
Report of the

COASTAL MARSH HAMMOCKS ADVISORY COUNCIL



Presented to
Commissioner Lonice C. Barrett
**GEORGIA DEPARTMENT OF
NATURAL RESOURCES**

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Table of Contents

EXECUTIVE SUMMARY.....	1
INTRODUCTION.....	2
DEFINING A MARSH HAMMOCK.....	4
LOCATION, SIZE, AND OWNERSHIP OF MARSH HAMMOCKS IN GEORGIA.....	6
Mapping Methodology.....	6
Summary of Findings.....	7
Table 1: Size Class in acres.....	7
Table 2: County distribution of hammocks by size class.....	7
Table 3: Summary ownership data by county.....	8
Table 4: Ownership for hammocks under 50 acres, All Counties.....	9
Table 5: Ownership for hammocks under 50 acres, Chatham County.....	9
Table 6: Ownership for hammocks under 50 acres, Bryan County.....	9
Table 7: Ownership for hammocks under 50 acres, Liberty County.....	10
Table 8: Ownership for hammocks under 50 acres, McIntosh County.....	10
Table 9: Ownership for hammocks under 50 acres, Glynn County.....	10
Table 10: Ownership for hammocks under 50 acres, Camden County.....	10
County Maps: Chatham, Bryan, Liberty, McIntosh, Glynn, Camden	
IMPORTANCE OF MARSH HAMMOCKS TO WILDLIFE.....	11
CONCERNS AND RECOMMENDATIONS.....	12
Habitat Loss/Degradation/Fragmentation.....	12
Waste Water Disposal.....	14
Archaeological Resources.....	15
Runoff/Water Quality.....	17
View Shed/Loss of Sense of Place.....	20
General.....	21
RESEARCH RECOMMENDATIONS.....	22
General.....	22
Wastewater Disposal.....	22
Habitat Loss/Degradation/Fragmentation.....	23
View Shed.....	23
Archeological Resources.....	24
Runoff/Water Quality.....	24
Economic Impact/ Private Property Rights.....	25
Management Related Needs.....	25

EXECUTIVE SUMMARY

In Georgia's six coastal counties there are approximately 1200 hammocks ranging in size from less than one acre to over 1000 acres. Nearly 85% are less than 10 acres. The total acreage of Georgia's hammocks is over 17,000 acres.

Department of Natural Resources Commissioner appointed a Coastal Marsh Hammocks Advisory Council (CMHAC) in February 2001 to review issues associated with developing marsh hammocks in coastal Georgia. This report addresses the charge to the CMHAC by Commissioner Barrett to: Identify the ecological importance of marsh hammocks; evaluate the impact of continued development of coastal marsh hammocks; and, recommend a range of solutions to mitigate development of coastal marsh hammocks.

The most difficult aspect of addressing this issue was defining a marsh hammock. The CMHAC decided to define Back Barrier Island and define a marsh hammock as a back barrier island of some size. The CMHAC agreed that a marsh hammock is a back barrier island that is 10 acres or less but did not all agree that a 50-acre back barrier island is a marsh hammock.

In addition to defining a marsh hammock it was important to locate and determine ownership of back barrier islands/hammocks, by size, in coastal Georgia. Tables and maps included in the document provide that information in detail. In the six coastal counties there are approximately 1200 hammocks ranging in size from less than one acre to over 1000 acres. Nearly 85% of these are less than 10 acres. The total acreage of Georgia's hammocks is over 17,000 acres. However, 64% of the total acreage is embodied in only 41 hammocks. These 41 hammocks account for less than 3% of the total number.

Recommendations are provided in seven areas. Habitat Loss/Degradation/Fragmentation; Waste Water Disposal; Archaeological Resource Concerns; Runoff/Water Quality; View Shed/Loss of Sense of Place; General; and Research Needs. Options for mitigating development of marsh hammocks are listed for each of these areas.

Clearly, continued development of Georgia's marsh hammocks is a concern to many Georgians. Not only do marsh hammocks constitute important habitat for a variety of wildlife, some of which are endangered or threatened, they are an integral part of the coastal view shed. Development of marsh hammocks can destroy valuable wildlife habitat and significantly alter Georgia's famous coastal landscape.

Access to marsh hammocks is available in one of two ways. Some hammocks are adjacent to deep water and access is available by boat. Others are surrounded by marsh and are not proximate to deep water making access only available by building a bridge across the marsh. For the most part, Georgia's coastal marshes are state-owned. Coastal Marshland Protection Act permits are required to construct bridges across the marsh. This is a requirement irrespective of the ownership of the marsh.

This report presents options for mitigating development of Georgia's marsh hammocks. It also has a strong research needs section that documents the paucity of scientific information about marsh hammocks. This fact made drafting specific recommendations problematic. Nonetheless, this report contains recommendations that should be considered by state policy-makers in any determination to manage further development of Georgia's marsh hammocks.

INTRODUCTION

Coastal Marshlands Protection Act

Passed by the General Assembly in 1970, Georgia's Coastal Marshlands Protection Act (CMPA) has been widely recognized as one of the best wetland conservation laws in the nation. The law has worked very well to protect the 400,000 +/- acres of coastal marshlands along the Georgia coast.

The CMPA created a committee of three individuals appointed by the Board of Natural Resources and chaired by the Commissioner of the Department of Natural Resources to evaluate requests for permits to alter coastal marshlands. The CMPA authorizes the committee to grant permits to alter coastal marshland after considering the public interest. The law deems the public interest to be determined by the following considerations:

- 1) *Whether or not unreasonably harmful obstruction to or alteration of the natural flow of navigational water within the affected area will arise as a result of the proposal;*
- 2) *Whether or not unreasonably harmful or increased erosion, shoaling of channels, or stagnant areas of water will be created; and*
- 3) *Whether or not the granting of a permit and the completion of the applicant's proposal will unreasonably interfere with the conservation of fish, shrimp, oysters, crabs, clams, or other marine life, wildlife, or other resources, including but not limited to water and oxygen supply.*

Development Trends and Permit Activity

Because of phenomenal growth of coastal Georgia, much of the upland that borders coastal marshland has been developed in several coastal Georgia counties. A trend is evident whereby back barrier islands, some of which have been commonly referred to as "coastal marsh hammocks", are now being developed. Many of these hammocks are adjacent to upland areas where a bridge can be constructed to provide access. Many are a great distance from the mainland or barrier islands or else they are separated from these areas by wide rivers making the construction of bridges to these back barriers impractical. In these cases the hammocks can only be reached by boat.

The CMPC has considered a number of bridge permits to back barrier islands in the past and granted all of them. Now, however, the number of permit requests is increasing and coastal residents and the department are concerned that this trend will have a negative impact on Georgia's coastal environment and/or the public's enjoyment of this environment. Also, there is a debate over the extent of the committee's authority under the CMPA. This debate has resulted in a lawsuit challenging a recent permit for bridges to three hammocks in Chatham County.

Coastal Marsh Hammocks Advisory Council

In February 2001, as a result of the above, Department of Natural Resources Commissioner Lonice Barrett appointed a Coastal Marsh Hammocks Advisory Council and charged the council with:

- 1) identifying the ecological importance of marsh hammocks,
- 2) evaluating the impact of continued development of coastal marsh hammocks, and
- 3) recommending a range of solutions to mitigate development of coastal marsh hammocks.

The members of the CMHAC are:

Duane Harris	Director, DNR-Coastal Resources Division, Chairman
Dr. Clark Alexander	Research Scientist, Skidaway Institute of Oceanography, Ex-Officio member Member, Coastal Marshlands Protection Committee and Shore Protection Committee
Phyllis Bowen	Executive Director, The Sapelo Foundation
Ben Brewton, III	President, Coastal Environmental Organization of Georgia
Dr. David Crass	State Archeologist, DNR-Historic Preservation Division
Mary Elfner	Executive Director, Coastal Georgia Land Trust
Cap Fendig	Commissioner, Glynn County Board of Commissioners
Bill Foster, Jr.	Consulting Engineer, Thomas & Hutton Engineering
Patty McIntosh	Coastal Programs Director, The Georgia Conservancy
Frank Quinby	Chairman, SE Georgia Group, Sierra Club
John Robinette	Wildlife Biologist, U.S. Fish & Wildlife Service, Savannah
David Rutherford	Administrator, Effingham County
Larry Stuber	CEO, EMC Engineering
Nancy Thomason	President, Residents United for Planning and Action, St. Simons
Barb Zoodsma	Coastal Nongame & Endangered Wildlife Program, DNR-WRD

Others who participated in the deliberations of the Council on a regular basis were: Dr. Jim Henry, Tara Merrill (for Larry Stuber), Ronnie Rogers (for David Crass), and Fred Hay (DNR-CRD, our GIS Expert). Chip Morgan, Historic Preservation Division, was a major participant in preparing the archaeological recommendations. The meetings were open to the public and a number of observers were present at one or more meetings.

DEFINING A MARSH HAMMOCK

Early in the CMHAC's deliberations, it was evident that there was a need to define a marsh hammock. This was difficult and contentious. At the twelfth meeting of the CMHAC, the group did agree that any back barrier island 10 acres in size or smaller was a marsh hammock. However, when the council was asked if a 50 acre back barrier island were a marsh hammock, they did not agree. The same was true when the same question was posed about 30 acres and 20 acres. The CMHAC agreed that **a marsh hammock is a small Back Barrier Island.**



Islands along the Georgia coast can be divided into two types: *Barrier-Island Complexes* and *Back-Barrier Islands*. [Back-Barrier Islands include areas commonly referred to in Georgia as Coastal Marsh Hammocks.] For the purposes of the Council's work, the following definitions were used:

- Island** An **Island** is a naturally occurring or man-made topographic feature with an elevation equal to or greater than 5.6 feet above mean sea level that is, or in its natural state was, surrounded by marsh (as defined in the Georgia Coastal Marshlands Protection Act), water or both. The determination of elevation is based on the most recently accepted, horizontally and vertically referenced, North American Datum in State law.
- Barrier Island Complex** **Barrier Islands**, which border the ocean, are defined by scientific and common usage. Because many of the islands in the coastal zone of Georgia are a composite of depositional features from various geological periods, it is not possible to delineate a single, contiguous feature as a barrier island, as can be done, for example, in North Carolina. Rather, barrier island complexes along the Georgia coast typically consist of a group of islands that were formed by similar processes.
- The Georgia Barrier Island Complexes and their component units are: Cumberland Island (Cumberland Island and Little Cumberland Island), Jekyll Island, St. Simons Island (St. Simons Island, Sea Island and Little St. Simons Island), Wolf Island, Sapelo Island (Sapelo Island and Blackbeard Island), St. Catherines Island, Ossabaw Island, Wassaw Island and Tybee Island (Tybee Island, Little Tybee Island and Williamson Island).
- Back-Barrier Islands** **Back-Barrier Islands** are all other islands between the **Landward Boundary** of the barrier island complexes and the mainland. Natural Back-Barrier Islands are erosional remnants of pre-existing upland, whereas man-made Back-Barrier Islands are comprised of dredge spoil material or ballast stones. These islands may or may not have existing connections to the mainland by bridges, causeways or other man-made structures.

**Landward
Boundary**

The Landward Boundary of a Georgia Barrier Island Complex is a line that follows the COLREGS (official sound limits) line across the mouth of the sounds and follows the marsh/upland border on all but the seaward facing side of each major land mass in a complex. Smaller Back Barrier Islands immediately adjacent to a Barrier Island Complex are explicitly excluded from the Barrier Island Complex by this line. Named islands occurring in areas south of major sediment sources (i.e., Little St. Simons Island and Little Tybee Island) are exceptions to this general definition in that each actually consists of a group of small, young islands, the landward boundary of which will be defined on regional charts. The region between the landward boundary of the Georgia barrier island complexes and the inland jurisdiction of the Georgia Coastal Marshlands Protection Act are being considered by this council.

Note: *We find that the definition of the term hammock refers to a topographic feature specifically found in South Florida, having soils and tropical vegetation characteristic of the Everglades. These hammocks typically represent slightly higher elevations on the Florida limestone platform and are surrounded by fresh water. However, for public education and public relations purposes, the term “hammock” has value as a colloquialism and therefore should be referred to in our definitions. If the General Assembly finds that protecting hammocks is in the public interest, it will need to define hammock as a back barrier island of a certain size.*

LOCATION, SIZE, AND OWNERSHIP OF MARSH HAMMOCKS IN GEORGIA

An important need of the CMHAC was to gather information on the location, size, and ownership of back barrier islands/marsh hammocks in Georgia. DNR staff did a significant amount of research on this issue and the findings are presented below. *Note: Throughout this document the term hammock is used to refer not only to the smaller hammocks but also to back barrier islands.*

Mapping Methodology

Analysis of Georgia’s coastal hammocks was accomplished in several distinct phases. First, base coverages for each coastal county were obtained. Landsat V satellite imagery was initially used to locate upland areas in the marshes. The resolution of this imagery is 30 meters, which inevitably led to the omission of many smaller hammocks. The second mapping iteration was created using 1993 Digital OrthoPhoto Quarter Quads (DOQQs) which are produced by the United States Geologic Survey at 1:12,000 scale. For Chatham County, a more recent set of 1997 aerial photos was used in conjunction with the 1993 DOQQs. These photos were produced by EarthData International, with funding from the Chatham County Metropolitan Planning Commission. The resolution of the photos is 1:200 which provided a high degree of detail for mapping hammocks.

Every hammock that was mapped was entered into a Geographic Information System (GIS) using ESRI’s ArcView 3.2a software. Attribute tables include the following information:

Area in square meters and acres	State	Golf Course
Perimeter in linear meters	State/Private	Timber
Ownership	Federal	High Density housing
Multiple Private	No Data	Marina Various other
Private	Development status	types of development
Conservation	House(s)	Dredge spoil
City	Roads	Bridge
County	Commercial	Causeway
		Name(s)

Each hammock was also given an identifier number within the database and was linked to an aerial photo where possible. Not every attribute field contains data for every hammock depending upon the source data available for analysis. The barrier islands were omitted from this database as were several large, developed back barriers such as Skidaway Island and Blythe Island. While not included in the following analyses, these large hammocks were mapped and recorded in the GIS as separate themes.

The next step in the process was to determine ownership for each hammock. Only two coastal counties, Chatham and Glynn, had digital cadastral data available at the time of this project. For these counties, digital data were entered into the GIS and then overlaid with the hammock coverage to determine ownership. For the other four counties, paper tax digest maps were used. This was accomplished by printing a copy of the hammock coverage and using the tax maps to locate each hammock, reference and then look up the parcel information. Over 400 hammocks were researched in this manner.

Hammocks that were identified as dredge spoil sites along the Atlantic Intracoastal Waterway were cross checked for ownership using a Georgia Department of Transportation GIS. This DOT GIS shows dredge spoil locations and gives information about ownership and the type of easement held by the DOT.

Although county tax digests, digital and paper, were found to have errors and omissions, they were used as the final authority on ownership. Most of the errors occurred where parcels of land were given no indication of ownership. In Camden County, nearly 10% of hammocks have unclear ownership. Liberty County hammocks were all identified as being privately owned. At most, these ‘No Data’ hammocks account for less than 2% of the total hammock land area or roughly 280 acres.

Summary of Findings

In the six coastal counties (Chatham, Bryan, Liberty, McIntosh, Glynn and Camden) there are approximately 1200 hammocks ranging in size from less than one acre to over 1000 acres. Nearly 85% of these are less than 10 acres. The total acreage of Georgia’s hammocks is over 17,000 acres. However, 64% of the total acreage is embodied in only 41 hammocks. These 41 hammocks account for less than 3% of the total number.

Size and Number

Table 1 summarizes size classes for the entire coast. In addition to actual acreage and number of hammocks, a percentage is given showing the proportional representation by each size class.

Table 1: Size Class in acres				
Size Class	Acres		#	
	total	% of total	total	% of total
0-.99	206.1	1.2	516	35.4
1-9.99	1904.6	11.2	714	49
10-49.99	2570.7	15.1	165	11.3
50-99.99	1511.7	8.9	21	1.4
100+	10832.6	63.6	41	2.8

The hammocks are not equally distributed among the counties but instead are concentrated in Chatham (38%), McIntosh (16%) and Glynn (24%). Table 2 presents distribution of hammocks and acreage by county according to size classes. Under each county name the total acreage per size class is given, followed by the number of hammocks within the class.

Table 2: County distribution of hammocks by size class												
Size Class (acres)	Chatham		Bryan		Liberty		McIntosh		Glynn		Camden	
	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#
0-.99	84.4	186	6.0	9	19.3	38	27.1	50	57.4	129	11.9	28
1-9.99	627.4	196	84.8	26	233.0	69	380.4	108	444.0	140	134.9	37
10-49.99	1044.7	53	99.4	5	260.3	15	505.6	28	457.7	21	203.0	13
50-99.99	560.3	8	216.9	3	63.9	1	225.9	3	310.8	2	133.9	2
100+	1919.5	7	491.9	2	1616.4	6	2318.1	6			4486.8	8

Ownership Patterns

The data indicate a predominance of private ownership both in number of hammocks and in acreage. Fifty-eight percent of Georgia’s hammocks are owned privately. That amounts to nearly fifty-four percent of the land area represented by coastal hammocks. While nearly 21% of the hammocks are State-owned, these represent only 11% of the total acreage of marsh hammocks.

Five hammocks totaling 45 acres are currently identified as conservation areas with ownership generally being under The Nature Conservancy, USA. These hammocks are found in McIntosh County. Bryan County has over 30 hammocks that are in State ownership but were purchased through an effort with conservation organizations. However, because these hammocks were transferred to State ownership, they are not included in the ‘conservation’ category. The same can be said for about 80 hammocks in Chatham County.

Private ownership is the rule with 60% of the hammocks under single or multiple private owners. This represents over 76% of the hammock acreage, or 13,090 acres. Ownership is not uniform, with Bryan County having over 70% state ownership and Liberty County having no publicly-owned hammocks. Ownership is not clear on 43 hammocks with a total acreage of 270.

Table 3: Summary ownership data by county

Table 3 offers number of hammocks, acreage, and the proportion represented by each ownership category.		Ownership	Number	%	Acreage	%
	All Counties	Private		722	60.4	13090.6
Conservation			5	0.4	45.0	0.3
City			24	2	55.0	0.3
County			29	2.4	97.6	0.6
State			247	20.6	1902.1	11.2
State/Private			2	0.2	261.7	1.5
Federal			125	10.4	1301.4	7.6
No Data			43	3.6	272.7	1.6
	Totals		1197	100	17026.1	100
Chatham	Multiple Private		12	2.7	652.7	15.4
	Private		183	40.7	1813.3	42.8
	City		1	0.2	1.7	0
	County		12	2.7	74.6	1.8
	State		140	31.1	1140.1	26.9
	Federal		98	21.8	541.7	12.8
	No Data		4	0.9	12.1	0.3
	Total		450	100	4236.2	100
Bryan	Private		9	20.9	290.4	32.3
	State		31	72.1	347.8	38.7
	State/Private		1	2.3	257.5	28.6
	No Data		2	4.7	3.3	0.4
	Total		43	100	899	100
Liberty	Multiple Private		1	0.8	113.0	5.2
	Private		128	99.2	2080.0	94.9
	Total		129	100	2193.0	100
McIntosh	Multiple Private		2	0.7	399.8	11.6
	Private		131	44.9	2632.8	76.2
	Conservation		5	1.7	45	1.3
	County		1	0.3	4.5	0.1
	State		27	9.2	272.7	7.9
	Federal		26	8.9	99.5	2.9
	No Data		3	1	2.7	0.1
Total		195	100	3457	100	
Glynn	Multiple Private		7	2.4	72.7	5.7
	Private		171	58.6	763.4	60.1
	City		23	7.9	53.3	4.2
	County		16	5.5	18.5	1.5
	State		49	16.8	141.1	11.1
	State/Private		1	0.3	4.2	0.3
	No Data		25	8.6	216.7	17.1
	Total		292	100	1269.9	100
Camden	Private		76	86.4	1522.6	30.6
	Multiple Private		2	2.3	2749.9	55.3
	Federal		1	1.1	660.2	13.3
	No Data		9	10.2	37.9	0.8
	Total		88	100	4970.6	100

Ownership for hammocks under 50 acres

The next series of tables looks at hammocks under 50 acres and shows the relationship between hammock size and ownership. Each county is shown separately due to the amount of information and the high degree of variability among counties.

In total, there are about 700 hammocks under 50 acres which are currently in private ownership. Twenty-two percent, or roughly 155 of the hammocks under 50 acres, are associated wholly or in part with the Atlantic Intracoastal Waterway (AIWW). Hammocks along the AIWW are generally under a restrictive covenant, perpetual or otherwise, that allows the Georgia Department of Transportation (GADOT) to authorize the placement of dredge spoil material on-site. These ‘dredge spoil’ hammocks are predominantly under private ownership (~60%) although there is some discrepancy between GADOT ownership records and the tax digests maintained by each individual county.

Table 4: Ownership for hammocks under 50 acres, All Counties

Size Classes	State		Private		County/City		Federal		Conservation		Multiple Private		No Data	
	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
<1	84	42.75	264	126.67	25	9.85	51	19.21			3	0.69	16	9.66
1-10ac	128	438.23	327	841.76	26	86.24	58	199.40	5	15.72	5	39.59	21	68.79
10-20ac	16	271.24	51	693.48	2	22.16	4	55.65	2	29.29	5	78.38		
20-30ac	6	143.08	18	251.08			1	26.74			1	69.38	1	20.86
30-40ac	3	69.10	7	238.79	1	34.34					3	38.23		
40-50ac			3	134.78			1	42.08						

Table 5: Ownership for hammocks under 50 acres, Chatham County

Size Classes	State		Private		County/City		Federal		Multiple Private	
	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
<1	52	23.89	90	44.27	1	0.77	43	15.44		
1-10ac	68	230.01	69	213.99	10	29.39	44	168.52	3	25.56
10-20ac	13	206.77	8	103.74	1	11.83	1	17.54	4	58.64
20-30ac	1	24.95	6	149.10					1	23.72
30-40ac	2	69.10	4	135.24	1	34.34			2	69.38
40-50ac							1	42.08		

Chatham County has the largest number of privately-owned hammocks under 50 acres, with 188.

Table 6: Ownership for hammocks under 50 acres, Bryan County

Size Classes	State		Private		No Data	
	#	Acres	#	Acres	#	Acres
<1	6	4.30	1	0.57	1	0.85
1-10ac	18	61.18	5	21.17	1	2.49
10-20ac	1	17.29	1	13.99		
20-30ac	2	47.84	1	20.23		
30-40ac						
40-50ac						

Bryan County has the fewest privately-owned hammocks under 50 acres, with only eight.

Table 7: Ownership for hammocks under 50 acres, Liberty County			
In Liberty County, all of the hammocks under 50 acres for which ownership could be determined (122), are owned privately.	Size Classes	Private	
		#	Acres
	<1	41	22.22
	1-10ac	67	239.99
	10-20ac	9	126.80
	20-30ac	5	123.57
	30-40ac		
40-50ac			

Table 8: Ownership for hammocks under 50 acres, McIntosh County													
McIntosh County has 124 privately-owned hammocks under 50 acres.	Size Classes	State		Private		County/City		Federal		No Data		Conservation	
		#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
	<1	4	2.29	36	19.65			8	3.77	2	1.34		
	1-10ac	18	78.38	70	248.65	1	4.46	14	30.87	1	1.32	5	15.72
	10-20ac	1	18.43	15	217.11			3	38.12			2	29.29
	20-30ac	3	70.29	1	28.11			1	26.74				
	30-40ac			1	32.62								
40-50ac			1	44.88									

Table 9: Ownership for hammocks under 50 acres, Glynn County											
Glynn County has the second largest number of privately owned hammocks under 50 acres, with 177.	Size Classes	State		Private		County/City		Multiple Private		No Data	
		#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
	<1	22	12.27	71	29.90	24	9.08	3	0.69	10	5.46
	1-10ac	24	68.67	84	258.94	15	52.39	2	14.03	14	49.93
	10-20ac	1	28.75	9	118.58	1	10.32	1	19.74		
	20-30ac			2	45.63						
	30-40ac	1	35.60	2	70.93			1	38.23		
40-50ac			2	89.90							

Table 10: Ownership for hammocks under 50 acres, Camden County					
In Camden County, all of the hammocks under 50 acres for which ownership could be determined (69), are owned privately. Nine hammocks under 50 acres were not listed on county tax roles and were therefore not clearly owned privately or by government agencies.	Size Classes	Private		No Data	
		#	Acres	#	Acres
	<1	25	10.06	3	2.01
	1-10ac	32	119.88	5	15.06
	10-20ac	9	113.25		
	20-30ac	3	68.88	1	20.86
	30-40ac				
40-50ac					

IMPORTANCE OF MARSH HAMMOCKS TO WILDLIFE



Upland hammocks surrounded by salt marsh offer unique habitat features important to many wildlife species. Many of the larger hammocks support a substantial amount of upland/salt marsh interface. These interfaces provide ample salt marshes with unrestricted aerial room for birds with large wingspans to approach and depart from large trees on the edge of uplands. Sandy upland habitat in close proximity to salt marshes (important for nesting diamondback terrapins) is also present in these areas. These beneficial habitat features are available to wildlife in isolation and, in most cases, without disturbance from humans and associated pets (e.g. house cats are known to be efficient killers of songbirds). Many back barrier islands/hammocks support natural vegetation communities that are in decline throughout part or all of their range. For instance, many of the larger hammocks support maritime forest species, a vanishing ecosystem.

Breeding Sites

Many wildlife species, including federally and/or state listed species or other species of concern, use hammocks as breeding sites. For instance, Georgia's coastal area has the greatest density of known bald eagle, wood stork, and wading bird nesting sites in the entire state. In 2000, six of 17 (35%) known bald eagle nests east of I-95 were on hammocks; five others were located on barrier islands with no bridge access (GDNR unpub. data). Data collected during a 1995/1996 survey for wading bird nesting areas in Georgia's coastal plain reveal that hammocks provide important nesting habitat to wading birds such as great blue herons and great egrets. Breeding Bird Atlas surveys indicate hammocks provide important nesting habitat for painted buntings, a species of concern (GDNR, unpub. data). Other birds such as white-eyed vireos, yellow-throated warblers, orchard orioles, northern parulas, summer tanagers, great-crested flycatchers, and blue-gray gnatcatchers (GDNR, unpub. data) nest in hammocks. Hammocks supporting sandy banks or dunes provide habitat for nesting diamondback terrapins.

Roost Sites

Hammocks are used as important roost sites by federally endangered wood storks and other large wading birds. Daytime roosts are often used by storks to minimize flight distances to tidally influenced feeding areas (Bryan, 1994). Most wood storks in coastal Georgia roost at an upland/salt marsh interface (Walsh, 1990 and Bryan, 1994). Furthermore, Bryan (1994) found that about 50% of the roost sites in his coastal Georgia study site were located on large estuarine islands (>100 ha and located within the intertidal zone – not including barrier islands) and 26% were located on small estuarine islands (<100 ha). In the *Habitat Management Guidelines for the Wood Stork in the Southeast Region*, Ogden (1990) recommends protecting “vegetative and hydrological characteristics” of roosting sites used by flocks of 25 or more storks.

Stopover Sites

Hammocks are also used as important stopover sites by migrating Neotropical songbirds. Data collected from the Savannah National Wildlife Refuge indicate that, during spring and fall stopovers, there is a positive correlation between oak hammock size and the abundance and diversity of Neotropical migrant species (Somershoe 2000). These data suggest that larger hammocks are particularly important for wildlife conservation.

CONCERNS AND RECOMMENDATIONS

The CMHAC listed concerns and recommendations in the following areas:

- Habitat Loss/Degradation/Fragmentation
- Wastewater Disposal
- Archeological Resource Concerns
- Runoff/Water Quality
- View Shed/Loss of Sense of Place
- General

The CHMAC also developed a list of research studies needed to enhance understanding of the functions and values of marsh hammocks and to support effective management of these resources (see Research Recommendations, page 22).

Habitat Loss/ Degradation/ Fragmentation

A primary concern of the CMHAC is that uncontrolled and/or unlimited development of back barrier islands may create significant habitat loss for a number of important wildlife and plant species. This habitat loss may manifest itself in a number of ways including direct loss, general or specific degradation of habitat, loss of unique natural communities, and fragmentation of habitat such that birds and other species cannot successfully use the habitat for migration stops, etc.

Most of the CMHAC was concerned that presently there is the potential to permit too many bridges to hammocks or back barrier islands.

- Options:**
1. Allow bulkheads along the perimeter of back barrier islands.
 2. Allow bulkheads only in areas where erosion is actively removing upland soils and/or vegetation.
 3. Bulkheads should only be allowed upland of the creek/marsh interface, i.e. at the DNR coastal marshland jurisdiction line.
 4. Prohibit bulkheads altogether.
 5. Bridges should not be permitted to hammocks for the purpose of affording access to other hammocks unless this is the least environmentally damaging way to gain access. The purpose of this recommendation is to prevent hop-scotching.
 6. As soon as possible, purchase and set aside as Natural Areas under the Georgia Natural Areas Act and the Heritage Trust Act of 1975, those hammocks for which there are occurrences of federally and/or state listed species, Species of Concern, or vanishing natural communities. "Species of Concern," as defined in Presidential Executive Order 13186 (January 17, 2001) includes those species listed in the periodic report "Migratory Nongame Birds of Management Concern in the United States," priority migratory bird species as documented by established plans (such as Bird Conservation Regions in the North American Bird Conservation Initiative or Partners in Flight physiographic areas), and those species listed in 50 C.F.R. 17.11.
 7. If back barrier islands/hammocks cannot be purchased, other protection measures, such as conservation easements, should be sought. This could be accomplished by the state working directly with landowners, or through non-governmental organizations.

***Habitat Loss
Options,
continued***

The CMHAC recommends the following prioritized criteria be used to identify hammocks for conservation protection:

1. Federal or State Listed Species Records – This includes breeding sites (e.g. eagle nests), important roost sites (e.g. wood storks), or other element occurrences (plants) of listed species;
2. Species of Concern Breeding Sites – Including sites supporting vanishing natural communities (e.g. maritime forests). Other high priority species could include those species on the rare and declining list maintained by the NWNHS;
3. Size – Species diversity increases with the size of the area—bigger is best;
4. Habitat Diversity – Back Barrier Islands/hammocks that are protected should be diverse in size, natural community type and in location (proximity to upland);
5. Spatial Distribution – Back Barrier Islands/Hammocks in undisturbed areas may be more valuable than those in disturbed areas where human disturbance and runoff may be issues. Back Barrier Islands/Hammocks under protection should be distributed throughout the coast, east and west, north and south.



**Waste Water
Disposal**

The CMHAC is concerned that septic tanks may not function properly on back barrier islands or marsh hammocks and thereby pose a threat to surrounding estuarine waters. The council was also concerned about potential problems with off-site (municipal) wastewater disposal.

- Options:**
1. EPD should be the permit issuing authority (rather than local health departments) for septic tanks on back barrier islands 50 acres in size and smaller. These areas should be considered sensitive areas and EPD should be the permit issuing authority.
 2. Prohibit construction of any on-site disposal system within 150 feet of the banks of tidally influenced waters. Some on the council supported this recommendation but the Council found no scientific evidence that 150 feet is an appropriate number. Each hammock less than 50 acres should be individually examined to determine an appropriate distance of an on-site disposal system from the banks of tidally influenced waters.
 3. On-site disposal systems on marsh hammocks or back barrier islands should
 - a) comply with the Regulations for On Site Management System Rules, Dept. of Human Resources, Public Health Chapter 290-5-26 as minimal requirements. These rules set forth minimum lot sizes, setbacks, buffers, densities as well as design criteria for the on site disposal system. The permit issuing authority can require more restrictive regulations if conditions warrant but in no case can the required regulations be less than is set forth in Chapter 290-5-26.
 4. Prohibit on-site disposal systems on dredge spoil and rock ballast hammocks.
 5. The effluent from malfunctioning on-site disposal systems has a greater potential for leaching into estuaries and threatening estuarine health and integrity. Therefore, the permit issuing authority should require more extensive testing of the site to insure that on-site disposal systems be designed so they will not malfunction.
 6. On-site disposal systems for commercial or more than one dwelling should be required to post a surety bond with the issuing authority to guarantee that the disposal system will be maintained and operated properly.

Note: *The CMHAC did not reach consensus on all of these options. Scientific information on the subject is one of the important research needs.*

Archaeological Resources

Georgia's archaeological sites represent the only way to know about 98% of the time that people have lived on the coast. They also contain important environmental data relating to both climate change and the distribution of animal and plant species prior to the European invasion. Georgia's coastal zone was first occupied by humans near the end of the Pleistocene Period, about 15,000 years Before Present. Humans since then have used the entire marsh ecosystem, leaving traces of their occupation on both high ground and in the marshes themselves. Because of rising and falling sea levels over this period, some of the earliest occupied sites in coastal Georgia are either wholly submerged or in marshes which later encroached on previously-dry terrain. In the context of back barrier island management, this means that the marsh is as potentially-significant archaeologically as are the islands themselves.

Unfortunately, Georgia does not have a regional archaeological survey program that has been ongoing for several decades. As a result, there is no comprehensive information available on coastal zone archaeology. In the absence of a federal review (rarely triggered), DNR-HPD itself has no review authority over development of the high ground on back-barrier islands. The Coastal Marshland Protection Committee requests and receives DNR-HPD review of permit applications that impact the marsh itself. However as noted above, this review takes place in the absence of representative archaeological data generated through a survey program.

Several individual islands and adjacent marshes were surveyed in the 1970s and 1980s by Drs. Charles Pearson and Chester DePratter (then graduate students at the University of Georgia), by Lewis Larson and Ray Crook (then faculty members at the West Georgia College), and by David Hurst Thomas (American Museum of Natural History). These surveys offer indications of the range of site types, locations, and conditions that may be found.

Information regarding migratory birds and harvesting of marsh-related resources from back barrier island archaeological sites is critical to our understanding of human history in the context of long-term global climate change, sea level fluctuation, and changing coastal environments. Recently, for example, archaeological data have influenced wildlife management decisions on DNR-managed barrier islands. In short, based on our current very limited data, most back-barrier islands and associated marshlands have a high potential for the presence of archaeological sites. *The issue is not whether sites are present, but whether they are scientifically important, i.e., worthy of preservation and study.*

Options: DNR-HPD currently lacks a representative sample of marsh-related archaeological sites because of the long-standing lack of a state archaeological survey program. Most of the extant archaeological data is project-based (i.e., it is highly-selective). It does not constitute a statistically-valid sample of the resources the state is charged with managing. Therefore, the CMHAC recommends a three step strategy for consideration of archaeological sites. This strategy is conservative, and is intended to ensure consideration of critical resources in the short-term through a standard survey requirement for permit applicants.

*Archeological
Resource Options,
continued*

Step 1: HPD recommends that permit applicants be required to complete a reconnaissance-level survey of the project area including marsh and riverine areas that will be impacted by construction. A reconnaissance-level survey is the most general and least-expensive type of survey, and is intended to characterize the range of site types in a project area. The survey should include a complete pedestrian inspection of the project area by an archaeologist meeting professional standards. The resulting report should be a component of permit submittals to the Coastal Marshlands Protection Committee.

A reconnaissance-level survey includes the following components:

- Reviewing regional prehistory, geography, geology, and history;
- Researching the Georgia Archaeological Site Files;
- Contacting professional archaeologists, RDC planners, landowners, and others who may have knowledge of archaeological sites;
- Sampling sites by means of a field survey;
- predicting the archaeological sensitivity of an area (this step guides the Intensive-level survey, below);
- reporting findings.

Step 2: Based on the results of the reconnaissance-level survey, DNR may carry out its own intensive-level survey of the proposed project, similar to the surveys currently carried out on lands the agency manages prior to ground-disturbing activities. In addition to the information recovered during a reconnaissance-level survey, an intensive-level survey includes systematic subsurface testing to determine the significance of a site(s). These DNR surveys will serve a dual purpose. First, they will serve to alert DNR to sites that must be either avoided or treated in some way. Just as importantly, the intensive-level survey will furnish the data needed to create a GIS-based review (or expert) system (see Step 3). Given the current lack of archaeological data, this step is absolutely critical to creation of a defensible review system.

Step 3: The intensive-level survey results would then be used over time to construct an archaeological sensitivity GIS. Once this GIS was developed it would serve as the primary tool used by DNR in the archaeology review system. Proposed development actions that could disturb back-barrier islands or the adjoining marsh and waterways would be reviewed by DNR-HPD archaeologists using the GIS, much as such actions are reviewed for federally permitted actions. Actions that impacted non-sensitive areas (for instance, dredge islands), might require no further actions. At the other end of the spectrum, DNR might condition the permit on avoidance, excavation, or other actions to insure that no critical archaeological resources would be impacted by the proposed project. Once a statistically-valid sample of back barrier islands and marsh areas had been sampled through Steps 1 and 2, and a GIS developed, no further DNR surveys would be necessary.

Runoff/ Water Quality

A number of potential adverse impacts to water quality in the surrounding marsh and tidal creeks may occur as a result of hammock development. Water quality is known to be degraded in direct correlation with the level of impervious surface in the watershed. Imperviousness is defined as the sum of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces.

In coastal systems in certain parts of the United States (little research has been done in the Southeastern U.S.), shellfish and wetlands become adversely impacted when impervious surface coverage exceeds 10 percent. And, as impervious coverage increases, the velocity and volume of surface runoff increase proportionately, and there is a corresponding decrease in infiltration.

Increasing cover of impervious surfaces concentrates pollutants during dry periods and then serves as a rapid conduit of these pollutants into water bodies during and following rain events. A strong correlation has been found between average estuarine fecal coliform counts and proportion of the developed land in the watershed, with an even stronger correlation with proportion of impervious surface coverage.

Stormwater runoff is increased as the amount of impervious surface declines, as well as from the construction of bridges built to access hammocks for development, although the magnitude of the bridge runoff problem is the subject of debate among researchers.

The kinds of impacts can be divided into *direct* and *indirect*. Direct impacts may include heavy metals from vehicular exhaust and brake contaminants at bridges, upland roads, rooftops and driveways, as well as organic contaminants from pesticides and herbicides associated with landscaping. Indirect impacts can include loss of marsh vegetation from bridge shading and upland conversion of the natural environment with a subsequent loss of ecological functioning as native species are lost or replaced.

There are also impacts from construction itself such as damage done by heavy equipment and vegetation removal and compaction of soils. Increased sediment loading to marsh and creeks may also occur during construction.

Nutrient levels are important considerations because they are related to eutrophication. Fertilizers, septic effluent leachate from coastal development, animal wastes, and atmospheric deposition are all sources of nitrate loading. Harmful algal blooms (HABs) have occurred in North Carolina and Maryland and are associated with nutrient loading. HABs are extremely deleterious to estuarine fish populations and have been implicated in serious human health problems.

Fortunately, Georgia's semi-diurnal tidal environment with mean tides of over two meters creates a well-flushed estuarine system. Nonetheless, as coastal Georgia's landscape becomes more developed, natural resource managers will need to be extremely diligent to ensure that nutrients do not exceed levels that cause problems for estuarine organisms and for humans.

Buffers can protect tidal marshes from the impacts of hammock development. Since hammocks have little elevation, pollutant removal performance is enhanced. In addition to pollutant removal, buffers have an additional benefit of preserving edge vegetation habitat along the transitional zone to the marsh. Buffers also protect development from damaging floods by slowing the velocity of floodwater and absorbing and slowly releasing floodwater.

The width of buffers can be contentious. In general, however, the wider the buffer the more functions they perform. Some researchers propose buffers of 100 feet or more. Georgia's Erosion and Sedimentation Law requires a naturally vegetated buffer of 25 feet from all waters of the state where vegetation is wrested. There is, however, a procedure where an individual may apply for a variance to encroach into the buffer. Moreover, this buffer does not apply to the construction of single family homes.

Some believe a *minimum* buffer width should be 50 feet. Because marsh hammocks may provide favorable conditions for infiltration, a 50-foot minimum may be sufficient or even greater than necessary. However, the smaller the island or hammock, the more difficult it is to maintain a buffer between the development and the marsh. And, the smaller the hammock, the greater the percentage of impervious surface under normal circumstances. Specific research is needed to determine what size buffer is needed along the marsh perimeter and the relationship of buffers, the percentage of impervious surface and water quality.

- Options:**
1. Establish a naturally vegetated buffer requirement of at least 25 feet from all coastal wetlands, including marshland and tidal creeks. Depending on other factors such as slope of the property, amount of impervious surface, etc., this buffer will need to be larger. The entire buffer should be maintained as an undeveloped landscaped area. Further, at a minimum there should be at least 50 feet of vegetation between the marsh and any pavement or structure. Twenty-five (25) feet of this vegetation may be turf grass.
 2. Require that permit applicants seeking state or local approval of activities related to hammock development clearly indicate buffers and on all plans and delineate buffers in the field.
 3. Impose some maximum on total impervious surface coverage on all marsh hammocks. Alternatively, impose such maximum on hammocks of a certain size.
 4. Require local governments to adopt and enforce rigorous stormwater ordinances for development projects on marsh hammocks. Ordinances should require that all runoff be returned to the soil on-site through the use of bio-retention areas, porous paving, irrigation, or other appropriate methods.
 5. Strengthen local and state enforcement of erosion and sedimentation ordinances. Included should be:
 - a) stricter issuance of stop-work orders and significant fines;
 - b) clear delineation of buffers on plans and in the field; and
 - c) site visits early in the construction phase to ensure that best management practices are used and properly installed.
 6. Establish state restrictions on the use of sea walls, bulkheads and other armoring devices on hammocks.

***Runoff/
Water Quality
Options,
continued***

7. Establish strict state guidelines for the construction of bridges connecting hammocks to the mainland or from one to another. Requirements should include:
 - a) bridge design that free-spans marshes to the maximum extent possible;
 - b) routing of run-off from bridges to infiltration ponds or other treatment areas located on solid ground beyond any buffers; routing of runoff from roads near bridge crossings away from the edge of the marsh or water body to a point inland of any buffers; and
 - c) treatment areas designed to maximize infiltration and provide for trapping or removal of contaminants.
8. Establish programs to permanently protect hammocks through conservation easements or acquisition.
9. Prohibit development of marsh hammocks under 10 acres.

**View Shed/
Loss of Sense
of Place**

One of the most important attributes to Georgia residents is the relatively undisturbed scenic vista that is viewed when looking across Georgia's 400,000 +/- acres of coastal marshes. Pristine marsh hammocks are an integral part of that vista. In 2001, Scenic America, a national organization dedicated to preserving natural beauty and distinctive community character, selected Georgia's marsh islands as one of the ten endangered places of beauty in the nation. It is obvious that this view shed will be impacted by the construction of bridges to back barrier islands/marsh hammocks. Construction of houses that line the perimeter of marsh hammocks will also interrupt the landscape that is so important to coastal Georgia residents.



Residents worry that construction of bridges to hammocks and houses along the perimeter of these areas will significantly alter the coastal Georgia landscape such that the present "character" of coastal Georgia will be lost forever. As developable property in coastal Georgia shrinks further and further and land values continue to rise, landowners are looking at property previously thought to be "too expensive" to develop. Because these "too expensive" areas are now being developed, there is a growing fear that coastal Georgia is losing its "sense of place."

- Options**
1. Adopt a state budget priority to purchase most of the remaining undeveloped hammocks that are less than 10 acres in size. This, in and of itself, would have a major positive impact on the view shed.
 2. In evaluating a coastal marshlands permit for a bridge to a back barrier island/marsh hammock, consider the degradation of the coastal view shed and condition the permit by using relocation, elevation, size, etc., to minimize this impact.
 3. Consider the view shed of the perimeter of a back barrier island/marsh hammock through the use of setbacks, use of natural colors for house paint, retention of native trees within the setback area, etc. In other words, construct the house(s) such that they blend in rather than stand out.

General Many of the concerns about the continued development of back barrier islands/marsh hammocks have been listed above. A summary list of these concerns includes: 1) degradation of coastal marshes from the construction of bridges to these areas; 2) runoff from fertilizers, pesticides, and herbicides into the marsh from construction in these areas; 3) installation of septic tank and drain fields in areas where the soil characteristics do not properly filter the sewage and under treated sewage finds its way into coastal marshes; 4) view shed changes that are objectionable to coastal residents and result in a loss of our sense of place; 5) loss of significant archaeological resources in these areas; 6) loss of critical nesting and roosting habitat for endangered and threatened species; and, 7) loss of habitat important to migrating neo-tropical birds.

Options were provided earlier to address each of these concerns. However, other options that cross over various areas above are listed below for consideration.

- Options:**
1. Adopt new legislation to be entitled the Coastal Marsh Hammock Protection Act of 2003. This new law would give a committee chaired by the Commissioner of the Georgia Department of Natural Resources and comprised of two members appointed by the DNR Board the authority to grant, deny, or condition permits for development on marsh hammocks. Marsh hammocks will need to be defined in the legislation. For example, “a marsh hammock is a back barrier island that is 10 acres or smaller in size.”
 2. Require that all claims of hammock ownership be proved to the satisfaction of Georgia’s Attorney General between March 1, 2002 and February 28, 2004.
 3. Provide for the State of Georgia to evaluate the feasibility of securing “right of first refusal” on the purchase of all back barrier islands/marsh hammocks in coastal Georgia.
 4. Provide for Georgia’s salt marshes and coastal water bottoms to be designated as Wildlife Management Areas and for all proceeds from the lease of marshlands and waterbottoms to be retained by the Department of Natural Resources.
 5. Give consideration to use of the State’s revocable license authority to prohibit the construction of bridges across state-owned marshes and/or to gain concessions from the developer/owner of marsh hammocks.

RESEARCH RECOMMENDATIONS

During the deliberations of the CMHAC, it has become clear that there is a paucity of scientific information regarding many aspects of the back-barrier island and marsh hammock environments of coastal Georgia. Scientific studies of various kinds will be critical to the wise management of these resources. Those data are not currently available.

To remedy this situation, the CMHAC has developed a list of research studies that would enhance our ability to effectively manage these resources. The research tasks outlined below should be carried out on a representative number of hammock types (i.e., natural, dredge-spoil and ballast-stone) and sizes (i.e., approximately 1, 10 and 50 acres) to constrain the range of characteristics and processes to be found in this range of environments. The Council recommends these studies be carried out in a manner that specifically addresses not only the individual impacts of these issues but cumulative impacts as well.

General 1. *Applicability of existing barrier island studies to marsh hammock environments.*

With the exception of dredge-spoil and ballast-stone islands, the back-barrier islands and marsh hammocks are erosional remnants of larger pieces of land similar to the large barrier islands that front the Georgia coast. As such, some of the research carried out on the barrier islands may be applicable to marsh hammocks and would satisfy some of the data needs of the CMHAC. A synthesis of existing geological, hydrological and biological data on these larger features should be carried out with a subsequent determination of the applicability of the studies to marsh hammock environments. This proposed barrier-island research synthesis will provide a database of research results applicable to marsh-hammock research goals and facilitate any additional research efforts. The Georgia Conservancy has completed a preliminary data-gathering effort on some aspects of marsh hammocks, which should be assimilated into this effort as well.

Wastewater Disposal 1. *Hydrological characteristics of natural and manmade hammocks*

The hydrological characteristics of hammocks are an important focus area as these parameters impact several applied aspects of hammock development. If septic systems become common on hammocks, the pathways and rates of groundwater flow will significantly affect the suitability of these systems on hammocks.

2. *Stratigraphy and geology and their relationship to hammock hydrological properties.*

The stratigraphy and geology of hammocks are the first order factors that determine the suitability of these environments to development and the hydrological characteristics. Sediment (and soil) type has the most direct bearing on hydrological properties (i.e., conductivity, infiltration rate) and construction substrate. The stratigraphy will determine the subsurface behavior of groundwater, particularly those derived from shallow sources (i.e., septic systems). If impermeable layers (i.e., humate or organic cemented sands) are present in the subsurface, as have been documented in some barrier islands, the hydrological properties and flow pathways in the system will be very different from those where impermeable layers do not exist.

3. *Relationship of hammock hydrologic system to surrounding waters.*

The hydrological system of a marsh hammock may be linked to several other systems. To identify the potential effects on the back-barrier environment of altering marsh hammocks, the interactions between shallow and/or deep aquifers, the saltmarsh and tidal creek systems and marsh hammocks need to be determined. These results will have direct bearing on the suitability of hammocks as habitat for biological organisms.

Habitat Loss/ Degradation/ Fragmentation

1. *Ecological communities permanently residing on hammocks*

At the present time, we know little about the ecological communities and individual organisms (e.g., birds, reptiles, mammals, insects, plants) that are characteristic of marsh hammocks. This information is fundamental to any attempt to manage back-barrier environments. Until we know the importance of these habitats to biota, we cannot seek an acceptable balance between conservation and development.

2. *Intensity of migratory species utilization of hammocks*

Neotropical songbirds are known to utilize the back-barrier islands and marsh hammocks as resting and feeding sites during their annual migrations. Modification of this habitat must be evaluated in light of the importance of this environment to these species of concern. Thus, the intensity of use, on an annual and seasonal basis, must be determined.

3. *Need for, existence of, and adequacy of existing wildlife corridor*

The concept of a wildlife corridor has been advanced as being important to the long-term maintenance of many species and communities that utilize the back-barrier island environment. However, little hard data exist to define the shape, size and need for these corridors. If needed and inadequate, the corridor could be enhanced by targeted land acquisitions by the State, but the basic data must be in hand to justify doing so.

View Shed

1. *Impacts of docks, bridges and houses to habitat*

Development within the back-barrier environment typically leads to a jarring juxtaposition of natural and manmade vistas. This view shed issue involves both public attitude (e.g., importance of pristine environment), personal property rights (see below) and conservation (e.g., environmental impact of development). Any development will have some amount of impact on the natural environment—the issue is to determine how much is too much.

Archeological Resources

1. Prevalence of historic sites on hammocks

Based on the scanty extant research literature, nearly all back-barrier islands and adjacent marshes and rivers have some archaeological potential. As development encroaches onto back-barrier island and the adjacent marshes and waterways, it will be critical for DNR to have defensible review procedures and tools to guide its permitting actions. Using the information derived from the proposed survey, as well as the extant literature, a GIS-based “expert system” would be developed to guide selection of the appropriate survey level and treatment options, given the property’s characteristics. The survey data needed to construct this review system would come from a combination of permitting applicant-funded reconnaissance-level surveys followed by intensive level surveys by DNR on selected hammocks. Intensive level surveys could be funded through CZM, state general funds, or a combination of the two sources.

2. Guidelines for level of future surveys

As development encroaches onto the back-barrier environment, it will probably not be feasible to perform intensive archaeological surveys of every piece of land. Using the information gleaned from previous surveys and the work in 1, above, an “expert system” should be developed to guide selection of the appropriate survey level, given the property’s characteristics.

Runoff/ Water Quality

Buffer characteristics and management of surface runoff are central issues in the management of back-barrier environments. Several important aspects are considered in the specific research goals laid out below.

1. Width of buffer to remove particulates and dissolved contaminants (pesticides, fertilizers, etc.)

Buffers must be wide enough to remove particulate organic material, inorganic sediment and dissolved organic and inorganic contaminants prior to their discharge into adjacent creeks and marshes. Failure to do so leads to increased turbidity (which decreases photosynthetic activity), aggradation and shoaling of creeks, environmental toxicity and burial of marsh biota, eutrophication and reduced oxygen levels, marine resource health advisories and shifts in community structure.

2. Density of vegetative cover required for effective buffer performance

The use of buffers is an accepted part of land management at the upland-marsh boundary. However, the composition of those buffers has ranged widely. Naturally vegetated buffers are thought to perform best, whereas landscaped buffers, with fertilizer and pesticide applications up to the marsh edge, typically have a negative effect. The density necessary to provide acceptable protection should be evaluated.

3. Ratio of impervious to pervious surfaces in relation to data from study of hydrological characteristics of hammocks (Wastewater Disposal, 1, above)

Developed surfaces need not be impervious to surface water infiltration. Knowledge of the hydrological properties and functions of hammocks will provide guidance as to the amount of impervious surface necessary to allow adequate hydrological processing of surface runoff.

**Economic
Impact/
Private
Property
Rights
(Economic-
Sociological)**

1. *Level of regulation landowners willing to accept to preserve “sense of place”*

Some amount of regulation will be necessary to preserve the unique environment that draws people to coastal Georgia. An acceptable, reasonable position in the delicate balancing act between owners and regulators needs to be determined.

2. *Sense of coastal Georgians on the immediacy of this issue*

Do the residents of coastal Georgia feel a strong, immediate need to protect the back-barrier environment? The answer to this question could provide guidance and a mandate for more direct management of the back-barrier environment.

3. *Relative costs of levels of development*

Given the value of the marsh and upland back-barrier habitats to biota, an economics-based estimate of the cost of different development scenarios can be made. The cost to the State of Georgia is an important figure for assessing reasonable charges for the use of State property to facilitate the development of private property (i.e., marinas, bridges and docks).

**Management
Related Needs**

1. *Additional rules and regulations required to meet hammock management goals*

Additional rules or regulations may be required to meet management goals.

