LAND LOSS AND HABITAT CHANGE IN THE FINA LATERRE MITIGATION BANK MANAGEMENT PLAN FROM 1984 TO 1988 USING CLASSIFIED LANDSAT SATELLITE IMAGERY WITH A COMPARISON BETWEEN EARLIER CLASSIFICATIONS AND PHOTOINTERPRETED DIGITAL DATA

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ABSTRACT

LAND LOSS AND HABITAT CHANGE IN THE FINA LATERRE MITIGATION BANK MANAGEMENT PLAN FROM 1984 TO 1988 USING CLASSIFIED LANDSAT SATELLITE IMAGERY WITH A COMPARISON BETWEEN EARLIER CLASSIFICATIONS AND PHOTOINTERPRETED DIGITAL DATA

The 7014 acre Fina LaTerre Mitigation Bank management plan was implemented in the fall of 1985. Management components consisted of: three 25 ft. fixed crest weirs, one 20 ft. flapgated variable crest weir, spoil bank maintenance (11,000 ft.), levee construction (3,300 ft.), and the gapping of a pipeline canal spoil bank. The habitats in 1988 consisted of 2200 acres of fresh marsh, 1392 ac. of intermediate marsh, 58 ac. of brackish marsh, 751 ac. of shrub/scrub, 135 ac. of aquatic vegetation, and 2020 ac. of open water for a total of 6839 acres. The goals of this wetland management plan consisted of reducing land loss and salinities, and increasing productivity.

The plan area has been monitored since 1982 (pre-implementation) for vegetation, land loss and habitat change, and hydrologic parameters such as water levels and salinity. The presentation will concentrate on the aerial imagery monitoring to determine land loss and habitat changes between managed and unmanaged (control) areas from plan implementation (1985) to 1988. Three methods of aerial monitoring have been employed to date. These are: 1.) the SCS Grid Method, 2.) the Earth Resources Data Analysis System (ERDAS) Thematic Mapper (TM) Landsat Satellite Method, and 3.) the Photointerpreted-digitized Method.

The SCS Grid method consisted of examining 1984 and 1988 aerial infrared (IR) photographs of the Fina area and determining the percentage of marsh and water. This was done by physically counting the number of 1.6 mm square grids that fell either on marsh or water when the grid was placed on top of the IR. The results indicated that there was a 421 ac. (+6%) increase in marsh in the area during the period. The marsh area increased from 4629 ac. (66%) in 1984 to 5050 ac. (72%) in 1988.

Digital satellite data was analyzed by the ERDAS TM techniques and software for the

same period. The data was rectified and classified into an CMD aggregate of the Cowardin habitat system. The 1984 data was compared to that of 1988, and a "change" map and set of statistics were produced. The ERDAS satellite imagery analysis indicated a marsh loss of 704 ac. (-14.2%) and a marsh gain of 1038 ac. (+ 20.9%) for a net gain of 335 ac. (6.7%) for the management area. A similar reference site did not show any change during the period of analysis.

The area was photointerpreted and digitized and the resulting digital data compared for the same periods 1984 and 1988. The IR's were photointerpreted according to the Cowardin habitat system and digitized into the Map Overlay Statistical System (MOSS). The data was then transferred and gridded in ERDAS for ease of comparison. The results indicated that 247 ac. (-3.6%) of marsh/land changed to water and 343 ac. (5%) from water to marsh from 1984 to 1988 for a net increase of 96 ac. (+1.4%). A total of 159 ac. (-2.3%) changed from water to marsh/land during the period.

Although the first two methods seem to correlate well with each other, the third or photointerpreted method differs. However it is interesting to note that all three methods indicate a gain in marsh in the management area from plan implementation in 1985 to 1988. The ERDAS analysis will be reclassified and re-analyzed in the future. We feel that this method may be superior in analyzing land loss efficiently for large areas provided the areas are classified correctly.

Introduction

Louisiana's coastal wetlands comprise approximately 41% of the nations total (Turner and Gosselink 1975). Figures vary concerning the amount of wetlands present in the coast from 2.925 M acres (1.18 M ha) (Wicker et al 1980, 1981) to 4.446 M acres (1.8 M or X 10-6 ha) (Cowan et al 1988). Land loss in the coastal zone has been well documented to be in the range of approximately 0.8%/ year (35,558 ac/yr; 130 km2/ yr) (Gagliano et al 1981, Turner 1985, Walker et al 1987). These losses are due to the natural causes of sea level rise, subsidence and lack of sedimentation (Turner 1985, Walker et al 1987). Man-made hydrologic alterations of the coastal wetlands have accelerated these losses (Davis 1973, Gosselink et al 1979, Craig et al 1980, Turner et al 1982, and Day et al 1986). Wetland losses translate to losses in renewable resources such as commercial and recreational fishing, hunting, trapping, and recreational coastal pursuits. These renewable coastal resources have been well documented in the literature (LCRP Final Environmental Impact Statement 1980, Gosselink et al 1979, Gagliano et al 1981, Costanza et al 1983, Turner 1985, and Day et al 1986). Louisiana coastal wetlands contribute over 30% of the US commercial fisheries harvest, 66% of the Mississippi Flyway's wintering waterfowl, and they produce the greatest amount of furs of any other state in the nation (Turner 1985). Therefore Louisiana has a well documented record of loosing a large amount of its renewable resources which are so important to both the state and the rest of the nation.

Louisiana has in the past, with the passage of the 1981 Coastal Restoration Trust Fund, attempted to begin some state sponsored projects which involved barrier island restoration, Mississippi River Freshwater Diversion Projects, vegetative plantings, and wetland management (Chambers and Clark 1986, Spicer et al 1986). At present the Governor's Coastal Restoration Plan contains many of these same types of projects plus it provides for a coastal authority in the governor's office in addition the people of the state have safeguarded the Coastal Restoration Trust Fund by protecting it constitutionally (La. Governor's Office 1990). Many of the 50 or so projects which have been recommended to the State Legislature for funding this year involve wetland management plans (Governor's Office 1990).

Marsh or wetland management has been used as a tool in coastal Louisiana to retard land loss and habitat change from fresh to more saline marsh types (Clark 1989, Clark and Hartman 1990). This tool can be used by coastal landowners and the state as mentioned above for possible land loss prevention. Management plans are generally implemented by coastal land owners for the following reasons as stated on coastal use permit applications: 1.) land loss prevention or revegetation, 2.) salt water intrusion prevention, 3.) improve habitat for wildlife and fisheries, 4.) improve or provide wintering habitat for waterfowl and furbearers, and 5.) reduction in tidal scour and general tidal flow in an area.

Land loss prevention, was generally not a major goal of management in the past (se CMD files or CMD MM database). It has only been within the recent 10 years (since 1981-2) that more active management has been planned to actively retard and reverse this trend of coastal land loss. This type of management is called active compared to passive management implemented by the use of fixed crest structures such as Wakefield fixed crest weirs, plugs, and small levees. Active management involves the use of sophisticated water control structures which are capable of reducing water levels within the managed area which in turn stimulates the germination of vegetation.

With this new "active" management, it became important to be able to monitor or evaluate how various active management plans were achieving their goals of land loss reduction or reversal and habitat stabilization. There are basically four ways of determining if emergent marsh (land for our definition) is increasing in a particular area. These methods are: 1.) Vegetative analysis (by transect or other methods) in the field, 2.) analysis of aerial photographs over time, 3.) LANDSAT Satellite or similar imagery, 4.) or by surveying the area by standard survey techniques.

Since active management has not been in practice in Louisiana for very long (less than 10 years) it is important to monitor these types of plans to determine if they are actually achieving their goals of land loss prevention or even reversal along with the secondary goals of increased primary and secondary productivity, and enhanced wildlife and fisheries resources. Some limited research has indicated that at least in some active management plans land loss has been either retarded or reversed (SCS 1989a, 1989b, Sweeney et al 1990, Clark 1989, Clark 1990). This work has involved both vegetation transect sampling and aerial imagery either by satellite or interpretation of aerial photographs. In one of the most extensive studies to date, Sweeney et al (1990) analysed 16 plan and control areas across the coast and found that the plan areas gained significantly more marsh or lost less marsh than their control counterparts. Three plan areas, AMOCO West Black Lake (SCS 1989b), Fina LaTerre (SCS 1989a, Clark 1989, Clark et al 1990) and Rockefeller Refuge (Sweeney et al 1990, Wicker et al 1983), have been studied more extensively than others. Some studies suggest that impoundments may increase land loss (Chabreck et al 1978, Day et al 1986). But these studies were involved more with total impoundments and not the semi-impoundment situation which is normal for wetland management plans in coastal Louisiana. It is therefore important to monitor management plans to see if indeed they are able to *achieve the goals under which they were established.*

Wetland Management in coastal Louisiana

By the end of 1989, 141 coastal use permits for management plans had been issued comprising 310, 602 ac or 010.7% of the 2.9M acres of coastal wetlands in coastal Louisiana (Cahoon et al 1990). Cahoon (1990) calculated, from the CMD database, that 1,146,764 ac (464,277 ha) (39.5%) of the coastal zone was under management prior to permitting. And that 1,650,000 ac (56.8%) were under management or proposed for management. Clark et al (1988) indicated that from 1981 to march 1988, 130 management permit applications were received which involved 489,214 ac. However, only 52 of these plans were both permitted and implemented (at least partially). These implemented plans comprised 211,109 ac or 7.2% of the coastal wetland area (Clark et al 1988). Over 15% (29, 69,826 ac) of this total were planned for Terrebonne parish. Most plans were found to be located either in fresh-intermediate (45%, 227,269 ac) or brackish marshes (39%, 205,929 ac) (Clark et al 1988). Management occurs in other SE US coastal states, but the goals of management may be quite different compared to those of land loss prevention in Louisiana. Louisiana may have from 10 to 39.5% (1,146,764 ac) of its coastal wetlands under some sort of management (Clark et al 1988, Cahoon et al 1990). Other coastal states have the following amounts of coastal wetlands in varying degrees of "management:" South Carolina 7.3 to 14% (36,000 to 70,425 ac), Florida 16% (30,000 ac), North Carolina 3% (6,916 ac), and Georgia, 2% (7,988 ac) (Montegue et al 1987, Tomkins 1987, Clark et al 1988. It is because of the amount of area involved in wetland management activities in Louisiana and in other states that we wish to ensure that these plans are achieving their goals. This can only be achieved by proper monitoring. This paper deals with the monitoring of land loss and habitat change for the Fina LaTerre Mitigation Bank management plan south from Houma Louisiana.

Materials and Methods

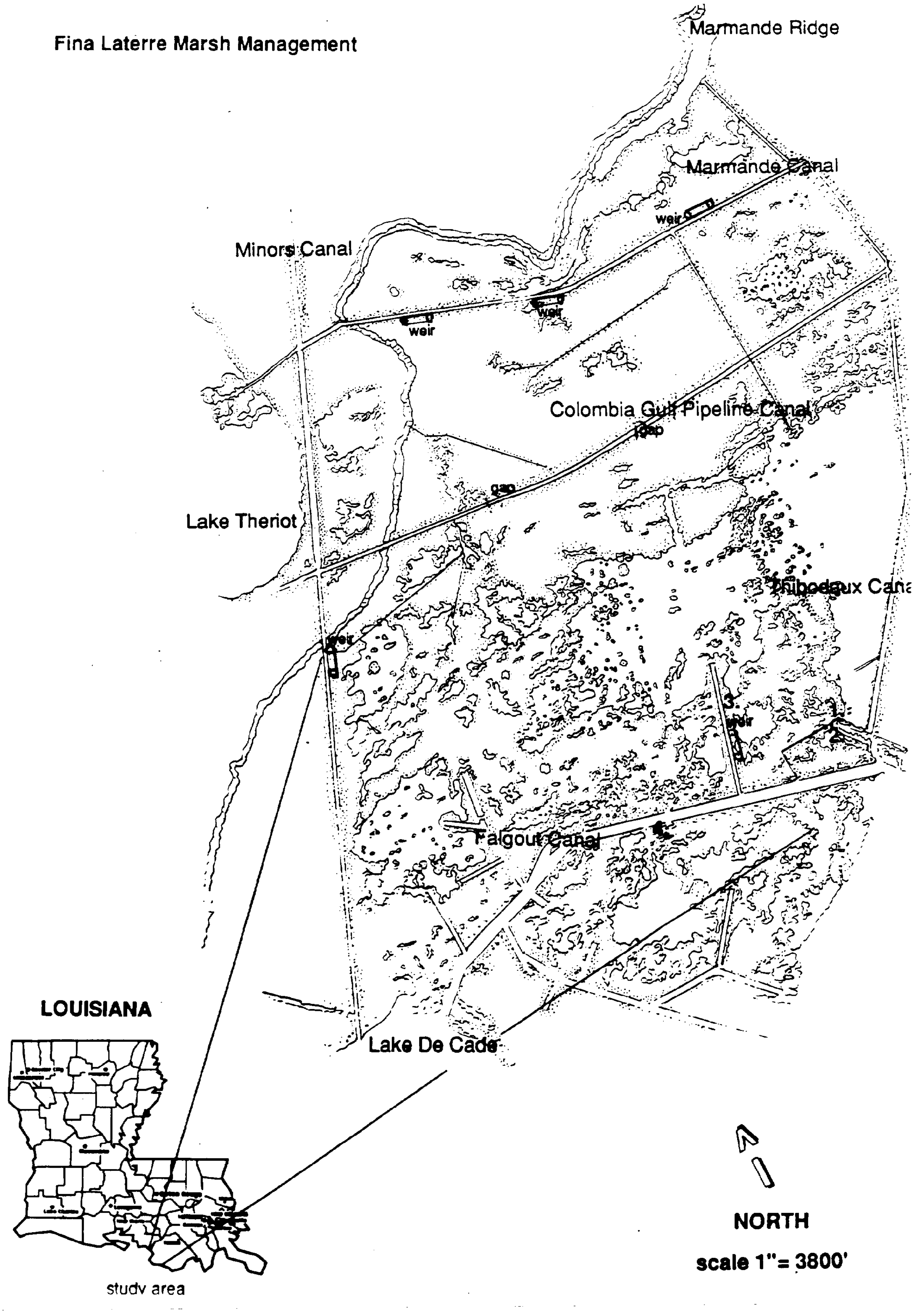
Study Area

The 7014 acre Fina LaTerre Mitigation Bank wetland management plan located approximately 12 miles south from Houma Louisiana (Figure 1). The area and an adjacent control was monitored for land loss and habitat change from plan implementation in 1985 to 1988. Three methodologies of; land loss analysis will be compared in this report. The SCS Grid or "graph paper" method, the ERDAS Thematic Mapper (TM) method, and the Photointerpretation method. These are described below.

According to 1988 photointerpreted aerial photographs of the area, the composition of wetland habitats consisted of the following: natural water 2020 ac (30%), fresh marsh 2196 ac (32%), intermediate marsh 1392 ac (21%), brackish marsh 58 ac (1%), swamp 3 (0.04%), shrub/scrub 751 (11%), aquatic vegetation 135 (2%) and spoil bank 154 ac (2%) (Sweeney et al 1990). The plan area is bounded on the east by the Bayou DuLarge Ridge, the north by the Marmande Ridge, Minors Canal to the west, and the Falgout Canal to the south. the management area has experienced marsh degradation since 1953 in the form of habitat change from solid fresh marsh to open water nad more saline marsh types. The area has lost over 34% (2385 ac) of its former fresh marsh to open water (Soileau 1984). If the marsh loss do to canals and spoil banks are added the marsh loss since 1953 becomes 2439 ac (35%) (Sweeney et al 1990).

The management components of the plan included the following:
1.) three fixed crest weirs. 2.) one 20 ft. wide flapgated variable crest weir, 3.) .maintain two existing fixed crest weirs, 4.) construct and maintain approximately 10,835 ft (3.7 ac., 10 ft. wide X 3 ft. MSL) of levee along the Falgout Canal, 5.) construct a 3,334 ft. (6 ft X 3 ft MSL; 2.3 ac) of new levee, 6.) maintain existing spoil banks along oil field canals, Minor's Canal, and the Marmande Canal, and 7.) cut existing levees in an E-W pipeline canal to allow fresh water to flow from the north (Soileau 1984, Cutshall 1982, Clark 1989). A supplemental structure consisting of a 25 ft. wide variable crest weir (# 85 b) was recommended by Clark (1989) and was initially a part of the permitted plan in 1984 (Figure 1). The plan was initially permitted in 1984 (P840349), however construction was not complete until the fall of 1985. The management plan is a part of the first and only Mitigation Bank in coastal Louisiana established in January 1984 (Soileau 1984). A more detailed management plan was

Fina Laterre Marsh Management



prepared by the SCS (Cutshall 1982). The goals of the management plan are to retard saltwater intrusion, decrease erosion, and enhancing the habitat for fish wildlife and waterfowl populations (Cutshall 1982, Clark 1989).

Land Loss and Habitat Change Analysis Methods

Three methods of aerial image monitoring have been employed to date. These are : 1.) the Soil Conservation Service (SCS) Grid Method, 2.) the Earth Resources Data Analysis System (ERDAS) Thematic Mapper (TM) Landsat Satellite Method, and 3.) the Photointerpreted-digitized Method.

SCS Grid Method

In the SCS Grid Method, 1953, 1971, 1983, and 1988 aerial infrared photographs were examined for percentage of marsh and water. the total area of the management plan was determined planimetrically. Grid counts were made to estimate the ratios of marsh and open water. The area was traced on mylar or graph paper. Graph paper with squares 1.6 mm square (1/16 inch square or 256 square inches) was overlain on top of the tracing. The number of squares falling on open water and the number on marsh were counted and a percentage marsh to open water ratio was determined from the total area. The percentages prior to 1985 were determined with a standard map grid count scale (SCS, 1989a).

ERDAS Thematic Mapper Satellite Data Analysis Method

The Coastal management Division Technical Services Section analysed land loss and habitat change by comparing the 1984 and 1988 Landsat satellite TM digital data and using the ERDAS software on the Data General 1000 computer in the CMD offices. CMD has complete 1984 and partial 1986 and 1988 Landsat TM coverage of the coastal zone. Data within ERDAS TM form at is in a 25 m gridded format. The habitats have been aggregated to the following 14 which are based on the Cowardin et al (1979) Fish and Wildlife Service habitat classification system: out (background), water, broken marsh, marsh, forest, swamp, shrub/ scrub, agriculture/pasture, developed, inert (mudflat), beach, clouds, floating (aquatic) vegetation, mixed vegetation, and unclassified (unknown) (Bourgeois et al 1989). The Matrix subroutine was used to compare the habitat statistics between years. Nine classes were used; 1.) water to water, 2.) broken marsh to water, 3.) marsh to water, 4.) water to broken marsh, 5.) broken marsh to broken marsh, 6.) marsh to broken marsh, 7.) water to marsh, 8.) broken marsh to marsh, 9.) and marsh to marsh. Each cell (grid) on the 1988 map was compared with the same location on the 1984 map and assigned to one of the above nine categories (after Bourgeois et al 1989). Printouts of the habitats and the acreages for managed and control areas for the two time periods (1984 and 1988) were produced. Printouts of the above nine categories of "change" statistics were also made of the managed and control areas. Care should be taken in the interpretation to consider water levels caused by meteorological conditions and management practices when comparing managed and control areas for land loss and habitat changes. Most of the clearest photographs and satellite images are taken in the fall and winter in Louisiana. This is the time of year when management plans are flooded to provide for wintering waterfowl habitat. Therefore, a management plan may appear to be "loosing" marsh or gaining open water if one image was taken prior to winter flooding and the later photograph or satellite image taken after winter flooding. Therefore the management plan must be taken into consideration when any plan is compared to an adjacent control area.

Photointerpretation-Digitizing Method

A series of five aerial photographs; 1956, 1978, 1981-83, 1984-85, and 1988, of the Fina LaTerre management and control areas were photointerpreted according to the methods of Wicker (1989) as reported in Sweeney et al (1990). The aerial photographs were traced on mylar and tied to UGGS maps of a scale of 1:24,000. Polygons were made as small as 0.25 ac and features as small as 12 to 20 ft wide were represented. Marsh types for the different time periods were determined from O'Neill (1949), Chabreck (1968), Chabreck and Lindscombe (1978), and (1989). An expanded version of the Cowardin et al (1979) habitat type system was employed according to Wicker (1980, 1981).

The mylar tracings of the photointerpreted maps were digitized at CMD's Technical Services Section by an EPA funded employee using a CalComp digitizer. The digital data was transported to the Map Overlay Statistical System (MOSS) in vector format and then changed to grid format for export to ERDAS. In the process the Cowardin et al (1979) habitats were aggregated into 15 habitat classes. These classes include: natural water, artificial water, aquatic vegetation, fresh marsh, intermediate marsh, brackish marsh, saline marsh, swamp forest, forest, shrub/scrub, shrub/scrub spoil, agriculture/ pasture, developed, inert, and beach (Sweeney et al 1990, Bourgeois et al 1989). The MATRIX subroutine within ERDAS was used to create a nine-class change map like the one described in the previous section.

Results

SCS Grid Method

Table 1 below shows the results of the SCS analysis of land loss in the management area from 1953 to 1988. The results show a 33% decline in marsh from 1953 to 1985 (99% to 66%) prior to plan implementation. A total of 2370 acres of marsh converted to open water from 1953 to 1985. After plan implementation in 1985, the amount of marsh in the area increased by 421 acres (6%) and water decreased by the same percentage (Table 1) (SCS 1989a).

Table 1. Percentages and amounts of marsh and open water from 1953 to 1988 in the Fina LaTerre management area as determined by the SCS Grid Method (SCS 1989a).

Date	Marsh	%	Water	%
1953	6,999	99%	15	< 1%
1971	5,729	82%	1,285	18%
1983	4,727	67%	2,287	33%
1985	4,629	66%	2,385	34%
1988	5,050	72%	1,964	28%

ERDAS Thematic Mapper Analysis Results

Tables 2 and 3 below show the various habitat types for the Fina managed and control sites for 1984 and 1988. The management area was composed of 36% water (1295 ac), 45% marsh (1592 ac), 12% broken marsh (435 ac), 4% shrub/scrub (151 ac), and 3% floating vegetation (105 ac) (Table 2). The control area was comprised of 22% water (468 ac), 47% marsh (1013 ac), 20% broken marsh (427 ac), 9% shrub/scrub (185 ac), 2% swamp (44 ac), and 1% agriculture (22 ac) in 1988 (Table 3). The managed area lost water, broken marsh, forest, swamp, and shrub/scrub habitats , but gained (+ 572 ac) marsh, and floating vegetation (+ 3 ac) from 1984 to 1988 (Table 2). The loss of water and broken marsh and the gain of marsh are indicators of marsh gain in the management area. the control area lost broken marsh (-46 ac), and shrub/scrub (-71 ac), and gained water (+89 ac), marsh (+ 211 ac), swamp (+19 ac), and agriculture (+12 ac) during this same period (Table 3).

Table 2. ERDAS Thematic Mapper habitat statistics for the Fina LaTerre management area for 1984 and 1988.

Class Name	1984 acres	%	1988 acres	%	Difference
Water	1301	37%	1295	36	- 6
Broken Marsh	755	21%	434	12%	-321
Marsh	1020	29%	1592	45%	+572
Forest	69	2%	0	0	-69
Swamp	9	0.3%	0	0	- 9
Shrub/scrub	283	8%	151	4%	-132
AG/Pasture	22	0.6%	0	0	-22
Developed	1	.02%	2	.06%	- 1
Inert	0	0	0	0	0
Beach	0	0	0	0	0
Clouds	102	3%	0	0	-102
Floating Veg.	0	0	105	3%	+105
Mixed Veg.	0	0	0	0	0
Unclassified	0	0	0	0	0
Totals	3561	100%	3580	100%	

Table 3. ERDAS Thematic Mapper Habitat Analysis of the Fina LaTerre Control Area for 1984 and 1988.

Class Name	1984 acres	%	1988 area	%	Difference
Water	378	18%	468	22%	+90
Broken Marsh	472	22%	427	20%	-45
Marsh	801	38%	1012	47%	+211
Forest	98	5%	0	0	-98
Swamp	25	1%	44	2%	+19
Shrub/scrub	256	12%	185	9%	-71
Ag/Pasture	11	0.5%	23	1%	+12
Developed	0	0	0	0	0
Inert	0	0	0	0	0
Beach	0	0	0	0	0
Clouds	55	3%	0	0	-55
Floating Veg.	0	0	0	0	0
Mixed Veg.	8	0.4%	0	0	- 8
Unclassified	0	0	0	0	0
Total	2104	100%	2159	100%	

In order to determine any land loss or gain which may have occurred at the managed or control areas, it is necessary to subtract all of the land loss categories or classes (ie. broken marsh to water) from the land gain classed (ie. water to broken marsh or marsh) (Tables 4 and 5). The management area lost a total of 704 acres (14.2%) during the period of 1984 to 1988 while it gained 1038 acres (20.9%) during that same period (Table 4). Thus the management area had a net gain of 335 acres or 6.7% (Table 6). The control area, on the other hand, lost and gained an equal amount (317 ac, 20%) and thus had a net gain of 0 (Tables 5 and 6).

Table 4. ERDAS Thematic Mapper Habitat Change Statistics for the Fina LaTerre Management Area from December 1984 to January 1988.

Habitat	Acres	Percentage
Marsh Loss		
Broken marsh-water	308	6.2%
Marsh-water	175	3.5%
Marsh-broken marsh	221	4.4%
Total	-704	-14%
Marsh Gain		

Water-broken marsh	137	2.7%
Water-marsh	151	3%
Broken marsh-marsh	750	15%
Total	+1038	+21%

Table 5. ERDAS Thematic Mapper Habitat Change Statistics for the Fina-LaTerre Control Area from December 1984 to January 1988.

Habitat	Acres	Percentage Change
Marsh Loss		
Broken marsh-water	111	7%
Marsh-water	72	5%
Marsh-broken marsh	134	9%
Total	-317	-20%
Marsh Gain		
Water-broken marsh	76	5%
Water-marsh	58	4%
Broken marsh-marsh	182	12%

Total	+317	+20%

Table 6: ERDAS Thematic Mapper Net Change Analysis Comparing the Managed and Control Fina LaTerre Areas from 1984 to 1988.

	Managed Area		Control	
	Acres	%	Acres	%
Marsh Gain	+1038	+21%	+317	+20%
Marsh Loss	-704	-14%	-317	-20%
Net Change	+335	+6.75%	0	0%

Fina LaTerre Photointerpreted and Digitized Data Results

The results of the photointerpreted and digitized data for the Fina LaTerre managed and control areas were further inspected to see if any trends existed in any of the major marsh or water categories (Table 7). The amount of natural open water for the plan area decreased by 159.4 ac (a 7.3% change; 2.3% of the total management area) from 1985-1988 according to photointerpreted and digitized Infrared photographs. Since something must replace the water (presumably land), we can say that the management area gained 159.4 ac of land (2.3% of management area) during this period. For the same period, the control area lost 5 ac of open water (a 0.8% change; or 0.3% of the total control area). Therefore, the amount of natural open water decreased both in the management (159.4 ac; 2.3%) and control (5 ac; 0.3%) areas.

In looking at what happened to the marsh during this period (1985-1988), if you add all of the marsh types including shrub/scrub, the management area gained 31.5 ac (0.7% change; 0.4% of the total area) and the control lost 70.4 ac (-6.7% change; -4.1% of the total area) of marsh for this period. When aquatic vegetation (beds) are added to the marsh categories, the management plan gained 132.2 ac (+3% change; 1.93% of the total area), and the control lost 51.2 ac (-4.9% change; -3% of the total area).

Therefore in calculating the major "land" categories, the plan area lost 159 ac of open water (7.3% change; 2.3% of total area) and gained 132.2 ac (3% change; 1.93% of total area) and the control lost 5 ac of water (0.8% change; 0.3% of total) and lost 51.2 ac (-4.9% change; -3% of total area). This makes a difference of 5.3% (2.3+ 3%) between the plan and control areas. There was a difference of 7.9% between plan and control if you consider the rate of change from 1985 to 1988 (plan= 3% change; control= -4.9% change). Therefore one might state that the plan did at least 5.3% better than the control as far as revegetation was concerned. Table 7 summarizes these statistics.

Table 7. **Fina LaTerre Photointerpreted and Digitized Habitat Data for the Management and Control Areas from 1983 to 1988.**

Fina Laterre Habitat Data						
	Plan			Control		
	1983	1985	1988	1983	1985	1988
marsh	3926	3843	3646 (-197,-5.1%)	1057.4	1045.3	973.8- (-71, -6.8%)
scrub/ scrub	591.6	522	750.6 (228.6,+43.8%)	22.5	7.3	8.4
subtot.	4517.6	4365.1	4396.6 (31.5,0.7%)	1079.9	1052.6	982.2 (-70, -6.7%)
aq.veg.	173.1	33.9	134.6 (+101,+297%)	74.6	0	19.2
TOTAL	4690.7	4399	4531.2 (132,3%)	1154.5	1053	1001 (-51, -5%)
Water	1748.6	2179	2019.7 (-159,-7.3%)	385.6	580.1	575 (-5,-0.9%)

Discussion

Both the SCS Grid Method and the ERDAS TM Methods done by CMD seemed to correlate well with each other. They both showed that the management had gained from 421 ac (SCS 1989a) to 334 ac (SCS 1989a, Clark 1989). Both studies indicated that approximately 6% of the management area had revegetated from open water to marsh from the period 1985 to January 1988. In analysing the separate habitat data from the ERDAS TM analysis, it was found that little water (only 6 ac) changed from 1984 to 1988 (Table 4). It appeared that the broken marsh and perhaps the area covered by clouds in 1984 had turned to marsh in the 1988 analysis (Table 4). The shrub/scrub habitat had an almost 50% decrease for the period(Table 4). It is difficult to explain that the wax myrtle could change from 283 ac in 1984 to only 151 ac in 1988, a period less than 3 years. The 1984 TM data indicated over 100 ac of cloud cover while their was none in 1988. If the area under the clouds was marsh, the removal of the clouds from 1984 to 1988 would make it appear as if marsh were being restored or created when this was not the case. The category "floating vegetation" appears in 1988 but was not present in the 1984 analysis. If this class is considered to be open water, this would add another 105 ac of open water. This would make the open water category increase by 99 acres from 1984 to 1988 which would indicate marsh deteriation rather than marsh building. The ERDAS classification of the Fina area was done by two different people, one familiar and the other not so familiar with the area. The computer map printouts were visually compared and the 1988 printout appears to have abnormally less shrub/scrub habitat compared to what is observed in the field. This analysis should be re classified for both 1984 and 1988 because CMD has developed better classification methods. The ERDAS TM figures should be conservative because the December 1984 data was taken before major freezes and the January 1988 data was collected after freezes had occurred. These freezes killed the annual vegetation which did not show up on the 1988 satellite view but may have been persistent in the 1984 (pre-management) data.

Differences between the SCS and the TM analysis may be partially explained by the following. The SCS used graph paper grids 1.6 mm square. This covered an area of approximately 126 ft square. Each ERDAS pixel was 25 m (75 ft) square. Therefore the SCS technique had a resolution of 126 ft square and the ERDAS TM analysis had a resolution approximately 50% finer (75 ft square). The SCS analysed the spoil bank and upland areas in their analysis. The TM analysis was restricted to wetland classes. The base photography used may have been different. The SCS used photography from the fall of 1988 while the TM data relied on January 1988 satellite data. Human error may have been greater with the SCS grid method. For an area of 7000 acres, a total of over 23,000 graph paper squares had to be hand counted. In addition, two different people made the 1985 and 1988 grid counts.

The Photointerpreted and digitized figures don't show the 300 ac. of marsh gain presented in the Thematic Mapper Landsat Satellite calculations of 1988, or the 420 acre gain reported by the SCS in 1989, it does show a gain of 132 ac. The control area shows a decrease. Although the managed area showed a decrease in marsh (-5%), it also showed an increase in shrub/scrub habitat (+44%) and a decrease in open water (-7.3%). However aquatic vegetation also showed an increase (101 ac, +297%) from 1985 to 1988 in the managed area. This class could be placed in the water category since it does not represent emergent marsh. If we place aquatic vegetation in the "water" category, the statistics for water becomes 2280 ac (-58 ac, -2.5%). This becomes a loss of only 2.5% water compared to the -7.3% presented in Table 7. The fact remains, no mater how the various statistics are calculated that the managed area has succeeded in revegetation marsh of from 32 ac (0.7%) to 420 ac (7%) during the 2 year period which included the fall 1985 to January 1988.

The Fina area is handicapped in its "drawdown" management capabilities because of the 4 fixed crest weirs present to the west and north of the plan. The data also only covers only 2 1/2 years after implementation which began in the fall of 1985. It would be better to have a longer period between implementation and land loss analysis. The photointerpretation and digitizing methods should be inspected for this plan and control area in order to determine the amount of photointerpretation and digitizing error involved.

Discrepancies in the methods used

There were definite differences among the three methods used. The SCS Grid method indicated a marsh increase of 420 ac (+6%); the ERDAS TM analysis resulted in an increase of 335 ac (+6.7%), while the Photointerpreted and Digitized method indicated a gain of from 32 ac (0.5%) to 160 ac (2.3%). The methods all indicated that the management area succeeded in revegetating marsh but to different degrees. The control areas either remained static or had marsh decreases. The following table (Table 8) lists some of the reasons for discrepancies among the three methods of determining land loss at Fina LaTerre:

Table 8: Listing of Reasons Why Discrepancies May Exist Among the Three Land Loss Methods Applied to Fina LaTerre from 1984 to 1988.

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1. Possible human fatigue involved with the SCS method because over 23,000 grids were counted.

2. Classification error may be involved in the ERDAS TM analysis. The two years were classified by two different people. Ground truthing of the areas should have been more intensive.

3. The shrub/scrub in the photointerpreted analysis gained (229 ac) from 1985 to 1988 while this same class lost 132 ac during this period according to the ERDAS analysis. This class may have been remaining constant according to field observations.

4. Photointerpreter and digitizer error may have been involved in the Photointerpretation analysis. Areas may have been misclassified as in the ERDAS classification. The area was very complex for digitizing. It consisted of many small islands or polygons.

5. Warping of the Infrared photograph could cause slight misregistrations when they are digitized although the "corners" of the map were correctly aligned.

6. The aerial photographs and the satellite data were not taken at the same time. Water levels and freezing conditions may have been different.

CMD plans to reclassify the ERDAS TM Satelite data and reanalyse the area in the near future. The satellite data if properly rectified and classified may be the method with the fewest chances for human error and may be the most efficient method in terms of time. The ERDAS TM method may be one that can be used in the future to relatively quickly and accurately determine the habitats and land loss rates of relatively large coastal areas such as management areas. In the future, the percent error of the above methods should also be calculated.

Literature Cited