However, in spite of abundant literature addressing the issue of negative tourism impacts upon the environment, this human/coastal environment relationship has not been examined within a conceptual evolutionary framework. Based upon previous and on-going research at tourist destinations along the Gulf of Mexico littoral, preliminary modeling of environmental impacts is attempted.

Temporally, a modified S-curve model of resort evolution is offered to describe the development of coastal resorts, and stages of exploration, infrastructural development, settlement expansion, and maturation are identified. The upper level of development, or maturation, differs among the sites, primarily as a function of demand. High-demand destinations may be subject to an additional stage prior to reaching maturation — one of landuse intensification. Here, a resort becomes characterized by high-density landuse and corollary high levels of visitation and seasonal occupancy. After reaching maturation level, a coastal destination loses its attractiveness to recreationists and tourists.

Environmentally, in spite of variability in degree of human impacts, general correlations are made. Dune disturbance, shoreline armoring, and wetlands dredging are abundant during the settlement expansion stage, but preservation efforts gain importance as a resort matures. If shoreline erosion rates are high, human efforts at stabilization may propel a resort into an early maturation stage. Hurricanes stimulate progression through the development stages, primarily by facilitating landuse intensification via redevelopment.

INTRODUCTION

Sandy shorelines of the world are experiencing high rates of urbanization as a result of demand for recreation and tourism opportunities. Increases in wealth, leisure time, mobility, and popularization of water-based activities have led to a proliferation of seaside recreational settlements since sea-bathing first became popularized at Scarborough, England in the early 1700s. Unprecedented high rates of coastal construction have characterized the decades of the 1970s and 1980s, especially in the affluent United States.

Accelerating rates of coastal urbanization have led to increased concern by earth scientists, environmentalists, and 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) increased 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 sea-
side urbanization, but the attraction to the coast was not 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 1982, the Coastal Barrier Resources Act, a strategy for federal disinvolvement in continued subsidization of development on barrier islands and beaches, was passed (USDI, 1982).

Despite extensive research into coastal and estuarine processes and forms — including human impacts upon them, few studies have correlated cultural-historical processes of coastal settlement and environmental impacts. The changing relationships between humans and their touristic coastal habitat have not been examined comprehensively within a systematic framework.

PREVIOUS STUDIES

Resort Cyclicity

Coastal resorts are highly dynamic places. According to prevailing fashions and tourists' demands, a resort may be "in style" or "passe". Thus a tourist destination generally undergoes phases of development, including areal growth and landuse intensification, and perhaps phases of decline, characterized by abandonment of facilities and general deterioration. During the progression through these phases, both the character of the resort and also the character of the tourist that frequents the resort changes. Social scientists have attempted to outline resort evolution on the basis both of the characteristics of the resort and also of the resort clientele.

One of the most cited theoretical models of resort evolution is one proposed by Butler (1980). By applying the product life cycle concept (employed in marketing) to the tourism industry, Butler outlined a 6-stage tourism area cycle of evolution (Fig. 1). 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. As the tourist market wanes, the decline stage is entered. However, countermeasures such as redirected foci of tourist attraction, beautification/urban renewal projects, beach nourishment, or even legalization of gambling may offset the decline and stimulate differing degrees of rejuvenation (Butler, 1980).

Inherent in Butler's model is the concept of carrying capacity which delineates a theoretical upper limit to growth. The determination of what levels of density, in terms of either population or extent of touristic development, constitute carrying capacity has remained an elusive goal of recreational geographers and other social scientists for years (Mathieson and Wall, 1982). In view of the many existent temporal and spatial variables inherent in such a theoretical threshold, a quantitative definition of carrying capacity probably is not forthcoming soon. However, in a qualitative sense the carrying capacity concept is valid, and an S-curve resort evolution model provides a useful framework for examining coastal resort development.

Butler's S-curve model has been applied, usually in slightly modified form, in the study of various social, economic, and planning aspects of tourism (e.g. Hovinen, 1982; Young, 1983; Keller, 1987; Weaver, 1988). With the exception of Meyer-Arendt's (1985) pilot study of environmental changes at Grand Isle, Louisiana, few researchers have...
Tourism and the Physical Environment

Humans have long been recognized as major agents of coastal landscape change. At a 1956 symposium addressing “Man’s Role in Changing the Face of the Earth”, Davis (1956) summarized the extent of human impacts upon the shoreline from shell midden creation to seawall construction. Most of the more recent shoreline impacts were attributed to the increasing attractiveness of coasts as tourist destinations. Not only were strand environments modified by motels and vacation homes, but so were mangrove swamps and tidal marshes (Davis, 1956). High levels of modification have led some coastal scientists to include an “anthropogenic” category in their coastal classifications (Walker, 1981; Walker, 1984).

The integration of the physical component into models of tourism development, both theoretical and spatial, has not been attempted by many. Cohen (1978), in reviewing literature on the environmental impacts of tourism, identified four major factors which affect the rate of 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 over environmental conservation), and (4) the transformational character of recreational development. Roy Wolfe, considered by many to be the “father of recreational geography”, noted a direct inverse relationship between
recreational urbanization and environmental quality in his seminal work on lakeside resorts in Ontario (Wolfe 1952). As lakeside cottage resorts became more urbanized and commercialized, they increasingly became "divorced from their geographic environment." Although environmental degradation usually is related directly to increases in recreational usage (Cohen, 1978; Pigram, 1980), some have questioned the linearity of this inverse relationship and also the necessity of the inverse relationship itself.

Wolfe (1983), reevaluating previous research on recreational travel (Wolfe, 1966), proposed a descriptive model of resort evolution that incorporates the environmental component. In his model, "a normative typology of tourist destinations" (also known as the Ellis curve, after an associate), the vertical axis represents the level of economic impact (from positive to negative) and the horizontal axis measures relative environmental impacts (Fig. 2). When tracing the course of development of a resort such as Torremolinos on Spain's Costa del Sol, early tourism development is accompanied by positive economic and environmental impacts. This is explained by both the initial inordinate attention paid to aesthetics of landscape in order to attract the tourist as well as by the initially low number of visitors. In time, however, environmental degradation becomes dominant, and even the economic benefits, although 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 net economic benefits are no longer being realized. If management decisions are not implemented at that stage, economic and environmental decline will continue.

OBJECTIVES OF STUDY

As part of a broader study into the cultural-historical aspects of coastal resort evolution (Meyer-Arendt, 1987), an attempt was made to correlate environmental impacts with stage of tourism development. If resort development represents an ongoing

![Fig. 2. Ellis curve (Wolfe, 1983).](image-url)
process of conversion of a pristine physical landscape to a cultural landscape, it was theorized, then both the form of the resort and the level of environmental modification should be dependent upon the stage of evolution.

Because of the relative similarity of site-specific physical environments, the Gulf of Mexico was selected as a regional setting, and eight seaside resorts were selected for analysis, six in the United States and two in Mexico (Fig. 3). Seven of the eight sites were located upon barrier islands, all of which experienced shoreline erosion and were susceptible to the onslaught of severe storms.

The methodology was primarily historical. By analysis of historic maps, photographs, and literary sources, complemented by field surveys and interviews, resort evolution was documented. Processes of development, settlement forms, and corollary environmental impacts extending up to the present were examined within a “resort cycle” framework.

TOURISM DEVELOPMENT ALONG THE GULF COAST

Beginning in the 1820s, the upper classes of many U.S. Gulf Coast urban areas developed a pattern of establishing summer residences or frequenting lodging facilities at proximal waterfront locations. Mississippi Sound and Lake Pontchartrain were favored by New Orleanians, Mobile Bay by Mobilians, and Galveston Bay by Houstonians, for example. Initially, however, the wave-washed coast of the Gulf of Mexico was avoided by recreationists.

Between the 1860s and the 1880s, the exposed Gulf shores near established urban centers became increasingly favored for beach recreation. This trend was facilitated by improvements in transportation, principally rail and steamship 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 during this period.

Fig. 3 Gulf of Mexico study sites (Meyer-Arendt, 1987).
From the 1880s until 1920, the fledgling resorts either grew slowly or failed, depending mainly upon human response to hurricanes. 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 nonexistent at the other sites. The economic boom years of the Roaring 1920s were accompanied by an upsurge in beach recreation, 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 (Mexico's primary Atlantic port, 170 km south of Tecolutla). The 1930s, although 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 Tecolutla.

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 then. 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.

RESULTS AND DISCUSSION
A Model of Resort Evolution and Corollary Environmental Impacts

The transformation of a pristine stretch of shoreline into a developed coastal resort can be described by a resort cycle model, similar to Butler's (1980) model (Fig. 4). For a resort to evolve from a state of zero recrea-

![Fig. 4 Theoretical model of resort evolution (Meyer-Arendt, 1987).](image-url)
tional 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 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 and stresses upon the environment are extremely high. The proposed conceptual model (Fig. 4) likewise has urban morphologic and environmental components to it, and these aspects in turn may be modeled. Using a barrier island as a hypothetical resort setting, an evolutionary model of environmental impacts is proposed (Fig. 5).

The first stage in the evolution of a resort is one of exploration, accompanied perhaps by isolated settlement. Tourists are drawn to the coast for purposes of health or pleasure, perhaps in response to popularization of sea-bathing. Access is initially difficult. If the coastal site becomes known among the local population, an entrepreneur may sense opportunities for ferrying tourists to the site. Some of these recreationists may build a modest seasonal or year-around dwelling. If access to the beach by land or small boat is a fairly straightforward undertaking, little or no structural development may occur as the sense of remoteness may be lacking.

This initial stage is characterized by relatively few human impacts upon the physical environment 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, where demand for fill material in a rapidly growing (nonrecreational) urban area was high.

The second stage is characterized by infrastructural development. This includes both access infrastructure (railroad or highway access via bridge or causeway) and also commercial or housing infrastructure at the destination. Generally, the former precedes the latter, although simultaneous infrastructural provision may take place. Bridges, restaurants, hotels, or property for sale all trigger demand for recreational usage of an incipient resort. This stage is entered generally as a result of the actions of one or more entrepreneurs, who foresee a potential for profit. A typical pattern is for the entrepreneur to acquire a large block of real estate, construct a commercial enterprise such as a hotel/restaurant, and offer for sale lots for vacation home development. A focal point on the beach — a recreational business district (RBD) — 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.

During the infrastructural development stage, landscaping of the platted beach subdivisions may be accompanied by removal of beach ridges and replacement of native upland vegetation with introduced plant species. Not only are the visual and olfactory linkages with the sea strengthened by minimizing geomorphic obstacles, but certain vegetation types (e.g. palms, palmettos, Australian pines, and oleanders) exude an aura of the balmy tropics that many touristic refugees from northern climes “find appealing.” In conjunction with settlement landscaping, the beach may become “aesthetically improved” by the removal of driftwood, debris, and perhaps even primary dunes. Although perhaps not intentional, these actions tend to accelerate erosion rates and leave the site more susceptible to damages during storm events.

Once the seeds of infrastructure have been planted, settlement expansion can take place. This stage is the one in which most of the transformation of a physical environment to a cultural one takes place. Initially, the resort area is relatively pristine, but towards the end of the stage a tourism landscape has become dominant and little room for further areal expansion is available. Technically, this stage should be subdivided into three parts: incipient expansion, “take-off,” and leveling off (see Fig. 4). During the settlement expansion phase, property perceived to be most desirable becomes developed first. Normally this property is along the beachfront closest to the previously established RBD. Development of housing and commercial businesses takes place as close to the beach as possible, usually immediately behind the vegetation line. The next most desirable property is on the higher beach-ridge plain (or barrier flat), provided that the visual and olfactory links to the sea are not removed. If wetlands comprise the backbarrier zone, then perception of them as valuable usually is tied to demand for
Fig. 5 Model of environmental impacts at seaside resorts (Meyer-Arendt, 1987).
residential canal lots where private pleasure boats can be docked (Plate 1).

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 or filled to both minimize mosquito outbreaks and provide homesites suitable for development. Modification of wetlands via dredge-and-fill soon follows, in order to provide boat access to private lots. The resulting dead-end residential canals may 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 becomes exported into the backbay, which now may well be crisscrossed with dredged navigation channels, and overall levels of bioproductivity — including commercial fish and shellfish harvests — become lowered. Along the shorefront, previous modifications of the beaches and dunes system have led to accelerated shoreline erosion, and human response is to combat this new "problem" with both structural and nonstructural methods. The previous negative impacts of dune removal are recognized and active dune restoration measures, such as sand-fencing or placement of brush, are begun. Also, shoreline erosion control devices such as groins, seawalls, revetments, offshore breakwaters, and beach nourishment, are implemented if funds are available. Private property owners may construct bulkheads at the seaward margins of their beachfront lots (Plate 2).

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 this trend sets in during a resort's settlement expansion phase, the increased number and density of housing units will raise the recreational car-

Plate 1. Backbarrier residential canal development, South Padre Island (photo by author).
Landuse intensification can occur by 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 tourists or by number of housing units — and also prolonging the settlement expansion stage and thereby delaying onset of the maturation stage. The second mechanism, usually referred to as “redevelopment,” entails replacement of a preexisting form of landuse by one of higher density. Landuse intensification is completed usually by land developers buying and removing older, decaying structures located on what is perceived as prime real estate, and replacing them with hotels or condominiums. This 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 also may be stimulated by destructive hurricanes which instantly remove older, low-density forms of landuse (e.g. beach cottages). This 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 (50 km east of Dauphin Island).

The environmental modifications implemented during the settlement expansion stage continue into the landuse intensification stage. Residential canal subdivision construction continues, and more defensive structures are placed on the beachfront in efforts to offset erosional trends usually stimulated by the previous erosion-control structures. Hard structural solutions may become increasingly replaced by soft structural solutions, including beach nourishment if accessible sediments are 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. A higher governmental authority (county, state, or federal) may be called upon to both institute and enforce limits-to-growth land-use legislation.

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, save perhaps for replacement construction, and levels of tourist visitation have stabilized. The level of maturation differs considerably from site to site, 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 microenvironments such as wetlands and unstable shorelines bordering tidal inlets are subject to development if sufficient demand exists and no prohibitive laws have been implemented yet. A low-demand resort such as Grand Isle has reached the maturation stage prior to extensive wetland modification or landuse intensification, whereas Fort Myers Beach (Estero Island) has reached that level prematurely because wetlands and landuse zoning legislation have halted ongoing reclamation and intensification processes. A hurricane, striking a mature resort and removing many beachfront structures, temporarily will upset the state of equilibrium. This equilibrium will be restored subsequently following post-storm construction, usually in a higher-density form.

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 vegetation removal, placement of erosion-control structures along the beachfront, wetlands removal, dredging-and-filling, and related 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.

Government Involvement in Resort Evolution

The proposed models of resort evolution are derived from coastal resorts that have developed spontaneously, that is development processes, settlement forms, and environmental impacts have resulted from unregulated, unrestricted human activities. Along the highly urbanized United States coastline, new development now 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 developers.

Although the myriad of laws and guidelines legislated ever since the 1920s (most heavily during the 1970s and 1980s) was intended to minimize development of coastal areas and preserve and conserve the natural resources, development has increased substantially in spite of them. First, the “restrictive” governmental policies were not effective because of 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 resulting from disaster was removed. Various other federal programs continue to provide 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 (USDI, 1985), which added 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 perhaps could lower the rate of development by withhold...
ing federal subsidies and passing on risks and higher costs to the private sector. Preliminary results show that the CBRA legislation indeed is slowing rates of development at some of the designated CBRA barrier units (Godschalk, 1984), but landuse is nonetheless intensifying because only major developers can afford to take the added financial risks of coastal development.

SUMMARY

The models of resort evolution presented herein are offered to summarize the historical and environmental patterns of recreational settlement growth. Seaside resorts seem to be following a classic S-curve growth pattern which can be subdivided into discrete stages. In spite of less "spontaneity" and more government regulation of resort growth, geographic patterns of seaside resort development can be modeled. Levels of environmental impacts also can be correlated roughly with stages of resort evolution, in spite of differing physical conditions and intensity of recreational demands. Although variability certainly exists, environmental impacts generally have been least at resorts either in early stages of development such as the Mexican resorts or at low-intensity levels of maturation (such as Dauphin Island). In conclusion, the models of resort evolution are offered as a way of recognizing patterns in the process of transformation of a physical landscape to a cultural landscape along recreational popular coastlines.

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REFERENCES


United States Department of Interior (USDI), 1985, Coastal Barrier Resources System: draft report to Congress: Washington D.C.


