Biological Services Program

FWS/OBS-79/45
December 1980

ECOLOGICAL CHARACTERIZATION OF THE SEA ISLAND COASTAL REGION OF SOUTH CAROLINA AND GEORGIA

EXECUTIVE SUMMARY

Interagency Energy-Environment Research and Development Program

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
AND
Fish and Wildlife Service

U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.
- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process to prevent or minimize the impact of development on fish and wildlife. Research activities and technical assistance services are based on an analysis of the issues, a determination of the decisionmakers involved and their information needs, and an evaluation of the state of the art to identify information gaps and to determine priorities. This is a strategy that will ensure that the products produced and disseminated are timely and useful.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; geothermal, mineral and oil shale development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; and systems inventory, including National Wetland Inventory, habitat classification and analysis, and information transfer.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning and management; National Teams, which provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms, and others; Regional Staffs, who provide a link to problems at the operating level; and staffs at certain Fish and Wildlife Service research facilities, who conduct in-house research studies.

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402
Stock No. 024-010-00590-4

FWS/OBS-79/45
December 1980

ECOLOGICAL CHARACTERIZATION OF THE SEA ISLAND COASTAL REGION OF SOUTH CAROLINA AND GEORGIA

EXECUTIVE SUMMARY

by

Michael D. McKenzie
Lee A. Barclay

Project Manager: Edwin B. Joseph
Project Coordinator: Michael D. McKenzie

Marine Resources Division
South Carolina Wildlife and Marine Resources Department
P.O. Box 12559
Charleston, South Carolina 29412

Contract No. 14-16-0009-77-016

Project Officer: Lee A. Barclay
U.S. Fish and Wildlife Service
P.O. Box 12559
Charleston, South Carolina 29412

Prepared for the
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior
Washington, D.C. 20240

DISCLAIMER

The opinions, findings, conclusions, or recommendations in this report are those of the authors and do not necessarily reflect the views of the Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior, nor does mention of trade names or commercial products constitute endorsement or recommendation for use by the Federal Government.

Any suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA/Slidell Computer Complex
1010 Gause Blvd.
Slidell, LA 70458
(504) 255-6511
FTS 685-6511

This report should be cited as follows:

McKenzie, M.D., and L.A. Barclay. 1980. Ecological characterization of the Sea Island coastal region of South Carolina and Georgia. Executive summary. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-79/45. 51 pp.

PROJECT CONTRIBUTORS

A complete list of contributors to the Sea Island Characterization Project is impractical since the talents, experience, and time of so many people were required. It is fitting, however, that the following individuals, who either served in an advisory capacity or as project consultants, be gratefully acknowledged:

Ken Adams - Bureau of Land Management, New Orleans, LA
Roger Banks - Fish and Wildlife Service, Charleston, SC
Joseph E. Burgess - Fish and Wildlife Service, Asheville, NC
Roberta Carney - Georgia Department of Natural Resources, Atlanta, GA
Randall P. Cheek - National Marine Fisheries Service, Beaufort, NC
Lynn P. Childers - Fish and Wildlife Service, Jacksonville, FL
O. Richard Cothran - Georgia Department of Natural Resources, Brunswick, GA
W. P. Crawford - National Park Service, Sullivan's Island, SC
Jack Crockford - Georgia Department of Natural Resources, Atlanta, GA
Richard E. Defenbaugh - Bureau of Land Management, New Orleans, LA
Timothy Fendley - Clemson University, Clemson, SC
Dennis Forsythe - The Citadel, Charleston, SC
Harry Freeman - College of Charleston, Charleston, SC
David Gould - Georgia Game and Fish Commission, Brunswick, GA
Evelyn Haines - University of Georgia, Sapelo Island, GA
Jay D. Hair - North Carolina State University, Raleigh, NC
Julian R. Harrison - College of Charleston, Charleston, SC
A. Sidney Johnson - University of Georgia, Athens, GA
James B. Johnston - Fish and Wildlife Service, Slidell, LA
James A. Kerwin - Bureau of Land Management, New Orleans, LA
James B. Kirkwood - Fish and Wildlife Service, Atlanta, GA
Bjorn Kjerfve - University of South Carolina, Columbia, SC
Fred C. Marland - Georgia Department of Natural Resources, Brunswick, GA
L. Glenn McBay - Fish and Wildlife Service, Brunswick, GA
Hans Neuhauser - The Georgia Conservancy, Savannah, GA
Robert J. Reimold - Georgia Department of Natural Resources, Brunswick, GA
D. Lamar Robinette - Clemson University, Clemson, SC
Reginald Rogers - Environmental Protection Agency, Atlanta, GA
Larry R. Shanks - Fish and Wildlife Service, Slidell, LA
Rebecca R. Sharitz - Savannah River Ecology Laboratory, Aiken, SC
Eric Slaughter - Coastal Plains Regional Commission, Charleston, SC
Michael H. Smith - Savannah River Ecology Laboratory, Aiken, SC
D. Reed Wiseman - College of Charleston, Charleston, SC

The following people deserve a special word of thanks for voluntarily assisting with the project either during the stages of data identification and acquisition or data presentation and review:

Diane Adams
Pat Adams
Fritz Aichle
Jane Allen
Robert Anderson
Mike Arnett
J. R. Bailey
H. Wayne Beam
Richard M. Blaney
Virginia Boyd
Marvin Bradford
William Brillhart
Paul D. Brooks
A. L. Buikema
William Burbanck
Jerry Chalmers
Paul Christian
J. W. Coker
Bob Collom
Bruce Coull
Marion T. Crum
William P. Davis
John Day
Thelma Elkins
Maria Ellis
Tom Eubanks
James Fitch
Nancy Foley
George Garris
J. W. Gibbons
Sarah Gillspie
Jim Greenfield
Carl Hall
Mike Hardisky
Carol Harrt
John M. Hefner
E. T. Heinen
Donald Herald
James M. Hillard
Ellis Hodgin
Barbara A. Hogan
Anna Marie Horn
Dave Hornig
Patrick Hudson
David M. Knott
Jan Kohlmeyer
Will Lacey
Lewis Larsen
J. D. Lazell, Jr.
Francis Ledbetter
Charles Lee
Marvin Lowry
Lizz Lyons
R. E. Mancke
D. Bruce Means
Gary Midkiff
Bill Mitchell
R. Montanucci
Robert H. Mount
Tom Murphy
Mary Anne Neville
Barbara Nickel
Ron R. Odom
Eugene Odum
George Oertel
Bruce Osburn
W. M. Palmer
Drennen Park
Tom Payne
Sam Pickering, Jr.
J. N. Pinson, Jr.
Camille Ranson
Lois Richter
Alison Ricker
Bryon Rogers
Douglas A. Rossman
Virginia Rugheimer
Al Sanders
Emily Sanders
James Schlindler
Jim Setser
S. A. Sherberger
Gene Slice
Cindy Smith
Theodore I. J. Smith
Stanly South
B. C. Spigner
Ken Stansell

R. Howard Hunt
Holbert Hutchinson
E. L. Inabinet
Alfred Jones
B. Kahn
Katherine Kelly
Donald W. Kinsey
Leow A. Kirtland
G. K. Williamson
Harry Yeatman
Harvey Young

R. L. Stephenson
Ken Stevens
Tom Teston
Lars Tilly
Henry Van Amerson
Gene Wadell
Charles H. Wharton
Phil Wilkinson
Julie Zachowski
Richard Zingmark

In addition to those people specifically mentioned in the lists of contributors for each volume of the final products, the following individuals provided support for data processing, interim report preparation, and other technical assistance for which we are grateful:

John P. Deveaux
Donna Florio
Pam Floyd
A. G. Gash
Steve Goldstein
Caroline Gray
Jim Grooms
Virginia Hargis
Jan Hiester
Louise Hodges
Anna Jeffcoat
Wally Jenkins
Carroll Kearse
Priscilla Knight
Nickie Kopacka

Glenn Murray
David Ott
Palma Seccombe
Gene Smoak
George Steele
Al Stokes
Frank Taylor
Dale Theiling
Ivy Ulrich
George Walters
Joe Wannamaker
Dave Whitaker
Elizabeth Williams
Josie Williams

ACKNOWLEDGEMENTS

We gratefully acknowledge the assistance of Barbara S. Anderson, Roger L. Banks, James M. Bishop, Steve S. Gilbert, Karen A. Harper, and Richard D. Porcher in the preparation of the distribution and relative abundance tables. We are grateful to Ted Borg and Robert A. Campbell of the South Carolina Wildlife and Marine Resources Department's Division of Information and Public Affairs for the fine photographs found throughout this publication. And we are appreciative to Jane S. Davis for graphics and lay-out assistance, and to Emily S. Schroeder for typing and editoral support. Special credit goes to the National Archives Society for the photograph at the top of page 17.

ECOLOGICAL CHARACTERIZATION OF THE SEA ISLAND COASTAL REGION OF SOUTH CAROLINA AND GEORGIA

EXECUTIVE SUMMARY

This document highlights results of the study entitled "An Ecological Characterization of the Sea Island Coastal Region of South Carolina and Georgia " and is intended to provide an overview of the study and to facilitate use of the full report. The reader who desires more detail or documentation of this summary is directed to the final products of the study, which include three volumes of text, an atlas, a directory of data sources, and a computerized bibliography.

INTRODUCTION TO THE STUDY

The Sea Island Coastal Region of South Carolina and Georgia is rich in natural resources, including moderate climate, dramatic scenic qualities, fertile soils, water, fish, wildlife and minerals. Those resources are valuable for a variety of often competitive uses, including active and passive recreation, transportation, agriculture, commercial fisheries, industrial development, preservation, and so forth.

A significant trend in the management and development of coastal resources is the growing realization that rational decisions and final judgements can be made only when all available information on local environmental conditions is considered. This trend recognizes the need for a holistic approach and has promoted the ecosystem concept in natural resource management.

Recognition of the need for an ecological approach in managing coastal resources has developed from increasing evidence that man's utilization of this environment has brought about major, yet often subtle, changes in the functioning of ecosystems. In order to perpetuate the economic, aesthetic, and biological values of coastal ecosystems, we must understand their functional relationships. Modern ecology is a "systems ecology," or a hybridization of both ecology and systems methodology. The theory behind this approach embodies an important ecological principle: an ecological system is comprised of many components, no one of which can be altered without affecting the total system, since no one part functions independently. By including a full assessment of the total ecosystem, management efforts - at both the field and administrative levels - can be designed to maximize the economic, social, and biological benefits derived from natural resources. Recognizing this, the U.S. Fish and Wildlife Service is employing the ecosystem concept as a holistic mechanism for managing natural resources and is developing ecological characterization as one basic tool for this application.

CONCEPT OF ECOLOGICAL CHARACTERIZATION

An ecological characterization is a synthesis of existing information and data structured in a manner which identifies functional relationships between natural processes and the various components of an ecosystem. Objectives of the Sea Island Ecological Characterization are to:

1) assemble, review, and synthesize existing biological, physical, and socioeconomic information and establish a sound information base for decisionmaking;
2) identify and describe various components (subsystems, habitats, communities, and key species) in this coastal ecosystem;
3) describe major physical, biological, and socioeconomic components and interactions;
4) describe known and potential ecosystem responses to man-induced changes; and
5) identify major information deficiencies for further study and decisionmaking needs.

Ecological characterizations are designed primarily to assist coastal resource managers engaged in comprehensive planning efforts such as assessment of the environmental impacts of development in the coastal zone. Other applications include the preparation of mitigation procedures and development alternatives. Characterization also provides an immediate data base for specific action programs (offshore oil and gas development, coastal construction permit reviews, etc.) and guidance in selecting parameters that need study for further defining coastal ecological systems.

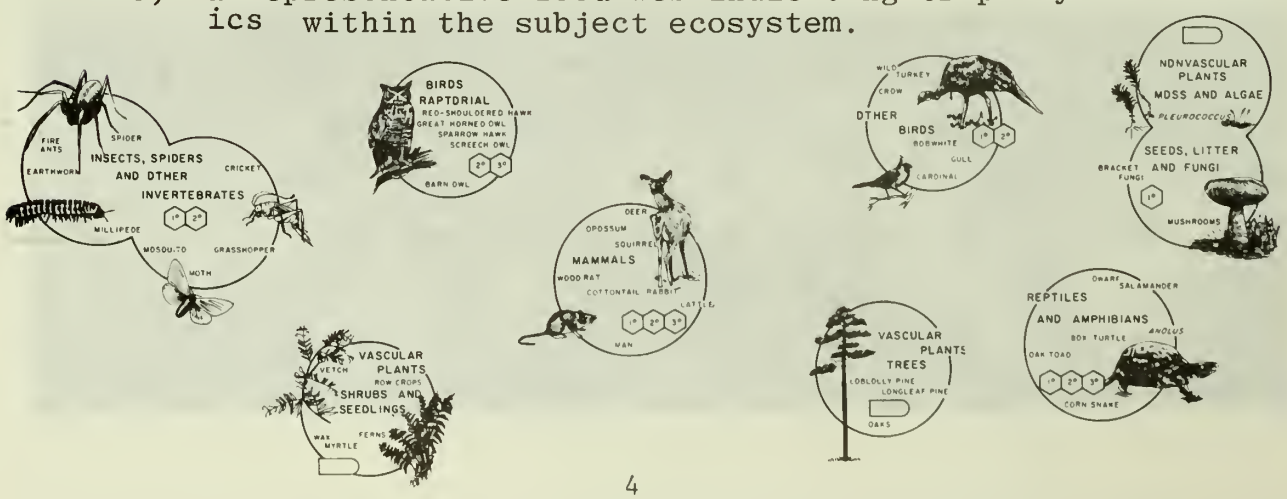
SEA ISLAND ECOLOGICAL CHARACTERIZATION

In February 1977, the U.S. Fish and Wildlife Service contracted with the Marine Resources Division of the South Carolina Wildlife and Marine Resources Department to develop an ecological characterization for the Sea Island Coastal Region of South Carolina and Georgia. The project area includes the coastal tier of counties between the Georgetown/Horry county line in northern South Carolina south to the St. Marys River on the Georgia/Florida border, and the three lowland counties of Dorchester, Berkeley, and Effingham (Figure 1).

The Sea Island Ecological Characterization is designed to yield products that will assist decisionmakers in evaluating and predicting impacts of man-induced perturbations (e.g., oil and gas development, dredging and filling, water resource projects) and, in general, coastal zone planning. The study identifies critical habitats and sensitive life history stages of important species, addresses functional interactions at the habitat level, and provides socioeconomic information relative to the coastal environment.

The overall framework for the preparation of ecological characterization materials is provided by conceptual models. These conceptual models have been modified for inclusion in the final products to facilitate understanding of ecosystem functions. To accommodate the broadest range of potential users, a three-tier model presentation is used and includes the following elements for each ecosystem:

1) a technical energese model demonstrating energy flow into and within the subject ecosystem, functional relationships among representative components of the system, and flow of energy in various forms from the system;
2) a less technical pictorial model of the same ecosystem illustrating representative flora and fauna; and
3) a representative food web indicating trophodynamics within the subject ecosystem.



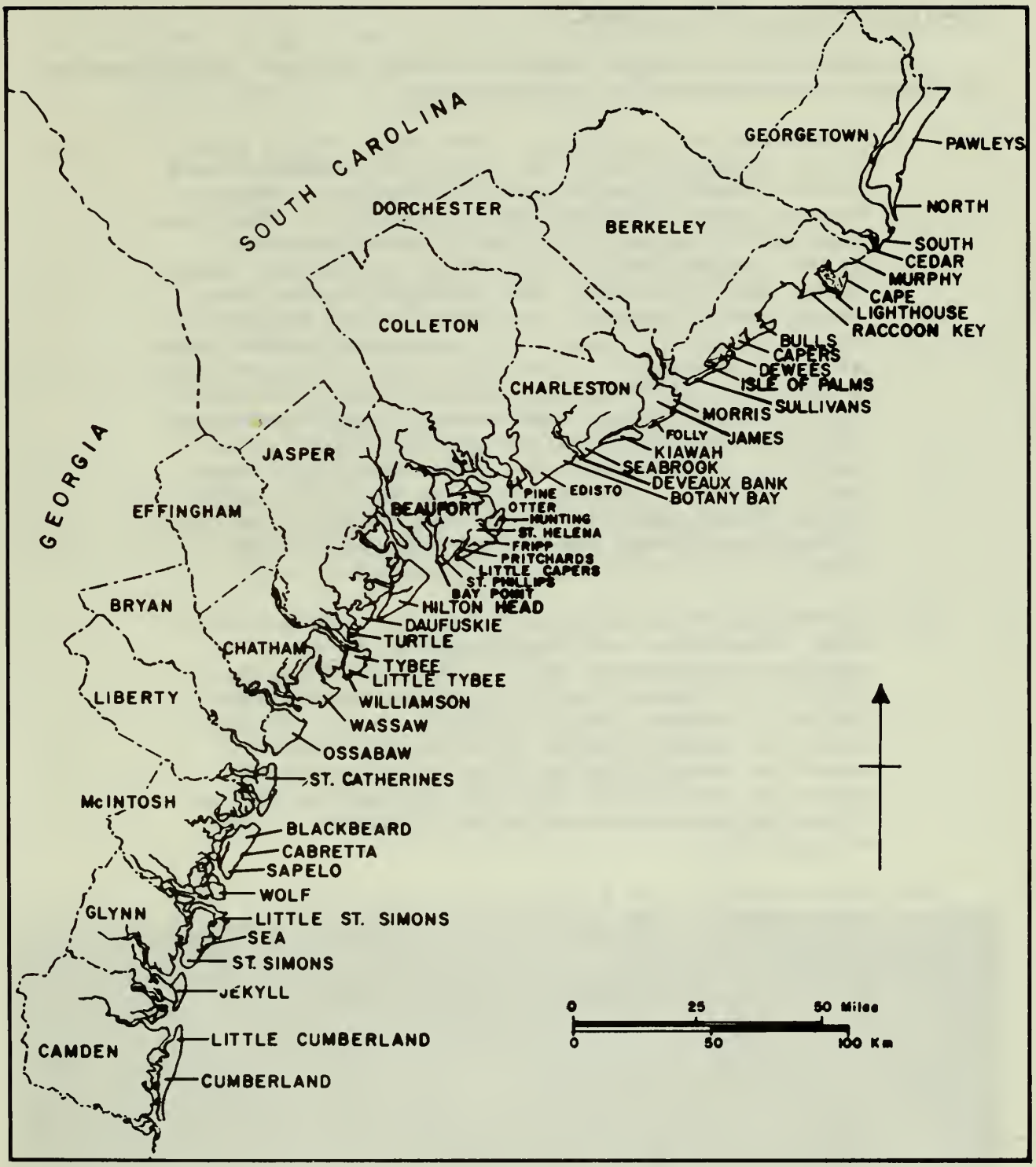


Figure 1. The Sea Island Coastal Region of South Carolina and Georgia.

ORGANIZATION OF FINAL PRODUCTS

Several products were developed from the Sea Island Ecological Characterization effort, as follows:

1) Characterization Atlas - the Atlas is an oversized document (28 x 42 in) that presents data in condensed form in several series at scales ranging from 1:24,000 to 1:1,000,000. The Physiographic Series (1:100,000) describes wetlands, physiographic features, ecological habitats, and land use. The Geology Series presents stratigraphic, structural, and geophysical information about the characterization area at several scales. Two topographic series at 1:250,000 and 1:100,000 depict various wildlife, archeological and recreational resources, military and educational institutions, water quality, spoil disposal, utilities, railroads and airports. Enlargements of the five major urban areas give more detailed information on industries, point source discharges, power plants, etc. All maps are printed in color.

2) Directory of Information Sources - this document identifies and describes major data sources relevant to the ecological characterization of coastal South Carolina and Georgia. The main purpose of the Directory is to guide users to known sources of data pertinent to specific subject areas. It is intended to serve as a referral service between groups or organizations with differing needs and types of expertise.

3) Bibliography - a computerized bibliography of over 8,000 references has been assembled as a central component of the Sea Island Characterization. The system is designed for periodic updating, and all entries can be retrieved in a variety of ways, including key word and author searches.

4) Narrative Volumes - detailed narrative treatment is provided for the three major ecosystem components: the physical, socioeconomic, and biological features of the Sea Island Coastal Region. Because conceptual models are particularly valuable in identifying ecosystem components and in relating their functional significance and regulatory processes, appropriate sections of the narrative text are prefaced by exemplary models. These models serve

as a tool to promote understanding of the functional relationships within and between systems, and the impacts of various impingements and perturbations on their components. Narrative materials are arranged as follows:

a) Physical features - detailed treatment is provided for topical areas such as climate, physiography, geologic history and structure, coastal and nearshore erosion and deposition, hydrology, and descriptions of individual coastal islands of the study area.

b) Socioeconomic features - data are presented on population, labor force characteristics and trends, transportation, industrial development, agricultural practices, public utilities, energy resources, fish and wildlife conservation and utilization, and recreational resources.

c) Biological features - this section describes biotic components along ecological lines. This approach facilitates the treatment of major community or habitat types, and generally deals with organisms at the population level. Functional relationships and areas of ecological sensitivity are stressed.

A summary outlining details of each volume is presented below. This material represents a condensed but descriptive table of contents for the documents.

VOLUME I: PHYSICAL FEATURES OF THE CHARACTERIZATION AREA

Chapter One - Introduction

The material in this volume is written to complement Volumes II and III. Specific geological, physical, geographical, and chemical data are presented to illustrate the current environmental status of the islands, estuaries, and sounds of the Sea Island Coastal Region. Whenever possible, historical data are included for comparison with current data or to illustrate long-term trends. Future plans for development, if available, are also included.

Chapter Two - Regional Geology

This chapter covers the general geology of the Sea Island Coastal Region, ranging from a discussion of the stratigraphy of the area to a description of economic mineral deposits and groundwater. Significant stratigraphic units and structural features are outlined, e.g., Carolina Bays, the Duplin Formation, and the Southeast Georgia Embayment. The following areas are covered in detail:

Stratigraphy
- Mesozoic and Tertiary
- Pleistocene
  - Coastal Terrace Complexes
  - Fluvial Deposits
  - Carolina Bays
- Holocene
  - Santee River Delta
  - Winyah Bay
  - Tybee Island Region
  - Charleston County
  - Snuggedy Swamp, Colleton County
- Regional Structural Geology
  - Major Structural Features
  - Minor Structural Features
  - Geophysics
  - Seismicity
  - Historic Sealevel Changes

(continued)

Economic Mineral Deposits
- Phosphorite
- Limestone
- Sand
- Peat

Groundwater
- Principal Artesian Aquifers
- Mesozoic Sandstone Aquifers
- Saltwater Encroachment
- Economic Value
- Management

Chapter Three - Soils

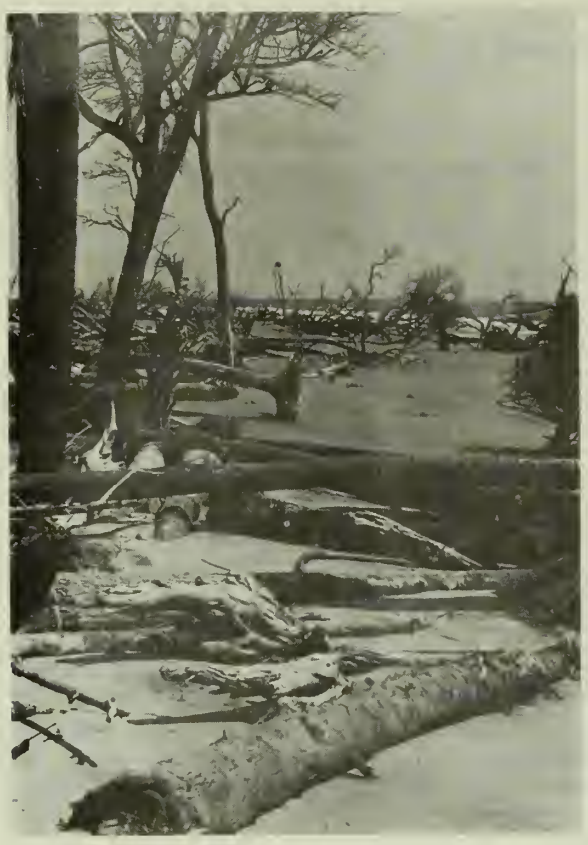
A description of the Pleistocene and Holocene soils of the Region is presented in this chapter. The soils of the mainland, sea islands, and some of the barrier islands were laid down during the Pleistocene period at least 25,000 to 35,000 years ago. Other barrier island soils are of more recent origin, having been laid down during the recent or Holocene period within the last 4,000 to 5,000 years. Marshland soils are also of Holocene origin. Details on soil types are presented in the following sections:

Soils of the Sea Island Coastal Region
- Pleistocene and Holocene Soils
  - Mainland
  - Island
  - Tidal Marsh
- Nutrient Dynamics
- Biological Impacts of Acid Soils

Summary: Use and Management of Soils

Chapter Four - Regional Climatic Trends

A discussion of climatic trends of the Sea Island Coastal Region is presented in this chapter. Historical data are summarized to illustrate trends in winds, minimum and maximum temperatures, and rainfall. Hurricane and tornado statistics are also included, especially data dealing with rates of incidence, general physical characteristics (wind speed, rainfall, and location), and destruction (particularly fatalities). Organization of the material is as follows:



- Temperatures
  - Maxima and Minima
  - Negative Temperature Departures from Normal
- Relative Humidity
- Rainfall
  - Variability
  - Occurrence of Drought Conditions
- Other Precipitation
- Wind Patterns
- Tornadoes
  - Incidence
  - Georgia Tornado Belt
  - Historical Data
- Tropical Cyclones
  - Criteria
  - Early History
  - Occurrence
  - Classification
  - Storm Tides
  - Probability
  - Precipitation
  - Destructive Potential

Chapter Five - Physiography

Chapter Five describes the physiographic features of the Sea Island Coastal Region. In particular, mainland physical features, major river valleys and river systems, estuaries, coastal inlets, and the islands are discussed. Charleston Harbor and Doboy Sound are discussed in detail as respective examples of a highly industrialized environment and a relatively unmodified, pristine area. Physiographic and statistical data

for the 14 counties in the study area are displayed in a number of tables. A brief synopsis of each major river system is also provided. Where available, specific information on sediment transport at tidal inlets is also included. The data are organized as follows:

- Islands
  - Island Types
  - Physiography
    - Sea Islands
    - Barrier Islands
    - Marsh Islands
  - Geologic Factors
  - Barrier Island Formation
    - Proposed Mechanisms
    - Observations from Sea Island Coastal Region
  - Erosion
    - Barrier Islands
    - Marsh Islands
    - Control Measures
- Mainland Physical Features

(continued)

- Major River Valleys
  - Introduction
  - Fluvial Deposits
  - Deltas
  - Pleistocene History
  - Sealevel Change
  - River Valley Dunes
- River System Description
  - Pee Dee
  - Santee-Cooper
  - Edisto-Combahee-Salkehatchie
  - Savannah
  - Ogeechee
  - Altamaha
  - Satilla
  - St. Marys
- Estuaries
  - Definition
  - Classification and Genesis
  - Sedimentation
  - Water Circulation Patterns
  - Charleston Harbor
    - Introduction
    - Size
    - Salinity Distribution
    - Temperature Distribution
    - Bottom Sediment
    - Suspended Sediment
    - Tidal Currents
    - Water Quality
  - Doboy Sound
    - Introduction
    - Size
    - Salinity Distribution
    - Temperature Distribution
    - Suspended Sediment
    - Tidal Currents
    - Alterations
- Coastal Inlets
  - Definition
  - Dynamics
  - Littoral Drift
  - Morphologic Classification
  - Ebb-tidal Deltas
  - Man's Modification

Chapter Six - Summary of Physical and Chemical Alterations

Chapter Six is basically an overview of man's impacts on the Sea Island Coastal Region in terms of physical and chemical environmental alterations and modification. This chapter describes causes of major alteration (e.g., agriculture, urbanization-industrialization, and mining) and presents detailed descriptions of historical dredging data for maintenance of harbors and the Atlantic Intracoastal Waterway. Additionally, the Santee-Cooper Diversion and Rediversion projects are discussed. Effects of man-induced alterations on air quality and water quality are also discussed. The chapter is organized as follows:

Natural Alteration
Man-induced Alteration
    Causes
      Agriculture
      Urbanization and Industrialization
      Mining

(continued)

- Dredging and Filling - Navigation Projects
  - Atlantic Intracoastal Waterway
  - Georgetown Harbor-Winyah Bay
  - Charleston Harbor
  - Port Royal Harbor
  - Savannah Harbor
  - Brunswick Harbor
  - Kings Bay-St. Marys Entrance
- Santee-Cooper Diversion and Rediversion

Effects

- Air Quality
- Water Quality
  - South Carolina River Basins
  - Georgia River Basins
- Solid Wastes

VOLUME II: SOCIOECONOMIC FEATURES OF THE CHARACTERIZATION AREA

There are a number of socioeconomic changes occurring simultaneously in the Sea Island Coastal Region of South Carolina and Georgia. Although it is difficult to isolate the effects of any single changing force, it is likely that they are all closely interrelated in producing new demands on natural resources of the study area. Of particular importance to the socioeconomic base of the coastal area is the fact that individuals, populations, and communities are not static entities; they change in direction, influenced, at least partly, by their history and environment.

The purpose of this volume is to present a comprehensive characterization of the human use environment of the Sea Island Coastal Region. This is a companion text to the physical and biological characterizations. Development of accurate ecological studies requires superimposing activities of man on the natural bio-physical environment. The information provided in this volume should be useful to public decisionmakers, planners, field biologists, and other citizens in formulating coastal resource management strategies.

Basically, the Sea Island Coastal Region of South Carolina and Georgia has developed over the last three centuries into an ecosystem that is strongly influenced by three major components: 1) agriculture, 2) urbanization, and 3) natural factors. All of these components function as systems and are interrelated through a flow of energy in the Sea Island regional ecosystem. The natural system, composed of the seven major ecosystems identified in Volume III of this study and a combination of energy sources, directly influences the agricultural and urban systems through a flow of natural resources, i.e., land, water, and oxygen. Natural resources are needed by the socioeconomic environment for nutrient exchange, biological diversity, habitat maintenance, wildlife productivity, and environmental quality. Once altered, the natural system ceases to function as a total system and the effects are transferred to the socioeconomic environment.

Following a general introduction in Chapter One, Chapter Two introduces the study area through an historical account of major events leading to socioeconomic development of the Sea Island Coastal Region. Major emphasis is placed on events, especially earlier ones, that have shaped the destiny of the region. They are presented as follows:

Prehistoric Occupation
- Paleo-Indians - 10,000 B.C. to 6000 B.C.
- Archaic Period - 6000 B.C. to 2000 B.C.
- Woodland Period - 2000 B.C. to 1000 A.D.
- Mississippian Period - 1000 A.D. to European Contact

(continued)

- Historic Contacts
  - Extinction of Coastal Tribes
  - The Europeans - Historic Occupation
    - Exploration and Early Settlement
    - Beginning of Agriculture
    - Rice Production
    - Rise and Fall of Local Rice Mills
    - Summer Villages
    - Storms
    - Game Preserves
- Archaeological Considerations
- Historic Landmarks

Chapter Three - Demographic, Economic and Social Changes

Chapter Three describes and quantifies population, employment, income, and industrial characteristics of the study area. Critical demographic factors such as population trends are discussed in this chapter. Also included are employment trends that contribute to an understanding of the economic structure of the study area. The sections on income characteristics provide a yardstick for measuring the past growth and future potential of the study area. Income is one of the more comprehensive measures of economic activity that can be compared on a regional basis. Industrial development is another economic indicator that can be used in appraising long-range regional trends. Data in this chapter are organized in the following manner:

- Demographic Characteristics of the Sea Island Coastal Region
  - Population Size and Growth
  - Urban and Rural Population Trends
  - Racial Population Trends
  - Projections of Population
- Economic Characteristics of the Sea Island Coastal Region
  - Income Distribution
  - Employment Trends
    - Employment
    - Unemployment
    - Employment Projections
- Major Business Activities
  - Agriculture
  - Coastal Fisheries
  - Forestry
  - Industry and Government

Chapter Four - Energy Resources

This chapter presents a descriptive analysis of energy resources of the study area. This section is pertinent to the characterization, since Outer Continental Shelf (OCS) development has been a major focus of the nation's search for energy. OCS oil and gas production has many influences on the coastal economy, generating new jobs, new tax revenues, new Federal funds, new costs and taxes, and new environmental risks. For many industries and all levels of government, OCS development requires decisionmaking. Information is presented as follows:

Conventional Energy Resources
- South Carolina Production and Projected Development
- Georgia Production and Projected Development
- Regional Development

Nuclear Energy Resources

Solar Energy Resources

Oil and Gas Resources
- Effects of Offshore Oil and Gas Development
  - Offshore
  - Onshore
- Natural Gas
- Liquefied Natural Gas

Chapter Five - Transportation Systems

Chapter Five deals with transportation systems within the study area. The three major modes of transportation - water, ground, and air transportation - are discussed in terms of their economic significance. Port facilities are of particular interest in this section, since they are a vital link in commercial trade between the study area and a much broader geographic zone. Information is presented as follows:

Waterborne Transportation
- The Port of Georgetown
- The Port of Charleston
- The Port of Savannah
- The Port of Brunswick
- Kings Bay
- Intracoastal Waterway
- Inland Waterways

Roads and Highways

Railroads

Air Carriers

Pipelines

Chapter Six - Agriculture Development

In this chapter, the authors have described the development of agriculture in the study area. Modern agricultural systems, no less than urban systems, may be regarded as artificial ecosystems that continue to function only as a result of extensive human manipulation. In this chapter, trends are shown from the traditional paleotechnic agricultural system, in which human and animal labor predominated, to modern neotechnic systems of agriculture where technology is the dominant force of production. The section on land use trends and their effects on the coastal environment is particularly applicable to coastal resource planning needs. The data are presented as follows:

```
Historical Trends
    Naval Stores
    Cotton
    Rice
Present Agriculture Practices
    Changes in Farms and Farmland Use
    Changes in Crop Acreage by Crop Type
    Changes in Value of Farm Products Sold
    Forest Land
      Forest Acreage and Production
      Timber Trends
      Timber Products Output
Factors Affecting Agricultural Land Use Change
    Decline of Cotton
    Soil Bank
    Land Quality
    Urbanization
```

Chapter Seven - Coastal Fisheries Conservation and Utilization

Chapter Seven presents a discussion on coastal fisheries conservation and utilization. General historical trends are emphasized throughout this section. Various segments of the fishing industry (e.g., shrimp, blue crab, and finfish fisheries) are discussed in detail. Descriptions of the fisheries resource base, the harvesting sectors, marketing, economic, and conservation factors are also related to the coastal economy. The chapter is organized as follows:

```
Commercial Fisheries
    Overview of the Fisheries
      General Historical Trends
      General Characterization of the
       Seafood Industry
```

(continued)

(continued)

Chapter Eight - Wildlife Conservation and Utilization

This chapter discusses wildlife conservation and utilization in the coastal region. A detailed discussion of the waterfowl and upland game resources is presented. Special emphasis is placed upon hunter participation, hunter success, conservation practices, and the role of wildlife in the coastal economy. This chapter not only presents biological species accounts, but also describes historical perspectives, habitat management procedures and resource use. It is organized as follows:

- Waterfowl Resources
  - Waterfowl Species Accounts
  - Coastal Waterfowl Habitats
    - Historical Perspectives
    - Waterfowl Habitat Under Private Control
    - Waterfowl Habitat Under Federal Control
  - Waterfowl Habitat Management Procedures
  - Economic Considerations of Waterfowl Management
  - Waterfowl Population Characterization
  - Waterfowl Resource Utilization
    - Harvest Characteristics
    - Hunter Participation
- Upland Game Resources
  - Hunting
    - White-tailed Deer
    - Mourning Dove
    - Bobwhite Quail
    - Squirrels
    - Rabbits
    - Raccoon
    - Wild Turkey
    - Feral Hog
  - Trapping
    - Terrestrial Furbearers
      - Opossum
      - Raccoon
      - Foxes
      - Bobcat
    - Aquatic and Semi-aquatic Furbearers
      - Mink
      - Otter
      - Muskrat
      - Beaver

Chapter Nine - Recreation

Chapter Nine addresses coastal recreation and its impact on the region's economy. As reflected throughout this chapter, recreation is one of the most important industries in the study area. Recreational activities in the Sea Island Coastal Region can be expected to increase with consumer trends toward water-based leisure. Data presented in this chapter are organized as follows:

- Tourism
- National Parks, Monuments, and Seashore
- National Forest
- National Wildlife Refuges
- State Parks
- State Wildlife Refuges and Game Management Areas
- Beaches and Public Access
- Camping
- Boating
- Coastal Area River Recreation

VOLUME III - BIOLOGICAL FEATURES OF THE SEA ISLAND COASTAL REGION

Volume III is organized around the seven major ecosystems found in the Sea Island Coastal Region: coastal marine, maritime, estuarine, riverine, lacustrine, palustrine, and upland. This volume emphasizes functional relationships among flora, fauna, and the physical components of their environment, as well as ecosystem dynamics and areas of ecological sensitivity. Each ecosystem and subsystem is defined and described, a generalized food web is presented, and trophic relationships are discussed. Dynamics and interrelationships of representative producer, consumer, and decomposer species are treated in detail.

Chapter One

The first chapter discusses major principles pertaining to all ecosystems (e.g., energy, matter, diversity, ecosystem stability and resilience, and biogeochemical cycles), defines the seven major ecosystems of the region, introduces the concept of ecosystem modelling, and highlights endangered and threatened species of the characterization area. It also explains that this ecological characterization was conducted at the "macroecosystem" level, and that it is organized along both structural (i.e., component) and functional (i.e., process) lines. The following topics are treated in detail in Chapter One:

Ecosystem Definition
Major Principles Pertaining to Ecosystems
Biogeochemical Cycles
Ecosystems of the Sea Island Coastal Region
Ecosystem Models
Endangered Species

Chapters Two through Six

These chapters discuss the seven major ecosystems found in the Sea Island Coastal Region. Each ecosystem chapter is introduced, in part, by a three-tier model presentation designed to convey ecosystem components and relationships to users having different levels of expertise in ecological modelling. This model package includes: 1) a technical energese model demonstrating energy flow into and within the subject ecosystem, functional relationships among representative components of the system, and

energy flow from the system (Figure 2); 2) a less technical pictorial model of the same ecosystem illustrating representative flora and fauna (Figure 3); and 3) a representative food web indicating trophic relationships within the subject ecosystem (Figure 4).

Each ecosystem chapter follows the same basic presentation format. The chapter is introduced with a definition and general description of the ecosystem and subsystems in question, followed by a discussion of the three-tier ecosystem models and food web relationships. Composition, dynamics, and interrelationships of representative producer, consumer, and decomposer species are then treated in detail by subsystem. A composite outline for Chapters Two through Six follows:

- Major Ecosystem Characteristics
  - Definition
  - General Description and Model
  - Generalized Food Web and Relationships
- Subsystem A
  - Description
  - Producers
    - Nonvascular Flora
    - Vascular Flora
  - Consumers
    - Invertebrates
    - Fishes
    - Amphibians and Reptiles
    - Birds
    - Mammals
  - Decomposers
- Subsystem B
  - Description
  - Producers
    - Nonvascular Flora
    - Vascular Flora
  - Consumers
    - Invertebrates
    - Fishes
    - Amphibians and Reptiles
    - Birds
    - Mammals

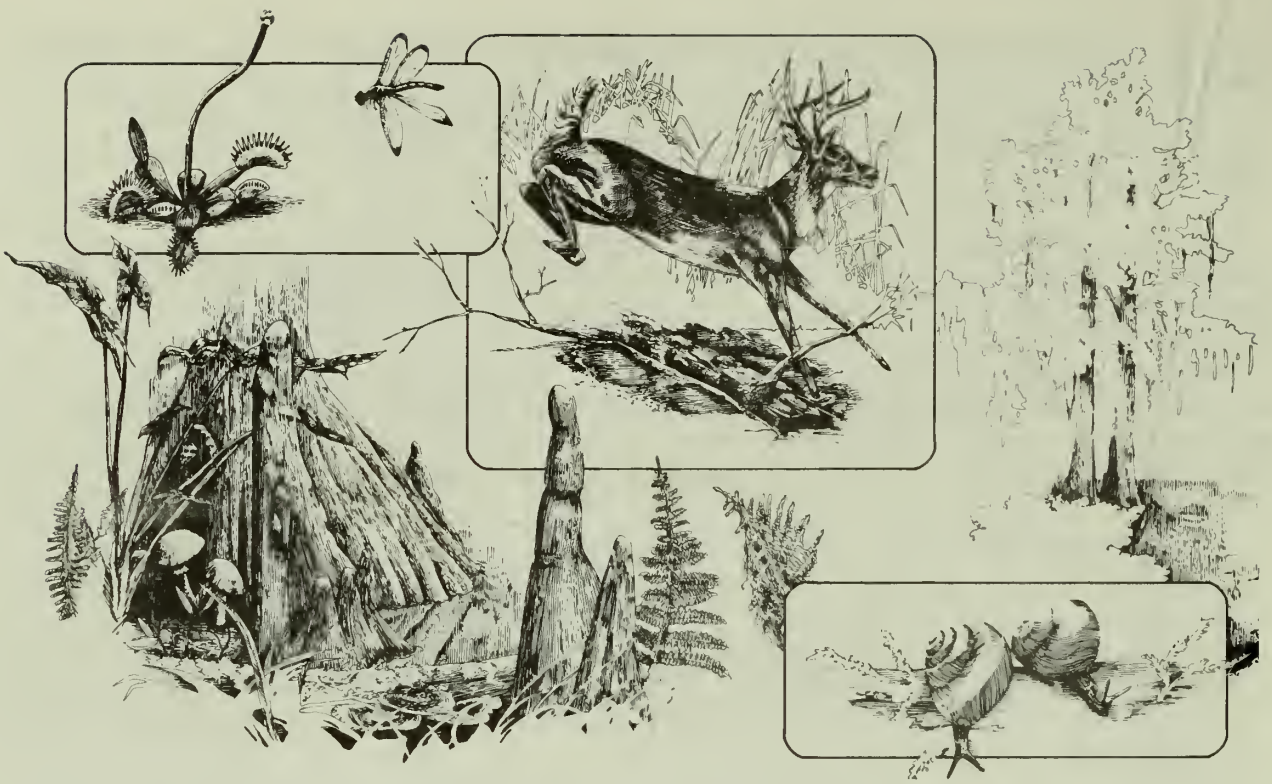


Figure 2. A representative energese model (palustrine ecosystem) from the Sea Island Ecological Characterization.

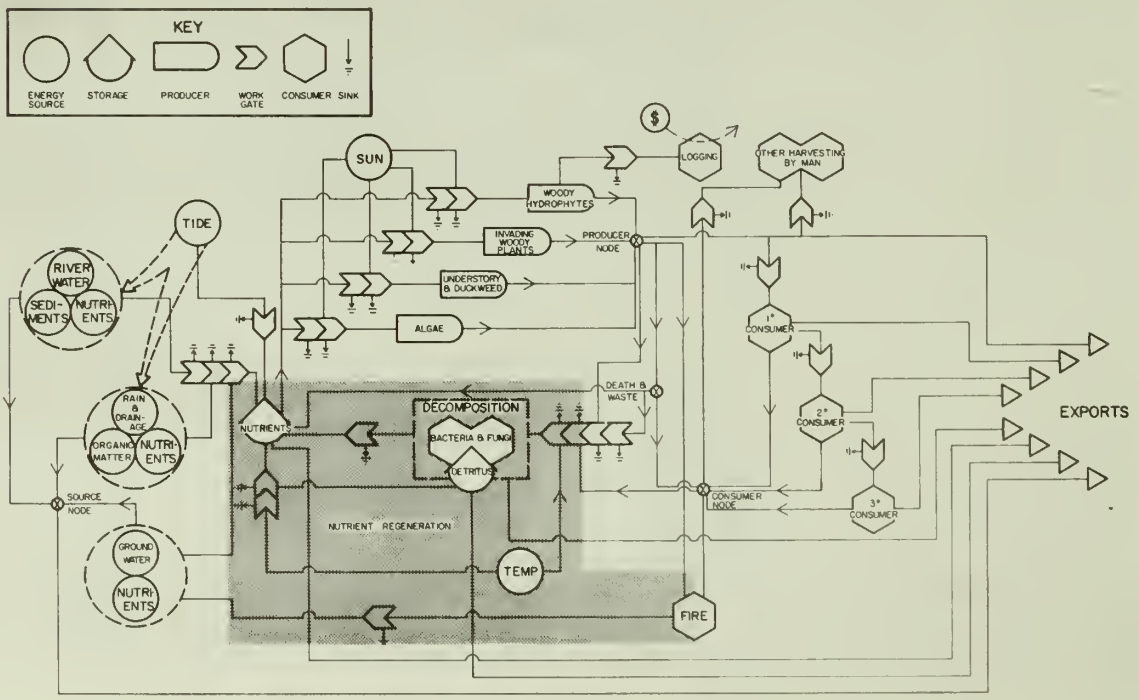


Figure 3. A representative pictorial model (palustrine ecosystem) from the Sea Island Ecological Characterization.

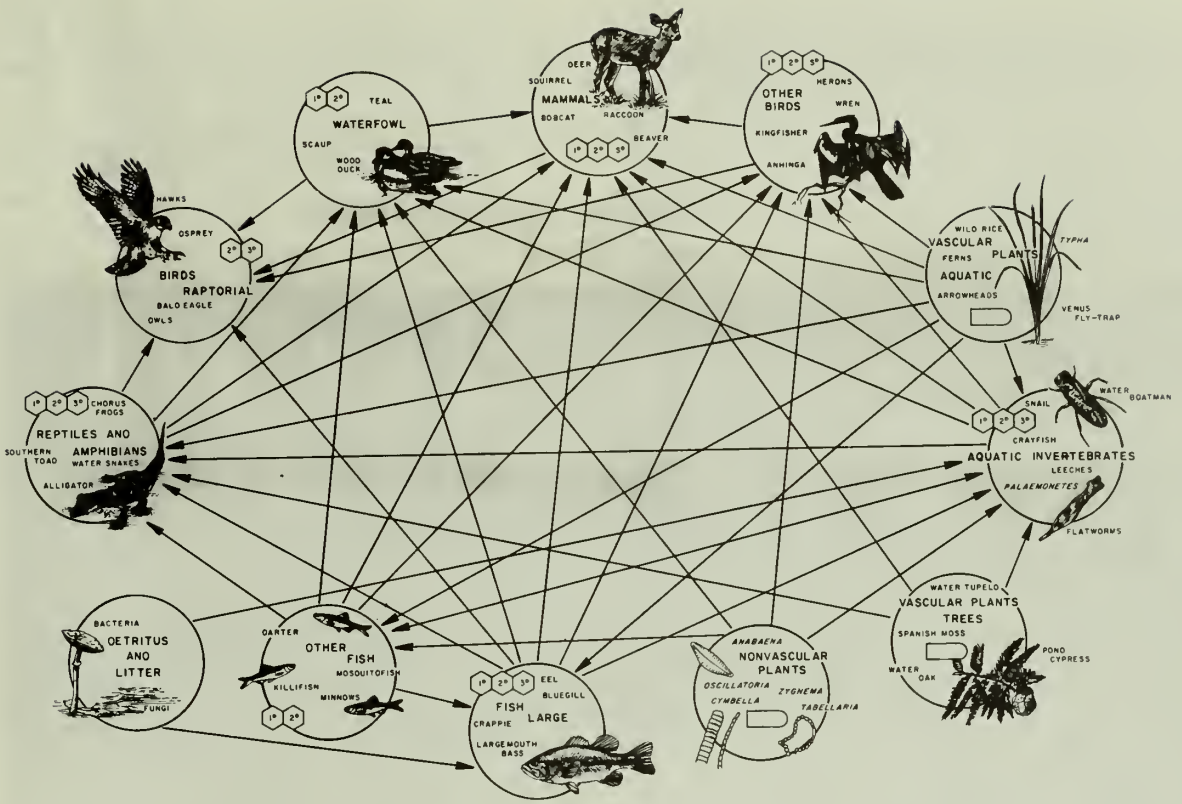


Figure 4. A representative food web (palustrine ecosystem) from the Sea Island Ecological Characterization.

Based partly on the wetland classification scheme of Cowardin et al. (1977, 1979), the seven ecosystems found in the Sea Island Coastal Region are described as follows:

Coastal Marine Ecosystem. For this characterization, the seaward limit of the coastal marine ecosystem is defined as the outer boundary of the 3-mile territorial sea. The inland boundary extends to either: (1) the landward limit of tidal inundation, including the splash zone from breaking waves; (2) the seaward limit of wetland emergents, trees, or shrubs; or (3) the seaward limit of the estuarine ecosystem where this limit is determined by factors other than vegetation.

The coastal marine ecosystem is divided into two subsystems, the subtidal and the intertidal. The subtidal subsystem consists of coastal waters extending seaward of the extreme low spring tide level, with salinities generally exceeding 30 °/oo, and the substrate is continuously submerged. The intertidal subsystem consists of tidal beaches and bars that are exposed and flooded by tides, and includes the associated splash zone.

The coastal marine ecosystem, then, consists of the open ocean and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean, and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 °/oo, with little or no dilution except near the mouths of estuaries.

Maritime Ecosystem. The maritime ecosystem is defined as all upland areas located on barrier islands (islands bordered on one side by tidal marshes, creeks, and/or rivers and on another side by an active oceanformed beach). Components of this system are influenced to varying degrees by salt water.

Four subsystems are recognized within the maritime ecosystem, each differentiated from the others primarily by physical features and vegetative communities. The bird key and bank subsystem consists of small, isolated sand spits and bars usually found in tidal inlets and bays; they exhibit low topographic profiles and are frequently subject to overwash by spring tides and

storm action. The maritime dune subsystem consists of a variety of dunes ranging from low, sprawling dune fields to high, well-developed dunes. The transition shrub subsystem is a dense but generally narrow ecotonal band between the dune community and the maritime forest; its location depends on salt spray intensity and the physical features of the island. The maritime forest subsystem is that zone of forest vegetation located between the seaward and landward transition shrub communities on barrier islands, and represents the ecological climax of vegetative succession on those islands.

Estuarine Ecosystem. The estuarine ecosystem extends upstream and landward to the place where ocean-derived salts measure less than 0.5 $^{0}/_{00}$ during the period of average annual low flow. The seaward limit of the estuarine ecosystem is (1) an imaginary line closing the mouth of a river, bay, or sound, or (2) the seaward limit of wetland emergents, shrubs, or trees where these plants grow seaward of the imaginary line described above.

The estuarine ecosystem is divided into two subsystems, the subtidal and the intertidal. Open water sounds, bays, tidal rivers, and tidal streams having salinities greater than 0.5 $^{0}/_{0}$ comprise the subtidal subsystem; the substrate is continuously submerged. The intertidal subsystem includes those areas where the substrate is exposed and flooded by tides (e.g., marshes, bars, flats, oyster rocks, etc.), and includes the associated splash zone.

The estuarine ecosystem, then, consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. At times, evaporation may increase the salinity above that of the open ocean. Estuaries are influenced more by terrestrial processes than is the contiguous coastal marine ecosystem.

Riverine Ecosystem. The riverine ecosystem includes all wetlands and deepwater habitats contained within a channel, except for: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and (2) habitats with waters containing ocean-derived salts in excess of 0.5 °/oo. A channel, as defined here, may be natural or artificial, but must contain either periodically or continually moving water, or form a connecting link between two bodies of standing water. The riverine system is bounded on the landward side by upland, by the channel bank, or by wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. It terminates at the downstream end where ocean-derived salts in the water exceed 0.5 °/oo during the period of average annual low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake.

Within the Sea Island Coastal Region, the riverine ecosystem is divided into three subsystems, each defined in terms of water permanence, gradient, water velocity, substrate, and extent of floodplain development. The tidal subsystem is characterized by water velocity fluctuating under tidal influence, a low gradient, a streambed composed mainly of mud, occasional oxygen deficits, and a well-developed floodplain. The lower perennial subsystem has nontidal flowing water throughout the year, low flow velocities, a substrate of sand and mud, occasional oxygen deficits, a fauna dominated by still-water and planktonic forms, a low gradient, and a well-developed floodplain. The intermittent subsystem has flowing water within its banks for only part of the year; the remainder of the time, channels may be dry or have water present only in isolated pools. A fourth subsystem, the upper perennial, does not occur in the characterization area.

Lacustrine Ecosystem. The lacustrine ecosystem includes wetlands and deepwater habitats having all of the following characteristics: (1) situated in a topographic depression or a

dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30% areal coverage; and (3) greater than 8 hectares (20 acres) in size. Wetlands smaller than 8 hectares are included in the lacustrine ecosystem if they have an active wave-formed or bedrock shoreline and if maximum water depth at low water is greater than 2 m (6.6 ft.). Lacustrine waters may be tidal or nontidal, but salinity is always less than 0.5 °/oo.

The lacustrine ecosystem, then, includes permanently flooded lakes and reservoirs, tidal lakes, oxbow lakes, and intermittent lakes. This ecosystem type is represented best in the Sea Island Coastal Region by reservoirs and oxbow lakes. Such systems typically exhibit large areas of deep water and much wave action, and frequently may encompass islands of palustrine wetlands.

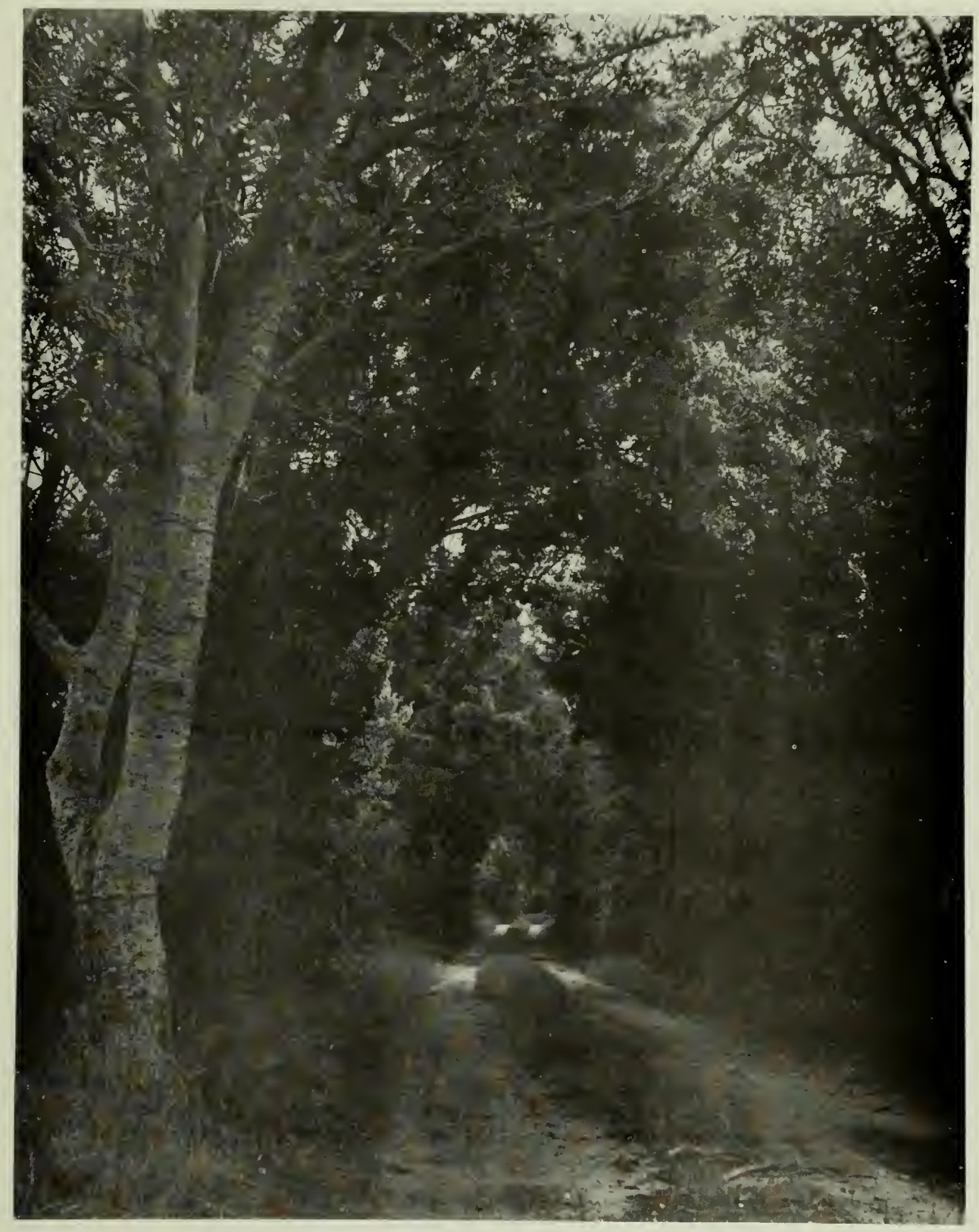
The lacustrine ecosystem is composed of two subsystems, the littoral and the limnetic. The littoral subsystem extends from the shoreward boundary of the system to a depth of 2 m (6.6 ft.) at low water, or to the maximum extent of nonpersistent emergents if they grow at depths greater than 2 m. The limnetic subsystem includes all habitats below a water depth of 2 m (6.6 ft.) or beyond the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 m.

Palustrine Ecosystem. This ecosystem includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 °/oo. It also includes wetlands lacking such vegetation, but having all of the following characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of the basin less than 2 m (6.6 ft.) at low water; and (4) salinity due to ocean-derived salts less than 0.5 °/oo. The palustrine ecosystem can be bounded by upland or by any of the other four aquatic ecosystems.

The palustrine ecosystem includes swamps, marshes, floodplains, savannahs, and other extensively vegetated wetlands of the Sea Island Coastal Region. In fact, all wetlands not falling into the marine, estuarine, riverine, or lacustrine systems are considered palustrine. Such environments often occur adjacent to lacustrine, riverine, or estuarine areas and may appear to grade into these systems. No subsystems are assigned to the palustrine ecosystem.

Upland Ecosystem. Uplands include all lands that are not part of the five previously described wetlands systems. We have divided uplands of the Sea Island Coastal Region into two distinct ecosystems: (1) a maritime ecosystem, defined as all upland areas located on barrier islands; and (2) an upland ecosystem, comprising all non-maritime upland areas, that is, all upland areas except those on barrier islands. The maritime ecosystem was previously described.

Following the logic of Cowardin et al. (1977, 1979), the upland ecosystem can be defined as those areas not classified as wetlands or aquatic systems and that are characterized by the water table not being at, near, or above the land surface for sufficient time each year to promote the formation of hydric soils and the growth of hydrophytes as the dominant plant type. Soils of the upland ecosystem, then, would be predominantly non-hydric, and the vegetation would be predominantly mesophytic or xerophytic rather than hydrophytic. In addition, uplands are further characterized as lands that are never flooded during years of normal percipitation.



Biological components of these seven ecosystems are extremely diverse and complex. Dynamics and functional relationships between biotic elements of these ecosystems are too complex to be summarized here. Distribution and relative abundance of floral and faunal species representative of the Sea Island Coastal Region, however, are presented here by ecosystem and subsystem in order to further characterize these systems. Table 1 summarizes the distribution and relative abuandance of representative plants of the Sea Island Coastal Region, while Table 2, 3, 4, 5, 6, and 7 summarize the same type of information for invertebrates, fishes, amphibians, reptiles, birds, and mammals, respectively.

The distribution and relative abundance tables are designed to serve two purposes. First, an ecosystem or subsystem can be characterized by reading down the tables to determine what types of plant and animal species live in the system, and in what relative abundance. And, second, by reading across the table, one can learn what types of habitats a given species is likely to frequent, thereby revealing quite a bit about the habitat requirements and potential limiting factors of that species. Since the published literature is incomplete regarding the distribution and relative abundance of plants and animals of the Sea Island Coastal Region, this information was supplemented by the authors' field experiences and by those of select local experts (see acknowledgements section). The reader should bear in mind, however, that these are summary tables and, as such, are necessarily generalized and somewhat simplified. The reader is referred to the Sea Island Characterization text and to the published literature for detailed information on these species and their habitats, interactions, and dynamics.

Table 1. Distribution and relative abundance of representative vegetation by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).

SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Arrow-arum					1	3	2		2	2	2								
Black needlerush					2							1			2				
Cat-tails					1		1					2							
Frog's-bit					2		1		2	2	2								
Giant cordgrass					3							1							
Glassworts												1					2		
Horseweed															3	2	3		
Pickerelweed					1	2	2		1	1	1								
Saltmeadow cordgrass												1			3	1	1		
Sea oats																1	2		
Sea ox-eye												1			1				
Smooth cordgrass												1					1		
Soft-stem bulrush					1							1							
Three awn grass	2	2	2	1		2								1	1	1			
White water lily					2		1	3	2	2	2	3							

Table 1. (continued)

SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Phytoplankton					2	2	2	2	2	2	1	1	1					2	1
Macroscopic algae					2	2	2	2	3	3	2	2	2					2	2
Bald cypress					2	1	2	3	3										
Cabbage palmetto		2												1					
Laural oak	2	1	3			1								1					
Live oak	1	1												1	2	2			
Loblolly pine	1	2	1			2								1	3				
Longleaf pine	3		1			1								2					
Pignut hickory		1				2								3					
Red bay	2	3				1								2	2	2			
Red maple	2	1	3			1			3										
Sweet gum	1	1	3		3	1								2					
Wax myrtle	2	2	1		3	2	2					3		2	1				
Yaupon holly	2	3	3											1	1	2			
Alligator-weed					2		2	2	2	1	1	3							

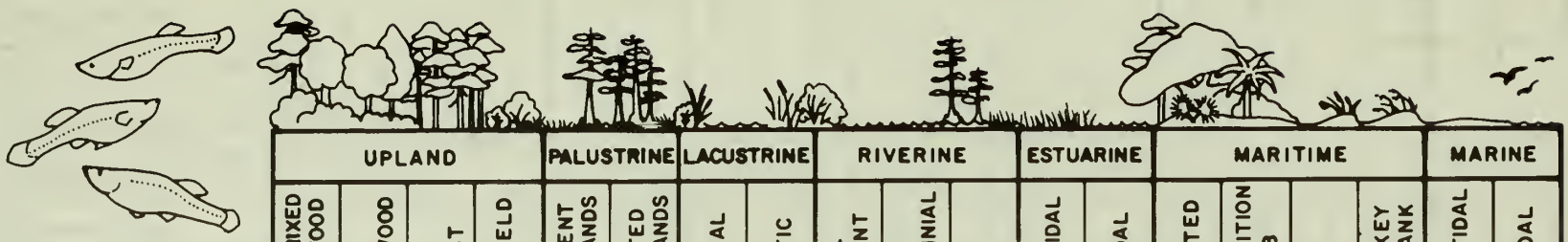
Table 2. Distribution and relative abundance of representative invertebrates by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).

SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
MARSH PERIWINKLE *Littorina irrorata*												1						1	
AMERICAN OYSTER *Crassostrea virginica*												1	2						
ASIATIC CLAM *Corbicula manilensis*							2	2	3	2	2								
HARD CLAM *Mercenaria mercenaria*												2	1					2	
EARTHWORMS *Lumbricus spp.*	1	1	1	1		2								1	1				
Springtail *Anurida maritima*												2						2	
WATER BEATLE *Haliplus triopsis*					2	2	2	2	2	2	2								
DRAGONFLIES *Odonata spp.*					2	2	2	2	2	2	2	2	2						
FIRE ANT *Solenopsis sacrissima*			3	1											3				
SALT MARSH MOSQUITO *Aedes spp.*												1		2	2	1	2	1	
GNATS *Culicoides spp.*	2	2	2	2	2	2			2	2		1		1	1	2	2		
WHITE SHRIMP *Penaeus setiferus*													1						1
BLUE CRAB *Callinectes sapidus*													1						1
GHOST CRAB *Ocypode quadrata*																2		2	
ZOOPLANKTON					2		2	2	2	1	1		1						1

Table 3. Distribution and relative abundance of representative fishes by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).

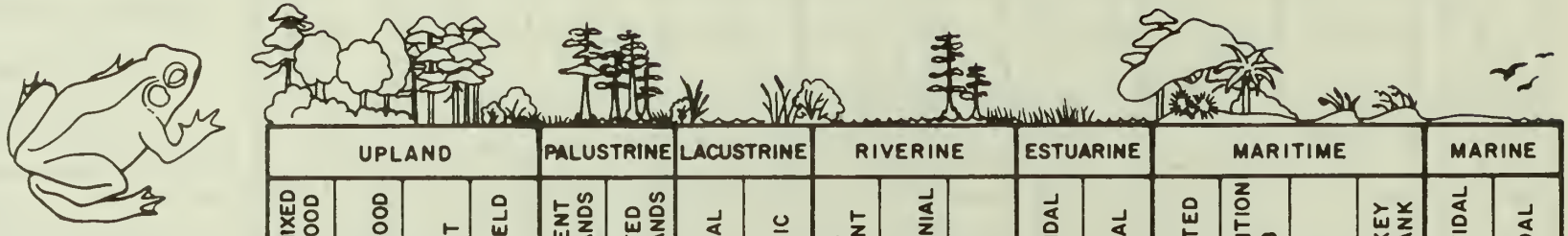
SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTERMITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Spiny dogfish													2					3	1
Longnose gar					3	3	1	2	3	1	1	2	2						3
Bowfin					1	1	1	2	3	2	2								
Atlantic menhaden												2	1					3	1
Gizzard shad					3	3	2	1	3	1	1								
Bay anchovy												1	1					1	2
Chain pickerel					1	1	1	3	3	3	3								
Carp					1	1	1	2	2	1	1								
Cypress minnow					1	1	3	3	3	3	3								
Silvery minnow					3	3	1	2	3	3	3								
Spotted sucker					1	1	2	2	2	1	1								
Flathead catfish					2	2	3	3	2	1	1								
White catfish					1	1	1	1	2	1	1	3	2						
Yellow bullhead					1	2	1	1	2	1	1								
Sea catfish												1	1					3	1

Table 3. (continued)



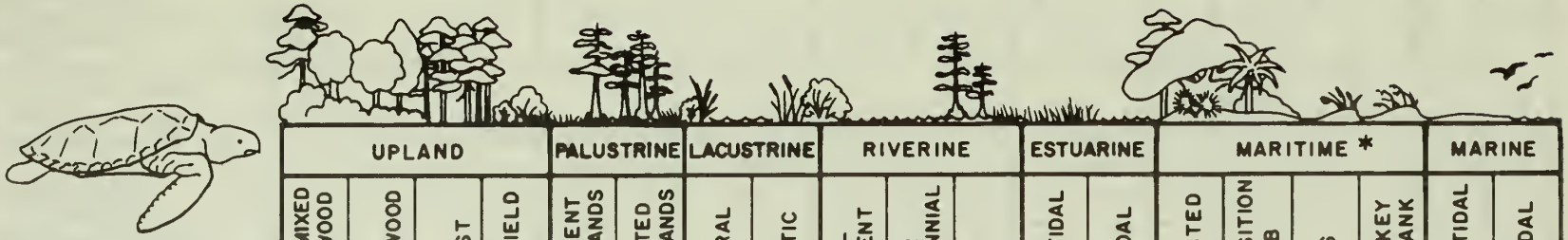
SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Starhead topminnow					1	1	1	3	2	3	3								
Striped killifish												2	3					1	3
Mosquitofish					1	1	1	2	1	2	2	3	3						
Black sea bass																			2
Banded pygmy sunfish					1	2	1	3	3	3	3								
Bluegill					1	1	1	2	2	1	2								
Green sunfish					1	2	1	2	1	1	1								
Largemouth bass					1	1	1	1	3	1	1								
Atlantic croaker												2	1					3	1
Spot												2	2					2	2
Star drum												2	1					3	1
Weakfish												2	1					3	3
Striped mullet										3	2	1	1					1	2
Spanish mackerel												3	3					3	1
Southern flounder											2	1	1					3	2

Table 4. Distribution and relative abundance of representative amphibians by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).



	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Greater siren					2	2	2	2	3	2	2								
Two-toed amphiuma					2	2	2	3	3	2	2								
Central newt	3	2	3		2	2	2							3					
Slimy salamander	1	1	2	3	3	2								3	3				
Southern dusky salamander	2	2	2	3	3	2	3		3					3					
Spotted salamander	2	2	3		3	2	3		3										
Eastern narrowmouth toad	2	1	2	3	1	1	2		3	3	3	3		3	3	3			
Eastern spadefoot toad	3	3	3	3	3	3	3		3	3	3			3	3	3			
Oak toad	2	3	2	3	2	2	3		3	3	3			3					
Southern toad	1	1	1	2	1	1	2		3	3	3	3		3	3	3			
Bullfrog					1	1	1		2	2	2								
Southern cricket frog	2	2	2	2	1	1	2		2	2	2	3		3	3				
Southern leopard frog	3	3	3	3	1	1	1		2	2	2	2		3	3				
Green treefrog	1	1	2	3	1	1	2		2	2	2	3		2	2				
Squirrel treefrog	1	1	1	3	1	1	2		2	2	2	3		2	2				

Table 5. Distribution and relative abundance of representative reptiles by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).



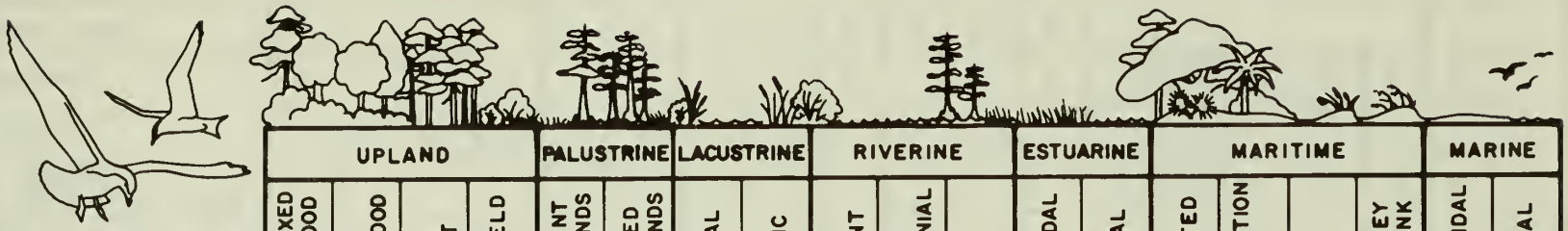
	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME *				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTERMITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Atlantic loggerhead turtle													3			3	3	3	2
Carolina diamondback terrapin												2	2				3		1
Common snapping turtle					2	2	2	2	3	2	2	3							
Eastern box turtle	1	1	2	3	3	3								2	3				
Yellowbelly slider					2	2	2	2	3	2	2								
Broadhead skink	2	2	2	2	3	1								3	3				
Eastern glass lizard	2	2	3	2										2	2	3			
Green anole	2	2	2	1	3	2								2	2				
Broad-banded water snake					2	2	2	3	3	3	3	3							
Cottonmouth					2	2	2	3	2	2	2	3		2					
Eastern diamondback rattlesnake	2	3	2	3	3	3								3	2	2			
Eastern kingsnake	2	2	2	2	3	2								2	3				
Southern black racer	2	2	1	2	3	3								2	2	3			
Yellow rat snake	2	1	2	2	3	3								2	2				
American alligator					2	2	2	3	2	2	2	2	2						

* WHEN PRESENT

Table 6. Distribution and relative abundance of representative birds by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).

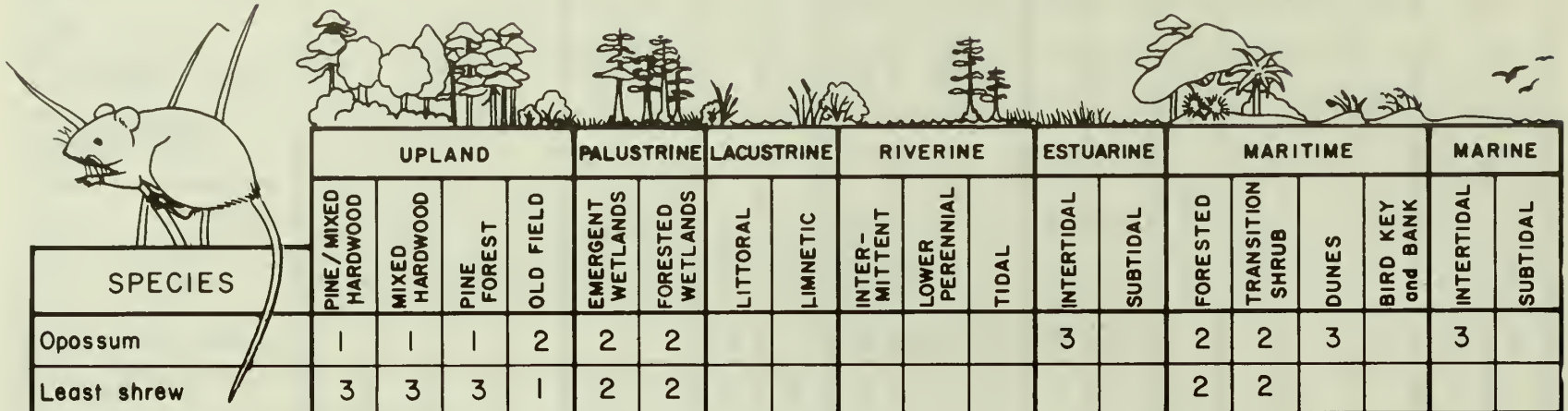
SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Eastern brown pelican									2	2	2	2	2				2	2	2
Anhinga					2	2	2	2	2	2	3								
Great blue heron					2	2	2	2	2	2	2	2							
Snowy egret					2	2	2	2	2	2		2						3	
White ibis					2	2			2	2	2	2							
Mallard					3	2			2	2	2	3							
Black duck					3	3			2	2	2	2							
Blue-winged teal					3				2	2	2	2					3		
American wigeon					3				2	2	3	2							
Wood duck					2	1			2	2	2								
Swallow-tailed kite					2	2			2	2									
Red-tailed hawk	3	2	2	2										2	3				
Bald eagle	3					2	2	2	2	2	2								
Marsh hawk				3	2					2		2				3			
Osprey							3		2	2	2	2	2						

Table 6. (continued)



SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Bobwhite	1	3	2	1															
Clapper rail										3		1							
American woodcock	2	3		2										2					
Herring gull							1	1	1	1	1	1	1					1	1
Ring-billed gull							1	1	1	1	1	1	1					1	1
Laughing gull							1	1	1	1	1	1	1					1	1
Royal tern							3		3	3	2	2	2					2	2
Mourning dove	2		2	2										2	2	2			
Belted kingfisher					2	2	2	2	2	2	2	2							
Pileated woodpecker	2	2	3			2								2					
Red-cockaded woodpecker			2																
Prothonotary warbler						2			2										
Pine warbler	2		2											3					
Red-winged blackbird		2		2	2				2	2		2		2	2	2			
Seaside sparrow										2		2			3	3			

Table 7. Distribution and relative abundance of representative mammals by ecosystem and subsystem in the Sea Island Coastal Region (1=abundant; 2=common; 3=occasional).



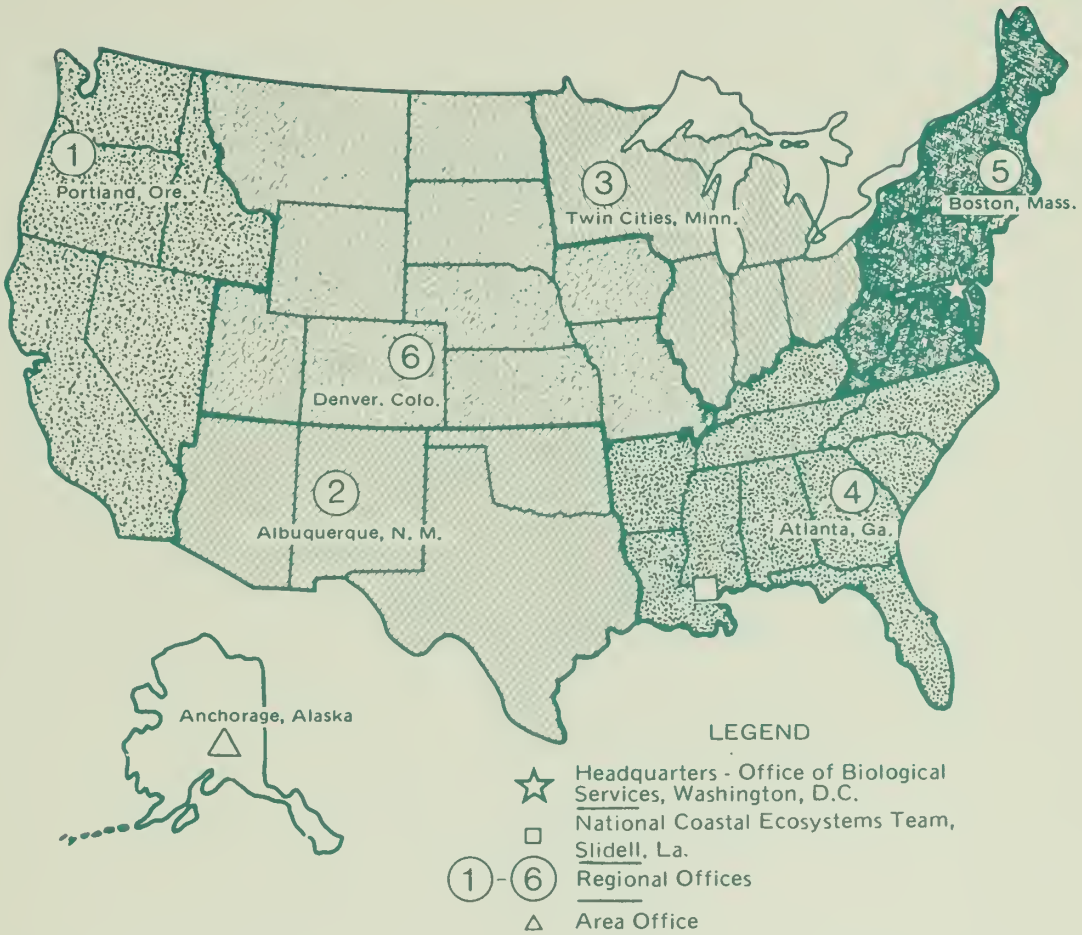
SPECIES	UPLAND				PALUSTRINE		LACUSTRINE		RIVERINE			ESTUARINE		MARITIME				MARINE	
	PINE/MIXED HARDWOOD	MIXED HARDWOOD	PINE FOREST	OLD FIELD	EMERGENT WETLANDS	FORESTED WETLANDS	LITTORAL	LIMNETIC	INTER-MITTENT	LOWER PERENNIAL	TIDAL	INTERTIDAL	SUBTIDAL	FORESTED	TRANSITION SHRUB	DUNES	BIRD KEY and BANK	INTERTIDAL	SUBTIDAL
Opossum	1	1	1	2	2	2						3		2	2	3		3	
Least shrew	3	3	3	1	2	2								2	2				
Red bat	2	2	2			2								2					
Marsh rabbit					1	2						1		2	1				
Gray squirrel	1	1	2	3		2								2	3				
Marsh rice rat				1	1	3						1		3	2				
Cotton rat	3	3	3	1	1	2						2		2	1	2	2	2	
Eastern wood rat	1	1	2	2	1	1								2	2	2		2	
Pygmy sperm whale																			1
Atlantic bottle-nosed dolphin													2						1
Gray fox	2	2	2	2	3	2								3	3				
Raccoon	1	1	2	3	1	1	2		2			1		2	2	2		2	
River otter					2	2	2	2	3	2	2	2	2	3					
Bobcat	2	2	2	3		3								3	3			3	
White-tailed deer	1	1	2	2	2	2						3		1	2	3		3	

LITERATURE CITED

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1977. Classification of wetlands and deep-water habitats of the United States. An operational draft. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. 100 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-79/31. 103 pp.

*U.S. GOVERNMENT PRINTING OFFICE: 1981--772-154



U.S. FISH AND WILDLIFE SERVICE
REGIONAL OFFICES

REGION 1
Regional Director
U.S. Fish and Wildlife Service
Lloyd Five Hundred Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

REGION 2
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

REGION 3
Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

REGION 4
Regional Director
U.S. Fish and Wildlife Service
Richard B. Russell Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

REGION 5
Regional Director
U.S. Fish and Wildlife Service
One Gateway Center
Newton Corner, Massachusetts 02158

REGION 6
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

ALASKA AREA
Regional Director
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

DEPARTMENT OF THE INTERIOR

U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.