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RARE, THREATENED, AND ENDANGERED PLANT SPECIES OF SOUTHWEST FLORIDA AND POTENTIAL OCS ACTIVITY IMPACTS

Bureau of Land Management
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.

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Cover design by Graham Golden depicting Florida nodding catopsis (Catopsis nutans), a small epiphytic bromeliad endangered because of its restricted occurrence in deep cypress swamps and its novelty among collectors.

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The opinions and recommendations expressed in this report are those of the author and do not necessarily reflect the views of the U.S. Fish and Wildlife Service or the Bureau of Land Management.

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PREFACE

This report on rare, threatened, and endangered plants is a compilation of all species so designated or considered for listing by various Federal, State, and private institutions and organizations. It identifies the spectrum of ecologically sensitive plants of southwest Florida that potentially could be affected by Outer Continental Shelf (OCS) development.

This report does not constitute or designate official status for all of the plants described herein, even though Federally listed species comprise a portion of them. Information relating to the current Federal status of particular plant taxa occurring in Florida may be obtained from the U.S. Fish and Wildlife Service Regional Office in Atlanta, Georgia (Region 4) at the address listed on the inside back cover of this report.

The U.S. Fish and Wildlife Service and the Bureau of Land Management have cooperated to prepare this document and a companion report that describes the rare, threatened, and endangered vertebrates of the southwest Florida coast.

Questions or suggestions about these reports should be directed to:

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SUMMARY

This report assembles information on the rare, threatened, and endangered plants of southwest Florida (Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties) and describes the potential impacts of Outer Continental Shelf (OCS) exploration and production upon them.

The introduction describes the extent of OCS oil activities in the eastern Gulf of Mexico and enumerates the contents of the report.

The section "Rare, Threatened, and Endangered Plants of the Eight Southwest Florida Counties and their Habitats" provides a complete tabulation of 274 plant species and a description of their ecological and geographical distributions.

"Causes of Rareness Among the Plants of the Eight Southwest Florida Counties" discusses three reasons for rareness: natural causes, plant destruction or removal, and habitat alteration. It concludes that habitat alteration is a severe and pervasive problem that is likely to worsen.

"Potential Impacts of OCS Development" lists some demographic and land use trends anticipated in the study area and integrates future OCS oil activities with them. Three aspects of oil exploration and production are considered: onshore development, pipeline construction, and oil spills. It is concluded that most of the direct adverse effects of OCS oil activities on plants will be minimal, especially if Port Manatee is chosen as the base of operations. Nearshore spills may cause severe local effects, however, and spills at the drilling rigs, under certain unfavorable conditions, could adversely affect the high concentrations of coastal plant species in predicted areas of landfall.

This report and a companion report on rare, threatened, and endangered vertebrates reach the same conclusions: coastal habitats in southwest Florida are important and sensitive, and great care must be exercised in avoiding even small spills from OCS exploration and petroleum development.

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ABBREVIATIONS

BLM	Bureau of Land Management, U.S. Department of the Interior
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDA	Florida Department of Administration
FDACS	Florida Department of Agriculture and Consumer Services
FS	Forest Service, U.S. Department of Agriculture
FWS	Fish and Wildlife Service, U.S. Department of the Interior
GS	Geological Survey, U.S. Department of the Interior
LUDA	Land Use and Data Analysis
OCS	Outer Continental Shelf
USDI	U.S. Department of the Interior

ACKNOWLEDGMENTS

Many of the data were gathered by research assistant John Juiliana. The staffs of the herbaria at the University of Florida and the University of South Florida provided access to their collections and botanical expertise. David Crewz of the Florida Department of Natural Resources in St. Petersburg checked much of the taxonomic and distributional information and aided in revision of the plant list. U.S. Fish and Wildlife Service Project Officer Timothy Sipe expedited the project significantly. Richard Wunderlin, University of South Florida, Tampa, and several anonymous reviewers provided useful comments on drafts of the report. John Cooper, Gaye Farris, Graham Golden, and Elizabeth Krebs helped prepare the final manuscript for publication.

INTRODUCTION

> "The most serious ecological losses from future energy systems are not likely to be characterized by sudden, easily visible catastrophic collapse of ecosystems. Rather, the historical pattern of slow, diffuse chipping-away of wildlife habitat is expected to become increasingly destructive . . ." (National Research Council 1980).

The above concern deserves serious consideration prior to oil and gas exploration and recovery in marine and estuarine environments. These ecosystems are presently exploited heavily in many locations. Additional pressures from energy-related activities may damage wildlife habitat in just the fashion predicted, unless great care is exercised.

Outer Continental Shelf (OCS) oil and gas lease sale 66 was held on 20 October 1981. This sale included approximately ninety 5,760-acre tracts off the west-central coast of Florida (Bureau of Land Management [BLM] 1980). Exploratory wells may be drilled on some of these tracts. If substantial reserves are discovered, offshore production will begin, and the need for a trunk pipeline to transport oil to onshore storage facilities will arise. The pipeline is expected to have landfall somewhere between Tampa Bay and Naples (BLM 1980). Further, lease sales 67, 69, and 79 will occur off Florida, and additional sales in the eastern Gulf of Mexico are scheduled through 1986.

In this report, the potential onshore impacts of these OCS oil exploration and production activities on rare, threatened, and endangered plant species in southwest Florida's eight coastal counties are evaluated. These plant species are examined quantitatively in the context of the habitat in which they are found, rather than as species-by-species accounts. This system of analysis places the problem in correct perspective, as entire habitats may be threatened by energy acquisition practices. A companion report (Woolfenden, in press) examines the effects of OCS oil activities on rare, threatened, and endangered vertebrates on the gulf coast of south Florida.

The eight coastal counties in the study area are Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe (Figure 1). De Soto County, which has a small amount of land bordering the inner reaches of Charlotte Harbor, is excluded. These eight counties will bear the ecological brunt of OCS oil activities in the region. For the purpose of this report, no distinction is made between the upper and lower Florida Keys (Monroe County), although geologically and floristically, the upper Keys are more similar to Dade County than to mainland Monroe County.

Background information on plant species listed as rare, threatened, or endangered is included: (1) their distributions by county; (2) their distributions by habitat; and (3) causes for their current status. Future

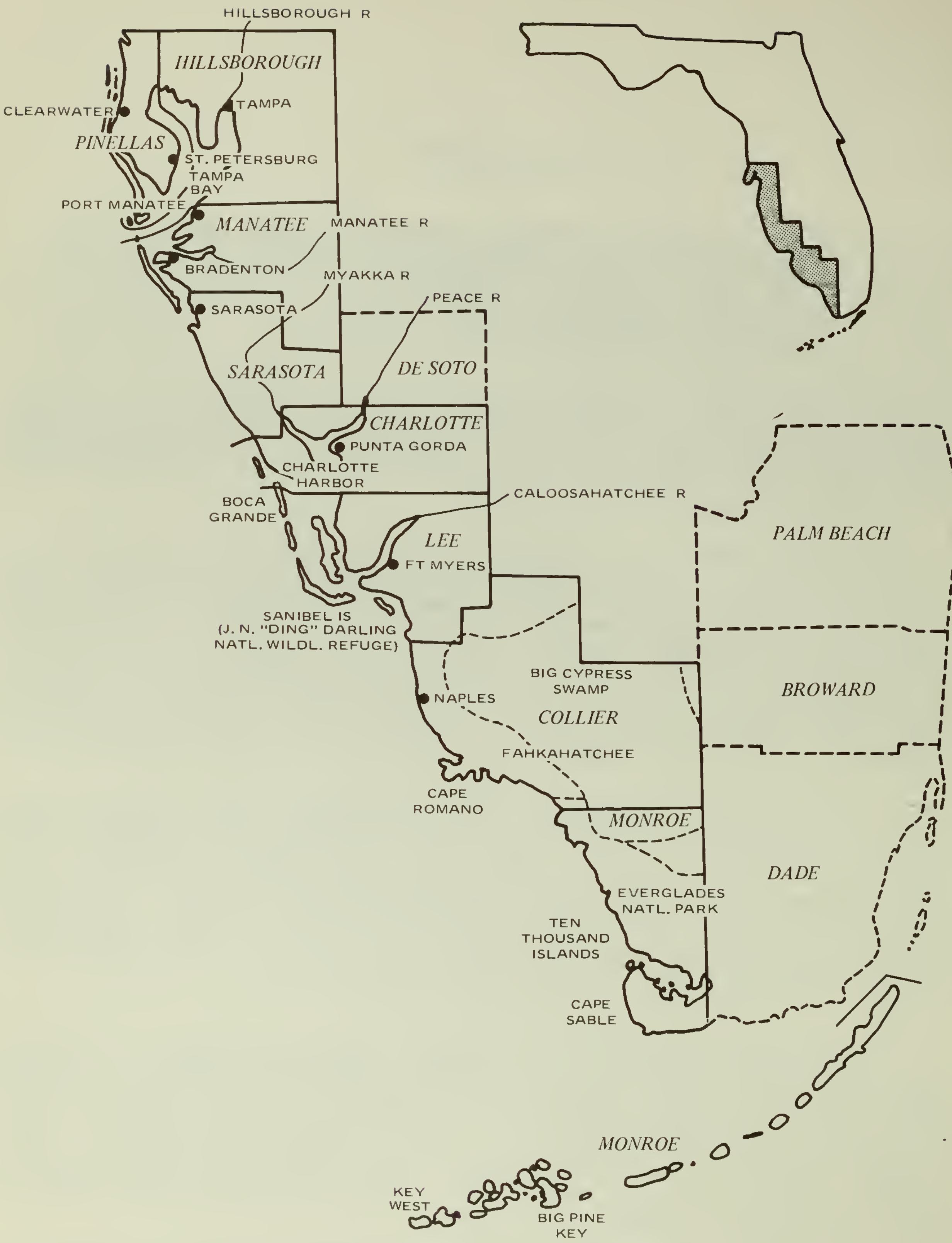

Figure 1. Map of Florida and southern coastal counties. Solid lines indicate the eight-county study area; dashed lines denote three adjacent southeast Florida counties.

developmental and ecological trends that may affect these species in the study area are detailed. A specific analysis of the potential adverse affects of OCS oil and gas exploration and production, and support facilities on these plants is presented.

RARE, THREATENED, AND ENDANGERED PLANTS OF THE EIGHT SOUTHWEST FLORIDA COUNTIES AND THEIR HABITATS

Geologically, the greater part of central and south Florida is a very young terrestrial area. Although the exact location of previous sea levels is controversial, most of Florida south of Sarasota County has been emergent for only a few tens of thousands of years (Alt and Brooks 1965). Consequently, many plant species have migrated relatively recently into present-day Florida from elsewhere. Biogeographers have identified three principal routes: (1) from the Caribbean, the Yucatan Peninsula, or other New World tropical areas; (2) from the southeastern Coastal Plain of the United States and other temperate areas of North America; and (3) from island refugia that remained above water in the central portion of Florida. The flora is thus an interesting assemblage of tropical, temperate, and endemic elements. The fact that many of these species are at the extremes of their ranges or are restricted to a few localities makes them susceptible to extinction in Florida. Florida's flora contains approximately 3,500 native and introduced plant species; a total of more than 400 of these have been designated by various governmental agencies as worthy of special concern. The Smithsonian Institution Report (Ayensu and DeFilipps 1978) indicates that only Hawaii, California, and Texas have a greater number of threatened and endangered plant species than Florida.

Designating a plant species as rare, threatened, or endangered relies not only upon the botanical and ecological expertise of the investigators involved, but also upon the objectives of the group preparing the list. For example, one group may be especially interested in preserving the genetic diversity within as well as among species, and thus will include subspecies or peripheral populations on its list, even though the species as a whole may be doing well. The Smithsonian Institution Report mentioned above (Ayensu and DeFilipps 1978) is of this nature. A second group may be much more restrictive in its listing, perhaps for the purpose of calling attention to the very critical species. The Florida Committee on Rare and Endangered Plants and Animals (FCREPA) list (Ward 1979) and the official United States list that comprises Part 17.11 of the Code of Federal Regulations (1980) are examples. Designations also depend upon the geographic units employed. A list compiled for Florida will contain species relatively common in other parts of the United States or elsewhere. For example, the Forest Service (FS) list (Duncan 1970) tabulates uncommon and rare species in the National Forests of the Southeastern United States; however, some included species are much more abundant, even common, elsewhere.

PLANT SPECIES TABULATION

The plant species listed in this report includes all species presented in several sources, regardless of the criteria by which original sources accumulated species. For certain analyses, subsets of the inclusive tabulation are used.

The following six lists of rare, threatened, and endangered plant species were consulted:

- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) list (CITES 1976)
- Florida Committee on Rare and Endangered Plants and Animals (FCREPA) list (Ward 1979)
- Official Florida list (Florida Statutes 1979)
- Smithsonian Institution Report list (Ayensu and DeFilipps 1978)
- Forest Service (FS) list (Duncan 1970)
- Federal Register (1980), which includes the official United States list

Plant species and subspecies from the eight southwest Florida counties were gleaned from these sources and compiled as a single tabulation (Table 1). Modifications of the tabulation were few, even though it is, in the opinion of many plant taxonomists, grossly inflated. The purpose of this report was not to make such judgments, but rather to compile all published information. The few modifications that were made were necessitated largely by two problems: (1) Large-scale taxonomic difficulties. For example, species of *Zamia* (Cycadaceae) are *floridana*, *integrifolia*, *umbrosa*, *pumila*; but in many cases the identical name on two lists does not apply to the identical population(s). (2) Highly-questionable validity. For example, *Agalinis stenophylla* (Scrophulariaceae), *Pisonia floridana* (Nyctaginaceae), and *Solanum bahamense rugelii* (Solanaceae) are included in the 1980 Federal Register, but are probably extinct.

The CITES list identifies those species threatened with extinction and also affected by trade. All plants native to southwest Florida that are included here are listed in Appendix II of the CITES list. Such a designation indicates that the danger is not imminent, but is predictable if strict regulations are not imposed.

The FCREPA list was published as an aid to both academics and planners. Four categories are recognized: "endangered," "threatened," "rare," and "species of special concern." Endangered species are in imminent danger of extinction or extirpation if causal factors presently at work continue to operate. Threatened species are likely to move into the endangered category in the near future if causal factors now at work continue to operate. Rare species are potentially at risk because of small population sizes in the State. Species of special concern fit none of these three categories, yet merit watchful attention (note that only *Avicennia germinans* [black mangrove] and *Rhizophora mangle* [red mangrove] are placed in this category).

The official Florida list was prepared by the Division of Plant Industry (Department of Agriculture and Consumer Services) for the Florida State

Table 1. Total list and sources of rare, threatened, and endangered plant species in the eight southwest Florida counties. CITES = Convention on International Trade in Endangered Species of Wild Flora and Fauna (1976); FCREPA = Florida Committee on Rare and Endangered Plants and Animals (Ward 1979); FDACS = Florida Department of Agriculture and Consumer Services (Florida Statutes 1979); SI = Smithsonian Institution (Ayensu and DeFilipps 1978); FS = Forest Service (Duncan 1970); FWS = Fish and Wildlife Service (Federal Register 1980); II = appendix II of CITES list; E = endangered; T = threatened; R = rare; U = uncommon; SC = special concern; 1, 2, 3B, and 3C = FWS categories in the 1980 Federal Register (explained in text).

		Source					
Species or subspecies	Family	CITES	FCREPA	FDACS	SI	FS	FWS
1. *Acacia choriophylla*	Fabaceae		E				
2. *Acoelorraphe wrightii*	Arecaceae			T			
3. *Acrostichum aureum*	Pteridaceae		R				
4. *Acrostichum danaeaefolium*	Pteridaceae			T			
5. *Adiantum tenerum*	Pteridaceae			T			
6. *Agalinus purpurea carteri*	Scrophulariaceae				T		1
7. *Andropogon arctatus*	Poaceae				E		2
8. *Anemia adiantifolia*	Schizaeaceae			T			
9. *Annona glabra*	Annonaceae			T			
10. *Argythamnia blodgettii*	Euphorbiaceae				T		1
11. *Aristida floridana*	Poaceae				E		1
12. *Aristida simpliciflora*	Poaceae			T			
13. *Asclepias curtissii*	Asclepiadaceae		T	T			
14. *Asclepias tomentosa*	Asclepiadaceae					R	
15. *Asimina pulchella*	Annonaceae				T		2
16. *Asimina pygmaea*	Annonaceae			T			
17. *Asplenium auritum*	Aspleniaceae		E	E			
18. *Asplenium platyneuron*	Aspleniaceae			T			
19. *Asplenium serratum*	Aspleniaceae		E	T			
20. *Avicennia germinans*	Avicenniaceae		SC				
21. *Azolla caroliniana*	Salviniaceae			T			
22. *Blechnum serrulatum*	Blechnaceae			T			

(continued)

Table 1. (Continued).

Species or subspecies	Family	Source: CITES	FCREPA	FDACS	SI	FS	FWS
23. Bletia purpurea	Orchidaceae	II		T			
24. Bonamia grandiflora	Convolvulaceae		T		T		2
25. Botrychium virginianum	Ophioglossaceae			T			
26. Bulbophyllum pachyrachis	Orchidaceae	II	E	T			
27. Burmannia flava	Burmanniaceae		R				
28. Cacalia floridana	Asteraceae					U	
29. Calopogon barbatus	Orchidaceae	II		T			
30. Calopogon multiflorus	Orchidaceae	II		T			
31. Calopogon pallidus	Orchidaceae	II		T			
32. Calopogon tuberosus	Orchidaceae	II		T			
33. Campylocentrum pachyrrhizum	Orchidaceae	II	E	T			
34. Campyloneurum angustifolium	Polypodiaceae		E	E			
35. Campyloneurum costatum	Polypodiaceae			T			
36. Campyloneurum latum	Polypodiaceae			T			
37. Campyloneurum phyllitidis	Polypodiaceae			T			
38. Cassia keyensis	Fabaceae		T	E	E		1
39. Catesbaea parviflora	Rubiaceae		E	T			
40. Catopsis berteroniana	Bromeliaceae		T	E			
41. Catopsis floribunda	Bromeliaceae			T			
42. Catopsis nutans	Bromeliaceae		E	E			
43. Celtis iguanaea	Ulmaceae		E				
44. Celtis pallida	Ulmaceae		E				
45. Centrosema arenicola	Fabaceae				E		2
46. Ceratiola ericoides	Empetraceae			T			
47. Ceratopteris pteridoides	Parkeriaceae			T			
48. Ceratopteris thalictroides	Parkeriaceae			T			
49. Cereus eriophorus fragrans	Cactaceae	II		T	E		1
50. Cereus gracilis aboriginum	Cactaceae	II	T	E	E		1
51. Cereus gracilis simpsonii	Cactaceae	II		E	E		1
52. Cereus pentagonus	Cactaceae	II		T			

(continued)

Table 1. (Continued).

Species or subspecies	Family	Source CITES	FCREPA	FDACS	SI	FS	FWS
53. Cereus robinii deeringii	Cactaceae	II	E	E	E		1
54. Cereus robinii robinii	Cactaceae	II		E	E		1
55. Cereus undatus	Cactaceae	II		T			
56. Chamaesyce cumulicola	Euphorbiaceae				T		1
57. Chamaesyce deltoidea serphyllum	Euphorbiaceae				E		1
58. Chamaesyce garberi	Euphorbiaceae				E		1
59. Chamaesyce porteriana keyensis	Euphorbiaceae				E		1
60. Chamaesyce porteriana porteriana	Euphorbiaceae				T		1
61. Chamaesyce porteriana scoparia	Euphorbiaceae				E		1
62. Cheilanthes microphylla	Pteridaceae		R	T			
63. Chionanthus virginicus	Oleaceae			T			
64. Chrysophyllum oliviforme	Sapotaceae			T			
65. Chrysopsis floridana	Asteraceae		E				1
66. Cienfuegosia heterophylla	Malvaceae			T			
67. Clusia flava	Hypericaceae						2
68. Clusia rosea	Hypericaceae			T			
69. Coccothrinax argentata	Arecaceae		T	E			
70. Corallorhiza wisteriana	Orchidaceae	II		T			
71. Cordia sebestena	Boraginaceae			T			
72. Coreopsis gladiata	Asteraceae					U	
73. Cornus florida	Cornaceae			T			
74. Cranichus muscosa	Orchidaceae	II		T			
75. Ctenitis sloanei	Aspidiaceae			T			
76. Ctenitis submarginalis	Aspidiaceae			T			
77. Cupania glabra	Sapindaceae		E	T			
78. Cyrtopodium punctatum	Orchidaceae	II	T	E			
79. Digitaria gracillima	Poaceae						2
80. Dryopteris ludoviciana	Aspidiaceae			T			
81. Elytraria caroliniensis angustifolia	Acanthaceae				T		1
82. Encyclia boothiana erythronioides	Orchidaceae	II	E	E	T		1

(continued)

Table 1. (Continued).

	Species or subspecies	Family	Source					
			CITES	FCREPA	FDACS	SI	FS	FWS
83.	Encyclia cochleata	Orchidaceae	II		T			
84.	Encyclia pygmaea	Orchidaceae	II	E	T			
85.	Encyclia tampensis	Orchidaceae	II		T			
86.	Epidendrum acunae	Orchidaceae	II	E	T			
87.	Epidendrum anceps	Orchidaceae	II		T			
88.	Epidendrum conopseum	Orchidaceae	II		T			
89.	Epidendrum difforme	Orchidaceae	II		T			
90.	Epidendrum nocturnum	Orchidaceae	II	T	T			
91.	Epidendrum rigidum	Orchidaceae	II		T			
92.	Epidendrum strobiliferum	Orchidaceae	II		T			
93.	Eragrostis tracyi	Poaceae		T	T			1
94.	Eriochloa michauxii simpsonii	Poaceae				T		1
95.	Ernodea littoralis	Rubiaceae		T				
96.	Erythrodes querceticola	Orchidaceae	II		T			
97.	Eugenia confusa	Myrtaceae			T			
98.	Eugenia rhombea	Myrtaceae		E				
99.	Eulophia alta	Orchidaceae	II		T			
100.	Eulophia ecristata	Orchidaceae	II		T			
101.	Euphorbia exserta	Euphorbiaceae				T		1
102.	Forestiera segregata pinetorum	Oleaceae				E		1
103.	Goniophlebium triseriale	Polypodiaceae			T			
104.	Gordonia lasianthus	Theaceae			T			
105.	Gossypium hirsutum	Malvaceae		E				
106.	Guaiacum sanctum	Zygophyllaceae	II	T	E			
107.	Gymnopogon floridanus	Poaceae				T		2
108.	Habenaria distans	Orchidaceae	II		T			
109.	Habenaria odontopetala	Orchidaceae	II		T			
110.	Habenaria quinqueseta macroceratitus	Orchidaceae	II		T			

(continued)

Table 1. (Continued).

	Species or subspecies	Family	Source					
			CITES	FCREPA	FDACS	SI	FS	FWS
111.	Habenaria quinqueseta quinqueseta	Orchidaceae	II		T			
112.	Habenaria repens	Orchidaceae	II		T			
113.	Harrisella porecta	Orchidaceae	II		T			
114.	Helianthus debilis vestitus	Asteraceae				T		2
115.	Heliotropium polyphyllum horizontale	Boraginaceae				T		2
116.	Hexalectris spicata	Orchidaceae	II		T			
117.	Hippomane mancinella	Euphorbiaceae		T				
118.	Hymenocallis latifolia	Amaryllidaceae				T		1
119.	Hypelate trifoliata	Sapindaceae		T				
120.	Hypolepis repens	Pteridaceae			T			
121.	Ilex ambigua	Aquifoliaceae			T			
122.	Ilex cassine	Aquifoliaceae			T			
123.	Ilex decidua	Aquifoliaceae			T			
124.	Ilex opaca opaca	Aquifoliaceae			T			
125.	Ilex vomitoria	Aquifoliaceae			T			
126.	Ionopis utricularoides	Orchidaceae	II		E			
127.	Ipomoea trichocarpa	Convolvulaceae					R	
128.	Isoetes flaccida	Isoetaceae			T			
129.	Jacquemontia curtissii	Convolvulaceae		T		T		1
130.	Justicia crassifolia	Acanthaceae				E		2
131.	Kosteletzkya smilacifolia	Malvaceae				T		1
132.	Lechea cernua	Cistaceae				T		2
133.	Lechea divaricata	Cistaceae				T		2
134.	Lechea lakelae	Cistaceae				T		2
135.	Leochilus labiatus	Orchidaceae	II		T			
136.	Lepanthopsis melanantha	Orchidaceae	II	T		T		2
*	Limonium carolinianum angustatum	Plumbaginaceae				E		3B
137.	Linum arenicola	Linaceae				E		1
138.	Linum carteri smallii	Linaceae				E		1

(continued)

Table 1. (Continued).

	Species or subspecies	Family	Source					
			CITES	FCREPA	FDACS	SI	FS	FWS
139.	Liparis elata	Orchidaceae	II		T			
140.	Listera australis	Orchidaceae	II		T			
141.	Lycopodium alopecuroides	Lycopodiaceae			T			
142.	Lycopodium appressum	Lycopodiaceae			T			
143.	Lycopodium carolinianum	Lycopodiaceae			T			
144.	Lycopodium cernuum	Lycopodiaceae			T			
145.	Lycopodium dichotomum	Lycopodiaceae		E	T			
146.	Lycopodium prostratum	Lycopodiaceae			T			
147.	Lythrum flagellare	Lythraceae						2
148.	Malaxis spicata	Orchidaceae	II		T			
149.	Mallotonia gnaphaloides	Boraginaceae		T				
150.	Manisuris tuberculosa	Poaceae				T		2
151.	Maxillaria crassifolia	Orchidaceae	II	E	T			
152.	Melanthera parvifolia	Asteraceae				T		1
153.	Microgramma heterophylla	Polypodiaceae			T			
154.	Nephrolepis biserrata	Davalliaceae			T			
155.	Oncidium carthagenese	Orchidaceae	II		T			2
156.	Oncidium floridanum	Orchidaceae	II		T			
157.	Oncidium luridum	Orchidaceae	II		T			
158.	Ophioglossum nudicaule	Ophioglossaceae			T			
159.	Ophioglossum palmatum	Ophioglossaceae		E	E	T		3C
160.	Ophioglossum petiolatum	Ophioglossaceae			T			
161.	Opuntia cubensis	Cactaceae	II					
162.	Opuntia humifusa	Cactaceae	II					
163.	Opuntia spinosissima	Cactaceae	II		T	T		2
164.	Opuntia stricta	Cactaceae	II		T			
165.	Opuntia triacantha	Cactaceae	II		T	T		2
166.	Paltonium lanceolatum	Polypodiaceae			T			
167.	Panicum pinetorum	Poaceae				T		2
168.	Peltandra sagittaefolia	Araceae		R				

(continued)

Table 1. (Continued).

	Species or subspecies	Family	CITES	FCREPA	FDACS	SI	FS	FWS
			Source					
169.	Peperomia floridana	Piperaceae		E	T			1
170.	Peperomia glabella	Piperaceae			T			
171.	Peperomia humilis	Piperaceae			T			
172.	Peperomia obtusifolia	Piperaceae			T			
173.	Peperomia simplex	Piperaceae			T			
174.	Peperomia spathulifolia	Piperaceae			T			
175.	Phlebodium aureum	Polypodiaceae			T			
176.	Phoradendron rubrum	Loranthaceae		T				
177.	Phyllanthus pentaphyllus floridanus	Euphorbiaceae				T		1
178.	Physalis viscosa elliottii	Solanaceae				T		2
179.	Physostegia leptophyllum	Lamiaceae				T		2
180.	Piscidia piscipula	Fabaceae			T			
181.	Platanthera blephariglottis conspicua	Orchidaceae	II		T			
182.	Platanthera ciliaris	Orchidaceae	II		T			
183.	Platanthera cristata	Orchidaceae	II		T			
184.	Platanthera nivea	Orchidaceae	II		T			
185.	Pleurothallis gelida	Orchidaceae	II		T			
186.	Pogonia ophioglossoides	Orchidaceae	II		T			
187.	Polygala boykinii sparsifolia	Polygalaceae				T		1
188.	Polypodium dispersum	Polypodiaceae			T			
189.	Polypodium plumula	Polypodiaceae			T			
190.	Polypodium polypodioides michauxianum	Polypodiaceae			T			
191.	Polypodium ptilodon caespitosum	Polypodiaceae			T			
192.	Polystachya flavescens	Orchidaceae	II		T			
193.	Pontheria racemosa racemosa	Orchidaceae	II		T			
194.	Pseudophoenix sargentii	Arecaceae		E	T			
195.	Psilotum nudum	Psilotaceae			T			
196.	Pteris longifolia	Pteridaceae			T			
197.	Restrepiella ophiocephala	Orchidaceae	II	E	T			
198.	Rhapidophyllum hystrix	Arecaceae		T	T	T		3C

(continued)

Table 1. (Continued).

	Species or subspecies	Family	Source: CITES	FCREPA	FDACS	SI	FS	FWS
199.	Rhipsalis baccifera	Cactaceae	II		T			2
200.	Rhizophora mangle	Rhizophoraceae		SC				
201.	Roystonea elata	Arecaceae		R	E	E		1
202.	Sabal etonia	Arecaceae			T			
203.	Sabal minor	Arecaceae			T			
204.	Sabal palmetto	Arecaceae			T			
205.	Sachsia bahamensis	Asteraceae		E				
*	Sageretia minutiflora	Rhamnaceae				T		3C
206.	Salvia blodgettii	Lamiaceae				T		1
207.	Salvinia rotundifolia	Salviniaceae			T			
208.	Scaevola plumieri	Goodeniaceae			T			
209.	Schizachyrium niveum	Poaceae				T		1
*	Schizachyrium rhizomatum	Poaceae				E		3B
210.	Schizaea germanii	Schizaeaceae		R		E		1
211.	Selaginella apoda	Selaginellaceae			T			
212.	Selaginella arenicola	Selaginellaceae			T			
213.	Sida rubromarginata	Malvaceae				T		1
214.	Smilax smallii	Smilacaceae		T	T			
215.	Sphenomeris clavata	Pteridaceae			T			
216.	Spiranthes brevilabris brevilabris	Orchidaceae	II		T			
217.	Spiranthes brevilabris floridana	Orchidaceae	II		T			
218.	Spiranthes cernua odorata	Orchidaceae	II		T			
219.	Spiranthes cranichoides	Orchidaceae	II		T			
220.	Spiranthes gracilis	Orchidaceae	II		T			
221.	Spiranthes grayi	Orchidaceae	II		T			
222.	Spiranthes laciniata	Orchidaceae	II		T			
223.	Spiranthes lanceolata lanceolata	Orchidaceae	II		T			
224.	Spiranthes lanceolata paludicola	Orchidaceae	II		T	E		1
225.	Spiranthes longilabris	Orchidaceae	II		T			
226.	Spiranthes polyantha	Orchidaceae	II		T	T		2

(continued)

Table 1. (Continued).

	Species or subspecies	Family	Source					
			CITES	FCREPA	FDACS	SI	FS	FWS
227.	Spiranthes praecox	Orchidaceae	II		T			
228.	Spiranthes tortilis	Orchidaceae	II		T			
229.	Spiranthes vernalis	Orchidaceae	II		T			
230.	Stillingia sylvatica tenuis	Euphorbiaceae				T		2
231.	Strumpfia maritima	Rubiaceae		E	E			
232.	Suriana maritima	Surianaceae			T			
233.	Swietenia mahogany	Melliaceae			T			
234.	Tephrosia angustissima	Fabaceae						1
235.	Tetrazygia bicolor	Melastomataceae			T			
236.	Thelypteris augescens	Aspidiaceae			T			
237.	Thelypteris dentata	Aspidiaceae			T			
238.	Thelypteris interrupta	Aspidiaceae			T			
239.	Thelypteris normalis	Aspidicaeae			T			
240.	Thelypteris ovata	Aspidiaceae			T			
241.	Thelypteris palustris	Aspidiaceae			T			
242.	Thelypteris quadrangularis versicolor	Aspidiaceae			T			
243.	Thelypteris serrata	Aspidiaceae			T			
244.	Thespesia populnea	Malvaceae			T			
245.	Thrinax floridana	Arecaceae		T	T			
246.	Thrinax microcarpa	Arecaceae		T	T			
247.	Tillandsia balbisiana	Bromeliaceae			T			
248.	Tillandsia circinata	Bromeliaceae			T			
249.	Tillandsia fasciculata	Bromeliaceae			E			
250.	Tillandsia flexuosa	Bromeliaceae		T	T			
251.	Tillandsia polystachia	Bromeliaceae			T			
252.	Tillandsia pruinosa	Bromeliaceae		T	T			
253.	Tillandsia setacea	Bromeliaceae			T			
254.	Tillandsia simulata	Bromeliaceae			T			
255.	Tillandsia utriculata	Bromeliaceae			T			
256.	Tillandsia valenzuelana	Bromeliaceae			T			

(continued)

Table 1. (Concluded).

Species or subspecies	Family	Source					
		CITES	FCREPA	FDACS	SI	FS	FWS
257. Tournefortia gnaphalodes	Boraginaceae			T			
258. Tournefortia hirsutissima	Boraginaceae			T			
259. Tragia saxicola	Euphorbiaceae				T		1
260. Triphora latifolia	Orchidaceae	II		T	E		2
261. Triphora rickettii	Orchidaceae	II		T			
262. Triphora trianthophora	Orchidaceae	II		T			
263. Tripsacum floridanum	Poaceae				E		1
264. Vanilla barbellata	Orchidaceae	II	T	T			
265. Vanilla phaeantha	Orchidaceae	II		T			
266. Verbena tampensis	Verbenaceae				E		1
267. Vittaria lineata	Vittariaceae			T			
268. Woodwardia areolata	Blechnaceae			T			
269. Woodwardia virginica	Blechnaceae			T			
270. Zamia pumila	Cycadaceae	II	T	T	E		3C
271. Zanthoxylum flavum	Rutaceae		E				
272. Zephyranthes atamasco	Amaryllidaceae			E			
273. Zephyranthes simpsonii	Amaryllidaceae			T	T		3C
274. Zephyranthes treatiae	Amaryllidaceae			T	T		3C

* These species were not included in any analyses.

Legislature. It also designates plant species as either "threatened" or "endangered." No criteria are stated for these designations.

The Smithsonian Institution list was prepared for the U.S. Congress as a guide to inclusion of species in the official United States list prepared by the FWS. Two categories are identified by the Smithsonian Institution: "threatened" and "endangered." Endangered species are defined as those in danger of extinction throughout all or a significant portion of their range. Threatened species are those likely to become endangered within the foreseeable future. The list from the Smithsonian Institution Report (Ayensu and DeFilipps 1978) was incorporated and published in revised form in a Notice of Review by the FWS on 15 December 1980 (Federal Register 1980).

The FS list identifies species of wildflowers found in southern National Forests determined to be "common," "rare," or "endangered." The designations are subjective evaluations of abundance and distribution.

The official United States list includes those species and subspecies deemed by the Director of the FWS to be threatened or endangered with extinction. Federal listing of a species is a rather lengthy process. The entire process is detailed in the 1980 Code of Federal Regulations. At this time, the official U.S. list includes only about 40 plant species in the entire United States, 2 of which occur in Florida. Neither of the Florida species, Rhododendron chapmanii (Chapman's rhododendron) or Harperocallis flava (Harper's beauty), occurs in the study area of southwest Florida.

The 1980 Federal Register includes the most up-to-date version of the official United States list of species already listed as threatened or endangered (from Code of Regulations 1980), but also considers for listing species on the Smithsonian Institution list, as well as some new species. It places these unlisted species into three categories: (1) taxa for which the Service presently has sufficient information on hand to support listing, (2) taxa for which further research is necessary to support listing, and (3) taxa no longer being considered for listing. Within the last category, three reasons are identified for removal from consideration: (a) the Service has persuasive evidence of extinction, (b) the taxon no longer meets the official definition of "species," and (c) the species is more widespread or abundant than previously believed and/or is not subject to any identifiable threat. It is noteworthy to point out that 75 plant species known to the study area were in the FWS Notice of Review that appeared in the 1980 Federal Register (Table 1).

HABITAT DESCRIPTIONS

The major habitats discussed here are usually recognized as units because they are geographically widespread. In contrast to areas with a more temperate climate, habitats of central and south Florida are not distinct; many variations and intergradations are present. Very slight changes in ecological conditions, particularly in elevation, can produce dramatic variations in the flora. A wet prairie may be next to a tropical hammock, with the demarcation between them as obvious as a fence. This sharp division results from elevational differences of perhaps only a few feet. No habitat described here covers much area uniformly; each "habitat" is instead a complicated mosaic of habitats with one predominating in surface coverage. This matter is dealt with further in the individual habitat descriptions below. In addition, note that the habitat scheme presented is primarily for Florida in a formerly pristine condition: the vegetational pattern has been altered substantially through man's activities. The alterations are discussed in a later section which details reasons for the relative rareness of certain species.

To derive a list of the habitat types to be used in this study, the system proposed by Davis (1967) was compared with those of the Geological Survey (GS), and the Florida Department of Administration (FDA 1976). Davis' system was preferred, based upon the author's observations, although it is similar to the others in many ways. Table 2 compares Davis' categories with those of the FDA (1976). The wetland habitats were also classified according to the FWS wetland classification scheme (Cowardin et al. 1979). Note that the category terminology of the FWS classification provides the most information about each habitat.

Figure 2 displays the distribution of habitats among the eight southwest Florida counties, and Table 3 presents the area covered by each in the study area and in individual counties. Note that Davis' habitats, (4) mixed hardwood and pine forest, (12) hardwood forest, (15) cabbage palm forest, and (16A) everglades saw grass marsh, are not represented in the study area. Detailed descriptions of the habitats, accompanied by distributional data on the plant species follow.

The data in Table 3 were derived in two ways. One was to trace Figure 2 on fine tracing paper, cut out the habitats, and weigh the pieces. This was done several times, until consistent estimates of relative area were obtained. The other way was to overlay Geological Survey's Land Use and Data Analysis (GS LUDA 1976) maps with Davis' (1967) habitat map. This was done by the Florida Resources and Environmental Analysis Center, Florida State University, Tallahassee. The similarity of the percentages derived by the two methods indicates that the quick, inexpensive, weighing procedure is adequate at this scale for these analyses.

DISTRIBUTION OF RARE, THREATENED, AND ENDANGERED PLANT SPECIES

The 274 plant species in Table 1 were categorized by the habitat(s) in which they could be expected to occur, and by their geographical distributions among the eight counties. These categorizations were derived from published species accounts and herbarium records. The habitat distribution in the original sources was condensed to match the habitat scheme presented in the previous section. Two assumptions were made to facilitate presentation of the information. The first was that the county is the smallest geographical division considered; thus, a plant species barely entering a county would be given equal weight to one occurring throughout the county. The second assumption was that the habitat(s) assigned to a given species represents the majority, but not the totality, of the species' geographical distribution. A species may be found in a different habitat type occasionally, but such unusual events are ignored.

It should be realized that distributional records are a function of collecting effort. In the absence of information to the contrary, the records

Table 2. Major Florida habitat types, in terms of areal extent, described by Davis (1967) and compared with classification systems of the Florida Department of Administration (FDA 1976) and the FWS (Cowardin et al. 1979). Numbers in parentheses denote the coding scheme of the source. Habitats with * are not present in this study area.

Davis (1967)	FDA (1976)			FWS (Cowardin et al. 1979)
	Identical to Davis' categories	FDA category is a subset of Davis	Davis' category is a subset of FDA	
(1) Coastal strand		Coastal scrub (322)		
(2) Pine flatwoods	Pine flatwoods (411)		Other (414)	Palustrine, forested wetlands, needle-leaved evergreen, saturated
(3) Southern slash pine forest			Other (414)	
(4)* Mixed hardwood and pine forest		Mixed forest (431)	Other (414)	
(5) Sand pine scrub forest	Sand pine scrub (413)			
(6) Longleaf pine/ xerophytic oak forest	Longleaf pine (412)			
(7) Cypress swamp	Cypress (611)			Palustrine, forested wetlands, needle-leaved evergreen, permanently flooded

(continued)

Table 2. (Continued).

Davis (1967)	FDA 1976): Identical to Davis' categories	FDA 1976): FDA category is a subset of Davis	FDA 1976): Davis' category is a subset of FDA	FWS (Cowardin et al. 1979)
(8) Swamp forest		Pond pine (612), freshwater swamp (621), mixed forest (631)		Palustrine, forested wetland, broad-leaved evergreen, seasonally flooded
(9) Mangrove swamp and coastal marsh		Saltwater swamp (622), saltwater marsh (642)		Estuarine (intertidal), forested wetland, broad-leaved evergreen and estuarine (intertidal), emergent wetland, persistent; regularly and irregularly flooded
(12)* Hardwood forest	Other hardwood (422)	Xeric oak (421)		
(13) Prairie grassland		Grassland (310), palmetto prairie (321), other scrub (323), mixed rangeland (320)		Palustrine, emergent wetland, persistent, seasonally flooded
(14) Open scrub cypress			Other scrub (323)	Palustrine, scrub-shrub wetland, needle-leaved evergreen, seasonally flooded (to semipermanently flooded)

(continued)

Table 2. (Concluded).

Davis (1967)	FDA (1976)			FWS (Cowardin et al. 1979)
	Identical to Davis' categories	FDA category is a subset of Davis	Davis' category is a subset of FDA	
(15)* Cabbage palm forest				
(16) Freshwater marsh			Freshwater marsh (641)	Palustrine, emergent wetland, persistent, semipermanently flooded
(16A)* Everglades saw grass marsh			Freshwater marsh (641)	Palustrine, emergent wetland, persistent, seasonally flooded
(16B) Everglades region marsh, slough, wet prairie, and tree islands			Freshwater marsh (641)	Palustrine, emergent wetland, persistent, seasonally flooded
(17) Wet to dry prairie marsh on marl or rockland			Freshwater marsh (641)	Palustrine, emergent wetland, persistent, seasonally flooded

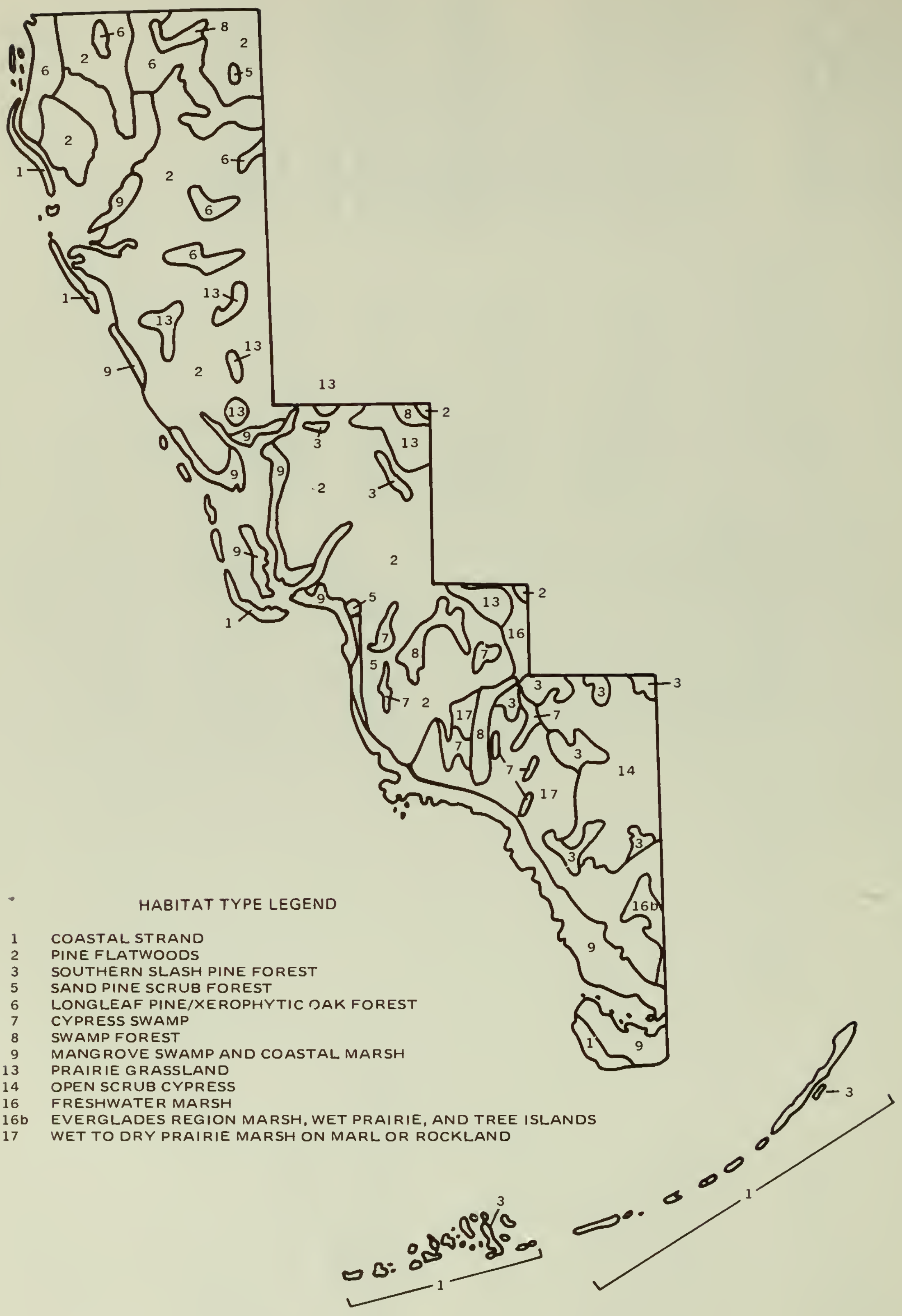

Figure 2. Distribution of 13 of Davis' (1967) habitats found in the eight-county study area.

Table 3. Percentage of land covered by the 13 major habitats (Davis 1967) in the eight-county study area. Values are derived from the weighing procedure described in text; those in parentheses are from GS LUDA map analysis; T = trace.

County	Land area (mi^2) (Total study area = 7,158 mi^2)	Coastal strand % (143 mi^2)	Pine flatwoods % (3,436 mi^2)	Southern slash pine forest % (215 m^2)	Sand pine scrub forest % (72 mi^2)	Long-leaf pine/xerophytic oak forest % (429 mi^2)	Cypress swamp % (215 mi^2)	Swamp forest % (215 mi^2)
Pinellas	265	15 (12.9)	45 (47.3)			40 (39.5)		
Hillsborough	1038	1 (0.4)	66 (68.9)		1 (0.4)	26 (24.1)		3 (2.8)
Manatee	740	2 (1.0)	85 (86.5)			8 (8.4)		
Sarasota	587	3 (3.5)	84 (84.6)					
Charlotte	703	2 (0.5)	62 (65.0)		2 (1.8)	T (T)	2 (1.9)	2 (1.8)
Lee	785	3 (5.1)	74 (74.9)		2 (2.1)		3 (2.5)	T (T)
Collier	2006		24 (26.0)	7 (8.1)	2 (1.6)		7 (6.4)	7 (6.4)
Monroe	1034	2 (10.5)		5 (1.5)			4 (4.4)	
Total % of study area		2 (3.1)	48 (49.6)	3 (2.5)	1 (0.9)	6 (6.0)	3 (2.9)	3 (2.4)

(continued)

Table 3. (Concluded).

County	Mangrove swamp and coastal marsh % ($859\ mi^2$)	Prairie grassland % ($286\ mi^2$)	Open cypress % ($573\ mi^2$)	Freshwater marsh % ($72\ mi^2$)	Everglades region marsh, slough, wet prairie and tree islands % ($72\ mi^2$)	Wet to dry prairie marsh on marl or rockland % ($644\ mi^2$)
Pinellas	T (0.3)					
Hillsborough	3 (3.3)					
Manatee	1 (0.4)	4 (3.7)				
Sarasota	1 (0.6)	12 (11.3)				
Charlotte	13 (12.0)	18 (16.9)				
Lee	17 (15.3)					
Collier	7 (7.2)	3 (2.9)	23 (22.3)	2 (2.0)		18 (17.1)
Monroe	45 (42.3)		10 (10.3)		5 (4.8)	28 (26.1)
Total % of study area	12 (11.4)	4 (3.8)	8 (7.8)	1 (0.6)	1 (0.7)	9 (8.5)

imply equal collecting effort throughout the geographical range examined. This is often not the case, however. For the eight counties examined here, Hillsborough and Pinellas Counties in the north, and Collier and Monroe Counties in the south probably have been more thoroughly sampled than those in between. An examination of the plants in the FCREPA list, the most thoroughly researched and probably most complete list (although it contains several inaccuracies; Richard Wunderlin, University of South Florida, Tampa; personal communication), seems to indicate that this is true. Uncertain presences account for 3 of 16 (19%) total records in Hillsborough and Pinellas Counties, and for only 1 of 59 (2%) total records in Collier and Monroe Counties; 8 of 30 (27%) total records are uncertain in the intermediate four counties. Another indication of the inadequacy of some of the distributional information comes from individual species accounts. The FCREPA threatened species Gossypium hirsutum, for instance, is recorded as present in six of the eight counties: Pinellas, Manatee, Charlotte, Lee, Collier, and Monroe. The species has been found in Hillsborough County only within the last year, and it is recorded in this report as present there. More extensive field searches for all rare, threatened, and endangered plant species are needed.

For this study, 16 habitat types have been identified as occurring in the eight-county study area. They include 13 of Davis (1967) habitats and 3 additional ones (hammock, shell mound, and other). Maps displaying the distribution of the Davis habitats and the number of plant species associated with each habitat in each county are presented in Figures 3 through 15. Small pockets of many habitats may occur virtually anywhere, but are not extensive enough to appear on the maps. Hammocks and shell mounds (Figures 16 and 17) are important in supporting uncommon plants, but do not cover enough contiguous area to appear in Davis' classification. The final habitat (other) includes plant species that cannot be matched to any classification scheme (Figure 18). Figures 3 through 18 contain the numbers of species from the FCREPA list and the total list (Table 1) that occur in each county. The FCREPA numbers denote the most severely compromised plants (recall the discussion on the restrictive nature of this list). The total list includes more plants.

Numerical habitat codes of Davis (1967) are utilized in the following discussion and are enclosed in parentheses.

Coastal strand (1). The coastal strand (Figure 3) is a halophytic plant association that occurs immediately landward of the highest tide mark on outer beaches, inlet beaches, and dunes. Areas of the habitat near mean high tide support pioneer shrubs and herbs, but the vegetation becomes progressively denser landward. The landward margin is set at the point where nonhalophytic, "upland" plants grow successfully. A similar habitat occurs artificially on spoil islands of dredged fill. Both the seaward and landward margins of the habitat are prone to shifts of position in response to environmental pressures such as erosion and unusually high tides. The substrate may be either sand, shell, or oolitic rock. All substrata are well drained (xeric).

Typical plants in this habitat include Australian pine (Casuarina spp.), Spanish bayonet (Yucca aloifolia), beach elder (Iva imbricata), sea oats (Uniola paniculata), various other species of grasses, railroad vine (Ipomoea pes-caprae), cacti (Opuntia spp.), sea grape (Cocoloba uvifera), salt bush (Baccharis halimifolia), wax myrtle (Myrica cerifera), and beach morning glory

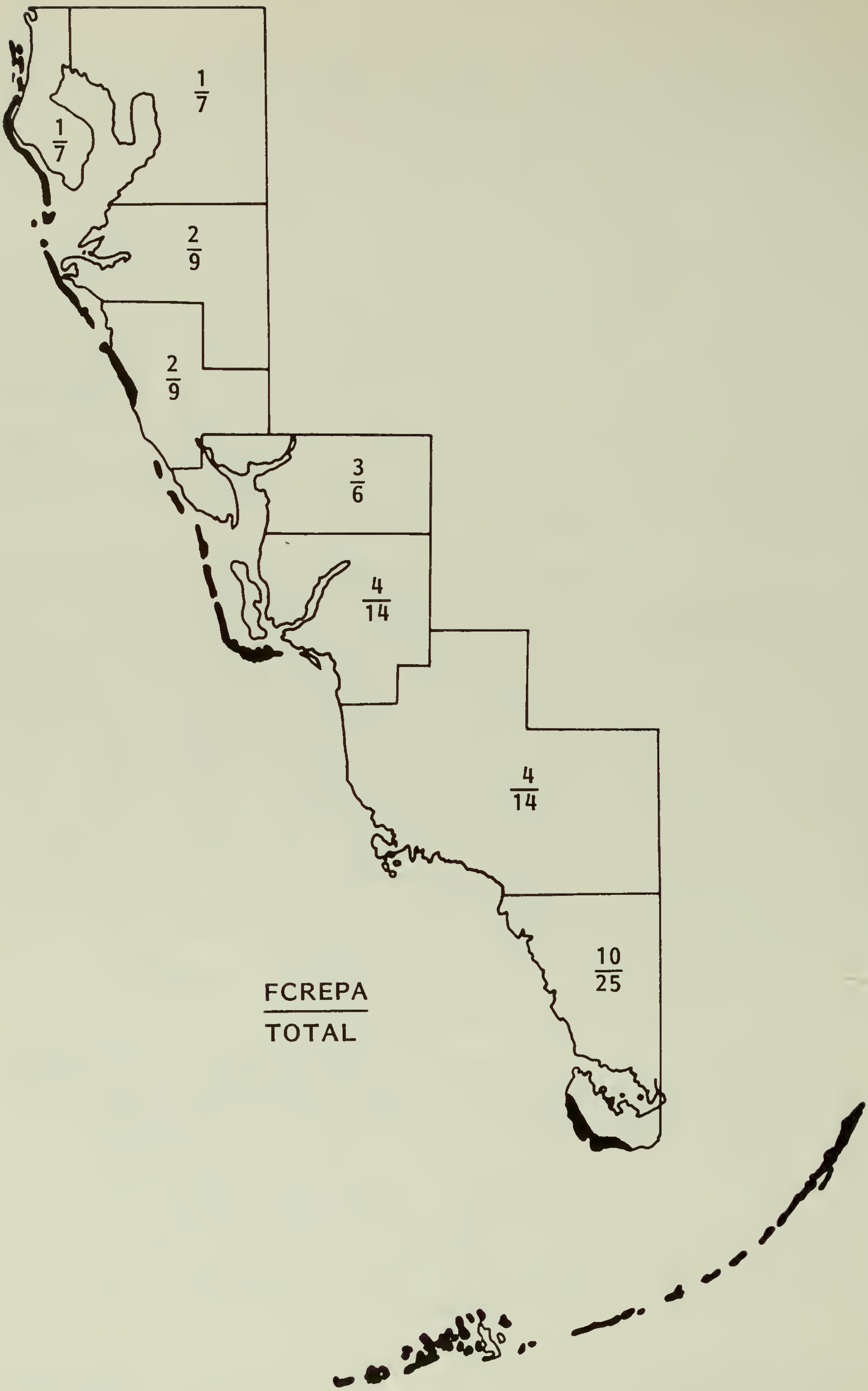

Figure 3. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the coastal strand habitat. Darkened areas denote coastal strand habitat of Davis (1967).

(*Ipomoea stolonifera*). Most of the Florida Keys were classified by Davis (1967) as entirely coastal strand. They are, however, predominately mangrove swamp (3) and hammock (described separately). The coastal strand of the Keys, as other habitats located there, includes many tropical elements. Coastal strand covers less than 2% (143 mi^2) of the land surface area of the eight southwest Florida counties, and is common, in terms of percent coverage, only in Pinellas County.

Pine flatwoods (2). The pine flatwoods (Figure 4) is dominated by medium-sized pines, too widely spaced to form a continuous canopy. The sparse understory is dominated by low shrubs and grasses. This habitat occurs only on level sandy ground. The sands were deposited during Plio-Pleistocene marine conditions and contain a moderate amount of organics in the top soil and a shallow organic acid hardpan beneath. The hardpan reduces rainfall percolation, upward water movement, and root penetration. These conditions limit the number of species that can live in the habitat, in spite of the large area that it covers. They also cause the patchy distribution of many resident species.

The dominant pine species found on a particular site is a function of soil drainage: longleaf pine (*Pinus palustris*) at better-drained sites, pond pine (*P. serotina*) at more poorly drained sites (this species is not found in the study area), and slash pine (*P. elliottii*) at intermediate sites. Plants commonly associated with longleaf pine include wiregrass (*Aristida stricta*) and running oak (*Quercus pumila*); gallberry (*Ilex glabra*) and saw palmetto (*Serenoa repens*) are common in slash pine stands; and rusty lyonia (*Lyonia ferruginea*) and swamp bay (*Persea palustris*) dominate the understory in pond pine forests. Often intermingled with pine flatwoods are cypress domes (7) and bayheads (8), typically in wet depressions.

Periodic burning is essential in maintaining pine flatwoods. This habitat is a disclimax and the pines will undergo succession to oaks and other hardwoods if fire is excluded. In fact, many pine flatwood stands now possess a canopy of hardwoods because they have been protected from fire. Pine flatwoods is the dominant habitat in the eight counties, accounting for 48% (3,436 mi^2) of the total land surface area; it is much less common in the two southernmost counties. Pine Island (Lee County) is mostly pine flatwoods, although Davis (1967) does not classify it as such.

Southern slash pine forest (3). This habitat (Figure 5) has an overstory of medium-sized pines that sometimes form a patchy canopy. Where pines are dense, the understory is sparse; elsewhere there is a dense thicket of tall shrubs. The southern slash pine forest is located principally on thin soil overlying limestone, but also on sand flats intermediate in soil moisture. The limestone rocklands on which this habitat typically occurs are characteristic of much of south Florida, and are of the Tamiami formation on the peninsula and Key Largo formation (coral rock) in the Keys. As these limestones are hard, the overlying soil is difficult to drain. As a result, the slash pine forests of Collier and Monroe Counties are less suited for clearing and intensive agriculture than those of Dade County, where the same soil conditions do not exist.

A south Florida subspecies of slash pine (*P. elliottii* var. *densa*) is the dominant canopy tree in these relatively open forests. Bustic (*Dipholis*

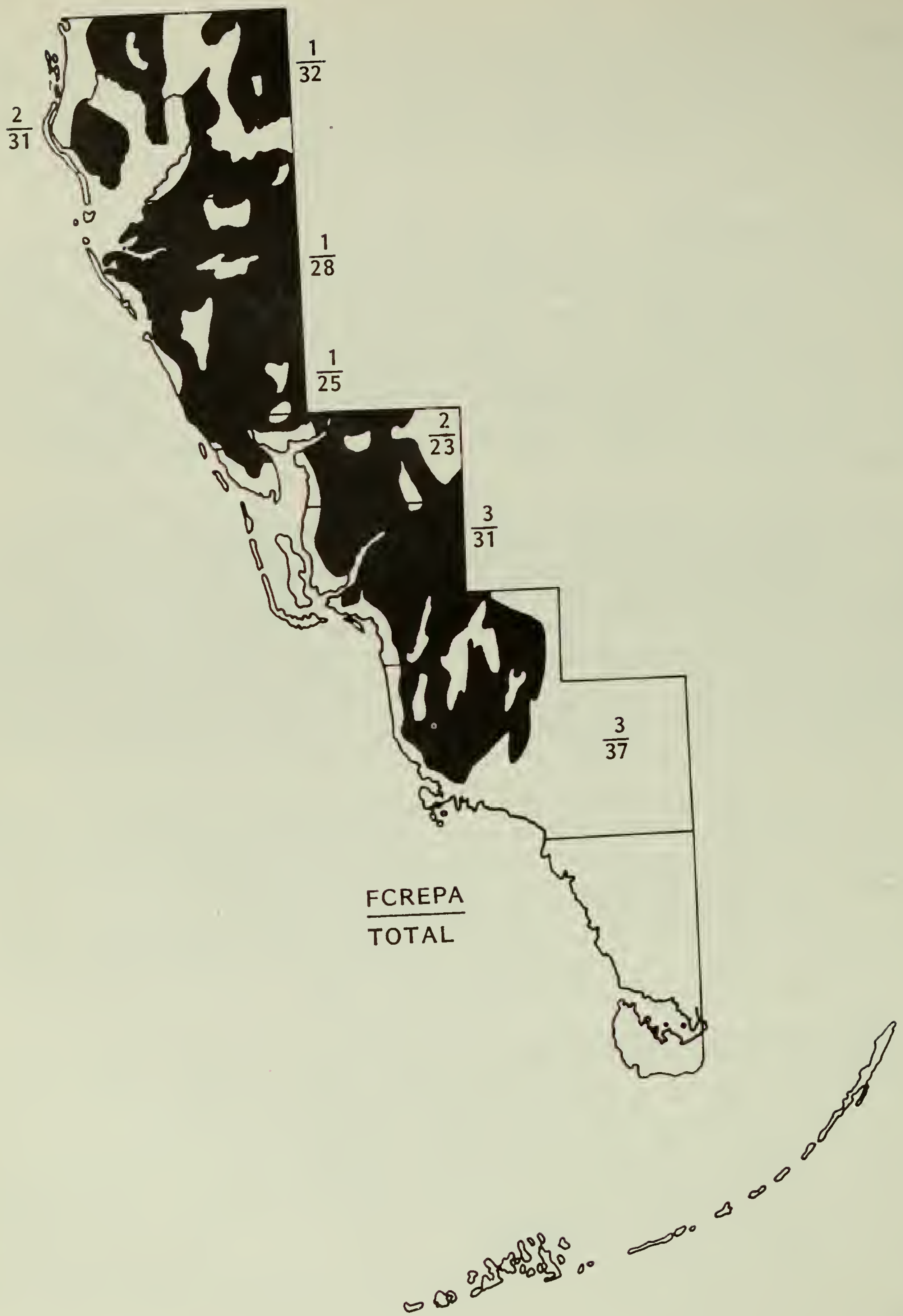

Figure 4. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the pine flatwoods habitat. Darkened areas denote pine flatwoods habitats of Davis (1967).

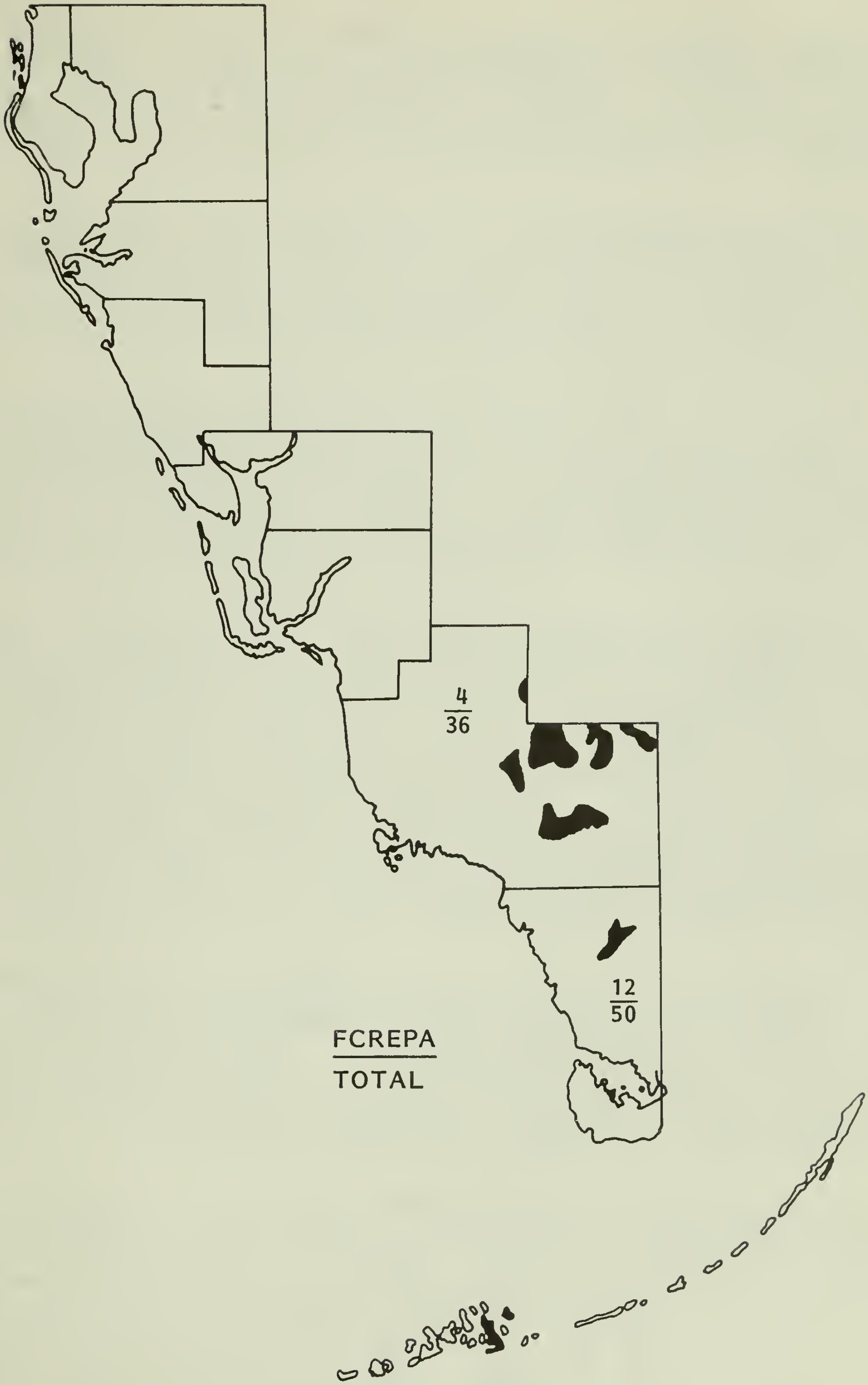

Figure 5. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the slash pine habitat. Darkened areas denote slash pine habitat of Davis (1967).

salicifolia), poisonwood (Metopium toxiferum), cabbage palm (Sabal palmetto), silver palm (Coccothrinax argentata), and various species of grasses are common in the understory. Periodic fires maintain the pine overstory by removing competing hardwoods. The habitat is restricted to Collier and Monroe Counties and accounts for less than 3% (215 mi^2) of the land area in the eight-county study area.

Sand pine scrub forest (5). The sand pine scrub forest (Figure 6) contains numerous low-growing oaks and scattered sand pines dominating the rolling topography of relict sand dunes (Plio-Pleistocene shorelines). These dunes are composed of deep, excessively drained, sandy soils (St. Lucie and Lakewood Series). The soils are acidic and of low fertility. Periodic fires retard intrusion by xeric oaks and other hardwoods.

The sand pine (Pinus clausa) dominated canopy is open and scattered. The thick, often clumped understory contains scrub oak (Quercus chapmanii), rosemary (Ceratiola ericoides), saw palmetto, and various species of scrubby hardwoods. Little ground cover is present. Sand pine scrub forest is uncommon in the eight southwest counties, covering only about 1% (72 mi^2) of the total land surface area. This habitat is largely confined to Charlotte, Lee, and Collier Counties.

Longleaf pine/xerophytic oak forest (6). This habitat (Figure 7), commonly called the "sandhill community," is characterized by tall, large longleaf pines with low shrubs and grasses growing in the ample spaces between them. The substrate is composed of well-drained white to yellowish (oxide coated) sand in gently rolling uplands. The sand is many feet deep and relatively sterile, but contains more organics than the substrata of the sand pine scrub forest (5). Again, fire is important in maintaining the overstory species. Wiregrass, the common ground cover, provides a superb fuel for fires; it also retards the germination and growth of hardwood seedlings. Tree species diversity is low and the overstory scattered. Where fires are excluded, understory turkey oak (Quercus laevis) and bluejack oak (Q. incana) enter the canopy.

Common plants are largely herbaceous and include wiregrass, beggar's tick (Bidens pilosa), partridge pea (Cassia chamaecrista), milk peas (Galactia spp.), and gopher apple (Licania michauxii). About 6% (429 mi^2) of the total study area is covered by this habitat; most occurs in Pinellas, Hillsborough, and Manatee Counties. More than one-quarter of each of the first two counties is covered by this forest type. The longleaf pine has been exploited for lumber for many years, and little of the habitat is pristine.

Cypress swamp (7). Cypress swamps (Figure 8) are composed of large cypress trees, often densely packed. Scattered among the cypress are patches of medium-sized hardwoods. Cypress swamps occur in depressions and on borders of lakes and rivers where standing water is at or above ground level for much of the year. The saturated conditions, together with fires, prevent succession to bayheads that would be dominated by broadleaf evergreen shrubs (8). Bald cypress (Taxodium distichum) dominates the canopy of wet margins while pond cypress (T. distichum nutans) dominates the canopy of depressions. Pond cypress and associated species form well-known "cypress domes." These are roughly hemispherical assemblages of trees, with the tallest individuals growing in the optimal, central locations.

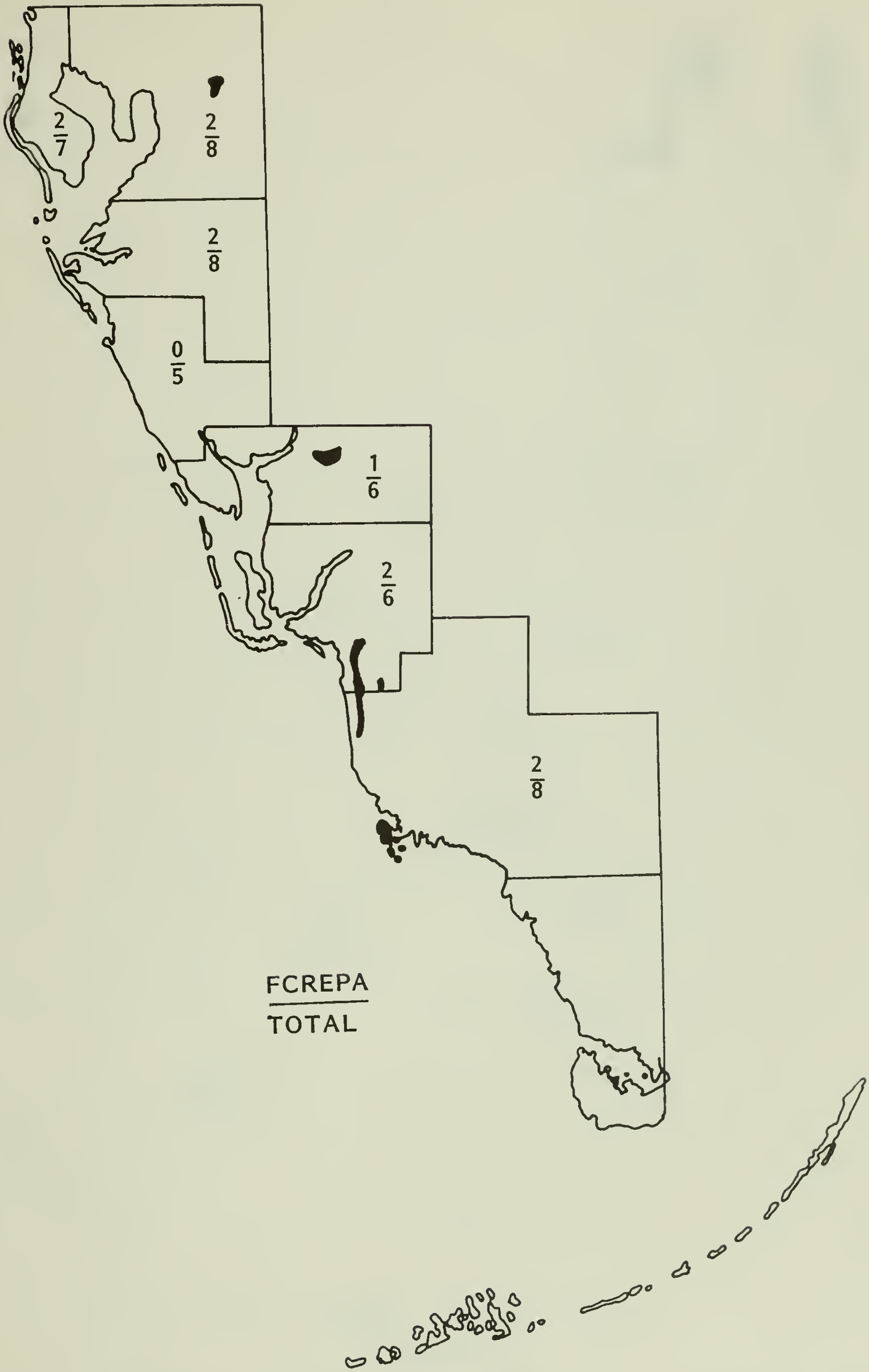

Figure 6. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the sand pine habitat. Darkened areas denote sand pine habitat of Davis (1967).

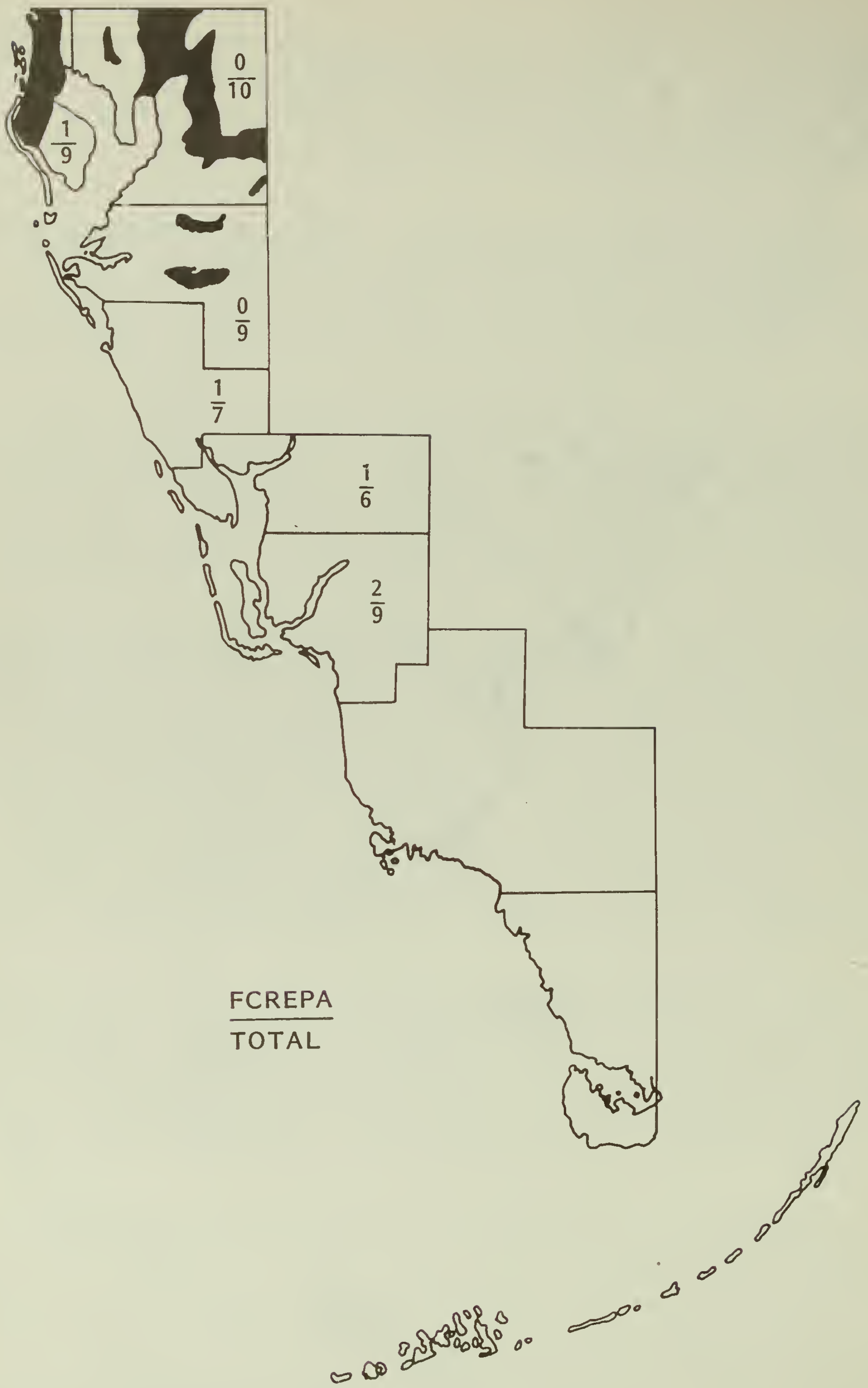

Figure 7. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the longleaf pine habitat. Darkened areas denote longleaf pine habitat of Davis (1967).

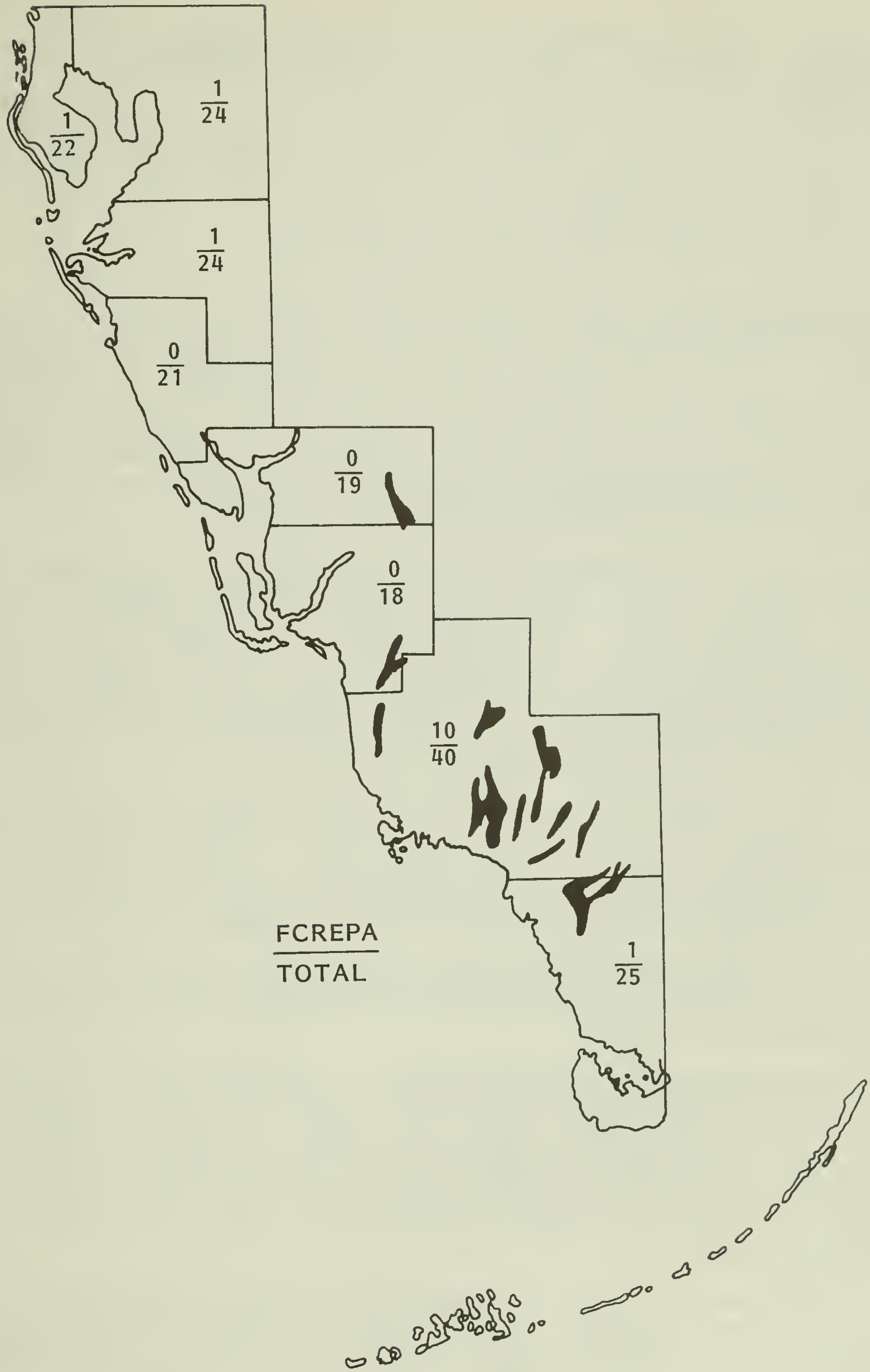

Figure 8. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the cypress swamp habitat. Darkened areas denote cypress swamp habitat of Davis (1967).

Black gum (Nyssa sylvatica), red maple (Acer rubrum), sweetbay (Magnolia virginiana), wax myrtle, water ash (Fraxinus caroliniana), willow (Salix caroliniana), and various species of ferns and epiphytes are common in cypress swamps. A typical south Florida open-water flora (arrowhead [Sagittaria spp.], pickerelweed [Pontederia cordata], sawgrass [Cladium jamaicensis], etc.) inhabits the standing water of the swamps. Depressions within other habitats, particularly pine flatwoods (3) and prairies (13), often support cypress domes. Cypress swamps cover about 3% (215 mi^2) of the total study area and are most abundant from Charlotte County southward.

Swamp forest (8). This forested habitat (Figure 9) consists of a variety of flood-tolerant hardwoods. Ground cover is minimal because of shading and flooding. Swamp forests border rivers and basins, where the forest floor is saturated or submerged for about half of the year (May to October) during periods of heavy rain. This seasonal flooding effectively excludes more mesic hardwood species. Small swamp forests may be dome shaped, as in cypress swamps (7), but larger stands are more forest-like. Many small swamp forests in south Florida are thought to have been replaced by hammocks when the deep solution holes they inhabited became filled with debris.

The dense, closed canopy of the wettest portions of the swamp forest is dominated by black gum, intergrading with cypress. Slightly higher areas support red maple, water oak (Quercus nigra), sweetgum, water ash, and water hickory (Carya aquatica). The habitat often intergrades with mesic forest. The shaded, humid interior supports dahoon holly (Ilex cassine), buttonbush (Cephalanthus occidentalis), willow, and various species of orchids and bromeliads. Ground cover is sparse, primarily patches of sawgrass in wetter areas and bracken fern (Pteridium aquilinum) in drier areas.

A major subtype of swamp forest is the bayhead. This is a broadleaf evergreen swamp inhabiting depressions within a number of habitats. Soils within bayheads are usually acidic peat. Water levels are relatively stable. Three distantly related species of similar morphology are dominant: red bay (Persea borbonia), sweetbay, and loblolly bay (Gordonia lasiantha).

Swamp forests comprise less than 3% (215 mi^2) of the total study area and are scattered mainly over Hillsborough (along the Hillsborough River), Charlotte, and Collier Counties.

Mangrove swamp and coastal marsh (9). Mangrove swamps (Figure 10) are forests consisting of from one to three species of trees: black (Avicennia germinans), red (Rhizophora mangle), and white (Laguncularia racemosa) mangroves. The morphology of these swamps varies considerably. Red mangroves often form dark, nearly impenetrable tangles of prop roots. Black mangroves, however, can occur as stands of widely spaced large trees with a carpet of low-growing halophytes.

Coastal marshes consist of dense to open stands of grasses (predominately Spartina spp. and Juncus). Most stands reach chest height, but patches of low vegetation are interspersed. This habitat is located on low-energy shores, often well up into tidal rivers.

The boundaries of these two communities shift in response to environmental pressures. Peat and quartz sand underlie the mangroves; shell or muck

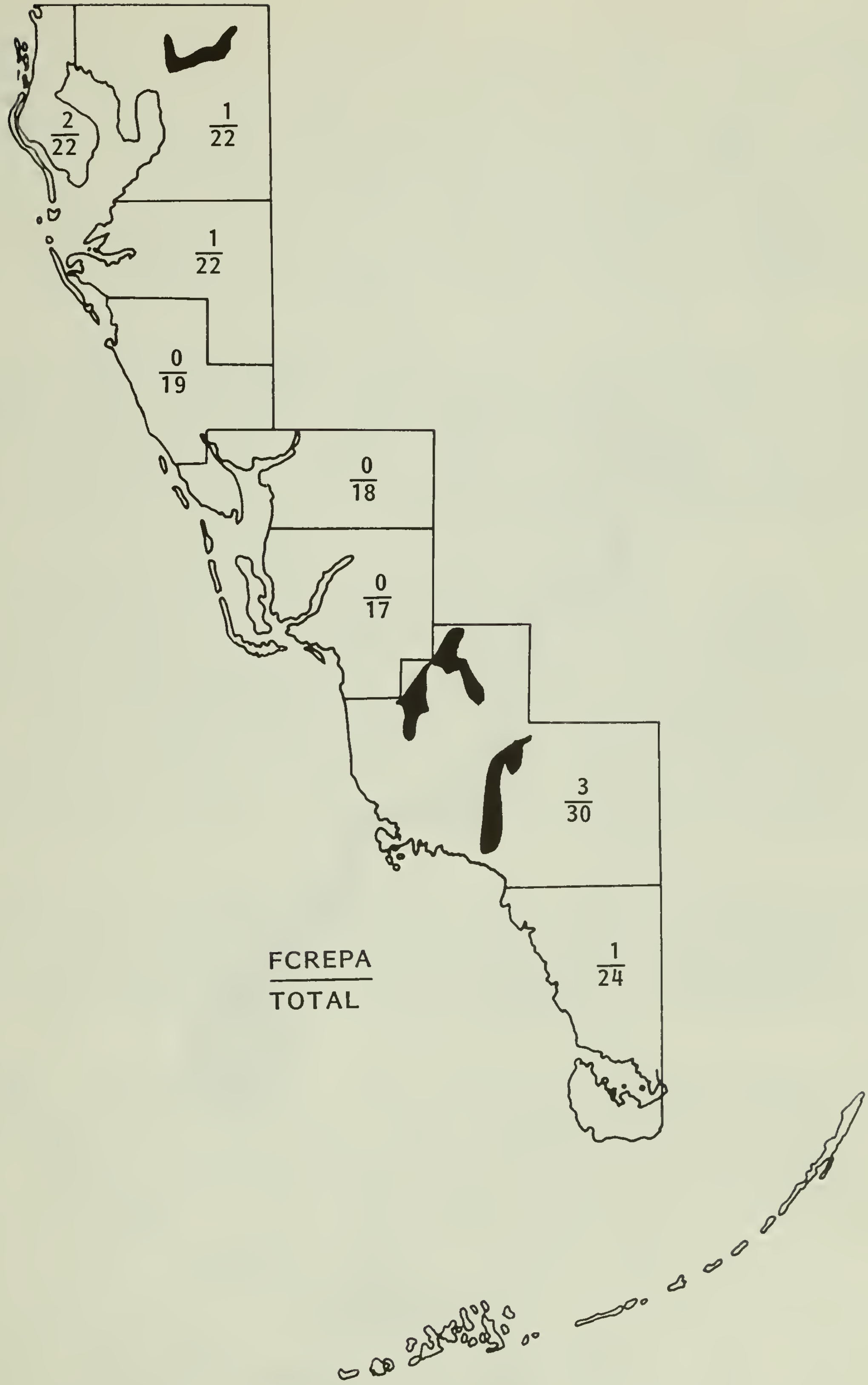

Figure 9. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the swamp forest habitat. Darkened areas denote swamp forest habitat of Davis (1967).

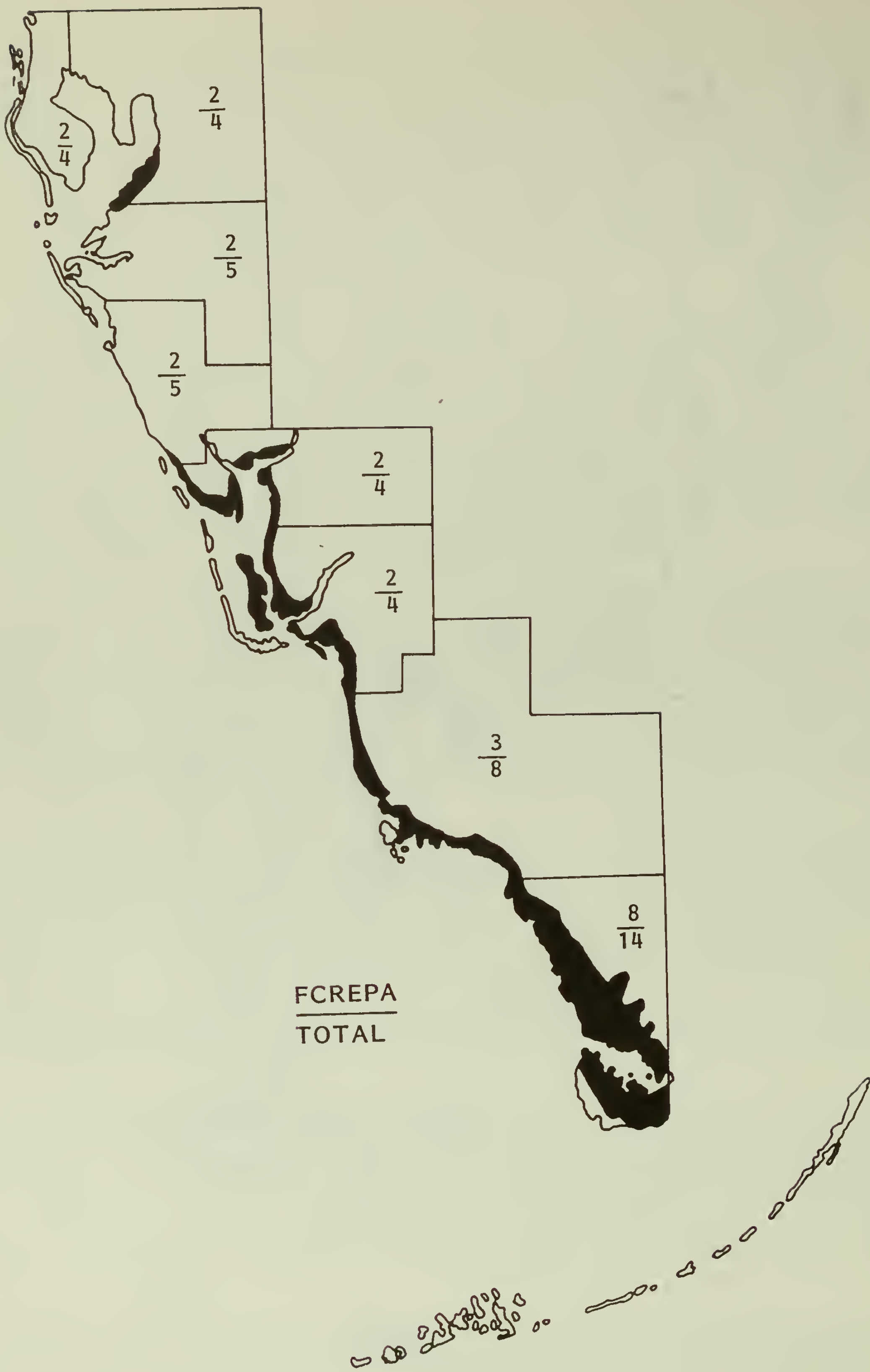

Figure 10. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the mangrove-marsh habitat. Darkened areas denote swamp mangrove-marsh habitat of Davis (1967).

underlies the marshes. Tidal regimes are a critical regulating factor for several reasons: (1) nutrient-rich detritus washes in and out of these communities, (2) various degrees of tolerance to tidally induced salt concentrations and desiccation promote conspicuous patterns of zonation, and (3) the low daily tidal amplitude along Florida's gulf coast causes the formation of irregularly flooded black mangrove/saltwort flats and glasswort salt pans. Marshes are not as extensive within the eight southwest counties as they are north of Tampa Bay. The northern limit of mangroves apparently is a function of freezing temperatures during the winter since mangroves cannot endure prolonged cold. Within their ranges, mangroves probably out-compete the marsh grasses and rushes through shading.

Common plants in mangrove swamps include red, white, and black mangroves, saltwort (Batis maritima), and glasswort (Salicornia spp.). Cordgrasses (Spartina spp.), black rush (Juncus roemerianus), and saltgrass (Distichlis spicata) dominate coastal marshes. Mangrove and coastal marsh communities often intergrade at the landward margin with freshwater marsh (16). This habitat covers 12% (859 mi^2) of the total surface area, becoming increasingly more conspicuous from Charlotte Harbor southward. Mangrove swamps comprise nearly half of Monroe County.

Prairie grassland (13). This habitat (Figure 11) includes periodically flooded grasslands (wet prairies) and seldom flooded grasslands (dry prairies). Wet prairies are similar to freshwater marshes (16), but are shallower and have a larger complement of grasses. Dry prairies are vast, treeless plains, often scattered with bayheads (8), cypress domes (7), and palm hammocks. The prairie grassland habitat occurs on level substrates consisting of shallow marl (formed from algal mats) or sands of various particle size, permeability, acidity, and depth. In Collier County, it often occurs on thin soil overlying limestone. Frequent fires on the prairies retard the growth of shrubs and trees.

Wet prairies are dominated by various grasses and some submerged and emergent species, depending upon water levels. Dry prairies are dominated by communities of grasses (wiregrass, broomsedge [Andropogon virginicus], carpet grass [Axonopus affinis]), saw palmetto, fetterbush (Lyonia lucida), and various herbs. Prairie grassland covers 4% (286 mi^2) of the total study area, mostly around Charlotte Harbor and in Collier County.

Open scrub cypress (14). Open scrub cypress habitat (Figure 12) is dominated by grasses and rushes, but also contains a moderate density of small cypress trees. The substrate is regularly flooded marl or rock soils, but at higher elevations than the adjacent Big Cypress Swamp and Everglades. These soils are poor in nutrients. The habitat occurs in an area of heavy rain, trapped efficiently by the eroded, relatively impervious limestone. As a result, the surface is wet in summer but somewhat dry in winter. This habitat occurs on sites intermediate in soil moisture between those that support cypress swamp (wetter) and hammocks (drier). Hardwood and palm hammocks (described separately) are found on slightly higher ground within the scrub cypress. These hammocks usually lie on a substratum of peat. Areas that are lower and always wetter support typical domes of taller cypress (7).

The open scrub cypress vegetation is primarily marsh (sawgrass, beakrushes [Rhynchospora spp.], and wax myrtle) with scattered dwarfed pond

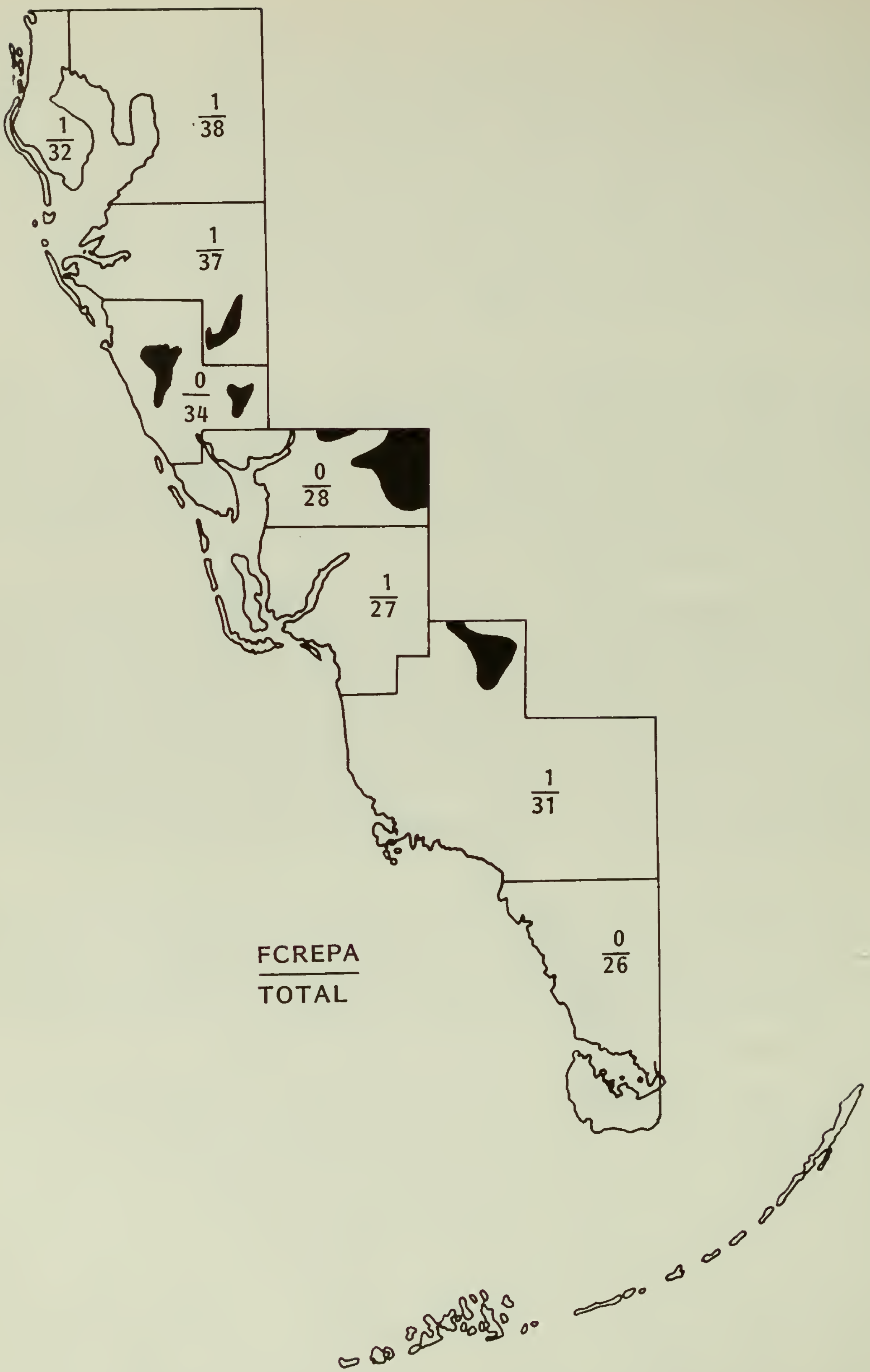

Figure 11. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the prairie grassland habitat. Darkened areas denote prairie grassland habitat of Davis (1967).

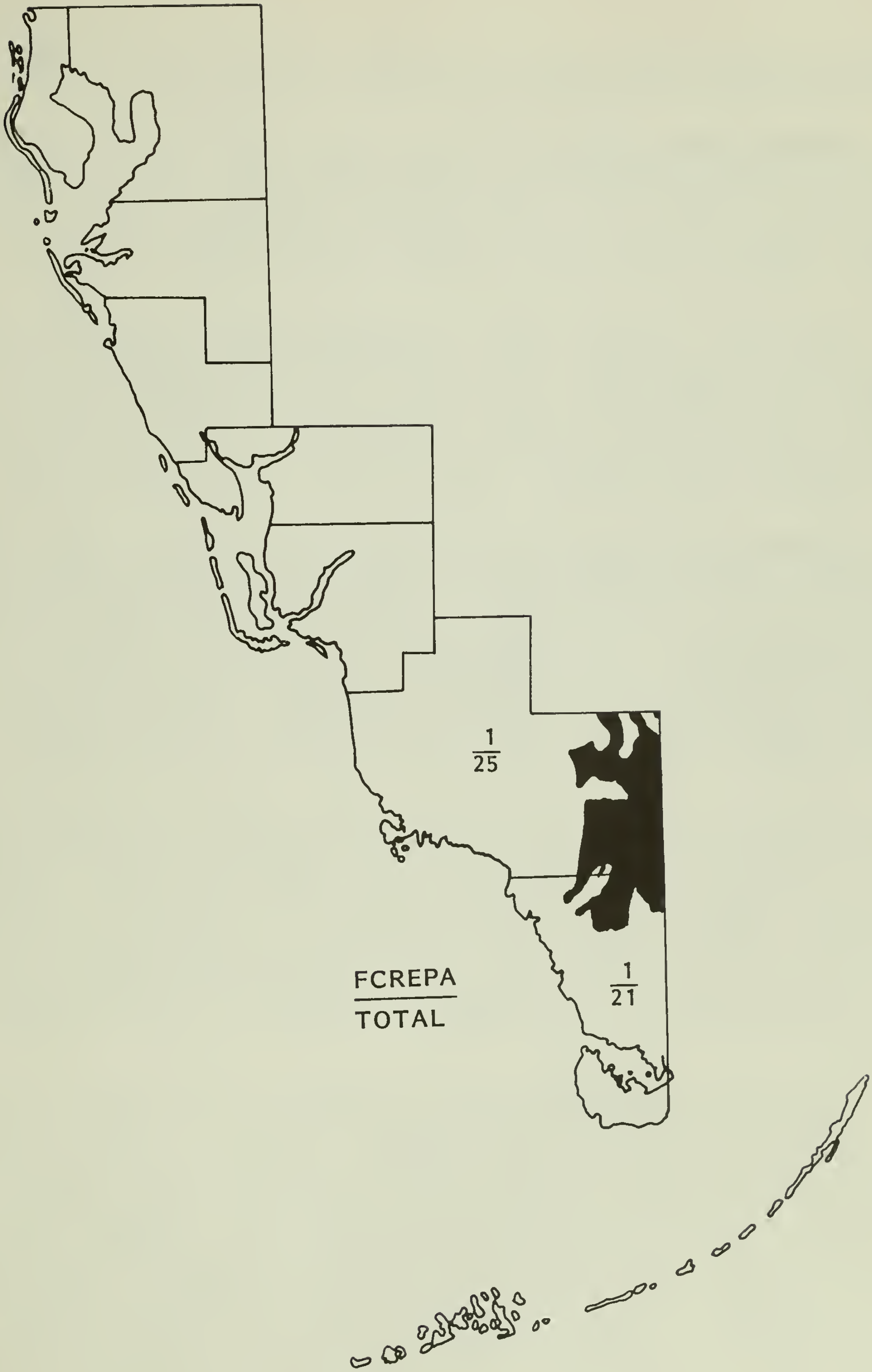

Figure 12. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the scrub cypress habitat. Darkened areas denote scrub cypress habitat of Davis (1967).

cypress. Orchids and bromeliads are common. This habitat covers 8% (573 mi^2) of the total land surface area, all within Collier and Monroe Counties.

Freshwater marsh (16). Freshwater marshes (Figure 13) vary from 6 ft high stands of rushes and cattails to lush, low-growing expanses of broadleafed forms. These marshes occur on highly organic muck soils that are nearly always saturated or covered with surface water. Submerged and emergent herbaceous species dominate these marshes; arrowroot (*Thalia geniculata*), pickerelweed, various rushes, and arrowhead are common.

Subtypes of freshwater marsh are recognized by their dominant plant species and include sawgrass marsh, spike-rush marsh (*Eleocharis* spp.), and cattail marsh (*Typha* spp.). Many marshes are not dominated by one species. Freshwater marsh often intergrades into wet prairies (13) and shrubs on higher margins. This habitat is widely scattered as wet borders along and within other habitats. Less than 1% (72 mi^2) is found in the eight southwest counties, and the only extensive fresh marshes are in eastern Collier County.

Everglades region marsh, slough, wet prairie, and tree islands (16B). The everglades habitat (Figure 14) is a composite of several types of marshes within which are scattered areas of higher ground supporting forested "tree islands." Tree islands are lenticular in shape and are molded to the prevailing drainage pattern. They may contain various plant associations, from swamp forest (8) to hammock (described below). Except for tree islands, the habitat is usually flooded during the summer rainy season. Sloughs are marshy creeks, holding deeper water than the surrounding areas. The substrate is mostly alkaline peat and marl, overlying limestone that is commonly emergent.

Remains of sawgrass peat indicate that sawgrass communities may have covered the areas between tree islands as recently as 1900 (this would make the area similar to the habitat 16A [Davis 1967] which is not described here as it presently occurs in Palm Beach and Broward Counties). Drainage and subsequent oxidation of the peat has altered the area to its present mixed condition. Characteristic habitat subtypes are (1) sawgrass marshes; (2) bayheads (8); (3) willow heads, which have developed with the increasing oxidation of the peat; and (4) spike-rush marshes. This habitat mosaic covers less than 1% (72 mi^2) of the study area, and all of it is in western Monroe County.

Wet to dry prairie marsh on marl or rockland (17). Prairie marsh (Figure 15) comprises two principal subtypes: sawgrass on deep peat beds and spike-rush on shallow marl. The habitat, however, is extremely diverse in vegetational morphology. As many as 16 total subtypes may be defined, ranging from tropical hardwood hammocks to dwarf red mangrove bordering small ponds. A few tree islands occur, as well as bayheads, palm savannas, cypress domes, and willow heads. Water drains into the area from the Shark River Slough, the higher pinelands, and the Big Cypress Swamp. In addition, considerable seepage from bedrock probably occurs. The result is a large variation in water levels throughout the year, from rarely flooded to permanently flooded. The habitat covers 9% (644 mi^2) of the study area, all within Collier and Monroe Counties.

Hammocks. Hammocks (Figure 16) are mesic hardwood forests of central and south Florida. They are located only where fires are rare. North of the

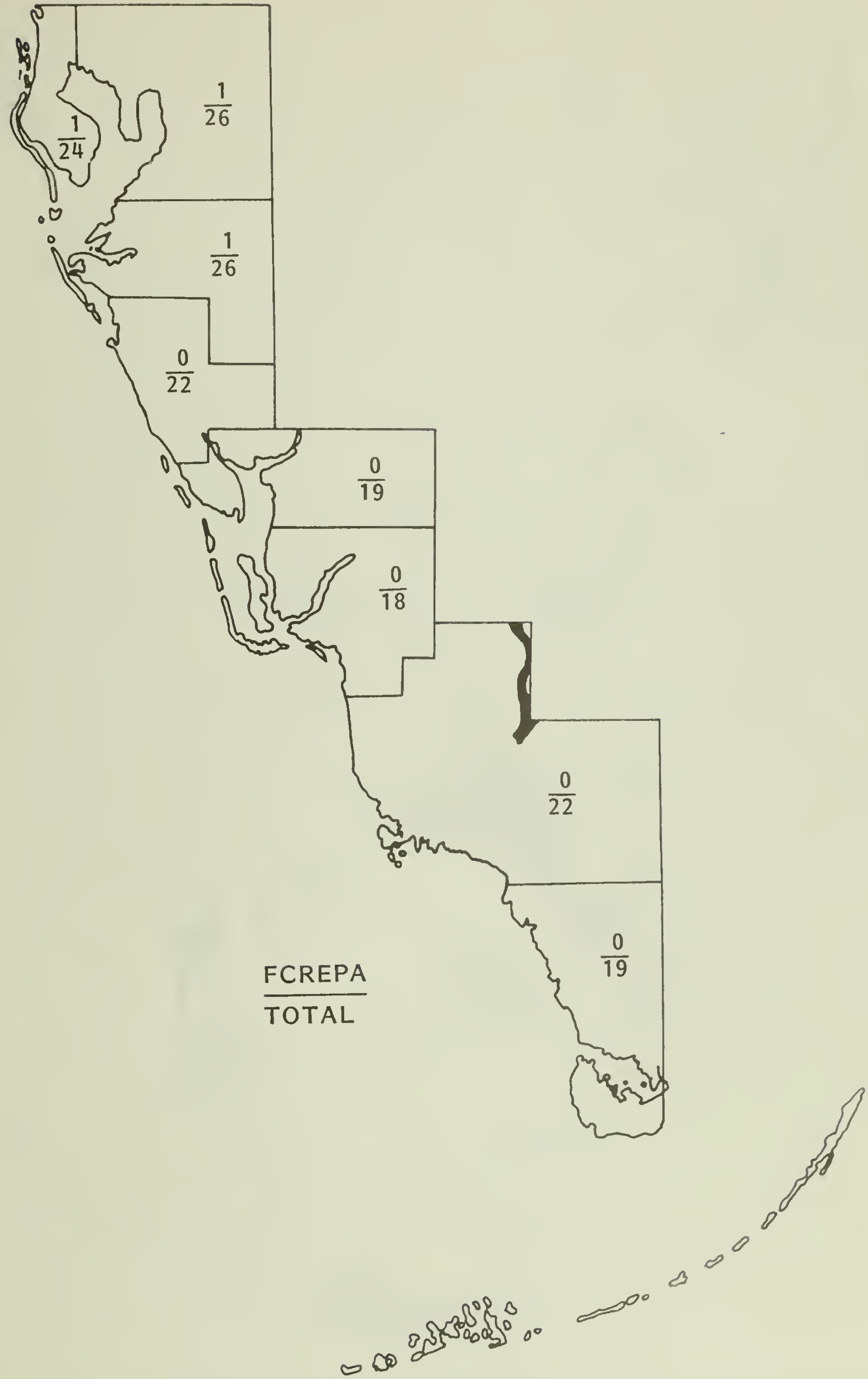

Figure 13. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the freshwater marsh habitat. Darkened areas denote freshwater marsh habitat of Davis (1967).

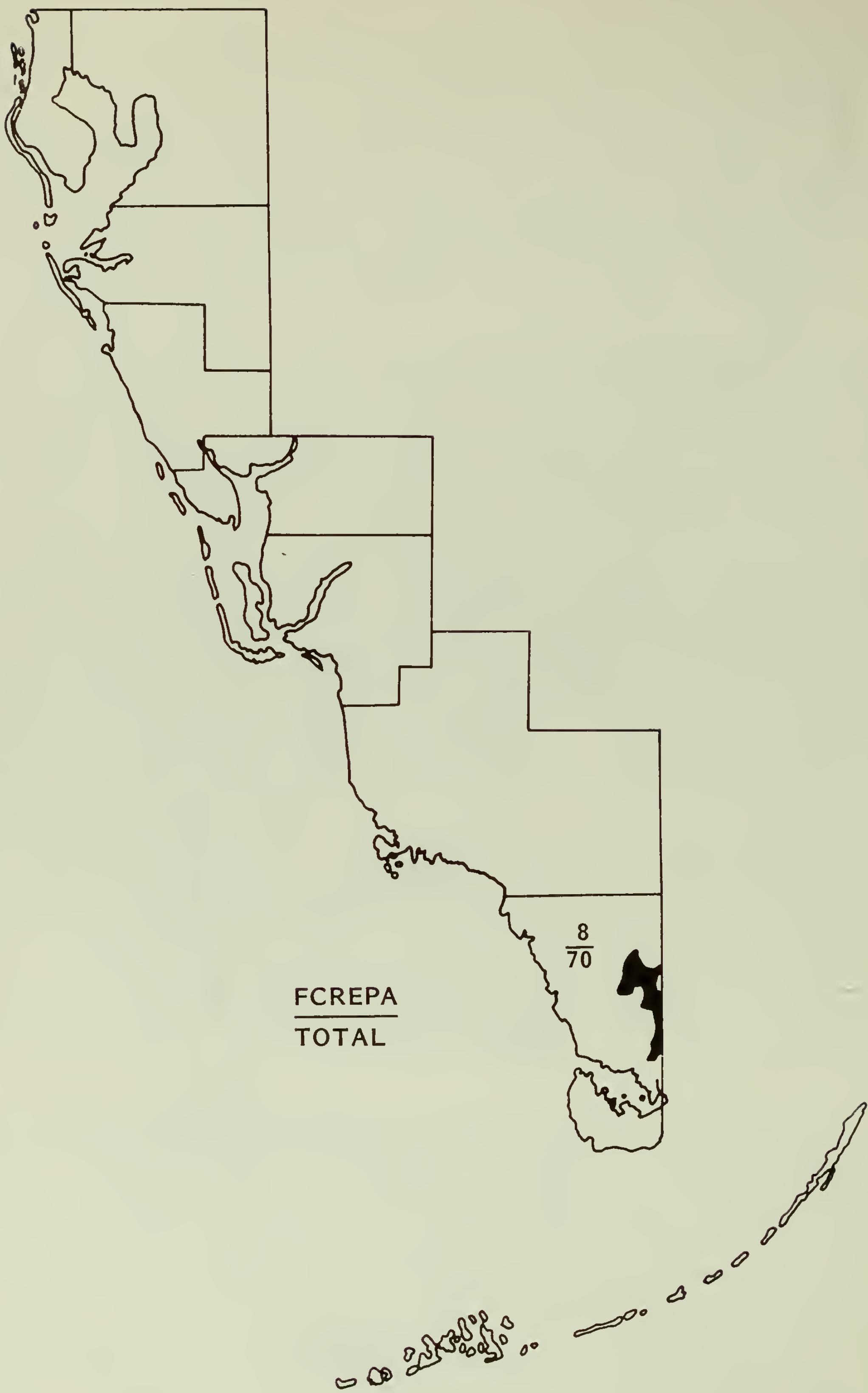

Figure 14. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the everglades region habitat. Darkened areas denote the everglades region habitat of Davis (1967).

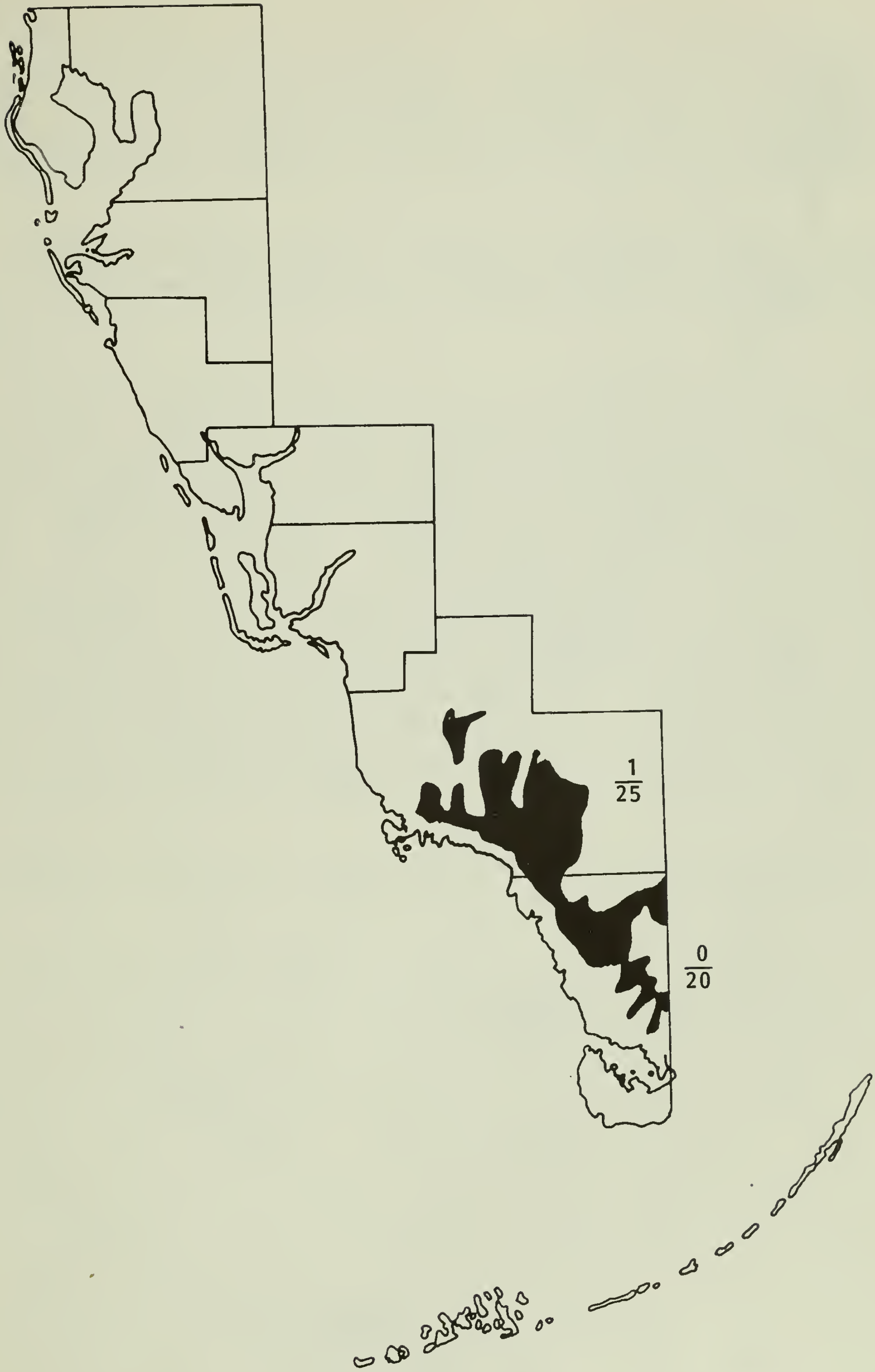

Figure 15. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the prairie marsh habitat. Darkened areas denote prairie marsh habitat of Davis (1967).

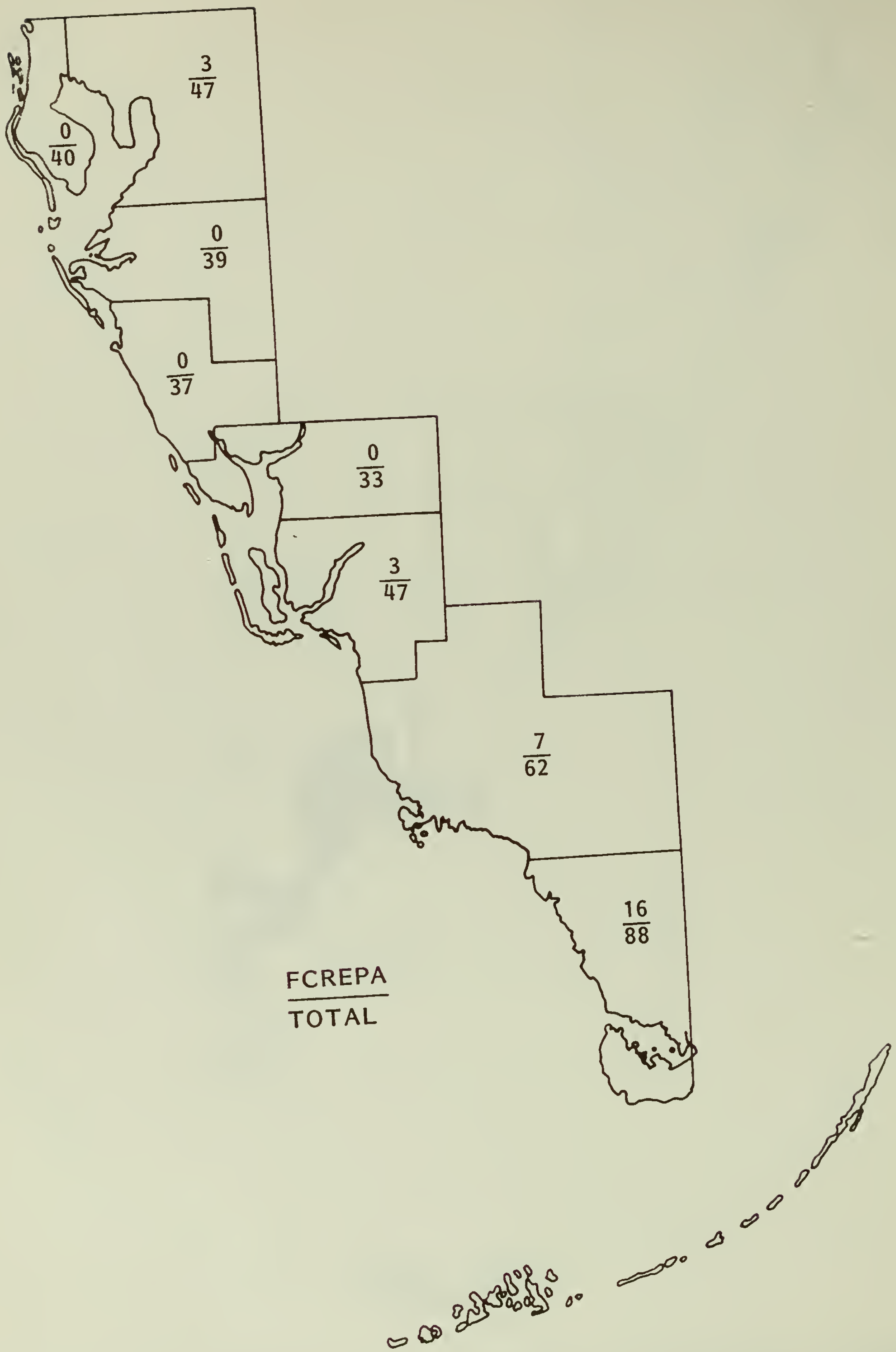

Figure 16. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the hammock habitat.

Everglades, hammocks occur on fairly rich sandy soils and are best developed on limestone or phosphate outcroppings. Variations in soil moisture and other factors promote high plant diversity. Southern magnolia (Magnolia grandiflora), laurel oak (Quercus laurifolia), American holly (Ilex opaca), blue beech (Carpinus caroliniana), and hop hornbeam (Ostrya virginiana) are characteristic species.

Two major subtypes of this hardwood association are coastal hammocks and live oak/cabbage palm hammocks. The former occur in narrow bands along the coast, often extending to the edge of coastal marshes. The latter often border lakes and rivers in prairies. Either oaks or palms may dominate particular hammocks.

Tropical hammocks are found in the Everglades on tree islands and in the Florida Keys. Remnants of these distinct associations may occur as far north as Sarasota. The tropical hammocks are characterized by high plant species diversity, containing 35 or more tree species and as many as 65 species of shrubs. Hammocks contain many tropical species, such as strangler fig (Ficus aurea), gumbo-limbo (Bursera simaruba), mastic (Mastichodendron foetidissimum), bustic and poisonwood. Vines, ferns, and air plants are conspicuous.

Shell mounds. Shell mounds (Figure 17) are a natural habitat found along or near the coast around the tip of Florida. They form the highest elevations in the coastal zone (Florida Coastal Coordinating Council 1972). They are mostly buried oyster bars built up by storm tides. The soils are a mixture of dark brown organic matter and broken shell, and are well drained and well aerated. The vegetation growing on these mounds consists chiefly of tropical hardwood trees, similar in composition to tropical hammocks. Most of these were occupied by pre-Columbian Indians, and many were subsequently farmed.

Other. A final map (Figure 18) shows the distribution and numbers of plant species that cannot be matched to any habitat classification. These species occur on open water, in disturbed areas, or are truly cosmopolitan.

Summaries of total numbers of species within each habitat and within each county are presented in Figures 19 and 20. Figure 19 points out important similarities and differences in emphasis between the FCREPA tabulation and the total list presented in Table 1 (prairie marsh tabulation includes only the hydrophilic species found there). The two lists are quite similar in delineating a number of important concentrations of species within habitats (hammocks, slash pine forest, and cypress swamp, for example). These similarities cause the two listings of species, as distributed over the habitats, to be correlated positively (Kendall's Tau; $K = 40$, $p < 0.01$). The deviation between the two distributions is attributable largely to two habitat groupings. Certain inland wet habitats (prairie grassland, freshwater marsh, pine flatwoods) are over-represented in the total list relative to the FCREPA list. Coastal habitats (coastal strand, mangrove swamp, coastal marsh, and shell mounds) are over-represented in the FCREPA list relative to the total list. This pattern results from the fact that many of the non-FCREPA plant species protected by the State of Florida (Florida Statutes 1979; a large number of ferns and orchids, for example) occur in wet habitats.

The distributions of species among the eight counties (Figure 20) follow similar patterns for both the total and FCREPA lists. The maxima occur in

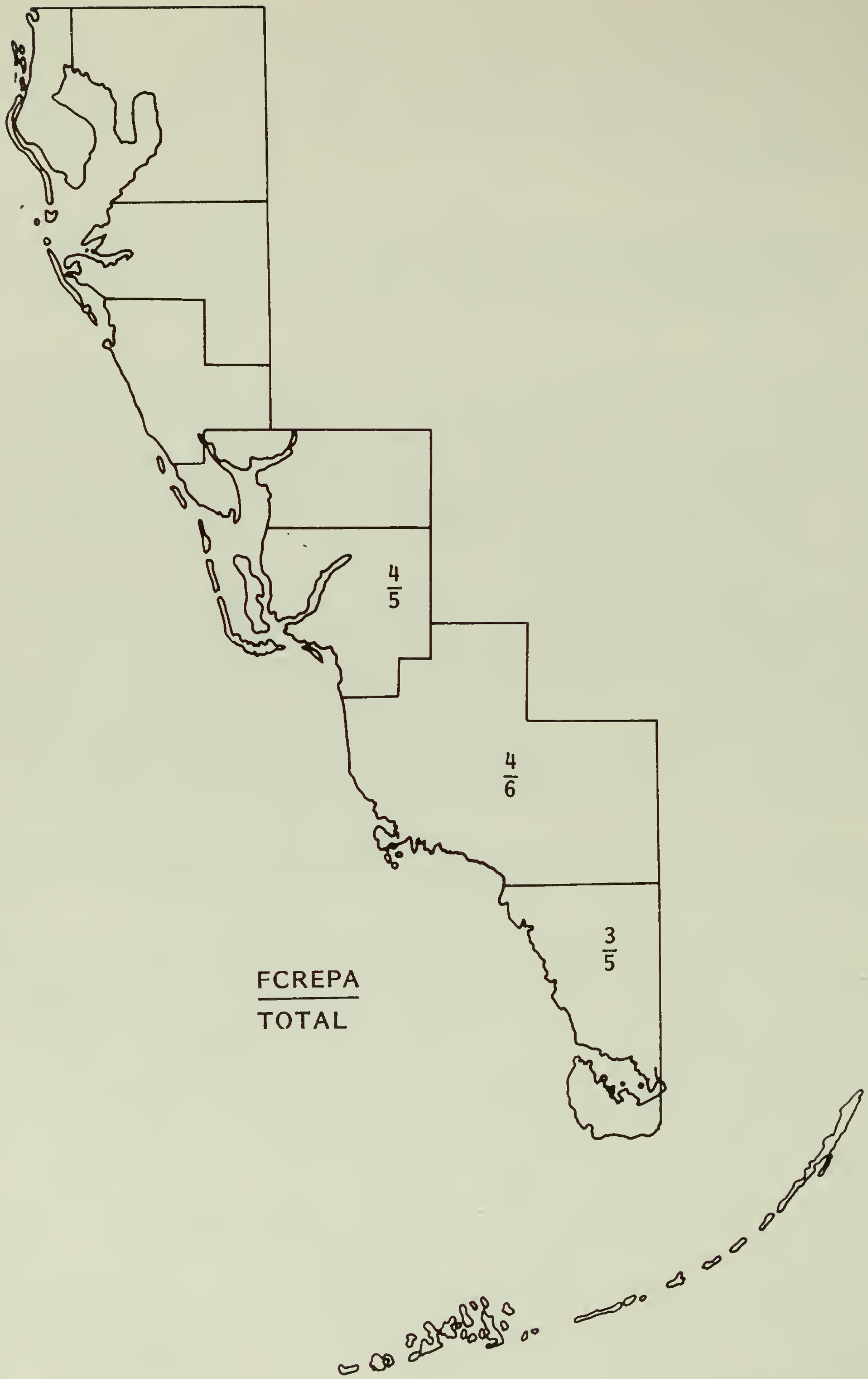

Figure 17. Distribution and numbers by county of plant species on the FCREPA list (upper number) and the total list (lower number) found in the shell mound habitat.

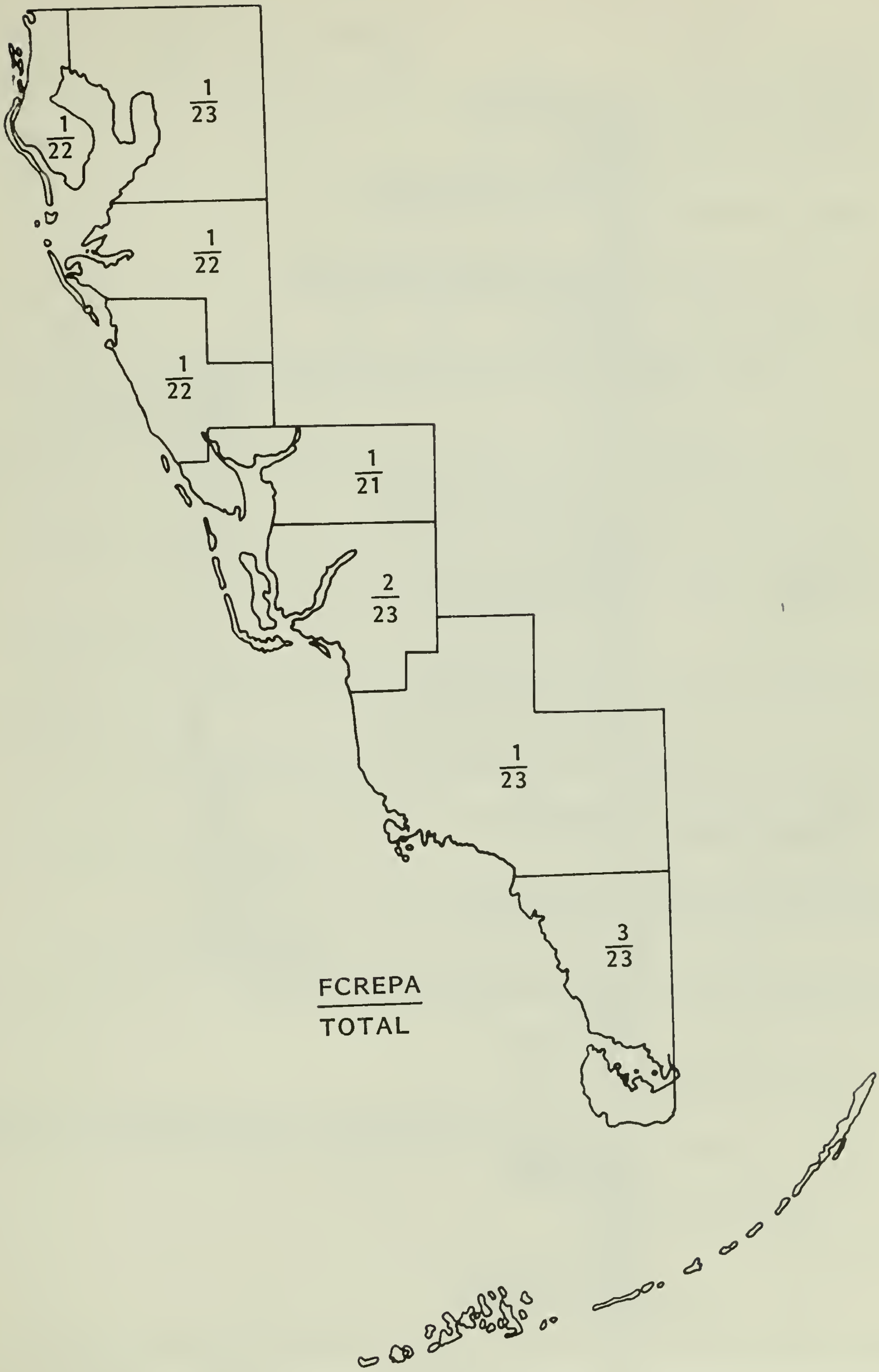

Figure 18. Distribution and numbers by county of other plant species found on the FCREPA list (upper number) and the total list (lower number) in the study area.

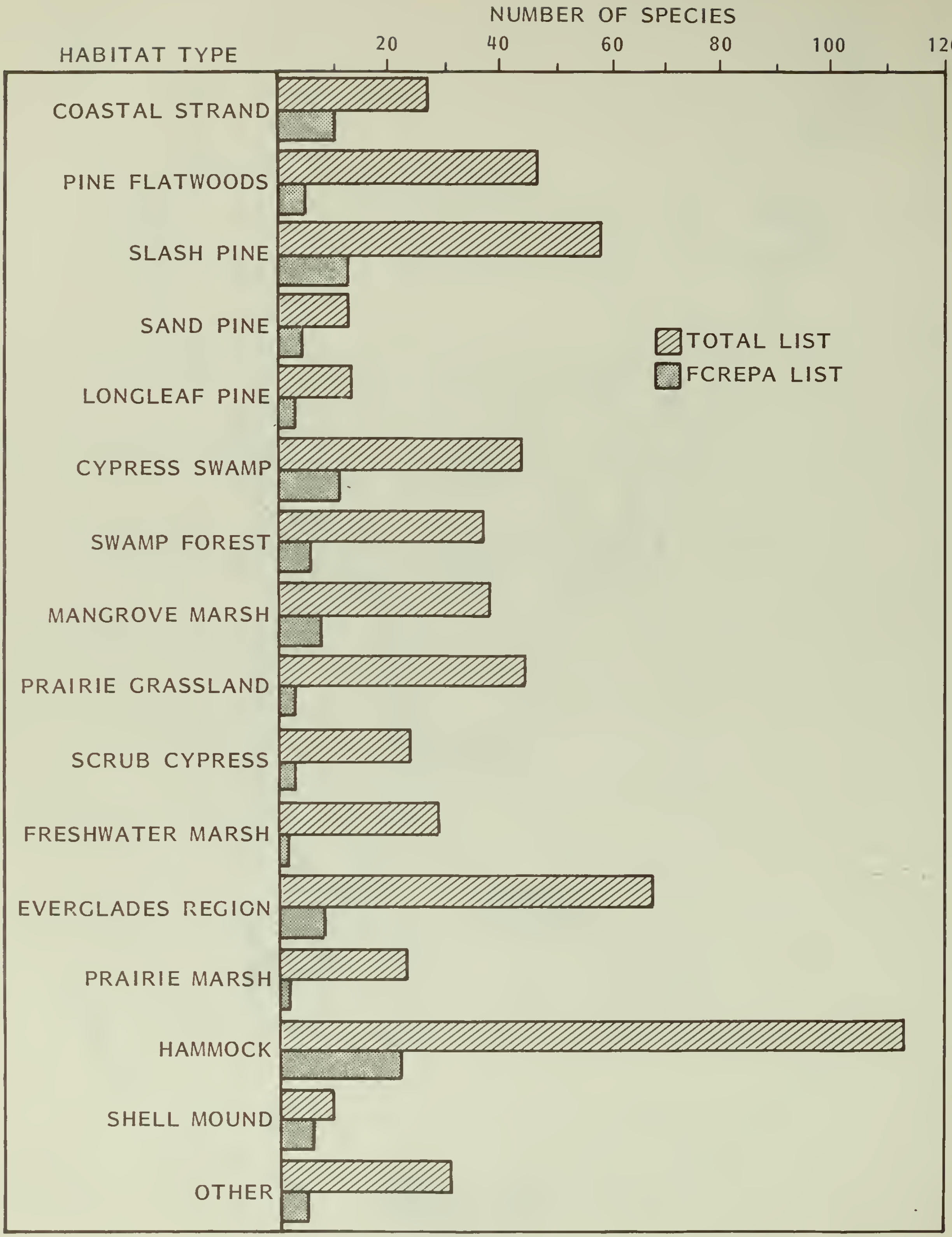

Figure 19. Distribution of 274 rare, threatened, and endangered plant species among 16 habitat types in southwest Florida. Identities of the species found in each habitat are in Appendix A.

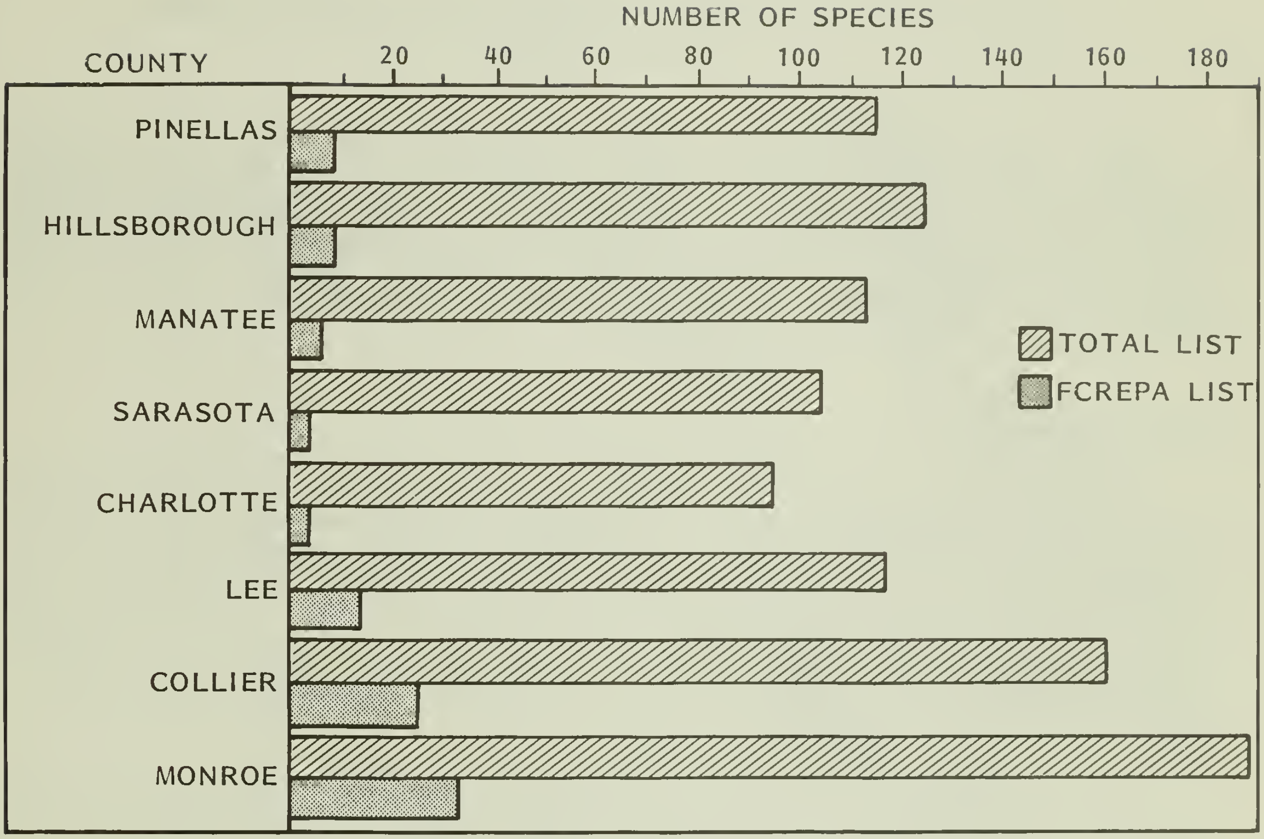

Figure 20. Distribution of 274 rare, threatened, and endangered plant species within the eight-county study area. Identities of the species found in each county are in Appendix B.

quasi-tropical Collier and Monroe Counties. The numbers of species within these two counties would be nearly equal if plant species endemic to the Keys were excluded, i.e., comparing only mainland Collier and Monroe Counties. The principal difference between the two distributions is the relatively larger numbers of species in the northern counties on the total list in comparison with the FCREPA list, particularly in Hillsborough County. This pattern reflects the presence of many Coastal Plain species on the total list that barely reach southward to the Tampa Bay area.

CAUSES OF RARENESS AMONG THE PLANTS OF THE EIGHT SOUTHWEST FLORIDA COUNTIES

Plant species may be rare in Florida for basically the same reasons as elsewhere: (1) natural causes (without human influence, as far as can be determined); (2) destruction or removal of the plants themselves, mostly by collection; and (3) alteration of habitat. Their plight is so obvious because of the sheer number of rare species and the extrememly fragile ecological settings in which many plants occur. This magnifies the probability of rareness in Florida.

NATURAL CAUSES

Many species of plants and animals are naturally rare. Habitat requirements may be extremely specific, competitive pressures may be severe, or specific pollinator populations may be small. These are only three of many possible reasons. For most naturally rare plant species, virtually no information on life histories or population dynamics exists. This information could provide potential explanations for their rarity. Several dozen examples of such species with naturally rare distributions and about which little is known occur in the study areas; seven are on the FCREPA list.

There is another, more easily understood reason for plants to be naturally rare in Florida. As discussed earlier, much of terrestrial Florida and virtually all of the study area are of recent origin. In the last half of the Pleistocene epoch, seas covered perhaps half of peninsular Florida (Alt and Brooks 1965), thereby excluding terrestrial plant species (Figure 21). Central and south Florida now contains a number of plants with disjunct populations, whose centers of distribution occur in Central or South America. These plants most likely arrived in Florida only recently from these tropical locations by over-water dispersal. This situation effectively makes peninsular Florida an "island" for these species, with all the concomitant problems of island colonization (enumerated in Carlquist 1974). These colonizers generally have low abundances in south Florida, and their movement up the peninsula is restricted by the subtropical and temperate weather conditions. In addition, the probability of natural recolonization of a particular species from the New World tropics is very small. Thus, any factor that adversely affects populations of these species, even in an apparently minor way, may be extremely damaging. Figure 22 classifies the world distribution of the species listed in Table 1. Data for this figure were compiled from various species accounts cited in the references. The importance of endemics (many with neotropical affinities) and circum-Caribbean species is evident.

Figure 21. Florida's present shore and Pamlico Shore (about 100,000 years ago) when sea level was 25 ft higher (redrawn from Hoffmeister 1974).

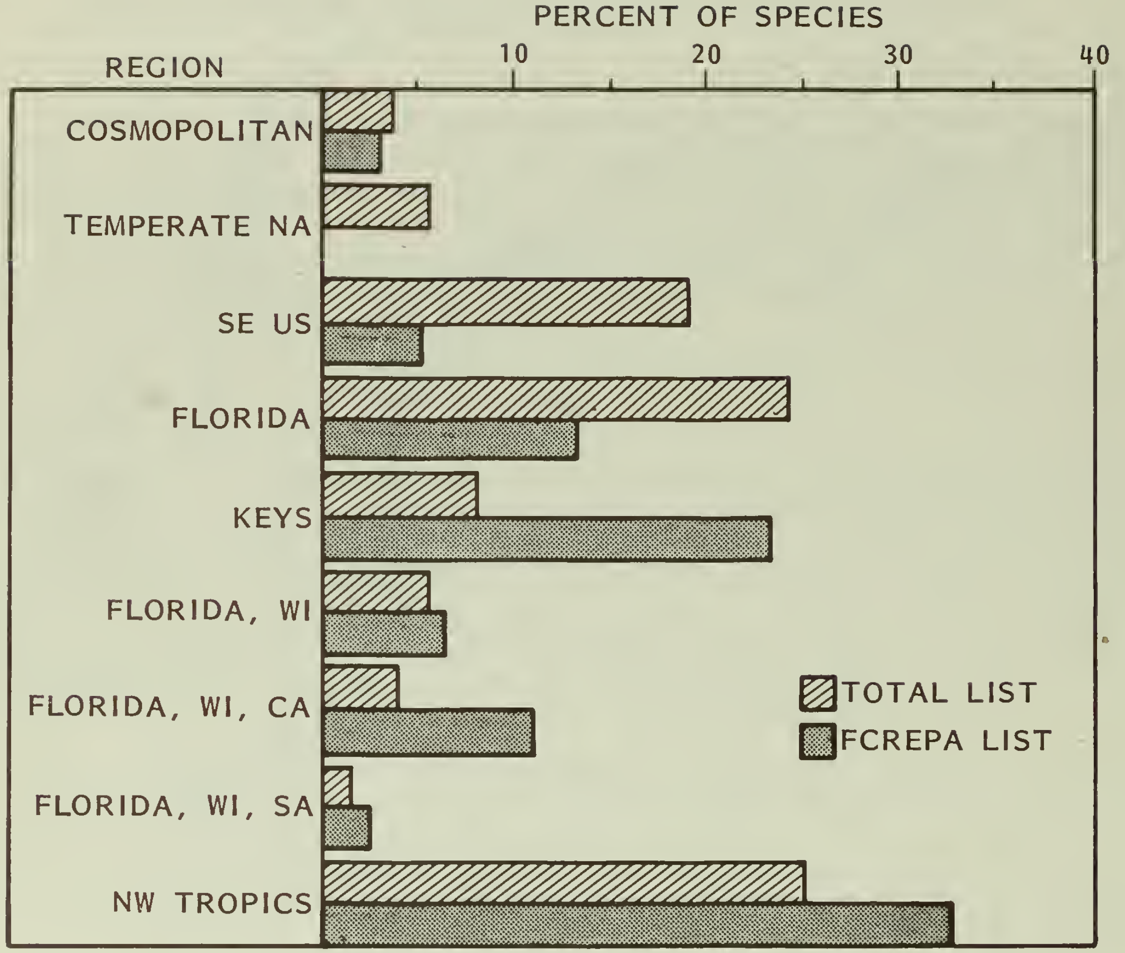

Figure 22. Biogeographical distribution by region of the plant species in Table 1. These data were gathered from published accounts of species cited in the References. NA = North America, SE = Southeast, US = United States, WI = West Indies, CA = Central America, SA = South America, NW = New World.

Further study of the populations of these rare species in Florida is imperative if we are to understand how they are to be preserved. Clues to their ecological requirements can be derived from studies of other populations of the same species located in the tropics, where most are relatively more abundant. Unfortunately, any plant that is naturally rare is vulnerable to man-imposed pressures (see following two sections). The royal palm (Roystonea elata) suffices as an example even though there is doubt this species is native (R. Wunderlin, University of South Florida, Tampa; personal communication). During the 1920's, a number of municipalities in South Florida used this handsome hammock tree to line boulevards. The wild populations of the species have not recovered from this exploitation, and subsequent destruction of many hammock areas has aggrevated recovery.

DESTRUCTION OF PLANTS

Many Florida plants are highly desired for landscaping or collection. Removal of plants from natural habitats can escalate rapidly, a process especially foreboding for naturally rare plants. Unfortunately, naturally rare plants are usually the most prized.

Of the plant species in Table 1, more than 80 of these are on the CITES list and are generally marketable, so as to produce a favorable return to those interested in selling them. In addition, many ferns and air plants, not on the CITES list, are also saleable. Orchids are most intensely affected by wholesale collection. Many orchid species would have been extirpated by now if not for the inaccessibility of some of the locations in which they grow. The Fakahatchee Swamp in Collier County is a prime example of the value of inaccessibility. The severely endangered rat-tailed orchid (Bulbophyllum pachyrhachis), leafless orchid (Campylocentrum pachyrrhizum), dollar orchid (Encyclia boothiana), dwarf epidendrum (Encyclia pygmaea), Acunas epidendrum (Epidendrum acunae), and snake orchid (Restrepiella ophiocephala) all are restricted presently to the Fakahatchee Swamp.

ALTERATION OF HABITAT

The literature indicates that, by far, the most severe impingement on plant species is loss of habitat to man's activities. This problem is especially conspicuous in Florida, as the State is the eighth most populous (Thompson 1979). Florida, an important agricultural producer, is 25th in the amount of agricultural land (Department of Agriculture 1980). Land is constantly usurped for farming and for urbanization. In addition, phosphate mining activities are a significant and potentially greater disturbance in Hillsborough and Manatee. Smaller-scale disturbances include mosquito control activities and public facilities, such as power plants, sewage treatment plants, rights-of-way, and air- and seaports.

The habitat destruction in the eight southwest Florida counties is presented below in several ways. Table 4 lists the amount and percentage of urbanized (including public facilities), agricultural (including intense cultivation, but not rangeland or forested lands), and conserved land in the

Table 4. Areal extent (mi^2) and percentage of land in each county occupied by agricultural, urban, conserved, and other land uses (from Thompson 1979). Numbers in parentheses are from GS LUDA maps (1976) as determined by the Florida Resources and Environmental Analysis Center (1981).

County	Total (mi^2)	Agricultural		Urban[a]		Conserved		Other land use	
		mi^2	%	mi^2	%	mi^2	%	mi^2	%
Pinellas	265	41 (28)	15 (11)	135 (127)	51 (48)	23	9	66	25
Hillsborough	1038	564 (458)	54 (44)	145 (194)	14 (19)	40	4	289	28
Manatee	740	366 (290)	49 (39)	54 (37)	7 (5)	64	9	256	35
Sarasota	587	317 (128)	54 (22)	67 (64)	11 (11)	57	10	146	25
Charlotte	703	273 (77)	39 (11)	40 (51)	6 (7)	138	20	252	35
Lee	785	161 (132)	21 (17)	82 (58)	10 (7)	33	4	509	65
Collier	2006	376 (155)	19 (8)	31 (22)	2 (1)	1128	56	471	23
Monroe	1034	<1 (0)	- (-)	6 (5)	1 (<1)	1028	99	-	0
Total	7158	2098		560		2511		1989	

[a]Numbers are low because they exclude land cleared for development.

study area. Figures 23 through 25 show the general location of these lands within the eight counties.

Table 4 and Figures 23 through 25 illustrate that development is most extensive around Tampa Bay, becoming progressively less southward. A reverse trend exists for conserved land, with a few exceptions. Apart from highly urbanized Pinellas County (St. Petersburg and Clearwater area), the bulk of development is agricultural. Large preserved areas in the south comprise the Big Cypress Swamp (Collier County) and Everglades National Park (Monroe County).

Although estimates of urban development derived from Thompson (1979) and from GS LUDA (1976) maps are reasonably close in Table 4, those of agricultural development often are not. The differences probably arise from the way in which land is classified by the two sources. The fact that GS LUDA estimates are consistently lower than Thompson's (1979) indicates this to be true. Regardless of which source is employed, the trends in the data are the same.

The estimated percentage of conserved and developed land within each habitat type in each county is presented in Table 5. Slash pine forest, wet-to-dry prairies, Everglades marshes, and scrub cypress habitats in the southern part of the study area are mostly conserved. This is true because they occur either largely or totally within relatively undeveloped Collier and Monroe Counties. Other conserved habitats in the study area are freshwater marsh, cypress swamp, swamp forest, coastal strand, mangrove swamp and coastal marsh, also in Collier and Monroe. Heavily exploited habitats are coastal strand, pine flatwoods, longleaf pine/xerophytic oak forest, sand pine forest, mangrove swamp and coastal marsh, and grasslands. Some habitats are both in the conserved and developed groupings, reflecting the fact that they incurred prolific development for many years but are now largely preserved. Common pinelands of the more northern, developed counties are also heavily exploited. A point not elucidated by these data is that hammocks are also prone to development because of their being relatively higher and drier.

Estimated percentages of developed land within the habitat types of each county produced from data gathered by the author differed from those derived from GS LUDA (1976) data and only the latter estimates are presented (Table 5). Several factors account for the differences: (1) the time scale of the analysis, (2) the greater resolving ability of the LUDA system, (3) the differences in sources of information, and (4) the differences in criteria of classification. The author's data, however, produced good estimates in some cases. Simple correlation analysis revealed two variables to be important in determining the accuracy of these estimates: the real percentage of developed land and the size of the habitat. Accuracy was improved for both larger habitats and habitats with either little or much development. Some inaccuracy also may be expected in the estimates of percentages of conserved land presented in Table 5. The inaccuracy probably varies in much the same fashion as it does for estimates of percentage of developed land.

The preceding analysis of conserved and developed habitat types could be misleading, unless other factors are considered. One might think that important habitats not designated as "most-heavily exploited," like slash pine forest and cypress swamp, are in little danger from development. Yet, they

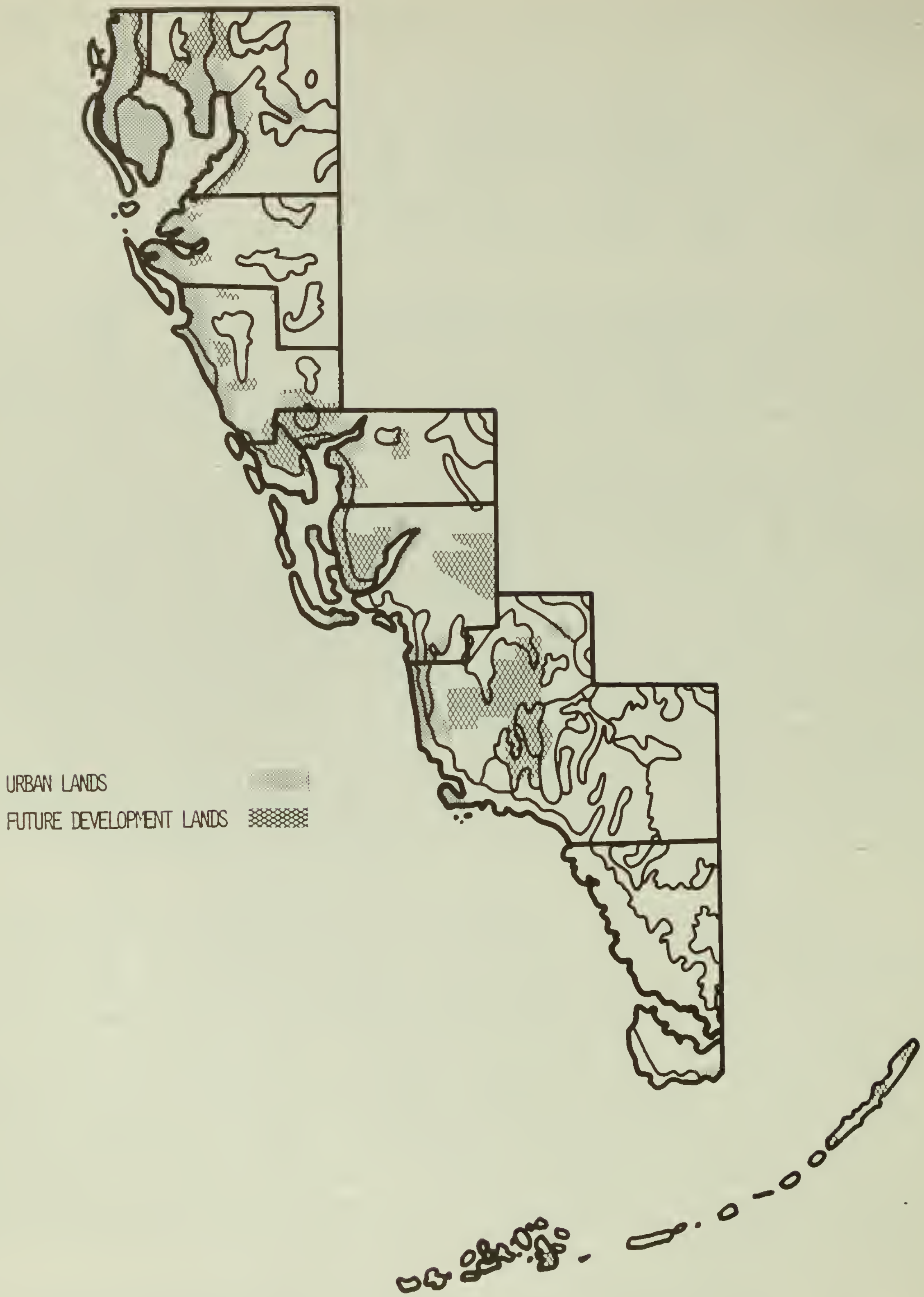

Figure 23. Location of urban development (stippled) superimposed upon the map of Davis' (1967) habitats identified in Figure 2. Crosshatched areas indicate the most likely sites of future development. Data are from numerous sources cited in the References.

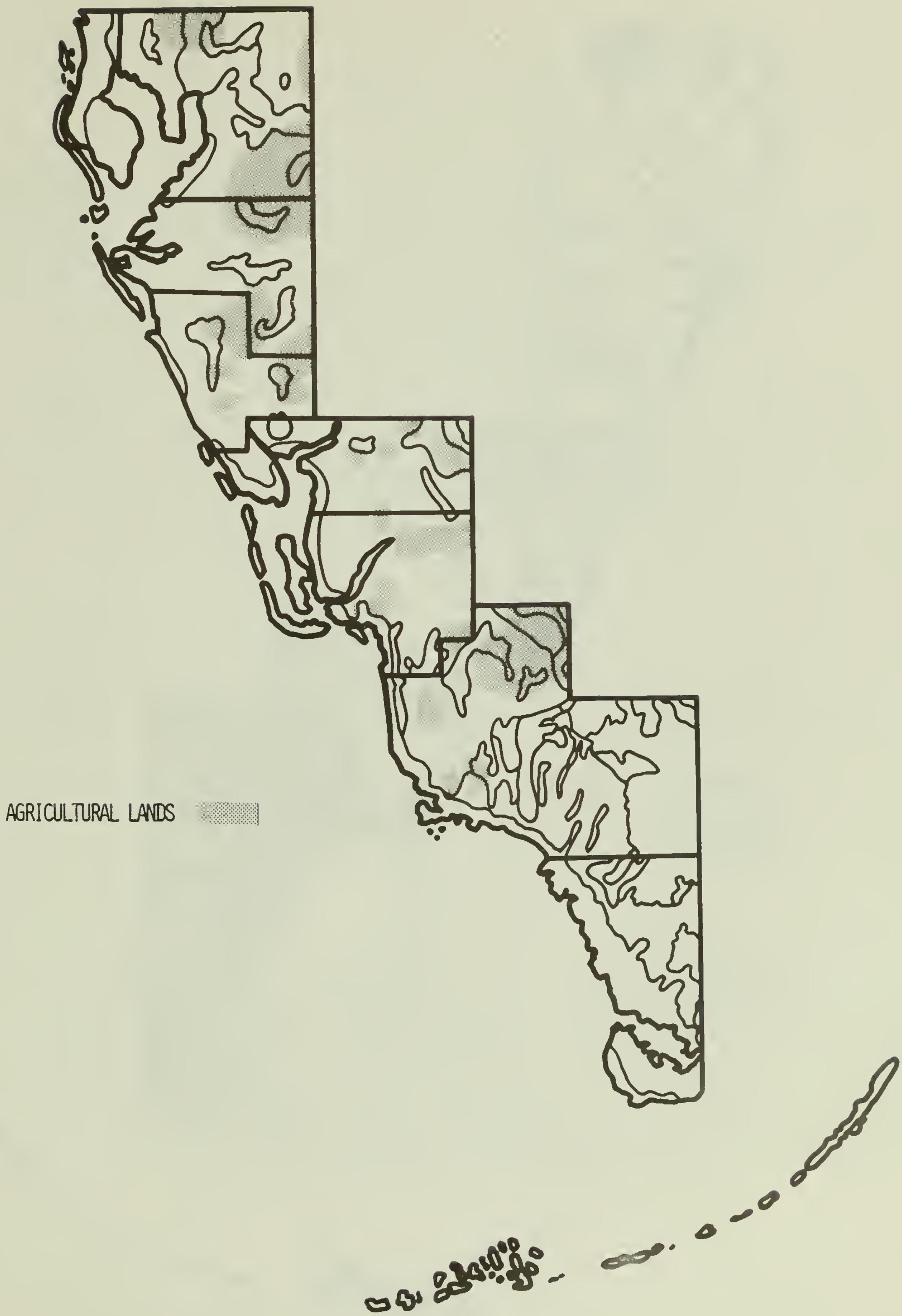

Figure 24. Location of agricultural development (stippled) superimposed upon the map of Davis' (1967) habitats identified in Figure 2. Data are from numerous sources cited in the References.

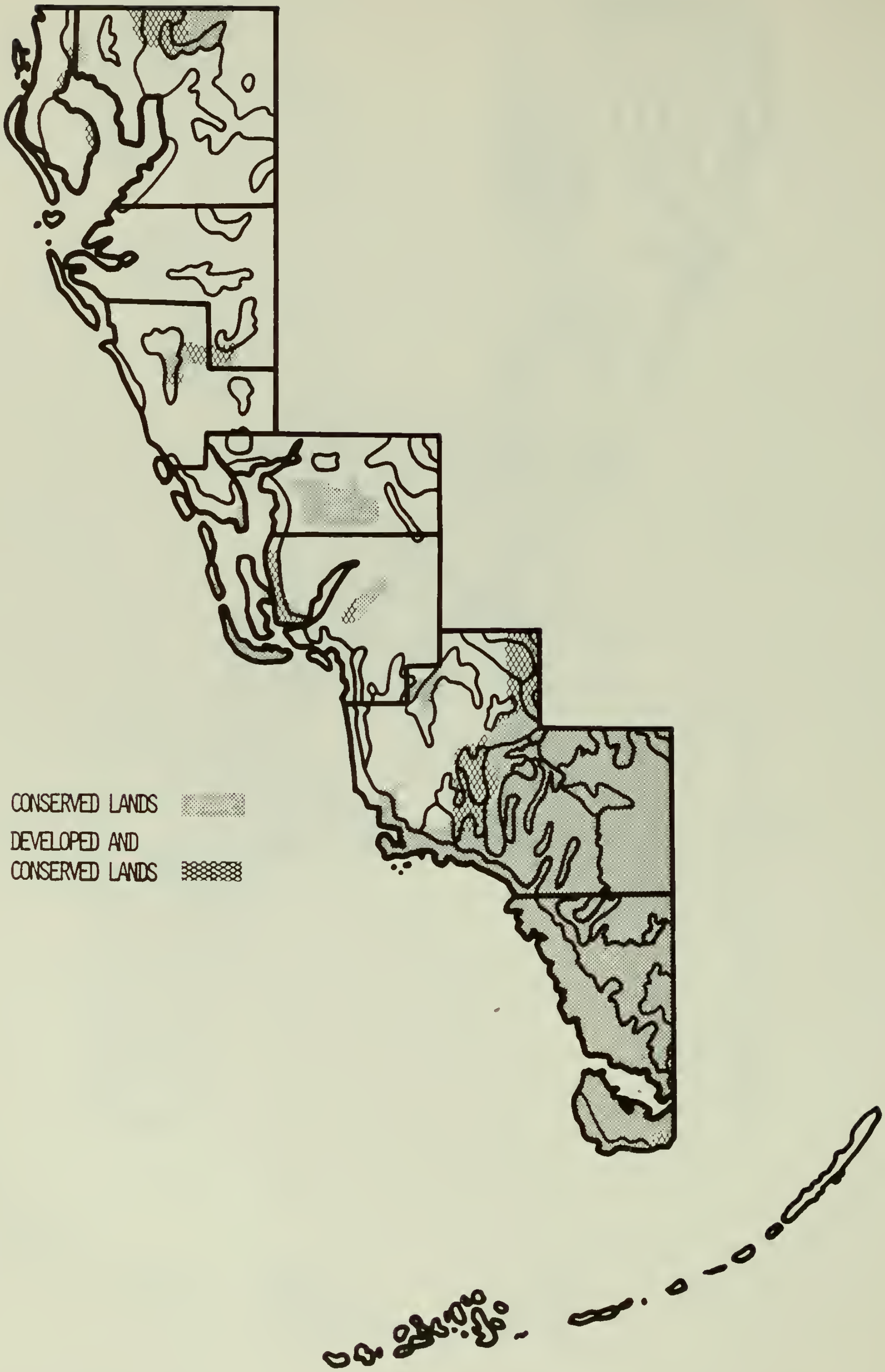

Figure 25. Location of conserved lands (stippled) superimposed upon the map of Davis' (1967) habitats identified in Figure 2. Crosshatched areas are where developed and conserved lands interdigitate greatly. Data are from numerous sources cited in the References.

Table 5. Percentage of habitat consigned to developed (agricultural and urban), conserved, and other land uses in the study area. Developed land values are from GS LUDA (1976) maps. Numbers for conserved land are estimated from numerous sources cited in the References.

County	Habitat type	Habitat area (mi^2)	Land use (%)		
			Developed	Conserved	Other
Pinellas					
	Coastal strand	40	32	15	53
	Pine flatwoods	119	61	5	34
	Longleaf pine/xerophytic oak forest	105	66	10	24
	Mangrove swamp and coastal marsh	1	37	16	47
Hillsborough	Coastal strand	2	-	-	100
	Pine flatwoods	685	62	5	33
	Sand pine scrub forest	10	56	-	44
	Longleaf pine/xerophytic oak forest	270	69	2	29
	Swamp forest	31	9	1	90
	Mangrove swamp and coastal marsh	40	72	16	12
Manatee	Coastal strand	15	37	5	58
	Pine flatwoods	629	44	10	46
	Longleaf pine/xerophytic oak forest	59	36	-	64
	Mangrove swamp and coastal marsh	7	81	-	19
	Prairie grassland	30	55	-	45
Sarasota	Coastal strand	18	46	21	33
	Pine flatwoods	493	30	10	60
	Mangrove swamp and coastal marsh	6	74	-	26
	Prairie grassland	70	45	10	45

(continued)

Table 5. (Continued).

County	Habitat type	Habitat area (mi^2)	Land use (%) Developed	Conserved	Other
Charlotte	Coastal strand	14	11	-	89
	Pine flatwoods	429	18	30	52
	Sand pine scrub forest	14	46	-	54
	Longleaf pine/xerophytic oak forest	<1	58	-	42
	Cypress swamp	14	5	-	95
	Swamp forest	14	1	-	99
	Mangrove swamp and coastal marsh	91	18	10	72
	Prairie grassland	127	18	-	82
Lee	Coastal strand	24	9	35	56
	Pine flatwoods	589	28	3	69
	Sand pine scrub forest	16	20	-	80
	Cypress swamp	24	1	-	99
	Swamp forest	<1	-	-	100
	Mangrove swamp and coastal marsh	133	14	5	81
Collier	Pine flatwoods	481	22	5	73
	Southern slash pine forest	140	3	97	-
	Sand pine scrub forest	40	23	-	77
	Cypress swamp	140	6	50	44
	Swamp forest	140	9	30	61
	Mangrove swamp and coastal marsh	140	10	35	55
	Prairie grassland	60	37	20	43
	Open scrub cypress	464	<1	>99	-
	Freshwater marsh	40	15	80	5
	Wet to dry prairie marsh on marl or rockland	361	1	80	19

(continued)

Table 5. (Concluded).

County	Habitat type	Habitat area (mi^2)	Land use (%)		
			Developed	Conserved	Other
Monroe	Coastal strand	21	22	78	-
	Southern slash pine forest	52	-	100	-
	Cypress swamp	41	-	100	-
	Mangrove swamp and coastal marsh	465	-	>99	-
	Open scrub cypress	103	-	100	-
	Everglades region marsh, slough, wet prairie, and tree islands	52	-	100	-
	Wet to dry prairie marsh on marl or rockland	290	-	100	-

certainly are in danger. Several more insidious forms of destruction are taking a large toll on many Florida habitats. Chief among these is modification of hydrologic regimes. Roads and railways retard sheet flow; paving prevents percolation and promotes run-off; filling low, flood-prone areas restricts recharge of ground waters; agriculture, mining, and municipalities severely lower aquifer levels. These and other impingements directly affect plant species whose continued existences depend upon standing water or saturated soil. Also, the reduction of the freshwater lens allows salt water to intrude through the porous substrate, affecting organisms not equipped to deal with saline conditions. Salt water intrusion is already a serious problem in southeast Florida, but less so in southwest Florida. Finally, a tremendous number of introduced plant species (exotics) flourishes in south Florida. When wet areas are drained, these exotics often prohibit recolonization by native species and further reduce habitats available to native flora. Exotic species such as Australian pines (Casuarina spp.), cajeput (Meleleuca quinquenervia), and Brazilian pepper (Schinus terebinthefolius) are so adaptable to a wide range of conditions and capable of out-competing native plants that monospecific stands have sprung up virtually everywhere, even in areas undisturbed by man. Land drainage and other disturbances accelerate this process dramatically.

The result of development and drainage patterns in ecologically fragile south Florida has been an increased fragmentation of habitats and the native biota. This process has placed many plants in the same situation as that of the naturally rare species discussed previously; that is, their population becomes isolated with virtually no chance of expansion. Small pockets of cypress swamp and freshwater marsh, rather than large stands, are becoming increasingly common. It follows that plants within habitats that are highly fragmented will be affected most severely by subsequent splintering.

For habitats whose total distributions cover approximately the same number of counties, it is easy to determine which of the habitats have most narrowly distributed plant species by county. Table 6 presents the mean percentages and variances of the total flora for habitats found in six, seven, or eight counties. For each habitat, the number of species within each county is divided by the total number of species in that habitat over all counties, and the mean and variance of these percentages are computed. A larger variance indicates a relatively narrow distribution of species within the habitat counties. For the percentages derived, variances are roughly inversely correlated with means. Plant species within coastal strand, mangrove swamp and coastal marsh, and hammock habitats are most restricted (Table 6). Plant species in prairie grassland, freshwater marsh habitats, and in the "other" category, comprising mostly cosmopolitan and deep-water species, are most broadly distributed.

The effects of fragmentation are best illustrated by the endangered Chrysopsis floridana (Florida golden-aster). This naturally rare plant was confined to Pinellas and Hillsborough Counties. Tremendous urban sprawl in Pinellas County extirpated the species there. As of 1979 only two populations remained in Hillsborough County: in a roadside park and in a housing development (Ward 1979). As this plant is a sand pine scrub species, its preservation would require the perpetuation of the natural ecological processes of that community, perhaps including periodic burnings. This would be extremely difficult, if not impossible, in either location. More recent surveys, however,

Table 6. Mean percentage and variance of plant species within the study area for 11 geographically widespread habitats.

Habitat type	Number of counties where habitat occurs	Total species in habitat type for counties containing the habitat	
		Mean (%)	Variance
Coastal strand	8	37	3.6
Pine flatwoods	7	58	0.7
Sand pine scrub forest	7	53	0.7
Long leaf pine/xerophytic oak forest	6	64	1.1
Cypress swamp	8	51	1.9
Swamp forest	8	53	0.9
Mangrove swamp and coastal marsh	8	40	4.8
Prairie grassland	8	69	0.8
Freshwater marsh	8	71	0.9
Hammock	8	42	2.1
Other	8	75	0.1

have located the species in other Hillsborough County areas (R. Wunderlin, University of South Florida, Tampa; personal communication). The discovery of additional populations emphasizes the need for extensive surveys of rare, threatened, and endangered species.

POTENTIAL IMPACTS OF OCS DEVELOPMENT

The Environmental Impact Statement for OCS lease sale 66 (BLM 1980) projects two scenarios:

1. little oil found; no development beyond exploration

2. substantial oil found; onshore pipeline and storage facilities and offshore drilling rigs constructed

At this time, no onshore Florida refineries are projected for Florida to accompany the potential increased oil flow. The development accompanying either scenario will most likely be centered at Port Manatee (Hillsborough-Manatee County border), or perhaps Boca Grande (Charlotte-Lee border) if scenario (2) becomes reality. Figure 1 shows the locations of these ports. To establish potential impacts on plant species resulting from either scenario, the following section describes the projected environmental setting in southwest Florida to the year 2000.

POPULATION TRENDS AND WATER MINING ANTICIPATED IN THE STUDY AREA

Past and projected population sizes to the year 2000 for the eight counties appear in Tables 7 and 8 (Thompson 1979). Southwest Florida is doubling in population about every 20 years. By the year 2000, small Pinellas County will have more people than all eight counties combined had in 1960. Pinellas and Hillsborough Counties, already the most populous, will add more individuals than elsewhere. The most rapid and significant expansion is projected for Lee County (Fort Myers). Much of the present and projected growth can be attributed to a population shift from large metropolitan areas on Florida's east coast (Odum and Brown 1975) to the more pristine west coast.

These demographic trends are likely to cause two significant problems for the rare, threatened, and endangered plants of southwest Florida. One is increased fragmentation and destruction of habitats; the other is a diminution of freshwater resources. The first problem already has been discussed, but the second also merits consideration.

Developed and undeveloped southwest Florida is prone to some degree of regular flooding (Tampa Bay Regional Planning Council 1977). Therefore, needed freshwater can be obtained from shallow aquifers or surface drainage, but such sources cannot be exploited indefinitely. Users are many. A city as large as Naples, Florida (about 18,000 persons) uses 35 to 40 million gallons per day. A single drainage canal (and there are many in south Florida, ostensibly for flood control) may discharge 500 million to 4 billion gallons per day. To produce one ton of phosphate takes 10,000 gallons of water.

Table 7. Population size and density by county for 1960 to 2000 in the the study area (data from Thompson 1979).

County	Population (1000's)					Population density (1000's/mi^2)		Gain per decade (mean %)
	1960	1970	1980	1990	2000	1960	2000	
Pinellas	374.7	522.3	749.7	934.9	1087.0	1.4	4.1	31
Hillsborough	397.8	490.3	644.0	783.5	910.9	0.4	0.9	23
Manatee	69.2	97.1	144.0	181.1	210.9	0.1	0.3	32
Sarasota	76.9	120.4	197.5	254.5	295.9	0.1	0.5	41
Charlotte	12.6	27.6	55.3	74.1	86.2	<0.1	0.1	67
Lee	54.5	105.2	198.2	262.7	305.5	0.1	0.4	57
Collier	15.8	38.0	82.8	112.4	130.7	<0.1	0.1	78
Monroe	47.9	52.6	56.5	64.2	74.7	<0.1	0.1	12

Table 8. Population growth rankings by county for 1960 to 2000 in the study area.

County	Individuals added ranking	Population density increase ranking	Gain per decade ranking (mean %)
Pinellas	1	1	6
Hillsborough	2	2	7
Manatee	5	5	5
Sarasota	4	3	4
Charlotte	7	6	2
Lee	3	4	3
Collier	6	8	1
Monroe	8	7	8

Demands on resources accelerate with population increases. Adverse effects of increased water usage may arise in the latter half of this decade. Southwest Florida Water Management District hydrologists predict that, if growth trends and usage rates continue, water will be mined (withdrawal exceeding recharge) by 1985 (Tampa Bay Regional Planning Council 1973). Water mining already occurs in some areas during the dry season (Odum and Brown 1975), but after 1985, levels will not be restored during the rainy season. Manatee County is the only study area county to use surface water sources. The county uses a 2000-acre impoundment on the Manatee River and may face similar problems by 1985 (Tampa Bay Regional Planning Council 1977). In addition, further interruptions of sheet flow (by the proposed extension of Highway I-75 to Naples, for instance), diversion of water courses, and prevention of percolation will reduce recharge even further.

The problems of freshwater diminution that are expected to begin around 1985 probably will require a number of years before affecting human populations adversely, and may do little to slow the population increase expected in southwest Florida. The effects will show up, however, much more rapidly among plant populations. Aquifer mining will drain the upper layers of soil in many locations, allowing these layers to dry out. Plants that depend upon wet conditions, as do many listed in this report, will be compromised severely. Lowered water tables and the consequent eradication of wet habitats have been identified (Odum and Brown 1975; McPherson et al. 1976) as the most pressing environmental concern of the southwest Florida coast. Although the need to retain adequate water levels for the benefit of native vegetation is recognized, it may be incompatible with, and eventually yield to, simultaneous demands placed upon water resources by development.

POTENTIAL ADVERSE EFFECTS OF OCS ACTIVITIES ON RARE, THREATENED, AND ENDANGERED PLANTS IN THE STUDY AREA

Potential adverse effects of offshore oil activities on terrestrial environments are those resulting from: (1) onshore development, (2) pipeline construction, and (3) oil spills (Pearman and Stafford 1975; Mumphrey and Carlucci 1978). These effects and their application to the OCS lease sale 66 scenarios will be discussed below.

Onshore Development

Onshore development includes all facilities needed to support oil activities: offices, warehouses, materials storage, parking, loading docks, crane service, helipads, and fuel and water storage. Ancillary activities involve deepening of channels to promote shipping and subsequent increased boating. Estimates (Pearman and Stafford 1975; BLM 1980) are that such facilities will occupy 50 to 100 acres of land and that 100 to 1000 individuals will be employed. The lower estimates are for small-scale exploration; the higher for relatively large-scale production (32 platforms).

Pipeline Construction

Oil may be transported from offshore rigs to onshore holding facilities by either pipeline or ship. If production is sufficient to warrant the investment, a pipeline is preferred as it is safer. If enough oil is discovered in the eastern Gulf of Mexico to warrant recovery, it likely would be transported to shore by pipeline. Present Federal OCS operating regulations require pipeline burial where water depths are less than 200 ft. Burial requires dredging, with its associated problems (BLM 1980). At landfall, pipelines may also cut through areas of marsh or mangrove.

Oil Spills

Oil spills can result from rig blowouts, pipeline rupture or leakage, spillage during transfer, and shipping accidents. Safety devices to prevent blowouts and the burial and coating of pipelines to retard corrosion have significantly reduced spillage. New sensing devices and inspection techniques have also helped. The danger of spills resulting from carelessness or accident still remains. An average spill rate of 42 barrels per year and a high probability of one spill greater than 1,000 barrels during the life of leases may result (BLM 1980). This estimate concurs with an earlier evaluation (BLM 1978) that the tracts off Florida's west coast pose no significant risk of oil landfalls from an average spill within 3 or 10 days, and only minimal risk within 30 days of spill occurrence.

Sites of oil spill landfall are proposed to be distributed more or less evenly from Cape San Blas (in Gulf County on Florida's panhandle) to Cape Romano, and from Key West to Big Pine Key. Spills resulting in landfall between Cape San Blas and Cape Romano and between Key West and Big Pine Key will impinge on areas of significant concentrations of rare, threatened, and endangered coastal plant species (Figures 3 and 10). Every effort must be made to minimize their severity, especially between Key West and Big Pine Key. A 30-day delay to landfall will lessen the impact of potential spills by natural weathering as well as by allowing ample time for containment and cleanup (BLM 1980).

Predicting oil spill impacts is tenuous for there is little good background information. The effects of spills depend heavily upon a number of variables, including location, duration, time of year, and proximity to shore (Pearman and Stafford 1975). They also noted the chance of a spill is directly proportional to the size of the oil field. For example, consider the time of year that a spill could occur on Florida's gulf coast. Prevailing winds are onshore during spring and early summer and are offshore beginning in late summer. In summer, convective thunderstorms (an average of 87 per year in Tampa Bay) produce high winds and water spouts. The hurricane season (an average landfall of once every 20 years in Tampa Bay) in summer and fall often produces unusual circulation patterns capable of driving oil onshore even without hurricane landfall (Pearman and Stafford 1975). Therefore, the chance for spillage and a rapid oil landfall are much higher during summer.

A final point to consider is the potential effect of spills upon plants. In 1971, the U.S. Coast Guard reported that 1,267 leaks and 376 pipeline ruptures resulted in only 6% of the oil spilled in United States waters (unpubl. data in Kash et al. 1973). Ninety-six percent of all spills in 1972 were estimated as less than 1,000 gal, and most of these are less than 100 gal (unpubl. data in Pearman and Stafford 1975). The Tampa Port Authority records hundreds of spills each year (unpubl.), few exceeding 50 gal. These data indicate that most oil spills are quite small. In spite of this fact, virtually nothing is known of the chronic effects of many such small spills (Pearman and Stafford 1975; also see Hershner and Lake 1980). Most of our knowledge about the biological effects of spills is derived from the acute effects of catastrophic accidents. Chronic and acute biological effects are not necessarily the same. Another point is that little is known about the effect of spills on tropical organisms, such as mangroves. Some evidence exists (Kash et al. 1973; Lewis 1980) to indicate that oil spill effects may be more marked in tropical environments.

An ancillary effect of oil activities is that they will place demands on freshwater reserves. At maximum, OCS activities will require an estimated 16 to 26 million gallons of freshwater per rig per year (BLM 1980). This is about the amount of water (50,000 to 100,000 gal per day) required by a golf course. Even if as many as 32 rigs are constructed (see Pearman and Stafford 1975), they would require a total of only 1.6 to 3.2 million gal per day. Thus, the projected demand of freshwater due to OCS development is not significant relative to water needs for projected population increases.

Since the effect of freshwater drawdown by onshore OCS facilities will be minimal under both proposed scenarios, coastal habitats are likely to suffer the greatest impacts, as a result of boating, pipeline construction, onshore facilities, and oil spills. Local impacts such as boating, onshore facilities, and construction of pipelines should be minimal and short term. The presence of black and red mangroves (species of special concern in the FCREPA listings) along the coast, however, means that considerable care should be exercised in these activities. In summary, the direct effects of exploration probably are minimal. These direct effects include some onshore facilities, such as docks, minor oil spills, and increased boat traffic of three to five trips a week per rig. Similarly, the direct effects of production are probably less than those arising from the construction of a coastal residential community. Direct production effects include expanded onshore facilities, potential for larger oil spills, pipeline construction, increased boat traffic, and an influx of workers.

Two indirect effects of oil exploration, however, must be considered. The first is that such development, while minimal in direct effect, is not an isolated instance. Oil exploration, like all other development in quasi-tropical Florida, further erodes sensitive wildlife habitats. The second indirect effect is based upon the assumption in Pearson and Stafford (1975) that small-scale production, i.e., no refinery, may well have a negative fiscal impact on the area surrounding the port chosen to support offshore activities, in this case, Port Manatee. This projected negative effect can be derived from the observation that the annual cost to residents, in terms of public services such as schools, hospitals, recreation, and the like, may exceed the annual revenue derived from oil-related activities. The losses can be offset by the local community through contributing more heavily to oil activities, such as with local fabrication yards, or by increasing the scale of activities with a refinery or a deepwater port. Thus, it would be reasonable for the port to promote such secondary developments. The associated impacts on habitats of these secondary developments would negate the estimate of small direct influence of OCS activities.

Potential Effects of OCS Activities at Port Manatee Versus Boca Grande

Although previous exploration has occurred, no oil has been removed from Florida's gulf coast. Nevertheless, shallow parts of the eastern gulf may yield as many as 3.8 billion barrels of oil (GS 1981). Exploration activities in the mid-1970's were centered at Port Manatee, which possesses a 40-ft channel and storage facilities capable of handling 2.5 million barrels of oil. Storage capacities of several million barrels would be required (Pearman and Stafford 1975). Thus, Port Manatee is probably best suited to handling oil production activities, with minimal modification. Boca Grande has a shallower channel and its storage facilities possess a capacity of less than one million barrels and would probably require expansion.

To determine the potential impacts of OCS activities at either Port Manatee (Manatee County) or Boca Grande (Lee County), distributional information in the rare, threatened, and endangered plant species, must be considered. If the rank order of abundance of species from the total list within the study area is examined (Table 9), several important patterns emerge:

1. Relatively high concentrations occur in Collier and Monroe Counties.

2. Relatively low concentrations occur in Sarasota and Charlotte Counties.

3. Coastal habitats such as coastal strand and mangrove swamp and coastal marsh have relatively high concentrations in the southern three counties.

4. Freshwater habitats have relatively high concentrations in Collier and Monroe Counties (cypress swamp, swamp forest) or Pinellas, Hillsborough, and Manatee Counties (freshwater marsh).

5. Upland pine forests such as pine flatwoods, sand pine scrub, longleaf pine/xerophytic oak have relatively high concentrations in Pinellas, Hillsborough and Collier Counties.

6. Hardwood forests in Hillsborough, Lee, Collier, and Monroe Counties have relatively high concentrations.

7. Five habitats are unique to the southern two or three counties, and thus have relatively high concentrations of species.

8. No single habitat in Sarasota or Charlotte Counties contains relatively high numbers of species.

These patterns reinforce the distribution of absolute numbers of species per county presented in Figure 20. These patterns are generally the same if the rank order of abundance of species from the FCREPA list is examined.

Spills at the drilling site will have the effects already discussed, regardless of which port is used. Oil spills associated with the ports themselves or with pipelines present a different picture, since such spills will

Table 9. Rank order of plant species abundance by county for each of 16 habitat types. The rankings (1 = highest, 8 = lowest) are based on the total species list in Table 1.

Habitat type	County: Pinellas	Hillsborough	Manatee	Sarasota	Charlotte	Lee	Collier	Monroe
Coastal strand	6.5	6.5	4.5	4.5	8	2.5	2.5	1
Pine flatwoods	2	4	5	5	6.5	3	1	-
Southern slash pine forest	-	-	-	-	-	-	2	1
Sand pine scrub forest	3	4.5	4.5	7	6	2	1	-
Longleaf pine/xerophytic oak forest	2.5	5	5	5	2.5	1	-	-
Cypress swamp	5	3.5	3.5	6	7.5	7.5	1	2
Swamp forest	4	4	3	6	6	6	1	2
Mangrove swamp and coastal marsh	6.5	6.5	3.5	3.5	6.5	6.5	2	1
Prairie grassland	3	1.5	1.5	4	6	8	5	7
Open scrub cypress	-	-	-	-	-	-	1	2
Freshwater marsh	3	2	1	4	5.5	8	5.5	7
Everglades region marsh, slough, wet prairie, and tree islands	-	-	-	-	-	-	-	1
Wet to dry prairie marsh on marl or rockland	-	-	-	-	-	-	1	2
Hammock	5.5	3	5.5	7	8	4	2	1
Shell mound	-	-	-	-	-	1	2	3
Other	4.5	1.5	1.5	4.5	7.5	4.5	4.5	7.5
Mean Rank	4.1	3.8	3.5	5.3	6.4	4.5	2.2	2.9

occur nearer to shore. Total risks from these spills probably are less pronounced at Port Manatee, simply because it lies further from concentrations of coastal plant species than does Boca Grande. Many coastal areas of environmental concern also are located closer to Boca Grande: Sanibel Island and The Ten Thousand Islands, for instance. Finally, two large national wildlife areas with coastal habitats (J.N. "Ding" Darling National Wildlife Refuge and Everglades National Park) are located south of Boca Grande. On the other hand, the relatively sheltered position of Port Manatee within Tampa Bay may intensify the effects of spills close to shore, as the spills will not be subjected as much to natural weathering. Although nearshore spills at Port Manatee may cause severe local effects, Port Manatee is probably a better choice than Boca Grande. Siting at Port Manatee would minimize the potential impact of OCS activities because of its geographical location and the presence of developed facilities.

Regardless of the port chosen, spills at the drilling rigs, under certain unfavorable conditions, could adversely affect the high concentrations of coastal plant species in predicted areas of landfall. Coastal habitats in southwest Florida are important and sensitive, and great care must be exercised in avoiding even small spills that are a consequence of OCS exploration and petroleum development.

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APPENDIX A

PLANT SPECIES CATEGORIZED BY HABITAT TYPE

The following list categorizes the plant species in Table 1 by habitat type. Numbers correspond to those designated for each species in Table 1, with asterisks denoting FCREPA-listed species.

<u>Coastal strand</u>

1*	49	52	69	101	125	152	178	208	244	257
39*	50*	56	94	114	133	162	180	231	245	
43*	51*	59	95	118	149	164	194	232	248	

<u>Pine flatwoods</u>

7	22	31	72	115	138	160	192	216	234	273
12	23	45	100	121	141	162	196	217	238	
14	28	56	101	123	143	167	209	225	250	
15	29	58	105	128	144	182	213	226	269	
16	30	64	107	129	146	183	215	230	270*	

<u>Southern slash pine forest</u>

7	22	40*	64	105	138	167	212	228	250
8	29	51*	65*	107	141	177	213	230	259
10	30	57	72	115	143	187	215	234	263
14	31	58	82	128	144	192	217	235	269
16	38*	60	100	129	152	196	225	246	270
17*	39*	61	102	137	162	205	226	248	273

Sand pine scrub forest

13*	46	65	124	132	133	134	202	209	247	250	267
24*											

Longleaf pine/xerophytic oak forest

22	121	123	144	160	182	209	226	238	247	250	270
100											

Cypress swamp

9	42*	76	99	130	142	147	156	181	203	249	268
19*	63	81	112	135	143	148	157	193	218	251	269
26*	74	84	122	136	144	150	168	195	238	252	274
33*	75	86	128	139	146	151	179	197	239	256	

Swamp forest

9	81	99	126	136	144	148	179	193	224
26*	82	102	128	139	145	150	181	203	253
63	92	112	130	142	146	157	185	210	268
72	96	122	135	143	147	158	192	218	269

Mangrove swamp and coastal marsh

2	4	20*	41	117	118	131	194	199	200	231	264
3*	9	40*									

Prairie grassland

6	31	99	121	142	150	179	184	204	225	263	272
9	63	100	122	143	158	181	186	216	234	268	274
27*	75	107	128	144	160	182	193	217	238	269	
30	81	112	141	146	168	183	203	218	241	270*	

Open scrub cypress

9	81	107	128	143	184	204	236	270*
27*	99	112	130	144	193	218	268	
78	100	122	142	147	203	225	269	

Freshwater marsh

4	63	99	122	142	146	158	181	186	218	269
9	72	102	128	143	147	168	182	193	238	
32	81	112	130	144	150	179	184	203	268	

Everglades region marsh, slough, wet prairie, and tree islands

5	40*	80	107	126	148	169	186	195	219	251	267
9	52	82	108	128	153	170	189	203	225	253	268
18	54	83	112	142	156	173	190	204	236	255	270*
22	58	89	117	143	157	175	191	211	239	258	
36	64	99	120	144	159	176	192	215	249	264	
37	75	100	122	147	164	184	193	218	250	265	

Wet to dry prairie marsh on marl or rockland

9	99	112	130	144	186	204	238	270*
27*	100	122	142	147	193	218	268	
81	107	128	143	184	203	225	269	

Hammock

5	35	66	80	108	126	157	171	192	215	249	264
8	36	67	82	110	136	159	172	193	219	250	265
10	37	68	83	116	139	160	173	195	233	251	266
11	40*	70	89	117	140	161	174	198	235	253	267
17*	52	71	97	118	144	163	175	201	236	254	270*
18	53	73	98	119	148	164	176	203	238	255	271
19*	54*	74	102	120	153	165	182	204	239	258	
22	55	75	103	121	154	166	188	206	240	260	
25	58	77	104	123	155	169	190	211	241	261	
34*	64	79	106	125	156	170	191	214	246	262	

Shell mounds

44*	50*	51*	52	62	93	103	105	117	270*

Other

16	48	88	93	111	138	218	222	227	264
21	85	90	105	113	207	220	223	229	266
47	87	91	109	127	213	221	226	242	272

APPENDIX B

PLANT SPECIES CATEGORIZED BY COUNTY

The following list categorizes the plant species in Table 1 by county. Numbers correspond to those designated for each species in Table 1, with asterisks denoting FCREPA-listed species.

Pinellas

4	22	60	100	120	142	164	189	210	223	240	269
5	29	65	104	122	143	168	190	211	224	241	270
6	30	70	105	127	144	175	191	212	225	249	272
7	31	72	107	128	146	178	193	213	226	253	273
13*	32	80	109	131	148	181	195	216	227	255	
14	45	85	111	132	150	182	200	217	229	261	
16	46	88	112	133	154	183	204	218	236	262	
18	47	95	113	139	158	184	207	219	237	266	
20*	48	96	114	140	160	186	208	221	238	267	
21	55	99	116	141	162	188	209	222	239	268	

Hillsborough

4	18	32	72	105	120	139	160	182	195	212	222
5	20*	45	73	107	121	140	162	183	198	213	223
6	21	46	80	109	122	141	164	184	200	214	224
7	22	47	85	110	123	144	168	186	203	216	225
9	25	48	88	111	124	146	175	188	204	217	226
12	28	55	96	112	127	148	178	189	207	218	227
13*	29	63	99	113	128	150	179	190	208	219	229
16	30	65	100	114	132	154	189	191	209	220	236
17*	31	70	104	116	133	158	181	193	211	221	237

Hillsborough (continued)

238	240	249	254	260	262	267	269	273
239	241	253	255	261	266	268	272	274

Manatee

4	21	48	99	116	142	175	191	211	226	254	274
5	22	51*	100	120	144	178	193	212	227	255	
6	24*	55	104	122	146	179	195	213	229	262	
7	28	63	105	123	148	181	200	217	237	266	
9	29	70	107	125	150	182	202	218	238	267	
13*	30	72	109	127	158	184	203	219	239	268	
14	31	80	111	128	160	186	204	221	240	269	
16	32	85	112	132	162	188	207	222	241	270*	
18	46	95	113	133	164	189	208	223	242	272	
20*	47	96	114	141	168	190	209	225	249	273	

Sarasota

4	21	48	95	113	132	162	190	208	223	242	269
5	22	51*	96	114	133	164	191	211	225	249	270*
6	28	55	99	116	141	175	193	212	226	253	272
7	29	63	100	120	142	178	195	213	227	254	273
9	30	70	104	122	144	179	200	217	229	255	274
14	31	72	107	125	148	184	202	218	238	262	
16	32	80	109	127	150	186	203	219	239	266	
18	46	85	111	128	158	188	204	221	240	267	
20*	47	93	112	131	160	189	207	222	241	269	

Charlotte

4	18	46	86	108	127	162	190	207	222	240	268
5	20*	47	95	109	128	164	191	208	223	241	269
6	21	48	96	111	132	178	193	211	225	249	270
7	22	55	99	112	133	179	195	212	226	253	272
9	29	70	100	113	141	184	200	213	227	254	273
13*	30	72	104	120	144	186	202	217	229	255	274
15	31	80	105	122	148	188	203	218	238	256	
16	32	85	107	126	150	189	204	219	239	267	

Lee

4	21	46	80	99	120	148	186	207	222	240	255
5	22	47	83	100	121	154	188	208	223	241	266
6	27*	48	85	104	126	159	189	211	225	242	267
7	29	51*	87	105	127	162	190	212	226	243	268
9	30	52	89	107	128	164	191	213	227	247	269
13*	31	55	91	108	132	167	193	214	229	248	270
15	32	64	93	109	133	175	195	215	232	249	273
16	36	70	94	111	142	178	200	217	236	250	
18	43*	71	95	112	143	180	203	218	238	253	
20*	44*	72	96	113	144	184	204	219	239	254	

Collier

2	6	13*	18	22	29	33*	37	46	51*	58	74
3*	7	14	19*	23	30	34*	41	47	52	62	75
4	8	16	20*	26*	31	35	42*	48	55	64	76
5	9	17*	21	27*	32	36	43*	50*	56	72	80

Collier (continued)

81	95	112	133	147	170	191	204	222	236	250	267
83	96	113	134	148	173	192	207	223	238	251	268
84	99	115	135	151	175	193	208	224	239	252	269
85	100	120	136	153	178	195	211	225	240	253	270*
86	103	122	138	154	180	196	212	226	241	255	273
87	105	126	139	156	184	197	213	227	242	256	
89	107	128	142	159	185	199	215	229	243	258	
91	108	129	143	162	186	200	217	230	247	263	
92	109	130	144	164	188	201	218	232	248	265	
94	111	132	145	167	190	203	219	234	249	266	

Monroe

1*	19*	40*	59	78	96	112	137	159	175	192	208
2	20*	41	60	79	97	113	138	161	176	193	211
3*	21	46	61	80	98	115	142	162	177	194	213
4	22	47	64	82	99	117	143	163	178	195	215
5	23	48	66	83	100	118	144	164	183	196	217
6	30	49	67	85	102	119	147	165	184	199	218
8	31	50*	68	87	103	120	148	166	185	200	219
9	32	52	69	89	105	122	149	169	186	202	222
10	35	53	71	90	106	126	152	170	187	203	223
11	36	54*	72	91	107	127	153	171	188	204	225
14	37	55	75	92	108	128	155	172	189	205	226
16	38*	57	76	94	109	129	156	173	190	206	227
18	39*	58	77	95	111	133	157	174	191	207	228

Monroe (continued)

229	233	239	245	248	251	256	259	265	268
231	235	243	246	249	253	257	263	266	270*
232	236	244	247	250	255	258	264	267	271

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report on rare, threatened, and endangered plants of southwest Florida is a compilation of all species so designated or considered for listing by Federal, State, and private agencies or organizations. Of 274 species in Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties, 43 occurring in coastal habitats will be most affected by Outer Continental Shelf (OCS) development.

The most serious potential affects of OCS activities on plants would result from oil spills. Under certain unfavorable conditions, offshore spills could adversely affect concentrations of coastal plants in predicted landfall areas. Rapid oil landfall is greater in summer, when onshore prevailing winds, thunderstorms and hurricanes occur. Potential damage to coastal habitats from OCS development can be lessened by centering activities at Port Manatee, relatively distant from concentrations of coastal plant species and already possessing developed facilities.

Except for oil spills, adverse effects of OCS oil exploration and production on rare, threatened, and endangered plants in southwest Florida are minor. As part of the pervasive historical reduction of natural habitats, however, the potential effects should not be ignored.

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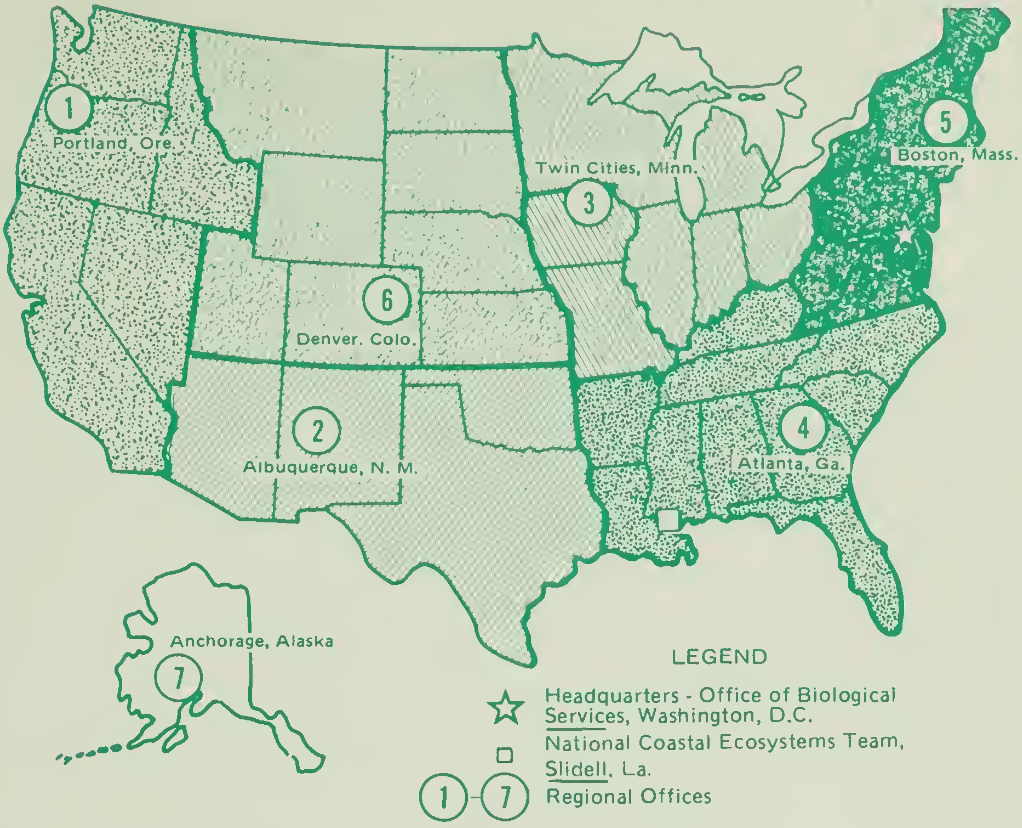

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