Coastal Louisiana is a dynamic environment experiencing constant changes in the temporal and spatial distribution of habitats as a result of natural and man-influenced processes. Management of this wetland environment for selected purposes, or for maintenance of a naturally renewable resource base, requires a knowledge of the relationship between forms and processes, quantification of spatial and temporal changes, and the ability to predict future trends in relation to natural and man-manipulated processes. The first comprehensive data base for the Louisiana deltaic plain to support management efforts was obtained through construction of habitat maps for 1955/56 and 1978 (using 1:24,000 controlled, 7.5 minute, quad-centered black-and-white photo mosaics and 1:24,000 uncontrolled, non-quad-centered color-infrared prints, respectively) and planimetering and tabulation of the habitat areas according to selected geographical units (state, parish, hydrologic unit, 7.5 minute quad sheet, and coastal zone). The results of this study have been incorporated into wetland management plans for Terrebonne and St. Bernard Parishes and are serving as an impetus for management implementation throughout the Louisiana coastal zone.

INTRODUCTION

It has been evident for many years that coastal Louisiana is a dynamic environment undergoing constant habitat change as a result of both natural and man-influenced processes. Numerous studies have documented the geomorphic forms, processes, and habitat types present in the region and have assessed the rate and amount of change in selected areas (Blackmon 1978; Chabreck 1972; Chabreck and Linscombe 1978; Craig and Day 1977; Craig, Turner, and Day 1978; Gagliano and van Beek 1970; Gosselink, Cordes, and Parsons 1979; Kwon 1969; Morgan 1973, 1974; Morgan and Larimore 1957). However, the first comprehensive study to map, measure, and document habitat change in the entire Mississippi River Deltaic Plain Region was funded by the U.S. Fish and Wildlife Service (FWS) and the Bureau of Land Management, and conducted by personnel from Coastal Environments, Inc. (CEI) (Wicker 1980; Wicker et al. 1980a). Evaluation of the results of this study permits spatial analysis and quantification of the type and amount of change, indicates possible causes for some of the changes, and provides an invaluable data base for formulation and implementation of management plans to offset or reverse the undesirable habitat changes.
For the purpose of discussing the type, amount, and cause of habitat change in terms of utilizing the data for wetland management, data for six of the eighteen parishes included in the FWS mapping project (Wicker 1980; Wicker et al. 1980a) were evaluated. These six parishes (Terrebonne, Lafourche, Jefferson, Plaquemines, St. Bernard, and Orleans) cover approximately 6,040,700 acres, encompass most of the southeastern Mississippi River deltaic plain, and include the southern portion of the seven major Mississippi River delta lobes (Figure 1). To determine spatial and temporal changes in habitat types, 464 7.5 minute, quad-centered habitat maps were constructed utilizing controlled, quad-centered, black-and-white photo mosaics at a scale of 1:24,000 for 1955 through 1956 (Petroleum Information Corporation 1955/56; Tobin Research, Inc. 1955/56) and uncontrolled, non-quad-centered color-infrared (CIR) photographs at a scale of 1:24,000 for October 1978 (National Aeronautics and Space Administration 1978). Habitat types were identified on the maps by alphanumeric symbols derived from a hierarchical classification system (Table 1) devised by the FWS (Cowardin et al. 1979; FWS n.d.) but amended to accommodate habitat types characteristic of the Louisiana coastal zone.

The large scale and high resolution of both sets of photographs permitted detailed interpretation for both time periods, but a larger number of habitats were interpreted on the 1978 imagery (97 versus 73 for 1955/56) because of: 1) the ability to field check the photographic signatures; 2) the availability of a larger collateral data base (i.e., vegetation maps, synchronous U.S. Geological Survey topographic maps, published information); and 3) the ability to

![Figure 1. Location of the Six-Parish Area in Coastal Louisiana with Reference to the Mississippi River Delta Lobes.](image-url)
discern more habitat types, especially various types of aquatic beds and mangroves, due to distinguishable color signatures (Table 2). Monoscopic, as opposed to stereoscopic, analysis was adequate for this project because: 1) habitat types are closely related to geomorphology and land use in the deltaic plain and are, therefore, easily discerned monoscopically; 2) determination of habitat change required that researchers to evaluate the data in terms of cause-and-effect relationships of habitat change that are associated with natural as opposed to direct, man-influenced processes.

This mapping project differed somewhat from previous FWS projects in that some habitat labels indicated the generic origin, especially where man-influenced, of the habitat type (e.g., excavated, mineral extraction, spoil, reclamation). This kind of detail enables researchers to evaluate the data in terms of cause-and-effect relationships of habitat change that are associated with natural as opposed to direct, man-influenced processes.

Areal measurements for the habitat types were obtained by manually planimetrizing the habitat maps using a Numonics 1224 electronic digitizer. Data for Louisiana were recorded by parish, hydrologic unit, topographic map unit, and location (e.g., inside and outside) with regard to the Louisiana coastal zone.
In order to evaluate habitat change to determine the necessity and feasibility of management procedures, the 97 habitat categories for both time periods were collapsed into nine functional habitat categories and separated into natural and man-influenced types (Table 3). The term "functional habitat" is defined as a generalized habitat category composed of smaller habitat units that have been combined based on similarity of vegetation type or form, physical appearance

<table>
<thead>
<tr>
<th>HABITAT</th>
<th>COLOR (BLACK-AND-WHITE)</th>
<th>SHAPE</th>
<th>ASSOCIATION/STATE</th>
<th>SIZE</th>
<th>TEXTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER:</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ponds/Pits:</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lakes   :</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immitations:</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estuaries:</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rivers  :</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coastal:</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canals  :</td>
<td>E, L, B, Y, R, O, G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESULTS**

In order to evaluate habitat change to determine the necessity and feasibility of management procedures, the 97 habitat categories for both time periods were collapsed into nine functional habitat categories and separated into natural and man-influenced types (Table 3). The term "functional habitat" is defined as a generalized habitat category composed of smaller habitat units that have been combined based on similarity of vegetation type or form, physical appearance
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Table 3. Mississippi River Deltaic Plain: Habitat Types by Function.

<table>
<thead>
<tr>
<th>FUNCTIONAL HABITATS</th>
<th>HABITAT LABELS WITHIN FUNCTIONAL HABITAT CATEGORIES, 1955-1978</th>
<th>NATURAL</th>
<th>MAN-INFLUENCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEVELOPED</td>
<td>Not Applicable</td>
<td>UDV1</td>
<td>UDV1e</td>
</tr>
<tr>
<td>AGRICULTURE/PASTURE/GRASSLANDS</td>
<td>UGRp*</td>
<td>UDV2</td>
<td>UDV2e</td>
</tr>
<tr>
<td>FORESTS</td>
<td>PFO1/2, PFO1/3, PFO1/4, UFD1/2, UFD1/3, UFD1/4</td>
<td>PDV</td>
<td>UFD1s</td>
</tr>
<tr>
<td>SWAMP</td>
<td>PFO1</td>
<td>Not Applicable</td>
<td></td>
</tr>
<tr>
<td>SCRUB/SHRUB</td>
<td>ES5S1, ES5S3</td>
<td>US1</td>
<td>US1s</td>
</tr>
<tr>
<td>FRESH MARSH</td>
<td>PEM</td>
<td>PEMd</td>
<td></td>
</tr>
<tr>
<td>NONFRESH MARSH</td>
<td>E2EM, E2EM3P5</td>
<td>E2EM6</td>
<td>E2EM6P5d*</td>
</tr>
<tr>
<td>OPEN WATER</td>
<td>M1OW, E2FL3</td>
<td>POW</td>
<td>R20Wo</td>
</tr>
<tr>
<td>BEACH/JETTY/REEF/BAR</td>
<td>M2BR2, E2BF2</td>
<td>R2BR2</td>
<td>R2BR2e</td>
</tr>
</tbody>
</table>

*Shown only on 1978 maps.

and formative processes, or activity and function. "Habitat change" is defined as the conversion of one habitat type to another. The term "natural," when applied to a functional habitat type, means the functional habitat shows no appearance on the air photos of being directly influenced, managed, or manipulated by human activities such as canals and structures. However, changes in natural habitat types may be influenced by secondary impacts resulting from human activity, but these cannot be determined from air photo interpretation alone. "Land loss," a type of habitat change, is defined as the increase in natural and man-influenced water habitat (including aquatic beds and flats) and can be determined directly from air photo interpretation.

When analyzed on both an individual parish and a collective parish basis, it is evident that the entire deltaic plain area, including the active Mississippi River delta lobe in Plaquemines Parish, is experiencing change characteristic of a deteriorating delta complex (Table 4). Tabulation of the data indicated that five of the functional habitat types (Developed, Agriculture/Pasture, Scrub/Shrub, Non-Fresh Marsh, and Water) increased in area (Table 5) largely because of man-influenced processes (e.g., canal building, spoil deposition, leveeing, mineral and groundwater extraction, and wetland "reclamation") whose habitat impact closely resembles the processes (e.g., deterioration of fresh-water habitats and land loss) dominant in a deteriorating deltaic environment (Table 4).
Table 4. Natural and Man-Influenced Cause and Effect Relationships Operable in Deltaic Environments.

<table>
<thead>
<tr>
<th>NATURAL PROCESSES AND DELTA DEGRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
</tr>
<tr>
<td>---Compaaction and Downwarping</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Wave Action</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Cessation of Freshwater Discharge</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Cessation of Sediment Input</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAN-INFLUENCED PROCESSES AND DELTA DEGRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
</tr>
<tr>
<td>---Canal Building</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Spoil Deposition</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Flood Protection Levees</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Withdrawal of Water, Sulfur, and Hydrocarbons</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---Land Reclamation</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

Land loss for this area over the 23-year period was approximately 362,200 acres, or an average of 15,748 acres per year (24.6 square miles per year). Even Plaquemines Parish, the site of active Mississippi River Delta development, lost 9.8 square miles per year, while the abandoned delta complexes covered by Terrebonne Parish and St. Bernard Parish lost 7.6 square miles per year and 1.2 square miles per year, respectively.

A distressing aspect evident from this data is the massive loss of fresh-water marsh (down 60.0%) and swamp (down 13.5%) habitat throughout the region (Table 5). A comparison of the "functional
Table 5. Habitat Change in a Six-Parish Area of the Mississippi River Deltaic Plain.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>1955/56 Area (in acres)</th>
<th>%</th>
<th>1978 Area (in acres)</th>
<th>%</th>
<th>Change (in acres)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>101,006</td>
<td>1.7</td>
<td>171,706</td>
<td>2.8</td>
<td>+70,700</td>
<td>70.0</td>
</tr>
<tr>
<td>Agriculture/Pasture</td>
<td>212,126</td>
<td>3.5</td>
<td>212,834</td>
<td>3.5</td>
<td>+708</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Forest</td>
<td>105,559</td>
<td>1.7</td>
<td>93,502</td>
<td>1.5</td>
<td>-12,057</td>
<td>11.4</td>
</tr>
<tr>
<td>Swamp</td>
<td>300,058</td>
<td>5.0</td>
<td>259,499</td>
<td>4.3</td>
<td>-40,559</td>
<td>13.5</td>
</tr>
<tr>
<td>Scrub/Shrub</td>
<td>13,669</td>
<td>0.2</td>
<td>89,803</td>
<td>1.5</td>
<td>+75,934</td>
<td></td>
</tr>
<tr>
<td>Fresh Marsh</td>
<td>901,809</td>
<td>14.9</td>
<td>357,952</td>
<td>5.9</td>
<td>-543,857</td>
<td>60.0</td>
</tr>
<tr>
<td>Nonfresh Marsh</td>
<td>1,037,407</td>
<td>17.2</td>
<td>1,127,983</td>
<td>18.7</td>
<td>+90,576</td>
<td>8.7</td>
</tr>
<tr>
<td>Water</td>
<td>3,360,423</td>
<td>55.6</td>
<td>3,722,581</td>
<td>61.6</td>
<td>+362,158</td>
<td>10.8</td>
</tr>
<tr>
<td>Beach/Reef/Jetty</td>
<td>8,465</td>
<td>0.1</td>
<td>4,872</td>
<td>0.1</td>
<td>-3,593</td>
<td>42.4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6,040,722</strong></td>
<td><strong>99.9</strong></td>
<td><strong>6,040,732</strong></td>
<td><strong>99.9</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

habitat maps (Figure 2) for Terrebonne Parish for 1955/56 and 1978 (derived from the redrafting of a mosaic of the photographically reduced 1:24,000 habitat maps constructed from aerial photographs; Wicker et al. 1980a, 1980b) illustrates the spatial distribution of habitat change and indicates some of the possible causes for these changes. Two of the more pervasive causes have been the construction of navigation and petroleum-related canals which permit saline Gulf of Mexico waters to intrude into the interior fresh-water areas and the deposition of spoil along canals which impound flood waters. The impact of both actions is to destroy fresh-water vegetation and prevent revegetation of the areas impacted. These two actions have contributed to the loss of 18,466 acres of swamp and 126,493 acres of fresh marsh in Terrebonne Parish over a 23-year period. During this same period St. Bernard Parish lost 20,206 acres (95.4%) of fresh marsh and 10,107 acres (99.9%) of cypress (Taxodium distichum) swamp. As a result of the spatial analysis and quantification of land loss and habitat alteration evident in the FWS habitat mapping project, these two parishes have pursued wetland management programs.

The Terrebonne Parish Police Jury has authorized the implementation of a project to determine the best methods to prevent further deterioration of the Terrebonne Barrier Island Complex. Between 1955/56 and 1978, this island complex decreased by 3,694 acres (44%). Some of this loss was due directly to erosion associated with hurricane activity. However, the large-scale CIR air photos reveal that oil and gas activity on the islands, especially canal dredging, selective construction of jetties and revetments, spoil deposition, and overall destruction of marsh and dune vegetation, may have made the barrier islands more vulnerable to storm activity and land loss.

In St. Bernard Parish, the local population was well aware of the unfavorable environmental changes that were occurring in the parish and resulting in a loss of wildlife habitat and subsequently a decline
Figure 2. Comparison of Changes in Spatial Distribution of Habitats in Terrebonne Parish, 1955-1978.
in the renewable fish and fur resource base. The parish police jury contracted with CEI to obtain Coastal Energy Impact Funds and to institute a wetland management program to retard or reverse the deterioration in habitat diversity and quality which was most evident in terms of land loss and conversion from fresher to more saline habitats. Tabulation of the habitat data revealed the severity of the problem (Table 6), and comparison of the habitat maps revealed the spatial distribution of the habitat change. The parish lost 95% of its swamp, 42% of its forest, 62% of its agriculture, and 99.9% of its fresh marsh habitat within 23 years. The developed area almost tripled in size as a result of the parish’s economic development and the urban-industrial sprawl radiating from New Orleans located to the northwest. Natural and man-made processes were also responsible for a 3% increase (27,814 acres) in aquatic habitat and a 5% decrease (10,379 ac) in non-fresh marsh habitat.

The development of a wetland management program (Wicker et al. 1981) for five management units in St. Bernard Parish (Figure 3) relied heavily on detailed analysis of a number of existing, relatively low-altitude, black-and-white and CIR photographs (Table 7) including the ones utilized in the FWS-sponsored habitat mapping project. Interpretation of aerial photographs aided in:

1) determining the geographic distribution and condition of historic (mid 1950s) environments in contrast to present conditions (late 1970s);
2) identifying the types and causes of environmental changes (e.g., canal dredging, spoil deposition, leveeing, development);
3) identifying the location for specific structural measures to be installed for environmental management and enhancement (e.g., weirs, hydraulic fill to mean sea level, siphon and pumping stations, flood gates, creative spoil deposition, and alignment); and
4) presenting the management plan to the public to achieve an awareness of the location, components, and objectives of the management plan.


<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>1955/56 Area</th>
<th>%</th>
<th>1978 Area</th>
<th>%</th>
<th>Change</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(in acres)</td>
<td></td>
<td>(in acres)</td>
<td></td>
<td>(in acres)</td>
<td></td>
</tr>
<tr>
<td>Developed</td>
<td>4,753</td>
<td>0.4</td>
<td>13,818</td>
<td>1.0</td>
<td>+9,065</td>
<td>190</td>
</tr>
<tr>
<td>Agriculture</td>
<td>8,137</td>
<td>0.6</td>
<td>3,032</td>
<td>0.2</td>
<td>-5,105</td>
<td>62</td>
</tr>
<tr>
<td>Forest</td>
<td>14,300</td>
<td>1.0</td>
<td>8,341</td>
<td>0.6</td>
<td>-5,959</td>
<td>42</td>
</tr>
<tr>
<td>Swamp</td>
<td>10,593</td>
<td>0.8</td>
<td>486</td>
<td>0.0</td>
<td>-10,107</td>
<td>95</td>
</tr>
<tr>
<td>Scrub/Shrub</td>
<td>379</td>
<td>0.0</td>
<td>15,861</td>
<td>1.2</td>
<td>+15,582</td>
<td>4108</td>
</tr>
<tr>
<td>Fresh Marsh</td>
<td>20,218</td>
<td>1.5</td>
<td>12</td>
<td>0.0</td>
<td>-20,206</td>
<td>99</td>
</tr>
<tr>
<td>Nonfresh Marsh</td>
<td>226,152</td>
<td>17.0</td>
<td>215,773</td>
<td>16.3</td>
<td>-10,379</td>
<td>5</td>
</tr>
<tr>
<td>Water</td>
<td>1,040,150</td>
<td>78.4</td>
<td>1,067,964</td>
<td>80.4</td>
<td>+27,814</td>
<td>3</td>
</tr>
<tr>
<td>Beach/Reef</td>
<td>2,623</td>
<td>0.2</td>
<td>1,925</td>
<td>0.2</td>
<td>-698</td>
<td>27</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,327,305</strong></td>
<td><strong>99.9</strong></td>
<td><strong>1,327,312</strong></td>
<td><strong>99.9</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3. Location of Management Units in St. Bernard Parish, Louisiana.

Table 7. Selected Aerial Photography of St. Bernard Parish.

<table>
<thead>
<tr>
<th>DATE</th>
<th>SOURCE</th>
<th>ALTITUDE</th>
<th>SCALE</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-1955-2-1956</td>
<td>Petroleum Information Corp.</td>
<td>Unknown</td>
<td>1:24,000</td>
<td>Black-and-white mosaic</td>
</tr>
<tr>
<td>1972</td>
<td>NASA - LANDSAT (in Burk &amp; Associates 1978)</td>
<td>≈ 370 mi</td>
<td>1:125,000</td>
<td>Computer-generated Land Surface Feature Classification map from multispectral data (color coded)</td>
</tr>
<tr>
<td>10-1972</td>
<td>NASA - Mission 194</td>
<td>≈ 60,000 ft</td>
<td>1:130,000</td>
<td>9&quot;x9&quot; CIR transparency (40&quot;x40&quot; print)</td>
</tr>
<tr>
<td>9-10-1974</td>
<td>NASA - Mission 289</td>
<td>≈ 60,000 ft</td>
<td>1:80,000</td>
<td>9&quot;x9&quot; CIR transparency (40&quot;x40&quot; print)</td>
</tr>
<tr>
<td>10-1978</td>
<td>NASA - EPA Flight Request #0754</td>
<td>≈ 65,000 ft</td>
<td>1:24,000</td>
<td>20&quot;x20&quot; CIR print</td>
</tr>
<tr>
<td>12-1979</td>
<td>NASA - Mission 935</td>
<td>≈ 44,500 ft</td>
<td>1:120,000</td>
<td>9&quot;x9&quot; CIR transparency</td>
</tr>
</tbody>
</table>
The management measures proposed for St. Bernard Parish are aimed at directly altering the present salinity and water level regimes in order to lower overall salinity levels and moderate the fluctuations in salinity and water levels. These objectives are to be obtained primarily through a comprehensive system of structural measures to be implemented on a subunit basis within the larger management units. Interpretation of the aerial photographs used in this project relied heavily on field checking (to verify the photographic signatures), a thorough understanding of the geomorphology and the land-use practices in the vicinity (e.g., marsh burning, trainasse construction, leveeing, weir construction), and seasonal changes in the environment (e.g., flooding in response to precipitation and/or waves, seasonal vegetation distribution and physiography, and dry climatic conditions).

Comparison of available photographs indicates that CIR is far superior to black and white for determining the subtle details necessary for environmental analysis and management. It is also evident that CIR photos taken in late fall, when vegetation dieback has begun, are best for distinguishing differences in vegetation associations because of the wide variation in the color and texture of their photographic signatures. A comparison of the authors' interpretations with a Land Surface Feature Classification map that was computer generated from multispectral data (Landsat 1972; Burk and Associates 1978) indicates that the computer map contained many inaccuracies in addition to lacking the high resolution needed for management planning. The major reason for the inaccuracies is that in a deteriorating wetland environment, such as St. Bernard's, different habitats (i.e., vegetation associations) often have the same signatures because of the extensive amount of marsh breakup, high water levels, and the similarity that different species, characterizing different habitat types, have during different life stages (e.g., young willows characteristic of a swamp or levee habitat have the same signature as some fresh marsh vegetation).

CONCLUSIONS

Construction of habitat maps through interpretation of large-scale, black-and-white and CIR photos and quantification of habitat changes have provided an insight into the deteriorating environmental conditions of coastal Louisiana. Between 1955/56 and 1978, the six deltaic parishes of southeastern Louisiana lost over 362,000 acres of land because of erosion (wave action), canal dredging, subsidence, abandonment of reclamation sites, cessation of sediment input, and destruction of fresher water habitats by saltwater intrusion. The interpretation of aerial photographs (especially the large-scale CIR imagery), when used in conjunction with field reconnaissance and other sources of environmental data, can be used to determine the probable cause and effect relationships responsible for habitat change and to determine the types of and location for structural measures to be used in combating the undesirable environmental changes.

ACKNOWLEDGMENTS

The author wishes to thank the many personnel of Coastal Environments, Inc., who worked on the habitat mapping projects and Terrebonne and St. Bernard Parish management studies which generated much of the raw data used in this report. Thanks are also extended to Susan
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