DREDGED MATERIAL RESEARCH PROGRAM

CONTRACT REPORT D-77-2

A COMPREHENSIVE STUDY OF SUCCESSIONAL PATTERNS OF PLANTS AND ANIMALS AT UPLAND DISPOSAL AREAS

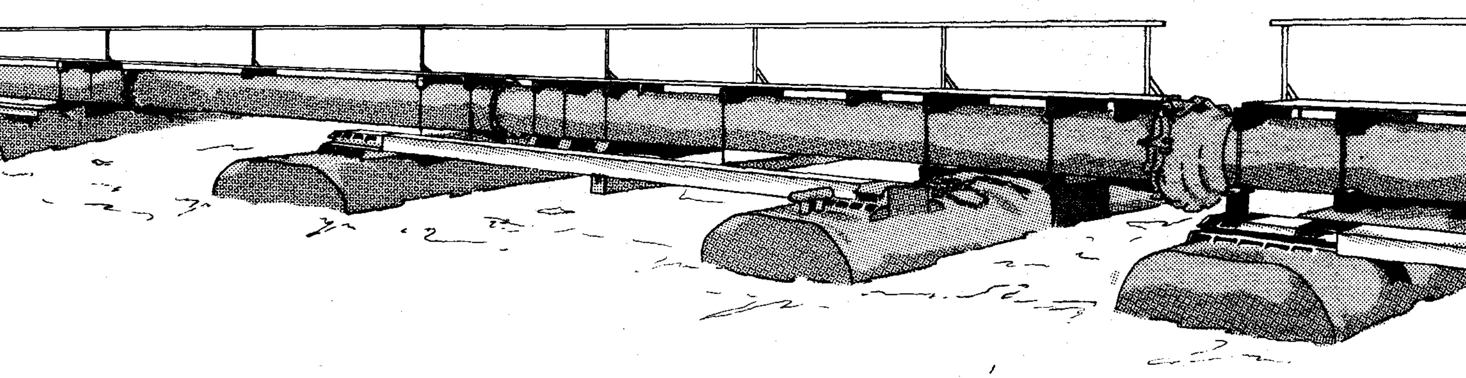
by

Coastal Zone Resources Corporation
Wilmington, N. C. 28401

March 1977

Final Report

Approved For Public Release; Distribution Unlimited



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Monitored by Environmental Effects Laboratory
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31 March 1977

SUBJECT: Transmittal of Contract Report D-77-2

TO: All Report Recipients

1. The contract report transmitted herewith represents the results of one of a series of research efforts (work units) undertaken as part of Task 4B (Terrestrial Habitat Development) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 4B is part of the Habitat Development Project, which has as one of its objectives the development of environmentally and economically feasible disposal alternatives compatible with the Corps' resource development directive.

2. A significant amount of dredged material from Federal navigation projects is placed in upland disposal sites. The use of dredged material as a substrate for terrestrial habitat development has received considerable attention in the DMRP and has proven to be an important disposal alternative.

3. Relatively little research has previously been directed to the flora and fauna of upland disposal sites. In this study, the DMRP has addressed the question of upland biotic-succession on selected sites in five locations on Corps-maintained waterways: Nott Island, Connecticut; Hillsborough Bay, Florida; Atchafalaya River, Louisiana; High Island, Galveston Bay, Texas; and Mott Island, Columbia River, Oregon. Existing and predicted successional stage developments at each site were found to be influenced strongly by regional climatic conditions and biophysical characteristics, plant and animal populations in adjacent areas, soil properties, and human disturbances and utilization.

4. This work unit (5B03) is part of a broader task (4B) concerned with terrestrial habitat development. A synthesis of plant and animal productivity and succession on dredged material and natural habitats will be developed from data generated by this and related work units (4B07, 4A04A, 4A04B/4A06, 4A05, 2A06, 4A10). Guidelines and recommendations

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for habitat development in different geographical regions of the United States will be formulated from these combined data and from marsh development field study work units (4A10, 4A11, 4A12, 4A13, 4A14, and 4B05).

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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Biota	Dredged material disposal
Plants (Botany)	Succession

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study examines the existing biota and plant and animal successional patterns at five upland dredged material disposal areas in the United States. The sites selected for study are: (a) Nott Island in the Connecticut River; (b) six islands in Hillsborough Bay near Tampa, Florida; (c) an area paralleling a portion of the Whiskey Bay Pilot Channel in the Atchafalaya River basin of Louisiana; (d) a disposal area paralleling a short segment of the Gulf Intracoastal Waterway between Port Arthur and Galveston, Texas; and (Continued)

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20. ABSTRACT (Continued)

(e) Mott Island in the Columbia River near Astoria, Oregon.

With the aid of historical aerial photography, on-site analysis and familiarity with regional biology, successional patterns of each site are discussed.

Semiquantitative sampling methods were used in the generation of data to document the occurrence of existing biota, particularly plant, small mammal, and avian populations. Qualitative methods were used for other important biota. Annotated lists of plant and vertebrate animal species encountered during the study are included as appendixes.

Succession on dredged material is considered to act under the same major set of factors operating at the regional level, but processes on dredged material substrates are modified by insular aspects of disposal areas.

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Summary

A research project designed and conducted by Coastal Zone Resources Corporation (CZRC) of Wilmington, North Carolina, under the direction of the Dredged Material Research Program (DMRP) of the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, to generate basic biophysical information regarding ecological succession on upland dredged material substrates was carried out between March 1974 and September 1975. The five sites agreed upon by CZRC and DMRP for active research were: (1) Nott Island, Connecticut, in the lower portion of the Connecticut River; (2) six disposal islands in Hillsborough Bay, Tampa, Florida; (3) a disposal area associated with Whiskey Bay Pilot Channel in the Atchafalaya River Basin, Louisiana; (4) a disposal area associated with the Gulf Intracoastal Waterway between Port Arthur and Galveston, Texas; (5) and Mott Island in the lower Columbia River near Astoria, Oregon.

Through combined on-site analysis of biota, interpretation of available historical photography, evaluation of available data of disposal history, and summary knowledge of regional biophysical characteristics, past, present, and future successional changes were hypothesized.

A significant amount of data regarding existing vegetation, mammal populations, and use of the areas by resident and transient avifauna was generated for each area. These data were produced as a result of vegetation sampling, small mammal trapping, and breeding bird censusing, respectively. In addition, general field observations provided a large portion of the interpretive information needed to outline the successional history of each site.

Major successional stages that had developed at each site were governed by regional biophysical characteristics, accessibility to regional biota, chemical and physical properties of the soils, and local extrinsic phenomena such as flooding, fire, grazing, and human utilization. All disposal areas, whether constructed as true islands or established on pre-existing upland surfaces, were considered to have many of the characteristics of insular habitats.

As a result of the effects of multiple disposals occurring through a range of years, insufficient information regarding disposal history, and various extrinsic factors, potential successional patterns at each site were confused. Though all successional stages have been subjected, at one time or another, to the above modifying influences, a generalized vegetational sere begins in relatively severe conditions on unvegetated dredged material. Early plant pioneers modifying the severe environment are herbaceous. Herb-shrub associations develop within a period of years and may, depending upon the peculiarities of the site, further modify conditions to allow growth of vegetation dominated by arborescent species. Animal diversity and abundance of the habitats thusly developed were dependent upon accessibility to the site, suitability of feeding, cover, and breeding habitat, and competitive pressures imposed in adjacent habitats.

Major factors governing succession in adjacent regional environments also act on succession at upland dredged material disposal sites, but generalized patterns are modified by factors contributing to the insular nature of disposal sites.

Preface

The work described in this report was performed under Contract DACW39-74-C-0092 (Neg.) entitled "A Comprehensive Study of successional Patterns of Plants and Animals at Confined Disposal Areas," dated 29 March 1974 between the U. S. Army Engineer Waterway Experiment Station (WES), Vicksburg, Mississippi, and Coastal Zone Resources Corporation (CZRC), Wilmington, North Carolina. The study was sponsored by the Office, Chief of Engineers, U. S. Army.

This material represents a period of research and analysis of existing biota and plant and animal successional patterns at five upland dredged material disposal sites.

The research was conducted under the general supervision of Dr. David A. Adams, President, CZRC. Principal participants in the activities of research and analysis were initially managed by Dr. John C. Nemeth. His departure from the company necessitated transfer of project managership to Mr. David M. DuMond. Other principal participants were Messrs. Steven Atkins, Steven Leonard, and Ronald Pscion.

The contract was monitored by Ms. Jean Hunt of the Dredged Material Research Program (DMRP), Environmental Effects Laboratory (EEL), WES. The study was under the general supervision of Dr. Hanley K. Smith, Project Manager, Habitat Development Project, and Dr. John Harrison, Chief, EEL.

Directors of WES during the study and preparation of this report were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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Conversion Factors, U. S. Customary to Metric (SI) and Metric (SI) to U. S. Customary Units of Measurement

Units of measurement used in this report can be converted as follows:

Multiply	By	To Obtain
U. S. Customary to Metric (SI)		
inches	2.54	centimetres
feet	0.3048	metres
miles (U. S. Statute)	1.609344	kilometres
miles per hour	1.609344	kilometres per hour
square miles	2.58999	square kilometres
cubic yards	0.7645549	cubic metres
acres	4046.856	square metres
acres	0.4046856	hectares
pounds (mass)	0.45359237	kilograms
Fahrenheit degrees	5/9	Celsius degrees or Kelvins *
Metric (SI) to U. S. Customary		
centimetres	0.3937	inches
decimetres	3.93701	inches
metres	3.2808	feet
kilometres	0.6214	miles (U. S. Statute)
square metres	10.76	square feet
hectares	2.471	acres
grams	0.0022	pounds
cubic centimetres	0.06102	cubic inches
Celsius degrees	9/5	Fahrenheit degrees **

*To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

**To obtain Fahrenheit (F) readings from Celsius (C) reading, use the following equation: $F = 9/5(C) + 32$. To obtain Fahrenheit from Kelvin (K), use: $F = 9/5(K - 273.15) + 32$.

A COMPREHENSIVE STUDY OF SUCCESSIONAL PATTERNS OF PLANTS AND ANIMALS AT UPLAND DISPOSAL AREAS

Part I: Introduction

Background

1. The environmental impacts of disposal of dredged material generated in constructing and maintaining harbors and navigation waterways have received nationwide attention in recent years. As a result of this interest and concern, the Dredged Material Research Program (DMRP) was initiated at the Waterways Experiment Station (WES). One of the objectives of this program is to realize the full potential of dredged material disposal areas as biological resources.

2. Most disposal areas eventually become viable substrates for the growth and development of various forms of life. As soon as material is deposited, it becomes subject to an orderly sequence of events known as ecological succession, or ecosystem development (Odum 1969). Seral, or successional, stages developing on dredged material are subject to a general set of environmental factors operative in the region at large. However, the specific sequence of events at any given site is conditioned by local environmental factors. Few studies have documented examples of ecological succession on disposal areas.

3. In March 1974, Coastal Zone Resources Corporation (CZRC) initiated an investigation of ecological succession at five upland dredged material disposal sites. The objective of the study was to examine existing biophysical conditions at the five sites and, working backward through time with the aid of historical aerial photography and other records, describe the sequence of events and seral stages characterizing succession at each disposal area since its construction or since the last period of disposal.

Site Selection Criteria

4. Because of the need to coordinate the succession studies with other elements of the overall research program, and because they had had considerable contact with the Engineer Districts regarding

upland disposal sites, DMRP staff was mainly responsible for preliminary site selection. CZRC then evaluated the DMRP selections and suggested the most appropriate specific sites.

5. The principal criteria used to screen DMRP's preliminary selections were the availability of historic records such as dredging and disposal plans and other project information, background ecological data, and aerial photography covering the history of the disposal site, with emphasis on disposal sites that had not been used within the previous 5 years or more. Because of the constant reuse of upland dredged material disposal sites, the number of suitable sites was considerably limited.

6. CZRC evaluated DMRP's preliminary selections by contacting each Engineer District involved and seeking opinions and descriptions of the sites from Environmental Resources Branch personnel and others. Simultaneously, DMRP was making contacts and, in some cases, visiting Engineer Districts to ascertain the suitability of certain sites for this study. CZRC then visited each District to inspect the sites and obtain as much criteria information as possible. The following sites, shown in Figure 1, were then selected for study:

Nott Island, Connecticut; New England Division

Hillsborough Bay Islands, Florida; Jacksonville District

Whiskey Bay Pilot Channel, Louisiana; New Orleans District

High Island-GIWW, Texas; Galveston District

Mott Island, Oregon; Portland District.

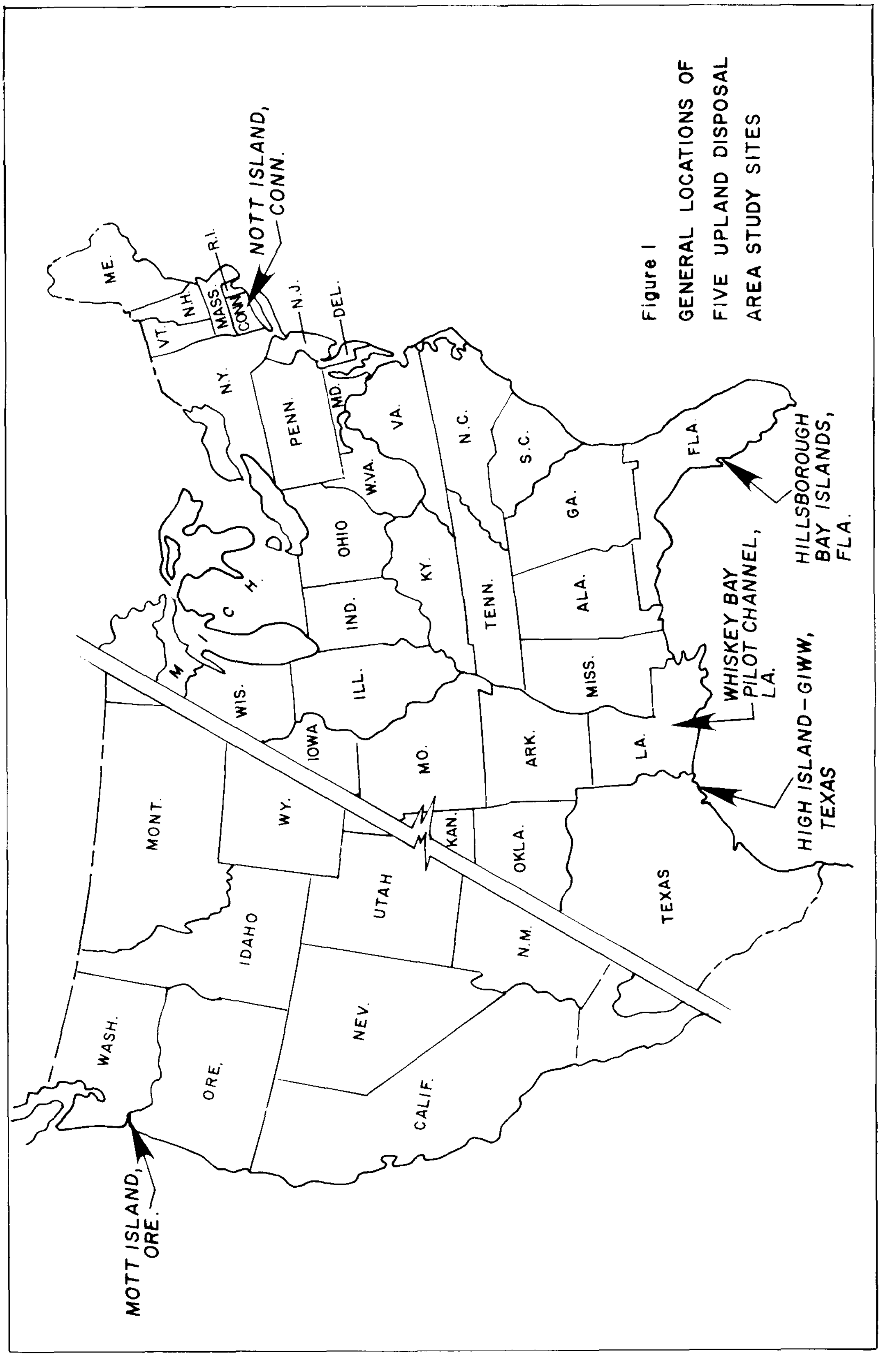

Figure 1
GENERAL LOCATIONS OF FIVE UPLAND DISPOSAL AREA STUDY SITES

Part II: Principles of Succession

7. The theory of ecosystem development is described in the standard text, Fundamentals of Ecology (Odum 1971). The following discussion of certain factors governing the theory's applicability to succession on dredged material is germane to this study.

8. Succession, or ecosystem development, results from interactions between physical and biotic portions of the environment. The assemblage of plants and animals occupying a given space at a given time is known as a biotic community, or seral stage, and can be recognized, identified, and named. Seral stages intergrade through time in a continuous process, the total range of which is known as a sere. Seres developing on raw parent material (primary sere) can be characterized as hydroseres (water), lithoseres (rock), or psammoseres (sand) (Weaver and Clements 1938). Theoretically, each sere culminates in a self-perpetuating stage, the climax community. In reality, classical seres are usually interrupted by disturbance, and most are prevented from reaching the climax stage by a combination of edaphic and disturbance factors. Thus secondary, rather than primary, succession is the more common condition. The concept of orderly change in biota, through time, as a result of an evolving environment remains valid, however. Generalized seres can be predicted from observations of consecutive seral stages, but seres within any one geographic region intergrade in response to many environmental factors. Soil factors, microclimate, moisture availability, the availability of organisms, human intervention, light, and exposure are but a few of these factors.

9. Intergradation of seres also occurs where dredged material flows onto an adjacent forest or field community. Identification of seres then becomes impossible. For example, three major seres may be represented at Nott Island, Connecticut: a dredged material sere, an old field sere, and an alluvium sere. Whether succession in such an area is primary or secondary is moot.

10. The study sites were probably constructed by pipeline dredge. Material deposited by a pipeline dredge as a slurry becomes

distributed over the disposal area in accordance with particle size. Larger particles tend to come to rest nearer the discharge point, and smaller particles further away. Distribution of subsequent vegetation may be affected by this substrate variation.

11. On naturally occurring soils, the major soil-forming factors are parent material, relief, climate, organisms, and time (Buol et al. 1973). These factors govern the gross limits of natural development of the soil in dredged material as well. Combinations of the above factors, at least indirectly, also govern the classification of soils into orders. Soils within the study areas can most nearly be placed in the soils order known as entisols because of their low level of development, but most dredged material soils in the areas visited were not strictly classifiable as soils due to lack of sufficient time for their developments.

12. Soil development begins with parent material; in this case, dredged material. The new dredged material lacks distinct horizons resulting from intrinsic soil-forming processes. Horizons or lenses of sand, silt, clay, or debris may occur, but are the result of mixing and stratification during disposal. Buried organic horizons may be created by successive disposals, particularly when enough time between disposal periods has elapsed to allow for the growth of plant cover.

13. All soils encountered for which dredged material was the parent material were very young. In some samples, deposition of organic materials as a result of illuviation since disposal can be inferred from the chemical analysis data, though only rarely was this visible in the field.

14. Suggestions of possible seral trends for each area in this study are based on generally applicable literature, sampling and observations at the sites, examination of similar non-dredged material seral stages, and available historical aerial photography.

15. Flora and fauna within a biotic region constitute the pool of organisms available for immigration and subsequent colonization of new habitat. Understanding seral relationships at dredged material

disposal sites is partially dependent upon knowledge of the regional biota and the biophysical characteristics of similar natural or quasi-natural habitats within the region.

Part III: Methodology

16. A BIOSIS File literature search was performed by the North Carolina Science and Technology Research Center, Research Triangle Park, North Carolina. This search provided basic abstracts and bibliographic material regarding upland succession. Additional literature was obtained through in-house knowledge of existing literature.

17. Biotic sampling consisted of plant cover estimation and density counts, small mammal trapping, and breeding bird censusing. Other sampling and general observations yielded information regarding microclimate, biotic diversity, and soils characteristics.

18. Microclimate sampling consisted of gathering air and soil temperature data by use of an instant-reading electric thermometer at 0.5 m above the ground, at the surface of the litter layer (if present), under the litter layer (if present), at 2-cm depth in the soil, and at 10-cm depth. Relative humidities were measured with a manual sling psychrometer.

19. Several series of dredged material samples were obtained from each site and were analysed for particle-size distribution by Law and Company, Wilmington, North Carolina. Phi and Wentworth size classes used for reporting correspond to U. S. Standard Sieve Mesh sizes and size in millimeters in the following way:

U. S. standard sieve	Millimeters	Phi	Wentworth
10	2.00	-1	granule
18	1.00	0	very coarse sand
35	0.50	1	coarse sand
60	0.25	2	medium sand
120	0.125	3	fine sand
230	0.0625	4	very fine sand
>325	0.031	5	coarse silt
	0.0156	6	medium silt
	0.0078	7	fine silt
	0.0039-0.00006	8-14	very fine silt and clay

Vegetation Sampling

20. Vegetation sampling was conducted during the following periods:

Nott Island -- 14-20 July 1974

Hillsborough Bay Islands -- 29 July-3 August 1974

Whiskey Bay Pilot Channel -- 21-27 July 1974

High Island-GIWW -- 4-10 August 1974

Mott Island -- 6-12 July 1974

Additional sampling was performed at the High Island-GIWW site during fall (October 1974) and spring (May 1975) trips. Voucher specimens of collected plants are deposited at the Herbarium, College of Life Sciences, Department of Botany and Bacteriology, Louisiana Tech University, Ruston, Louisiana.

21. Major plant associations were identified at each site and served as the basis for plant and animal sampling. Plant associations served as the basis for recognizing biotic communities, or the variations expressed as a result of interaction of all biophysical factors. These variations are most readily reflected by plant associations. Initial points were established at each site, and compass lines were extended from these points in directions that would divide the study areas into approximately equal segments. Every 100 ft* along these lines, a compass heading and a distance between 1 and 16 paces were drawn from a standard random numbers table. The distance was traversed in the direction indicated and sampling was accomplished at the destination point. At each destination point, all shrub stems over 1 ft in height were counted within a 4-m^2 quadrat, and percent cover estimates of herbs and shrubs 1 ft tall or under were made within a 0.5-m^2 quadrat.

22. From each point the sampler also viewed all trees over 1 in. DBH** within 360° through a glass cruising prism.† Appropriate

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* A table of factors for converting U. S. customary units of measurement to metric (SI) is given on page 18.

** DBH = Diameter Breast Height, or 4.5 ft above the ground.

† Prisms used in this study had an angle of inclusion 104°18", or BAF 10 (Basal Area Factor 10).

individuals were identified and DBH's were recorded. One hundred feet were then paced in the direction of the original compass heading, and the process repeated until a sufficient number of samples was taken to reasonably characterize the vegetation (modification of the Bitterlich variable plot method explained by Grosenbaugh 1952).

23. Where a stratification of canopy, shrub, and herb layers existed together, the same random points were used for both variable plot and quadrat methods. Where no continuous tree canopy existed, the random point method was applied to the location of quadrats.

24. Raw data for trees were summed by number of trees of each species per point and divided by the total number of points to derive the average number of trees per point for each species. These figures were multiplied by BAF 10 (10 ft^2 per tree) to derive the average basal area per acre per species. The average basal area for each species was divided by the average basal area for all species and multiplied by 100 to derive relative basal area. Density and relative density were derived thusly:

$$\frac{\Sigma \text{ number of trees by species per diameter class } (F_t)}{\text{Total number of points}} = \begin{array}{l}\text{Average}\\ \text{density of}\\ \text{stems per}\\ \text{acre by}\\ \text{species}\end{array}$$

$$\left(\frac{\text{Average density of stems per acre per species}}{\text{all stems}} \right) \times 100 = \text{Relative density}$$

where F_t is a Tree Factor derived from standard tables. All data then were converted to metric (basal area in m^2 per hectare and stems per hectare). An importance value for each species in each community was obtained by adding its relative basal area and relative density.

25. The sampling methods for shrubs and herbs employed metric measurements. For shrubs, the total number of stems of each species was summed and then divided by the total number of frames sampled to give the average number of stems per 4-m^2 quadrat. The quadrat

is 0.0004 hectare in extent; therefore 2500 multiplied by the average number of stems per species equals the average number of stems per species per hectare.

26. Herb and small shrub species data for each community were summed and divided by the total number of 0.5-m^2 quadrats sampled to give average percent cover for each species per quadrat. Relative values, an index to plant sociability, were derived for each species by dividing each average cover value or each value of stems per hectare by the total for the community and multiplying by 100.

Animal Populations

27. Breeding bird censuses were performed on selected areas of the Mott Island, Oregon; High Island, Texas; and Whiskey Bay, Louisiana study sites to obtain quantitative information about breeding bird densities and diversities. Methods used follow those standardized by Hall (1964). All territorial singing male birds were counted repeatedly, once each day, over a period of several days from a transect established prior to counting. Distances from the transect and heights from the ground were estimated. The bearing in degrees of each male was recorded using a sighting compass at the time of singing. These positions were later plotted and counted. Pertinent data regarding each breeding bird census plot are presented in Table 1.

28. Breeding bird censuses were also performed on the Hillsborough Bay, Florida islands for CZRC by F. M. Dunstan (warden/biologist for the National Audubon Society) and R. R. Lewis (Professor at Hillsborough Community College). Dunstan and Lewis (1974) describe their methods as follows:

> Quantitative methods to estimate the diversity and density of avian nesting populations for each island were arrived at separately depending on the nesting habitat and species present. On Fishhook, Gull, and Pine Islands a direct count was employed by walking the islands in their entirety and recording all birds observed. Each island was walked on three consecutive days before

Table 1

Pertinent Data Regarding Breeding Bird Census Plots Established at the Mott Island, High Island, and Whiskey Bay Study Sites[a]

			Whiskey Bay		
	Mott Island	High Island	Plot A	Plot B	Plot C
Plot shape	Rectangular	Two parcels: one rectangular, one roughly L-shaped	Linear	Roughly U-shaped	Linear
Method of plot delineation	Paced w/ compass	Paced w/ compass	Paced w/ compass	Paced w/ compass	Paced w/ compass
Plot size (acres)	30.1	29.4 and 3.8	9.5	18	9.5
Dimensions (feet)	1000 wide, 1250 to 1400 long	Rectangle: 400 wide, 3200 long. L-shaped plot: 750 long, varied from 125 to 300 wide.	150 wide, 2750 long	150 wide, 5200 long	150 wide, 2750 long
Dates censused	6-10 June 1975	16-21 May 1975	7-14 May 1975	7-14 May 1975	7-14 May 1975

[a]Locations of the census plots are shown on figures presented within each respective study site analysis section

Table 1 (concluded)

			Whiskey Bay		
	Mott Island	High Island	Plot A	Plot B	Plot C
Hours censused	Daily between 0500-0930 and one on 8 June, 2055-2155	Daily between 0600-0900	Daily between 0600-0930	Daily between 0600-0900	Daily 0600-1000
Total man-hours	27	22.5	21	15.5	19

10:00 AM. On Pelical Point Island a direct count was employed for non-colonial species while a strip census was used to count nests of colonial species. The strip width was 6m and the length varied with the habitat. Nests encountered within the strip could be identified to the species and an estimate of the total nesting population was determined by multiplying the number of nests per m^2 found in the strip by the total nesting habitat of the island. On Sunken Island the strip census method was used to estimate both colonial and non-colonial species. The same technique was used on Bird Island, however not all of the nests could be identified. All nests within the strip were counted and classified as to size (large or small). Brown pelican and double-crested cormorant nests were identified by the young present on the nests. A total estimate of the number of nests was calculated for each habitat.

A number of flight path counts were made at the heronry (Bird Island). All nesting species arriving or departing the island over a 15-minute interval for a segment of the island were identified and counted. These counts were made from a boat anchored off shore. The counts were made periodically from March through August at the same time of day.

In order to arrive at an estimate of the nesting population's species composition for Bird Island, the flight path counts were used as an index. The total number of individuals of each species appearing in all the flight path counts was converted to a percentage of the total number of nesting birds counted entering or leaving the colony. This percentage was then applied to the estimated number of nests on the island. The result is an estimate of species nesting composition.

Strip census counts and direct counts were conducted from July through October (the time period of this study). However, the nesting season for these islands was well underway as early as January for some species. For this reason, we have included supplemental information in the results for avian species diversity and density.

29. Quantitative and qualitative live-trapping censuses were performed at all five study areas to facilitate identification of small mammals and obtain information about their population characteristics.

30. A mark-release-recapture technique described in Giles (1971) was employed for the quantitative censuses. Collapsible Sherman Live Traps were placed in a grid and were baited with sunflower seeds. Grids were established in the field in such a way as to cover the maximum amount of habitat variation with the available number of traps. Traps were checked once daily, usually in the early morning. At Nott Island, traps were also checked in the evening because meadow voles (Microtus pennsylvanicus) frequently entered them during daylight hours. Animals captured were permanently marked by toe-clipping using a numbering system similar to that described by Baumgartner (1940). All captured individuals were examined externally to determine age, sex, reproductive status, and presence of parasites. A cone constructed of one-quarter in. mesh hardware cloth was used to facilitate handling of captured animals. Daily population density estimates were computed when possible using the Schnabel formula:

$$P = \frac{\Sigma(AB)}{\Sigma C}$$

where P = population estimate

A = total number of individuals captured in one day

B = total number of marked animals available for capture

C = total number of marked animals captured in one day.

Ninety-five percent confidence limits were placed around the mean of the daily estimates using methods described in Steel and Torrie (1960). Pertinent information about the quantitative census plots established at each study site is presented in Table 2.

Table 2

Pertinent Data Regarding Quantitative Small Mammal Live-Trap Census Plots Established at Each Dredged Material Disposal Area[a]

					Hillsborough Bay	
	Mott Island	Nott Island	High Island	Whiskey Island	Bird Island	Sunken Island
Plot shape	Rectangular	Rectangular	Rectangular	Rectangular	Elliptical	Figure eight pattern
Method of plot delineation	Paced w/ compass	Paced w/ compass	Paced w/ compass	Paced w/ compass	Paced w/ compass	Paced w/ compass
Plot size (acres)	2.8	2.8	2.8	3.6	3.7	3.4
Number of traps	47	47	48	60	25	30
Trap interval (feet)	50	50	50	50	100	100
Dates trapped	15-18 Oct 1974	17-21 Sept 1974	8-11 Oct 1974 16-20 May 1975	23-26 Sept 1974	30 Sept-4 Oct 1974	30 Sept- 4 Oct 1974
Number of nights[b]	188	235	192 (Oct.) 240 (May)	240	125	120

[a]Locations of the census plots are shown on figures presented within each respective study site analysis

[b]Trap nights equal the number of traps multiplied by the number of 24-hour sample periods

31. Methods employed for the qualitative live-trapping censuses were similar to those used for the quantitative censuses except that traps were selectively placed in habitats too distant from the quantitative sample area to be sampled in the grid. Qualitative sampling insured sampling within all major habitat types (vegetation associations), and within sub-types where it was thought profitable for establishing diversity.

32. Additional information about the fauna inhabiting the five study sites was gathered by means of reconnaissance surveys. Notes on relative abundance, habitats occupied, behavior, and other various topics of interest were collected for most species identified.

Part IV: Nott Island, Connecticut

Description of Regional Setting

33. Nott Island is located in the Connecticut River one-fourth mile east of Essex at approximately river mile 7. The island is largely a natural, riverine alluvial formation (Figure 2).

34. The region surrounding Nott Island is a part of the Eastern Deciduous Forest Biome. More specifically it is a part of the smaller glaciated section of the Oak-Chestnut Forest region (Braun 1950). Climax forests of the area are generally dominated by broadleaf deciduous tree species including white oak (*Quercus alba*), red oak (*Q. rubra*), black oak (*Q. velutina*), red maple (*Acer rubrum*), and several species of hickory (*Carya* spp.).

35. Climatologically, the area is strongly influenced by maritime weather patterns. During the fall and winter months, the climate of the study area is dominated by cold, dry subarctic air; during the spring and summer months, the area is influenced by warm, moist air originating from the Gulf of Mexico and the Atlantic Ocean. Due to the coastal location of the study area, it is subjected to easterly flows of cool, damp air from the North Atlantic. These flows have an important moderating influence on the subarctic and subtropical air flows (Pack 1959).

36. Temperature and precipitation data given below are based on a 10-year record (1951-60) from Westbrook, Connecticut, approximately 6 miles southwest of the study area (U. S. Department of Commerce 1964c). The mean annual temperature is 49.5°F. January is the coldest month of the year with an average temperature of 28.7°F and a record low temperature of -21°F. July is the warmest month of the year with an average temperature of 70.1°F and a record high of 95°F.

37. Precipitation is evenly distributed throughout the year; annual precipitation over the 10-year period averaged 50.10 in. Annual snowfall averaged over the 10-year period was 27.7 in. The majority of the snowfalls occur during December, January, February, and March.

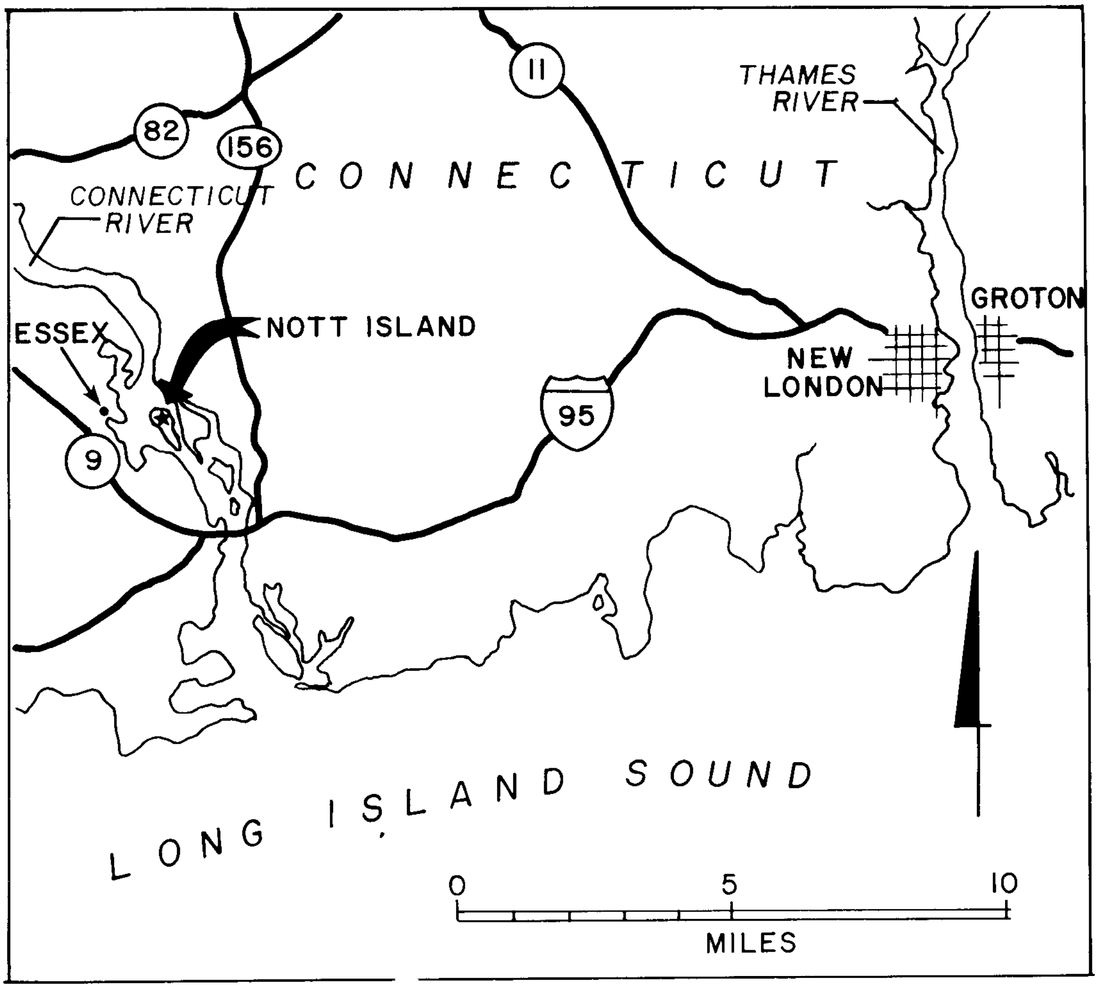

Figure 2 - Vicinity Map, Nott Island, Connecticut

38. Relative humidity data are not available at weather stations in close proximity to the study area. However, relative humidity is recorded at Bridgeport, 42 miles east southeast of the study area on Long Island Sound. In 1973 annual average relative humidity ranged from 72 percent at 0100 hours to 59 percent at 1300 hours (U. S. Department of Commerce 1973c).

39. Prevailing winds are from the northwest during winter months and from the southwest during the summer. Mean hourly windspeeds at Bridgeport range from 10 to 14 mph. Along the coast, summer afternoon temperatures are moderated by a cool onshore sea breeze which penetrates 5 to 10 miles inland (Pack 1959).

40. Thunderstorms occur frequently during the summer months, especially during the late afternoon or early evening hours. Such storms occur during an average of 20 to 30 days each year. Damaging winter storms of glaze or freezing rain occur most every year (Pack 1959).

41. Tornadoes and hurricanes are relatively uncommon. The most hazardous storms occurring in the area are northeasters which produce high winds and heavy rains (Pack 1959). Tropical storms of hurricane intensity have occasionally struck the Connecticut coast, causing severe wind and flood damage. Some of the more devastating hurricanes that have struck Connecticut occurred in 1938, 1944, 1954, and 1955.

42. Flooding occurs occasionally on the lower Connecticut River during late winter and early spring snow melt and/or rains. Other flooding conditions in the area may be caused by tropical storms and northeasters.

43. Geologically, the entire regional landscape has been most profoundly influenced by the Wisconsin period of glaciation during the Pleistocene. Soil and rock material removed from the landscape during glaciation was deposited to the south along what is presently Long Island, or removed farther out to sea by outwash melt waters. Most soils of the area are residual, except along alluvial deposits, and date from the close of the last glaciation. Alluvial materials, such as those that compose most of the substrate on Nott Island, have been

transported from decayed crystalline parent rocks composed largely of glacier-scoured granites within the Connecticut River and basin. At Nott Island the greatest portion of alluvial material is sand.

44. Little literature regarding ecological analyses of either riverine alluvium or dredged material is available for the general region of the study area. Sand flats formed by dredged material disposal in 1929 along the Hudson River in Columbia County, New York, have been examined by McVaugh (1947 and 1957). As of 1957, the upland portions of the sands were occupied by arborescent species including cottonwood (*Populus deltoides*), black locust (*Robinia pseudo-acacia*), and wild black cherry (*Prunus serotina*), all with heavy growths of woody vines. Other woody species include smooth sumac (*Rhus glabra*), staghorn sumac (*R. typhina*), and sandbar willow (*Salix interior*). Dominants in open, sandy areas included *Cyperus filiculmis*, panic grass (*Panicum virgatum*), and others. Most of the plant species observed by McVaugh are generally considered characteristic pioneer species along riverbanks, roadbanks, and railroad rights-of-way.

History of the Disposal Area

45. Nott Island was first used as a dredged material disposal area in 1937 when the channel through Essex Shoal was deepened from an original project depth of 12 ft to a new depth of 15 ft.* Material from this period was placed adjacent to the west bank of the upland portions of Nott Island, and, along with disposal in 1948, effectively increased the total upland land mass of the island (U. S. Engineer Office, Providence, Rhode Island 1937). Subsequent periods of disposal took place largely within the land mass of the island. These periods and amounts of dredged material deposited are as follows (Personal communication, 31 May 1974, Mr. Bob Rossetti, New England Division, Corps of Engineers, Waltham, Massachusetts):

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*New England Division, Corps of Engineers, contract record 19-016-62-37, page SC-2.

Year	Cubic Yards
1948	5,000
1953	40,000
1955	6,700
1957	20,000
1962	66,000
1964	30,000

The largest dredged material deposit (visible as a large unvegetated area in Figure 3) is thought to have been deposited during the 1962 and 1964 disposal periods. Corresponding ages and locations of other deposits are outlined later.

Ecological Analysis

Physical characteristics

46. Topography. Nott Island is a low-lying riverine alluvial formation. Original elevations were probably not over 10 ft above the mean level of the Connecticut River (as surmised from 1937 photography. A 1974 topographic survey showed portions of the island have been elevated to nearly 17 ft as a result of dredged material disposal since 1937. Approximately seven major deposits are visible on the island, shown as unvegetated areas or as areas supporting a growth of beachgrass (*Ammophila breviligulata*) on Figure 3. The extent to which material flowed over the rest of the island is unknown. The deposits of dredged material contribute to a somewhat variable topography of much of the island. For the most part, the northern half of the island is upland and the southern half is tidal marsh. Along the western shore of the northern half of the island, sandy dredged material has been eroded by river action, and a bank 5 or 6 ft high drops to a narrow sandy beach.

47. None of the northern half of the island is subject to tidal inundation under normal conditions. Flooding was an almost annual occurrence before construction of flood-control devices upstream in the Connecticut River during the 1940's (Personal communication, February 1975, Oliver LaPlace, Essex, Connecticut).

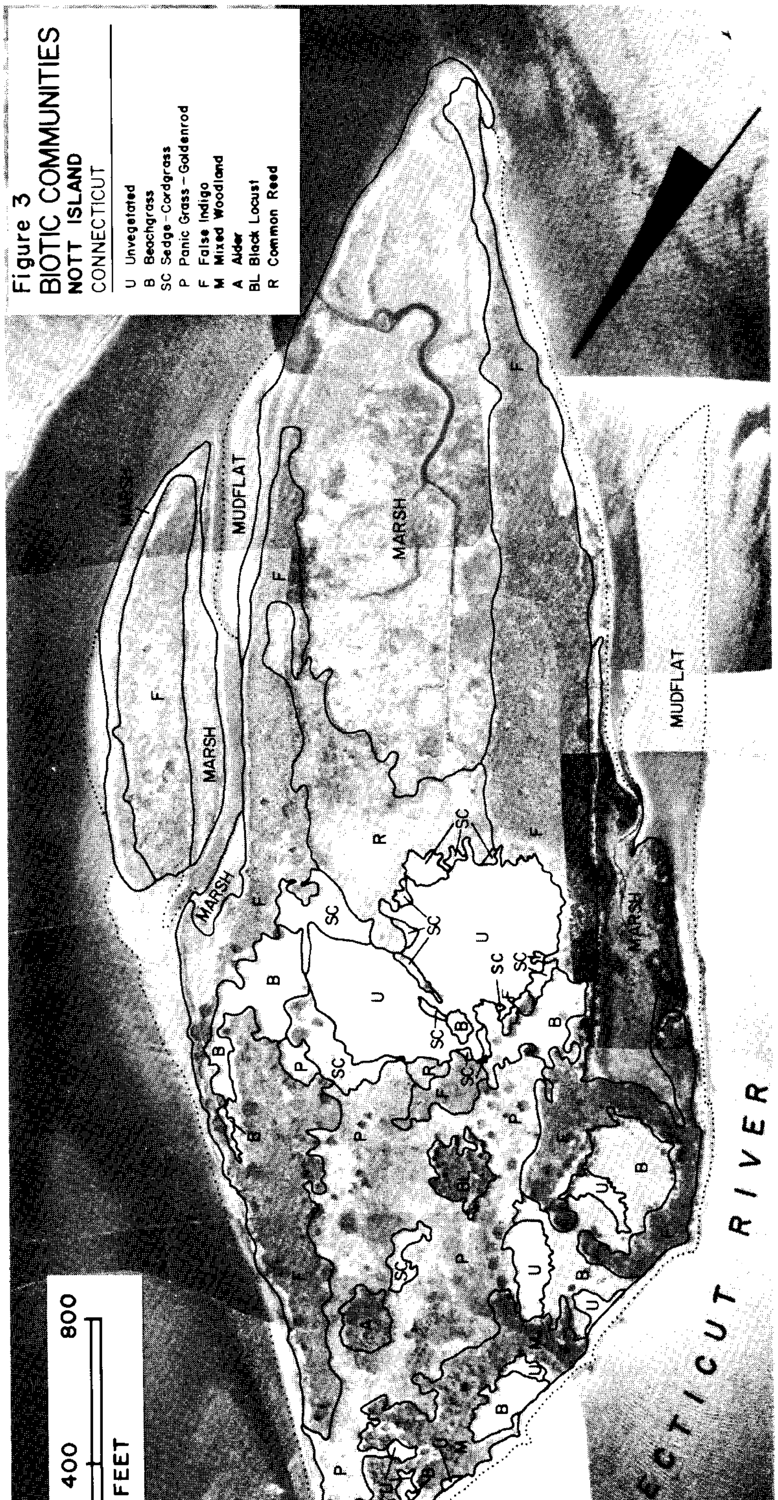
Figure 3
BIOTIC COMMUNITIES
NOTT ISLAND
CONNECTICUT
U Unvegetated
B Beachgrass
SC Sedge-Cordgrass
P Panic Grass-Goldenrod
F False Indigo
M Mixed Woodland
A Alder
BL Black Locust
R Common Reed
0
400
800
FEET
MARSH
MUDFLAT
CONNECTICUT RIVER

48. Soils. Disposal of dredged material began in 1937. Prior to this, until about 1920, the area was farmed intensively. A farm owned and worked by the MacWhinney family was located on the island. Buildings associated with this farm are visible on 1937 aerial photography. Following cessation of farming, upland portions of Nott Island were used for grazing and hay production until the 1940's (Personal communication, July 1974, Andrew MacWhinney, Saybrook, Connecticut).

49. Two age categories of soils exist on Nott Island: riverine sands deposited by the river before 1937, and sands deposited by pipeline dredged since 1937. Though the two soils are very similar in textural characteristics, the former have been subject to modification by natural vegetation and agricultural practices for many more years.

50. The seven soil samples obtained from Nott Island exhibit a high degree of similarity of particle-size distribution (Table 3). The soils are largely fine to medium sands, but contain small amounts of finer materials (samples 2-3, 3-3, and 7-2). A layer of finer material is particularly apparent in soil taken from the alder (*Alnus serrulata*) stand. The variation between the upper sample (7-1) and a lower sample (7-2) of soil in the alder stand may represent an interface formed where sandy dredged material flowed over a pre-existing soil surface.

51. Microclimate. Microclimate data were recorded on Nott Island during July and September 1974 (Table 4). These data most effectively quantify the moderating influences of the various types of vegetative cover on associated soil and lower air layers.

52. Data from unvegetated areas indicate a severe environment unbuffered from microclimatic extremes. The relative effectiveness of shade on upper soil layers is demonstrated by the data for mean differences between temperatures at 0.5 m and temperatures under the litter. Negative values occurred where little or no vegetation grew.

Table 3

Physical Description of Nott Island Soils

Biotic Community[b]	Sample Number	Sample Depth, cm	Depth to Water Table, cm	Particle-Size Distribution - Phi Scale[a] -1	0	1	2	3	4	5	6	7	8-14
Unvegetated	1-1	0-15	-	0.2	1.2	8.4	54.5	32.2	3.5	0.0	0.0	0.0	0.0
	1-2	31-46	-	0.2	0.8	17.5	53.0	24.5	2.4	1.6	0.0	0.0	0.0
False indigo	2-1	2.5-31	-	0.0	0.2	0.4	24.0	64.2	10.1	0.4	0.0	0.7	0.0
	2-2	32-61	-	0.0	0.0	0.4	15.4	55.8	14.5	12.3	0.4	1.0	0.2
	2-3	61-92	91	0.0	0.2	0.2	7.8	27.2	44.2	8.8	9.2	1.6	0.8
Black locust	3-1	2.5-6	-	0.8	0.4	1.4	42.2	41.0	9.2	3.4	1.2	0.4	0.0
	3-2	15-31	-	0.0	0.2	0.9	18.7	78.7	0.0	0.6	0.7	0.2	0.0
	3-3	31-91	-	0.0	0.2	0.2	5.5	54.7	27.3	5.9	3.2	2.0	1.0
	3-4	91	91	0.0	0.0	0.2	22.4	46.0	22.0	4.4	4.0	1.0	0.0
Panic grass-goldenrod	4-1	0-5	-	0.2	0.2	3.9	44.1	26.1	18.8	5.2	0.7	0.6	0.2
	4-2	5-31	-	0.0	0.0	5.8	70.0	20.0	4.2	0.0	0.0	0.0	0.0
	4-3	46-91	-	0.0	0.0	1.2	27.2	33.8	23.6	11.4	1.8	1.0	0.0
Beachgrass	5-1	0-31	-	1.4	9.8	30.2	45.6	11.6	0.4	0.0	0.4	0.6	0.0
	5-2	31-61	-	0.4	6.2	24.8	51.0	15.8	0.4	0.6	0.4	0.4	0.0
False indigo	6-1	0-8	-	0.2	0.2	1.0	17.5	61.0	10.0	7.8	1.5	0.6	0.2
	6-2	8-33	-	0.0	0.0	0.2	7.8	73.8	16.2	0.6	0.4	1.0	0.0
	6-3	33-42	-	0.0	0.2	1.0	12.4	31.2	44.0	9.2	1.0	1.0	0.0
	6-4	42-55	-	0.0	0.0	0.2	20.2	44.4	26.8	7.2	1.2	0.0	0.0
Alder	7-1	1-15	65	0.0	0.2	1.8	55.2	23.2	6.8	11.2	1.0	0.4	0.2
	7-2	15-40	-	0.0	0.0	0.2	7.3	35.9	29.4	14.8	7.2	5.2	0.0
	7-3	40-55	-	0.0	0.0	0.2	12.0	35.6	34.2	8.6	8.0	1.2	0.2
	7-4	55-65	65	0.0	0.0	0.4	29.4	53.0	14.6	1.2	0.8	0.4	0.2

[a] Phi scale corresponds to the following Wentworth sizes:

Phi Scale	Wentworth Size
-1	Granule
0	Very coarse sand
1	Coarse sand
2	Medium sand
3	Fine sand
4	Very fine sand
5	Coarse silt
6	Medium silt
7	Fine silt
8-14	Very fine silt and clay

[b] See Figure 3

Table 4

Microclimate Data for Nott Island

Date 1974	Biotic Community	Time	Percent Relative Humidity[a]	Depth of Sample - Temperature, °C 0.5 m	Litter Surface	Below Litter	-2 cm	-10 cm
15 Jul	Unvegetated	PM	60	35	54.5	N/A[b]	45.5	35.5
	False indigo	PM	69	36.5	40.5	38	26	20
	Black locust	PM	N/R[c]	34	30	25	24	20
	Panic grass-goldenrod	PM	60	33	38.5	37	34	27.5
	Beach grass	PM	N/R	35.5	43	44	44	28
17 Jul	False indigo	AM	66	28	25	24	22	20
	Panic grass-goldenrod	AM	45	29	22.5	22.5	21	20
	False indigo	AM	50	27	21	21.5	19.5	19
	Panic grass-goldenrod	AM	45	30	34	33	28	21.5
	Alder	PM	48	26	22	21.5	19.5	18.5
18 Jul	Beach grass	AM	81	24.5	24.5	24	23.5	22.5
	Panic grass-goldenrod	AM	N/R	25	23	22.5	22	21.5
	False indigo	AM	79	24	22.5	22	20.5	19.5
	Unvegetated	AM	63	30	33	N/A	28	25
	Black locust	AM	69	28	23	23	20	19
	Panic grass-goldenrod	AM	70	35	31.5	27.5	26.5	23.5
	Alder	AM	71	26.5	22.5	22	19.5	18.5
	Alder	AM	71	30	N/R	27	25	22
17 Sep	Unvegetated	PM	38	31	39	N/A	30	25
	Panic grass-goldenrod	PM	60	27	31	29	26	21
	Black locust	PM	66	27	26	26	20	17
	Sedge-cordgrass	PM	57	28	29	N/A	27	22
	Beachgrass	PM	60	32	24	21	20	19
	Common reed	PM	60	27	25	23	19	18
20 Sep	Panic grass-goldenrod	PM	79	28	27	26	25	22
	Black locust	PM	83	26	N/R	21	20	19
	Alder	PM	76	25	21	20	19	18

[a]From 0.5 to 1.0 m above the litter

[b]N/A entry indicates not applicable

[c]N/R entry indicates no value recorded

Vegetation Association	Mean Difference in Temperatures at 0.5 m and Under Litter
Unvegetated	-10.2*
Sedge-cordgrass	-1.0
Beachgrass	0.9
Panic grass-goldenrod	1.2
False indigo	2.8
Common reed	4.0
Alder	4.0
Black locust	5.0

Similarly, relative humidities were generally higher in denser vegetation during any morning or afternoon period.

53. During heavily overcast conditions with relative humidity near 80 percent temperature stratification is weaker than on clear days with no overcast. Data for 17 July and 18 July show this trend for first morning readings in panic grass-goldenrod and false indigo communities. On 17 July, the day was clear. On 18 July, the day was heavily overcast.

Biological characteristics

54. Analysis of existing vegetation. Seven upland plant associations and one marsh association occur on Nott Island. The upland associations are covered in detail in the following order:

Unvegetated
Sedge-cordgrass
Common reed
Beachgrass
Panic grass-goldenrod
False indigo
Mixed woodland
Alder
Black locust

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*A negative number indicates that temperatures at 0.5 m were lower than temperatures at the surface of the soil. Effectively, this means litter was absent or very sparse.

55. The marsh association, not the topic of this study, will be discussed briefly before proceeding with the discussion of upland communities. Brackish tide marsh vegetation presently occupies about 23 percent of the total areal extent of Nott Island (Figure 3, Table 5). Two main species dominate the major portion of marsh: narrow-leaf cattail (*Typha angustifolia*) in the most constantly flooded portions, and common reed (*Phragmites communis*) in the less frequently flooded and well-drained portions. Dredged material disposal since the 1960's has doubtless enhanced overall growing conditions for the latter species. Stands dominated by common reed rarely contain other species. Marsh dominated by narrow-leaf cattail contains many other plant species including great bulrush (*Scirpus validus*), water parsnip (*Sium suave*), hibiscus (*Hibiscus* sp.), and forget-me-not (*Myosotis laxa*).

a. *Unvegetated*. Unvegetated areas are sandy dredged material deposits that support occasional small clumps or individuals of sedge (*Cyperus dentatus*), sandspur (*Cenchrus longispinus*), and sand grass (*Triplasis purpurea*). Rhizomes 10 to 20 ft from clones of common reed occasionally send up low vigor stems. One large clone of bayberry grows near the southeastern edge of the largest dredged material deposit. Indian grass (*Sorghastrum nutans*), panic grass (*Panicum virgatum*), and turkey foot (*Andropogon gerardi*) are present in small, frequently circular clumps, particularly near the lower edges of dredged material lumps. Presence of the latter three species in otherwise bare sand may be due to covering by sand moved over clumps previously rooted in more optimum soils. Movement of sand particles by wind, rain, and man has an important bearing on plant growth on the dredged material.

Establishment of natural pioneer plants such as sedge is aided by two special adaptations. In addition to seeds, this species produces plantlets that become lodged and established much sooner because of their greater mass and quicker rooting ability. Lateral growth of sedge is accomplished by rhizomes that, in turn, produce younger aerial stems away from the central clump. Juvenile rhizomes produce the more robust flowering culms, for the tallest plants up to 3

Table 5

Acreages of Biotic Communities, Nott Island[a]

Biotic Community	Acres	Percent
Marsh	20.4	23.2
Unvegetated	7.1	8.1
Sedge-cordgrass	2.4	2.7
Beachgrass	5.4	6.1
Common reed	4.9	5.6
Panic grass-goldenrod	9.8	11.1
False indigo	33.3	37.9
Mixed woodland	3.5	4.0
Alder	0.5	0.6
Black locust	0.6	0.7
Total	87.9	100.0

[a]Acreages do not include small island to the east of Nott Island

decimeters (dm) are nearly always at the outer edges of the circles. The centers usually consist of older plants, while the younger seed and plantlet stems are at the outside of the circle. The circular clumps both trap moving particles and retain the soil in which they are growing.

Seeds of other plant species transported to the centers of the sedge circles occasionally germinate and grow successfully. Reproductively mature individuals of panic grass and cordgrass (*Spartina pectinata*) were seen in some circles. The sedge circles in otherwise unvegetated dredged material are the precursors of the sedge-cordgrass community.

b. Sedge-cordgrass. Sedge and cordgrass are the dominant vascular plant species of the sedge-cordgrass community. As mentioned earlier, sedge is an important pioneer species in some disposal areas. It is even more important at the bases of the mounds where growing conditions are somewhat less severe. The sedge seems to be the first species to establish a continuous ground cover, while cordgrass always becomes established in the area of older sedge stems.

Two other species also occur in this early established community: a species of haircap moss (*Polytrichum commune*) and woolgrass (*Scirpus cyperinus*). Haircap moss provides a low, thick ground cover. Presence of these two species suggests moister soil conditions than were noted at the time of field work.

Full expression of this association is limited to a small area at the northeastern base of the largest unvegetated area. Sampling was designed to include sedge circles as well as representative portions of the sedge-cordgrass community. The sampling data show the relative average percent cover of the two dominants (Table 6). Beachgrass appears in the data, but is not a characteristic member of this community.

c. Common reed. Common reed is a pioneer on dredged material, particularly where marsh conditions prevail. Once established, common reed propagates itself most efficiently by rhizomes. As a result of this habit, it is able to spread into less optimum habitats.

Table 6

Average Percent Cover and Relative Values for Herb Species in the Sedge-Cordgrass Community of Nott Island

Herbaceous Species	Average Percent Cover[a]	Relative Value
Sedge (*Cyperus dentatus*)	28.6	63.6
Cordgrass (*Spartina pectinata*)	13.2	29.3
Beachgrass (*Ammophila breviligulata*)	3.2	7.1
	45.0	100.0

[a]Average cover for all 0.5-m^2 quadrats

Table 7

Average Percent Cover and Relative Values for Herb Species in the Common Reed Community of Nott Island

Herbaceous Species	Average Percent Cover[a]	Relative Value
Common reed (*Phragmites communis*)	45.0	95.3
Cordgrass (*Spartina pectinata*)	2.2	4.7
	47.2	100.0

[a]Average cover for all 0.5-m^2 quadrats

On Nott Island, common reed probably first became established at the base of dredged material in a more or less marshy situation. Rhizomes grew into drier dredged material to a point where growing conditions were prohibitive. Decreased vigor of the culms at the edge of open dredged material indicates the colony as a whole may have reached its habitat limits. A narrow fringe of sedge may grow between the common reed and unvegetated sand, particularly where the stands of common reed afford shade during hottest times of the year.

Very few other plants are able to survive within the thickest common reed stands due to heavy litter cover, shading, and root competition (Table 7). Shrubs such as bayberry or false indigo also have clonal growth habits and occasionally are able to establish or remain for a time after they are surrounded. Some clonal shrubs within the reed stands appear to be dying as dominance shifts to reed. Once established, reed stands may persist for a very long time.

The microhabitat within reed stands is more moderate than on unvegetated dredged material (Table 4). Relative humidity averages much higher than in adjacent sandy areas, and soil temperatures show much less variation. Litter accumulation adds organic material to the soil and enhances nutrient accumulation.

d. Beachgrass. Beachgrass presently occurs in five major areas (Figure 3). Beachgrass is also a pioneer plant, characteristic of loose dry sands. As far as is known, this species occurs naturally on Nott Island. It is probably the only species with the capability of spreading over the most xeric portions of the unvegetated dredged material. This point is indicated by presence of scattered clumps attached to rhizomes well away from the main mat of the grass. Such clumps are customarily less robust than those of the primary mat, but increase in vigor as they become more abundant. Increased vigor is due to their moderating influence on the soil, even though this influence is small.

Litter accumulations are heavy in the primary mat. Both living and dead stems have formed a thick ground cover of loose, fibrous mats of litter up to 6 and 8 in. in depth that act as a very effective erosion inhibitor and soil moisture retainer.

There is little chance for establishment of other plant species within the beachgrass mats (Table 8). Annuals such as fireweed (Erechtites hieracifolia) occur sporadically, but growth of seedlings of most herbaceous and woody species is uncommon.

e. Panic grass-goldenrod. The dominant herbaceous plant species throughout the upland portions of Nott Island are perennial panic grass and a rhizomatous goldenrod (Solidago rugosa). Both species are more characteristic of abandoned fields than of dredged material, but panic grass frequently occurs on and near the bases of some of the dredged material mounds.

Separation of this community from the next association (false indigo) is difficult because they intergrade. On the map (Figure 3), separation is largely for the sake of convenience. Goldenrod is also a frequent element of the false indigo community. Panic grass, as well, is established in some of the larger openings within the false indigo community. The observable tendency is for panic grass to occur in the looser, xeric sandy soils, while goldenrod grows in more closed or mesic situations. Goldenrod is not as dense under a heavy cover of false indigo, due to greater light requirements.

The data obtained by quadrat sampling in this community show a higher cover percentage for red fescue (Festuca rubra) than for goldenrod (Table 9). Red fescue, very abundant in only a small number of plots, seems more common than goldenrod, which appeared regularly in all plots.

The panic grass-goldenrod community occurs in the northern central portion of the island (Figure 3). Except for a few areas dominated by other species, this area is probably hydrologically intermediate between the main dredged material deposits and the false indigo community. Higher points occur within this community where the tops of sand ridges support small circles of sedge. Panic grass vegetates the lower sides of some of these ridges, while upper sides are usually bare sand.

Table 8

Average Percent Cover and Relative Values for Herb Species in the Beachgrass Community of Nott Island

Herbaceous Species	Average Percent Cover[a]	Relative Value
Beachgrass (*Ammophila breviligulata*)	36.4	86.1
Cyperus sp.	5.9	13.9
	42.3	100.0

[a]Average cover for all 0.5-m^2 quadrats

Table 9

Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Herb and Shrub Layers of the Panic Grass-Goldenrod Community of Nott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Panic grass (*Panicum virgatum*)	13.33	27.1	24.3
Red fescue (*Festuca rubra*)	13.33	27.1	24.3
Goldenrod (*Solidago rugosa*)	7.50	15.2	13.7
Hair-cap moss (*Polytrichum* sp.)	4.17	8.5	7.6
English rye grass (*Lolium perenne*)	2.50	5.1	4.6
Unidentified grass	1.67	3.4	3.0
Panicum clandestinum	0.83	1.7	1.5
Panicum sp.	0.83	1.7	1.5
Sorrel (*Oxalis stricta*)	0.83	1.7	1.5
Panicum lanuginosum	0.83	1.7	1.5
Asteraceae	0.83	1.7	1.5
Water-horehound (*Lycopus americanus*)	0.83	1.7	1.5
Rush (*Juncus* sp.)	0.83	1.7	1.5
Agrostis hyemalis	0.83	1.7	1.5
	49.14	100.0	
Shrubs:			
Poison ivy (*Rhus radicans*)	1.67	33.5	3.0

[a]Average cover for all 0.5-m^2 quadrats

Table 9 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Smooth sumac (*Rhus glabra*)	0.83	16.7	1.5
Unidentified seedling	0.83	16.6	1.5
Unidentified seedling	0.83	16.6	1.5
Bittersweet (*Celastrus orbiculatus*)	0.83	16.6	1.5
	4.99	100.0	
Trees:			
Tree-of-heaven (*Ailanthus altissima*)	0.83	100.0	1.5
			100.0

Species	$\#/4\ m^2$	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Smooth sumac (*Rhus glabra*)	2.33	5825.0	60.8
False indigo (*Amorpha fruticosa*)	0.83	2075.0	21.7
Winged sumac (*Rhus copallina*)	0.67	1675.0	17.5
	3.83	9575.0	100.0

Shrubs are scattered within the panic grass-goldenrod community. Notable species are smooth sumac (Rhus glabra) and winged sumac (Rhus copallina). False indigo is quite important. Bayberry forms occasional dense clumps throughout upland portions of the island. Seedlings of tree-of-heaven (Ailanthus altissima), a tree species common in the mixed woodland community, are more common in the northern portions of the community. A more extensive stand of tree-of-heaven will probably result, as indicated by the occurrence of many young individuals.

f. False indigo. False indigo is the most abundant shrub species on Nott Island and dominates 33 of the 67 acres of upland community found on the island. It is also the dominant shrub on a small island just to the east of Nott.

Two sections of the community in the northern half of the island are topographically higher than the two long segments in the southern half. Storm tides frequently inundate portions of the latter two lobes, as indicated by the collection of buoyant rubbish on the ground under the shrubs. This diversity of habitat enhances the overall plant species diversity as indicated by the data (Table 10).

Several other shrub species occur frequently, but are not usually codominant. Winged sumac is common to both the northern and southern segments, while wild rose (Rosa carolina) is common in the dryer northern sections and does not occur in the southern. Bayberry is common to both sections.

The northern section contains more frequent thinnings or openings in the shrub stratum. These openings are vegetated by wild rose and small mats of dewberry (Rubus flagellaris), while the southern, more mesic area is a more continuous dense tangle of shrubs and vines. Bindweed (Mikania scandens), a twining vine adjusted to moist soils, is common in shrubs in the south section. Seven species constitute 83 percent of the total herb cover in both sections (Table 10). Mustard (Brassica nigra) and red fescue are most abundant in shaded soil under false indigo.

Table 10

Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Herb and Shrub Layers of the False Indigo Community of Nott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Red fescue (*Festuca rubra*)	12.83	30.7	23.9
Goldenrod (*Solidago rugosa*)	6.09	14.6	11.3
Stachys sp.	4.13	9.9	7.7
Bindweed (*Mikania scandens*)	3.70	8.8	6.9
Fall witch-grass (*Leptoloma cognatum*)	3.04	7.3	5.7
Mustard (*Brassica nigra*)	2.83	6.8	5.3
Panicum lanuginosum	1.74	4.2	3.3
Sorrel (*Oxalis stricta*)	0.87	2.1	1.6
Carex annectans	0.87	2.1	1.6
Carex sp.	0.65	1.6	1.2
Peppergrass (*Lepidium virginicum*)	0.44	1.1	0.8
Asteraceae	0.44	1.1	0.8
English rye grass (*Lolium perenne*)	0.44	1.1	0.8

[a]Average cover for all 0.5-m^2 quadrats

Table 10 (continued)

Species	Average Percent Cover	Relative Value	Total Relative Value
Poke weed (*Phytolacca americana*)	0.44	1.1	0.8
Unidentified seedling	0.44	1.0	0.8
Fleabane (*Erigeron strigosus*)	0.22	0.5	0.4
Yarrow (*Achillea millefolim*)	0.22	0.5	0.4
Pearly everlasting (*Anaphalis margaritacea*)	0.22	0.5	0.4
Thistle (*Crisium* sp.)	0.22	0.5	0.4
Panic grass (*Panicum virgatum*)	0.22	0.5	0.4
Panicum sp.	0.22	0.5	0.4
Juncus effusus	0.22	0.5	0.4
Water-horehound (*Lycopus americanus*)	0.22	0.5	0.4
Agrostis sp.	0.22	0.5	0.4
Scouring rush (*Equisetum* sp.)	0.22	0.5	0.4
False nettle (*Boehmeria cylindrica*)	0.22	0.5	0.4
Running bent (*Agrostis stolonifera*)	0.22	0.5	0.4
Jewel weed (*Impatiens capensis*)	0.22	0.5	0.5
	41.81	100.0	
Shrubs:			
Bayberry (*Myrica pensylvanica*)	2.83	24.1	5.3

Table 10 (continued)

Species	Average Percent Cover	Relative Cover	Total Relative Value
False indigo (*Amorpha fruticosa*)	2.39	20.3	4.5
Wild rose (*Rosa carolina*)	2.17	18.5	4.0
Dewberry (*Rubus flagellaris*)	1.74	14.8	3.3
Bittersweet (*Celastrus orbiculatus*)	0.87	7.4	1.6
Virginia creeper (*Parthenocissus quinquefolia*)	0.87	7.4	1.6
Poison ivy (*Rhus radicans*)	0.44	3.7	0.8
St. John's wort (*Hypericum mutilum*)	0.22	1.9	0.4
Winged sumac (*Rhus copallina*)	0.22	1.9	0.4
	11.75	100.0	
Trees:			
Tree-of-heaven (*Ailanthus altissima*)	0.22	100.0	0.4
			100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
False indigo (*Amorpha fruticosa*)	3.78	9,450.0	43.0	42.3
Wild rose (*Rosa carolina*)	2.34	5,850.0	26.6	26.2

Table 10 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Bayberry (*Myrica pensylvanica*)	1.34	3,350.0	15.2	15.0
Winged sumac (*Rhus copallina*)	1.26	3,150.0	14.3	14.1
Staghorn sumac (*Rhus typhina*)	0.08	200.0	0.9	0.9
	8.80	22,000.0	100.0	
Trees:				
Tree-of-heaven (*Ailanthus altissima*)	0.13	325.0	100.0	1.5
				100.0

Tree-of-heaven is frequent throughout the community, reaching an average density of 325 stems per hectare. American elm (*Ulmus americana*), wild cherry (*Prunus serotina*), black willow (*Salix nigra*), and black oak (*Quercus velutina*) occur along the eastern side of the island in the false indigo community. An individual oak (possibly black oak, although it may be a hybrid) on the east side is the largest living tree on the island (DBH = 43 in.).

g. *Mixed woodland*. A mixed association of arborescent species grows at the northern and northeastern tip of Nott Island. Species represented are: American elm, tree-of-heaven, silver maple (*Acer saccharinum*), white ash (*Fraxinus americana*), large-toothed aspen (*Populus grandidentata*), black locust (*Robinia pseudo-acacia*), wild black cherry, and red cedar (*Juniperus virginiana*). Younger individuals of some of these species occur in the shrub layer.

Vines such as bittersweet (*Celastrus orbiculatus*), Virginia creeper (*Parthenocissus quinquefolia*), fox grape (*Vitis labrusca*), Japanese honeysuckle (*Lonicera japonica*), and poison ivy (*Rhus radicans*) frequently form a thick ground cover and continue into the tree canopies. This condition is well illustrated (except for Japanese honeysuckle which did not appear in samples taken) by the data (Table 11). In the thickest situations, species other than the various vines are uncommon. One frequently repeated condition develops when a thick cover of poison ivy covers the ground and lower tree limbs, while bittersweet occurs well into the canopy. Shrubs in openings are those that predominate in the false indigo community.

Other plant species do occur, particularly along edges where sunlight is more available near beachgrass or panic grass-goldenrod communities. Small stands of tansey (*Tanacetum vulgare*), along with a variety of the species more characteristic of panic grass-goldenrod and false indigo communities, often occur.

h. *Alder*. One nearly circular stand of alder (*Alnus serrulata*) grows near the northern end of upland portions of Nott Island (Figure 3). It is growing in a slight depression of unknown

Table 11

Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Herb and Shrub Layers of the Mixed Woodland Community of Nott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
English rye grass (*Lolium perenne*)	2.5	61.0	7.1
Mullein (*Verbascum thapsus*)	0.8	19.5	2.3
Goldenrod (*Solidago rugosa*)	0.8	19.5	2.3
	4.1	100.0	
Shrubs:			
Poison ivy (*Rhus radicans*)	18.3	59.4	52.4
Bittersweet (*Celastrus orbiculatus*)	9.2	29.9	26.4
False indigo (*Amorpha fruticosa*)	1.7	5.5	4.9
Virginia creeper (*Parthenocissus quinquefolia*)	0.8	2.6	2.3
Unidentified young shrub	0.8	2.6	2.3
	30.8	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
		Shrub Layer		
Shrubs:				
False indigo (*Amorpha fruticosa*)	3.0	7,500.0	57.6	49.1

[a]Average cover for all 0.5-m^2 quadrats

Table 11 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Winged sumac (*Rhus copallina*)	1.7	4,250.0	32.7	27.9
Staghorn sumac (*Rhus typhina*)	0.3	750.0	5.8	4.9
Barberry (*Berberis thunbergii*)	0.2	500.0	3.9	3.3
	5.2	13,000.0	100.0	
Trees:				
American elm (*Ulmus americana*)	0.3	750.0	33.3	4.9
Silver maple (*Acer saccharinum*)	0.2	500.0	22.2	3.3
Black willow (*Salix nigra*)	0.2	500.0	22.2	3.3
Tree-of-heaven (*Ailanthus altissima*)	0.2	500.0	22.2	3.3
	0.9	2250.0	99.9	100.0

origin. Whether or not the alder stand represents some effects related to dredged material deposition is unclear. Water was encountered at about 65 cm while the soil sample was being taken in this area.

Very few other species were abundant under the dense alder canopy in summer foliage. Carex annectens, a mat forming sedge, is the major herb species under a heavy canopy. Panic grass is common where light is available (Table 12). Woody and herbaceous species from adjacent communities grow at the outer edge of the alder colony and within the less dense portions.

i. Black locust. A circular, nearly pure stand of black locust occupies about 0.6 acres near the center of the upland portion of Nott Island. Stem diameters range from 4.5 to 9.5 in. Average stem density is 911.4 stems per hectare (Table 13). Some black locust may be rooted in the dredged material at the western edge of the stand. Presence of dredged material is reflected by the rather irregular topography of coarse sand ridges that continue southwest of the stand toward the nearest unvegetated dredged material deposit. This ridge may represent the remnants of a dike.

Characteristic herb species are English rye grass (Lolium perenne), goldenrod, and another species of panic grass (Panicum clandestinum) (Table 14). Winged sumac is the most abundant shrub. The herb species, excepting English rye grass, are essentially continuous with the adjacent panic grass-goldenrod community.

56. Seral relationships of vegetation. Seral relationships of vegetation associations on Nott Island are confused by variation in ages of dredged material disposal sites and the degree to which disposal has displaced stages of the old field sere.

57. Disposal in 1937 was confined largely to shallow water along the western margin of Nott Island (Figure 4). Subsequent disposal in 1948 extended the land mass of the island and left a small island off the western shore. The combined 1937 and 1948 disposal areas are labeled Disposal Area A on the 1951 photography (Figure 5). A small

Table 12

Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Herb and Shrub Layers of the Alder Community of Nott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Panic grass (*Panicum virgatum*)	7.0	33.3	30.4
Carex anectans	5.0	23.8	21.7
Panicum lanuginosum	3.0	14.2	13.0
Poke weed (*Phytolacca americana*)	2.0	9.5	8.7
Loosestrife (*Lythrum alatum*)	1.0	4.8	4.3
Mustard (*Brassica nigra*)	1.0	4.8	4.4
Rush (*Juncus effusus*)	1.0	4.8	4.4
Bryophytes	1.0	4.8	4.4
	21.0	100.0	
Shrubs:			
False indigo (*Amorpha fruticosa*)	1.0	100.0	4.4
Trees:			
Alder (*Alnus serrulata*)	1.0	100.0	4.3
			100.0

[a]Average cover for all 0.5-m^2 quadrats

Table 12 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
	Shrub Layer			
Shrubs:				
Bayberry (*Myrica pensylvanica*)	3.2	8,000.0	72.7	59.3
False indigo (*Amorpha fruticosa*)	1.2	3,000.0	27.3	22.2
	4.4	11,000.0	100.0	
Trees:				
Alder (*Alnus serrulata*)	1.0	2500.0	100.0	18.5
				100.0

Table 13

Density, Basal Area, and Importance Values for Tree Species in the Canopy and Understory of the Black Locust Community of Nott Island

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value[c]
		Canopy			
Black locust (*Robinia pseudo-acacia*)	911.40	11.70	96.7	96.3	193.0
Tree-of-heaven (*Ailanthus altissima*)	31.05	0.45	3.3	3.7	7.0
	942.45	12.15	100.0	100.0	200.0
		Understory			
Black locust (*Robinia pseudo-acacia*)	203.70	0.90	100.0	100.0	200.0

[a]Stems per hectare

[b]Square meters per hectare

[c]Relative density plus relative basal area

Table 14

Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Herb and Shrub Layers of the Black Locust Community of Nott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
English rye grass (*Lolium perenne*)	20.0	63.5	51.3
Panicum clandestinum	6.5	20.6	16.7
Goldenrod (*Solidago rugosa*)	3.0	9.5	7.7
Morning glory (*Ipomoea* sp.)	0.5	1.6	1.3
Panic grass (*Panicum virgatum*)	0.5	1.6	1.3
Bluegrass (*Poa pratensis*)	0.5	1.6	1.3
Unidentified grass	0.5	1.6	1.3
	31.5	100.0	
Shrubs:			
Bittersweet (*Celastrus orbiculatus*)	4.5	75.0	11.5
Virginia creeper (*Parthenocissus quinquefolia*)	1.0	16.7	2.5
Unidentified woody plant	0.5	8.3	1.3
	6.0	100.0	
Trees:			
Black locust (*Robinia pseudo-acacia*)	1.0	66.7	2.5

[a]Average cover for all 0.5-m^2 quadrats

Table 14 (concluded)

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Red cedar (*Juniperus virginiana*)	0.5	33.3	1.3
	1.5	100.0	100.0

Species	$\#/4\ m^2$	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Winged sumac (*Rhus copallina*)	1.0	2500.0	83.3	76.9
Wild rose (*Rosa carolina*)	0.2	500.0	16.7	15.4
	1.2	3000.0	100.0	
Trees:				
Black locust (*Robinia pseudo-acacia*)	0.1	250.0	100.0	7.7
				100.0

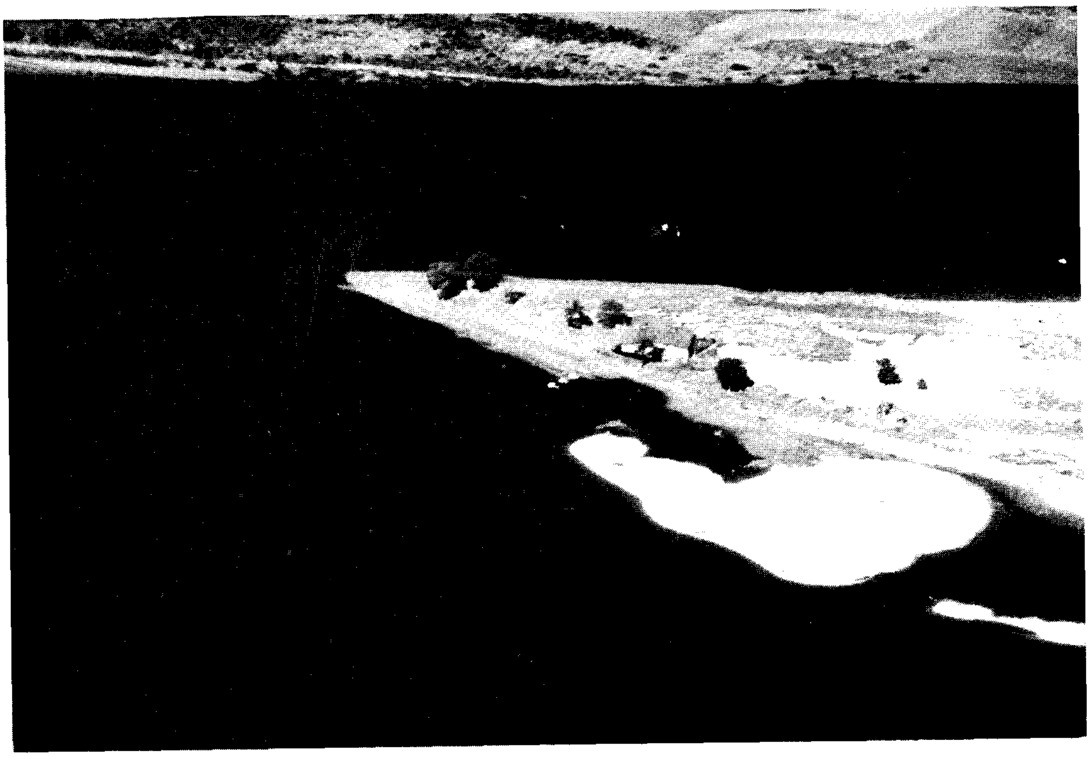

Figure 4 – Historical Photography 1937, Nott Island, Connecticut

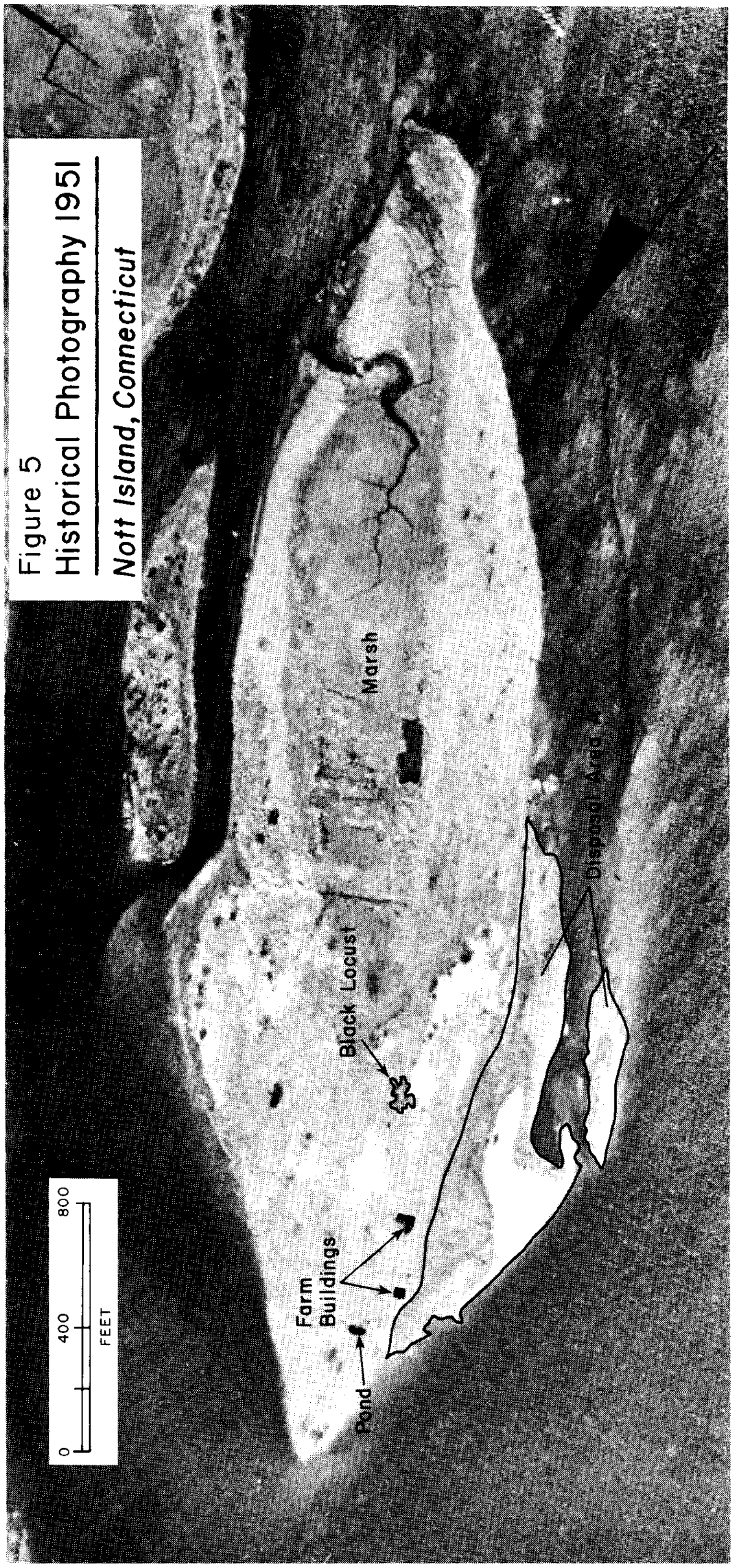

Figure 5
Historical Photography 1951
Nott Island, Connecticut

amount of dredged material may have moved to the east over the western portion of the island with disposal during 1948. The 1951 photographs also show relative positions of the farm buildings on the island and the location and size of the young black locust stand. Prior to completion of Disposal Area A, cattle still grazed the upland portions of the island. By 1951, all agricultural use of the island was abandoned, and old field succession, at least in the eastern half, began.

58. By 1963, Disposal Areas B and C had been created by dredged material placement between 1953 and 1962. Area B occurred over and somewhat to the east of Area A (Figure 6). Area C is new and displaced several acres of marsh. Growths of beachgrass were present in both areas. The farm buildings had been removed. The alder stand was visible by 1963, and the stand of black locust had increased in size.

59. The final period of disposal occurred in 1964. This disposal increased the size of Disposal Area C to the extent represented by Area D (Figure 7). Old Areas A and B probably received no further dredged material after 1962, but were simply reshaped by river action to their present shape. The present shape of Areas A and B (taken from 1974 aerial photography), as well as areal extent of Nott Island uplands prior to any disposal (taken from 1951 aerial photography) is also shown on the 1970 photographs (Figure 7).

60. By 1970, alder and black locust stands had increased in size, and mixed woodland had nearly reached to its present areal extent.*

61. The Biotic Community Map (Figure 3) shows present (1974) conditions on Nott Island. Since 1937, the island has gained approximately 16 additional acres of uplands due to dredged material disposal. Approximately 5 acres of marsh have been converted to upland dredged material, and 11 acres have been added to the west of the pre-disposal configuration of the island. Movement of materials outside of the disposal areas indicated may have influenced as much as an additional 10 acres or more.

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*This unit appears less extensive in 1970 than it does in 1963 because the 1970 photograph was taken under winter conditions.

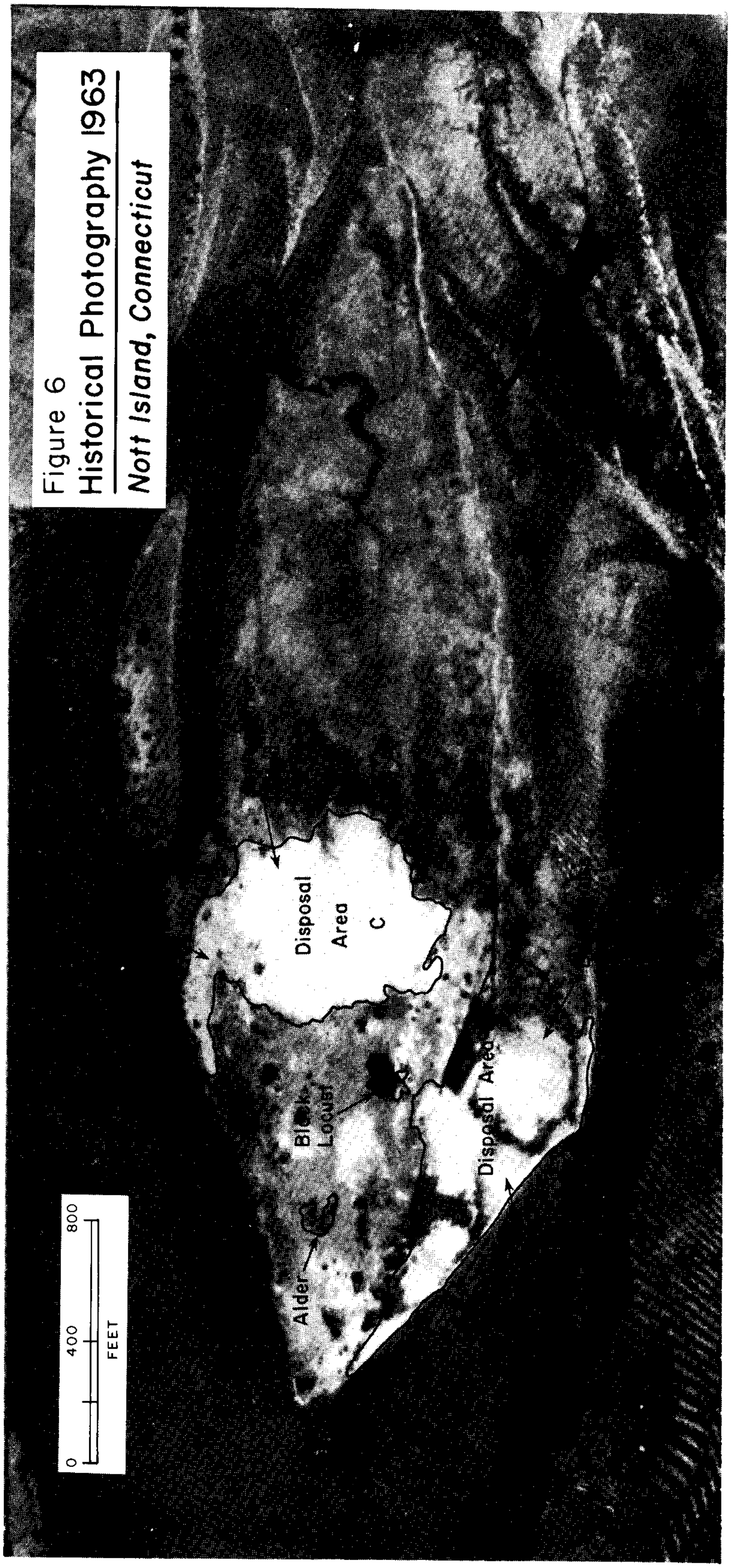

Figure 6
Historical Photography 1963
Nott Island, Connecticut

Figure 7
Historical Photography 1970
Nott Island, Connecticut

62. Successional affinities of plant communities on Nott Island are presented in summary form below, and seral relationships of communities are suggested in Figure 8.

Unvegetated - Dredged material succession in most areas.

Sedge-cordgrass - Dredged material succession except in the northcentral portion of the island.

Common reed - Dredged material succession in response to more abundant soil moisture where dredged material has been placed over or near pre-existing marsh. Community may be long-lasting.

Beachgrass - Dredged material succession (apparently naturally introduced to the island).

Panic grass-goldenrod - Succession over sandy alluvium and abandoned fields influenced in some areas by sandy dredged material.

False indigo - Succession over abandoned agricultural field influenced by outwash of fine sand and silt from dredged material. Additional influences from storm tides or somewhat higher water tables.

Mixed woodland - Response to dredged material from Disposal Areas A and B, as well as riverine sands.

Alder - Presence of a natural depression where the water table was within 65 cm below the soil surface in July 1974. Alder usually grows in response to hydric or near hydric soil conditions. This community's association with dredged material, if any, is unclear.

Black locust - Present prior to any disposal, but subsequent growth may have been somewhat influenced (enhanced or retarded) by disposal.

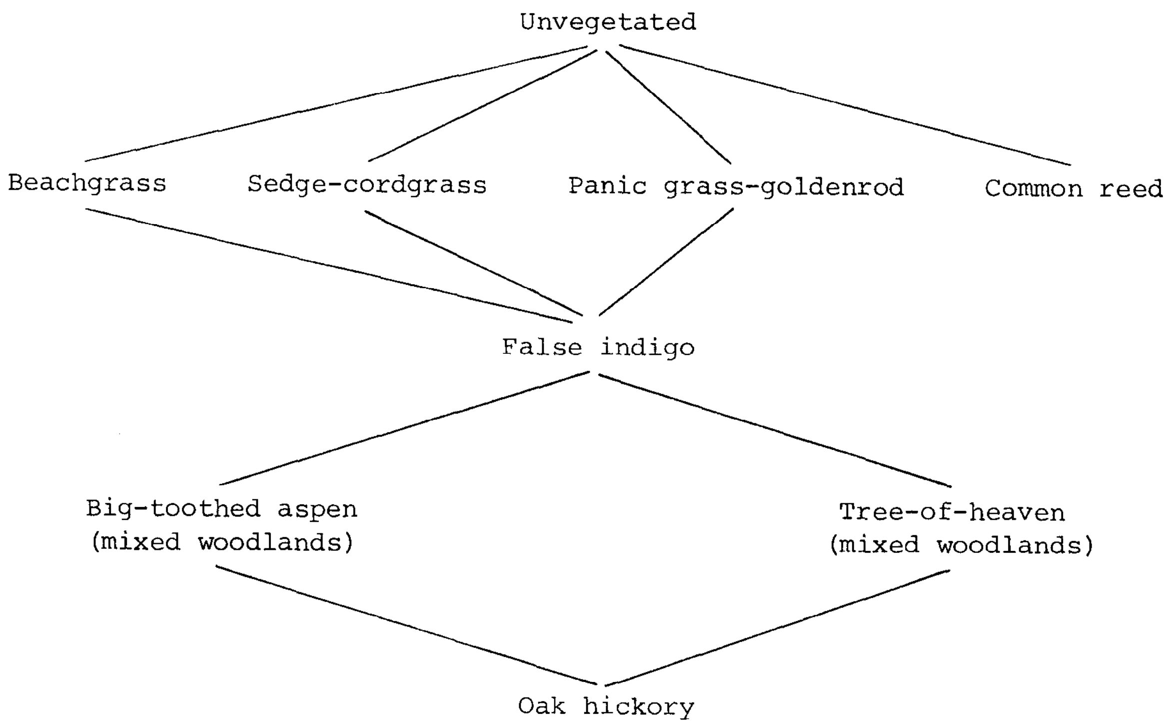

Figure 8. Suggested Seral Relationships of Vegetation Associations on Nott Island

63. Based on the preceding discussion, mixed woodland, including big-toothed aspen, American elm, and tree-of-heaven as the most abundant species, is the most mature of the dredged material-oriented communities on the island. Except for the beachgrass community, no single community type is restricted entirely to a dredged material sere. Plant dominants present at the mixed woodland stage respond to relative soil moisture status. Big-toothed aspen will dominate in moister areas, and tree-of-heaven will dominate for a time on drier sandy soil.

64. Since 1951, false indigo seems to have progressively invaded the areas which it presently dominates, at least in the northern half of the island. As a rhizomatous legume it is a highly competitive species in young sandy soil. The fact that it always occurs on the lower portions of the island may indicate its optimum habitat is in low,

moist areas. This species is not shade tolerant and will eventually disappear as tree-of-heaven and big-toothed aspen rise above it.

65. The low, eastern-most stand of beachgrass is being replaced by false indigo. If this replacement is an indication of a trend, other stands of beachgrass may be invaded by false indigo as microclimates are moderated.

66. Big-toothed aspen is a short-lived tree. Individuals on optimum sites may live for 60 to 70 years. The species is also extremely shade intolerant (U. S. Department of Agriculture 1965). On Nott Island, big-toothed aspen dominance has resulted from its rapid growth in open situations prior to heavy invasion by more competitive species. It will only gain dominance in the future where root suckers can grow rapidly in relatively open situations. This species should become unimportant within 50 years.

67. American elm is most important in portions of the mixed woodlands where the soils are strongly influenced by tidal flux. On Nott Island, it is most abundant around the northwestern edges of the woodlands bordering the river. Growth on coarse, dry sands is poor. This species will probably spread very little beyond its present relative limits in the mixed woodlands, though it will most likely continue to be an important species within these limits.

68. Black locust and alder stands, though well adapted as arborescent pioneers in sandy soil, are probably not growing in total response to dredged material. Both species have nitrogen-fixing capabilities and may add substantial organic material to the soil. As other tree species, such as black oak, increase in abundance, both of these stands will be replaced, largely because neither are shade tolerant.

69. Black oak, one of the dominants of regional climax hardwood forests, occurs sporadically throughout the island. Of the individuals examined, none appeared to be reproductively mature. Within 5 to 10 years they will be producing acorns and will have established an important seed source on the island. With incorporation of other important climax species, development of a hardwood forest may occur

within the next 100 years. Such a climax will not develop, however, with continued use of the island as a disposal area.

70. Analysis of existing animal populations

a. Birds. Thirty-three species of birds were observed on Nott Island during the July and September 1974 field surveys. Life history information and general field notes for each species are presented in Appendix A.

Eighteen of the 33 species are year-round residents in the study area, 13 are summer residents, 1 is a winter resident, and 1 is a spring-fall transient (Robbins et al. 1966). Other migratory species probably utilize the study site, but were not observed because of the scheduling and shortness of the sample periods.

Avian diversity was greatest on the island in July; 28 species were seen during this period, whereas only 20 species were recorded in October. Year-round residents comprised 57 percent of the bird species seen in the mid-summer and 70 percent of those observed in late summer.

Breeding bird censuses were not performed on Nott Island, but nests of four species were found during the July survey; mallard* (*Anas platyrhynchos*), bobwhite (*Colinus virginianus*), common flicker (*Colaptes auratus*), and starling (*Sturnus vulgaris*).

Twenty-six of the 33 bird species are commonly regarded as forest-edge or hedgerow inhabitants**, 5 are woodland species, and 2 prefer marshlands. Nott Island is composed of a variety of early seral stage plant associations, none of which are large in areal extent and most of which are interspersed by narrow stands of trees. The vegetational composition creates edge and hedgerow habitats over much of the island's upland sector. Thus, the abundance of forest-edge and hedgerow

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*Common names for bird species follow those established by the American Ornithologists' Union (1957 and 1973).

**Forest-edge and hedgerow species generally require trees or tall bushes for roosting, nesting, or singing, and open or shrubby habitats for feeding.

bird species is not surprising. Distributions of the recorded avian species by plant associations are noted in Table 15.

Twenty-three of the 33 recorded bird species are insectivores, 6 are granivores, 3 are vertebrate carnivores, and 1 is a scavenger. Migrants comprise two-thirds of the insectivores, whereas all of the granivores are year-round residents.

None of the avian species recorded on Nott Island are classified endangered by the U. S. Department of the Interior (1974). Upland game birds present include the bobwhite, ring-necked pheasant (*Phasianus colchicus*), and mourning dove (*Zenaida macroura*). Only the bobwhite is possibly present in sufficient numbers to tolerate hunting pressure. This species is a common nesting resident; four nests and one group of fledglings were observed during the July survey. Utilization of Nott Island's upland habitats by waterfowl for nesting is apparently limited to mallards. Two nests, one of which was active, were found in the beachgrass habitat in July. Mallards, Canada geese (*Branta canadensis*), and mute swans (*Cygnus olor*) utilize the island's marshlands and surrounding waters for feeding.

b. *Mammals*. Seven species of mammals or their sign were observed on Nott Island: the short-tailed shrew (*Blarina brevicauda*), eastern mole (*Scalopus aquaticus*), meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*), meadow jumping mouse (*Zapus hudsonius*), raccoon (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*). Old, dessicated rabbit pellets were also observed on the island in July. However, no rabbits or tracks were seen during either field survey. Rabbits may have recently been extirpated from the study site.* Life history information and general field notes regarding the seven mammal species are presented in Appendix A. Distributions of each species by plant associations are shown in Table 16.

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*A barn owl inhabits the study site and could have influenced the elimination of the island's rabbit population. Barn owls in the northeast feed extensively on rabbits as well as meadow voles (Bent 1919-1968).

Table 15

Distribution of Bird Species by Plant Associations on Nott Island, Based on July and September 1974 Field Investigations

Species	Plant Association[a]								
	U	R	SC	B	P	F	A	BL	M
Mallard				X					
American kestrel				X	X	X	X	X	
Ring-necked pheasant					X				
Bobwhite					X	X			
Mourning dove	X					X			
Barn owl						X			
Ruby-throated hummingbird						X			
Belted kingfisher									X
Common flicker						X		X	X
Hairy woodpecker									X
Eastern kingbird		X			X	X	X	X	
Eastern phoebe		X			X	X	X	X	
Eastern wood pewee						X			X
Empidonax sp.									X
Barn swallow	X	X	X	X	X	X	X	X	X
Tree swallow	X	X	X	X	X	X	X	X	X
Purple martin	X	X	X	X	X	X	X	X	X
Blue jay									X
Common crow						X			
Black-capped chickadee								X	X
Winter wren						X			
Long-billed marsh wren		X							
Brown thrasher								X	
Gray catbird					X	X	X		X
American robin						X			X
Starling						X			
White-eyed vireo									X
Yellow warbler						X		X	
Yellow-rumped warbler						X			
Common yellowthroat		X	X	X	X	X	X	X	X

[a] U = unvegetated
R = common reed
SC= sedge-cordgrass
B = beachgrass
P = panic grass-goldenrod
F = false indigo
A = alder
BL= black locust
M = mixed woodland

Table 15 (concluded)

Species	Plant Association								
	U	R	SC	B	P	F	A	BL	M
Common grackle						X	X		X
Cardinal						X	X		X
American goldfinch						X			X
Song sparrow					X	X	X		
Totals	4	7	4	6	11	23	11	11	17

Table 16

Distribution of Mammals on Nott Island by Plant Association Based on July and September 1974 Field Surveys

Species	Plant Association[a]								
	U	R	SC	B	P	F	A	BL	M
Short-tailed shrew (*Blarina brevicauda*)		X			X				
Eastern mole (*Scalopus aquaticus*)					X	X			
Meadow vole (*Microtus pennsylvanicus*)		X	X	X	X	X	X	X	X
White-footed mouse (*Peromyscus leucopus*)					X	X			
Meadow jumping mouse (*Zapus hudsonius*)		X	X	X	X	X			X
Raccoon (sign) (*Procyon lotor*)	X					X			
White-tailed deer (sign) (*Odocoileus virginianus*)	X	X	X	X	X	X	X	X	X
Totals	2	4	3	3	6	6	2	2	3

[a]U = unvegetated area
R = common reed
SC= sedge-cordgrass
B = beachgrass
P = panic grass-goldenrod
F = false indigo
A = alder
BL= black locust
M = mixed woodland

Quantitative and qualitative small mammal censusing was performed on Nott Island in September (Tables 17 and 18). Six communities were included on the quantitative sample plot: panic grass-goldenrod, false indigo, beachgrass, black locust, sedge-cordgrass, and unvegetated. Four were present on the qualitative sample areas: common reed, false indigo, alder, and mixed woodland (Figure 9).

Estimates of population densities for all species captured on the quantitative sample plot range from 13 to 39 individuals per acre (Table 19). Meadow voles and meadow jumping mice were the most abundant mammals on the sample plot and population densities for each were estimated to range from 9 to 19 and 1 to 11 individuals per acre, respectively. Ranges resulting from placing 95 percent confidence limits around the mean of the density estimates are presented in Table 19.

Greatest number of meadow voles on the quantitative sample plot was captured in the false indigo and panic grass-goldenrod habitats, but highest capture ratios (i.e., estimated number of individuals captured per 100 trap nights) were recorded in the false indigo and black locust associations (Table 20). Greatest number and highest capture ratios for meadow jumping mice were recorded in the beachgrass community.

Meadow voles and meadow jumping mice were also the most frequently captured mammals in the qualitatively sampled habitats (Table 20). Capture ratios for meadow voles on the qualitative sample areas were lower than those recorded for the quantitative sample plot, but the opposite was true for meadow jumping mice.

Meadow voles and meadow jumping mice generally prefer to inhabit mesic grasslands (Quimby 1951, Grant 1971). At the present, mesic grasslands are limited to the understories of the black locust and alder communities. All other habitats on the island's upland section are regarded as marginal for these two species.

Deer tracks and scats were observed in all communities on Nott Island. Bedding sites were found within the alder association.

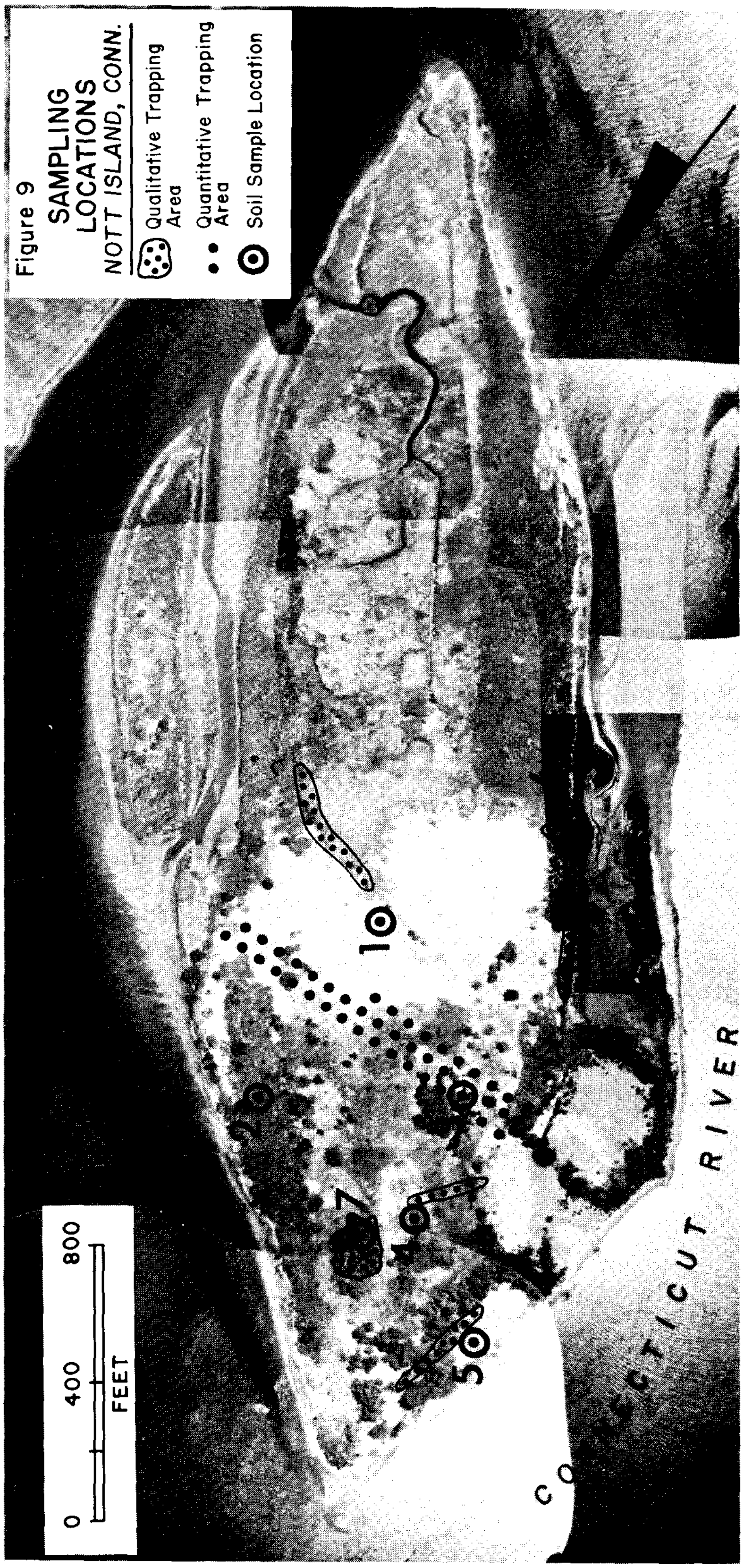
Figure 9
SAMPLING
LOCATIONS
NOTT ISLAND, CONN.
Qualitative Trapping Area
Quantitative Trapping Area
Soil Sample Location
0
400
800
FEET
RIVER

Table 17

Quantitative Small Mammal Live-Trap Census Capture Results, by Species, Nott Island, 17-21 September 1974[a]

Species	Number of Individuals Captured	Number of Recaptures	Total Captures	Mortality
Meadow vole (*Microtus pennsylvanicus*)	41	31	72	8
Meadow jumping mouse (*Zapus hudsonius*)	14	0	14	0
White-footed mouse (*Peromyscus leucopus*)	1	1	2	0
Short-tailed shrew (*Blarina brevicauda*)	1	0	1	1
Total	57	32	89	9

[a]Sample plot size was 2.8 acres; 47 traps were spaced at 50-ft intervals, and total number of trap nights was 235

Table 18

Qualitative Small Mammal Live-Trap Capture Results, by Species, Nott Island, 17-21 September 1974[a]

Species	Number of Individuals Captured	Number of Recaptures	Total Captures	Mortality
Meadow vole (*Microtus pennsylvanicus*)	9	0	9	3
Meadow jumping mouse (*Zapus hudsonius*)	5	0	5	0
White-footed mouse (*Peromyscus leucopus*)	1	0	1	0
Short-tailed shrew (*Blarina brevicauda*)	1	0	1	1
Total	16	0	16	4

[a]Total number of trap nights was 65

Table 19

Population Estimates for Small Mammals Captured on the Quantitative Sample Plot, Nott Island

Species	Population Estimate[a] (individuals/acre) 18 Sep	19 Sep	20 Sep	21 Sep	Mean	95 Percent Confidence Limit[b]
Meadow vole (*Microtus pennsylvanicus*)	9	11	11	19	12	8-16
Meadow jumping mouse (*Zapus hudsonius*)	1	3	9	11	6	4-8
White-footed mouse (*Peromyscus leucopus*)	1[c]	1[c]	1[c]	1[c]	1[c]	-
Short-tailed shrew (*Blarina brevicauda*)	1[c,d]	0	0	0	0	-
Total estimate for sampled species	13	16	21	39	24	13-34

[a]Estimates are based on the Schnabel formula (see page 32): $P = \frac{\Sigma(AB)}{\Sigma C}$, where P = population estimate, A = total number of individuals captured in one day, B = total number of marked animals available for capture, and C = total number of marked individuals captured in one day

[b]Around the mean

[c]Number of trapped animals used for estimate

[d]Died in trap

Table 20

Small Mammal Capture Results by Species and Plant Associations, Nott Island, 17-21 September 1974

Species	Captures/Plant Association[a]									Totals
	U	R	SC	B	P	F	A	BL	M	
Quantitative Sample Plot										
Meadow vole (*Microtus pennsylvanicus*)	0[b]	-[c]	2	3	27(30)[d]	28(62)	-	12(40)	-	72(30)
Meadow jumping mouse (*Zapus hudsonius*)	0	-	1	8(20)	3	2	-	0	-	14(6)
White-footed mouse (*Peromyscus leucopus*)	0	-	0	0	1	1	-	0	-	2

[a]
U = unvegetated
R = common reed
SC= sedge-cordgrass
B = beachgrass
P = panic grass-goldenrod
F = false indigo
A = alder
BL= black locust
M = mixed woodland

[b]Community sampled without results

[c]Community not sampled; therefore, no results were expected

[d]Estimated number of captures per 100 trap nights are enclosed within parentheses; not calculated for species captured less than five times

Table 20 (concluded)

Species	Captures/Plant Association[a]									
	U	R	SC	B	P	F	A	BL	M	Totals
Short-tailed shrew (*Blarina brevicauda*)	0	-	0	0	1	0	-	0	-	1
Totals	0	-	3	11(28)	32(35)	31(68)	-	12(40)	-	89(37)
Number of Trap Nights	5	0	25	40	90	45	0	30	0	235
Qualitative Sample Areas										
Meadow vole (*Microtus pennsylvanicus*)	-	2	-	-	-	3	3	-	1	9(14)
Meadow jumping mouse (*Zapus hudsonius*)	-	2	-	-	-	2	0	-	1	5(8)
White-footed mouse (*Peromyscus leucopus*)	-	0	-	-	-	0	0	-	1	1
Short-tailed shrew (*Blarina brevicauda*)	-	1	-	-	-	0	0	-	0	1
Totals	-	5(25)	-	-	-	5(27)	3	-	3	16(24)
Number of Trap Nights	0	20	0	0	0	19	13	0	13	65

One deer was seen on the island in July and two were observed in September. Deer may frequently move back and forth between the island and the mainland.

Raccoon tracks were observed on the upland sections of Nott Island during both field surveys. Raccoons likely obtain the major portion of their food supply from the island's marshlands. Vegetation and small vertebrates in the island's upland region probably serve as supplemental food sources.

Two eastern mole tunnel systems were observed on the study site: one in the panic grass-goldenrod community and the other in false indigo. Eastern moles prefer moist, loamy soils. Two tunnels are usually constructed. One is located an inch or so beneath the ground surface, producing a noticeable ridge. The other is located six inches to a foot underground and is utilized during dry or cold weather (Lowery 1974).

None of the mammal species on Nott Island are classified endangered (U. S. Department of the Interior 1974).

c. Reptiles and amphibians. A northern black racer (*Coluber constrictor constrictor*) and eastern garter snake (*Thamnophis sirtalis sirtalis*) were the only reptiles sighted on Nott Island. The former was seen in July in the panic grass-goldenrod association and the latter was observed in September in the beachgrass community.

Turtles apparently utilize the uplands of Nott Island for nesting. Eggshells from an unidentified species were found in September in an unvegetated region near Disposal Area C.

No amphibians were recorded on the island upland region during the field surveys. Most amphibians require ponded water for reproduction, and no ponds currently exist on the study site. Soils on the upland sector are also coarse-grained, which limits the possibility of temporary pond formation.

d. Immigration and colonization. The minimum water barrier width separating Nott Island from the mainland is about 750 ft, based on current aerial photography. White-tailed deer, raccoons, garter snakes, and black racers are excellent swimmers and likely reached the study site by this method. Deer may have also crossed when ice bridges were present. Meadow jumping mice inhabiting the study site likely immigrated by rafting on floating debris or were accidentally introduced by man. Immigration via an ice bridge can virtually be ruled out since jumping mice hibernate during the late fall and winter. Swimming across the water barrier is also a remote possibility because jumping mice cannot swim freely for longer than 3 to 5 minutes without becoming exhausted (Quimby 1951, Hamilton 1935). Utilization of the island for grazing and farming during the first half of the century would likely have increased the potential of immigration via accidental introduction by man. Other small mammals inhabiting Nott Island do not hibernate and probably crossed when an ice bridge was present. Beer et al. (1954) noted that this was probably the commonest means of immigration by meadow voles, deer mice (*Peromyscus maniculatus*), and Gapper's red-backed mice (*Clethrionomys gapperi*) to islands in Basswood Lake, Minnesota. Invertebrates present on Nott Island have probably immigrated via flying, rafting, or accidental introduction by man.

Although the water barrier between Nott Island and the mainland is approximately 750 ft wide at its narrowest point, the effective distance is much greater for animal species that swim or raft to the island because of tidal currents. Thus, the region from which these animals immigrate is likely upstream or downstream from Nott Island rather than from the nearest mainland area. The distance that animals are moved depends on current patterns, current velocities, and animal size.

Many animals may immigrate to an island but fail to establish populations because required habitats are unavailable or reproductive functions cannot be fulfilled. Furthermore, failures could be induced by predation, disease, food shortages, or inclement weather.

Once a species population becomes established on an island it may also be subject to extinction by one of the above factors as well as the effects of intraspecific behavior (Chitty 1960, Christian and Davis 1964). Multiple invasions through time may be necessary to maintain an insular population.

Island size and habitat availability largely determine the number of animal species which it may support (Wilson 1961, Preston 1962, Grant 1966, and MacArthur and Wilson 1967). Islands colonized by relatively few species are often unstable, and populations are frequently subject to extreme density fluctuations due to lack of checks and balances in the form of predators, parasites, etc. (Elton 1958, Grant 1966). When such fluctuations occur, random extinction is a hazard (Grant 1966).

Nott Island has probably been colonized by many species in the past; many of these, in turn, have probably been extirpated by one of the above-mentioned processes.

Man's activities on the island have also likely affected faunal colonization to a significant degree. Grazing and farming operations severely modified upland habitats in the past, eliminating favorable habitat for some faunal species and creating favorable habitat for others. Disposal of dredged material temporarily creates pioneer seral stages (unvegetated areas) unsuitable for inhabitation by most vertebrate species or other animals. Disposal of dredged material in the past may have hastened or caused immediate extinction of some animal species on the study site.

71. Past patterns of animal succession. No photography of Nott Island is available prior to 1937. Consequently, plant communities and likely associated animal components cannot be identified.

72. The 1937 aerial photograph (Figure 4) shows that the upland portions of Nott Island were dominated by grassland; a few isolated trees were scattered throughout, producing somewhat of an edge effect. Grazing livestock were the dominant animals on the island at this time (Personal communication, July 1974, Andrew MacWhinney, Saybrook, Connecticut). Diversity and density of native fauna were probably not great due to the presence of livestock and grasslands that generally support relatively few animals (Odum 1971, Emlen 1972, Wiens 1973, Shelford 1963). Birds of that time likely included a few grassland species (such as eastern meadowlarks, savannah sparrows, and field

sparrows), species that are associated with human habitations* (like the starling and house sparrow), and species that prefer very exposed edge habitats (such as eastern kingbirds, eastern phoebes, and American kestrels).

73. A pond was present on the north end of Nott Island in the past (Figures 4 and 5) and could have supported several amphibian species. The pond, probably created for livestock, was filled by dredged material disposal or spillage between 1951 and 1962 (Figure 6).

74. Small mammals and raccoons now inhabiting Nott Island may have established populations by 1937. Short-tailed shrews and white-footed mice do not have very restrictive habitat preferences and are frequently found in agricultural areas in the Northeast. Meadow jumping mice and meadow voles prefer moist grasslands; such habitats may have existed when the upland section was topographically low (i.e., before dredged material disposal in the 1950's and 1960's) and was used for hay and livestock production.

75. Shrublands and woodlands have developed on Nott Island since 1937. The island's grassland habitat has become much reduced in size as a result of vegetational succession. However, some xeric grasslands have been created by dredged material disposal operations. Woodlands and grasslands now present are generally not of sufficient areal extent to support many vertebrates that exclusively inhabit these communities. If the assumption that grassland bird species were present on the island in the past is correct, then it seems that succession has influenced their elimination as none were observed during the two recent field surveys.

76. Vegetational changes since 1937 have essentially created edge habitat over the upland portion of Nott Island. Avian diversity has likely increased at a progressive rate, with immigrating species consisting primarily of hedgerow and forest-edge inhabitants. Edge species that utilized the island in 1937 have possibly maintained a population on the island.

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*Farm buildings were present on the island in 1937.

77. White-tailed deer may have established populations on Nott Island after livestock were removed in the early 1940's, and once shrubs and trees reached sufficient height to provide protection.

78. Future patterns of animal succession. The upland areas on Nott Island are succeeding to a deciduous hardwood climax. As the island becomes more forested, hedgerow and forest-edge habitats will diminish in extent. Correspondingly, hedgerow and forest-edge bird species will likely decrease in diversity and density. Woodland bird species now present will likely remain and additional species, such as the red-eyed vireo (*Vireo olivaceus*), tufted titmouse (*Parus bicolor*), white-breasted nuthatch (*Sitta carolinensis*), wood thrush (*Hylocichla mustelina*), and ovenbird (*Seiurus aurocapillus*) may invade.

79. Range maps in Burt and Grossenheider (1964) indicate that 36 mammal species are present in the lower Connecticut River area in addition to the 7 species listed for Nott Island. Five of the 36 species, the Virginia opossum (*Didelphis marsupialis*), eastern chipmunk (*Tamias striatus*), eastern gray squirrel (*Sciurus carolinensis*), woodland vole (*Microtus pinetorum*), and gray fox (*Urocyon cinereoargenteus*) are characteristic inhabitants of eastern deciduous forests (Shelford 1963) and could conceivably establish populations on Nott Island in the future.

80. Eastern moles, white-footed mice, short-tailed shrews, raccoons, and white-tailed deer frequently inhabit deciduous woodlands and would likely remain on the island once the climax vegetative stage is reached. Carrying capacities for deer, however, will likely be reduced with loss of hedgerow and forest edge habitats.

81. Woodlands are marginal habitats for meadow voles and meadow jumping mice (Grant 1971, Quimby 1951). Mammals occasionally establish populations in marginal habitats on islands (Grant 1971), and thus it is possible that these two species could maintain a residual population after the island becomes forested. However, it is more probable that they will eventually be eliminated.

82. Thirty-seven species of reptiles and amphibians are present in the lower Connecticut River area in addition to the two species

listed for Nott Island (Conant 1975). Twenty-one of the 35 species require permanent or temporary pools of water and could never establish populations on the study site unless these habitats are created. Of the remaining 14 species, the eastern box turtle (Terrapene carolina carolina), eastern smooth green snake (Opheodrys vernalis vernalis), black rat snake (Elaphe obsoleta obsoleta), northern copperhead (Agkistrodon contortrix mokeson), and red-backed salamander (Plethodon cinereus cinereus) are commonly found in deciduous woodlands and could colonize the island in the future. Northern black racers and eastern garter snakes, which were observed on Nott Island during the field surveys, are not very restrictive in their habitat preferences and could also be a part of the island's future faunal composition.

Potential Resources of Regional Upland Disposal Areas

83. At the time of this study, only small value could be placed on the island as a waterfowl and upland game bird breeding area, particularly in the communities dominated by herbaceous species. Nests and indications of nesting were found for bobwhite and mallard during the field work.

84. Vegetation developing naturally on sandy dredged material in areas similar to Nott Island is not considered highly valuable in terms of commercial or natural resources.

85. In 1975, a joint project by the WES and State of Connecticut (owner of the island) resulted in construction of an 8-acre disposal site in the panic grass-goldenrod community. Sandy dredged material from the Essex shoal was deposited in the confinement and top-dressed with finer-grained material from the recreation channel. After dewatering, mixing, liming, and fertilizing the site, Kentucky 31 tall fescue (Festuca elatior) and white clover (Trifolium repens) were seeded in September 1976 to establish feeding pasture for Canada geese. Nott Island is one of seven field sites selected by the DMRP to test the concept of developing wildlife habitat on a dredged material substrate.

Regional Sere for Upland Disposal Areas

86. In addition to Nott Island, dredged material disposal areas on the mainland north of Essex were visited during the course of the field work. These sites support an assemblage of plant species very similar to that at the northern end of Nott Island. After approximately 20 years, the development of pioneer forest dominated by big-toothed aspen (or perhaps other species of *Populus*) seems typical for dredged material succession in this region. Time for development of mature stages of climax forests will vary in response to distances from seed sources of dominant species and to relative moisture regimes at each disposal area.

Part V: Hillsborough Bay Islands, Florida

Description of Regional Setting

87. Tampa Bay is a shallow, bifurcated estuary on the west coast of Florida. The Interbay Peninsula divides Tampa Bay into eastern and western lobes, Hillsborough Bay and Old Tampa Bay, respectively, about 20 miles north of its confluence with the Gulf of Mexico. The city of St. Petersburg lies on the west side of lower Tampa Bay, and Tampa occupies the northern and western shores of Hillsborough Bay.

88. The average depth of the bay is about 3 m, and nearly one-third is less than 2 m. Tides are chiefly diurnal but contain a semi-diurnal component that is more pronounced toward the head of the bay. The average tidal range is 2.3 ft, but ranges as small as 0.5 ft and as large as 3.5 ft are not unusual. Storm tides occasionally inundate low-lying areas; the highest recorded tide of 10.6 ft mean low water (mlw) occurred in October 1921 and the lowest recorded tide of -7.5 ft mlw occurred during October 1910 (U. S. Army Engineer District, Jacksonville 1974).

89. The main ship channel through Tampa Bay divides south of the Interbay Peninsula, with most of the commercial traffic into the port of Tampa arriving via the Hillsborough Bay Channel. A secondary channel provides access to Tampa Electric's Big Bend generating station, and the Alafia River Channel provides access to the Gardinier phosphate facility. Disposal areas border all of the dredged channels and are represented by submerged shoals and emergent islands.

90. Six of the emergent vegetated islands in Hillsborough Bay comprise the study area (Figure 10). Bird and Sunken Islands lie south of the Alafia River Channel. Fish Hook, Gull, and Pelican Point Islands lie south of the Big Bend Channel, and Pine Island (also shown on navigation maps as Pine Key) lies south of the Big Bend Channel and slightly southeast of the junction of this channel with the main Tampa Harbor Channel near mile 26.

91. The Tampa Bay area is influenced by subtropical maritime weather conditions characterized by long humid summers and mild winters,

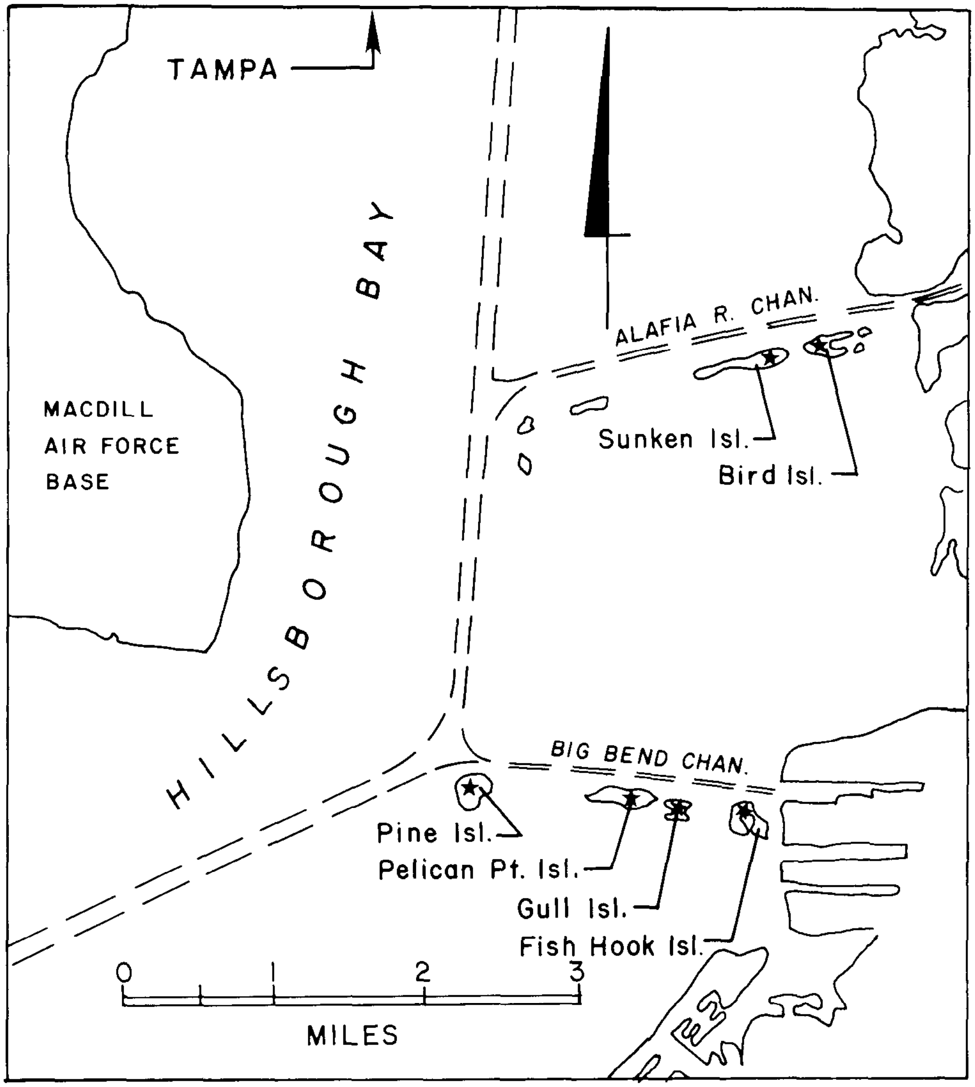

Figure 10-Vicinity Map, Hillsborough Bay Islands, Florida

which are occasionally punctuated by polar air masses. Temperature and precipitation data recorded at Tampa, Florida, are based on 83 years of records (1890-1973). The mean temperature for the Tampa area is 72.2°F, and the months of January and August, respectively, have mean temperatures of 61.0 and 82.0°F. The maximum temperature for the area was recorded as 98°F in June 1952 and the lowest was 18°F in December 1962. Mean annual precipitation is 49.24 in. Sixty percent of the annual rainfall occurs in the summer months (June through September). The wettest months are July and August; each averages slightly more than 8 in. of precipitation. During the summer season the area has, on the average, 91 days with thundershowers, which usually occur in the late afternoon and are accompanied by sudden drops in temperature. For all months of the year, the relative humidity in the late evening and early morning hours is 80 percent or greater while the late afternoon and early evening periods will have relative humidities ranging from 50 percent to 75 percent (U. S. Department of Commerce 1973e, U. S. Department of Commerce 1964a).

92. For the major part of the year, the prevailing winds are from an easterly direction, at a mean speed of 8.9 mph. Factors affecting wind direction are local summer thunderstorms, tropical storms, and cold fronts that move across the state during the winter months.

93. Extended periods of dry weather are most common in spring and in fall. Occasionally, droughts are of sufficient duration to noticeably affect plant growth. While the spring droughts tend to be shorter than those in the fall, the spring dry spells are more damaging to the vegetation because plants are putting out new growth and temperatures are generally higher than those of the fall.

94. Tornadoes and waterspouts are sighted in the area during all seasons, but the former are most frequent in spring. Tornadoes are the most destructive of the two as waterspouts usually dissipate soon after reaching land (Bradley 1972).

95. From 1885 to 1971, 150 tropical storms have entered or affected the state, 84 of which were of hurricane intensity. Ten or 11 of these hurricanes passed through the Tampa Bay area. The hurricane

of 25 October 1921 produced tides of 10.5 ft mlw (U. S. Department of Commerce 1973e). The chances of hurricane force winds striking the Tampa Bay area in any given year are 1 in 25 (Bradley 1972).

96. The geologic history of the area is one of land inundation and emergence. During the Oligocene, the central and southern portions of Florida were separated from the mainland of the United States by a seaway stretching across the lowlands of north Florida and south Georgia. Only the central highlands -- the so-called Orange Island -- were exposed in Miocene times, but the sea waters subsequently receded so that by the Pliocene, peninsular Florida was reunited with the mainland. Massive inundations led to deposition of the calcareous material that presently dominates the geology of the Tampa area and consists of fine marine limestones, marine sands, and shell-laden marls (U. S. Department of Agriculture 1972).

97. The Gulf coastal region of Florida, particularly the Tampa area, contains a rich variety of plants and animals. This diversity is due to the overlap of the temperate deciduous forest and tropical forest biomes, the availability of habitats for adventive species, and the variety of terrestrial and salt, brackish, and fresh aquatic environments. As a result, the flora of the Tampa Bay area is one of the most diverse in the southeastern United States.

98. Long and Lakela (1971) identified several major plant formations in the Tampa Bay area. Pine flatwoods comprise the most prevalent vegetation association on upland sites and are dominated by slash pine (*Pinus elliottii*) and longleaf pine (*Pinus palustris*) in the canopy, with a very dense ground cover of saw palmetto (*Serenoa repens*). In moist depressions, bald cypress (*Taxodium distichum*) is usually dominant. Clumps of hardwoods, known as hammocks, and freshwater marshes or swamps may be scattered as isolated communities through this formation.

99. Pine and xerophytic oak forests are found generally north of the study area and are dominated by slash pine and scrub oaks, such as the sand live oak (*Quercus virginiana* var. *geminata*), myrtle oak (*Quercus myrtifolia*), and dwarf live oak (*Quercus minima*).

100. Mangrove associations and coastal marshes are woody and herbaceous communities, respectively, which occur in tidal areas. The mangrove association includes the three mangrove species: red mangrove (Rhizophora mangle), black mangrove (Avicennia germinans), and white mangrove (Laguncularia racemosa); and buttonwood (Conocarpus erecta). The tidal marshes are usually dominated by smooth cordgrass (Spartina alterniflora), but may have other salt-tolerant herbs such as saltmeadow cordgrass (Spartina patens), saltweed (Philoxerus vermicularis), and glasswort (Salicornia virginica) near the upland interface.

101. Coastal strand vegetation may be found along the Gulf and bay beaches and around dredged material islands. This vegetation type consists of mostly salt-tolerant herbaceous species, such as railroad vine (Ipomoea pes-caprae), paspalum (Paspalum vaginatum), glasswort, cow pea (Vigna luteola), or June bean (Canavalia maritima).

102. Swamp forests are typically freshwater associations occurring inland. Two associations are differentiated by Long and Lakela (1971): the cypress swamp dominated by bald cypress, red maple (Acer rubrum), and water ash (Fraxinus caroliniana); and the hardwood swamps characterized by the three bays -- sweet bay (Magnolia virginiana), red bay (Persea borbonia), and loblolly bay (Gordonia lasianthus) -- and blackgum (Nyssa sylvatica var. biflora).

103. Sand pine scrub forests occur infrequently in the Tampa Bay area. Typical species are sand pine (Pinus clausa), rosemary (Ceratiola ericoides), and scrub oaks.

104. Grasslands consist of wet prairies on seasonally flooded lowlands and dry prairies on infrequently flooded flatlands. Pennywort (Hydrocotyle spp.), coinwort (Centella asiatica), bacopa (Bacopa monnieri), spike rushes (Eleocharis spp.), beak rushes (Rhynchospora spp.), yellow-eyed grass (Xyris spp.), Baker's cordgrass (Spartina bakeri), and many other grasses, sedges, and mesophytic herbs are found in this uncommon community.

History of the Disposal Area*

105. When the Alafia River Channel was constructed in 1931, dredged material deposited along the south side of the channel created a series of small islands that subsequently eroded from west to east. Eroded material was swept along the northern and southern shores of the islands and eventually built peninsulas on the eastern end of Bird Island. Except for narrow emergent sand bars and shoals, all of the original Sunken Island was obliterated by 1957. In 1961, the Alafia Channel was redredged and dredged material was deposited west of Bird Island. The new material coalesced into a single island (Sunken Island) and a narrow land bridge, emergent during low tides, formed between Sunken Island and Bird Island. Thus, Bird Island originated in 1931 and the existing Sunken Island in 1961.

106. Fish Hook, Gull, and Pelican Point Islands were created in 1965 when the channel to Tampa Electric's Big Bend electrical generating station was constructed. Between 1969 and 1974, the configuration of Fish Hook Island reversed. The hook which was formerly on the south side of the island rejoined the main axis of the island, inducing a shallow lagoon, and a new hook accreted on the north side of the island. Gull Island, which is approximately one-half the size of Fish Hook, originally was an oval-shaped deposit, but by 1974 it had also assumed a fish hook configuration. Pelican Point originally was elliptical with the long axis oriented east-west. After the completion of field work for this report, this island allegedly suffered severe erosion on the western tip and probably is much altered from the configuration appearing on the 1974 aerial photography.

107. The history of Pine Island prior to 1957 is uncertain. Although it may have originated from the initial dredging of the Tampa Harbor Channel, Pine Island may have been a small natural island or shoal area. The general area of Pine Island was used for dredged material placement when the Tampa Harbor Channel was redredged in 1957, but has probably not been used by the Corps since. However, when the

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*Aerial photography included in the report by Dunstan and Lewis (1974) served as an historical basis for this discussion.

Big Bend Channel was constructed in 1965, a large amount of dredged material was deposited on Pine Island, destroying any vegetation or wildlife that was present on the island at that time. Therefore, the present conditions on this island probably date from the 1965 deposition.

Ecological Analysis

Physical characteristics

108. Topography. Elevations of the Hillsborough Bay islands have not been determined except on Pine Island, where a topographic survey indicates a maximum elevation of approximately 18 ft mean sea level (msl). Most of the islands have a peripheral beach that is inundated by high tides and wakes from passing ships. Storm tide surges frequently flood large portions of the islands, and erosion along their western extremities has produced vertical bluffs that are particularly noticeable on Bird, Gull, and Pine Islands. A general topographic description of each island follows:

a. Bird Island. Gradual slope on the eastern part of the island from the cabbage palm community across the marsh elder community and into the mangroves; abrupt drop around periphery of beggartick-lantana and croton-dayflower communities to beach; greatest elevation contrast on western end of island; maximum elevation about 8 ft msl.

b. Sunken Island. Ridge with two dome-like prominences, the higher one near the center of the lantana-cabbage palm community (estimated elevation 12-15 ft msl), the lower one near the center of the Brazilian pepper community; beach and sand spit connecting Bird Island on the eastern end; a narrow overwash beach connecting grass and shrub communities on the attenuated western extremity.

c. Fish Hook Island. Low ridge oriented northwest-southeast with an overwash pass leading into a lagoon near the center island. A recurving spit extends eastward from the northern extremity and forms the hook which was formerly located on the western side of the island; the old hook has reattached to the southeastern part of the island enclosing the lagoon. Highest elevations are probably near the center of the central ridge (about 6 ft msl).

d. Gull Island. Originally an oval deposit, severely eroded on the northwestern extremity. Two recurving spits extend southeastward from the original dredged material, enclosing a shallow cove; the western edge of the island drops sharply from the silverling community; maximum elevation is about 8 ft msl.

e. Pelican Point Island. Very low elongate island, oriented east-west with large expanses of beach, overwash passes, and lagoons; maximum elevation about 3 ft msl.

f. Pine Island. A dome of nearly barren sand; bean-shaped with very severe erosion on the western side where an abrupt cliff of 6 ft or more delimits the beach from the natal grass community; relatively broad beaches along the northern periphery and on the southeastern point; maximum elevation about 18 ft msl.

109. Island geomorphology is influenced by climate, estuarine hydrology, consistency of the parent material dredged from Hillsborough Bay, and stability of substrate afforded by vegetation cover. In addition, the frequency of dredging and such engineering factors as dikes, configuration of the initial placement, etc., also determine to some extent the shape and area of the dredged material island.

110. Soils. The material deposited by dredging operations in Tampa Bay consists of a mixture of sand, clay, hard rock, shells, and shell fragments. The coarser materials, if transported by discharge pipes, are located near the discharge points, whereas the finer materials settle in more distant positions or interstitially among the coarse fragments. Depending upon the material dredged and method of dredging, rocks 0.5 to 12 in. in diameter may be present. The general surface soil characteristics of the study area islands are as follows:

a. Bird Island -- Medium to fine sands, except for sporadic pebbles and cobbles in the cabbage palm community. Larger cobbles, 6 to 8 in. in diameter, are scattered along the south beach.

b. Sunken Island. Coarse to fine sands around the periphery of the island with the higher elevations of the island composed predominantly of cobbles 8 to 12 in. in diameter. Cobbles are also found along the south beach midway between the ends of the island.

c. Fish Hook Island. Coarse sands and pebbles predominate.

d. Gull Island. Coarse to fine sands with considerable deposits of sand from beach overwash.

e. Pelican Point Island. Silt and medium to fine sands, largely deposited from overwash.

f. Pine Island. Coarse to medium sands with numerous shell fragments.

111. Ten soil samples from the Hillsborough Bay Islands* consisted principally of medium to fine sands (Table 21). Largest particle sizes encountered in the samples were granules found mostly on Gull, Fish Hook, and Pelican Point Islands. Fine sand predominated in the mangrove community on Bird Island. The buried fine silts in the paspalum community on Gull Island and the croton-dayflower community on Bird Island may represent a buried tidal flat or the fringe of the initial dredged material deposit which has since become covered by overwash. The same explanation may apply to the sample from the Sunken Island beach, where 28.1 percent of the sample is medium silt. The water table was at a depth of 107 cm in the paspalum community on Pelican Point Island and 76 cm in the marsh elder community on Sunken Island -- communities that approach the mesic end of the moisture gradient. Neither surface freshwater seepages nor freshwater ponds were found on the islands. The absence of fresh water, as will be shown later, has a significant effect upon the establishment and survival of pioneer wildlife species.

112. Microclimate. Microclimate data were recorded during field trips to the study site on 29 July and 3 October 1974 (Table 22). In order to obtain a range of microclimatological information, contrasting habitats were selected from five of the study area islands. The July recordings, both taken during early and mid-afternoon, show uniform relative humidity for each of the stations, and minor differences in temperatures. Because the paspalum community is often

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*Soil sample locations are included in Figures 17-21, located elsewhere in the text.

Table 21

Physical Description of Soils of Hillsborough Bay Islands

Island	Sample Number	Sample Depth, cm	Depth to Water Table, cm	Particle-Size Distribution - Phi Scale[a] -1	0	1	2	3	4	5	6	7	8-14
Fish Hook	1-1-1[b]	0-15	-	10.9	27.9	21.0	20.8	14.8	0.8	0.4	2.0	0.1	1.2
	1-1-2	15-41	-	14.0	14.8	20.8	27.7	18.4	2.4	0.6	1.0	0.2	0.0
	1-2-1[c]	0-15	-	2.6	2.0	4.2	42.2	43.0	5.7	0.2	0.0	0.2	0.0
	1-2-2	15-122	-	5.4	5.0	6.6	24.8	46.2	10.2	0.4	1.0	0.4	0.0
Gull	2-1-1[d]	0-183	-	6.8	8.2	10.4	27.4	30.0	12.0	3.8	1.0	0.4	0.0
	2-1-2	-	-	2.4	10.9	14.5	15.6	24.4	4.0	27.1	0.0	1.0	0.0
	2-1-3	-	-	0.0	0.4	2.0	6.9	26.4	19.5	27.5	1.6	15.6	0.2
	2-1-4	-	-	18.4	16.0	14.0	16.2	19.4	7.0	5.6	2.0	1.4	0.0
Pelican	3-1-1[e]	0-41	107	11.3	6.0	7.8	34.2	34.2	0.6	3.3	1.8	0.8	0.0
	3-1-2	41	107	2.5	3.9	9.0	42.4	36.3	0.7	1.6	3.1	0.6	0.0
Pine	4-1-1[f]	0-51	-	2.0	1.8	4.0	33.2	48.0	4.2	3.8	1.4	1.6	0.0
Bird	5-1-1[g]	0-31	-	3.1	2.3	7.6	38.3	38.5	7.0	2.3	0.2	0.8	0.0
	5-1-2	31-91	-	1.2	1.8	8.0	42.2	36.0	11.2	0.0	0.2	0.2	0.6
	5-1-3	91-129	-	0.4	1.2	6.0	31.0	44.4	5.0	11.9	0.2	15.1	0.0
	5-2-1[h]	0-31	-	0.5	0.5	3.1	25.9	59.7	3.8	5.2	1.0	0.3	0.0
Sunken	6-1-1[i]	0-31	76	1.2	2.0	3.4	53.7	33.3	2.0	0.8	3.0	0.6	0.0
	6-2-1[j]	0-31	-	5.5	9.3	14.2	28.2	30.9	9.7	1.2	0.8	0.2	0.0
	6-3-1[k]	-	-	0.0	0.0	5.1	11.5	19.0	10.7	19.4	28.1	6.1	0.2

[a]Phi scale corresponds to the following Wentworth sizes:

Phi Scale	Wentworth Size
-1	Granule
0	Very Coarse Sand
1	Coarse Sand
2	Medium Sand
3	Fine Sand
4	Very Fine Sand
5	Coarse Silt
6	Medium Silt
7	Fine Silt
8-14	Very Fine Silt & Clay

[b]Paspalum community

[c]Overwash community

[d]Paspalum community

[e]Paspalum community

[f]Natal grass

[g]Croton-dayflower community

[h]Mangrove community

[i]Marsh elder community

[j]Brazilian pepper community

[k]Beach community

Table 22

Microclimate Data, Hillsborough Bay Islands

Date 1974	Location	Biotic Community	Time	Percent Relative Humidity	Temperature (°C)				
					0.5 m	Litter Surface	Below Litter	-2 cm	-10 cm
29 Jul	Fish Hook Is.	Paspalum	PM	82	33	34.5	[a]	33.5	29.5
29 Jul	Fish Hook Is.	Paspalum-silverling	PM	82	36	36	[a]	32.5	28.5
3 Oct	Sunken Is.	Beggartick-lantana	AM	68.5	27	27	24	24	24.5
3 Oct	Bird Is.	Cabbage palm	AM	56	28.5	28.5	24	23	23.5
3 Oct	Bird Is.	Croton-dayflower	AM	50	30	[b]	[c]	35.5	28.5
3 Oct	Pine Is.	Paspalum	PM	47.5	31	34.5	33	31.5	28.5

[a] Litter absent

[b] 46.5 in the sun; 35.5 in the shade

[c] 45 in the sun; 35.5 in the shade

located near the high tide level, differences in soil temperatures probably correspond with soil moisture. The data show a uniformity of temperatures in the paspalum community on Pine Island -- the range being 31°C at 0.5 m above the litter surface to 28.5°C at 10-cm depth beneath the litter layer. In the paspalum community on Fish Hook Island, a litter layer was absent, but the temperature at the soil surface was slightly higher (34.5°C) than for the measurement taken at 0.5 m (33°C) and did not fall below the air temperature until a point greater than 2 cm was reached; the 10-cm temperature was 29.5°C (only slightly higher than the temperature recorded at a comparable depth on Pine Island). In the paspalum-silverling community on Fish Hook Island where a shrub layer afforded some shade, the air temperature at 0.5 m was higher (36°C) than at either of the other stations. The silverling shrubs presumably trap heat by retarding air circulation, a fact supported by identical temperatures measured at 0.5 m and at the soil surface. At the 2-cm depth, insulation was important, but at the 10-cm depth, the soil temperatures were more uniform between stations.

113. During the October sampling relative humidity had dropped from the mid-summer levels and differed between late morning sampling (68.5 percent) and mid-afternoon sampling (47.5 percent). The communities in which the microclimate samples were recorded differ considerably in aspect. The paspalum and croton-dayflower communities are sparse herbaceous associations; the beggartick-lantana is an herbaceous-mixed shrub association; and the cabbage palm community is a typically stratified community with a canopy, shrub layer, and ground cover. The 0.5-m temperature recordings indicated the typical autumn morning to mid-afternoon rise (from 27 to 31°C). The litter surface readings also showed a corresponding rise in temperature with a very notable recording in the croton-dayflower community of an 11°C difference depending upon whether the reading was taken in full sun or in shade. The below litter readings also differed significantly from the open, sparsely vegetated communities to the shaded ones. For example, the paspalum community had a below litter temperature of 33°C, whereas the comparable

measurements in both the cabbage palm and the beggartick-lantana communities were 24°C. At 2-cm depths, the croton-dayflower and paspalum communities still maintained very high soil temperatures (35.5 and 31.5°C, respectively). At 10 cm below the litter layer, the soil temperature was 28.5°C in the open communities and about 4 degrees cooler in the closed communities (24.5°C in the beggartick-lantana and 23.5°C in the cabbage palm).

Biological characteristics

114. Analysis of existing vegetation. The six islands comprising the Hillsborough Bay Island study site contain plant communities typical of dredged material islands along the central Gulf Coast of Florida (Table 23). Vegetation patterns and species composition are consistent with the findings of Beaman (1973) and Carlson (1972) for dredged material islands in Sarasota Bay and Charlotte Harbor, respectively. While the task of this contract centers primarily around upland succession, the ecological interrelationship between upland communities and tidal communities is especially pronounced, particularly in an estuarine setting such as Hillsborough Bay.

115. Tide-influenced communities such as mangrove and paspalum are therefore included in this report. As indicated later, the existence of tidal communities also influences the fauna of the islands (Figures 11-16).

a. Bird Island. Seventy species of plants were recorded on Bird Island, the most vegetationally diverse island within the study area. The floral diversity is not surprising in view of the facts that Bird Island is relatively close to the mainland, and is the oldest of the islands studied. A complete plant species list, based on Dunstan and Lewis (1974) and CZRC field observations in July and October 1974 and February 1975, is provided in Appendix B.

Accretion of sediments at the northeast and southeast extremities of Bird Island has produced two narrow peninsulas or sand spits that have become partially vegetated by mangroves (Figure 11). About half of the main body of the island on the eastern side is also covered by a dense mangrove stand and supports a nesting colony of wading birds. Small exposures of beach occur on the northern and

Table 23

Acreages of Biotic Communites of
Six Hillsborough Bay Islands

Biotic community	Acres					
	Bird	Sunken	Fish Hook	Gull	Pelican Point	Pine
Paspalum	-	2.0	4.8	1.4	1.8	2.6
Paspalum-silverling	-	-	1.5	-	-	-
Marsh elder	0.5	1.9	-	-	-	-
Silverling	-	2.9	-	0.3	-	-
Lantana-cabbage palm	-	4.8	-	-	-	-
Brazilian pepper-cabbage palm	-	3.1	-	-	-	-
Brazilian pepper	-	1.5	-	-	-	-
Cabbage palm	1.0	-	-	-	-	-
Croton-dayflower	0.4	-	-	-	-	-
Beggartick-ragweed	1.2	-	-	-	-	-
Natal grass	-	-	-	-	-	11.6
Beggartick-lantana	1.0	-	-	-	-	-
Mangrove	5.0	2.5	0.8	0.1	1.2	0.1
Ponds	-	0.03	-	-	-	-
Unvegetated	2.4	6.1	4.6	1.2	2.7	2.4
Total	11.5	24.83	11.7	3.0	5.7	16.7

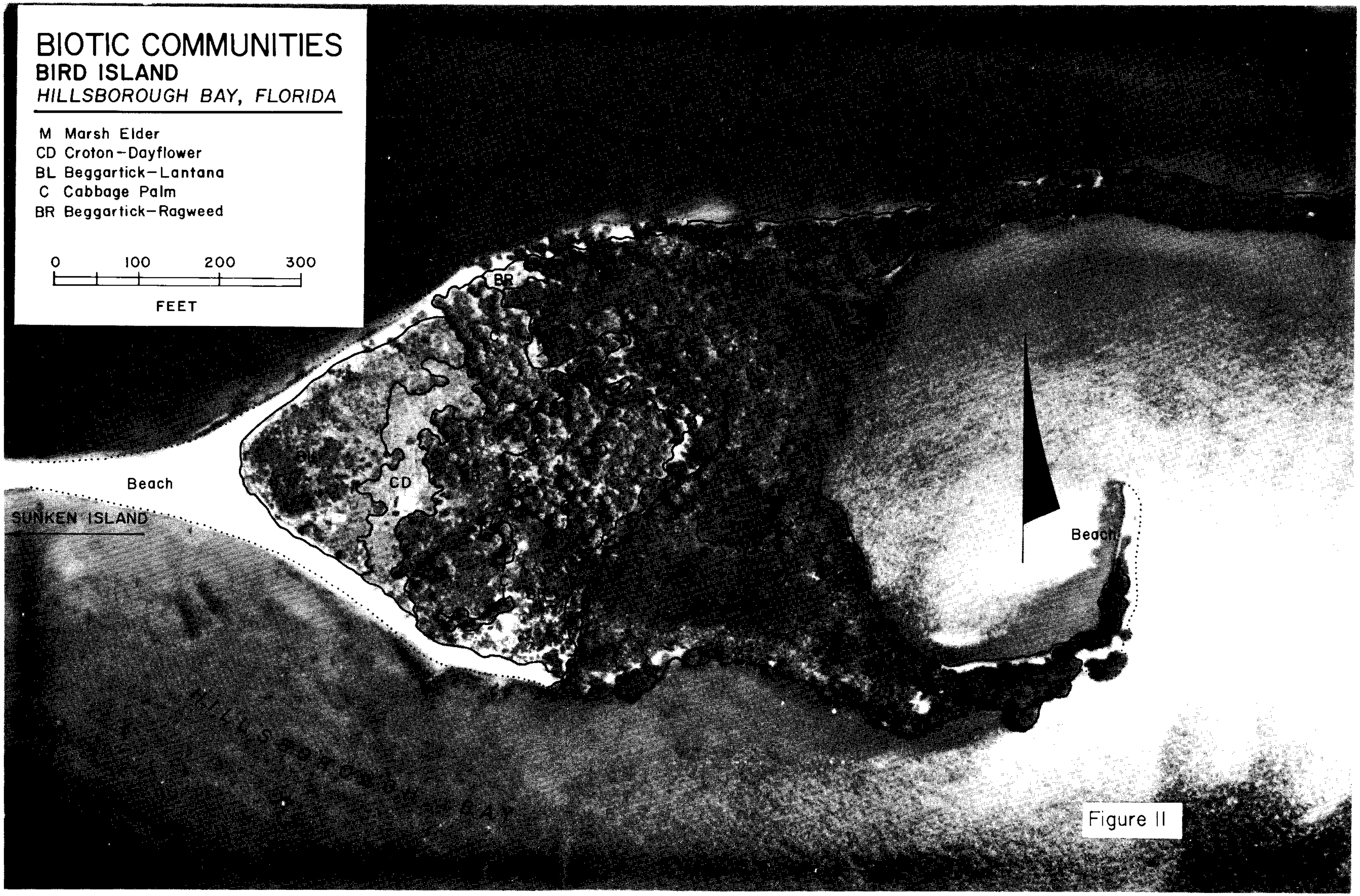

BIOTIC COMMUNITIES
BIRD ISLAND
HILLSBOROUGH BAY, FLORIDA
M Marsh Elder
CD Croton–Dayflower
BL Beggartick–Lantana
C Cabbage Palm
BR Beggartick–Ragweed
0 100 200 300
FEET
BR
CD
Beach
SUNKEN ISLAND
Beach
HILLSBOROUGH BAY

Figure II

southern shores, and a few clumps of smooth cordgrass (*Spartina alterniflora*) have become established along the eastern edge of the mangroves. A low wet area, probably cut off from the larger lagoon area by colonizing mangroves, is located near the center of the mangrove stand.

A narrow community of shrubs dominated by marsh elder (*Iva frutescens*) occurs along the western fringe of the mangrove community at the tidal-upland ecotone (Table 24). Saltmeadow cordgrass (*Spartina patens*) grows along the uplands adjacent to the beach, and a single plot in which this species was very abundant somewhat distorts the field results. The herbaceous species most typical of the marsh elder community is probably the goldenrod (*Solidago sempervirens* var. *mexicana*).

The most noticeable vegetative feature as one approaches Bird Island is the grove of cabbage palms (*Sabal palmetto*), which represents the only distinctly stratified forest within the project area. Stand densities are variable -- at some sites the cabbage palms are close together with crowns forming a dense canopy; at others, the trees are scattered or grow singly. Toward the north-central part of the island is a younger stand of cabbage palms, the densities of which make this grove nearly impenetrable. Canopy and understory layers consist solely of cabbage palm (Table 25). The woody vine *Passiflora suberosa* is extremely dense at places, often climbing up the trunks and into the crowns of the cabbage palms. The herbaceous layer is poorly developed, as would be expected in the shaded community, and consists mostly of beggartick (*Bidens pilosa*).

Adjacent to the cabbage palm community are three less distinct assemblages of plants that extend across the island from the north to the south beaches. The first of these communities is characterized by the tall coarse herbs of beggartick and ragweed (*Ambrosia artemisiifolia*) as well as occasional shrubs of silverling (*Baccharis halimifolia*), or extremely dense tangles of the vine *Passiflora suberosa* (Table 26). Shrub lantana (*Lantana camara*) may also be thick. Adjacent to the beggartick-ragweed a croton-dayflower association of low herbaceous

Table 24

Density and Relative Values for Tree and Shrub Species and Percent Cover and Relative Values for Herb Species in the Marsh Elder Community of Bird Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Saltmeadow cordgrass (*Spartina patens*)	13.33	47.1	40.0
Common ragweed (*Ambrosia artemisiifolia*)	10.00	35.3	30.0
Paspalum (*Paspalum vaginatum*)	3.33	11.8	10.0
Wild balsam apple (*Momordica charantia*)	0.83	2.9	2.5
Goldenrod (*Solidago sempervirens* var. *mexicana*)	0.83	2.9	2.5
	28.32	100.0	
Shrubs:			
Marsh elder (*Iva frutescens*)	5.00	100.0	15.0
			100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
		Shrub Layer		
Shrubs:				
Marsh elder (*Iva frutescens*)	6.83	17,075.0	95.4	91.0
Gray nicker (*Caesalpina crista*)	0.33	825.0	4.6	4.4
	7.16	17,900.0	100.0	

[a]Average cover per 0.5-m^2 quadrat

Table 24 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Trees:				
Red mangrove (Rhizophora mangle)	0.17	425.0	50.0	2.3
Brazilian pepper (Schinus terebinthifolius)	0.17	425.0	50.0	2.3
	0.34	850.0	100.0	100.0

Table 25

Density and Relative Values for Tree and Shrub Species and Percent Cover and Relative Values for Herb Species in the Cabbage Palm Community of Bird Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Beggartick (*Bidens pilosa*)	17.00	73.1	24.5
Moon flower (*Ipomoea tuba*)	2.50	10.7	3.6
Spurge (*Chamaesyce* sp.)	1.25	5.4	1.8
Spurge (*Euphorbia* sp.)	1.25	5.4	1.8
Cow pea (*Vigna luteola*)	1.25	5.4	1.8
	23.25	100.0	
Shrubs:			
Passion flower (*Passiflora suberosa*)	45.00	100.0	64.7
Trees:			
Cabbage palm (*Sabal palmetto*)	1.25	100.0	1.8
			100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Trees:			
Cabbage palm (*Sabal palmetto*)	1.75	4375.0	100.0

[a]Number of stems per 0.5-m^2 quadrat

Table 26

Density and Relative Values for Tree and Shrub Species and Percent Cover and Relative Values for Herb Species in the Beggartick-Ragweed Community of Bird Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Beggartick (*Bidens pilosa*)	47.14	52.3	45.1
Common ragweed (*Ambrosia artemisiifolia*)	18.57	20.6	17.8
Smutgrass (*Sporabolus poiretii*)	7.14	7.9	6.8
Dayflower (*Commelina diffusa*)	6.43	7.1	6.2
Moon flower (*Ipomoea tuba*)	4.29	4.8	4.1
Spurge (*Chamaesyce* sp.)	2.57	2.8	2.4
Wild balsam apple (*Momordica charantia*)	1.43	1.6	1.4
Dog fennel (*Eupatorium capillifolium*)	1.14	1.3	1.1
Ground cherry (*Physalis viscosa* var. *elliottii*)	0.71	0.8	0.7

[a]Number of stems per 0.5-m^2 quadrat

Table 26 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Pokeweed (*Phytolacca americana*)	0.71	0.8	0.7
	90.13	100.0	
Shrubs:			
Passion flower (*Passiflora suberosa*)	14.29	100.0	13.7
			100.0

Species	$\#/4\ m^2$	#/ha	Relative Value	Total Relative Value
		Shrub Layer		
Shrubs:				
Silverling (*Baccharis halimifolia*)	0.29	725.0	100.0	67.4
Trees:				
Ligustrum (*Forestiera segregata*)	0.14	350.0	100.0	32.6
				100.0

species incompletely covers the ground and shows little evidence of community dominance by a single species (Table 27). Saltmeadow cordgrass occurring in pure, dense stands again distorts the field data. On the western tip of the island is a thick beggartick-lantana community, which indistinctly grades into the croton-dayflower community on the east. The presence of community dominants such as cabbage palm, beggartick, ragweed, and dayflower from adjacent sites results in the beggartick-lantana being the most heterogeneous of Bird Island plant associations (Table 28). Along the eroded embankment of the western end of Bird Island, vines have spread into the shrubbery of lantana and silverling and formed a dense thicket.

b. Sunken Island. The largest of the Hillsborough Bay Islands studied, Sunken Island, is also one of the most difficult to traverse (Figure 12). Land travel is hampered by piles of stones and cobbles and the extremely dense growth of the shrub lantana, immature cabbage palms, and large rounded bushes of Brazilian pepper (*Schinus terebinthifolius*) over much of the island. Wherever a small opening in the shrubbery permits sunlight to reach the ground, beggarticks usually abound.

The number of species of plants recorded on Sunken Island was only 32, however -- next to Pelican Point Island, the lowest in diversity. Sunken Island has a mangrove community (Table 29) composed of the usual species of red, black, and white mangroves located in seven discontinuous areas, but, unlike typical mangrove stands, most of these areas have been cut off from tidal inundation by beaches or low beach ridges. A small pond enclosed by beach ridges near the western extremity of the island retains small amounts of rainfall, but is flooded by saline water from Hillsborough Bay with sufficient regularity to prevent establishment of vegetation. On the eastern end of the island, the beach ridges have become covered by paspalum (*Paspalum vaginatum*) or succulent halophytic herbs such as orach (*Atriplex arenaria*), seaside heliotrope (*Heliotropium curvassavicum*) (last two species were observed only, not sampled), and sea purslane (*Sesuvium portulacastrum*). Paspalum dominance is clearly evident (Table 30).

Table 27

Density and Relative Values for Shrub Species and Percent Cover and Relative Values for Herb Species in the Croton-Dayflower Community of Bird Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Saltmeadow cordgrass (*Spartina patens*)	13.33	19.8
Dayflower (*Commelina diffusa*)	11.67	17.3
Beggartick (*Bidens pilosa*)	10.83	16.1
Natal grass (*Rhynchelytrum roseum*)	6.67	9.9
Common ragweed (*Ambrosia artemisiifolia*)	5.00	7.4
Ground cherry (*Physalis viscosa* var. *elliottii*)	3.33	4.9
Golden aster (*Heterotheca subaxillaris*)	3.33	4.9
Smutgrass (*Sporobolus poiretii*)	2.50	3.7
Dwarf horseweed (*Conyza canadensis*)	2.50	3.7
Finger grass (*Chloris glauca*)	2.50	3.7
Sandspur (*Cenchrus echinatus*)	1.67	2.5
Spurge (*Chamaesyce* sp.)	0.83	1.2

[a]Average cover per 0.5-m^2 quadrat

Table 27 (concluded)

Species	Average Percent Cover	Relative Value
Sandspur (*Cenchrus* sp.)	0.83	1.2
Paspalum (*Paspalum vaginatum*)	0.83	1.2
Three-seeded mercury (*Acalypha rhomboidea*)	0.83	1.2
Cenchrus incertus	0.83	1.2
	67.48	99.9

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Sandspur (*Croton punctatus*)	0.17	425.00	100.0

Table 28

Density and Relative Values for Tree and Shrub Species and Percent Cover and Relative Values for Herb Species in the Beggartick-Lantana Community of Bird Island

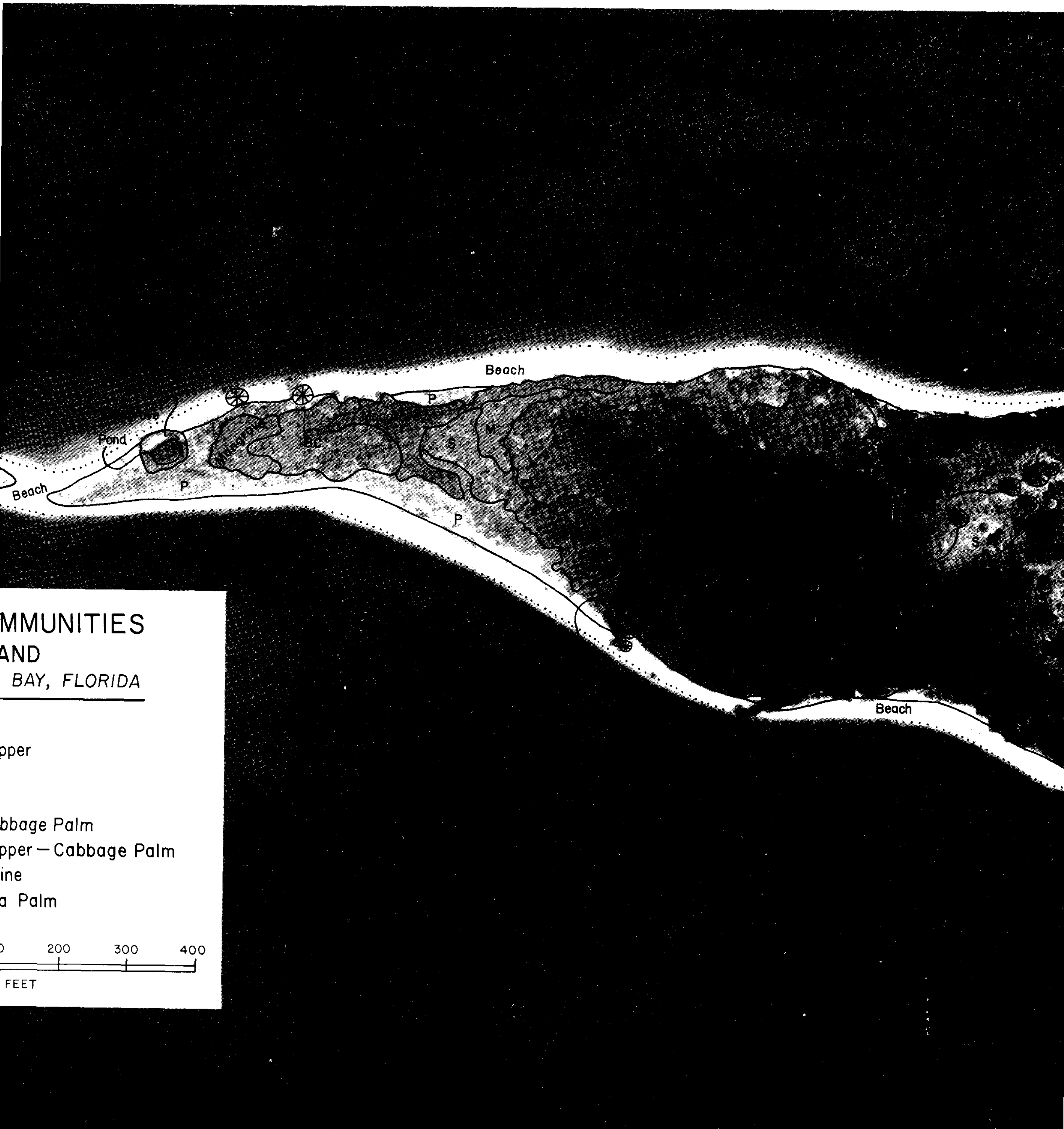
Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Beggartick (*Bidens pilosa*)	55.83	63.2	54.5
Common ragweed (*Ambrosia artemisiifolia*)	15.83	17.9	15.5
Smutgrass (*Sporobolus poiretii*)	6.67	7.6	6.5
Ground cherry (*Phypalis viscosa* var. *elliottii*)	3.33	3.8	3.3
Three-seeded mercury (*Acalypha rhomboidea*)	1.67	1.9	1.6
Spurge (*Chamaesyce* sp.)	1.67	1.9	1.6
Dayflower (*Commelina diffusa*)	1.67	1.9	1.6
Cow pea (*Vigna luteola*)	0.83	0.9	0.8
Natal grass (*Rhynchelytrum roseum*)	0.83	0.9	0.8
	88.33	100.0	
Shrubs:			
Shrub verbena (*Lantana camara*)	14.17	100.0	13.8
			100.0

[a]Number of stems per 0.5-m^2 quadrat

Table 28 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
		Shrub Layer		
Shrubs:				
Shrub verbena (*Lantana camara*)	1.33	3325.0	72.7	66.5
Silverling (*Baccharis halimifolia*)	0.50	1250.0	27.3	25.0
	1.85	4575.0	100.0	
Trees:				
Cabbage palm (*Sabal palmetto*)	0.17	425.0	100.0	8.5
				100.0

Figure 12



MMUNITIES
AND
BAY, FLORIDA
pper
bbage Palm
pper — Cabbage Palm
ine
a Palm
0 200 300 400
FEET
Beach
Pond
Mangrove
P
BC
S
M
Beach
P
Beach
S

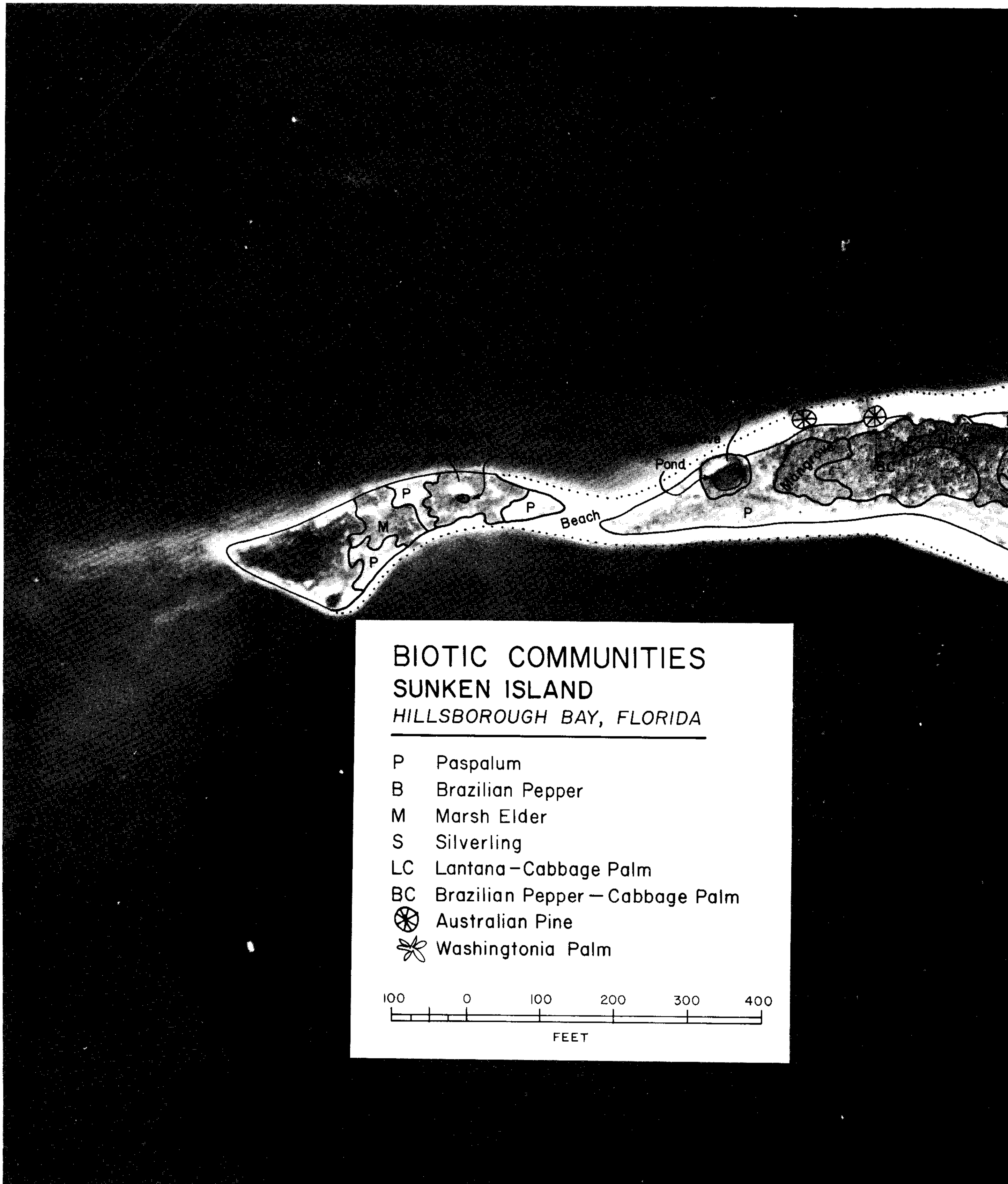

BIOTIC COMMUNITIES
SUNKEN ISLAND
HILLSBOROUGH BAY, FLORIDA
P Paspalum
B Brazilian Pepper
M Marsh Elder
S Silverling
LC Lantana–Cabbage Palm
BC Brazilian Pepper — Cabbage Palm
Australian Pine
Washingtonia Palm
100 0 100 200 300 400
FEET
P
M
P
P
Beach
Pond
P
BC

Table 29

Density and Relative Values for Tree and Shrub Species and Average Percent Cover and Relative Values for Herb Species in the Mangrove Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Saltweed (*Philoxerus vermicularis*)	13.33	42.1	39.0
Sea purslane (*Sesuvium portulacastrum*)	9.17	29.0	26.9
Paspalum (*Paspalum vaginatum*)	8.33	26.3	24.4
Goldenrod (*Solidago sempervirens* var. *mexicana*)	0.83	2.6	2.4
	31.66	100.0	
Trees:			
White mangrove (*Laguncularia racemosa*)	2.50	100.0	7.3
			100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
		Shrub Layer		
Shrubs:				
White mangrove (*Laguncularia racemosa*)	0.83	2075.0	45.4	11.6

[a]Average cover per 0.5-m^2 quadrats

Table 29 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Marsh elder (*Iva frutescens*)	0.67	1675.0	36.6	11.6
Black mangrove (*Avicennia germinans*)	0.33	825.0	18.0	4.6
	1.83	4575.0	100.0	
Trees:				
White mangrove (*Laguncularia racemosa*)	3.00	7,500.0	56.2	41.8
Black mangrove (*Avicennia germinans*)	2.17	5,425.0	40.0	30.3
Red mangrove (*Rhizophora mangle*)	0.17	425.0	3.2	2.4
	5.34	13,350.0	100.0	100.0

Table 30

Density and Relative Values for Shrub and Tree Species and Average Percent Cover and Relative Values for Herb Species in the Paspalum Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Paspalum (*Paspalum vaginatum*)	55.00	81.6	79.9
Goldenrod (*Solidago sempervirens* var. *mexicana*)	6.43	9.5	9.4
St. Augustine grass (*Stenotaphrum secundatum*)	2.14	3.2	3.1
Galingale (*Cyperus ligularis*)	1.71	2.5	2.5
Saltweed (*Philoxerus vermicularis*)	1.43	2.1	2.1
Sea purslane (*Sesuvium portulacastrum*)	0.71	1.1	1.0
	67.42	100.0	
Trees:			
White mangrove (*Laguncularia racemosa*)	0.71	50.0	1.0

[a]Average cover per 0.5-m^2 quadrat

Table 30 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Brazilian pepper (*Schinus terebinthifolius*)	0.71	50.0	1.0
	1.42	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Trees:			
White mangrove (*Laguncularia racemosa*)	0.14	350.0	100.0

Seasonality is not pronounced except in the case of the seaside goldenrod (*Solidago sempervirens* var. *mexicana*), which exists most of the year as a low clump of leaves but during the late summer, fall, and early winter, sends up tall stalks of bright yellow flowers, which often persist into the following spring. Because the paspalum community is near the tidal interface, representatives of the mangrove association occasionally persist, typically white mangrove.

A more or less crescent-shaped community of marsh elder (*Iva frutescens*) fringes the upland face of the mangrove community on the eastern end of Sunken Island. This community occurs distinctly elsewhere on the island but always near the high tide line. Marsh elder plants typically have three to six stems arising from a single plant at ground level and grow in dense stands approximately 1 to 2 m high. The ground surface is often bare and frequently riddled with the burrows of fiddler crabs (*Uca pugnax*). When herbaceous plants are present, they are usually species that have invaded from adjacent communities (Table 31). In contrast to the paspalum community that occurs on white or yellowish sands the marsh elder community is found on gray soils with higher silt and organic content.

A concentric zone of silverling, growing slightly upland from the marsh elder community, occurs on the eastern half of Sunken Island. The community is dominated by a single shrub (Table 32). Paspalum is occasionally present, though lacking the robustness that it often achieves in the marsh elder and paspalum communities, and salt-meadow cordgrass occurs, indicating the continued influence of salinity. The most abundant herb, however, is beggartick with a total relative value of nearly 46. Invader plants such as lantana and cabbage palm from more upland communities were also found, and Australian pine (*Casuarina equisetifolia*) grows along the margin of the silverling and marsh elder communities.

The eastern half of the upland portion of Sunken Island is covered by lantana and cabbage palm. The lantana shrubs usually have several stems arising from a single rootstock, and these branches tend

Table 31

Density and Relative Values for Shrub Species and Average Percent Cover and Relative Values for Herb Species in the Marsh Elder Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Paspalum (*Paspalum vaginatum*)	27.56	46.6	45.9
Sea purslane (*Sesuvium portulacastrum*)	13.12	22.2	21.8
Goldenrod (*Solidago sempervirens* var. *mexicana*)	12.19	20.6	20.3
Saltweed (*Philoxerus vermicularis*)	6.25	10.6	10.4
	59.12	100.0	
Shrubs:			
Marsh elder (*Iva frutescens*)	0.94	100.0	1.6
			100.0

Species	$\#/4\ m^2$	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Marsh elder (*Iva frutescens*)	2.00	5000.0	97.1
Black mangrove (*Avicennia germinans*)	0.06	150.0	2.9
	2.06	5150.0	100.0

[a]Average cover for $0.5\text{-}m^2$ quadrat

Table 32

Density and Relative Values for Shrub and Tree Species and Average Percent Cover and Relative Values for Herb Species in the Silverling Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Beggartick (*Bidens pilosa*)	31.00	45.7
Goldenrod (*Solidago sempervirens* var. *mexicana*)	22.50	33.1
Saltmeadow cordgrass (*Spartina patens*)	11.88	17.5
Paspalum (*Paspalum vaginatum*)	1.88	2.8
Railroad vine (*Ipomoea pes-caprae*)	0.62	0.9
	67.88	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Silverling (*Baccharis halimifolia*)	6.00	1500.0	90.6	89.0
Shrub lantana (*Lantana camara*)	0.62	155.0	9.4	9.2
	6.62	1655.0	100.0	
Trees:				
Cabbage palm (*Sabal palmetto*)	0.12	300.0	100.0	1.8
				100.0

[a]Average cover per 0.5-m^2 quadrat

to sprawl as a result of bird utilization and a heavy fruit crop. Heights of 2 m are not uncommon for the lantana. Seedlings of cabbage palms may be present (Table 33). In addition, the northern part of this community has several palms that have already surpassed the lantana shrubs in height and will likely shade out others as they gain dominance in the community. Sporadically found in this community are well-developed trees of Brazilian pepper and an occasional guava (*Psidium guajava*) or fig (*Ficus carica*), the seeds of which have evidently been carried to the island by birds. Observations made during February 1975 revealed tremendous numbers of seedlings of beggarticks beneath the lantana and in open spaces where taller shrubs had died. Apparently the new spring growth of other species shades out many of the beggartick seedlings, while others succumb as a result of competition for nutrients, space, and water. Compared with all other ground cover species, beggarticks had a total relative value of nearly 80 (Table 33).

About midway between the east and west ends of Sunken Island is another small hill composed of rounded stones and covered by Brazilian pepper (Table 34). The Brazilian pepper plant assumes two growth forms. In open uncrowded conditions, it becomes a low rounded shrub with branches to ground level; in dense stands, the lower branches are shed and the plant becomes more tree-like with a single trunk and a relatively dense canopy and attains heights of at least 5 m. The latter situation occurs on Sunken Island. A forest of Brazilian pepper occupies the high point of the dredged material. Beneath the canopy, species such as silverling and lantana once grew, but apparently were shaded out. In some portions of the community the ground is relatively barren; in other areas, many seedlings of cabbage palm were observed. The edges of this community sometimes reach the high-tide zone and contain species normally found along beach ridges, such as paspalum and moonflower (*Ipomoea tuba*).

The Brazilian pepper-cabbage palm community lies mostly north of the Brazilian pepper community near the center of the island, and probably represents the most advanced successional stage of upland

Table 33

Density and Relative Values for Shrub Species and Average Percent Cover and Relative Values for Herb and Shrub Species in the Lantana-Cabbage Palm Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
Beggartick (*Bidens pilosa*)	15.00	95.2	79.6
Slender amaranth (*Amaranthus viridus*)	0.38	2.4	2.0
Wild balsam apple (*Momordica charantia*)	0.38	2.4	2.0
	15.76	100.0	
Shrubs:			
Shrub lantana (*Lantana camara*)	3.08	100.0	16.4
			100.0
Species	**#/4 m^2**	**#/ha**	**Relative Value**
Shrub Layer			
Shrubs:			
Shrub lantana (*Lantana camara*)	1.54	3850.0	68.7
Cabbage palm (*Sabal palmetto*)	0.54	1350.0	24.1
Silverling (*Baccharis halimifolia*)	0.08	200.0	3.6
Brazilian pepper (*Schinus terebinthifolius*)	0.08	200.0	3.6
	2.24	5600.0	100.0

[a]Average cover per 0.5-m^2 quadrat

Table 34

Density and Relative Values for Shrub and Tree Species and Average Percent Cover and Relative Values for Herb and Tree Species in the Brazilian Pepper Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Paspalum (*Paspalum vaginatum*)	15.00	92.3	80.0
Moonflower (*Ipomoea tuba*)	1.25	7.7	6.7
	16.25	100.0	
Trees:			
Brazilian pepper (*Schinus terebinthifolius*)	2.50	100.0	13.3
			100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Cabbage palm (*Sabal palmetto*)	1.25	3125.0	71.4
Trees:			
Brazilian pepper (*Schinus terebinthifolius*)	0.50	1250.0	28.6
	51.25	4375.0	100.0

[a]Average cover per 0.5-m^2 quadrat

communities on Sunken Island (Table 35). The largest plants are Brazilian peppers, although they cover less area than the cabbage palms. In the shrub layer, many seedlings of cabbage palms are present, and the shrub layer dominant, lantana, appears to be slowly dying out. The herbaceous layer contains only a few species such as pokeweed (*Phytolacca americana*) and invaders from the beach community.

c. *Fish Hook Island*. Vegetation of Fish Hook Island (Figure 13) is more diverse than the other islands in this chain, probably because of its closer proximity to the mainland. Mangroves fringe the central lagoon, paspalum occurs on the high overwashes of the eastern peninsulas, and a paspalum-silverling community exists at the topographic high point on the northwestern tip of the island. Approximately 10 Australian pines are located on the island, most of them occurring near the southeastern extremity. Sixty-three species were found on the island, including old field species such as broomsedge (*Andropogon virginicus*), dwarf horseweed (*Conyza canadensis* var. *pusilla*), dogfennel (*Eupatorium capillifolium*), and sweet clover (*Melilotus alba*) as well as a few naturalized cultivated plants, such as Spanish dagger (*Yucca aloifolia*) and a small yellow-flowered aster, *Wedelia trilobata*. A broad overwash area affords partial protection to a mangrove fringe on the southwestern side of the island.

The mangrove community is dominated by black and white mangroves (Table 36), but red mangrove may be present. Salt-tolerant herbs, notably sea blite (*Suaeda linearis*) and paspalum, have invaded the margins of the mangrove community from adjacent areas.

Many more salt-tolerant species have become established on the beach overwash than in the mangrove community and include such plants as sea purslane, seaside heliotrope, saltwort, Virginia dropseed, orach, railroad vine, capeweed, glasswort (*Salicornia virginica*), and two species of sea blite (*Suaeda linearis* and *S. maritima*).

The paspalum community has several species of herbaceous plants, but *Paspalum vaginatum* is by far the most abundant, comprising more than half the ground cover (Table 37). A few other shrubs are also present, usually silverling (*Baccharis halimifolia*) or an occasional

Table 35

Density and Relative Values for Shrub and Tree Species and Average Percent Cover and Relative Values for Herb, Shrub, and Tree Species in the Brazilian Pepper-Cabbage Palm Community of Sunken Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
Moonflower (*Ipomoea tuba*)	3.08	61.6	15.4
Paspalum (*Paspalum vaginatum*)	1.54	30.8	7.7
Poke weed (*Phytolacca americana*)	0.38	7.6	1.9
	5.00	100.0	
Shrubs:			
Shrub lantana (*Lantana camara*)	5.38	100.0	26.9
Trees:			
Cabbage palm (*Sabal palmetto*)	7.69	80.0	38.5
Brazilian pepper (*Schinus terebinthifolius*)	1.92	20.0	9.6
	9.61	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Shrub lantana (*Lantana camara*)	0.62	1550.0	62.0	38.3
Cabbage palm (*Sabal palmetto*)	0.38	950.0	38.0	23.5
	1.00	2500.0	100.0	

[a]Average cover per 0.5-m^2 quadrat

Table 35 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Trees:				
Cabbage palm (*Sabal palmetto*)	0.46	1150.0	74.2	28.4
Australian pine (*Casuarina equisetifolia*)	0.08	200.0	12.9	4.9
Brazilian pepper (*Schinus terebinthifolius*)	0.08	200.0	12.9	4.9
	0.62	1550.0	100.0	100.0


BIOTIC COMMUNITIES
FISH HOOK ISLAND
HILLSBOROUGH BAY, FLORIDA
PS Paspalum - Silverling
P Paspalum
Australian Pine
0 100 200 300
FEET
Beach
Beach
Beach
Beach
Overwash
P
P

Figure 13

Table 36

Density and Relative Values for Tree Species and Average Percent Cover and Relative Values for Herb Species in the Mangrove Community of Fish Hook Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Sea blite (*Suaeda linearis*)	15.00	50.0
Paspalum (*Paspalum vaginatum*)	15.00	50.0
	30.00	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Trees:			
Black mangrove (*Avicennia germinans*)	7.50	18,750.0	57.7
White mangrove (*Laguncularia racemosa*)	5.50	13,750.0	42.3
	13.00	32,500.0	100.0

[a]Average cover per 0.5-m^2 quadrat

Table 37

Density and Relative Values for Shrub and Tree Species and Average Percent Cover and Relative Values for Herb and Shrub Species in the Paspalum Community of Fish Hook Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
Paspalum (*Paspalum vaginatum*)	37.69	56.2	56.2
Natal grass (*Rhynchelytrum roseum*)	7.88	11.8	11.7
Capeweed (*Lippia nodiflora*)	5.38	8.0	8.0
Broom sedge (*Andropogon virginicus*)	4.23	6.3	6.3
Cow pea (*Vigna luteola*)	3.27	4.9	4.8
Goldenrod (*Solidago sempervirens* var. *mexicana*)	2.62	3.9	3.9
Smutgrass (*Sporobolus poiretti*)	1.54	2.3	2.3
Finger grass (*Chloris glauca*)	1.35	2.0	2.0
Railroad vine (*Ipomoea pes-caprea*)	1.15	1.7	1.7
Vasey grass (*Paspalum urvillei*)	0.77	1.1	1.1
Saltmeadow cordgrass (*Spartina patens*)	0.38	0.6	0.6

[a]Average cover per 0.5-m^2 quadrat

Table 37 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
June bean (*Canavalia maritima*)	0.19	0.3	0.3
Finger grass (*Chloris petraea*)	0.19	0.3	0.3
Dwarf horseweed (*Conyza canadensis*)	0.19	0.3	0.3
Sea-side evening primrose (*Oenothera humifusa*)	0.19	0.3	0.3
	67.02	100.0	
Shrubs:			
Silverling (*Baccharis halimifolia*)	0.19	100.0	0.3
			100.0

Species	$\#/4\ m^2$	#/ha	Relative Value	Total Relative Value
	Shrub Layer			
Shrubs:				
Silverling (*Baccharis halimifolia*)	0.04	100.0	100.0	50.0
Trees:				
Australian pine (*Casuarina equisetifolia*)	0.04	100.0	100.0	50.0
				100.0

clump of dalbergia (*Dalbergia ecastophyllum*). Australian pines may also be present in this community.

The paspalum-silverling community, as the name implies, is somewhat intermediate between the predominantly herbaceous paspalum community and the densely crowded silverling shrub community. Presence of silverling in the herbaceous layer indicates reproduction of this species. Silverling will eventually shade out the herbs such as paspalum, golden aster (*Heterotheca subaxillaris*), natal grass (*Rhynchelytrum roseum*), cow pea (*Vigna luteola*), and seaside goldenrod that were found in the field samples (Table 38).

d. Gull Island. Forty-three species of plants were recorded on Gull Island. Three vegetation associations are present but the only true upland community is silverling, which occurs at the highest point near the western end of the island, 1 to 2 m above sea level. The mangrove community and much of the paspalum community are subject to flooding (Figure 14).

Red, black, and white mangroves are present on Gull Island, but the single random field sample in this community contained only paspalum. The mangrove community is nearly landlocked at the head of a small cove, but could easily colonize the margins of the cove in a few years when the present population becomes mature enough to set seed.

The largest biotic community on Gull Island is the paspalum community, which occupies a long curving spit projecting southeastward from the main body of the island. Accretion along the northern boundary of Gull Island has built another shorter spit, likewise mostly covered by paspalum. The total average cover is slightly greater in the paspalum community on Gull Island (83.9 percent) than on Fish Hook Island (67.0 percent). The relative value of paspalum at 75.1 is also greater than on Fish Hook (56.2), and species diversity is less on Gull Island. Both marsh elder and silverling occurred in the shrub layer (Table 39).

The highest part of Gull Island is covered by silverling with patches of paspalum growing around the margin of the community

Table 38

Density and Relative Values for Shrub Species and Average Percent Cover and Relative Values for Herb and Shrub Species in the Paspalum-Silverling Community of Fish Hook Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Paspalum (*Paspalum vaginatum*)	43.33	65.0	61.9
Golden aster (*Heterotheca subaxillaris*)	13.33	20.0	19.0
Natal grass (*Rhynchelytrum roseum*)	5.00	7.5	7.1
Cow pea (*Vigna luteola*)	3.33	5.0	4.8
Goldenrod (*Solidago sempervirens* var. *mexicana*)	1.67	2.5	2.4
	66.66	100.0	
Shrubs:			
Silverling (*Baccharis halimifolia*)	3.33	100.0	4.8
			100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Silverling (*Baccharis halimifolia*)	2.33	5825.0	100.0

[a]Average cover per 0.5-m^2 quadrat

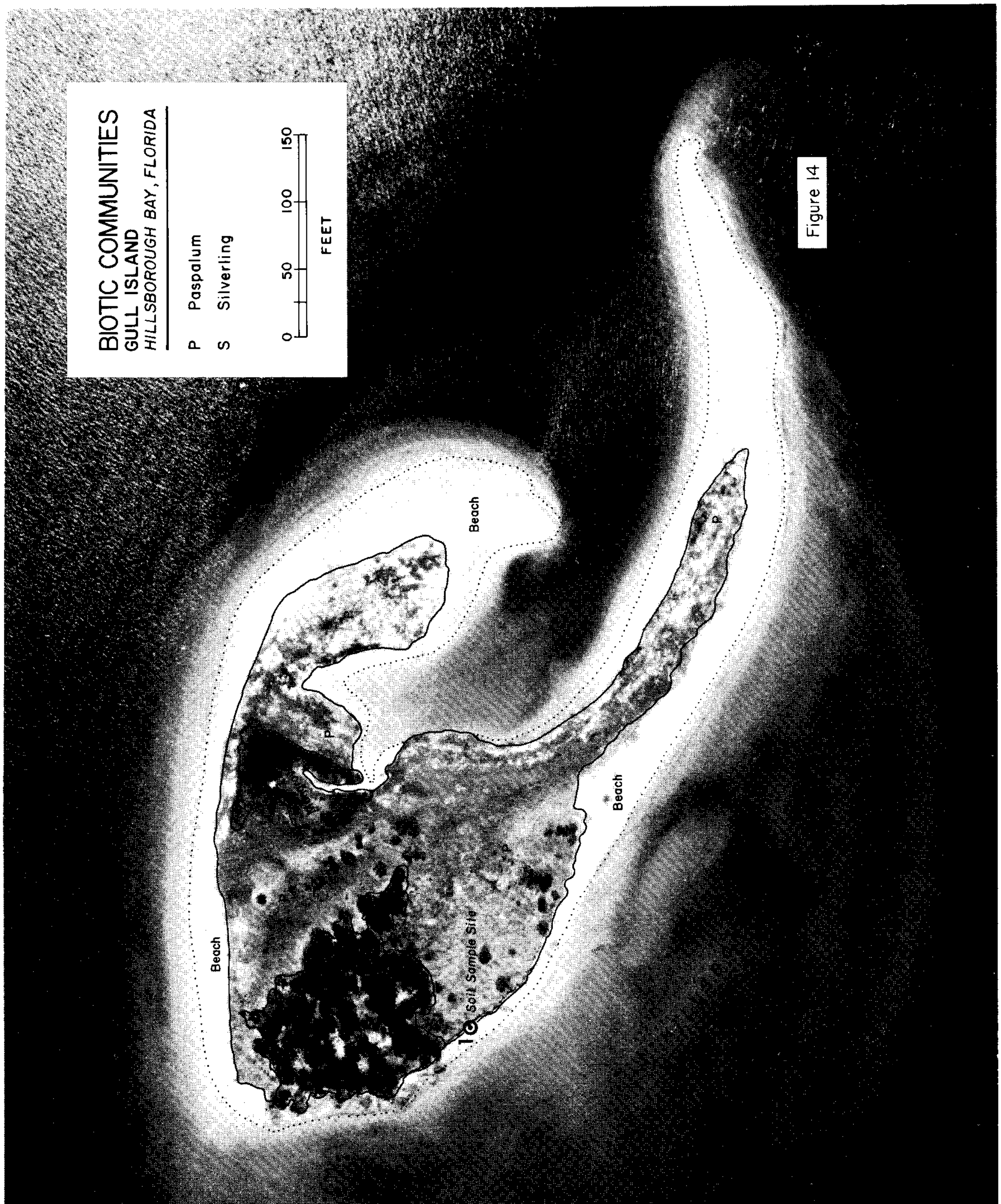

BIOTIC COMMUNITIES
GULL ISLAND
HILLSBOROUGH BAY, FLORIDA
P Paspalum
S Silverling
0 50 100 150
FEET
Beach
Beach
Beach
Soil Sample Site
1
P
P

Figure 14

Table 39

Density and Relative Values for Shrub Species and Percent Cover and Relative Values for Herb Species in the Paspalum Community of Gull Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Paspalum (*Paspalum vaginatum*)	63.00	75.1
Sea-side evening primrose (*Oenothera humifusa*)	9.09	10.8
Vigna luteola	5.45	6.5
Boerhaavia diffusa	5.45	6.5
Sesuvium portulacastrum	0.91	1.1
	83.90	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Iva frutescens	0.18	450.0	66.7
Baccharis halimifolia	0.09	225.0	33.3
	0.27	675.0	100.0

[a]Average cover per 0.5-m^2 quadrat

or in isolated openings within it. Species recorded in the field plots show stratification in two layers: a pure silverling shrub layer and an herbaceous layer in which paspalum, beggarticks, and goldenrod dominate (Table 40). The dense shade of the silverling probably excludes a greater variety and abundance of herbaceous plants from this community. As erosion on the western end of the island removes dredged material now occupied by silverling, transport of the material to the developing sand spits on the eastern end of the island will provide new habitat for mangroves and paspalum.

e. Pelican Point Island. Pelican Point Island is topographically low, physically unstable, and nearly dissected into three smaller islands by overwash and shore erosion (Figure 15). The vegetation reflects the frequency of tidal inundation and absence of a stable substrate. The slight protection afforded by the beaches and overwash zones apparently promotes the colonization and growth of mangroves, which are the most abundant vegetation on the island. The herbaceous layer in the mangrove community is almost a pure growth of paspalum and seedlings of all three mangrove species (Table 41). White mangrove is dominant in the shrub layer and composes almost half the stand density. Red mangroves comprise only a fifth of the stand density, but are the most abundant mangrove species in the herbaceous layer, representing nearly half of the tree seedlings found. Black mangrove, while fairly abundant in the shrub layer, is very sparse in the herb layer.

The highest portion of the island supports a paspalum community with beach and salt flat vegetation such as saltweed, sea purslane, orach (*Atriplex arenaria*), slatwort (*Batis maritima*) (latter two species observed, only), June bean, seaside heliotrope, and other salt-tolerant herbs. In addition, there are occasional species typical of dry sandy habitats, such as the golden aster, sandspur, and Australian pine. A dense population of the vine milkweed (*Cynanchum palustre*), occupying several square meters, was found on Pelican Point and on none of the other islands within the study area. The total average percent cover of the paspalum community is 90.65, of which paspalum comprises 80 percent (Table 42).

Table 40

Density and Relative Values for Shrub Species and Average Percent Cover and Relative Values for Herb Species in the Silverling Community of Gull Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Paspalum (*Paspalum vaginatum*)	25.00	51.8
Beggartick (*Bidens pilosa*)	11.25	23.3
Goldenrod (*Solidago sempervirens* var. *mexicana*)	8.25	17.1
Cow pea (*Vigna luteola*)	1.25	2.6
Railroad vine (*Ipomoea pes-caprae*)	1.25	2.6
Golden aster (*Heterotheca subaxillaris*)	0.62	1.3
Bermuda grass (*Cynodon dactylon*)	0.62	1.3
	48.24	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Silverling (*Baccharis halimifolia*)	3.00	7500.0	100.00

[a]Average cover per 0.5-m^2 quadrat

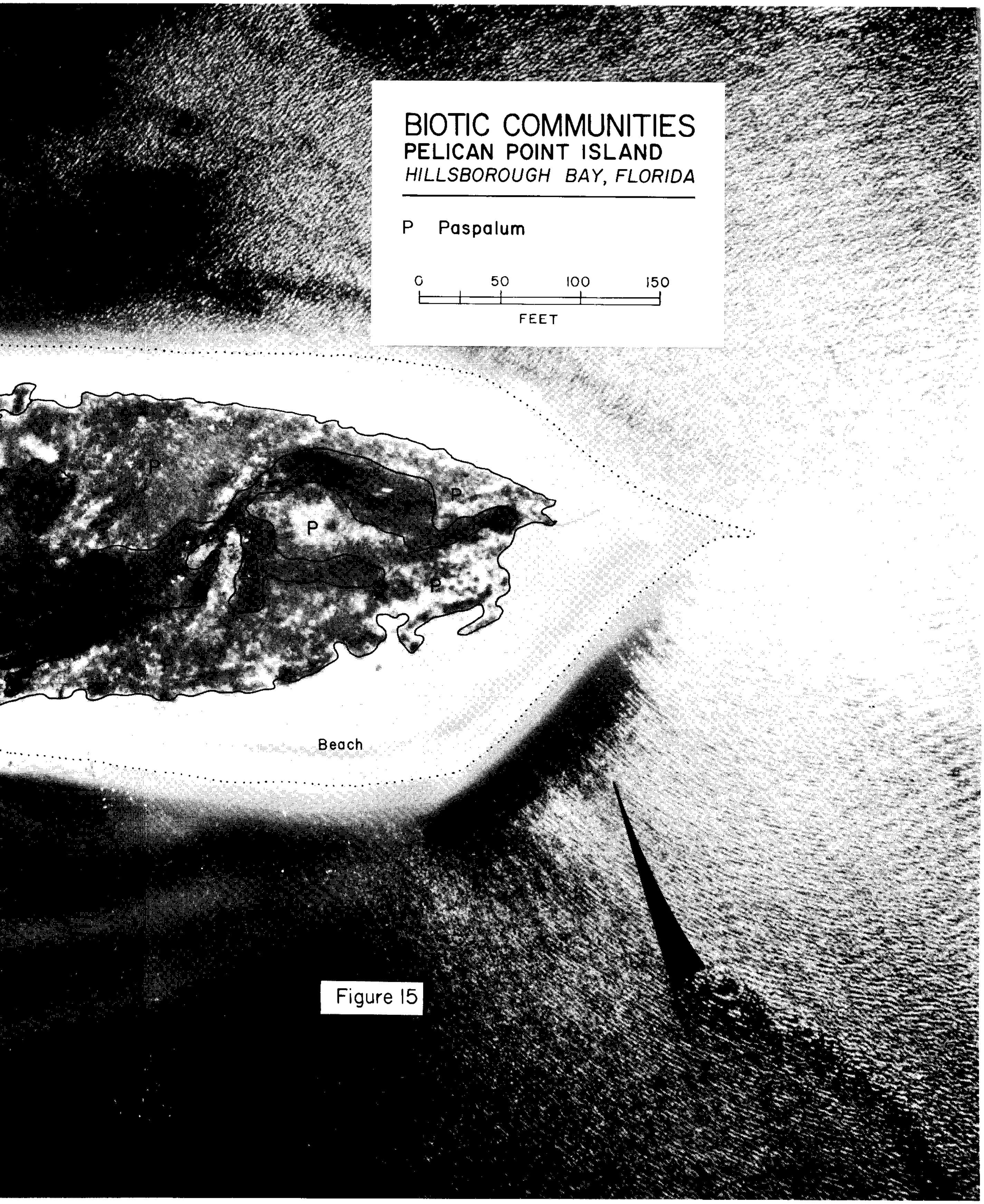
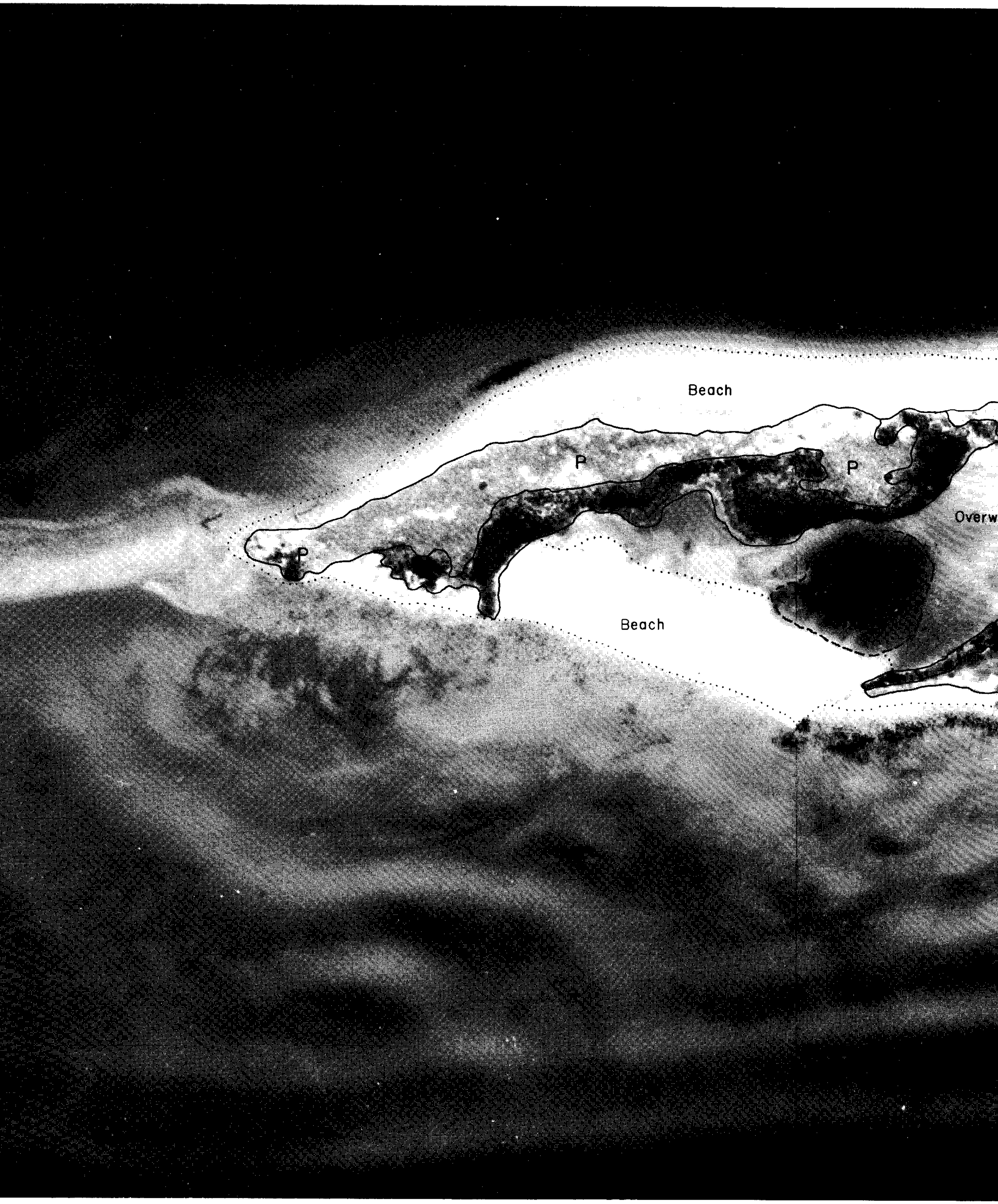

BIOTIC COMMUNITIES
PELICAN POINT ISLAND
HILLSBOROUGH BAY, FLORIDA
P Paspalum
0 50 100 150
FEET
P
P
P
P
Beach

Figure 15

Beach
P
P
Overwash
Overwash
P
P
ch
P
P
HILLSBOROUGH



Beach
P
P
P
Overw
Beach

Table 41

Density and Relative Values for Shrub and Tree Species and Percent Cover and Relative Values for Herb and Tree Species in the Mangrove Community of Pelican Point Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Paspalum (*Paspalum vaginatum*)	60.31	97.0	79.7
Saltweed (*Philoxerus vermicularis*)	1.25	2.0	1.7
Sea purslane (*Sesuvium portulacastrum*)	0.63	1.0	0.8
	62.19	100.0	
Trees:			
Red mangrove (*Rhizophora mangle*)	6.56	48.8	8.7
White mangrove (*Laguncularia racemosa*)	6.25	46.5	8.3
Black mangrove (*Avicennia germinans*)	0.63	4.7	0.8
	13.44	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
	Shrub Layer			
Shrubs:				
Marsh elder (*Iva frutescens*)	0.06	150.0	100.0	0.4
Trees:				
White mangrove (*Laguncularia racemosa*)	8.19	20,475.0	49.8	49.6

[a]Average cover per 0.5-m^2 quadrat

Table 41 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Black mangrove (*Avicennia germinans*)	4.94	12,350.0	30.1	29.9
Red mangrove (*Rhizophora mangle*)	3.31	8,275.0	20.1	20.1
	16.44	41,100.0	100.0	100.0

Table 42

Percent Cover and Relative Values for Herb Species in the Paspalum Community of Pelican Point Island

Species	Average Percent Cover[a]	Relative Value
	Herbaceous Layer	
Herbs:		
Paspalum (*Paspalum vaginatum*)	72.17	79.6
Sea purslane (*Sesuvium portulacastrum*)	8.04	8.9
Sea blite (*Suaeda linearis*)	4.56	5.0
Virginia dropseed (*Sporobolus virginicus*)	4.35	4.8
Vine milkweed (*Cynanchum palustre*)	.87	1.0
Railroad vine (*Ipomoea pes-caprae*)	.22	.2
Saltweed (*Philoxerus vermicularis*)	.22	.2
Wild balsam apple (*Canavalia maritima*)	.22	.2
	90.65	99.9

[a]Average cover per 0.5-m^2 quadrat

During the spring of 1975, Pelican Point underwent severe erosion on the western tip. The extent to which the vegetation was altered has not been appraised.

f. Pine Island. Pine Island is well covered by vegetation. Fifty-eight species of flowering plants were found on the island. The natal grass community, covering the largest area, occurred on no other islands in the study area (Figure 16). The presence of natal grass (*Rhynchelytrum roseum*), sandspur (*Cenchrus echinatus*), finger grasses (*Chloris glauca* and *C. petraea*) and golden aster (*Heterotheca subaxillaris*) is attributable to the efficient dispersal mechanisms of these species and to the availability of a sandy, dry habitat more or less free of other competing species (Table 43).

At the present time, the most evident limiting factors are erosion of the island along the western periphery, sand movement by wind erosion, moisture loss, leaching of nutrients, and amphibious motor vehicles. Tracks of these vehicles are evident on the biotic community map of this island.

A stand of Australian pines occurs mostly within the natal grass community on the northern end of the island (not sampled). There are 50 trees on the island, the largest having a DBH of 17.6 in. and 8 trees having diameters greater than 10 in. If all vegetation were destroyed during the 1965 dredging, these trees must be less than 9 years old; if they survived that deposition, they may be as old as 17 years.

Between the natal grass community and the bare unvegetated beach is a zone of vegetation distinctive because of its thick ground cover. Golden asters, sandspurs, and finger grasses gradually give way to an herbaceous assemblage dominated by paspalum, an occasional shrub of marsh elder and herbs such as cow pea, capeweed (*Lippia nodiflora*), saltweed, and Virginia dropseed (Table 44). Nearer the edge of the water, in an area more susceptible to flooding, are salt flat species such as sea blite, sea purslane, and seaside heliotrope. On the sandy overwashes are two robust vines, railroad vine and June bean.


Beach
Overwash
Beach
Beach
N
N
N
N
P
BIOTIC COMMUNITIES
PINE ISLAND
HILLSBOROUGH BAY, FLORIDA
P Paspalum
N Natal Grass
Australian Pine
0 50 100 150
FEET
Figure 16

Table 43

Percent Cover and Relative Values for Herb Species in the Natal Grass Community of Pine Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Natal grass (*Rhynchelytrum roseum*)	13.6	34.3
Sandspur (*Cenchrus echinatus*)	5.9	14.9
Finger grass (*Chloris glauca*)	3.9	9.9
Finger grass (*Chloris petraea*)	3.7	9.3
Golden aster (*Heterotheca subaxillaris*)	3.2	8.1
Sea-side evening primrose (*Oenothera humifusa*)	2.7	6.8
Sand grass (*Triplasis purpurea*)	2.5	6.3
Railroad vine (*Ipomoea pes-caprae*)	1.1	2.8
Sandspur (*Cenchrus incertus*)	1.1	2.8
Smutgrass (*Sporobolus poiretii*)	.9	2.3
Sandspur (*Cenchrus longispinus*)	.4	1.0
Rose-purslane (*Portulaca pilosa*)	.2	.5

[a]Percent cover per 0.5-m^2 quadrat

Table 43 (concluded)

Species	Average Percent Cover	Relative Value
Goose grass (*Eleusine indica*)	.2	.5
Cow pea (*Vigna luteola*)	.2	.5
	39.6	100.0

Table 44

Density and Relative Values for Shrub Species and Percent Cover and Relative Values for Herb Species in the Paspalum Community of Pine Island

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Paspalum (*Paspalum vaginatum*)	51.7	95.7
Sandspur (*Cenchrus longispinus*)	1.1	2.1
Saltweed (*Philoxerus vermicularis*)	0.6	1.1
Finger grass (*Chloris petraea*)	0.6	1.1
	54.0	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Marsh elder (*Iva frutescens*)	0.5	1250.0	100.0

[a]Average percent cover per 0.5-m^2 quadrat

Near the northeast corner of the island where a peninsula is beginning to form, a small area of mangroves has become isolated from the tidal zone as a result of beach overwash and deposition. Under present conditions, these small mangroves probably will not survive more than a few years. The shrub dalbergia, now competing with the mangroves at this site, will eventually replace this small population. However, the shore along the eastern face of the island is coming increasingly under the protection of two spits forming on the northern and southern tips of Pine Island and will probably become colonized by mangroves. In the paspalum community, the occurrence of marsh elder and finger grass also indicates vegetation changes although the relative value of paspalum is exceptionally high (95.7). One reason for this disparity is that the community only shows a 54 percent cover value, sparse in comparison with the paspalum communities on other islands. The natal grass community, covering topographically high and well-drained soils, is diverse but sparse, probably due to low soil moisture and perhaps salt spray.

116. Seral relationships of vegetation. Successional patterns on the six Hillsborough Bay islands have been strongly influenced by tidal flooding, salt spray, dredged material disposal, substrate characteristics, distance from mainland propagule sources, erosion, and time. Fish Hook, Gull, Pelican Point, and Pine Islands have been available for biotic habitation only since 1965. Sunken Island has been available since 1961, and Bird Island since 1931.

117. Plant community diversity is generally much less on the younger islands. The exception is Sunken Island. Increased diversity of this island probably has been strongly influenced by its proximity to Bird Island, and by its greater size and area of upland habitat.

118. Plant propagules have reached the six islands with the aid of wind, by floating, by becoming attached to birds, or through introduction by man. Time and the frequency of opportunities for introduction combined with the occurrence of suitable habitat have largely governed past changes in plant species diversity on the islands.

119. Plant communities on Bird and Sunken Islands will probably change less in the next 5 years than communities on the other islands. Fish Hook, Gull, and Pelican Point Islands will likely be removed by erosion within the next 30 years. Pine Island will undergo severe erosion, but will probably develop some communities similar to those presently on Sunken Island. For example, the natal grass will eventually give way to communities dominated by shrubs such as silverling, lantana, marsh elder, and Brazilian pepper. These species will probably modify the habitat to the extent that cabbage palm will eventually become the dominant canopy tree species, as is presently occurring on Sunken Island.

120. Continuation of major seral modifications following development of cabbage palm is uncertain. If seeds of some of the mainland oak species such as live oak and water oak become available, there is a strong possibility an oak canopy would develop in the most upland situations. For all practical purposes, erosion and other disturbance factors would probably prohibit such a long-term transition.

121. Analysis of existing animal populations.

a. Birds. The Hillsborough Bay islands are intensively utilized for resting, feeding, and nesting by shorebirds, wading birds, and waterfowl. Avian populations on the islands were investigated from January through October 1974 by Dunstan and Lewis (1974). These authors found 81 species to be present, 26 of which were nesting residents. The nesting population in 1974 was comprised of approximately 31,254 individuals. Other data from Dunstan and Lewis (1974) are summarized in the following tables and descriptions. Resident status and distribution by island for each of the 81 observed species are noted in Appendix B.

(1) Bird Island. Ranking fourth in areal extent and located 0.21 mile from the mainland, Bird Island is inhabited by the greatest diversity of avifauna and supports the greatest nesting density recorded for the six Hillsborough Bay islands (Table 45). The high nesting density is attributable to the presence of a multispecies wading bird colony that is dominated by cattle egrets (*Bubulcus ibis*) (Table 46).

Table 45

Summary of Bird Census Data for the Hillsborough Bay Islands[a]

Parameter	Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island
Distance from mainland, miles	0.21	0.78	0.12	0.26	0.90	1.92
Island size, acres	11.5	24.8	11.7	3.0	5.7	16.7
Percent unvegetated	21	25	39	40	47	14
Percent mangroves	43	10	7	3	21	1
Percent upland habitats	36	65	54	57	32	85
Number of year-round residents	37	26	23	15	18	15
Number of winter visitants	32	22	20	16	17	12
Number of summer residents	2	1	3	1	1	2
Number of spring-fall transients	4	3	4	1	2	1
Total number of bird species observed	75	52	50	33	38	30
Nesting census dates:						
Direct-count census	4 July 1974	--	29-30 June 1974	28-30 June 1974	13 June 1974	28-30 June 1974
Strip census	4 July 1974	15 July 1974 2 Oct 1974	--	--	13 June 1974	--
Flight path census	Periodic Mar-Aug 1974	--	--	--	--	--
Number of colonial nesting species	13	9	0	1	2	0
Number of non-colonial nesting species	7	5	6	3	2	2
Number of ground-nesting species	1	3	4	2	2	2
Number of arboreal-nesting species	19	11	2	2	2	0
Total number of nesting species	20	14	6	4	4	2
Percent colonial nesting	99	92	0	40	99	0
Percent non-colonial nesting	1	8	100	60	1	100
Percent ground nesting	0.01	0.5	60	45	99	10
Percent arboreal nesting	99.99	99.5	40	55	1	90
Total number of nesting individuals[b]	20,002	9,050	54	40	2,088	20
Dominant nesting species	Cattle egret	White ibis	Red-winged blackbird	Red-winged blackbird	Laughing gull	Red-winged blackbird
Endangered species nesting	Brown pelican	--	--	--	--	--

[a]Based on Dunstan and Lewis (1974)

[b]Dunstan and Lewis may have overestimated nesting densities on islands where strip censuses were employed; this seems to be especially true for noncolonial nesting species, such as ground doves, red-winged blackbirds, and rufous-sided towhees (see Table 46)

Table 46

Avian Nesting Densities by Species on the Hillsborough Bay Islands[a]

Species[b]	Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island	Totals
Brown pelican (c, a)	700	--	--	--	--	--	700
Double-crested cormorant (c, a)	294	--	--	--	--	--	294
Great egret (c, a)	244	--	--	--	--	--	244
Snowy egret (c, a)	738	--	--	--	--	--	738
Cattle egret (c, a)	15,888	--	--	--	--	--	15,888
Great blue heron (c, a)	184	--	--	--	--	--	184
Reddish egret (c, a)	6	--	--	--	--	--	6
Louisiana heron (c, a)	738	108	--	--	--	--	846
Little blue heron (c, a)	554	76	--	--	--	--	630
Green heron (c, a)	2	--	--	--	--	--	2
Yellow-crowned night heron (c, a)	130	784	--	--	--	--	914
Black-crowned night heron (c, a)	18	584	--	--	--	--	602
Glossy ibis (c, a)	370	56	--	--	--	--	426
White ibis (c, a)	--	6,752	--	--	--	--	6,752
American oystercatcher (nc, g)	--	2	6	2	--	--	10
Wilson's plover (nc, g)	--	--	12	--	--	--	12
Willet (nc, g)	2	6	12	--	--	2	22
Laughing gull (c, g)	--	36	--	16	2,038	--	2,090
Caspian tern (c, g)	--	--	--	--	32	--	32
Ground dove (nc, a)	28	92	2	--	2	--	124
Common nighthawk (nc, g)	--	--	4	--	--	--	4
Fish crow (nc, a)	2	4	--	2	--	--	8
Mockingbird (nc, a)	2	2	--	--	--	--	4
Prairie warbler (nc, a)	ND[c]	--	--	--	--	--	--
Red-winged blackbird (nc, a)	66	354	18	20	16	18	492
Rufous-sided towhee (nc, a)	36	194	--	--	--	--	230
Totals	20,002	9,050	54	40	2,088	20	31,254

[a]From Dunstan and Lewis (1974)

[b]c=colonial nesting species; nc=non-colonial nesting species; a=nests are commonly placed in an arboreal situation; g=nests are usually placed on the ground

[c]The prairie warbler (Dendroica discolor) is known to be a breeding resident on Bird Island but had completed nesting prior to the 1974 nesting census

Ninety percent of all nests on Bird Island in 1974 were located in the mangrove community. The nesting population in 1974 included 350 pairs of brown pelicans (Pelecanus occidentalis) and 3 pairs of reddish egrets (Dichromanassa rufescens). Brown pelicans are classified endangered by the U. S. Department of the Interior (1974) while reddish egrets have been given a peripheral status (U. S. Department of the Interior 1973b). Brown pelicans have suffered serious population declines in recent years as a result of widespread reproductive failures. These failures have been caused by the ingestion of pesticides with their food (fish), which renders thin eggshells that are easily cracked during incubation (U. S. Department of the Interior 1973b).

Although the nesting population on Bird Island in 1975 was not censused for this report, Dunstan (Personal communication, July 1975, warden/biologist, National Audubon Society, Ruskin, Florida) stated that 15 to 20 pairs of roseate spoonbills (Ajaia ajaja) had successfully nested -- this is the first time in the last 63 years that this species has successfully nested in the Tampa Bay area. During the non-breeding season, the cabbage palm community on Bird Island is utilized for communal roosting by 200 to 300 fish crows (Corvus ossifragus).

(2) Sunken Island. The largest of the six Hillsborough Bay islands is Sunken Island, located 0.78 mile from the mainland. The island ranked second in avian diversity and nesting density in 1974. Like Bird Island, Sunken Island supports a multispecies wading-bird nesting colony. White ibises (Eudocimus albus) were the dominant nesting species in 1974 with black-crowned (Nycticorax nycticorax) and yellow-crowned night herons (Nyctanassa violacea) also being very abundant. Most wading-bird nests were located in upland shrub and arborescent vegetation (Table 47).

The 1974 nesting population on Sunken Island also included a remnant laughing gull (Larus atricilla) colony (18 pairs). All laughing gull nests were located in the paspalum community.

Table 47

Avian Nestings on the Hillsborough Bay Islands by Species and Plant Association[a]

Species	Plant Association[b]													
	P	P-S	ME	S	L-CP	BP-CP	BP	CP	C-D	B-R	N	B-L	M	U
Brown pelican	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Double-crested cormorant	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Great egret	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Snowy egret	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Cattle egret	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Great blue heron	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Reddish egret	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Louisiana heron	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Little blue heron	-	-	-	-	-	X	-	X	-	-	-	-	-	-
Green heron	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Yellow-crowned night heron	-	-	-	X	X	X	X	-	-	-	-	-	X	-
Black-crowned night heron	-	-	-	X	X	X	X	-	-	-	-	-	X	-
Glossy ibis	-	-	-	-	-	-	X	-	-	-	-	-	X	-
White ibis	-	-	-	-	X	X	X	-	-	-	-	-	-	-
American oystercatcher	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilson's plover	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Willet	X	X	-	-	-	-	-	-	X	-	-	-	-	-
Laughing gull	X	-	-	X	-	-	-	-	-	-	-	-	X	-
Caspian tern	X	-	-	-	-	-	-	-	-	-	-	-	-	X
Ground dove	-	X	-	X	-	-	-	X	X	X	-	X	-	-
Common nighthawk	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Fish crow	X	-	-	X	-	-	-	X	-	-	-	-	-	-
Mockingbird	-	-	-	X	X	-	-	-	-	-	-	X	-	-
Prairie warbler	-	-	-	-	-	-	X	-	-	-	X	X	-	-
Red-winged blackbird	X	X	-	X	X	X	-	X	-	-	-	X	X	-
Rufous-sided towhee	-	-	-	X	X	-	-	X	-	X	-	X	X	-
	7	4	0	8	6	5	5	11	2	2	1	5	15	1

[a]Based on Dunstan and Lewis (1974)

[b]P=paspalum; P-S=paspalum-silverling; ME=marsh elder; S=silverling; L-CP=lantana-cabbage palm; BP-CP=Brazilian pepper-cabbage palm; BP=Brazilian pepper; CP=cabbage palm; C-D=croton-dayflower; B-R=beggartick-ragweed; N=natal grass; B-L=beggartick-lantana; M=mangrove; U=unvegetated

Non-colonial species which nested on Sunken Island in 1974 were the American oystercatcher (Haematopus palliatus), willet (Catoptrophorus semipalmatus), ground dove, fish crow, mockingbird (Mimus polyglottus), red-winged blackbird, and rufous-sided towhee.

(3) Fish Hook Island. Fish Hook Island is slightly larger than Bird Island and is located 0.12 mile from the mainland. Avian utilization is primarily limited to the resting and feeding activities of water birds; most activity occurs in the unvegetated sectors along the island periphery. Six species, none of which are colonial, nested on the island in 1974. The red-winged blackbird was the dominant nesting species.

(4) Gull Island. Gull Island is the smallest of the six Hillsborough Bay islands and is located 0.26 mile from the mainland. Nearly half of the island is unvegetated. A small remnant nesting colony (8 pairs) of laughing gulls was present in the paspalum and silverling communities in 1974 (Figure 17). Three non-colonial species also nested: willet, fish crow, and red-winged blackbird.

(5) Pelican Point Island. Pelican Point Island, the second smallest island, is located 0.90 mile from the mainland. Similar to Gull Island, nearly half of Pelican Point Island is unvegetated.

Despite its small size, Pelican Point Island had a high breeding bird density in 1974. The high density was due to the presence of a large laughing gull nesting colony (1019 pairs) which was located primarily in the paspalum community. The island also supported 16 Caspian tern (Hydroprogne caspia) nesting pairs, representing the largest caspian tern nesting colony ever reported for Florida (Dunstan et al. In Press). Caspian tern nests were located in the unvegetated and paspalum habitats.

Pelican Point Island is topographically low and subject to frequent storm wave overwash. One such overwash occurred in late June 1974 causing severe mortalities to laughing gull and caspian tern nestlings and eggs. The bird census line for Pelican Point Island is shown in Figure 18.

(6) Pine Island. Pine Island, the most distant from the mainland (1.92 miles), is the second largest of the six Hillsborough Bay islands. Pine Island ranked last in avian diversity and nesting


SAMPLING LOCATION
BIOTIC COMMUNITIES
GULL ISLAND
HILLSBOROUGH BAY, FLORIDA
P Paspalum
S Silverling
0 50 100 150
FEET
Beach
Beach
Beach
P
1 Soil Sample Site

Figure 17

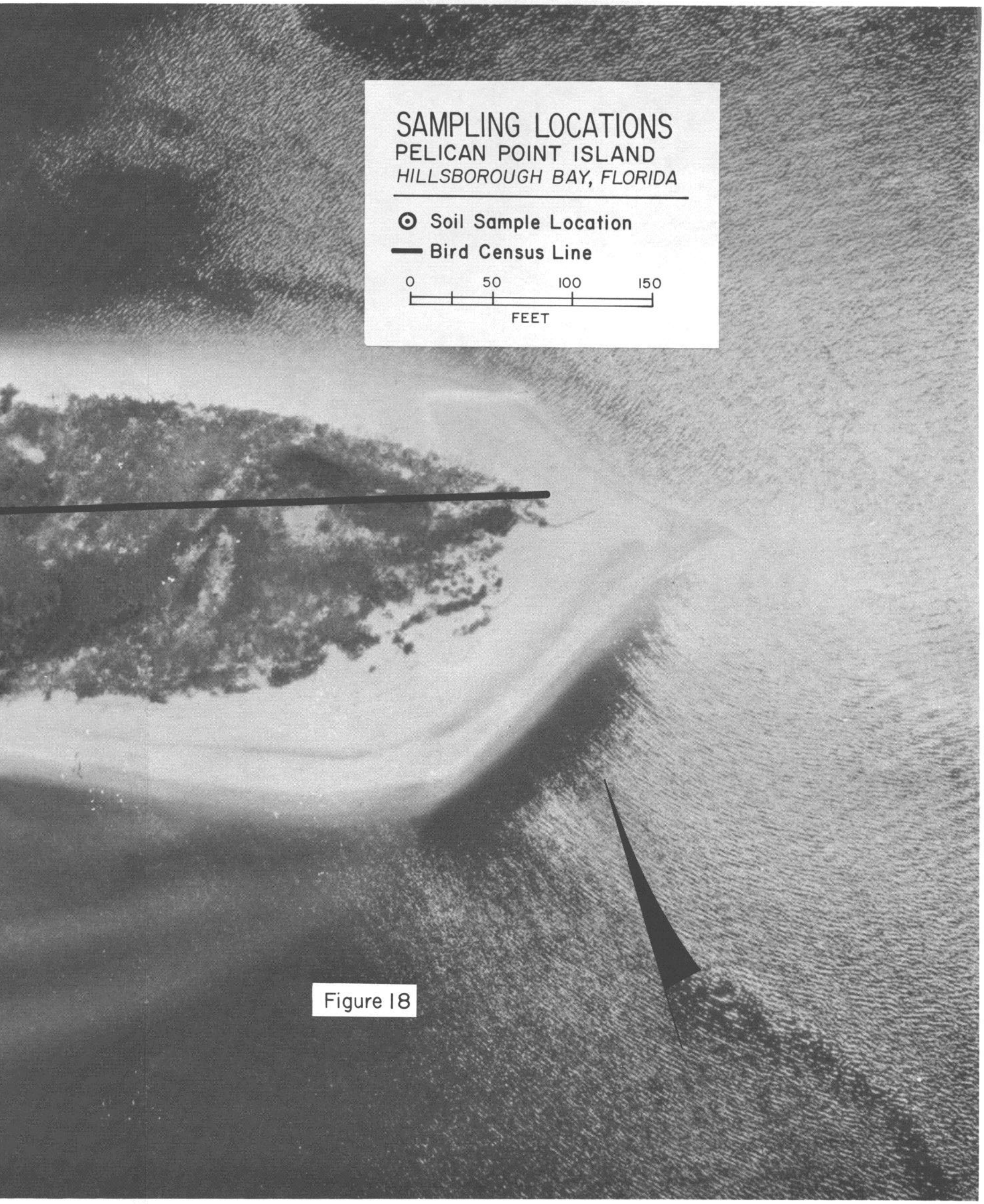
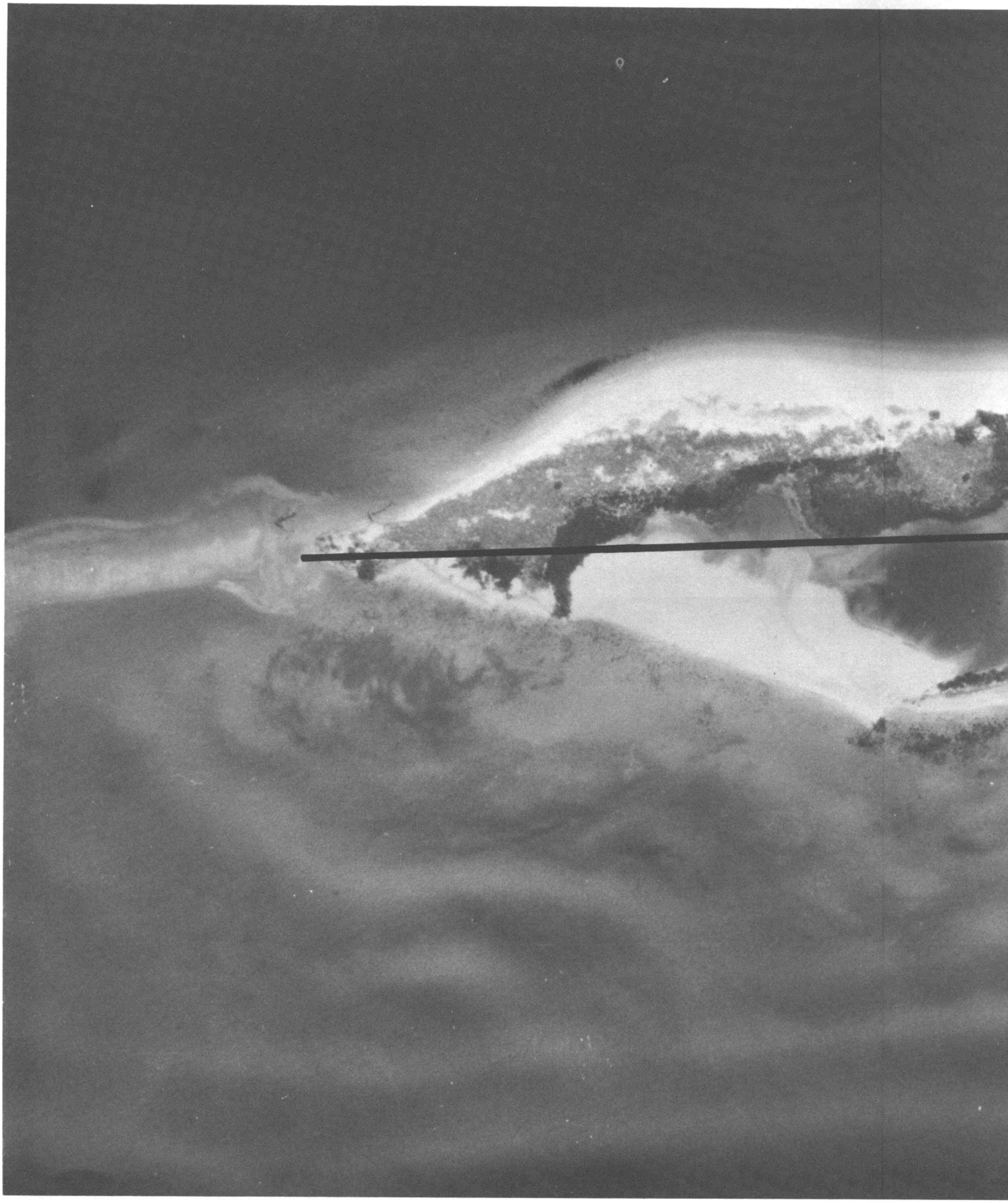

SAMPLING LOCATIONS
PELICAN POINT ISLAND
HILLSBOROUGH BAY, FLORIDA
Soil Sample Location
Bird Census Line
0 50 100 150
FEET

Figure 18


HILLSBOROUGH BAY
1
HILLSBOROUGH BAY



density in 1974. Only two nesting species, neither of which are colonial, were present in 1974. The red-winged blackbird was the most abundant nesting species.

Like Fish Hook and a few of the other islands, Pine Island is primarily utilized for water bird resting and feeding activities. Most of these activities take place along the island's shoreline.

Table 47 summarizes habitat usage for nesting by bird species of the six islands investigated. Mangrove supports the greatest diversity, while unvegetated and sparsely vegetated communities such as croton-dayflower and natal grass support very low diversities. These sparsely vegetated areas, however, are of decided importance to certain nesting species (Caspian tern, ground dove).

b. Mammals. It is questionable whether any of the six Hillsborough Bay islands support established populations of mammals. A house mouse (*Mus musculus*) was the only small mammal known to be present during the field surveys and was captured on 3 October 1974 in a live trap set on Bird Island.* Old, dessicated rabbit (*Sylvilagus* sp.) scats were observed on Bird Island and similar signs of raccoons (*Procyon lotor*) were recorded on Sunken Island during the fall survey. However, neither species was actually observed by CZRC personnel nor have they been sighted in the past by Audubon wardens. Rabbits and raccoons are excellent swimmers and it may be that both are occasional visitors to these nearshore islands.

c. Reptiles and Amphibians. Populations of the green anole (*Anolis carolinensis carolinensis*) existed in all shrub and arborescent communities on Bird and Sunken Islands during all field surveys. Brown anoles (*Anolis sagrei*) were abundant in the Brazilian pepper, Brazilian pepper-cabbage palm, and lantana-cabbage palm communities on Sunken Island in February 1975. Bird Island, which is connected to Sunken Island at low tide, may have also supported a brown anole population

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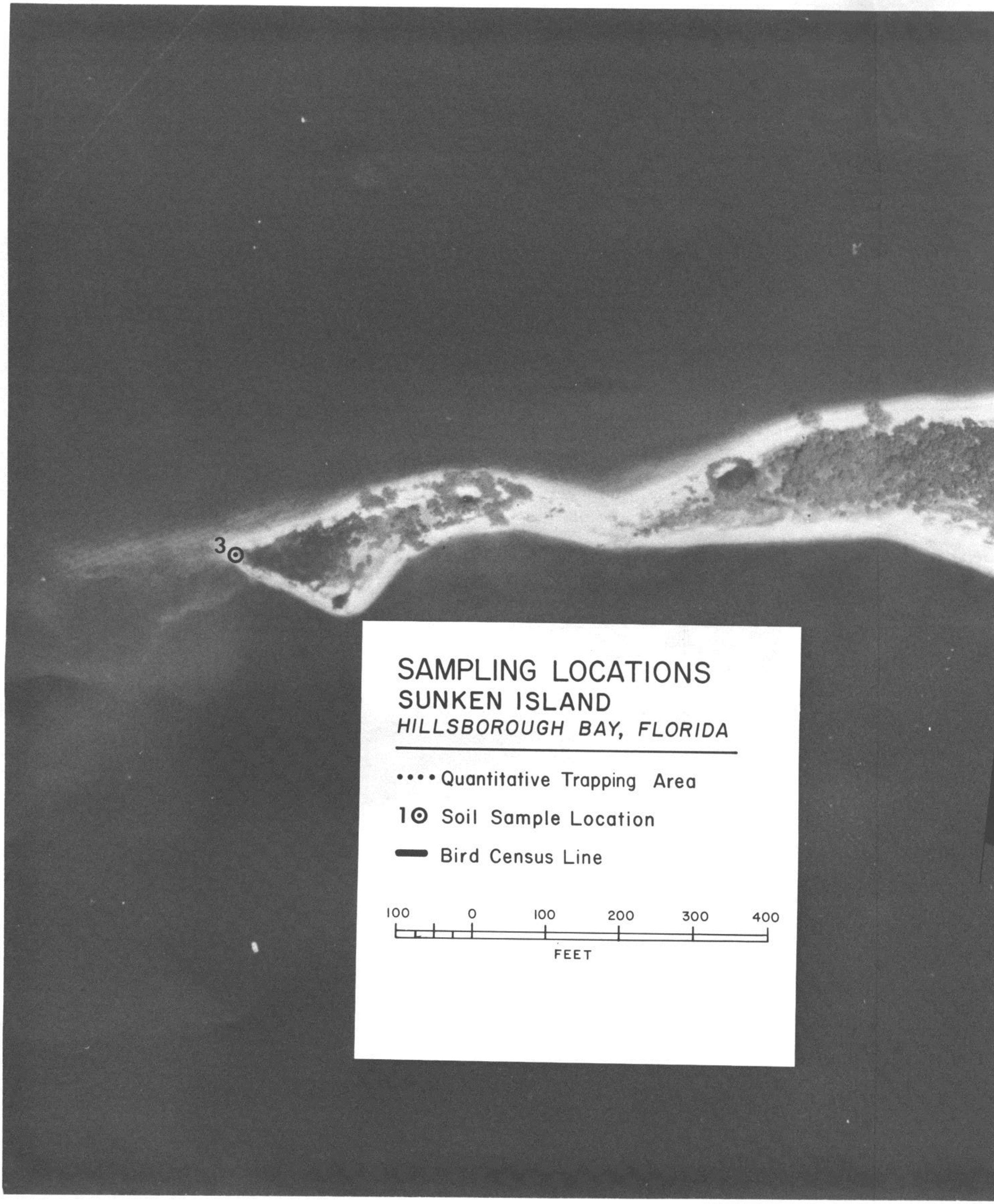
*During the fall survey, small mammal live traps were placed in a grid system on Bird and Sunken Islands and selected areas of Fish Hook and Pine Islands (Figures 19, 20, 21 and 22). Total number of trap nights spent on each island was: Bird Island (125), Sunken Island (120), Fish Hook Island (15), and Pine Island (45).


SAMPLING LOCATIONS
BIRD ISLAND
HILLSBOROUGH BAY, FLORIDA
Quantitative Trapping Area
1 Soil Sample Locations
Bird Census Line
0
100
200
300
FEET
HILLSBOROUGH BAY
SUNKEN ISLAND
HILLSBOROUGH BAY
1
2

Figure 19


3
SAMPLING LOCATIONS
SUNKEN ISLAND
HILLSBOROUGH BAY, FLORIDA
Quantitative Trapping Area
1 Soil Sample Location
Bird Census Line
100 0 100 200 300 400
FEET


H I L L S B O R O U G H B A Y
2
H I L L S B O R O U G H B A Y

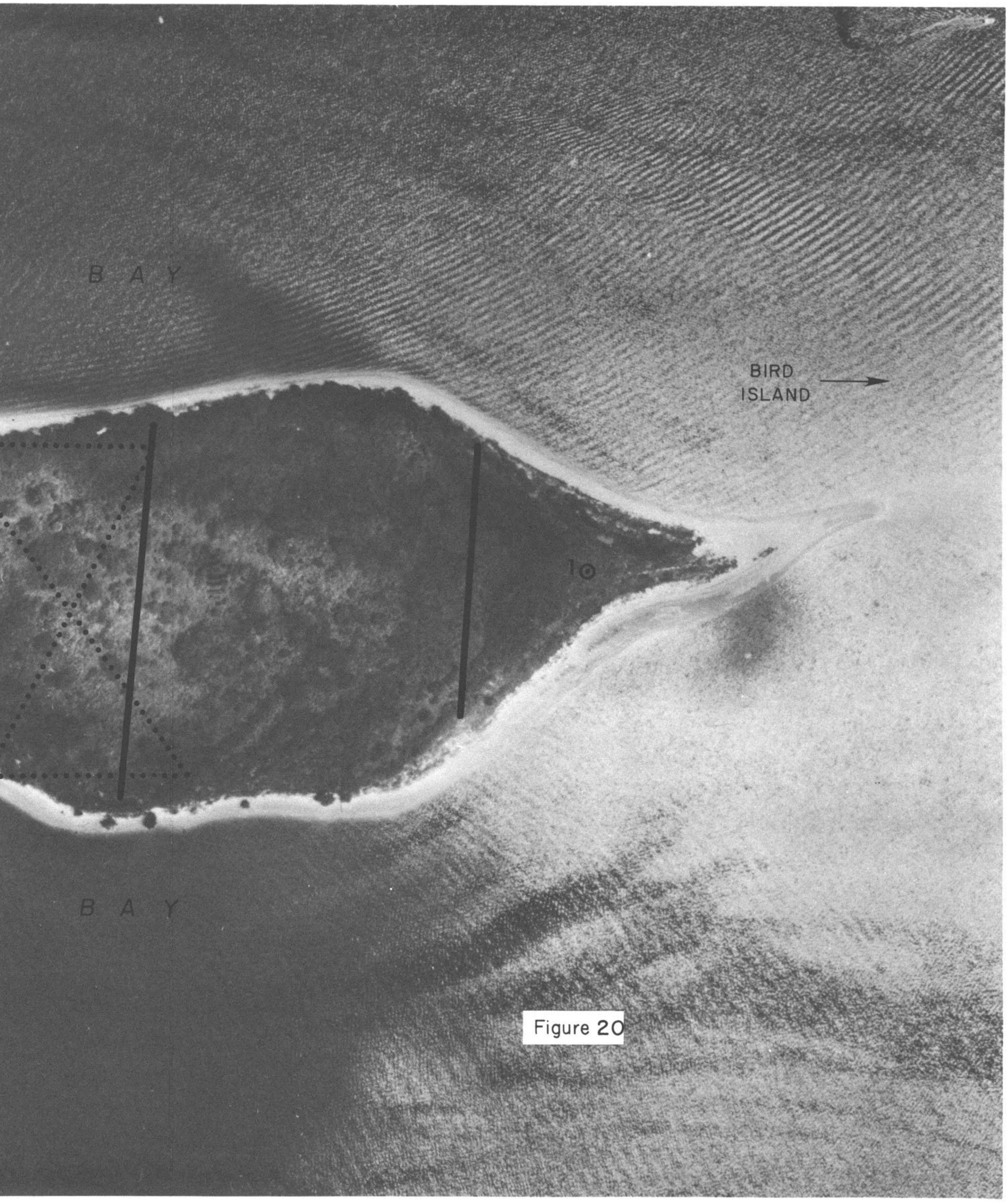
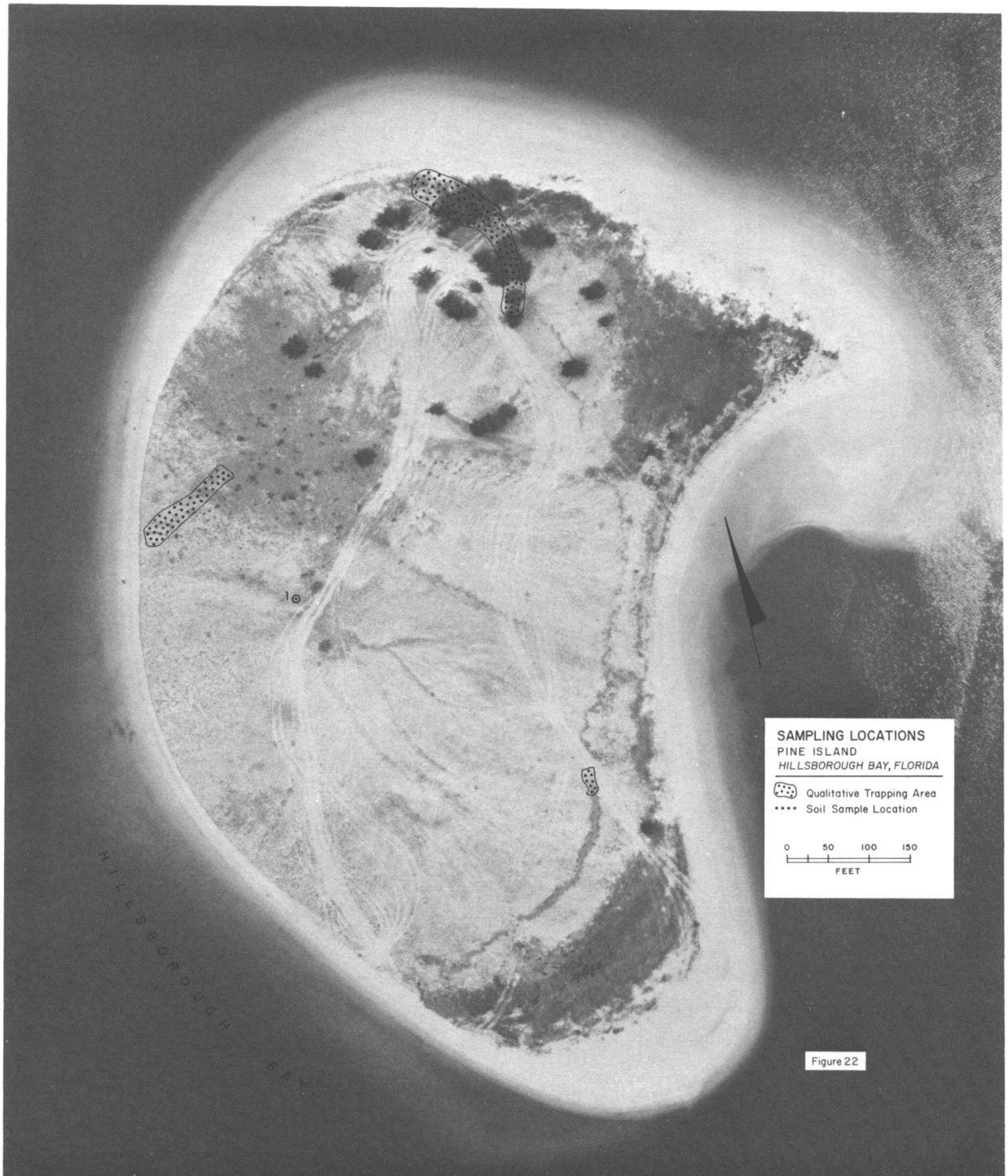


Figure 20


SAMPLING LOCATIONS
FISH HOOK ISLAND
HILLSBOROUGH BAY, FLORIDA
Qualitative Trapping Area
1 Soil Sample Location
0
100
200
300
FEET
HILLSBOROUGH BAY
HILLSBOROUGH BAY
1
2
Figure 21


SAMPLING LOCATIONS
PINE ISLAND
HILLSBOROUGH BAY, FLORIDA
Qualitative Trapping Area
Soil Sample Location
0 50 100 150
FEET
HILLSBOROUGH BAY
1
Figure 22

during the period but this was not confirmed. A skeleton of the diamond-back terrapin (Malaclemys terrapin) was found on Bird Island in July 1974 and Dunstan (Personal communication, July 1975, warden/biologist, National Audubon Society, Ruskin, Florida) reported that several nested in the cabbage palm community in the spring of 1975. An articulated eastern garter snake (Thamnophis sirtalis sirtalis) skeleton was found on Sunken Island during the fall survey. Whether this snake was killed on the island or was dropped by a bird flying overhead is unknown. No amphibians were found on any of the six Hillsborough Bay islands.

d. Immigration and colonization. Rates of faunal immigration and colonization are influenced by water barrier widths and mainland population characteristics. In a situation where several islands are strung out in a series, immigration and colonization rates tend to progressively decrease with increasing distance from the mainland (MacArthur and Wilson 1967, Simberloff and Wilson 1970).

Many animals may immigrate to an island but fail to establish populations because required habitats are unavailable or reproductive functions cannot be fulfilled. Furthermore, failures could be induced by predation, disease, food shortages, or inclement weather. Once a species population becomes established, it may also be subject to extinction by one of the above factors as well as the effects of intraspecific behavior (Chitty 1960, Christian and Davis 1964).

The six Hillsborough Bay islands are topographically low and portions or all of each island are periodically subject to storm wave overwash. Overwashings are certainly a major limiting factor affecting the establishment of ground-dwelling fauna on these islands. The establishment of small mammals, reptiles, and amphibians is probably also curtailed by the abundance of wading birds, crows, and occasional presence of raptors which may find them an attractive food source.

At Hillsborough Bay, habitat availability appears to be the most critical factor determining the number of animals that an island can support. The islands that were dominated by shrub and arborescent vegetation supported greater densities and diversities of fauna than islands that were dominated by grasses and forbs. Presumably, this is because the shrub and arborescent vegetation provides greater spatial area for nesting, roosting, and feeding activities.

Island size appears to be only of secondary importance in determining faunal densities and diversities. For example, Bird Island, which ranks fourth in areal extent, supported the greatest faunal diversity and density in 1974, while Pine Island, which ranks second in total size, supported the fewest. Beer et al. (1954), Elton (1958), Grant (1966), and others have indicated that islands that support greater faunal densities and diversities are more stable and less dependent on periodic restocking than islands inhabited by relatively few animals.

122. Past patterns of animal succession. Past patterns of animal succession have been described by Dunstan and Lewis (1974) for five of the six Hillsborough Bay islands. The following summarizes their findings:

123. Bird Island, first referred to as Alafia Spoil Banks, was first used by colonial nesting birds in 1934. Numbers of species noted at that time were: 1000 pairs of laughing gulls, 50 pairs of least terns (*Sterna albifrons*), and 100 pairs of black skimmers (*Rhynchops niger*). During 1935 and 1936, 1500 and 2000 pairs, respectively, of laughing gulls used the island. Grasses dominated the island at this time, and sandspurs were a particular hazard to young chicks leaving their nests. In 1939, overwash as a result of a three-day storm killed chicks and eggs of 2000 pairs of laughing gulls and black skimmers. Later in the same season, 250 pairs of least terns built nests and successfully raised young. Nesting by laughing gulls and black skimmers continued seasonally through 1942, when a pair of American oystercatchers were noted nesting. By 1960, herons and ibises were nesting on the island. By 1967, an estimated 6000 pairs of eight species of herons and two species of ibises were nesting. In 1970, 300 pairs of brown pelicans (*Pelecanus occidentalis*) and 20 pairs of

double-crested cormorants (*Phalacrocorax auritus*) were nesting on the island. White ibis nested in rookeries of as many as 3000 pairs seasonally between 1967 and 1970 (15 pairs in 1970).

124. Sunken Island was used by laughing gulls in the middle 1960's. By 1967, 1200 pairs were noted, but nests of 300 of these were destroyed by high tides. In 1970, 2400 pairs of white ibises, 100 pairs of yellow-crowned night herons, and 22 pairs of Louisiana herons (*Hydranassa tricolor*) nested on the island for the first time. Dunstan observed approximately 75 nests of laughing gulls in 1973. Dunstan also observed in the same year glossy ibis (*Plegadis falcinellus*), white ibis, Louisiana heron, yellow-crowned night heron, and black-crowned night heron.

125. No historical evidence is available for Fish Hook Island. Gull Island has been used by laughing gulls, but with development of a shrub community nesting by this species has diminished.

126. Pelican Island has been used extensively by laughing gulls, but no colonial nesting species have been noted on Pine Island.

127. Future patterns of animal succession. Existing upland communities on the Hillsborough Bay islands could probably support additional faunal species. Grasslands, for example, provide sufficient habitat for oldfield mice (*Peromyscus polionotus*), hispid cotton rats (*Sigmodon hispidus*), marsh rice rats (*Oryzomys palustris*), least shrews (*Cryptotis parva*), six-lined racerunners (*Cnemidophorous sexlineatus*), and island glass lizards (*Ophisaurus compressus*). Similarly, shrub and forest communities provide ample habitat for eastern woodrats (*Neotoma floridana*), cotton mice (*Peromyscus gossypinus*), black rats (*Rattus rattus*), Virginia opossums (*Didelphis marsupialis*), ground skinks (*Leiolopisma laterale*), southeastern five-lined skinks (*Eumeces inexpectatus*), yellow rat snakes (*Elaphe obsoleta quadrivittata*), black racers (*Coluber c. constrictor*), rough green snakes (*Opheodrys aestivus*), eastern narrow-mouthed toads (*Gastrophryne c. carolinensis*) green treefrogs (*Hyla cinerea*), squirrel treefrogs (*Hyla squirella*), and greenhouse frogs (*Eleutherodactylus p. planirostris*). Assuming

that the islands do not erode away in the near future, it is possible that some of these species could eventually become established in the appropriate communities. Nearly all of the above species are quite common on the adjacent mainland.

128. Upland vegetational succession, if allowed to proceed, will probably result in the development of a maritime-like forest on some topographically high areas and shrub vegetation over much of the remaining areas. Nesting habitats for most existing non-colonial avian species should be present in the future, and populations of these birds should be maintained. Vegetational succession, however, should cause a sharp reduction and possible elimination of nesting habitat for colonial ground-nesting bird species such as the laughing gull and Caspian tern, and these will likely emigrate. Whether existing wading-birds will maintain nesting populations in the future is uncertain, as they show no easily identified nesting habitat preference. For example, nesting colonies have reportedly been established in maritime forests and shrublands on islands in North Carolina (Funderburg 1960, Adams 1963, Soots and Parnell 1975) and in herbaceous vegetation on islands in Texas (Simersky 1970 and McMurray 1971). In mainland areas, wading birds frequently nest in isolated swamp forest openings. In addition to showing no specific nesting habitat preference, wading birds may often nest in a certain area one year and be completely gone or be represented by only a remnant colony the next year (Dunstan and Lewis 1974). Thus, about all that can be said at the present is that the Hillsborough Bay islands can potentially provide nesting habitat for wading birds in the future.

Potential Resources of Regional Upland Disposal Areas

129. Potential resources of disposal areas of the type in Hillsborough Bay are limited to reuse as disposal areas, or as is already the case, shore and wading bird nesting colonies. A combination of these two uses is entirely possible in areas used by gulls and terns for nesting. The isolation afforded by the island habitats is particularly beneficial to such bird species. Gulls and terns nest in

successionally young areas such as unvegetated and sparsely vegetated areas. Maintenance of such stages requires irregular overwash or regular placement of fresh dredged material of a coarse texture.

130. Enhancement of more advanced seral stages for endangered species such as osprey could be possible by establishment of nesting platforms.

Regional Sere for Upland Disposal Areas

131. Within the Tampa Bay area, a regional sere is not strictly definable in terms of species content. A general trend from pioneer herbaceous species to intermediate stages represented by herb-shrub and shrub-tree associations is characteristic. A climax community, if one were developed, would probably be dominated by cabbage palm and various oaks. Lower communities subject to regular flooding will eventually be vegetated by mangrove in sufficiently protected areas. In unprotected areas, such as overwash zones, herbaceous cover may persist.

Part VI: Whiskey Bay Pilot Channel, Louisiana

Description of Regional Setting

132. The Whiskey Bay Pilot Channel (WBPC) study site is located between river miles 58.04 and 54.54 in Iberville and St. Martin Parishes, Louisiana, on a 3.5-mile segment of the disposal area constructed during dredging of the WBPC. The site lies north of Interstate 10 (I-10) (Figure 23). State Route (SR) 975 follows the crest of the dredged material and provides access along the length of the site from I-10 to Krotz Springs approximately 10 miles to the northwest of the site.

133. The project area lies in the Mississippi Embayment of the Gulf Coastal Plain physiographic province, and more specifically in the Atchafalaya River Basin Floodway. Vegetation of the surrounding area is defined in general terms by Penfound (1952) as Southeastern swamp forest with shallow freshwater swamps dominated by complexes of willow (*Salix nigra*-*S. interior*), hackberry-elm-ash (*Celtis*-*Ulmus*-*Fraxinus*), and red maple-sweetgum-oak (*Acer*-*Liquidambar*-*Quercus*).

134. Thieret (1971) performed quantitative vegetation studies in bottomland forests in St. Martin Parish along the higher (or "second bottom") floodplains that are now largely above the level of long-term flooding. Major canopy dominants were found to be sugarberry (*Celtis laevigata*), ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and bald cypress (*Taxodium distichum*). Other canopy species included Nuttall's oak (*Quercus nuttalli*), red maple (*Acer drummondii* = *A. rubrum* of the present study), American elm (*Ulmus americana*), black willow (*Salix nigra*), and rough-leaved dogwood (*Cornus drummondii*).

135. Meteorological data taken at Baton Rouge, Louisiana, 35 miles east of the study area, show that the area has a humid subtropical climate but is subject to some influences from arctic polar air masses during the winter months. Temperature and precipitation data are based on 80 years of record (1893-1973) (U. S. Department of Commerce 1973b).

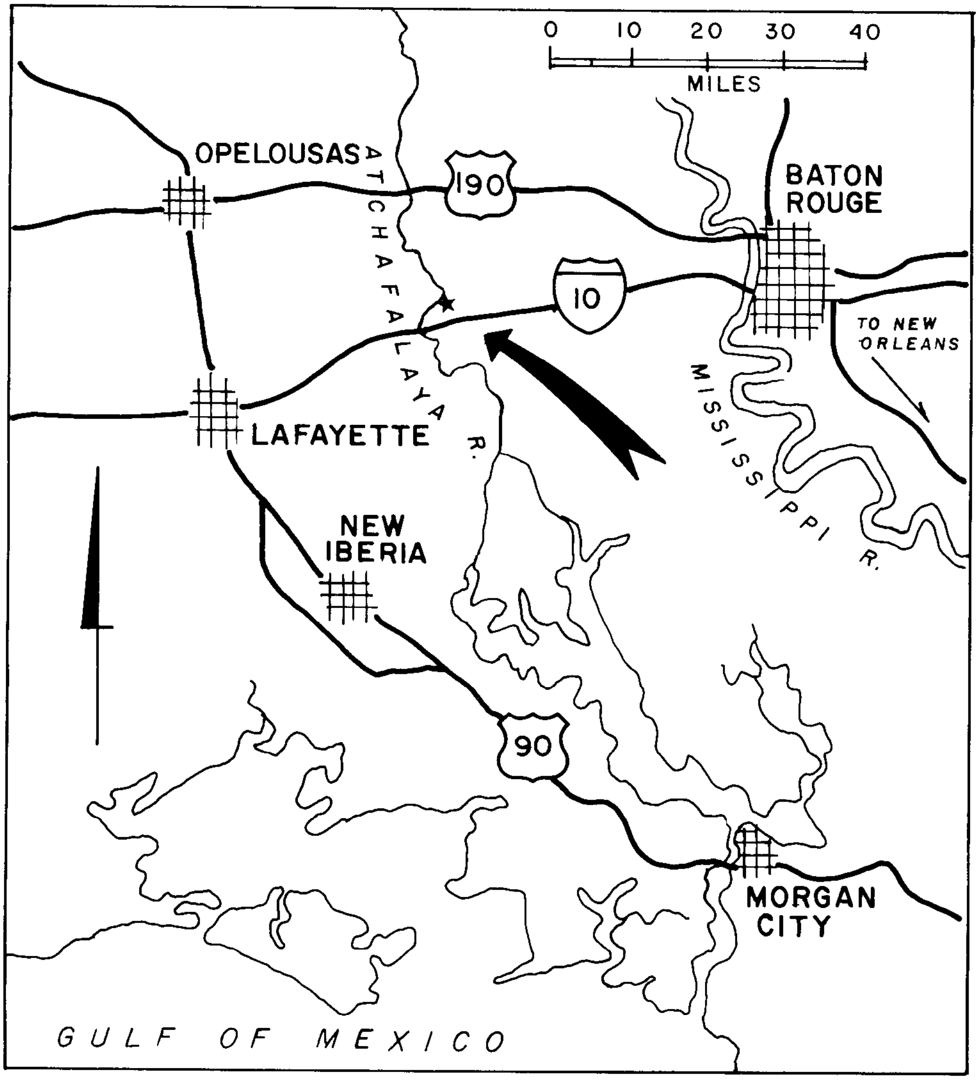


Figure 23 Vicinity Map, Whiskey Bay Pilot Channel, Louisiana

136. The mean annual temperature for the area is 67.6°F while the months of January and July have average temperatures of 52.6 and 81.9°F, respectively. The highest temperature for the area, 110°F, was recorded in August 1909, and the lowest, 2°F, was recorded in February 1899. Precipitation is seasonally distributed. Mean annual precipitation is 56.54 in. with highest monthly precipitation averaging 6.53 in. in July. The least precipitation occurs during October and averages 3.02 in. Relative humidities averaging 80% or greater occur in all months of the year. Highest humidities occur late at night and during the early morning hours.

137. For the major part of the year, prevailing winds are from the southeast; however, during the winter months the winds are from the northeast and north. Wind speeds are variable with a mean annual speed of 7.9 mph.

138. Hailstorms, tornadoes, and windstorms are geographically localized, but occur throughout the year and are most frequent during the spring months. Since 1900, the eyes of five hurricanes have passed over Baton Rouge. The area has also been affected by several other hurricanes and by several tropical storms which did not attain hurricane intensity (U. S. Department of Commerce 1973b).

139. Major flooding occurs along the Atchafalaya River every years. Outstanding floods occurred on the river in 1882, 1913, 1927, 1945, and 1950 (Sanders 1959).

140. The Atchafalaya River Basin is a portion of the lower Mississippi River delta plain formed in a basin that has undergone many periods of submersion, and, more recently, changes in the course of the Mississippi River. Surficial deposits are composed of materials brought in since the cessation of Pleistocene glaciation. Presently, the Atchafalaya River carries a substantial portion of the Mississippi drainage, and, because of the former's greater gradient, may become the main channel for Mississippi flow. In spite of radical changes in drainage patterns across the delta plain in the last 2000 years, conditions for the support of bottomland forests have probably been in existence for that amount of time.

History of the Disposal Area

141. Information gained at the New Orleans District Corps of Engineers and from historical aerial photography indicates the WBPC was under construction from 1935 to 1936. Dredged material generated by this project was placed on the northeast bank parallel to WBPC. Dredged material was deposited at intervals of about 600 ft (as evidenced by cut lines for disposal pipes) and evenly spread along a 400-ft-wide ridge. A 600-ft strip of buffer was left between the disposal area and the channel to prevent re-entry of dredged material into the channel.

142. Between 19 December 1961 and 26 September 1962, the channel was widened and, to some extent, deepened between river miles 54.54 and 60.64. Dredged material generated from this operation was deposited in nine mounds along the northeast slope of the 1935-36 material. In all cases slurry was allowed to flow freely to the northeast, and may have extended up to about 3000 ft into the existing bottomland forest. No volume estimates were available for either of the above projects.

143. Activities influencing the disposal area after its construction were related to clearing and road construction of SR 975 from September 1969 to July 1970 (Personal communication, 14 July 1975, representative of the Louisiana State Highway Department, Baton Rouge, Louisiana); oil drilling operations during various periods; hunting camp construction; and construction of I-10 at the southern end of the project area. Prior to disposal, the oldest major disturbance from human activity in the unbroken bottomland habitat was construction of a railroad along the right-of-way followed by the utility corridor at the southeastern end of the study area. I-10 presently parallels this early construction.

Ecological Analysis

Physical characteristics

144. Topography. Contour intervals on the Maringouin NW, Butte La Rose, and Cow Bayou 7.5' U. S. Geologic Survey quadrangles indicate a maximum elevation of the dredged material along WBPC of slightly

more than 50 ft msl at the tops of some mounds and a minimum elevation slightly less than 25 ft msl. The area in the Atchafalaya River Basin offers much more topographic relief than is characteristic of the surrounding swamps and bayous. Generalized flooding occurs in the lower portions of the study area, and local ponding occurs throughout the site. Surface drainage is poor in many areas, and subsurface drainage is very slow.

145. Construction of WBPC bisected Bayou des Ourses and Alabama Bayou. Dredged material dammed Bayou des Ourses, forming Lake Valerie, which is little more than a long slough east of the study area. Similarly, placement of dredged material at the mouth of Alabama Bayou has formed a much larger lake that retains the name of the original bayou.

146. Soils. Soils existing in the site prior to dredging would have belonged to the Commerce family-Sharkey family association of entisols or to the Sharkey family association of inceptisols. The former are silty soils of floodplain alluvium, and the latter are alluvial and swamp clayey soils (Brown et al. 1970). Particle-size distributions of samples collected at the site do not indicate a predominance of silts and clays (Table 48). On the contrary, most are sand or coarse silt.*

147. Microclimate. Microclimatic variations at the WBPC site are very slight due to existence of heavy plant growth (Table 49). On the average, the litter surface temperatures were only 3°C greater than soil temperatures 10 cm below the surface. Air temperatures in the southern ragweed field and the willow-cottonwood-mixed forest were comparable. Recorded relative humidity never fell below 80 percent. The humid subtropical climate of the region is well demonstrated by these data.

Biological characteristics

148. Analysis of existing vegetation. Three major biotic communities occur along upland portions of the WBPC site: southern ragweed,

*There was a considerable problem in breaking up the soil samples adequately before measurement of particle size. The data may therefore be skewed toward the coarser fraction.

Table 48

Physical Description of Soils of Whiskey Bay Pilot Channel Site

Biotic Community[b]	Sample		Particle-Size Distribution - Phi Scale[a]									
	Number	Depth, cm	-1	0	1	2	3	4	5	6	7	8-14
Willow-sycamore-mixed forest	1-1	0-5	0.0	0.0	13.3	19.1	44.4	22.6	0.3	0.1	0.0	0.2
	1-2	5-31	0.0	8.4	10.2	8.4	24.2	3.0	24.8	21.0	0.0	0.0
	1-3	31	0.0	0.0	22.9	22.4	14.8	37.7	0.6	0.1	0.1	1.4
	2-1	0-2.5	0.0	4.8	19.0	26.5	18.0	30.8	0.5	0.1	0.0	0.3
	2-2	5-31	0.0	0.5	6.7	19.6	12.9	28.3	30.4	0.1	0.0	1.5
	2-3	61	0.0	2.5	10.1	19.2	16.7	0.1	51.1	0.2	0.1	0.0
	3-1	0-43	0.0	0.5	6.6	24.9	19.3	0.5	47.9	0.1	0.0	0.2
	3-2	43-46	0.0	1.8	2.3	4.8	8.1	49.5	28.0	4.3	0.8	0.4
	3-3	46-61	0.0	0.2	0.6	1.8	4.7	22.2	68.7	1.6	0.2	0.0
	3-4	61-69	0.2	1.0	2.0	2.9	14.0	69.0	9.1	1.8	0.0	0.0
	3-5	69	0.0	0.0	0.2	0.6	36.9	41.6	15.8	3.7	1.0	0.2
Willow-cottonwood	4-1	0-25	0.0	2.2	9.8	9.9	21.1	1.7	53.9	1.4	0.0	0.0
	4-2	25-33	0.0	1.2	3.4	4.4	7.1	15.2	60.6	4.1	0.2	3.8
	4-3	33-46	2.2	2.8	5.9	8.9	8.1	13.6	21.6	25.4	8.5	3.0
	4-4	46	0.0	1.8	11.5	14.7	20.5	0.0	49.9	1.6	0.0	0.0
	5-1	0-61	0.0	8.9	18.0	11.6	14.6	8.9	36.2	1.6	0.2	0.0
	5-2	61	0.2	2.4	19.1	16.5	12.3	0.0	45.9	3.6	0.0	0.0

[a]Phi Scale corresponds to the following Wentworth sizes:

Phi Scale	Wentworth Size
-1	Granule
0	Very coarse sand
1	Coarse sand
2	Medium sand
3	Fine sand
4	Very fine sand
5	Coarse silt
6	Medium silt
7	Fine silt
8-14	Very fine silt & clay

[b]See Figure 24

Table 49

Microclimate Data for Whiskey Bay Pilot Channel Site

Date	Biotic Community[a]	Time[b]	Relative Humidity, %	Depth of Sample - Temperature, °C				
				0.5 m	Litter Surface	Below Litter	-2 cm	-10 cm
22 Jul 1974	Willow-cottonwood	N/R	89	29	29	26	26	25
		N/R	81	32	31	28	27	25
		N/R	80	33	33	30	28	26
26 Sep 1974	Willow-cottonwood	AM	91	24	25	24	23	23
		AM	90	24	24	23	23	22
		AM	90	27	27	24	23	23
8 May 1975	Field (southern ragweed)	AM	96	20	22	21	21	21
13 May 1975	Field (southern ragweed)							
	Low	AM	88	29	30	27	25	24
	High	AM	88	29	30	25	24	24
	Willow-cottonwood							
	Low	AM	87	25	25	24	22	22
	High	AM	88	26	26	25	23	21
14 May 1975	Field (southern ragweed)							
	Low	AM	97	23	23	24	24	25
	High	AM	98	22	23	23	24	24
	Willow-cottonwood							
	Low	AM	99	23	23	22	22	22
	High	AM	100	24	25	22	21	22

[a] Measurements were made at relative high and low elevations at different locations in the same community in some instances

[b] N/R indicates time of measurement was not recorded

willow-cottonwood forest, and willow-sycamore-mixed forest. These constitute a total of 584.5 acres (Table 50). A fourth community occurs within the study area as indicated on the map (Figure 24). This community, young swamp forest dominated by bald cypress and ash, was not sampled because it was not upland, and did not occur directly on dredged material. These small swamp forest sloughs may exist under the influence of water runoff from dredged material and ponding of water following flooding. The most obvious sloughs occur between SR 975 on the WBPC as seven or eight pockets within the willow-sycamore-mixed forest community along the buffer strip between the disposal area and the channel.

a. Southern ragweed. The southern ragweed (*Ambrosia bidentata*) community is predominantly an association of pioneer herbaceous species that have quickly invaded areas of secondarily disturbed soils such as old oil drilling sites, roadsides, ditches, banks, and other man-modified environments. Because the vast majority of land in the Atchafalaya Basin is forested or covered by water and aquatic vegetation, the southern ragweed association is somewhat unique. In addition, the diversity of species maintained here, as well as the abundance of small seeded legumes, sedges, composites, and other vascular plants, helps to sustain much of the bird and small mammal life found in the area.

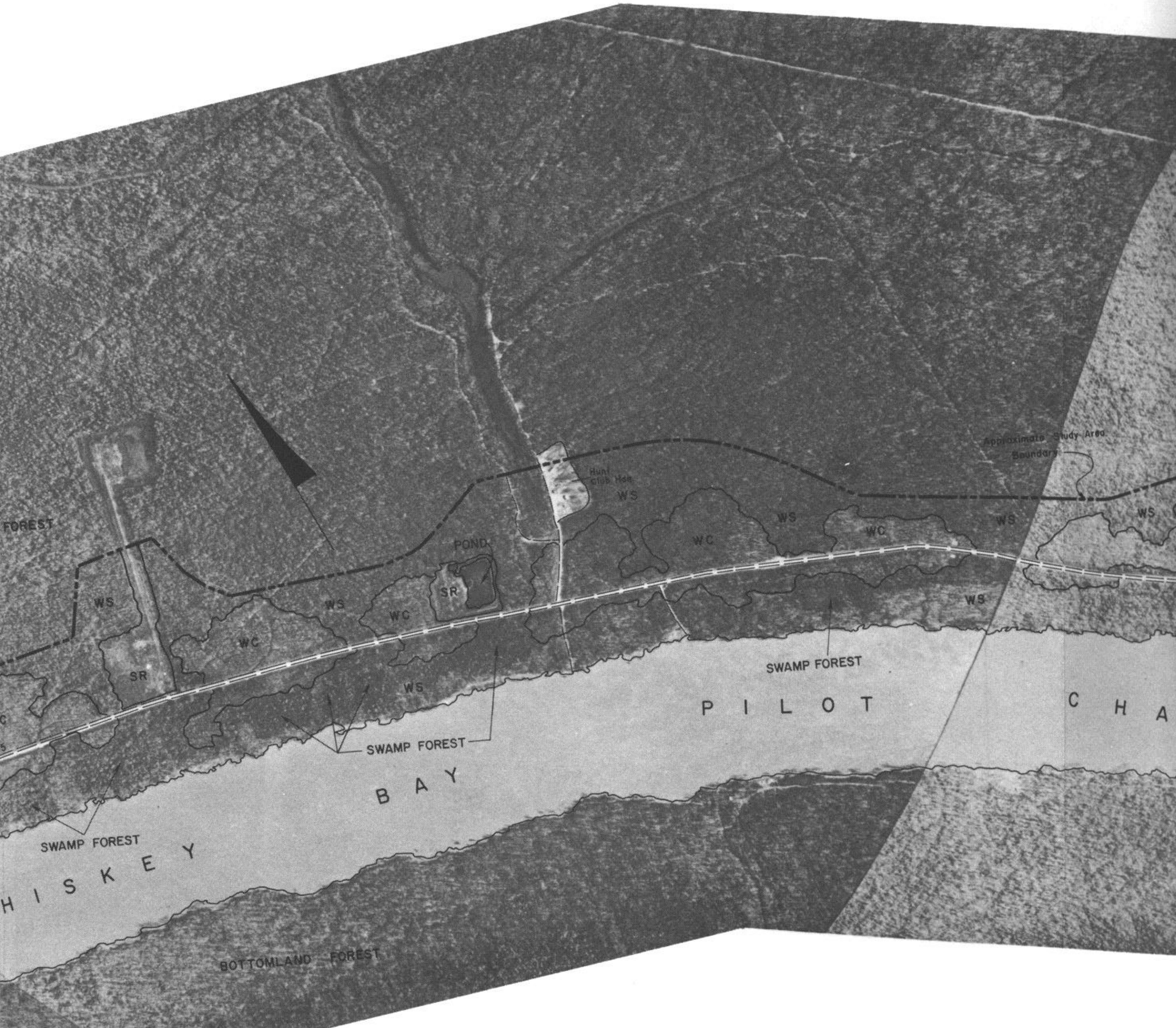
The major species of plants found in this community are typically coarse weeds (Table 51). The only evidence of community stratification is a ground cover of white clover (*Trifolium repens*), overtopped by an intensely competitive stratum of southern ragweed. The ragweed plants are often unbranched, spindly, and shallow-rooted with only a cluster of leaves near the tops of stems. This habit results from strong inter-and intra-specific competition for light and nutrients. Of lesser importance value but still a conspicuous part of the flora are other ragweeds, notably great ragweed (*Ambrosia trifida*) and common ragweed (*A. artemisiifolia*). Of the three species, great ragweed is by far the tallest at maturity. In a study

Table 50

Acreages of Biotic Communities, Whiskey Bay Pilot Channel Site

Community	Acres	Percent
Southern ragweed	24.6	4.2
Willow-cottonwood	191.4	32.8
Willow-sycamore-mixed	358.5	61.3
Road	8.3	1.4
Pond	1.7	0.3
Total	584.5	100.0

Figure 24
BIOTIC COMMUNITIES
WHISKEY BAY PILOT CHANNEL
LOUISIANA


FOREST
WS
SR
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POND
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WC
WS
Approximate Study Area Boundary
WS
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SWAMP FOREST
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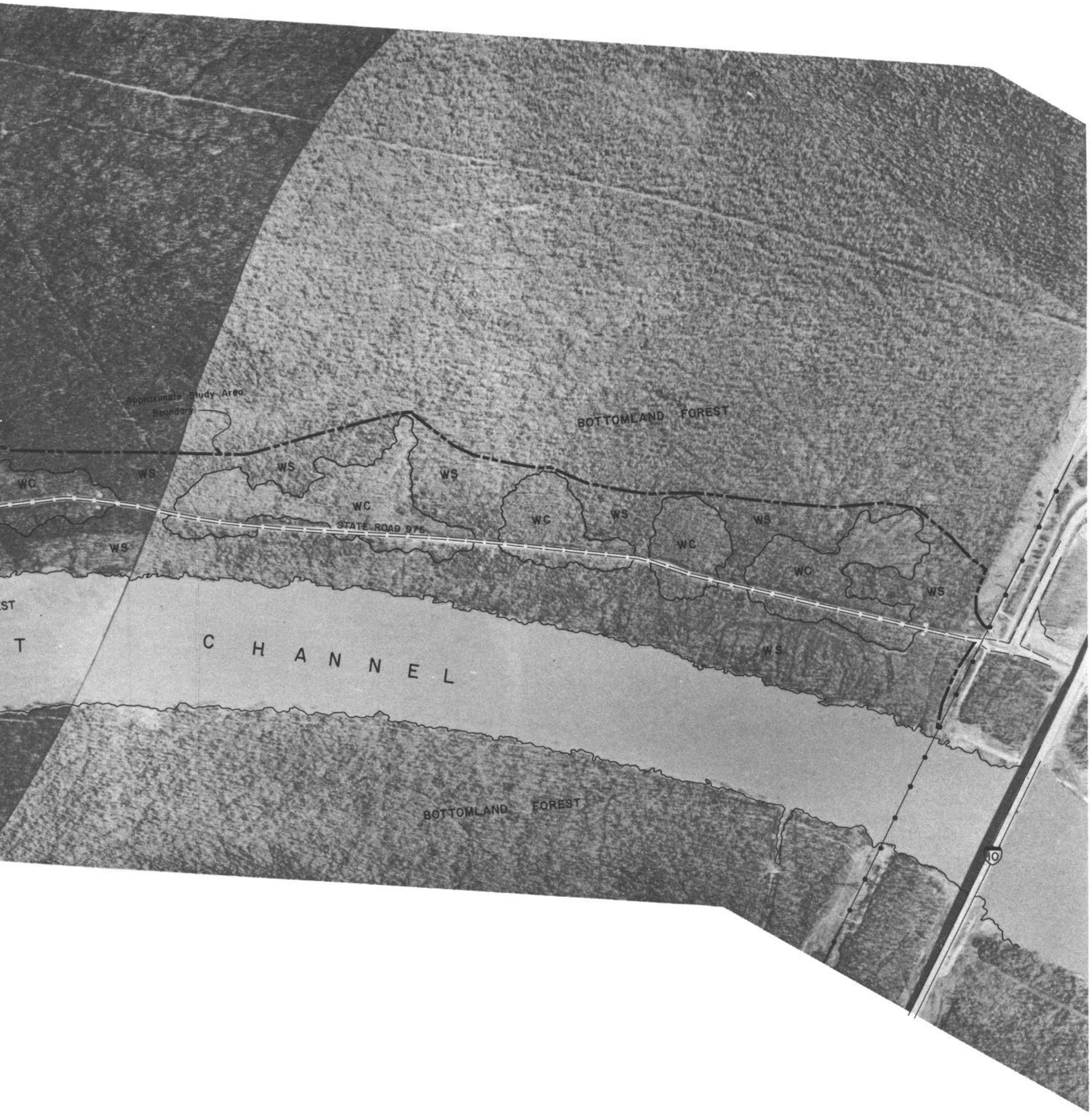
C H A
SWAMP FOREST
B A Y
SWAMP FOREST
H I S K E Y
BOTTOMLAND FOREST


Approximate Study Area Boundary
BOTTOMLAND FOREST
WC
WS
WS
WC
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WC
WS
WC
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WS
WC
WS
STATE ROAD 975
WS
WS
EST
T C H A N N E L
BOTTOMLAND FOREST
10

Table 51

Average Percent Cover and Relative Values for Herb Species in the Southern Ragweed Community of Whiskey Bay Pilot Channel Site

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Southern ragweed (*Ambrosia bidentata*)	80.00	41.3
White clover (*Trifolium repens*)	76.67	39.6
Giant ragweed (*Ambrosia artemisiifolia*)	10.00	5.2
Goldenrod (*Solidago altissima*)	6.67	3.4
Blackberry (*Rubus argutus*)	3.33	1.7
Sedge (*Carex* sp.)	3.33	1.7
Vervain (*Verbena brasiliensis*)	3.33	1.7
Poor Joe (*Diodia teres*)	2.00	1.0
Prairie mimosa (*Desmanthus illinoensis*)	1.67	0.9
Beggar lice (*Desmodium glabellum*)	1.67	0.9
Daisey fleabane (*Erigeron* sp.)	1.67	0.9
Evening primrose (*Oenothera speciosa*)	1.67	0.9
Horsemint (*Monarda punctata*)	1.67	0.9
	193.68	100.1

[a]Average cover in each 0.5-m^2 quadrat

of the ecophysiology of common ragweed, Bazzaz (1974) found that complex germination characteristics and genetic plasticity allowed common ragweed to be a very successful dominant in early seral stages of secondary succession. The species was found to have a high rate of photosynthesis in optimum light conditions and to be able to recover rapidly from periods of water stress. Many of the same characteristics may be true of other species in this genus, as they are all early seral pioneers.

Other important herbs in the southern ragweed community are goldenrod (*Solidago altissima*) and verbena (*Verbena brasiliensis*). Occasionally around woodland borders or shallow depressions grow juveniles of several semiwoody and woody species, such as blackberry (*Rubus argutus*), cottonwood (*Populus deltoides*), black willow, sandbar willow (*Salix interior*), and sycamore saplings (*Platanus occidentalis*).

The small southern ragweed community northwest of the hunting club headquarters (Figure 24) is at a somewhat more advanced successional stage, possibly due to moister soils. Sycamore and cottonwood saplings are abundant in the mesic portions of this area, but black willow saplings and cattail (*Typha latifolia*) dominate the hydric areas closer to the pond.

Though not of a size to allow delineation on the biotic community map, a roadside zone of mostly herbaceous plants dominated by ragweeds and various other herbs and grasses exists along SR 975. This strongly man-influenced segment of the study area reflects several types of disturbance arising from road grading, drainage, herbicides, and increased light availability. Nonetheless this edge community enhances the diversity of the project area and provides a perpetual corridor for early successional biota.

b. *Willow-cottonwood forest*. The willow-cottonwood community occurs on the highest dredged material mounds at elevations well above the general flood zone. Black willow and cottonwood are the characteristic species (Table 52). Box elder (*Acer negundo*), sycamore, laurel oak (*Quercus laurifolia*), and red maple are other canopy constituents.

Table 52

Absolute Density, Basal Area, Relative Values, and Importance Values for Tree Species in the Canopy and Understory of the Willow-Cottonwood Forest Community of Whiskey Bay Pilot Channel Site

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value[c]
		Canopy			
Black willow (*Salix nigra*)	314.30	5.24	50.7	47.2	97.9
Cottonwood (*Populus deltoides*)	170.42	3.76	27.5	33.9	61.4
Box elder (*Acer negundo*)	50.98	0.74	8.2	6.7	14.9
Rough-leaved dogwood (*Cornus drummondii*)	47.75	0.38	7.7	3.4	11.1
Sycamore (*Platanus occidentalis*)	12.78	0.38	2.1	3.4	5.5
Laurel oak (*Quercus laurifolia*)	8.75	0.38	1.4	3.4	4.8
Red maple (*Acer rubrum*)	10.18	0.11	1.6	1.0	2.6
Shumard oak (*Quercus shumardii*)	5.20	0.11	0.8	1.0	1.8
	620.36	11.10	100.0	100.0	200.0

[a]Stems per hectare

[b]Square meters per hectare

[c]Relative density plus relative basal area

Table 52 (concluded)

Species	Density	Basal Area	Relative Density	Relative Basal Area	Importance Value
		Understory			
Rough-leaved dogwood (*Cornus drummondii*)	6168.20	3.24	81.2	54.5	135.7
Cottonwood (*Populus deltoides*)	332.35	0.99	4.4	16.7	21.1
Box elder (*Acer negundo*)	89.12	0.63	1.2	10.6	11.8
Wax myrtle (*Myrica cerifera*)	509.30	0.25	6.7	4.2	10.9
Black willow (*Salix nigra*)	148.48	0.50	2.0	8.4	10.4
Ampelopsis cordata	254.65	0.11	3.3	1.9	5.2
Elderberry (*Sambucus canadensis*)	63.68	0.11	0.8	1.9	2.7
Red elm (*Ulmus rubra*)	28.30	0.11	0.4	1.8	2.2
	7594.08	5.94	100.0	100.0	200.0

Rough-leaved dogwood is conspicuous in the understory, forming an almost pure stand along the woodland ecotone of SR 975. Vines such as poison ivy (Rhus radicans), rattan vine (Berchemia scandens), and pepper-vine (Ampelopsis arborea) are particularly abundant, not only as ground cover but also as canopy and understory constituents because of their habit of growing into the highest forest stratum where light is more available.

An eventual shift in canopy dominance is indicated by the data for this community. Black willow and cottonwood occur at densities of about 314 and 170 stems per hectare in the canopy (Table 52). In the understory, the stem densities increase for cottonwood, but the density of black willow is much lower than in the canopy. The importance value for cottonwood is also lower, but not to such a great extent. Neither of these species occurs in the herb layer, and their total relative values in the shrub layer are much lower than those of rough-leaved dogwood, box elder, and red maple (Table 53). The regenerative potentials of black willow and cottonwood under existing shaded conditions are very low (U. S. Department of Agriculture 1965), and they will eventually be replaced by most abundant tree species in herb and shrub layers. In fact, box elder, American elm, and red maple are already present in the canopy and understory of this community. Other tree species present in the canopy which may also be present in later seral stages are laurel oak, sycamore, and Shumard oak (Quercus shumardii), though they were not yet of sufficient importance to have appeared in samples at lower forest strata.

Considerable variation exists in herb-layer density and composition (Table 53) as a result of the amount of sunlight reaching the forest floor, the soil texture, frequency and duration of ponding, and competition. The most abundant ground cover herb is white snakeroot (Eupatorium rugosum), but occasional dense populations of the fern Thelypteris normalis also occur (Table 53).

c. Willow-sycamore-mixed forest. Willow-sycamore-mixed forest, dominated by black willow and sycamore, occurs at somewhat lower elevations within the study area. This forest type is frequently

Table 53

Density and Relative Values for Shrub, Tree, and Vine Species and Percent Cover and Relative Values for Herb, Shrub, Tree, and Vine Species in the Willow-Cottonwood Forest Community of Whiskey Bay Pilot Channel Site

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
White snakeroot (*Eupatorium rugosum*)	6.66	56.0	25.4
Fern (*Thelypteris normalis*)	1.22	10.3	4.6
Goldenrod (*Solidago* sp.)	0.94	7.9	3.6
Snakeroot (*Sanicula canadensis*)	0.83	7.0	3.2
Eupatorium album	0.56	4.7	2.1
Rattlesnake fern (*Botrychium virginianum*)	0.56	4.7	2.1
Snakeroot (*Sanicula marilandica*)	0.28	2.4	1.1
Spring ladies tresses (*Spiranthes vernalis*)	0.28	2.4	1.1
Spiny-leaved sow thistle (*Sonchus asper*)	0.28	2.3	1.1
Violet (*Viola* sp.)	0.28	2.3	1.1
	11.89	100.0	
Shrubs:			
Blackberry (*Rubus argutus*)	2.33	89.3	8.9

[a]Square meters per hectare

Table 53 (continued)

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Wax myrtle (*Myrica cerifera*)	0.28	10.7	1.1
	2.61	100.0	
Trees:			
Box elder (*Acer negundo*)	0.83	59.7	3.1
Rough-leaved dogwood (*Cornus drummondii*)	0.28	20.1	1.1
American elm (*Ulmus americana*)	0.28	20.1	1.1
	1.39	99.9	
Vines:			
Poison ivy (*Rhus radicans*)	7.56	73.1	28.8
Pepper-vine (*Ampelopsis arborea*)	1.11	10.8	4.2
Rattan vine (*Berchemia scandens*)	0.83	8.0	3.1
Matelea decipiens	0.56	5.4	2.1
Virginia creeper (*Parthenocissus quinquefolia*)	0.28	2.7	1.1
	10.34	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Blackberry (*Rubus argutus*)	2.33	5825.0	74.9	11.9

Table 53 (continued)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Wax myrtle (*Myrica cerifera*)	0.67	1675.0	21.5	3.4
Elderberry (*Sambucus canadensis*)	0.11	275.0	3.6	0.6
	3.11	7775.0	100.0	
Trees:				
Rough-leaved dogwood (*Cornus drummondii*)	3.17	7,925.0	59.9	16.1
Box elder (*Acer negundo*)	1.39	3,475.0	26.3	7.1
Red maple (*Acer rubrum*)	0.33	825.0	6.3	1.7
Cottonwood (*Populus deltoides*)	0.28	700.0	5.3	1.4
Black willow (*Salix nigra*)	0.06	150.0	1.1	0.3
American elm (*Ulmus americana*)	0.06	150.0	1.1	0.3
	5.29	13,225.0	100.0	
Vines:				
Poison ivy (*Rhus radicans*)	6.17	15,425.0	54.9	31.4
Pepper-vine (*Ampelopsis arborea*)	2.33	5,825.0	20.8	11.9
Rattan vine (*Berchemia scandens*)	1.78	4,450.0	15.9	9.1
Trumpet creeper (*Campsis radicans*)	0.56	1,400.0	5.0	2.8
Ampelopsis cordata	0.22	550.0	1.9	1.1

Table 53 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Virginia creeper (*Parthenocissus quinquefolia*)	0.11	275.0	1.0	0.6
Climbing hempweed (*Mikania scandens*)	0.06	150.0	0.5	0.3
	11.23	28,075.0	100.0	100.0

subject to standing water due either to general flooding within the basin or to poor internal and surface soil drainage. The diversity of this forest is considerably greater than that of the previous type (Tables 54 and 55). Most portions of this forest type occur on older dredged material or have been modified by past dredged material movement.

Although black willow was dominant in this community, its importance as a future dominant is lower than in the previous community. Importance values of black willow are much greater for the willow-cottonwood forest (almost 98) than for the willow-sycamore-mixed forest (36). For sycamore, importance values are only 5.5 in the willow-cottonwood forest and 33.4 in the willow-sycamore-mixed forest. Several of the canopy species mentioned by Thieret (1971) as being important canopy dominants of "second bottoms" are present in the canopy. Bald cypress is very rare.

As in the previous community, rough-leaved dogwood was the major understory species, but its importance in the present community was lower due to nearly a 50 percent decrease in number of stems per hectare.

Woody vines are important in all arborescent communities at WBPC. Rattan increases in importance from subdominant (4,450 stems per hectare) in the willow-cottonwood forest to the dominant vine (15,400 stems per hectare) in the willow-sycamore-mixed forest.

Average percent cover by herbs is somewhat lower in this community than the former woodland type, probably because of the greater frequency and longer duration of standing water. The species present are somewhat more indicative of undisturbed soil and low light levels.

149. Seral relationships of vegetation. Prior to construction of the WBPC in 1935 and 1936, the swamp forest of the area was largely undisturbed except for some scattered timbering operations. Alabama Bayou and Bayou des Ourses flowed freely into the Atchafalaya River

Table 54

Absolute Density, Basal Area, Relative Values, and Importance Value for Tree Species in the Canopy and Understory of the Willow-Sycamore-Mixed Forest Community of Whiskey Bay Pilot Channel Site

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value
Canopy					
Black willow (*Salix nigra*)	73.45	2.84	12.5	23.5	36.0
Sycamore (*Platanus occidentalis*)	99.18	2.00	16.8	16.6	33.4
Box elder (*Acer negundo*)	72.20	1.19	12.3	9.9	22.2
Red elm (*Ulmus rubra*)	70.20	1.06	11.9	8.8	20.7
Sweetgum (*Liquidambar styraciflua*)	64.55	0.72	11.0	6.0	17.0
Red maple (*Acer rubrum*)	60.32	0.72	10.2	6.0	16.2
Cottonwood (*Populus deltoides*)	22.55	1.42	3.8	11.8	15.6
Rough-leaved dogwood (*Cornus drummondii*)	45.22	0.36	7.7	3.0	10.7
Ash (*Fraxinus pennsylvanica*)	39.80	0.36	6.8	3.0	9.8

[a]Stems per hectare

[b]Square meters per hectare

Table 54 (continued)

Species	Density	Basal Area	Relative Density	Relative Basal Area	Importance Value
Laurel oak (*Quercus laurifolia*)	8.48	0.47	1.5	3.9	5.4
Hawthorn (*Crataegus flabellata*)	20.00	0.22	3.4	1.8	5.2
Sugarberry (*Celtis laevigata*)	6.05	0.36	1.0	3.0	4.0
Black oak (*Quercus nigra*)	2.02	0.22	0.3	1.8	2.1
Willow oak (*Quercus phellos*)	4.92	0.11	0.8	0.9	1.7
	588.94	12.05	100.0	100.0	200.0
			Understory		
Rough-leaved dogwood (*Cornus drummondii*)	3665.68	2.84	63.7	58.8	122.5
Sweetgum (*Liquidambar styraciflua*)	569.62	0.47	9.9	9.7	19.6
Ash (*Fraxinus pennsylvanica*)	542.82	0.36	9.4	7.4	16.8
Wax myrtle (*Myrica cerifera*)	542.82	0.36	9.4	7.4	16.8
Sycamore (*Platanus occidentalis*)	268.05	0.25	4.6	5.2	9.8
Black willow (*Salix nigra*)	60.32	0.11	1.0	2.3	3.3

Table 54 (concluded)

Species	Density	Basal Area	Relative Density	Relative Basal Area	Importance Value
Box elder (*Acer negundo*)	26.80	0.11	0.5	2.3	2.8
Red elm (*Ulmus rubra*)	26.80	0.11	0.5	2.3	2.8
Ironwood (*Ostrya virginiana*)	26.80	0.11	0.5	2.3	2.8
Red maple (*Acer rubrum*)	26.80	0.11	0.5	2.3	2.8
	5756.51	4.83	100.0	100.0	200.0

Table 55

Density and Relative Values for Shrub, Tree, and Vine Species and Percent Cover and Relative Values for Herb, Shrub, Tree, and Vine Species in the Willow-Sycamore-Mixed Forest Community of Whiskey Bay Pilot Channel Site

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Eupatorium album	3.42	31.7	16.2
Thelypteris normalis	2.89	26.8	13.7
Microstegium vimeneum	1.32	12.2	6.3
White snakeroot (*Eupatorium rugosum*)	1.05	9.8	5.0
Snakeroot (*Sanicula canadensis*)	1.05	9.8	5.0
Broomsedge (*Andropogon virginicus*)	0.53	4.9	2.5
Snakeroot (*Sanicula marilandica*)	0.26	2.4	1.2
Vetch (*Vicia* sp.)	0.26	2.4	1.2
	10.78	100.0	
Shrubs:			
Blackberry (*Rubus argutus*)	2.37	90.1	11.2
Wax myrtle (*Myrica cerifera*)	0.26	9.9	1.2
	2.63	100.0	
Trees:			
Box elder (*Acer negundo*)	1.05	57.1	5.0

[a]Average cover for all 0.5-m^2 quadrats

Table 55 (continued)

Species	Average Percent Cover	Relative Value	Total Relative Value
Rough-leaved dogwood (*Cornus drummondi*)	0.53	28.8	2.5
Red maple (*Acer rubrum*)	0.26	14.1	1.2
	1.84	100.0	
Vines:			
Poison ivy (*Rhus radicans*)	2.37	40.3	11.2
Pepper-vine (*Ampelopsis arborea*)	1.95	33.1	9.2
Rattan vine (*Berchemia scandens*)	0.79	13.4	3.8
Trumpet vine (*Campsis radicans*)	0.26	4.4	1.2
Matelea decipiens	0.26	4.4	1.2
Virginia creeper (*Parthenocissus quinquefolia*)	0.26	4.4	1.2
	5.89	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Blackberry (*Rubus argutus*)	3.58	8,950.0	64.9	17.7
Wax myrtle (*Myrica cerifera*)	1.05	2,625.0	19.0	5.2
Hawthorn (*Crataegus flabellata*)	0.63	1,575.0	11.4	3.1
Possum haw (*Ilex decidua*)	0.11	275.0	2.0	0.5

Table 55 (continued)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
St. John's wort (*Hypericum* sp.)	0.05	125.0	0.9	0.3
Elderberry (*Sambucus canadensis*)	0.05	125.0	0.9	0.2
Silverling (*Baccharis halimifolia*)	0.05	125.0	0.9	0.2
	5.52	13,800.0	100.0	
Trees:				
Rough-leaved dogwood (*Cornus drummondii*)	2.21	5,525.0	47.9	11.0
Box elder (*Acer negundo*)	0.89	2,225.0	19.3	4.4
Ash (*Fraxinus pennsylvanica*)	0.63	1,575.0	13.6	3.1
Red maple (*Acer rubrum*)	0.21	525.0	4.5	1.0
Black willow (*Salix nigra*)	0.16	400.0	3.5	0.8
Sycamore (*Platanus occidentalis*)	0.16	400.0	3.5	0.8
Sweetgum (*Liquidambar styraciflua*)	0.10	250.0	2.2	0.5
Sugarberry (*Celtis laevigata*)	0.10	250.0	2.2	0.5
Bitternut hickory (*Carya cordiformis*)	0.05	125.0	1.1	0.3

Table 55 (concluded)

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Red elm (*Ulmus rubra*)	0.05	125.0	1.1	0.3
Ironwood (*Ostrya virginiana*)	0.05	125.0	1.1	0.3
	4.61	11,525.0	100.0	
Vines:				
Rattan vine (*Berchemia scandens*)	6.16	15,400.0	61.3	30.5
Pepper-vine (*Ampelopsis arborea*)	1.58	3,950.0	15.7	7.8
Poison ivy (*Rhus radicans*)	1.26	3,150.0	12.5	6.2
Trumpet creeper (*Campsis radicans*)	0.63	1,575.0	6.3	3.1
Virginia creeper (*Parthenocissus quinquefolia*)	0.42	1,050.0	4.2	2.1
	10.05	25,125.0	100.0	100.0

as did other minor drainage from the surrounding forest. A railroad and a utility corridor were already constructed (Figure 25).

150. By 1936, construction was almost complete and dredged material had been disposed of (in part) along a 400-ft-wide swath beginning about 600 ft from the edge of the channel (Figure 26). The material formed a dam that changed the direction of flow of Alabama Bayou, Bayou des Ourses, and minor tributaries of the Atchafalaya River.

151. Historical photography from 1940 and 1950 shows the development of what is interpreted as willow-cottonwood forest along the crest of the dredged material (Figures 27 and 28). Changes in vegetation adjacent to the dredged material ridge are not readily apparent. Also by 1950, Alabama Bayou and Bayou des Ourses were reopened and drained directly into the WBPC.

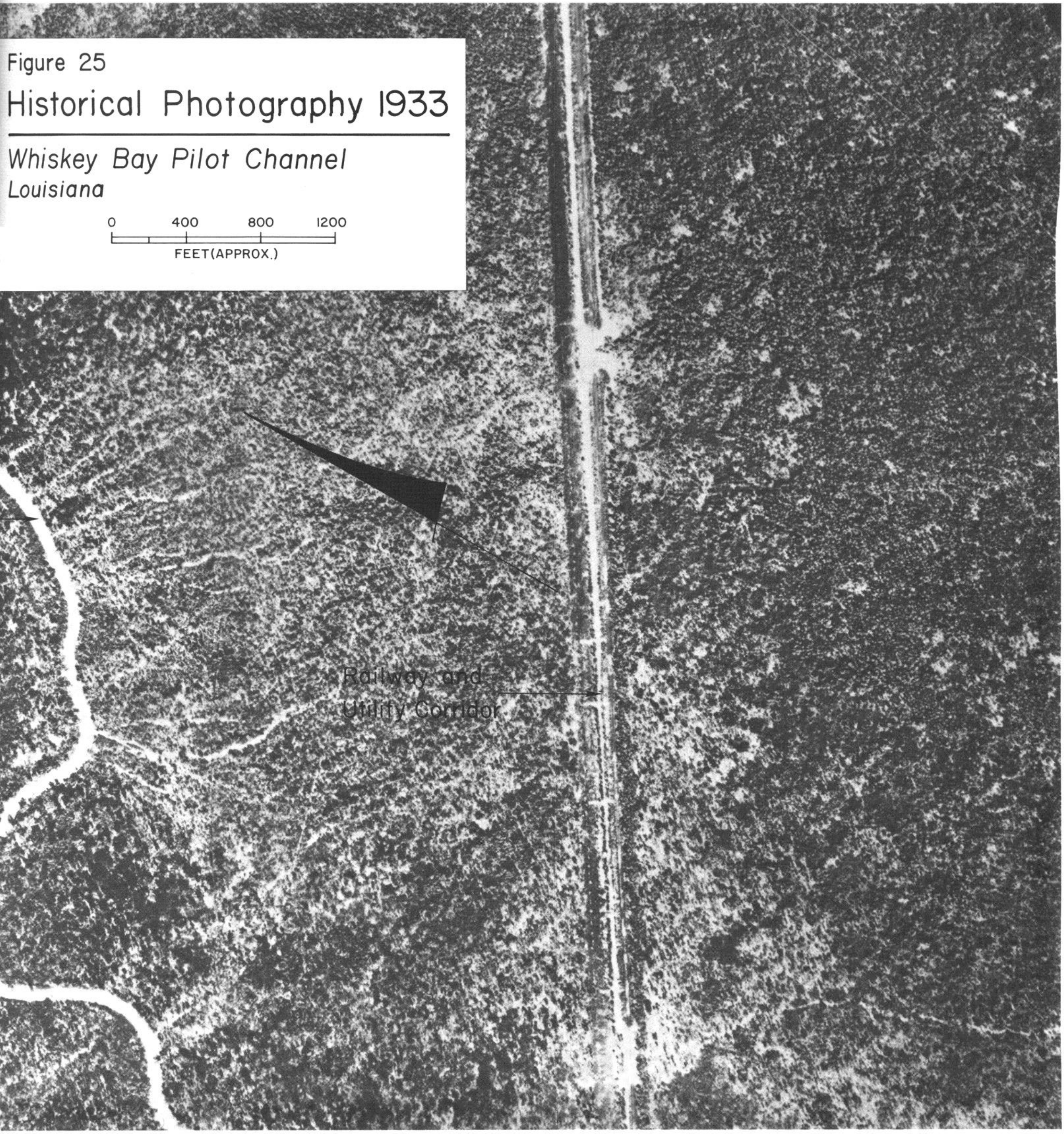
152. Aerial photography for 1962 was taken in November, only months after disposal of fresh dredged material from widening of the WBPC (Figure 29). Alabama Bayou and Bayou des Ourses were again closed, but must have been closed sometime prior to the second period of disposal. The growth of shrubs in what were the outlets of these bayous is much too heavy to have grown on 1961-1962 dredged material. As a result of the second disposal, nine mounds were created along and to the northeast of the earlier construction. Because of the 21 disposal pipeline access lines cut through the vegetation of the buffer, disposal probably occurred in areas other than at the nine mounds.

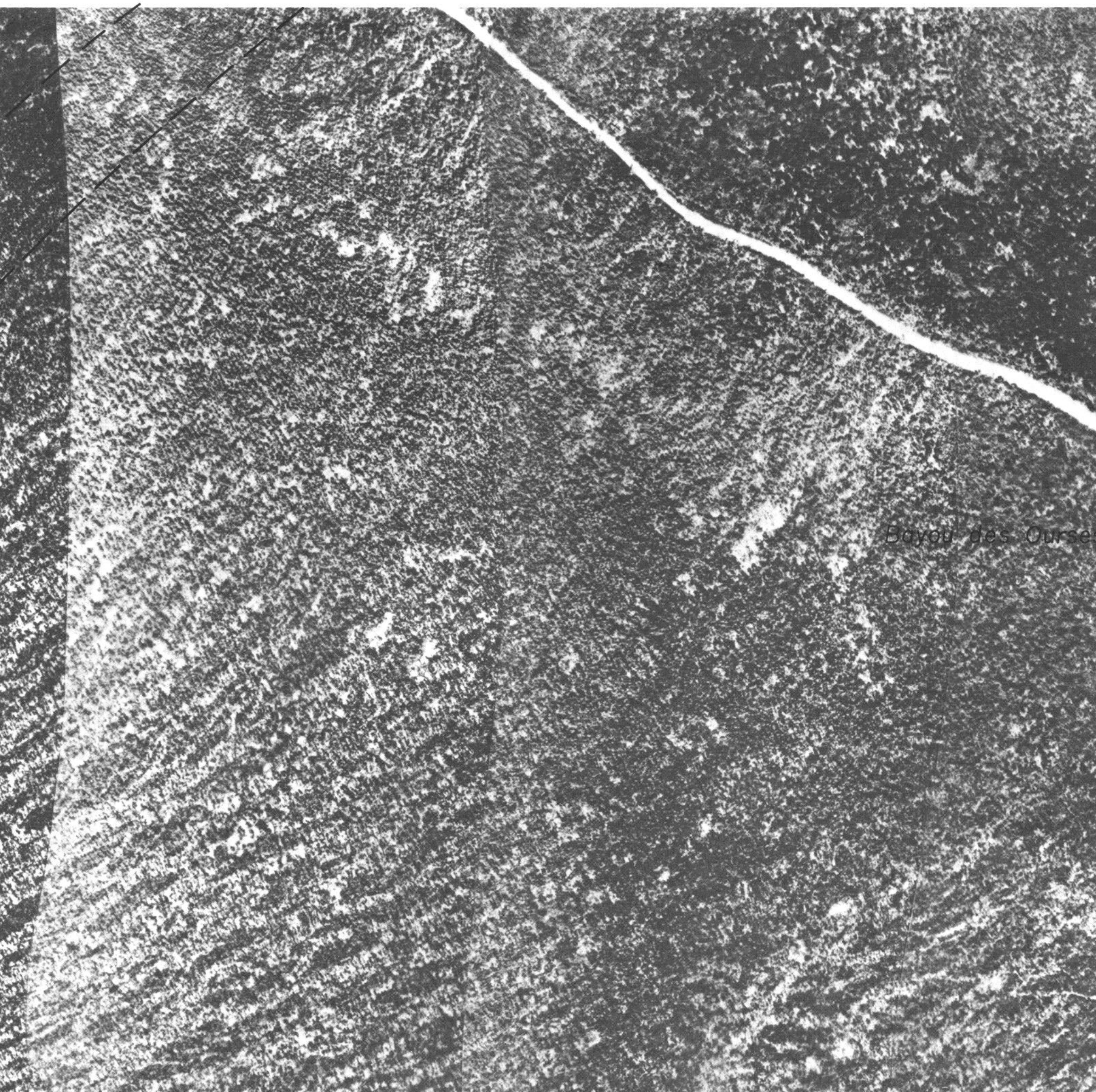
153. Three general vegetation age categories apply to the site: forests that are about 40 years old, forests that are about 13 years old, and secondarily created herbaceous communities that are relatively recent. Dredged material disposed during the 1935-36 period either supports the 40-year old forest (willow-sycamore-mixed) or has experienced a selective clearing process that began 40 years ago as a result of flow beyond the limits of the constructed ridge. Stands so influenced were revegetated by the same or other species, depending upon the extent to which soil conditions were modified. Species which could tolerate fill around their bases remained; those that could not

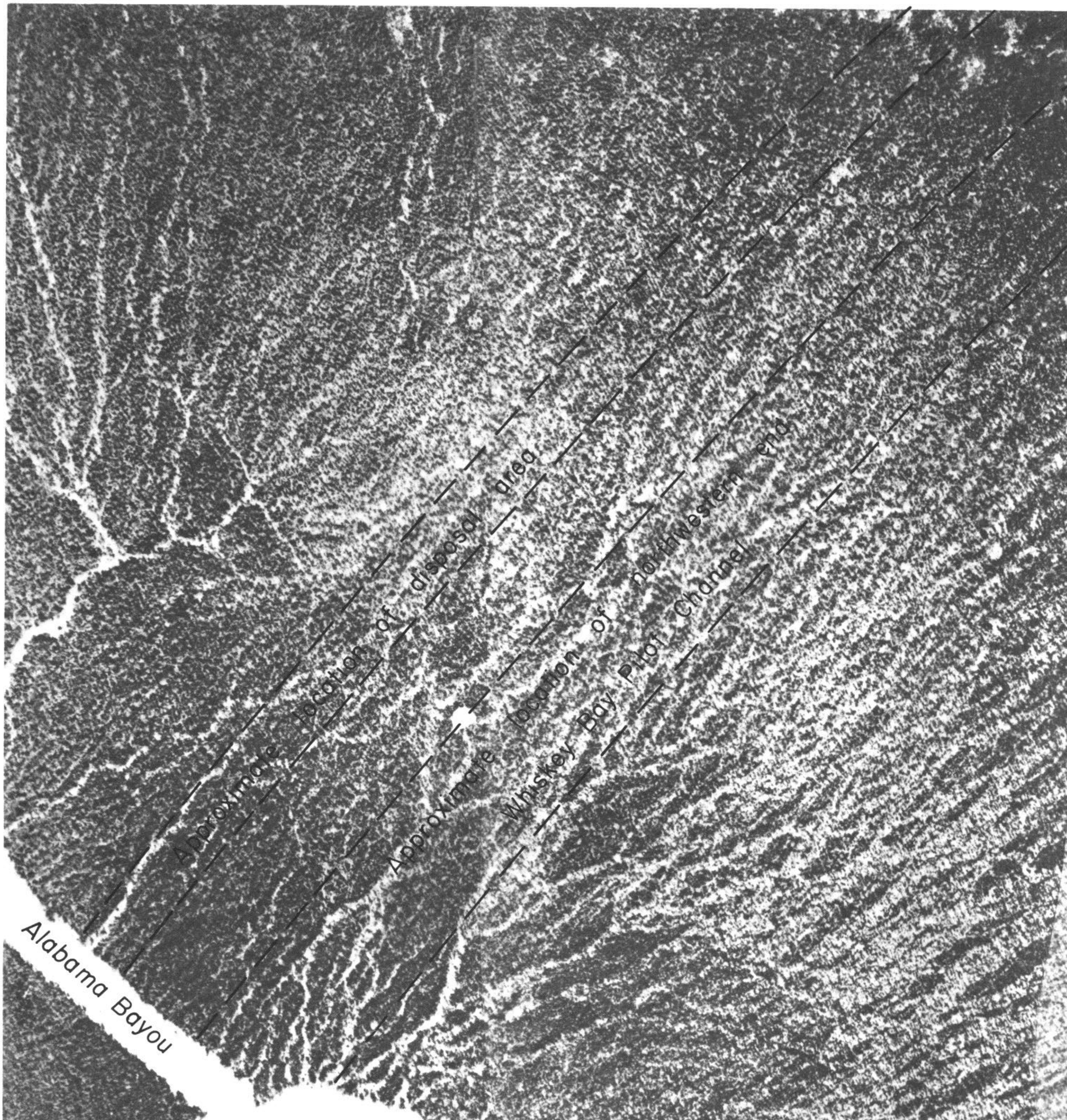
Figure 25

Historical Photography 1933

Whiskey Bay Pilot Channel
Louisiana




Bayou des Ourses


Approximate location of disposal area
Approximate location of northwestern end
Whiskey Bay Pilot Channel
Alabama Bayou
ATCHAFALAYA RIVER

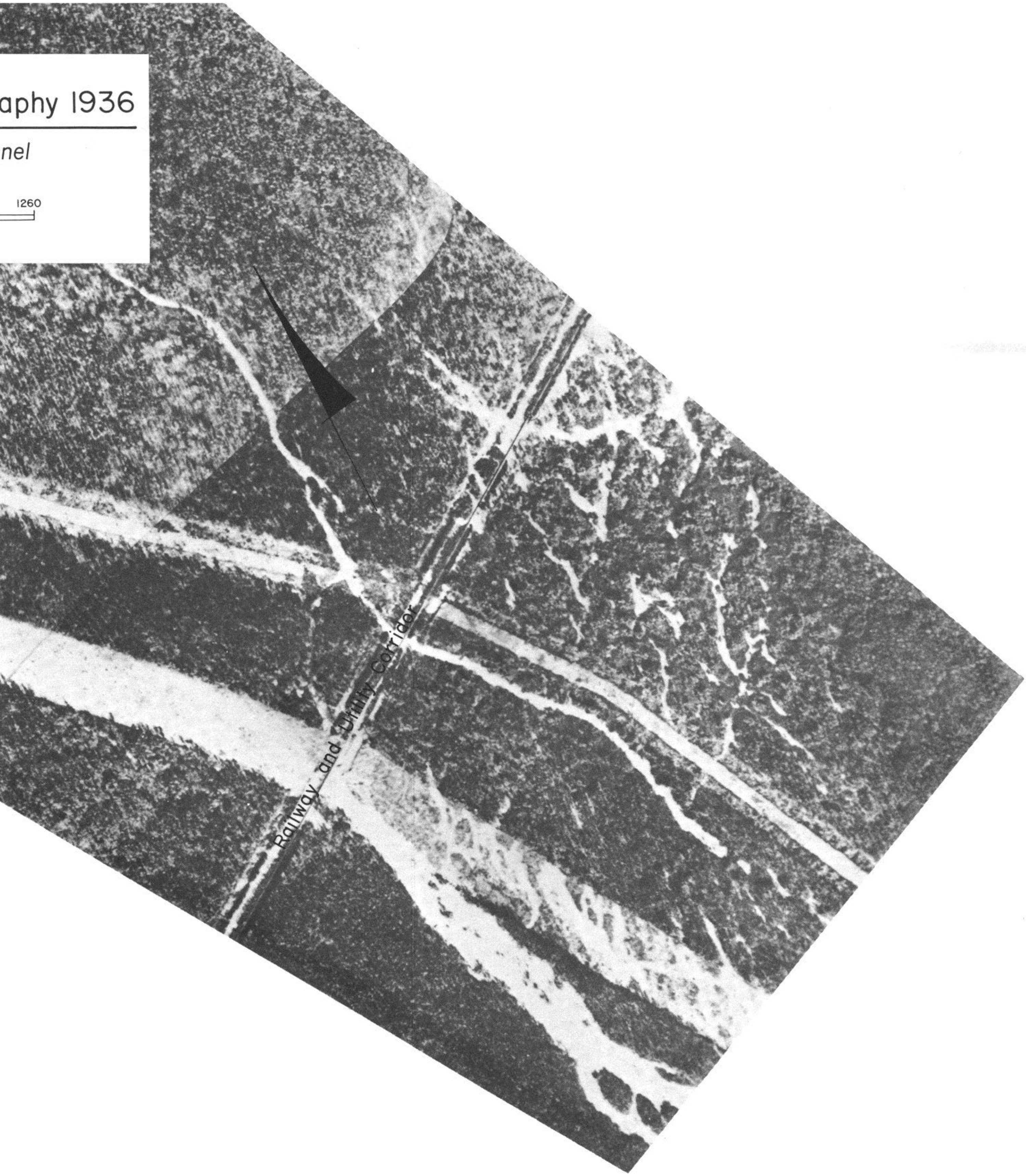
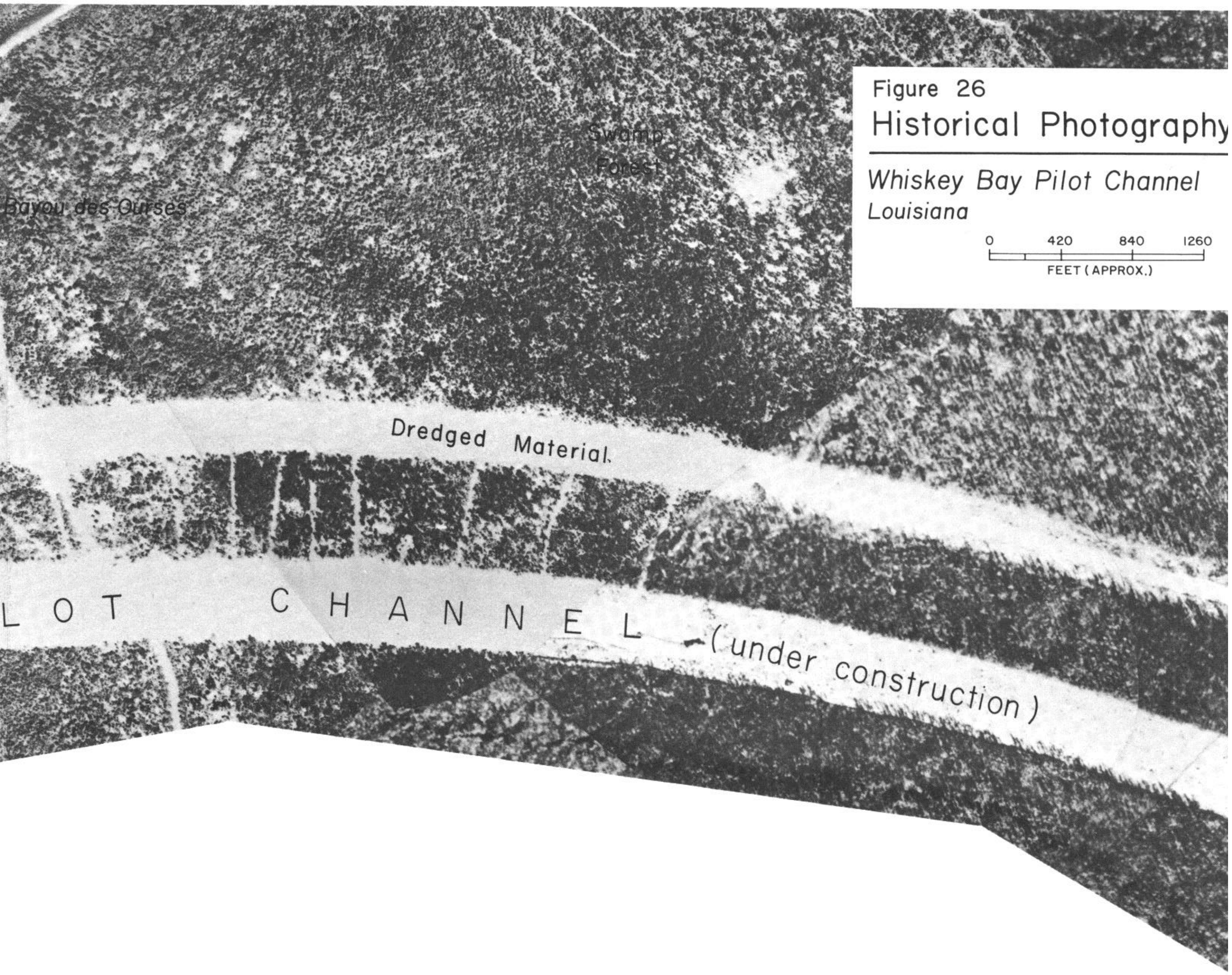
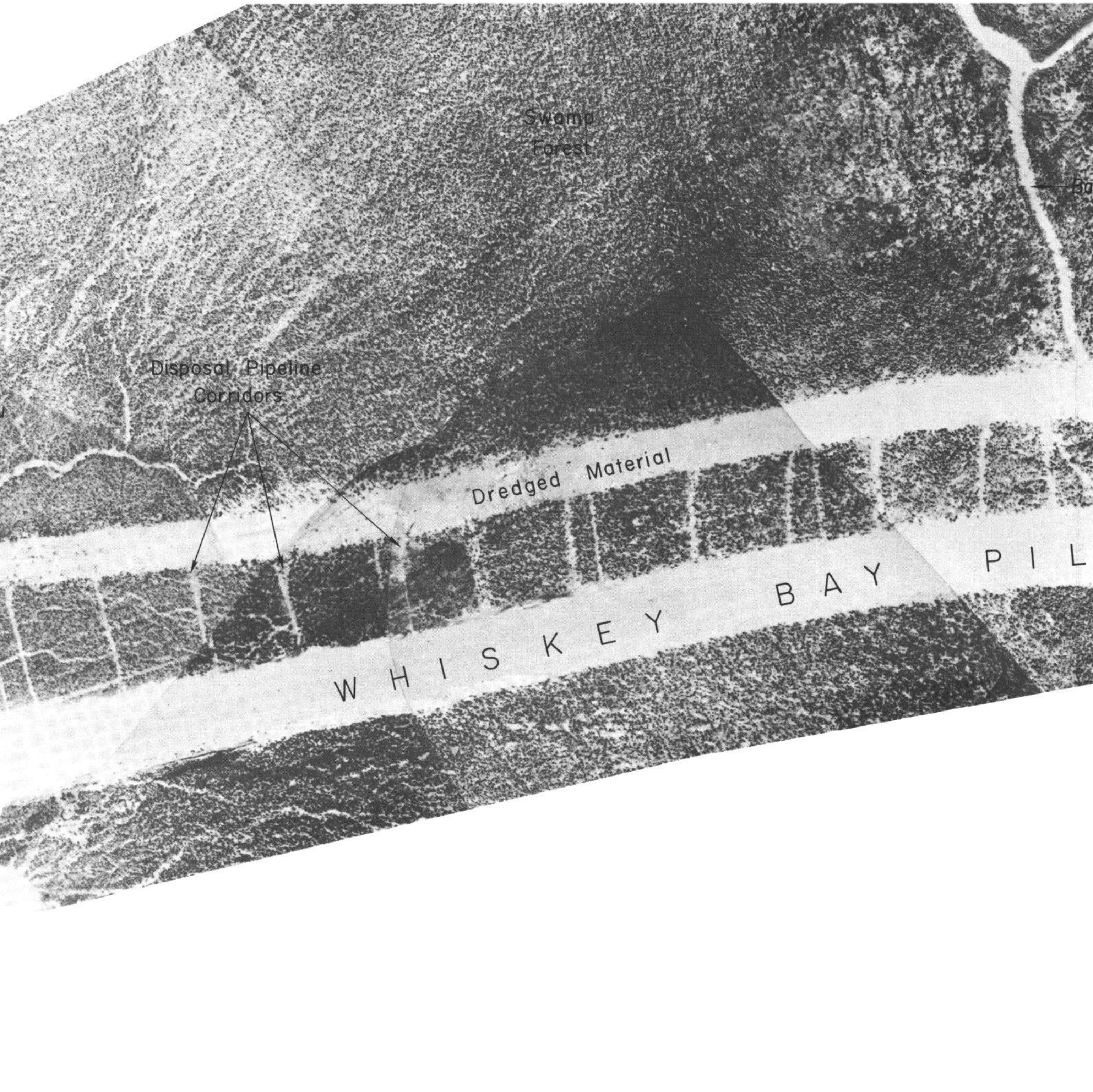
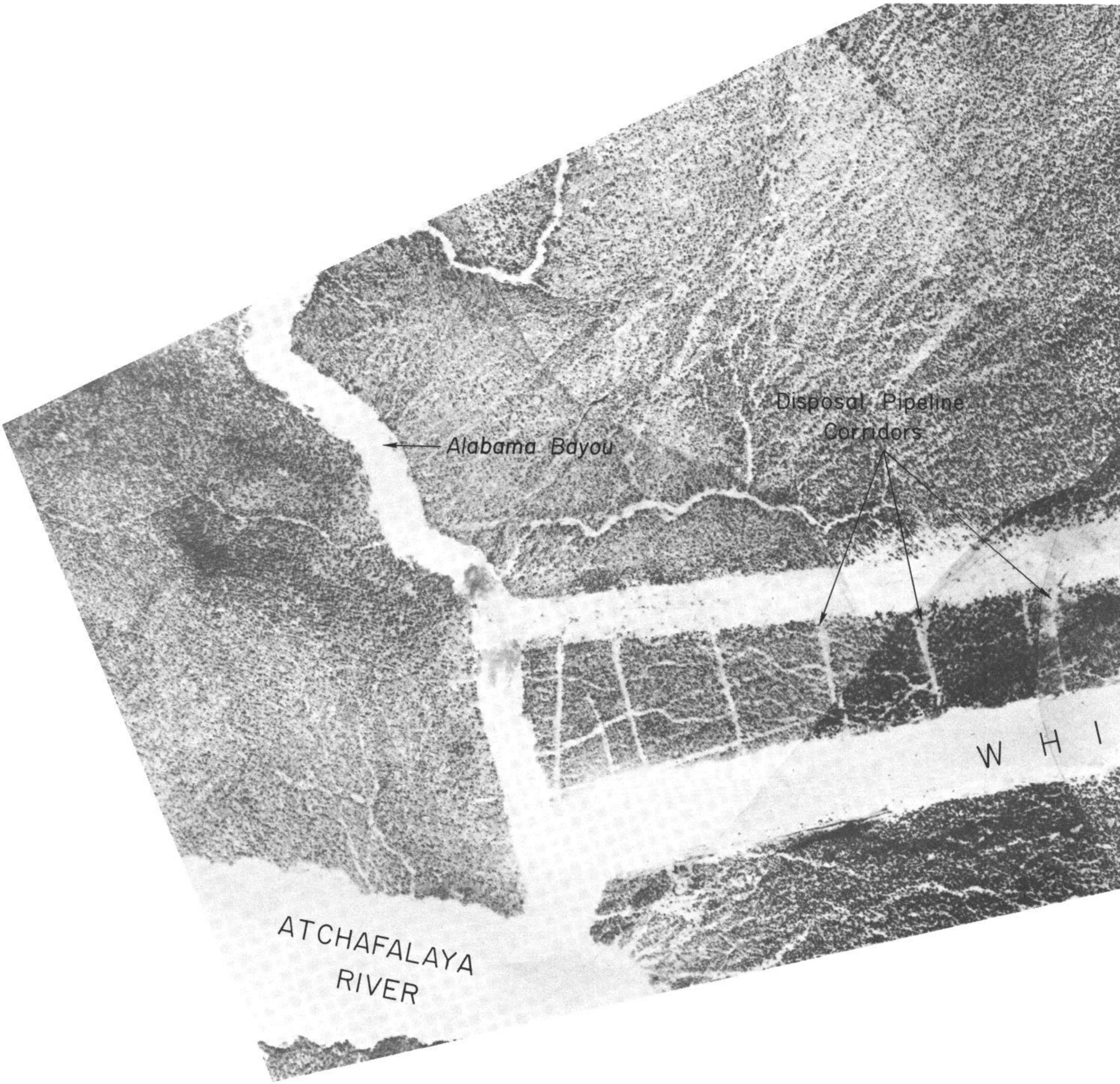

aphy 1936
nel
1260
Railway and Utility Corridor

Figure 26
Historical Photography

Whiskey Bay Pilot Channel
Louisiana




Swamp
Forest
Bay
Disposal Pipeline
Corridors
Dredged Material
W H I S K E Y B A Y P I L



Alabama Bayou
Disposal Pipeline Corridors
W H I
ATCHAFALAYA RIVER

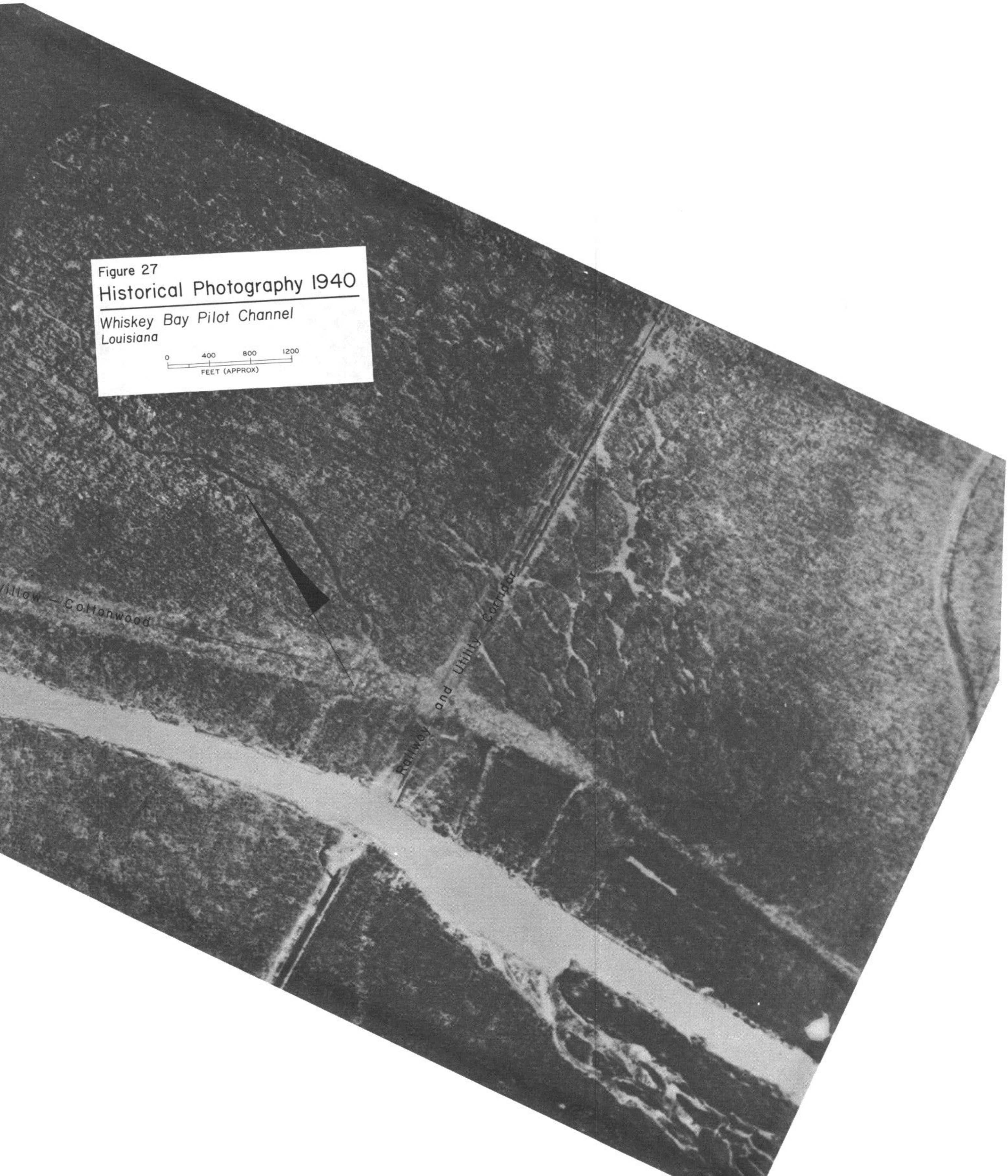
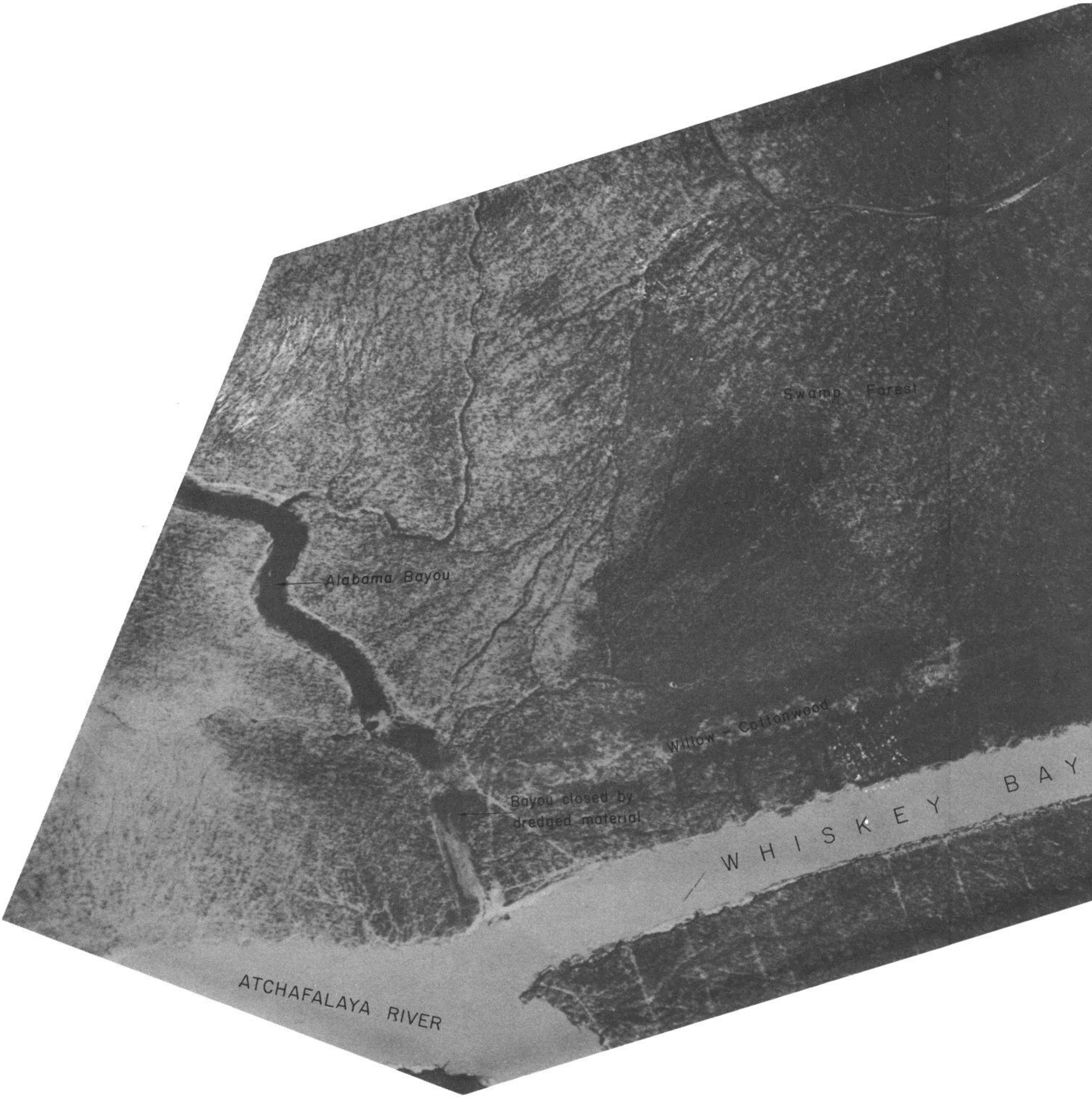


Figure 27
Historical Photography 1940
Whiskey Bay Pilot Channel
Louisiana

Forest
Swamp Forest
Bayou des Ourses
Bayou closed by dredged material
Willow
KEY BAY PILOT CHANNEL



Swamp Forest
Alabama Bayou
Willow - Cottonwood
Bayou closed by
dredged material
WHISKEY BAY
ATCHAFALAYA RIVER

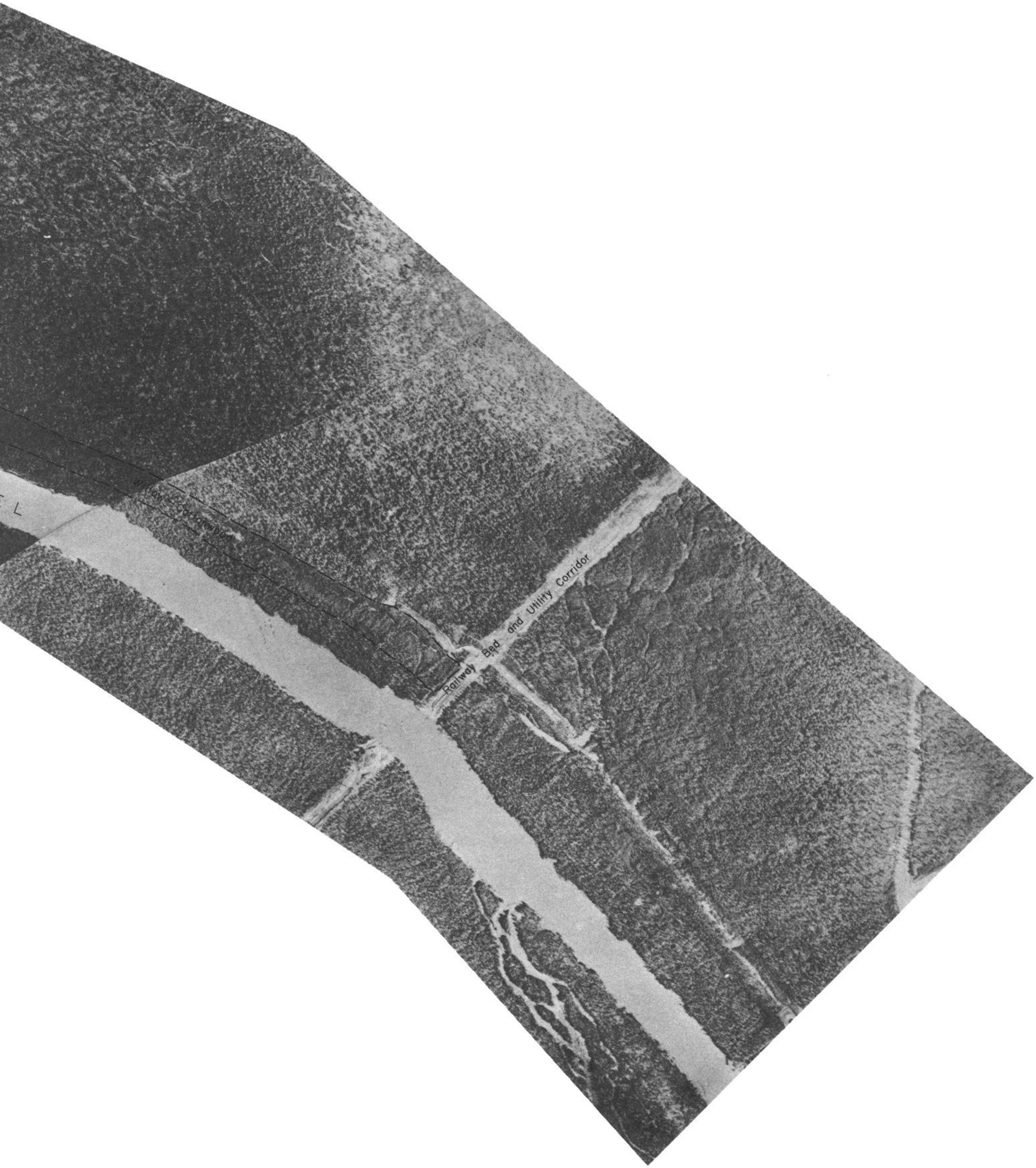

Willow - Cottonwood
Railway Bed and Utility Corridor

Figure 28
Historical Photography 1950
Whiskey Bay Pilot Channel
Louisiana

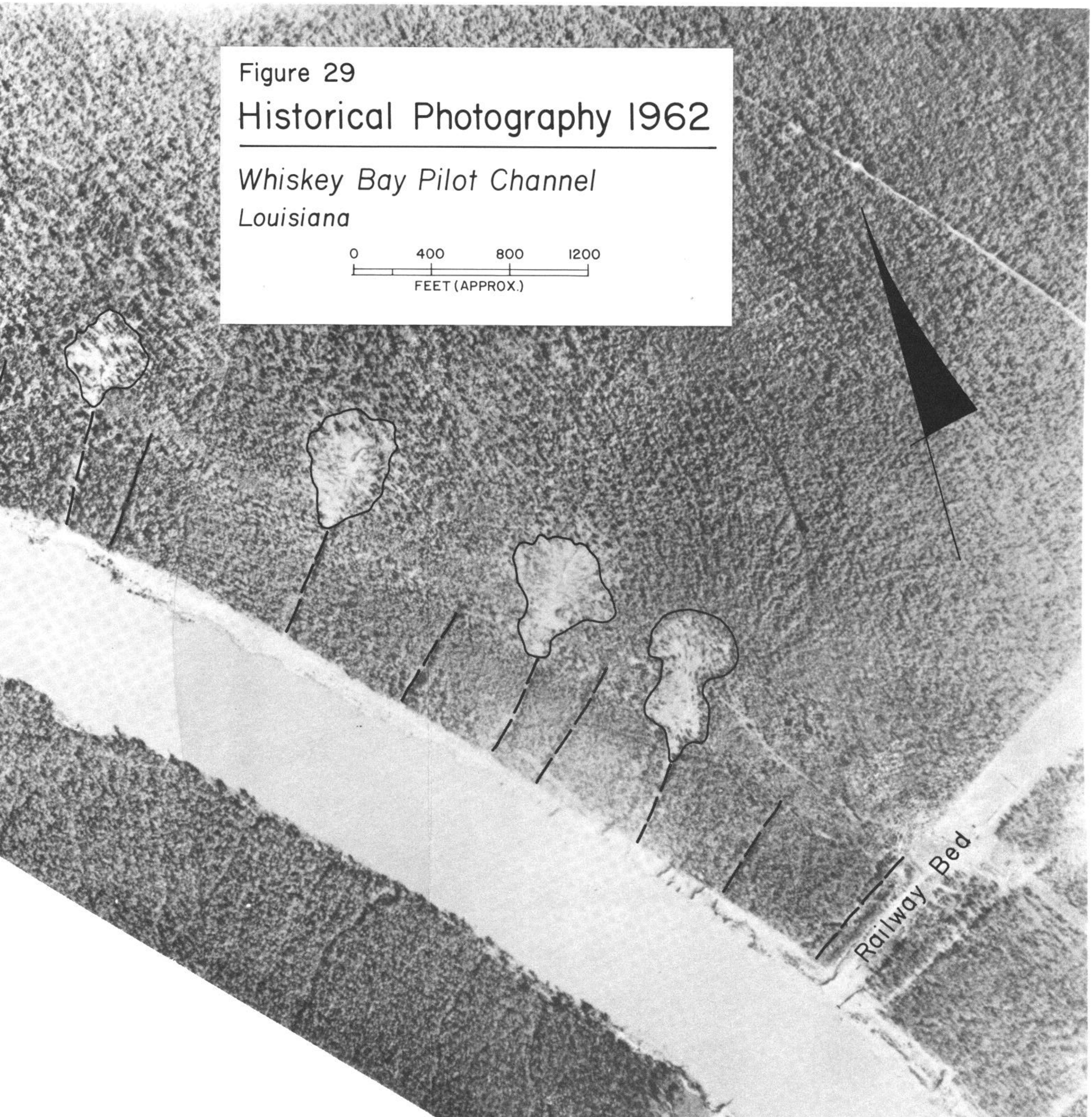
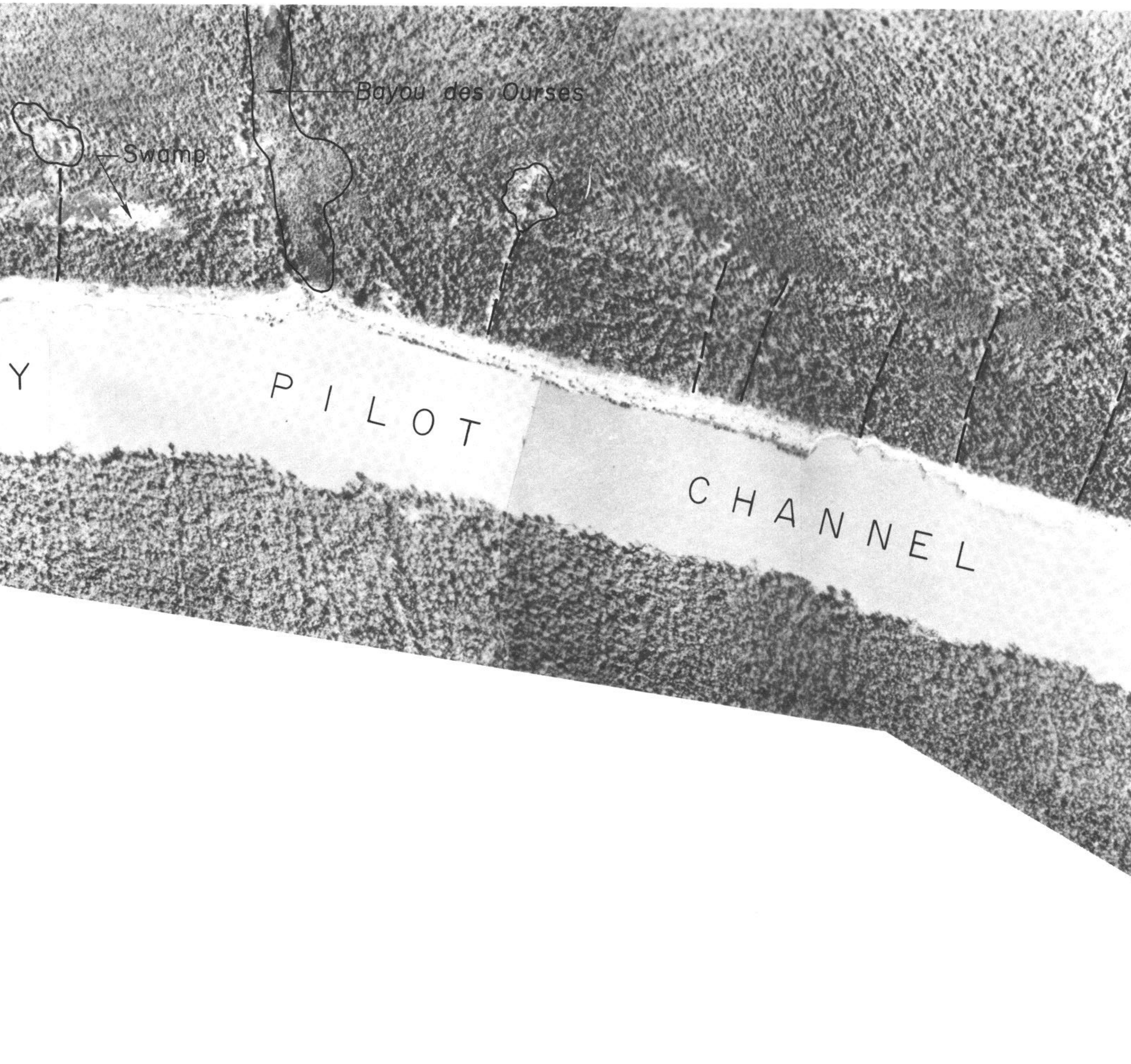
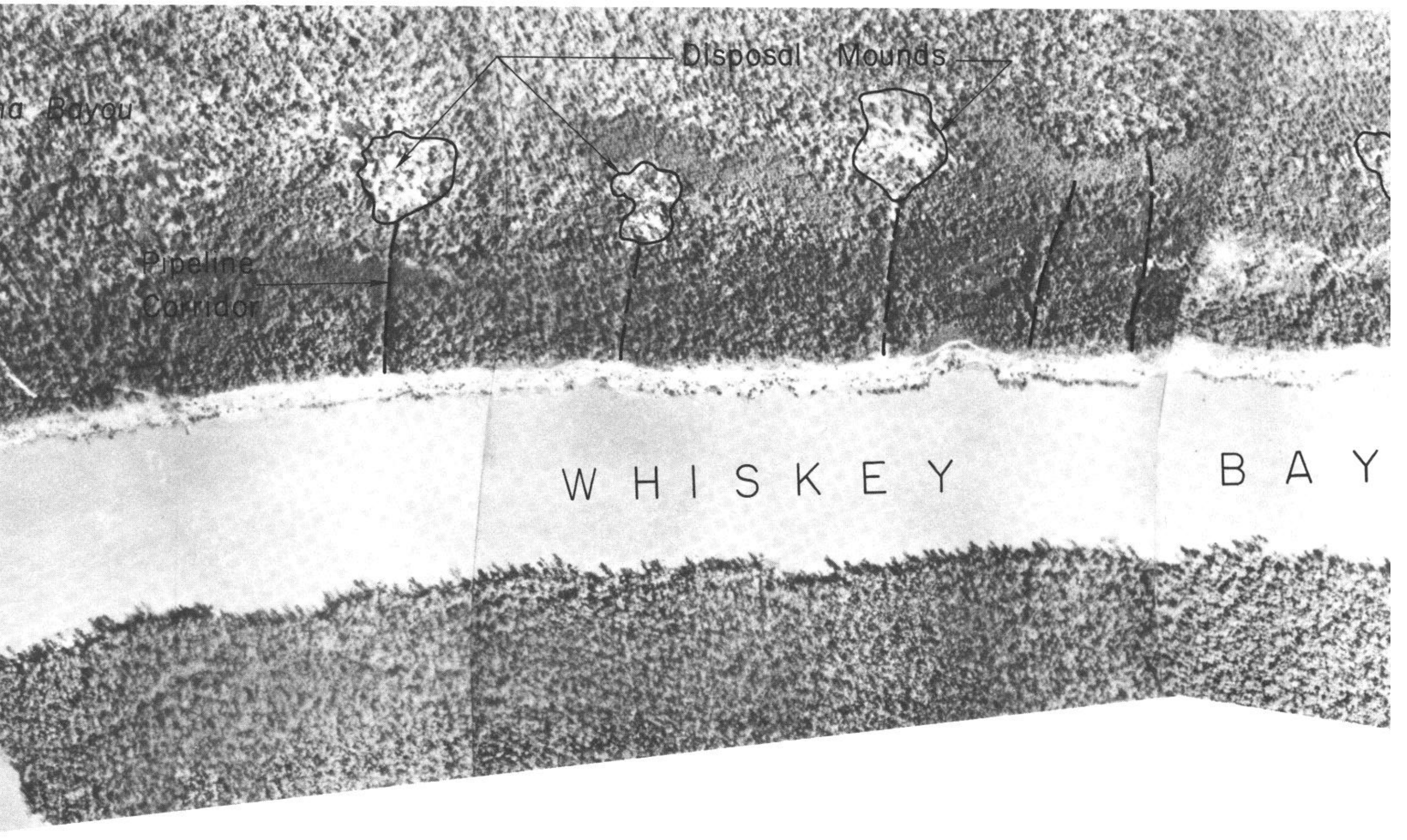


Figure 29

Historical Photography 1962

Whiskey Bay Pilot Channel
Louisiana


Bayou des Ourses
Swamp
Y PILOT CHANNEL



Disposal Mounds
Bayou
Pipeline Corridor
WHISKEY BAY

Alabama Bayou
Pipeline
Corridor
ATCHAFALAYA RIVER
W

were replaced. The process of elimination resulted, essentially, in selective clearing of forests adjacent to the main disposal area. Until the 1961-62 disposal, two forest types were thusly affected. The 1961-62 disposal, about 26 years later than the first disposal, probably had the same impact, except that the forests affected were largely those created by earlier disposal.

154. Black willow, cottonwood, and sycamore were important in stand replacement as well as in growth on the dredged material ridge and mounds. Within the scope of this study it was not possible to document the degree to which each species became important in which area. Sycamore is generally thought to be a typical replacement species for willow and cottonwood in more natural seres, unless the stands are somehow selectively maintained. Sycamore is usually an intermediate successional species, giving way to trees characteristic of more advanced seral stages, particularly in upland sites (U. S. Department of Agriculture 1965).

155. Between 1962 and 1974 construction of SR 975, construction of a hunting club, oil prospecting, and possibly timbering were among the other disturbances at the WBPC site (Figure 24).

156. A possible sere for upland dredged material at the WBPC site is suggested in Figure 30. Whether the initial herbaceous community and freshly dredged material were dominated by ragweed is not known. Monte (1974) found that great ragweed dominated freshly dredged material in the Bayou LaFourche Basin. On a 10-year old disposal area of approximately the same height (5 ft above the level of the surrounding forest), red maple was dominant and sugarberry was beginning to appear. On 25-year old sites, a sugarberry-oak forest had developed. The same general trends seem reasonable for the WBPC site.

157. Another, somewhat more subtle factor influencing vegetation at the site is hydroperiod. Water stands longer in poorly drained areas in the willow-sycamore-mixed forest than in the willow-cottonwood forest. The former is more nearly like the earlier seral stages of a swamp forest. In the ultimate climax, the same hydrological factors will persist so that the more upland areas will contain fewer hydric

Unvegetated dredged material

Ragweed (and other forbs)

Willow-cottonwood or willow-sycamore-mixed forest

Sycamore-mixed forest

Red maple-sweetgum-sugarberry

Sweetgum-sugarberry-oaks

Figure 30. Possible Sere for Upland Dredged Material at the WBPC Site

species. Of the three dominants listed for the climax, sugarberry and oaks will probably be more common in higher areas.

158. Analysis of existing animal populations.

a. Birds. Fifty-nine species of birds were observed on the WBPC site during the July 1974, September 1974, and May 1975 field surveys. Thirty-three of these are classified as year-round residents in the study area, 22 are summer residents, 1 is a winter visitant, and 3 are spring-fall transients (Lowery 1960, Robbins et al. 1966). Resident status for each species is shown in Table 56. Life history information and field notes recorded for each species are presented in Appendix C.

Table 56

General Characteristics and Field Notes Regarding Avian Species Observed on the Whiskey Bay Pilot Channel Site

Species	Resident Status[a]	Period Observed[b]	Habitat Preference[c]	Distribution on the Study Site[d]			
				W	FE	SR	P
Wood duck	Y	M	WP	X	-	-	-
Turkey vulture	Y	J, S, M	FE	-	-	X	-
Black vulture	Y	J, S, M	FE	-	-	X	-
Mississippi kite	S	J, M	W	X	X	X	-
Cooper's hawk	Y	M	W	-	-	X	-
Marsh hawk	W	S	G	-	-	X	-
Red-tailed hawk	Y	J	FE	-	-	X	-
Red-shouldered hawk	Y	M	FE	X	X	X	-
Bobwhite	Y	J	FE	-	X	-	-
Cattle egret	Y	J, S	G	-	-	X	-
Great blue heron	Y	M	M	-	-	-	X
Green heron	S	M	M	X	-	-	-
Killdeer	Y	J, S, M	G	-	-	X	-
Yellow-billed cuckoo	S	J, S, M	W	X	-	-	-
Screech owl	Y	M	W	X	-	-	-

[a]Y=year round resident; W=winter visitant; S=summer resident; T=spring-fall transient

[b]J=July 1974; S=September 1974; M=May 1975

[c]WP=woodland ponds and streams; FE=forest-edge or hedgerow situations; W=woodlands; G=grasslands or sparsely vegetated areas; M=marshlands

[d]W=willow-cottonwood and willow-sycamore-mixed forest; FE=forest-edge areas; SR=southern ragweed; P=pond and surrounding marsh vegetation

Table 56 (continued)

Species	Resident Status	Period Observed	Habitat Preference	Distribution on the Study Site: W	FE	SR	P
Barred owl	Y	M	W	X	X	-	-
Common nighthawk	S	M	G	-	-	X	-
Chimney swift	S	J, S, M	FE	-	-	X	-
Ruby-throated hummingbird	S	M	FE	-	X	X	-
Common flicker	Y	J, S, M	FE	X	X	-	-
Pileated woodpecker	Y	J, S, M	W	X	X	-	-
Red-bellied woodpecker	Y	J, S, M	W	X	X	-	-
Red-headed woodpecker	Y	J, S, M	W	X	X	-	-
Hairy woodpecker	Y	J, S, M	W	X	X	-	-
Downy woodpecker	Y	J, S, M	FE	X	X	-	-
Great crested flycatcher	S	M	W	X	X	-	-
Acadian flycatcher	S	M	W	X	X	-	-
Barn swallow	T	M	FE	-	-	X	-
Purple martin	S	J, S	FE	-	-	X	-
Blue jay	Y	J, S, M	FE	X	X	-	-
Fish crow	Y	J, S, M	FE	X	X	X	-
Carolina chickadee	Y	J, S, M	W	X	X	-	-
Tufted titmouse	Y	J, S, M	W	X	-	-	-
Carolina wren	Y	J, S, M	W	X	X	-	-
Mockingbird	Y	J	FE	-	X	-	-
Gray catbird	T	S, M	FE	X	X	X	-
Brown thrasher	Y	S	FE	-	X	-	-
Wood thrush	S	J, S, M	W	X	X	-	-
Blue-gray gnatcatcher	Y	J, S, M	W	X	-	-	-
White-eyed vireo	Y	J, S, M	W	X	X	-	-

Table 56 (concluded)

Species	Resident Status	Period Observed	Habitat Preference	Distribution on the Study Site W	FE	SR	P
Yellow-throated vireo	S	S	W	X	-	-	-
Red-eyed vireo	S	J, S, M	W	X	X	-	-
Prothonotary warbler	S	J, S, M	W	X	X	-	-
Worm-eating warbler	T	M	W	X	-	-	-
Swainson's warbler	S	M	W	X	-	-	-
Northern parula	S	J, S, M	W	X	X	-	-
Common yellowthroat	Y	J, S, M	FE	-	X	X	-
Yellow-breasted chat	S	J, S, M	FE	X	X	X	-
Kentucky warbler	S	J, S, M	W	X	X	-	-
Hooded warbler	S	J, S, M	W	X	X	-	-
Red-winged blackbird	Y	J, S, M	M	-	X	X	X
Common grackle	Y	J, S, M	FE	X	X	X	X
Brown-headed cowbird	Y	J, S, M	FE	X	X	X	-
Orchard oriole	S	M	FE	-	X	X	-
Summer tanager	S	M	W	X	X	-	-
Cardinal	Y	J, S, M	W[e]	X	X	-	-
Indigo bunting	S	J, S, M	FE	-	X	X	-
Painted bunting	S	J, S, M	FE	-	X	X	-
Rufous-sided towhee	Y	J, S, M	FE	X	X	-	-

[e]The cardinal is considered a woodland species in the southeast and a forest-edge species elsewhere (Johnston and Odum 1956)

Greatest avian diversity was recorded during the May 1975 survey. Fifty-one species were observed during this period, whereas 38 species were observed during the July and September 1974 surveys (Table 56). Year-round residents comprised 68, 63, and 55 percent of the species observed in July, September, and May respectively.

Forty-one of the observed bird species are primarily insectivores, 7 are granivores, 6 are terrestrial vertebrate carnivores, 3 are scavengers, and 2 feed on aquatic organisms. All species that feed on bark insects and nearly all species that feed on ground insects are year-round residents. All species that feed on flying insects and most species that feed on foliage insects are migratory. Most of the avian species that fall within the other food preference categories are also year-round residents.

Twenty-seven of the 59 bird species generally prefer to inhabit woodlands, 24 are commonly associated with forest-edge situations,* 4 commonly inhabit grasslands or sparsely vegetated areas, 3 prefer marshlands, and 1 is usually associated with woodland ponds and streams (Table 56). Human activities following disposal of dredged material have created numerous forest-edge situations on the study site and have undoubtedly influenced the number of forest-edge bird species now present. Distributions of avian species by habitat on the study site are shown in Table 56.

A breeding bird survey was performed at the WBPC site in May 1975. Three census plots were established and designated A, B, and C (Figure 31). Plot A was located to the south of SR 975. Plant communities present included willow-cottonwood, willow-sycamore-mixed forest, and a small area of bald cypress. Forest-edge situations were present along most of the plot's eastern border, two surveyor cut lines, and an unpaved road which traversed the width of the plot.

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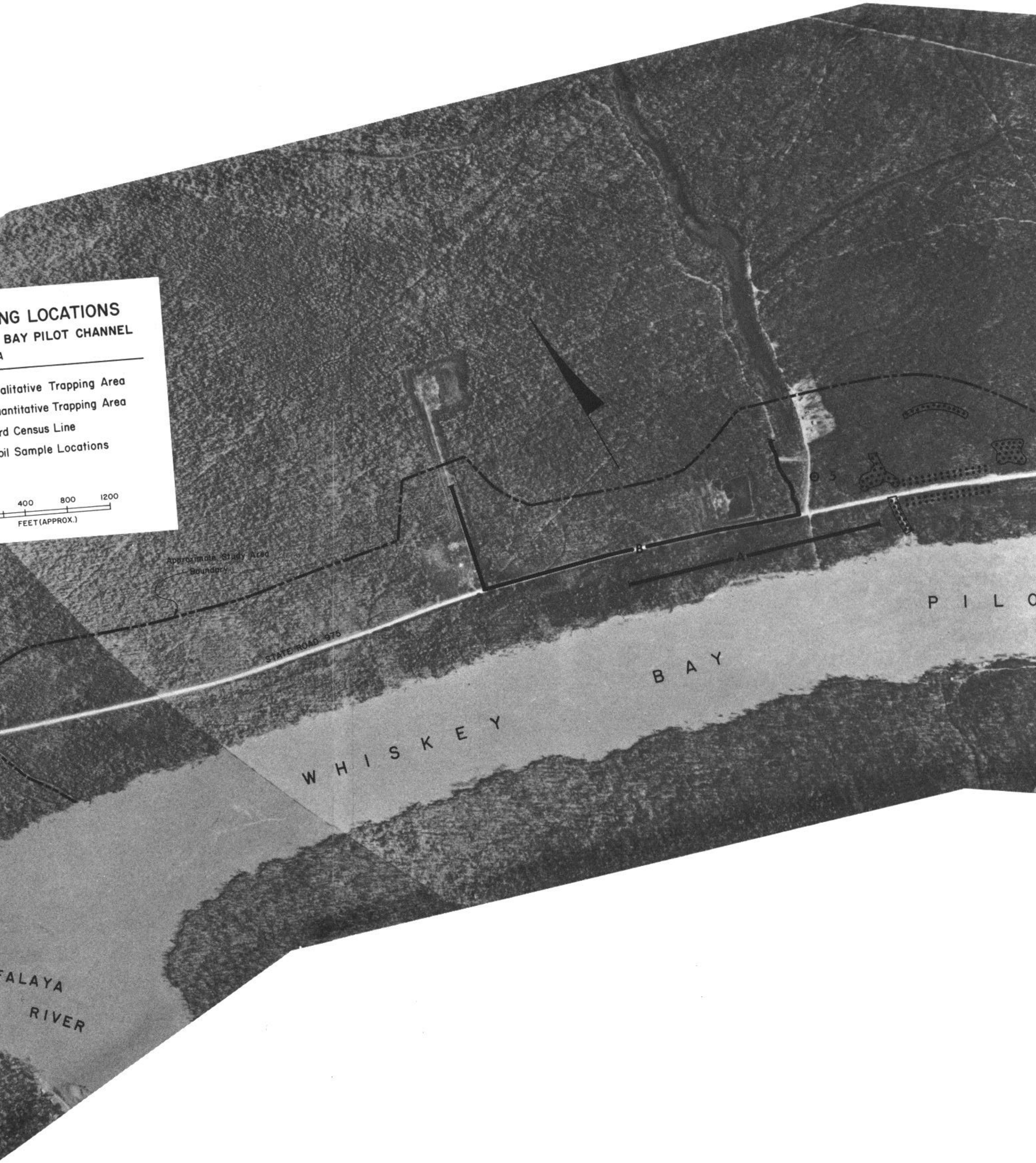
*Species that inhabit forest-edge habitats generally require trees or tall shrubs for nesting, roosting, and singing, and open or shrubby areas for feeding. Many of the same species also inhabit hedgerow situations, but these areas were lacking at the WBPC site.

Approximate Study Area
Boundary
C
STATE ROAD 975
3
2
4
1
OT
C H A N N E L


NG LOCATIONS
BAY PILOT CHANNEL
alitative Trapping Area
antitative Trapping Area
rd Census Line
oil Sample Locations
400 800 1200
FEET (APPROX.)
Approximate Study Area Boundary
STATE ROAD 975
B
A
5
P I L O
W H I S K E Y B A Y
FALAYA
RIVER

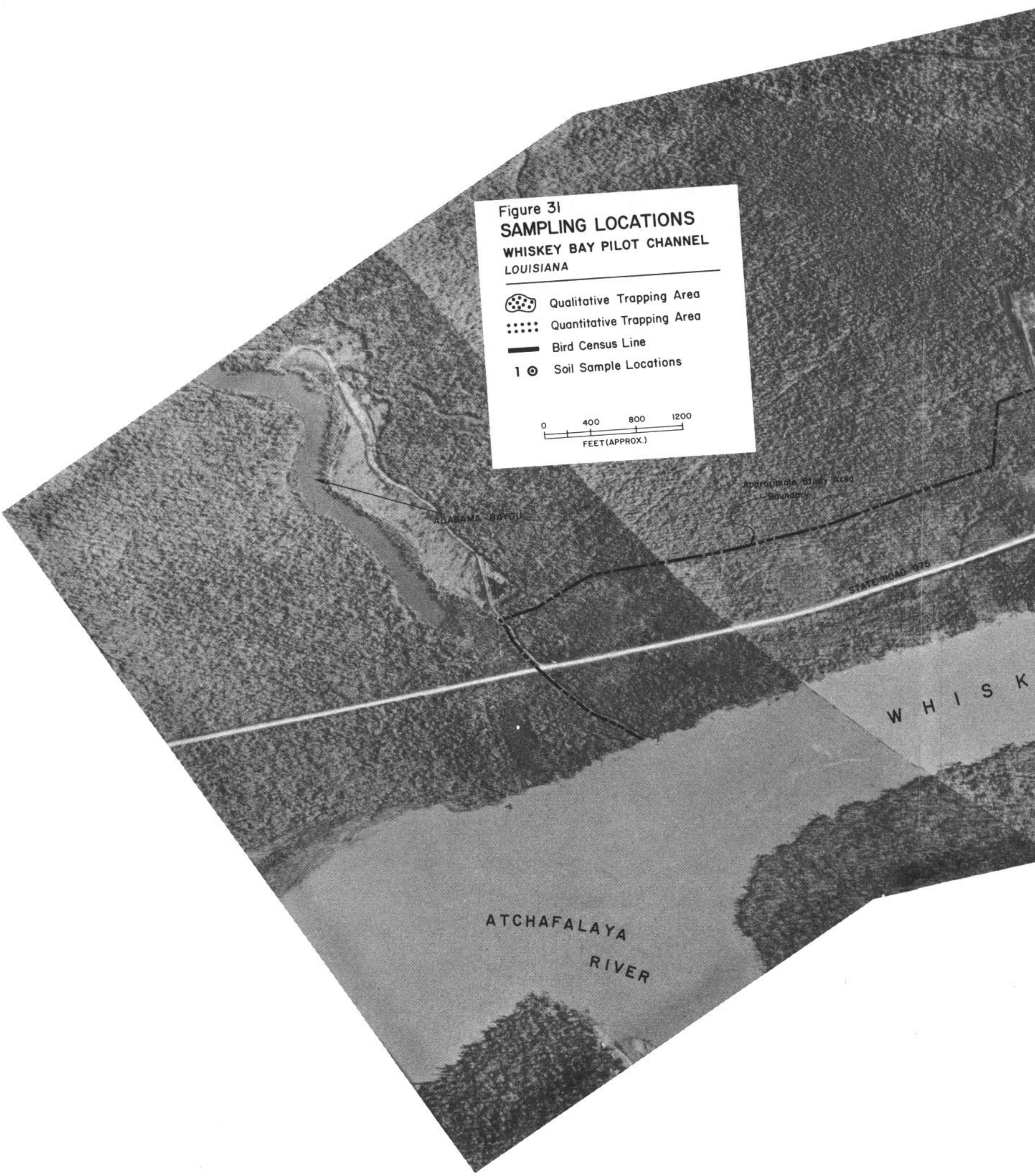


Figure 31
SAMPLING LOCATIONS
WHISKEY BAY PILOT CHANNEL
LOUISIANA

Plot B was located along SR 975 and two unpaved roads. Willow-cottonwood, willow-sycamore-mixed forest, and southern ragweed communities were present on the plot and were arranged such that forest-edge situations predominated throughout. Plot C was located to the north of SR 975 and was vegetated by many of the same plant species found on plot A. However, vegetation on plot C was more homogeneously distributed and stratified. Forest-edge situations occurred along a surveyor cut line at the plot's northwestern terminous and in a small forest opening near the plot's center.

Thirty-one species of birds had established full or partial breeding territories on the three census plots (Table 57). Nineteen of these are summer residents and 12 are year-round residents. The 31 breeding species represent 56 percent of the year-round and summer residents observed on the study site.

The number of breeding territories present on the census plots ranged from 43.5 to 67 (Table 57). The estimated number of breeding territories per 100 acres of similar habitat ranged from 373 to 559. Greatest breeding bird densities were recorded on the woodland census plots (Plots A and C). For comparison, Noble and Hamilton (1973) and Hamilton and Noble (1974) reported 432-645 territories per 100 acres in a loess bluff forest in West Feliciana Parish, and Dickson (1973) reported 308 territories per 100 acres in a mature bottomland hardwood forest in St. Landry Parish.

Seventeen of the 31 breeding species are woodland inhabitants, 11 are forest-edge species, and 3 fall into other habitat preference categories. The number of woodland species present on each census plot was fairly even: 14 were present on plot A, 12 on plot B, and 14 on plot C. As expected, forest-edge species were more numerous on plot B than on plots A and C: 11 forest-edge species on plot B, 5 on plot C, and 4 on plot A. Greatest diversity of breeding species was, therefore, recorded for plot B.

White-eyed vireos, cardinals, and prothonotary warblers were the most abundant woodland breeding species, whereas yellow-breasted

Table 57

Breeding Bird Census Data, Whiskey Bay Pilot Channel Study Site May 1975

Species	Number of Breeding Territories[a]			
	Plot A	Plot B	Plot C	Weighted Average/100 acres[b]
Woodland species:				
White-eyed vireo	11.5 (121)	9.5 (53)	9.5 (100)	82.0
Cardinal	5.0 (53)	3.5 (19)	9.0 (95)	47.0
Prothonotary warbler	8.5 (90)	2.5 (14)	2.0 (21)	35.0
Red-eyed vireo	5.5 (58)	2.0 (11)	2.0 (21)	26.0
Hooded warbler	1.5 (16)	2.5 (14)	5.5 (58)	26.0
Northern parula	4.0 (42)	1.0 (6)	4.0 (42)	24.0
Carolina wren	2.0 (21)	2.0 (11)	1.0 (11)	14.0
Wood thrush	4.0 (42)	+[c]	+	11.0
Yellow-billed cuckoo	2.0 (21)		1.0 (11)	8.0
Acadian flycatcher	2.0 (21)			5.0
Red-bellied woodpecker	+	0.5 (3)	+	1.0
Hairy woodpecker			+	

[a]Estimated number of territories per 100 acres is enclosed within parentheses

[b]Weighted average = $\Sigma A \left(\frac{B}{\Sigma C}\right)$ where A=number of territories recorded on each plot
B=100 acres
C=number of acres on each plot

[c]Indicates less than one-half territory on the census plot

Table 57 (continued)

Species	Number of Breeding Territories			Weighted Average/ 100 acres
	Plot A	Plot B	Plot C	
Mississippi kite	+		+	
Swainson's warbler	+		+	
Summer tanager		+		
Kentucky warbler		+		
Forest-edge species:				
Yellow-breasted chat	3.5 (37)	15.5 (86)	2.0 (21)	57.0
Indigo bunting	0.5 (5)	10.0 (56)	0.5 (5)	30.0
Painted bunting		6.5 (36)		18.0
Brown-headed cowbird	1.0[d] (11)	2.0[d] (11)	2.0[d] (21)	14.0
Rufous-sided towhee		1.5 (8)	3.0 (32)	12.0
Orchard oriole	2.0 (21)	2.0 (11)		11.0
Common yellowthroat		3.0 (17)	1.0 (11)	11.0
Ruby-throated hummingbird		3.0 (17)		8.0
Red-shouldered hawk		+		
Common flicker		+		
Downy woodpecker		+		
Other species:				
Green heron			1.0 (11)	3.0
Wood duck		+		
Red-winged blackbird		+		

[d]Based on the average number of females seen per daily census trip

Table 57 (concluded)

Species	Number of Breeding Territories			
	Plot A	Plot B	Plot C	Weighted Average/ 100 acres
Totals:				
Plot size (acres)	9.47	18.00	9.47	
Number of breeding species	17	25	19	
Number of breeding territories	53.0 (559)	67.0 (373)	43.5 (460)	441

chats, indigo buntings, and painted buntings were the most abundant forest-edge breeding species. Similar findings have been reported by Noble and Hamilton (1973) and Hamilton and Noble (1974). Breeding territory sizes for the above and other species are presented in Tables 58-60.

Active nests of the following species were found on the census plots: cardinal (3), prothonotary warbler (3), Mississippi kite (2), yellow-billed cuckoo (2), green heron (1), wood thrush (1), red-eyed vireo (1), and hooded warbler (1). One of the prothonotary warbler nests had been parasitized by a brown-headed cowbird. Three yellow-breasted chat nests and one wood thrush nest were also found on the study area in July 1974.

Additional year-round and summer residents likely breed on the study area but were not recorded during the breeding bird survey because: (a) some species are early nesters and finished nesting prior to the survey; (b) some species are late nesters and had not begun to establish territories at the time of the survey; and (c) some species are rare, uncommon, or have specialized habitat preferences, minimizing the possibility of their occurrence on the census plots.

Heron nesting colonies were neither present on the census plots nor were any found in other sectors of the study area. Favorable nesting habitat for these birds exists on the study site, and heron nesting colonies are known to be present in nearby woodlands (U. S. Army Engineer District, New Orleans Corps of Engineers 1973). Numerous black-crowned night herons, yellow-crowned night herons, great egrets, snowy egrets, little blue herons, great blue herons, white ibises, and anhingas flew back and forth over the project site in May 1975. These birds may have been flying to feeding grounds to gather food for nestlings.

None of the 59 bird species observed on the Whiskey Bay site are classified endangered by the U. S. Department of the Interior (1974). However, the study area is within the range of the endangered ivory-billed woodpecker and some may still exist in the vicinity

Table 58

Minimum, Maximum, and Average Breeding Territory Sizes for Selected Species on Plot A, Whiskey Bay Pilot Channel Site

Species	Number of Individual Territories Mapped	Territory Size (acres)		
		Minimum	Maximum	Average
White-eyed vireo	11	0.05	0.20	0.10
Prothonotary warbler	9	0.03	0.18	0.09
Cardinal	5	0.13	0.37	0.27
Northern parula	4	0.08	0.24	0.18
Wood thrush	4	0.06	0.31	0.16
Red-eyed vireo	4	0.03	0.11	0.07
Yellow-breasted chat	3	0.08	0.25	0.18
Carolina wren	2	0.07	0.18	0.13
Acadian fly-catcher	2	0.05	0.17	0.09
Yellow-billed cuckoo	2	0.12	0.20	0.16
Hooded warbler	2	0.10	0.12	0.11

Table 59

Minimum, Maximum, and Average Breeding Territory Sizes for Selected Species on Plot B, Whiskey Bay Pilot Channel Site

Species	Number of Individual Territories Mapped	Territory Size (acres)		
		Minimum	Maximum	Average
Yellow-breasted chat	15	.05	.28	.15
Indigo bunting	9	.09	.56	.29
White-eyed vireo	6	.03	.18	.09
Painted bunting	6	.12	.40	.25
Cardinal	3	.34	.40	.32
Common yellowthroat	2	.11	.41	.26
Prothonotary warbler	2	.08	.08	.08
Carolina wren	2	.11	.28	.20
Orchard oriole	2	.09	.32	.21
Red-eyed vireo	1	.03	.03	.03
Rufous-sided towhee	1	.20	.20	.20
Northern parula	1	.17	.17	.17

Table 60

Minimum, Maximum, and Average Breeding Territory Sizes for Selected Species on Plot C, Whiskey Bay Pilot Channel Site

Species	Number of Individual Territories Mapped	Territory Size (acres)		
		Minimum	Maximum	Average
White-eyed vireo	9	.06	.24	.15
Cardinal	7	.06	.28	.15
Hooded warbler	4	.03	.14	.09
Northern parula	3	.06	.12	.09
Rufous-sided towhee	2	.04	.05	.05
Prothonotary warbler	2	.05	.07	.06
Yellow-breasted chat	2	.09	.11	.10
Red-eyed vireo	1	.16	.16	.16
Yellow-billed cuckoo	1	.10	.10	.10
Common yellow-throat	1	.13	.13	.13
Carolina wren	1	.13	.13	.13

(Personal communication, May 1975, G. H. Lowery, Jr., Professor of Zoology, Louisiana State University, Baton Rouge, Louisiana).

b. Mammals. Twelve mammal species or their signs were observed on the WBPC site. Life history information and field notes recorded for each are presented in Appendix C.

Quantitative small mammal live-trapping censuses were performed in the site's willow-cottonwood and willow-sycamore-mixed forest communities in September 1974 (Figure 31). Only eight captures were recorded, thus precluding any attempt to quantify population densities. All animals captured were white-footed mice (*Peromyscus leucopus*).

Qualitative live-trapping for small mammals was performed in willow-cottonwood, willow-sycamore-mixed forest, and southern ragweed communities during the May 1975 survey (Figure 31). Species of small mammals captured were the white-footed mouse, fulvous harvest mouse (*Reithrodontomys fulvescens*), eastern woodrat (*Neotoma floridana*), marsh rice rat (*Oryzomys palustris*), and hispid cotton rat (*Sigmodon hispidus*). All rice rats and cotton rats were captured in the southern ragweed community, although rice rats were usually around ponded water. All other animals were captured within the woodlands or along woodland edges. Rice rats, white-footed mice, and cotton rats were the most frequently captured, and capture ratios (estimated number of individuals captured per 100 trap nights) for all three species were similar (Table 61).

Capture ratios recorded in the southern ragweed community were nearly three times greater than those in woodlands (Table 62). Comparison of capture data also reveals that capture ratios were greater in the woodlands in May than in September. However, since neither of the capture ratios recorded for the woodlands are very great, the small mammal population densities within these habitats may be low. Flooding, which commonly occurs from late winter to late spring throughout the Atchafalaya Basin, is probably the major factor limiting small mammal population densities in the study site's woodland communities. Flooding also probably causes seasonal concentrations of mammals on topographically elevated areas. The willow-cottonwood

Table 61

Quantitative and Qualitative Small Mammal Census Capture Results, Whiskey Bay Pilot Channel Site

Species	Captures[a] Quantitative Census[b]	Captures[a] Qualitative Census[c]
White-footed mouse (*Peromyscus leucopus*)	8[d] (3)	7 (3)
Fulvous harvest mouse (*Reithrodontomys fulvescens*)	0	1
Eastern woodrat (*Neotoma floridana*)	0	3
Marsh rice rat (*Oryzomys palustris*)	0	10 (4)
Hispid cotton rat (*Sigmodon hispidus*)	0	5 (2)
Totals	8 (3)	26 (9)

[a]Capture ratios (estimated number of individuals captured per 100 trap nights) are enclosed in parentheses. Capture ratios were not computed when less than five individuals were captured

[b]Number of trap nights equals 240

[c]Number of trap nights equals 275

[d]Includes three recaptures

Table 62

Small Mammal Capture Results, by Habitat, Whiskey Bay Pilot Channel Site

	Woodlands Sept	Woodlands May	Southern Ragweed Sept	Southern Ragweed May
Number of trap nights	240	180	0	95
Number of individuals captured	8	11	0	15
Capture ratio[a]	3	6	0	17

[a]Estimated number of individuals captured per 100 trap nights

community, which is located on dredged material disposal mounds, likely serves as such a refuge. Some mammals may be able to cope with the flood season by becoming more arboreal in their habits. For example, Neal (1967) has indicated that white-footed mice and eastern woodrats usually construct ground nests throughout the drier portions of their ranges, but frequently construct arboreal nests or utilize abandoned bird nests in flooded areas.

The white-tailed deer (*Odocoileus virginianus*) is probably the dominant mammal on the Whiskey Bay site in terms of biomass and effect on vegetational structure. The average carrying capacity of bottomland hardwood forests in the Atchafalaya Basin is about one deer per 40 acres. However, optimum growth conditions for deer herds located in the mid and lower portions of the basin have persisted over the past 2 years. Deer populations have increased dramatically, as evidenced by densities of one deer per 10 to 15 acres. The deer population on the WBPC study site is presently estimated to have a density of one individual per 15 acres (Personal communication, 31 August 1975, Cecil LaCaze, Wildlife Biologist, Louisiana Wildlife and Fisheries Commission, Region 6, Opelousas, Louisiana).

The white-tailed deer is a browsing herbivore. The 25 most important food plants for deer in Louisiana bottomland hardwood forests have been noted by Murphy (1974). All of these occur on the study site: 19 are present in the willow-sycamore-mixed forest community, 17 are in the willow-cottonwood community, and 8 are in the southern ragweed habitat (Table 63). Understory vegetation in many areas of the study site's woodlands had been extensively browsed by deer between the September 1974 and May 1975 field visits. Extensive browsing during this period may be related to high deer population densities as well as the concentrating effects of flooding. Deer had reportedly overbrowsed vegetation in hardwood forests located to the immediate south of the study site during the winter of 1974-1975. Densities in these areas approximate one deer per 10 acres (Personal communication, Cecil LaCaze).

Table 63

Preferred Food Plants of Deer in Bottomland Hardwood Forests and Their Distribution on the Whiskey Bay Study Site[a]

Species	Common Name	Occurrence Within Dominant Communities[b] WC	WS	SR
Lactuca floridana	Wild lettuce	X	X	X
Desmanthus illinoensis	Prairie mimosa	-	-	X
Campsis radicans	Trumpet creeper	X	X	-
Cephalanthus occidentalis	Buttonbush	-	X	-
Rubus spp.	Dewberry	X	X	X
Desmodium spp.	Beggar's lice	X	X	X
Cornus drummondii	Rough-leaved dogwood	X	X	-
Aster vimineus	Aster	X	-	X
Vitis spp.	Grape	X	X	-
Berchemia scandens	Rattan vine	X	X	-
Ambrosia trifida	Giant ragweed	-	-	X
Fraxinus pennsylvanica	Green ash	X	X	-
Solidago altissima	Goldenrod	-	-	X
Saururus cernus	Lizard's-tail	-	X	-
Sanicula canadensis	Snakeroot	X	-	-
Cocculus carolinus	Red-berried moonseed	X	X	-
Rhus radicans	Poison ivy	X	X	-
Ampelopsis arborea	Pepper-vine	X	X	-
Celtis laevigata	Sugarberry	-	X	-
Quercus spp.	Oak	X	X	-
Smilax spp.	Greenbriar	X	X	-
Acer negundo	Box elder	X	X	-
Ilex decidua	Deciduous holly	-	X	-
Parthenocissus quinquefolia	Virginia creeper	X	X	-
Vicia spp.	Vetch	-	-	X

[a]Based on Murphy (1974)

[b]WC=Willow-cottonwood community; WS=Willow-sycamore-mixed community; SR=Southern ragweed community

White-tailed deer are the most important game species on the study site and deer weighing from 200 to 220 lb have been taken within this region (Personal communication, July 1974, J. B. Angelli and G. R. Hoffman, Louisiana Wildlife and Fisheries Commission). The black bear (Ursus americanus), however, is the largest game animal in the Atchafalaya River Basin. Louisiana Wildlife and Fisheries Commission personnel transported 130 black bear from Minnesota between 1964 and 1967 for release on the Lottie Wildlife Protection Association Hunting Club property, about 12 miles north of the study area between Krotz Springs and Lottie, Louisiana. Approximately 100 bears are believed to be inhabiting the area between the original release point and I-10. This same area, which includes the study site, has been delineated as an approved hunting area for black bear. One bear was reportedly taken during the 1973-1974 hunting season, but the kill was never confirmed (Personal communication, Cecil LaCaze). Signs of black bear were observed on the study site in September 1974.

Other game mammals on the Whiskey Bay site include the raccoon (Procyon lotor), swamp rabbit (Sylvilagus aquaticus), and gray squirrel (Sciurus carolinensis). Raccoons are abundant, especially in low-lying woodlands during the late spring. Crawfish are concentrated in small moist depressions during floodwater recession period and provide an abundant food source for raccoons. Swamp rabbits are also common on the study site but may occasionally suffer heavy population losses as a result of extensive flooding. Swamp rabbits rear their young in ground nests and peak nesting often coincides with the flood season. Lowery (1974) reported that extreme flooding has been known to inflict heavy population losses and to extirpate this species locally. Gray squirrels are not common on the study site because existing woodlands provide little favorable food.

None of the 12 mammal species recorded on the Whiskey Bay site are classified endangered (U. S. Department of the Interior 1974). However, the site is within the range of the endangered red wolf (Canis rufus). Lowery (1974) indicated that a few individuals may still exist in the region.

c. Reptiles and amphibians. Bottomland hardwood forests provide a variety of microhabitats and often support a great diversity and density of reptiles and amphibians. Seasonal flooding within bottomland hardwood forests is especially beneficial for amphibians as it creates the necessary aquatic habitats that many of these animals require for egg laying and larval development. Range maps in Conant (1975) indicate that 82 species of reptiles and amphibians may occur in the Whiskey Bay area. Eighteen of these were observed on the study site during the field surveys: two turtles, two lizards, seven snakes, two toads, and five frogs (Appendix C). Two of the observed species, the bullfrog (*Rana catesbeiana*) and red-eared turtle (*Chrysemys scripta elegans*), provide sport and/or economic benefits for residents in the Atchafalaya River Basin.

None of the 17 reptile and amphibian species are classified endangered (U. S. Department of the Interior 1974). However, the endangered American alligator inhabits the WBPC and could be present in favorable habitat on the study site.

d. Immigration and Colonization. The Whiskey Bay site is not isolated by any barriers; consequently, faunal immigration and colonization should not be retarded. Most of the site is surrounded by woodlands, which should facilitate the invasion of animals associated with these habitats.

159. Past patterns of animal succession. Dredged material disposal from 1935 to 1936 destroyed existing habitats and displaced existing fauna. Unvegetated areas were created that were initially unsuitable for utilization by most vertebrates except as nesting or burrowing sites. Vertebrates that perhaps utilized the unvegetated areas include killdeer, common nighthawks, gulf coast toads, and red-eared turtles. Several species of gulls and terns utilize coastal dredged material disposal sites for nesting. However, most of these species seldom wander far inland and only the least tern may have utilized this disposal site for such purposes.

160. By 1940 the dredged material disposal site was vegetated by an advanced old field habitat interspersed by numerous shrubs and young trees. The presence of the old field provided open areas that forest-edge fauna require for feeding. Many of the same forest-edge species observed during the field surveys may have established populations at this time. The old field habitat may also have been inhabited by many of the same vertebrate species now present in the southern ragweed community. An abandoned railroad in the southern portion of the site was vegetated by similar habitat and may have provided a corridor by which many less mobile species (such as hispid cotton rats and marsh rice rats) may have immigrated. Utilization of the dredged material disposal site by species associated with the unvegetated stage was likely much reduced by 1940.

161. Willows and cottonwoods dominated the dredged material disposal site by 1950. Many of the woodland species now present may have established populations by this period. Growth of arborescent vegetation reduced forest-edge and old field habitats and the diversity and density of associated faunal species. Species associated with the unvegetated stage had probably emigrated.

162. The study site was again utilized for dredged material disposal between 1950 and 1962. Nine dredged material mounds were created at varying intervals along the older ridge. The mounds created insular situations within the woodland community. Faunal succession was probably similar to that which occurred on the initial dredged material disposal site. Many of the forest-edge and early successional species now present may have established populations following the second disposal period.

163. Future patterns of animal succession. Most vertebrates now inhabiting the willow-cottonwood and willow-sycamore-mixed forest communities are characteristic of deciduous woodlands in southern Louisiana and should remain when the climax stage is reached. Some species, however, will likely experience density fluctuations in association with successional changes in vegetation.

164. Several species of vertebrates are common on deciduous woodlands throughout the lower Atchafalaya Basin but were not observed on the WBPC site. These include the Virginia oppossum (*Didelphis marsupialis*), fox squirrel (*Sciurus niger*), striped skunk (*Mephitis mephitis*), broad-headed skink (*Eumeces laticeps*), southeastern five-lined skink (*Eumeces inexpectatus*), eastern spadefoot (*Scaphiopus holbrooki*), several salamanders, wild turkey, warbling vireo, and yellow-throated warbler. Some of these may currently use the study site but were overlooked because of their inconspicuousness or secretive habits. Others could establish populations in the future.

165. The gray squirrel and white-tailed deer are important game species in the Atchafalaya Basin. Gray squirrels will likely increase in abundance as mast-producing trees become established. The deer population of the study site, however, could probably not exceed existing densities without the occurrence of overbrowsing conditions.

166. Forest-edge species and species associated with the southern ragweed community will likely remain on the study site as long as road rights-of-way and the powerline corridor are maintained.

Potential Resources of Regional Upland Disposal Areas

167. Dredged material deposited in otherwise bottomland or swamp forest of the Atchafalaya River Basin creates insular situations utilized by more upland biotic types. Overall biotic diversity of the region is increased, and the insular situations provide refuge during regional flooding for local ground-dwelling animals. The establishment of a hunting camp within the study site attests to the more favorable hunting conditions created by the dredged material.

Regional Sere for Upland Disposal Areas

168. A regional sere for upland dredged material follows that suggested in Figure 30. Because of the great species diversity of the Atchafalaya bottomlands and swamps, and because direct seral relations are confused by intermittent disposal in the same areas, development of climax vegetation may take many courses. In general, a herbaceous community forms the pioneer stage. A shrub species stage is absent,

but the shrub stage of tree species is functional in a similar way, even if for a shorter period of time. Black willow, cottonwood, and sycamore will probably dominate the pioneer arborescent stage, and will be slowly replaced by other tree species characteristic of more mature or climax vegetation of upland areas.

Part VII: High Island-GIWW, Texas

Description of Regional Setting

169. The High Island-GIWW disposal area (High Island site) is located along the northwest side of the Gulf Intracoastal Waterway (GIWW), approximately 1.5 miles northeast of High Island, Texas, the nearest town (Figure 32). More specifically, the site is in Chambers County immediately southwest of North Prong Mud Bayou and extends one mile southwest toward the State Highway 124 swing-bridge that crosses the GIWW.

170. The region around the High Island site is known as the Gulf Prairies and Marshes Area (Correll and Johnston 1970), but is generally referred to as wet prairie in this study. Most of the wet prairie in the vicinity of the study area is low and subject to tidal and/or storm flooding. Where drainage is poor, standing water may remain over the soil surface for long periods. Soils are usually sandy loams and clays. The portion of the wet prairie immediately surrounding the High Island site is very low and poorly drained. It is dominated by saltmeadow cordgrass (*Spartina patens*) and supports various species of sedges (Cyperaceae), rushes (*Juncus* spp.) and other grasses. A strong saltwater influence is indicated by the abundance of facultative halophytes.

171. Other important vegetation associations occurring in the general vicinity are more-or-less disturbed maritime-like forests on sandy, well-drained salt domes. The town of High Island is on the closest dome. Live oak (*Quercus virginiana*) is the dominant tree and yaupon (*Ilex vomitoria*) is the most important shrub of the less disturbed portions of this forest type. Even on the dome, which rises at least 25 ft above the surrounding terrain, this forest type is not very extensive. Much of it may have been displaced for agricultural use and buildings.

172. The low latitude and coastal location of the study area provide a maritime-subtropical climate. Rainfall is concentrated in the summer months and mean monthly temperatures do not fall below 50°F.

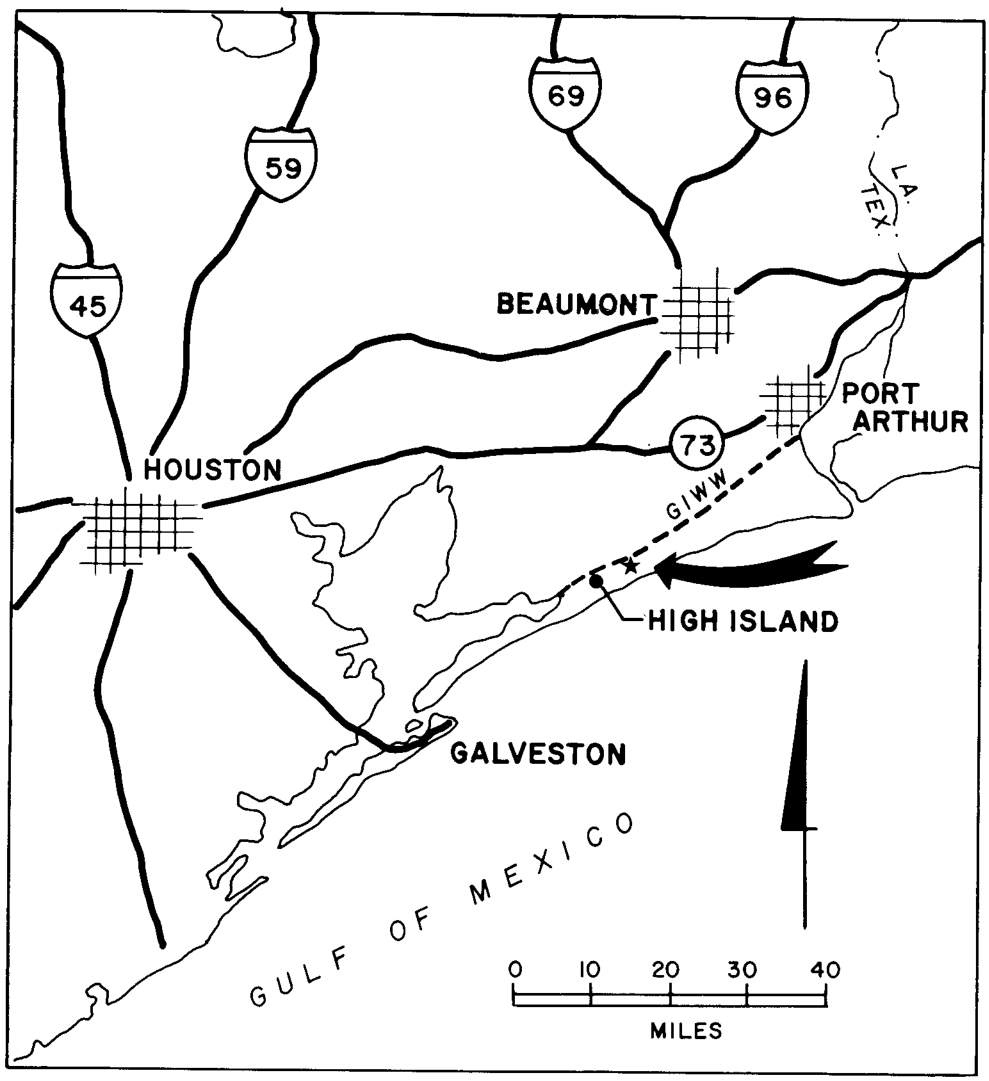


Figure 32 Vicinity Map, High Island, Texas

173. Stations recording meteorological data most pertinent to the High Island site are located in Port Arthur and Galveston (U. S. Department of Commerce 1965b). The mean annual temperature is 69.9°F at Galveston and 69.3°F at Port Arthur. Highest temperatures occur in July and August. Both months at each station have a mean temperature only slightly above 83°F. January, the coldest month of the year, has a mean temperature of about 54°F at each station. Mean annual precipitations of 41.81 in. in Galveston and 69.5 in. in Port Arthur illustrate the increasing annual precipitation from west to east across the state (U. S. Department of Commerce 1973d).

174. Winds are variable with an annual mean speed of 11 mph. During the winter months frontal systems influence the wind direction, while during the summer and fall months winds are influenced by the Azore High, local thunderstorms, tropical depressions, and the land-sea breeze effect (Orton 1969).

175. The most prevalent storms are thunderstorms that occur during an average 60 days each year. They occur most frequently during the summer months (Orton 1969). Tropical storms of all intensities, a frequency of one per year, have affected the Texas coast. The tropical storm season extends from June through October.

176. Reports of investigations of vegetation associations developing on dredged material within the wet prairie were not found in the literature. The nearest similar situation was described for a dredged material island along the GIWW in Laguna Madre by Barnes (1971). This island, created between 1945 and 1949, receives additional dredged material approximately every 2 years. The seral stages are therefore maintained at a very early level. Soils on the island were more than 80 percent sand, very different from soils of the High Island site. The most abundant plants found by Barnes were ragweed (*Ambrosia artemisiifolia*), dropseed (*Sporobolus virginicus*), purslane (*Sesuvium portulacastrum*), paspalum (*Paspalum vaginatum*), camphor weed (*Heterotheca subaxillaris*), and sea oxeye (*Borrichia frutescens*).

177. The High Island site lies in the outer Western Gulf Coastal Plain of largely recent, low, marine and eolian sediments that includes the coastal prairies and marshes (Thornbury 1965). Topographic highs occasionally occur in the form of salt domes such as the one on which the town of High Island is located. Just south of High Island, a low dune parallels the shoreline of the Gulf of Mexico. The eastern end of the Western Gulf barrier island system is the Bolivar Peninsula that extends southwest from near High Island. Recent sediments lie over older strata layed down since Cretaceous times by a series of largely marine deposits.

History of the Disposal Area

178. Initial disposal of dredged material at the High Island site took place between 1931 and 1933, according to information provided by the Galveston District. These first materials were primarily soft clay and small amounts of stiff sandy clay, topsoil, and mud. Additional disposals took place in 1952 and 1965. The disposal areas were diked only so that slurry flowed to the northwest away from the GIWW and creeks adjacent to the site.

Ecological Analysis

Physical characteristics

179. Topography. The High Island disposal site is almost exactly 1 mile in length. Widths vary, depending upon the extent dredged material flowed to the northwest. Approximately seven major dredged material hills have been constructed along the length of the site at pipeline discharge points. Elevations of these hills vary from 10 to 15 ft msl along the highest that form the southern edge of the site along the waterway. The surface of the dredged material slopes northward and intergrades along an ill-defined line with the native soils of the wet prairie.

180. The southern edge of the site is formed by a vertical escarpment that drops to the waterway. The height of the escarpment is 8 or 9 ft at the highest portions, and less than 2 ft at the lowest sections. The bank has formed largely as a result of slumping caused

by boat wakes. Erosion is rapid and probably measurable in terms of feet per year. During periods of heavy fog or at night when travel is unsafe, the vertical banks are used for mooring when barges are purposely run aground against the bank. This activity is also responsible for much erosion.

181. Soils. Soils of the High Island-GIWW disposal area are composed of largely fine sand and some silt, with lenses of coarser sand and larger particles (Table 64). Thin surface veneers of soil are usually composed of fine sand bleached white by the sun.

182. Microclimate. Microclimate data gathered at the High Island site point out that, on the average, temperatures above the ground and below the litter vary more widely in communities with less vegetation (Table 65). Means of temperature differences between 0.5 m above the soil and below the litter may be used to ordinate the communities in terms of temperature regimes. From most extreme to least extreme the order is:

Vegetation Association	Means of Temperature Differences Between 0.5 m and Below the Litter
Unvegetated	0.8
Sea oxeye-gulf cordgrass	2.0
Toothache tree-silverling-common reed	2.0
Common reed	4.0
Silverling-saltmeadow cordgrass	4.6
Tamarisk	4.7

Temperatures at the surface and within the soil were generally greater in unvegetated and sea oxeye-gulf cordgrass areas. Litter surface temperature under tamarisk is less than that under silverling-saltmeadow cordgrass because of more effective air mixing and shade. Mixing of outside air within mats of saltmeadow cordgrass is slower.

183. Mean relative humidity for the entire sample was 73.4 percent, while the mean for each month when sampling occurred was 53.7

Table 64

Physical Description of High Island Site Soils

Biotic Community[b]	Sample Number	Sample Depth, cm	-1	0	1	2	3	4	5	6	7	8-14
			Particle-Size Distribution - Phi Scale[a]									
Silverling-saltmeadow cordgrass	1-1	0-8	0.0	0.0	0.8	6.8	22.6	39.8	15.0	11.6	2.4	1.0
	1-2	8-25	0.0	0.0	0.0	4.8	22.8	55.2	13.8	1.6	1.8	0.0
	1-3	25-48	18.2	15.2	12.4	9.2	12.0	28.8	3.0	1.2	0.0	0.0
	1-4	48-97	0.0	0.0	0.4	4.0	10.6	38.4	44.0	2.0	0.6	0.0
	1-5	97-183	0.0	0.0	2.8	11.6	10.2	35.0	7.6	30.6	2.2	0.0
Tamarisk	2-1	8-10	0.0	0.4	2.6	4.4	15.8	57.2	13.0	6.2	0.4	0.0
	2-2	10-183	0.0	0.0	0.2	10.4	20.8	22.6	17.8	25.2	1.2	1.8
Unvegetated	3-1	0-38	0.0	0.0	0.0	0.8	18.0	46.2	18.6	14.6	0.2	1.6
	3-2	38	0.0	0.0	0.8	42.6	21.0	8.6	1.0	14.8	11.2	0.0
Toothache tree-silverling-common reed	4-1	0-13	0.0	3.6	12.4	13.2	21.0	6.2	30.0	12.0	1.6	0.0
	4-2	13-122	0.0	3.0	15.8	14.8	19.2	12.0	14.0	19.8	1.2	0.2

[a]Phi scale corresponds to the following Wentworth sizes:

Phi Scale	Wentworth Size
-1	Granule
0	Very coarse sand
1	Coarse sand
2	Medium sand
3	Fine sand
4	Very fine sand
5	Coarse silt
6	Medium silt
7	Fine silt
8-14	Very fine silt & clay

[b]See Figure 33

Table 65

Microclimate Data for High Island

Date 1974	Biotic Community	Time	Percent Relative Humidity	Depth of Sample - Temperature, °C: 0.5 m	Litter Surface	Below Litter	-2 cm	-10 cm
5 August	Silverling-saltmeadow cordgrass	AM	72	31	27	27	25	25
		PM	58	34	37	26	25	24
		PM	48	34	38	31	29	28
		PM	51	34	36	28	28	26
	Unvegetated	PM	52	35	38	NA[a]	31	27
	Silverling-saltmeadow cordgrass	PM	50	35	42	27	25	25
		PM	54	31	32	29	28	26
		PM	45	32	33	27	26	25
7 August	Silverling-saltmeadow cordgrass	PM	NR[b]	35	27	27	26	25
		PM	NR	28	27	26	25	25
9 Oct	Silverling-saltmeadow cordgrass	AM	92	25	24	23	23	23
		AM	87	29	26	26	24	24
	Tamarisk	AM	84	28	25	23	22	21
	Common reed	AM	76	26	23	22	21	20
	Unvegetated	AM	68	31	32	NA	28	24
10 Oct	Toothache tree-silverling-common reed	AM	66	30	29	28	27	24
18 May	Tamarisk	AM	97	24	24	22	22	22
	Silverling-saltmeadow cordgrass	AM	100	23	22	22	22	22
	Sea oxeye-gulf cordgrass	AM	91	25	27	24	24	24
	Unvegetated	AM	89	26	26	NA	26	24
21 May	Silverling-saltmeadow cordgrass	AM	82	33	27	26	25	24
	Tamarisk	AM	84	33	25	NA	25	24
	Sea oxeye-gulf cordgrass	AM	84	31	28	28	28	26
	Unvegetated	AM	84	32	31	NA	30	29

[a]NA = Litter absent [b]NR = Not recorded

percent for August, 78.8 percent for October, and 88.9 percent for May.

Biological characteristics

184. Analysis of existing vegetation. Variations in slope and elevation along the main ridge and from the ridge northward are among the major factors controlling plant distribution within the study area. Other factors controlling plant associations are the occurrence of drainage ditches, plant species composition of the surrounding landscape, distributions and extent of dredged material from the various disposal periods mentioned previously, fire, grazing, and ants.

185. A ditch is located about one half mile to the west of the North Prong Mud Bayou. This ditch cuts the lower elevations of the study site into two somewhat different areas. On the northeast side of the ditch, wet prairie has been displaced further to the north by dredged material. The other drainage ditch occurs next to North Prong Mud Bayou at the northeastern end of the site, but its effectiveness within most of the study site has been considerably reduced as a result of plugging with dredged material and subsequent plant growth. An ephemeral pond is the last remaining evidence of this ditch.

186. Fire, usually moving in from adjacent wet prairie, is common in the study area. Evidence of past fire was found during all field trip periods, and a very recent fire had burned into a portion of the study area just prior to the May 1975 field trip. Grazing by cattle was important in the past, but no recent signs of grazing were found during any of the trips.

187. Hundreds of colonies of fire ants (*Solenopsis invicta*) occur throughout the study area. Presence of these insects in such great numbers strongly influences certain physical and biological processes on and within the dredged material. The ants construct mounds up to 2 or 2.5 ft above the ground, and probably well below the surface. The annual rate of soil turnover and change in physical and chemical characteristics as a result of ant-mound construction must be very great.

188. Farrier et al. (1972) found a range in size of 27 fire ant mounds in North Carolina in which the above-ground volume varied between 2458.62 cc and 28.26 cc. Below-ground volumes varied between 9780.05 cc and 207.44 cc. In all cases, it was found that below-ground volumes exceeded above-ground volumes. In all mounds measured by Farrier, above-ground volumes were found to constitute only one fourth or less the total volume of the nest. If both portions of the nest have equal chambering, then a great deal of soil material must be removed by rain, wind, and disturbance by animals. Unfortunately, the relative uniformity of chambering is not known. Although soil particles are rather firmly cemented during mound construction, rain causes erosion, particularly when mounds are constructed in the most exposed situations.

189. Frequently, the mounds are constructed around or within clumps of plants, notably, saltmeadow cordgrass and gulf cordgrass (*Spartina spartinae*). Both of these species may offer some protection from armadillos, possibly the ants' major predator. Mounds constructed in heavy growths of saltmeadow cordgrass are scarcely visible. Ant mounds in unvegetated areas are generally small, unless a clump of cordgrass or camphor daisy (*Machaeranthera phyllocephala*) has been incorporated into their construction.

190. Each mound is a maze of above-ground and below-ground passageways. These passageways act as gas exchange conduits, which probably increase soil aeration within the volume of the mound. Organic matter transported by ants is incorporated in the above and below-ground portions of the mounds and eventually becomes a portion of the soil.

191. Several mounds were uninhabited, but retained their basic structure even after periods of rain. The crumb structure of soil particles as reconstituted by ants around the outside surface broke down, and entrance holes to the surface were clogged; however, very little if any of the internal structure changed through short periods

of rain. If the mound was inhabited, the ants would reopen the passages to the surface after the rain ceased. How long the mounds retain their internal structure after abandonment is not known. Some abandoned mounds noted during the October 1974 field work were also seen during the May 1975 trip.

192. Just north of the study site there is gradual transition to wet prairie dominated by saltmeadow cordgrass, saltgrass (Distichlis spicata), paspalum (Paspalum vaginatum), sedges (Scirpus spp. and Cyperus spp.) and rushes. Within the study area, the above plants decrease in overall dominance in high ground habitat. The primary habitat gradients occur across the study site (northwest-southeast) rather than parallel to the waterway. The plant associations occurring across these gradients have been divided into the following biotic communities (Figure 33):

Unvegetated
Sea oxeye-gulf cordgrass
Toothache tree-silverling
Tamarisk
Silverling-saltmeadow cordgrass
Common reed

a. Unvegetated. More than 7 acres (Table 66) of unvegetated soil are scattered throughout the study site in both high and low areas, but within the units defined as "unvegetated" in the biotic community map sparse vegetation does exist (Table 67). The plants composing this vegetation are of three basic sorts: (1) clump or tussock plants growing well away from any other plants of adjacent biotic communities, (2) plants with long rhizome systems extending into otherwise unvegetated areas from adjacent communities, and (3) short-lived spring or early summer annuals.

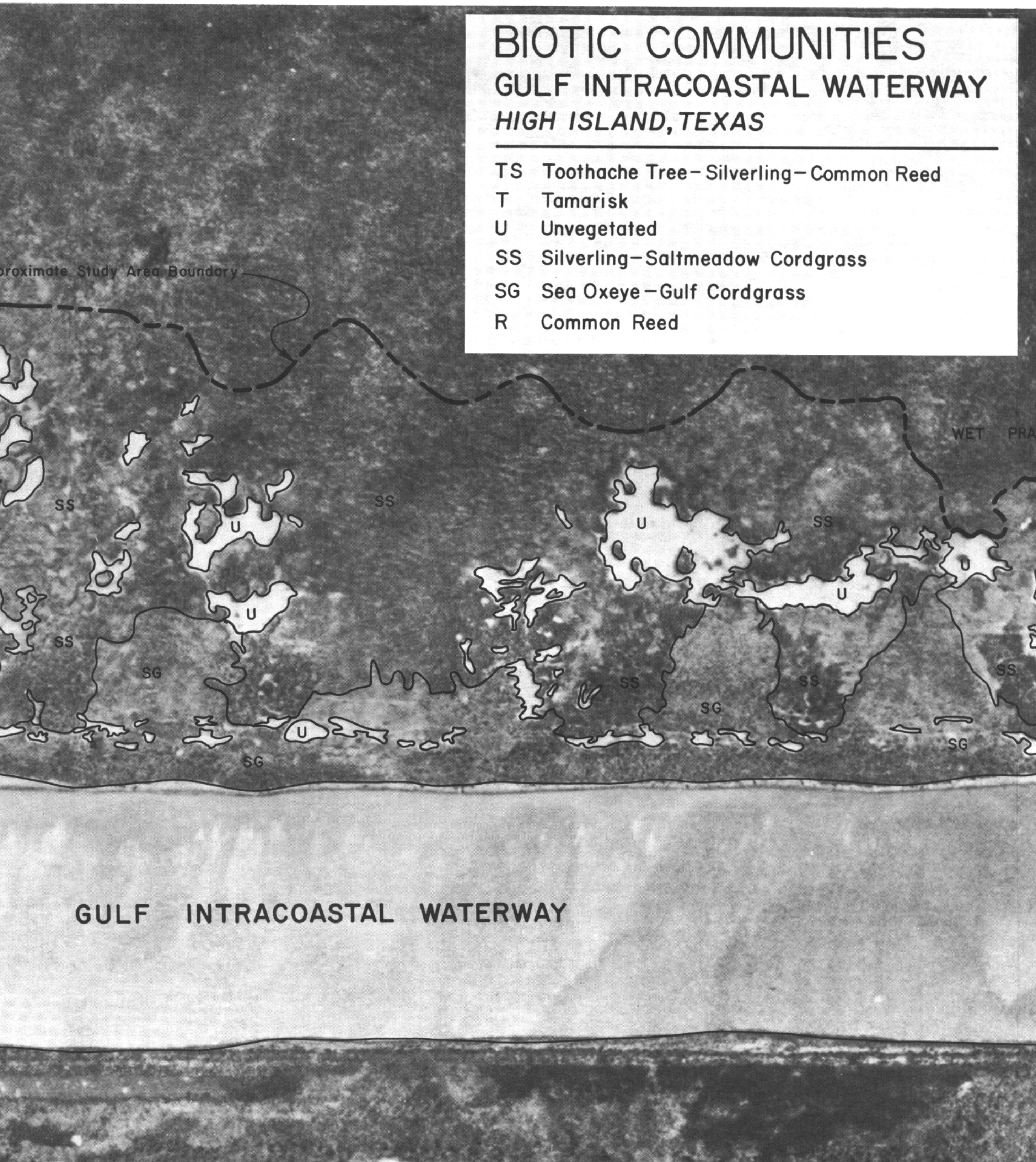
Clump-forming plants most commonly growing in the defined bare areas are gulf cordgrass, camphor daisy, and broomsedge (Andropogon glomeratus). Plants growing into unvegetated areas on long rhizome systems are paspalum, saltgrass, and common reed (Phragmites communis). Spurrey (Spergularia marina) and peppergrass (Lepidium virginicum)


WET PRAIRIE
R
R
SS
U
U
R
R
R
U
U
SG
SS
SS
SG
U
T
T
U
SG
U
U
T
T
T
T
EPHEMERAL POND
DRAINAGE
DITCH
MUD BAYOU
NORTH PRONG
WATERWAY
0
100
200
300
400
FEET (APPROX.)

Figure 33


Approximate Study Area Boundary
R
R
R
SS
SS
SS
SS
SS
SS
SS
U
U
U
U
U
U
U
U
SG
SG
SG
SG
SG
GULF INTRACOASTAL WAT
100
0
10
FEE

ES
TERWAY
on Reed
DRAINAGE DITCH
WET PRAIRIE
WET PRAIRIE
SS
R
SS
U
U
U
SS
SS
SG
SS
SG
SS
U
SG
U
U


BIOTIC COMMUNITIES
GULF INTRACOASTAL WATERWAY
HIGH ISLAND, TEXAS
TS Toothache Tree – Silverling – Common Reed
T Tamarisk
U Unvegetated
SS Silverling – Saltmeadow Cordgrass
SG Sea Oxeye – Gulf Cordgrass
R Common Reed
proximate Study Area Boundary
WET PRA
SS
U
SG
GULF INTRACOASTAL WATERWAY

Approximate Study Area Bou
DRAINAGE DITCH
SS
U
TS
SG
Approximate
GULF
HIGH ISLAND, TEXAS 1.5 MILES

Table 66

Acreages of Biotic Communities, High Island Site

Biotic Community	Acres	Percent
Unvegetated	7.2	10.1
Sea oxeye-gulf cordgrass	15.0	21.0
Toothache tree-silverling-common reed	1.9	2.7
Tamarisk	0.4	0.6
Silverling-saltmeadow cordgrass	42.5	59.7
Common reed	3.7	5.2
Ephemeral pond	0.5	0.7
Total	71.2	100.0

Table 67

Average Percent Cover and Relative Values for Herb Species in the Unvegetated Community of the High Island Site

Species	Average Percent Cover[a]	Relative Value
August 1974		
Herbaceous Layer		
Rush (*Juncus* sp.)	2.5	33.3
Seaside heliotrope (*Heliotropium curassavicum*)	2.5	33.3
Paspalum (*Paspalum vaginatum*)	2.5	33.3
	7.5	99.9
May 1975		
Camphor daisy (*Machaeranthera phyllocephala*)	4.0	36.4
Spurrey (*Spergularia marina*)	3.0	27.3
Saltgrass (*Distichlis spicata*)	2.0	18.2
Seaside heliotrope (*Heliotropium curassavicum*)	1.5	13.6
Saltmeadow cordgrass (*Spartina patens*)	0.5	4.5
	11.0	100.0

[a]Average cover for all 0.5-m^2 quadrats

function as annuals. Seaside heliotrope (*Heliotropium curassavicum*) is also frequently present. Table 67 gives an indication of the seasonal variation within these areas.

Growth of plants in unvegetated areas is strongly influenced by fire. Evidence of fire was noted in the field during the summer and fall trips in 1974. Recent fire had burned about 10 to 15 acres of the southwestern portion of the study area by the time of the May 1975 trip. If fires frequently sweep across portions of the study site, plants growing in or into unvegetated areas are "fire pruned." Clump-forming plants are much more capable of surviving such fires. Spring annuals grow, flower, and produce seed for the following year in a very short time, therefore there is less risk of their being burned.

b. Sea oxeye-gulf cordgrass. The ridge and lumps along the southern margin of the site rise 10 to 15 ft above the surrounding wet prairie. The most common shrub and herb species along the ridge are sea oxeye and gulf cordgrass, respectively. Both are perennial, somewhat xerophytic, and facultative halophytes. Sea oxeye reproduces largely by sending up 1 to 3 ft aerial stems from a complex system of underground rhizomes. Gulf cordgrass grows in very dense round clumps that arch over from the centers and resemble large, green cushions. The tips of the blades are armed with very sharp points. Single clumps may be as much as 2.5 to 3 ft high and 5 ft in diameter. The clumps provide excellent cover for small animals.

Many other mostly herbaceous species occur throughout this association (Tables 68 and 69). Boneset (*Eupatorium serotinum*), splitbeard bluestem (*Andropogon ternarius*), verbena (*Verbena* sp.), and a goldenrod (*Solidago sempervirens*) are most noteworthy. A shift in herb subdominants is indicated by comparing data taken in the summer with data obtained in the fall (Tables 68 and 69). This shift is probably only an apparent one, as the fall sampling included only a few hundred feet of the northeastern end of the ridge.

Table 68

Density, Average Percent Cover, and Relative Values for Shrub and Herb Species in the Sea Oxeye-Gulf Cordgrass Community of the High Island Site, August 1974

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Gulf cordgrass (*Spartina spartinae*)	7.44	16.0	15.5
Boneset (*Eupatorium serotinum*)	6.80	14.6	14.2
Splitbeard bluestem (*Andropogon ternarius*)	5.00	10.7	10.4
Verbena (*Verbena* sp.)	4.23	9.1	8.8
Goldenrod (*Solidago sempervirens*)	4.10	8.8	8.5
Unidentified grass	2.31	5.0	4.8
Broomsedge (*Andropogon glomeratus*)	2.18	4.7	4.5
Saltmeadow cordgrass (*Spartina patens*)	2.05	4.4	4.3
Three-awn (*Aristida* sp.)	2.05	4.4	4.3
Euthamia leptocephala	1.67	3.6	3.5
Camphor daisy (*Machaeranthera phyllocephala*)	1.54	3.3	3.2
Seaside daisy (*Gaillardia pulchella*)	1.28	2.7	2.7

[a]Average cover for all 0.5-m quadrats

Table 68 (continued)

Species	Average Percent Cover	Relative Cover	Total Relative Value
Eupatorium sp.	1.28	2.7	2.7
Paspalum (*Paspalum vaginatum*)	0.51	1.1	1.0
Loosestrife (*Lythrum lanceolatum*)	0.51	1.1	1.1
Common reed (*Phragmites communis*)	0.51	1.1	1.1
Rush (*Juncus* sp.)	0.38	0.8	0.8
Sourgrass (*Oxalis* sp.)	0.38	0.8	0.8
Goldenrod (*Solidago altissima*)	0.38	0.8	0.8
Goldenrod (*Solidago* sp.)	0.26	0.6	0.5
Spurge (*Euphorbia* sp.)	0.26	0.5	0.5
Panic grass (*Panicum* sp.)	0.26	0.5	0.5
Unidentified sp.	0.13	0.3	0.3
St. John's wort (*Hypericum drummondii*)	0.13	0.3	0.3
Unidentified herb	0.13	0.3	0.3
Sensitive brier (*Shrankia microphylla*)	0.13	0.3	0.3
Sneezeweed (*Helenium amarum*)	0.13	0.3	0.3
Primrose (*Oenothera* sp.)	0.13	0.3	0.3

Table 68 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Unidentified seedling	0.13	0.3	0.3
Bentgrass (*Agrostis* sp.)	0.13	0.3	0.3
Daisy fleabane (*Erigeron strigosis*)	0.13	0.3	0.3
	46.55	100.0	
Shrubs:			
Sea oxeye (*Borrichia frutescens*)	0.78	54.9	1.6
Silverling (*Baccharis halimifolia*)	0.64	45.1	1.3
	1.42	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Sea oxeye (*Borrichia frutescens*)	17.97	44,930.0	92.3
Silverling (*Baccharis halimifolia*)	1.49	3,730.0	7.7
	19.46	48,660.0	100.0

Table 69

Average Percent Cover and Relative Values for Herb Species in the Sea Oxeye-Gulf Cordgrass Community of the High Island Site, October 1974

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Gulf cordgrass (*Spartina spartinae*)	29.00	37.7
Drop-seed (*Sporobolus asper*)	10.00	13.0
Splitbeard bluestem (*Andropogon ternarius*)	8.50	11.0
Saltmeadow cordgrass (*Spartina patens*)	8.00	10.4
Western ragweed (*Ambrosia psilostachya*)	4.00	5.2
Three-awn (*Aristida longespica*)	4.00	5.2
Sneezeweed (*Helenium amarum*)	3.00	3.9
Lacegrass (*Eragrostis capillaris*)	2.00	2.6
Goldenrod (*Solidago sempervirens*)	1.50	2.0
Saltgrass (*Distichlis spicata*)	1.50	2.0
Common reed (*Phragmites communis*)	1.00	1.3
Broom sedge (*Andropogon glomeratus*)	1.00	1.3

[a]Average cover for all 0.5-m^2 quadrats

Table 69 (concluded)

Species	Average Percent Cover	Relative Value
Camphor daisy (*Machaeranthera phyllocephala*)	1.00	1.3
Marsh elder (*Iva* sp.)	1.00	1.3
Goldenrod (*Solidago altissima*)	.50	.6
Seaside daisy (*Gaillardia pulchella*)	.50	.6
Daisy fleabane (*Erigeron strigosus*)	.50	.6
	77.00	100.0

Several shrubs of young trees, such as silverling (*Baccharis halimifolia*), rattlebush (*Sesbania drummondii*), huisache (*Acacia farnesiana*), live oak, and yaupon, are widely scattered over this portion of the study site.

One of the unusual features of this community is the presence of many faculative halophytes, such as sea oxeye, marsh elder (*Iva* sp.), and gulf cordgrass, in dominant or near dominant quantities where marsh conditions never prevail. High soluble-salt content of soils is possibly responsible.

c. *Toothache tree-silverling-common reed*. A hook in the ridge at the southwestern end of the project area supports a different set of plant dominants. Toothache tree (*Zanthoxylum clavi-herculis*) and common reed form a higher vegetation stratum than sea oxeye and gulf cordgrass and nearly replace them altogether. During late summer, the herb layer is dominated by two species of goldenrod (*Solidago sempervirens* and *S. altissima*), western ragweed (*Ambrosia psilostachya*) and marsh elder (*Iva* sp.).

Herbaceous species just mentioned become somewhat less abundant in the eastern portion of the toothache tree stand. They are replaced by a variety of low percent-cover species of grasses, such as drop-seed (*Sporobolus asper*), splitbeard bluestem, and three-awn grasses (*Aristida oligantha* and *A. longespica*). Total percent ground cover decreases, but species diversity increases.

Vegetation in this portion of the site was not sampled. The decision to include the area as a separate community rather than a variation of the former community was based largely upon the presence of about 30 toothache trees from 5 to 15 ft tall and the higher-than-usual understory formed by reed and silverling.

d. *Tamarisk*. Salt cedar or tamarisk (*Tamarix gallica*), an introduced tree, grows throughout the gulf coastal area and has become established in many older dune or dredged material disposal areas. Several small clumps covering about four-tenths of an acre occur at the extreme east end of the site.

Tamarisk grows in very dense thickets and produces shade to the extent that few subcanopy species can survive. One common associate is pigeon-berry (*Rivina humilis*), a shrub that matures to a scrambling vine (Table 70). Other species occur at the edges of the clumps, or internally where holes in the tamarisk canopy allow sunlight to pass through.

e. *Silverling-saltmeadow cordgrass*. The most extensive community in the study site is dominated by silverling and saltmeadow cordgrass. Lower portions of this community are marsh-like and are probably inundated at least once each year by overflow from the adjacent wet prairie. The silverling-saltmeadow cordgrass community bears a great resemblance to wet prairie. As wet prairie conditions become dominant, the habitat factors introduced by dredged material disposal fade. The boundary is very indistinct.

Silverling-saltmeadow cordgrass lobes extend somewhat up slope and southward into lower areas between deposits dominated by sea oxeye and gulf cordgrass. Here the distinction between good and poor surface drainage is exhibited by a gradual shift in community dominants.

Eastward, near the drainage ditch and North Prong Mud Bayou, marsh exists at the margin of the ephemeral pond. Moving toward the pond from the southwest, silverling-saltmeadow cordgrass gives way to saltmeadow cordgrass-great bulrush (*Scirpus validus*). The bulrush is a rhizomatous perennial attaining a height of 2 m or more. This association intergrades with heavily matted saltmeadow cordgrass, which, in turn, gives way to Texas frogfruit (*Phyla incisa*), a low herbaceous ground cover where the soil is wet for most of the year. The edges and portions of the middle of the ephemeral pond are covered by water-hyssop (*Bacopa monnieri*), a low stoloniferous aquatic plant.

Many of the herb species of the sea oxeye-gulf cordgrass community also occur in the silverling-saltmeadow cordgrass community (Table 71). Gulf cordgrass is quite common. Broomsedges

Table 70

Density, Average Percentage Cover, and Relative Values for Shrub and Herb Species in the Tamarisk Community of High Island Site

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
Scirpus sp.	1.25	33.3	6.25
Sourgrass (*Oxalis* sp.)	1.25	33.3	6.25
Blackberry (*Rubus* sp.)	1.25	33.3	6.25
	3.75	99.9	
Shrubs:			
Pigeon-berry (*Rivina humilis*)	16.25	100.0	81.25
			100.00

Species	#/4 m^2	#/ha	Relative Value	Total Relative Value
Shrub Layer				
Shrubs:				
Silverling (*Baccharis halimifolia*)	0.50	1250.0	100.0	100.0

[a]Average cover for all 0.5-m^2 quadrats

Table 71

Density, Average Percent Cover, and Relative Values for Shrub and Herb Species in the Silverling-Saltmeadow Cordgrass Community of the High Island Site, August 1974

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
Herbaceous Layer			
Herbs:			
Saltmeadow cordgrass (*Spartina patens*)	75.00	82.8	82.2
Gulf cordgrass (*Spartina spartinae*)	6.10	6.7	6.7
Paspalum (*Paspalum vaginatum*)	2.07	2.3	2.3
Verbena (*Verbena* sp.)	1.71	1.9	1.9
Scirpus americanus var. *longispicatus*	1.58	1.8	1.7
Camphor daisy (*Machaeranthera phyllocephala*)	1.34	1.5	1.5
Goldenrod (*Solidago sempervirens*)	0.49	0.6	0.6
Common reed (*Phragmites communis*)	0.49	0.5	0.5
Boneset (*Eupatorium serotinum*)	0.49	0.5	0.5
Spurge (*Euphorbia* sp.)	0.37	0.4	0.4
Camphor daisy (*Pluchea purpurascens*)	0.24	0.3	0.3
Splitbeard bluestem (*Andropogon ternarius*)	0.24	0.3	0.3

[a]Average cover for all 0.5-m^2 quadrats

Table 71 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Seaside heliotrope (*Heliotropium curassavicum*)	0.12	0.1	0.1
Broomsedge (*Andropogon* sp.)	0.12	0.1	0.1
Downy ground cherry (*Physalis pubescens*)	0.12	0.1	0.1
Scirpus acutus	0.12	0.1	0.1
	90.60	100.0	
Shrubs:			
Silverling (*Baccharis halimifolia*)	0.49	80.3	0.6
Sea oxeye (*Borrichia frutescens*)	0.12	19.7	0.1
	0.61	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Silverling (*Baccharis halimifolia*)	2.71	6,775.0	52.6
Sea oxeye (*Borrichia frutescens*)	2.42	6,050.0	47.0
Marsh elder (*Iva* sp.)	0.02	50.0	0.4
	5.15	12,875.0	100.0

(*Andropogon* spp.) are less common in the latter and *Solidago sempervirens* was the only goldenrod present in the August sample. Southwestward and across the drainage canal the dominance by plant species drops to three: silverling, saltmeadow cordgrass, and a sedge (*Scirpus americanus* var. *longispicatus*). In these areas, the saltmeadow cordgrass grows as a very thick mat up to 3 ft deep. Coverage by this species is 100 percent in most areas except where burning has recently occurred. Much of this portion of the site was burned recently, and the relative dominance of species has shifted somewhat as light and growing conditions were provided for other species (Table 72). Herb dominance during the fall is given for the northeastern end of the site only (Table 73).

Two mutually exclusive species, paspalum and saltgrass, grow within the silverling-saltmeadow cordgrass community often at the edges of unvegetated areas. Both species form thick rhizomatous mats that are rarely invaded by other species. Runners of saltgrass up to 3 m long frequently extend into unvegetated soil. These rhizomes, while rooting at the nodes, bear regular erect stems that diminish in stature away from the main mat. Still further from the grass-bare soil edges there is frequently an abrupt break in the mat of saltgrass. Paspalum, at this point, takes over, or both are are replaced by saltmeadow cordgrass. This species arrangement is very well exemplified at the large unvegetated area in the northeast end of the project site.

f. Common Reed. Six very dense stands of common reed occur in the eastern half of the study site. Together they total 3.7 acres. Common reed is a characteristic species of disturbed soils and dredged material disposal areas, especially where there has been some influence associated with wet soil. Growth, as indicated for the Nott Island project site, is rhizomatous, allowing the clone to spread well outside or away from the optimum site.

Table 72

Average Percent Cover and Relative Values for Herb Species in the Silverling-Saltmeadow Cordgrass Community of the High Island Site, October 1974

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Saltgrass (*Distichlis spicata*)	17.22	29.1
Ambrosia psilostachya	12.22	20.6
Boneset (*Eupatorium serotinum*)	11.67	19.6
Saltmeadow cordgrass (*Spartina patens*)	6.11	10.3
Gulf cordgrass (*Spartina spartinae*)	4.44	7.5
Camphor daisy (*Machaeranthera phyllocephala*)	3.89	6.5
Goldenrod (*Solidago altissima*)	1.11	1.9
Rabbit tobacco (*Gnaphalium purpureum*)	0.56	0.9
Silverling (*Baccharis halimifolia*)	0.56	0.9
Marsh elder (*Iva* sp.)	0.56	0.9
Verbena (*Verbena* sp.)	0.56	0.9
Unidentified herb	0.56	0.9
	59.46	100.0

[a]Average cover for all 0.5-m^2 quadrats

Table 73

Average Percent Cover and Relative Values for Shrub and Herb Species in the Silverling-Saltmeadow Cordgrass Community of the High Island Site, May 1975

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Camphor daisy (*Machaeranthera phyllocephala*)	29.17	33.6	32.8
Saltmeadow cordgrass (*Spartina patens*)	23.75	27.4	26.7
Western ragweed (*Ambrosia psilostachya*)	4.58	5.3	5.2
Boneset (*Eupatorium serotinum*)	4.42	5.1	5.0
Goldenrod (*Solidago sempervirens*)	3.33	3.8	3.7
Sensitive brier (*Schrankia microphylla*)	2.50	2.9	2.8
Broomsedge (*Andropogon glomeratus*)	2.50	2.9	2.8
Gulf cordgrass (*Spartina spartinae*)	2.08	2.4	2.3
Flax (*Linum* sp.)	1.92	2.2	2.2
Borrichia frutescens	1.25	1.4	1.4
Rush (*Juncus effusus*)	1.25	1.4	1.4
Unidentified seedling	0.83	1.0	0.9
Unidentified herb	0.83	1.0	0.9
Scirpus americanus var. *longispicatus*	0.83	0.9	0.9

[a]Average cover for all 0.5-m^2 quadrats

Table 73 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Cyperus sp.	0.83	0.9	0.9
Rose pink (*Sabatia campestris*)	0.83	0.9	0.9
Eupatorium sp.	0.83	0.9	0.9
Pepper grass (*Lepidium virginicum*)	0.42	0.5	0.5
Spurge (*Euphorbia* sp.)	0.42	0.5	0.5
Rabbitfoot grass (*Polypogon monspeliensis*)	0.42	0.5	0.5
Spurrey (*Spergularia marina*)	0.42	0.5	0.5
Rush (*Juncus tenius*)	0.42	0.5	0.5
Rabbit tobacco (*Gnaphalium purpureum*)	0.42	0.5	0.5
Sourgrass (*Oxalis* sp.)	0.42	0.5	0.5
Verbena (*Verbena* sp.)	0.42	0.5	0.5
Scirpus sp.	0.42	0.5	0.5
Buckthorn (*Plantago aristata*)	0.42	0.5	0.5
Unidentified herb	0.42	0.5	0.5
Little foxtail grass (*Setaria glauca*)	0.42	0.5	0.5
	86.77	100.0	
Shrubs:			
Silverling (*Baccharis halimifolia*)	2.08	100.0	2.3
			100.0

Openings within the common reed stands are vegetated by saltmeadow cordgrass and occasionally little foxtail grass (*Setaria glauca*). Silverling also grows in the stands (Table 74).

193. Seral relationships of vegetation. Dredged material was first deposited at the High Island site between 1931 and 1933. Aerial photography from 1941 (Figure 34) shows the configuration and extent of seven major dredged material mounds along and to the north of a ridge extending about a mile southwest of North Prong Mud Bayou. The southwest end of the ridge bears a hook of dredged material that turns almost due north. The ridge appears to have been vegetated by shrubs and herbs, but the mounds bear little or no vegetation, particularly along their sides. Low dikes were constructed along the waterway and at each end of the ridge to prevent re-entry of dredged material into the canal. Some dredged material probably moved to the northwest, away from the main ridge, but 1941 photography gives little indication of the extent of vegetation affected.

194. Most vegetation associations present now (Figure 33) were also present in 1941. Tamarisk occurred in only a very small stand at the northeastern end of the site. Toothache tree was not present.

195. In 1941, a great deal more area was unvegetated than at present. This pattern was probably due to erosion, movement of cattle, fire, and time. Side slopes of the mounds and the ridge were being eroded and material was being deposited at their northern bases. Cattle grazing is a very common use of wet prairie, and the cattle frequently move into disposal areas along the waterway, particularly during wet periods. Trails are evident on all aerial photographs of the wet prairie adjacent to the site. The effect of grazing is twofold: soil is more readily eroded from slopes along which cattle move; grazing maintains vegetation at a younger seral stage, thereby preventing the development of normal vegetational changes. Evidence of fire can also be seen on the 1941 photography. Its effect on vegetation is similar to that of grazing.

Table 74

Density, Average Percent Cover, and Relative Values for Herb and Shrub Species in the Common Reed Community of High Island Site

Species	Average Percent Cover[a]	Relative Value
Herbaceous Layer		
Herbs:		
Common reed (*Phragmites communis*)	55.00	66.7
Saltmeadow cordgrass (*Spartina patens*)	25.00	30.3
Little foxtail grass (*Setaria glauca*)	2.50	3.0
	82.50	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Silverling (*Baccharis halimifolia*)	2.5	6250.0	100.0

[a]Average cover for all 0.5-m^2 quadrats

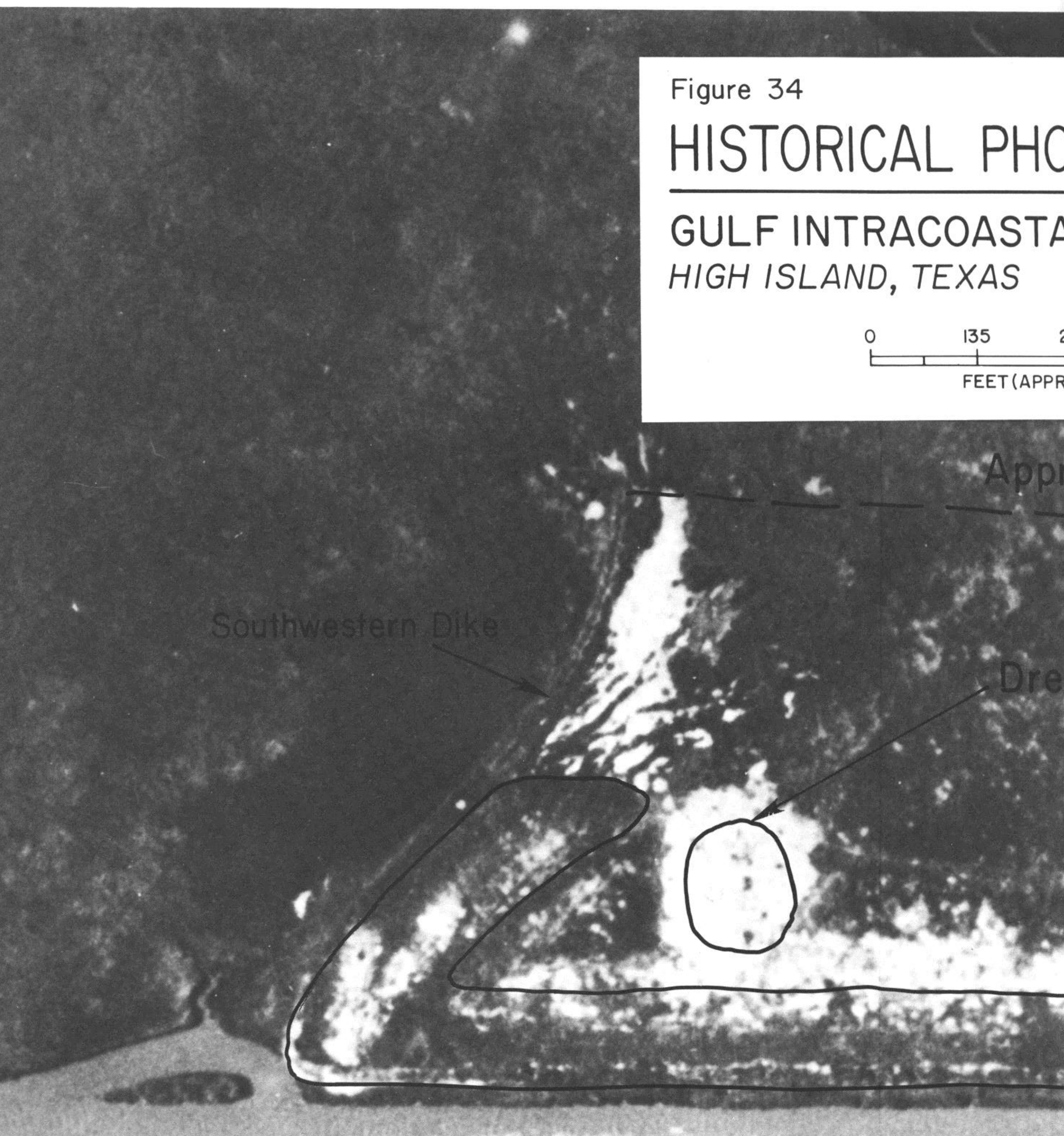
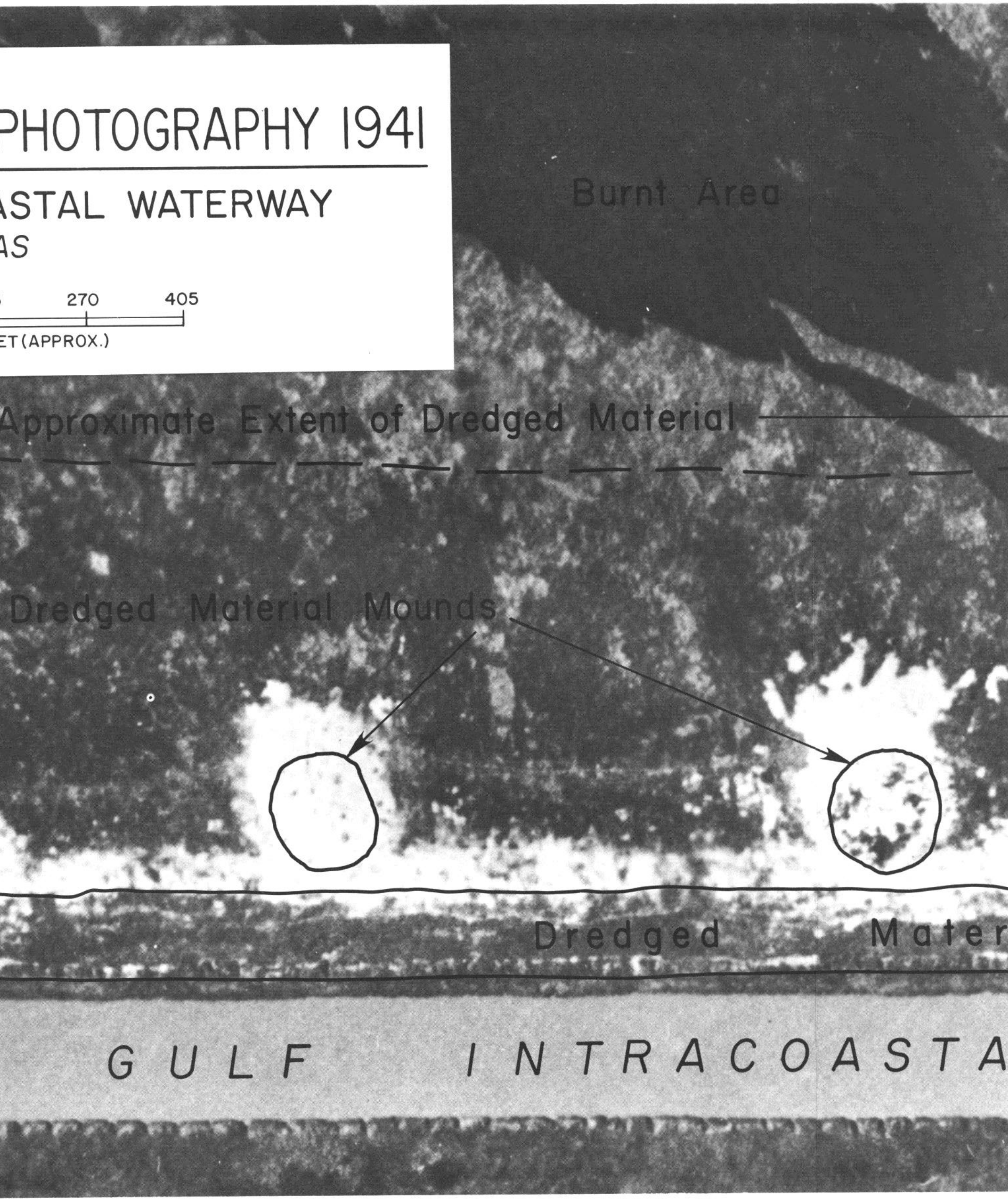
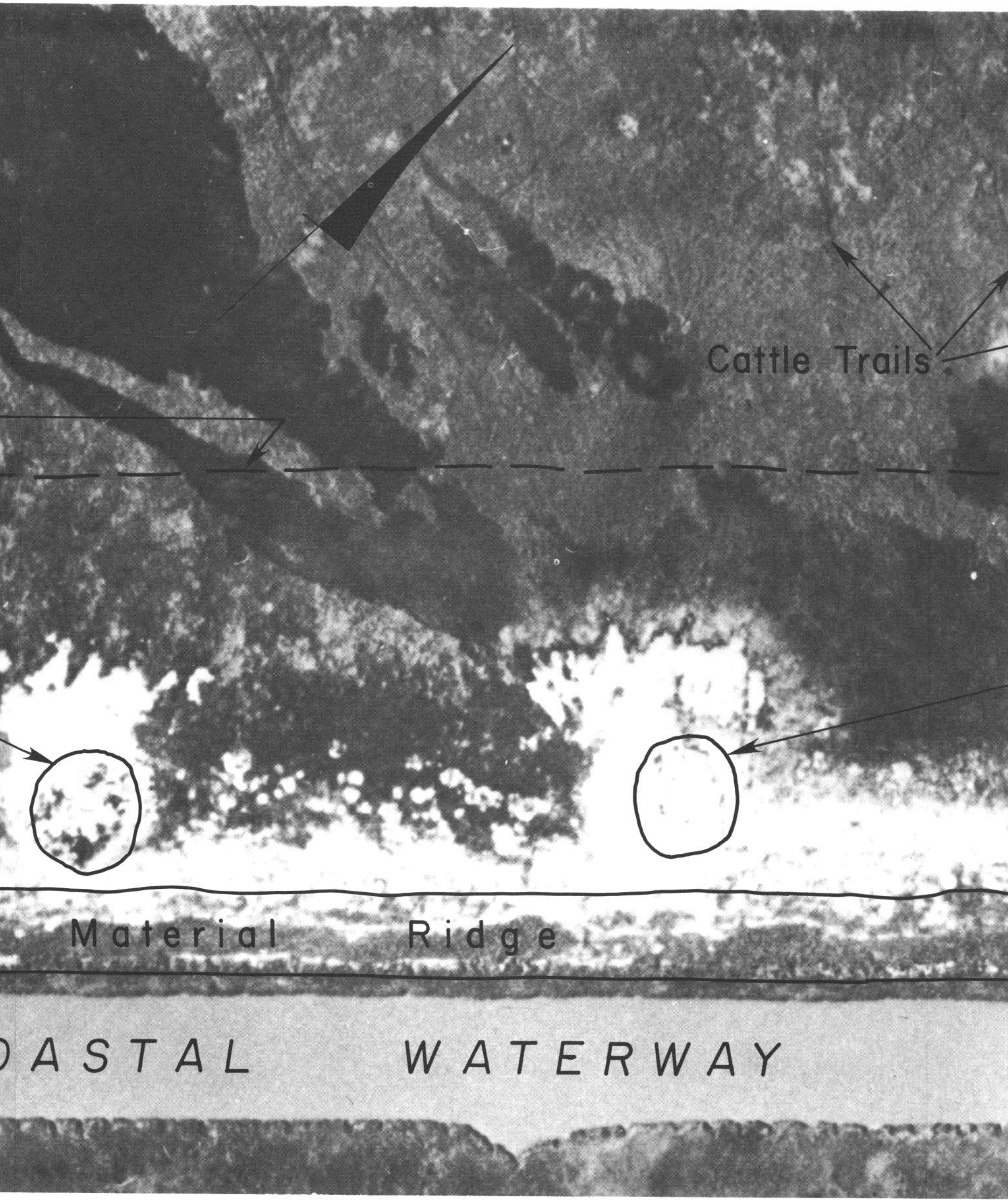
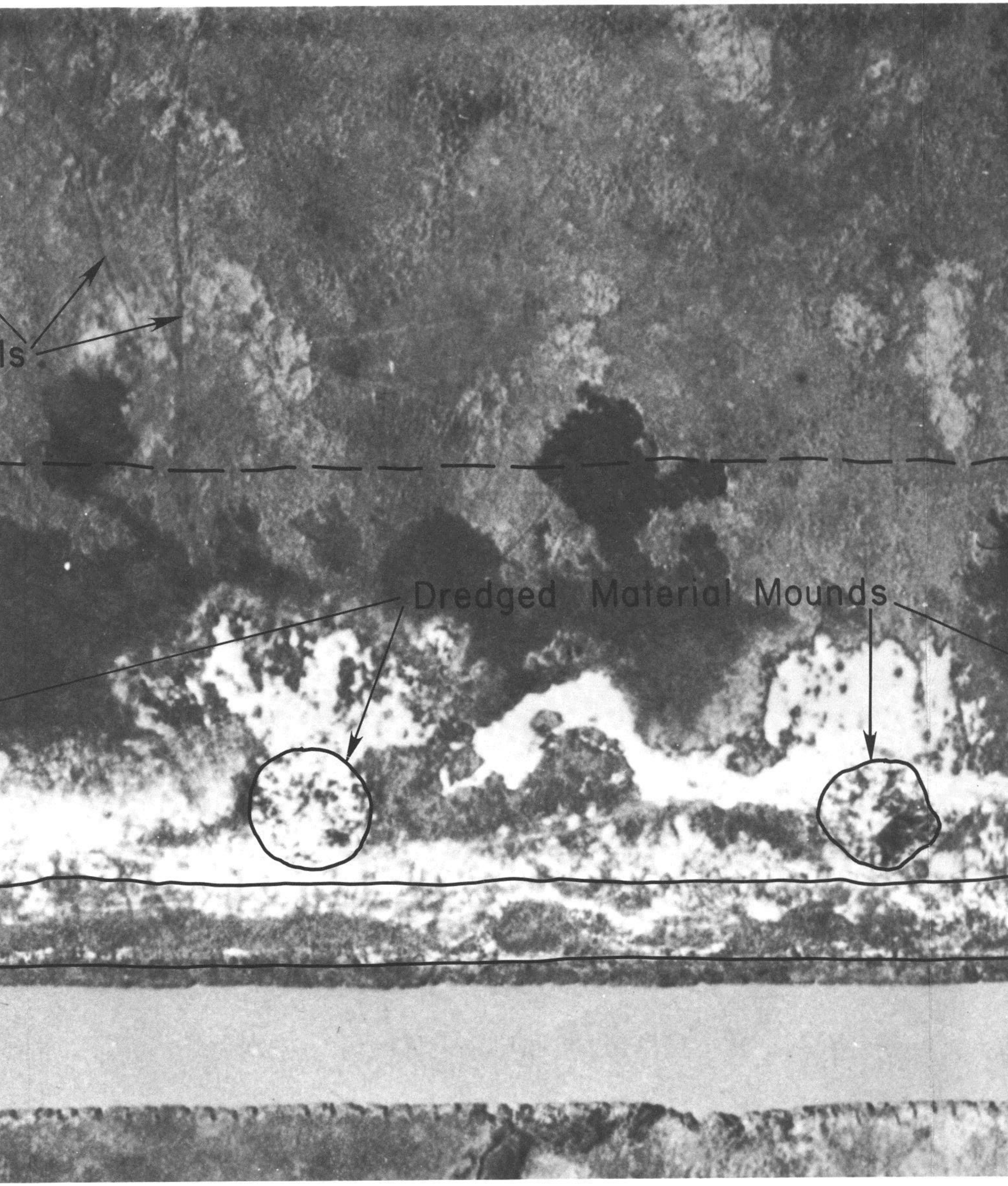


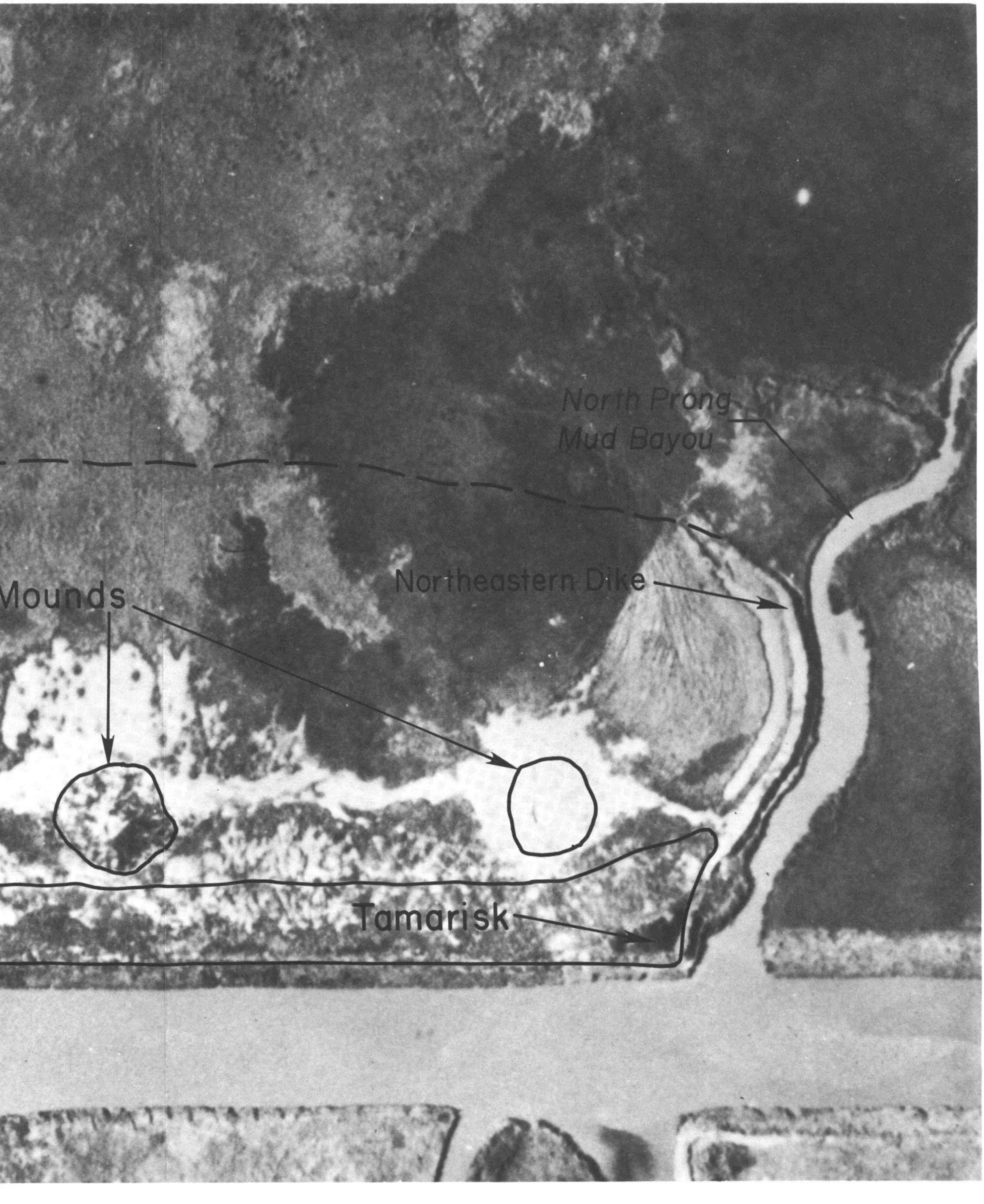
Figure 34
HISTORICAL PHO
GULF INTRACOASTA
HIGH ISLAND, TEXAS
0
135
FEET(APPR
Appr
Southwestern Dike
Dre


PHOTOGRAPHY 1941
ASTAL WATERWAY
AS
270
405
ET (APPROX.)
Burnt Area
Approximate Extent of Dredged Material
Dredged Material Mounds
Dredged
Mater
GULF INTRACOASTA



Cattle Trails
Material Ridge
OASTAL WATERWAY


ls
Dredged Material Mounds


North Prong
Mud Bayou
Northeastern Dike
Mounds
Tamarisk

196. By 1941, 8 to 10 years had passed since the original disposal. Sufficient time had not elapsed for vegetation to become established on all portions of the dredged material, when the effects of fire, grazing, erosion, and distance from sources of seeds of plants capable of surviving in the higher portions of the disposal area are considered.

197. In 1952, the High Island site received additional dredged material. Approximate limits of direct influence are visible on 1953 aerial photography (Figure 35). The basic configurations of mounds and ridges remained the same. The dike at the northeast end of the site was extended southeast and south. Vegetation types other than common reed cannot be identified from the photography. Most vegetation appears to be largely herbaceous. Low tamarisk trees are present along the northeastern dike. Cattle grazing was still important, and there was no evidence of recent fire.

198. In 1956, common reed had become more abundant (Figure 36). Scattered young tamarisk trees were present; by 1963, tamarisk had spread to its present extent (Figure 37). Common reed in 1973 was not readily apparent except in a few areas, though it was probably abundant.

199. The biotic community map (Figure 33) represents the present extent of vegetation associations at the High Island site. Changes caused by addition of dredged material in 1965 are so slight as to be nearly insignificant. Increased sizes of unvegetated areas are possibly the most outstanding evidence of this disposal period. The southern extension of the dike at the northeastern end of the site was buried and is now overgrown by common reed. Otherwise, it is not possible to estimate the extent to which revegetation patterns were modified by the 1965 disposal. The degree to which vegetation was removed at this time is the key to better understanding the plant successional history of the site.

200. With continued stress imposed by grazing and fire, it is not likely the High Island site will ever support a cover of

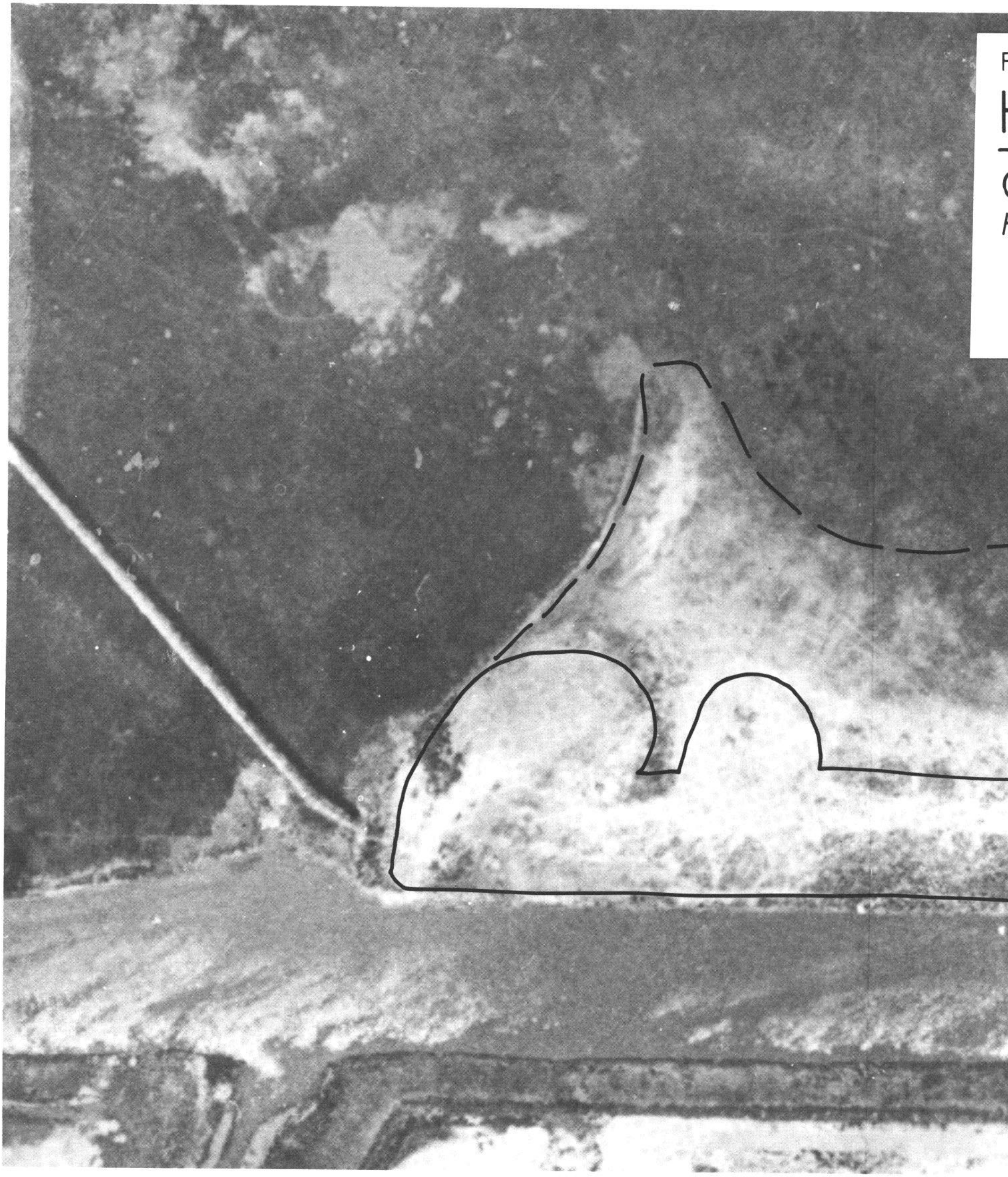
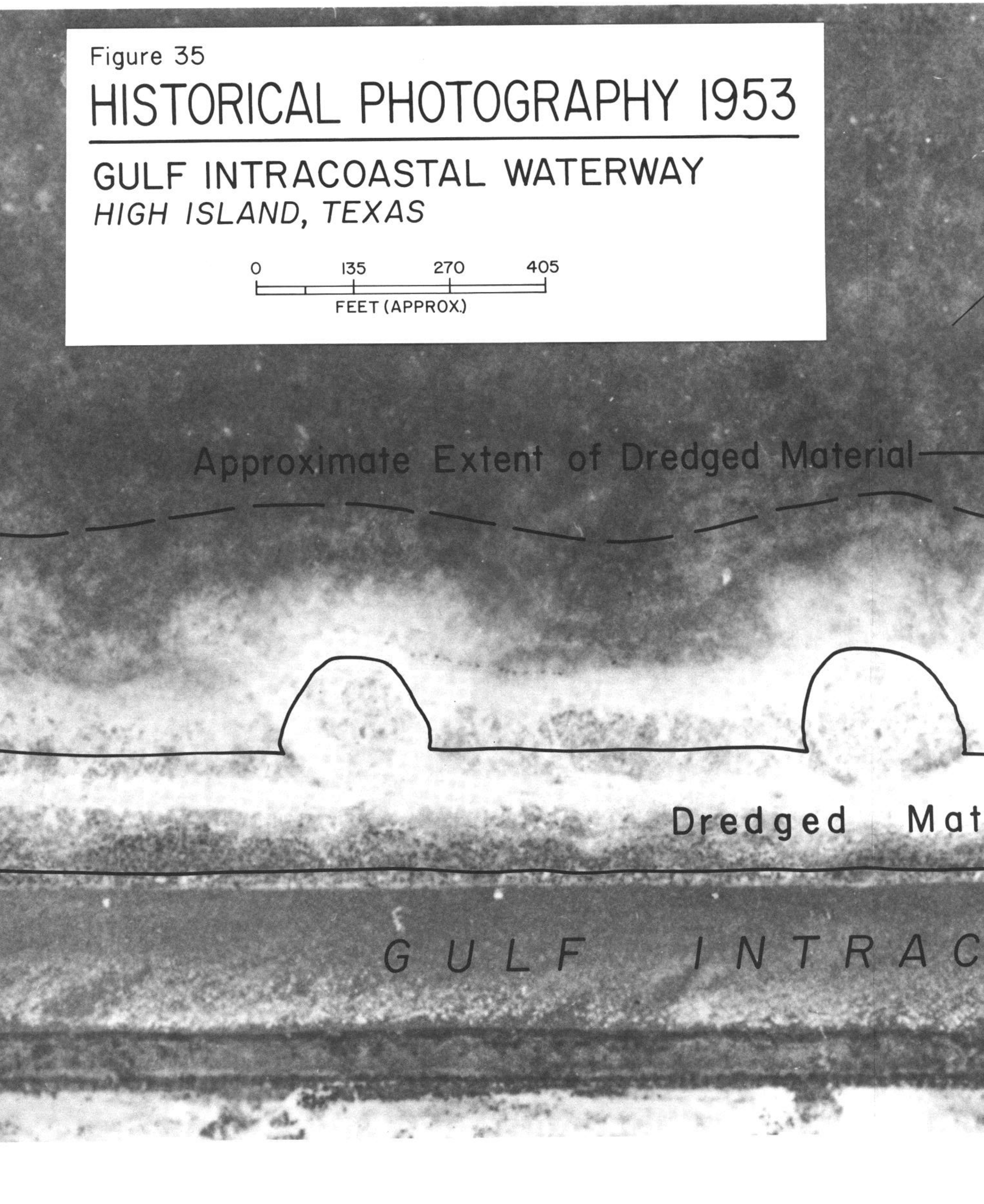


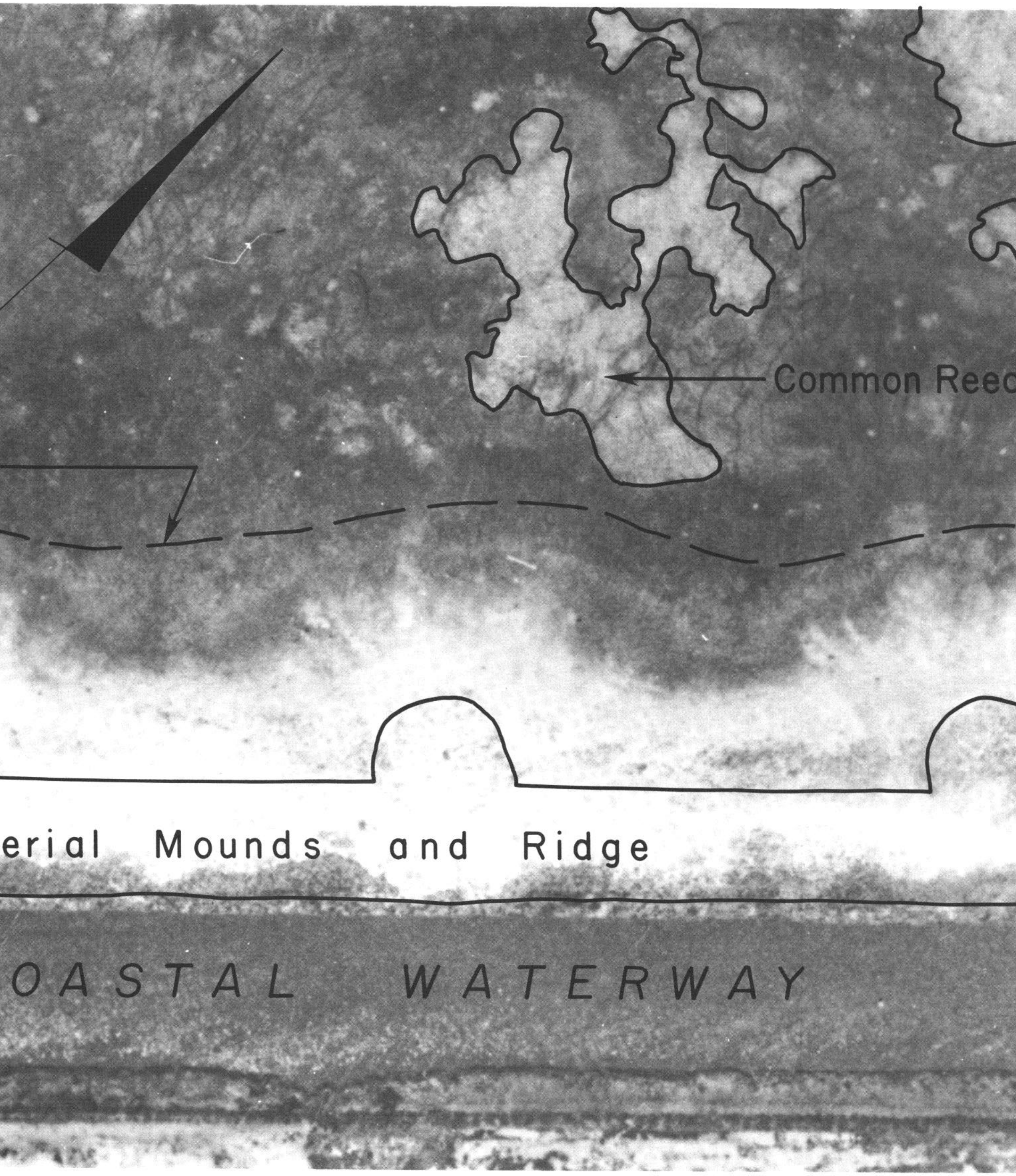
Figure 35

HISTORICAL PHOTOGRAPHY 1953

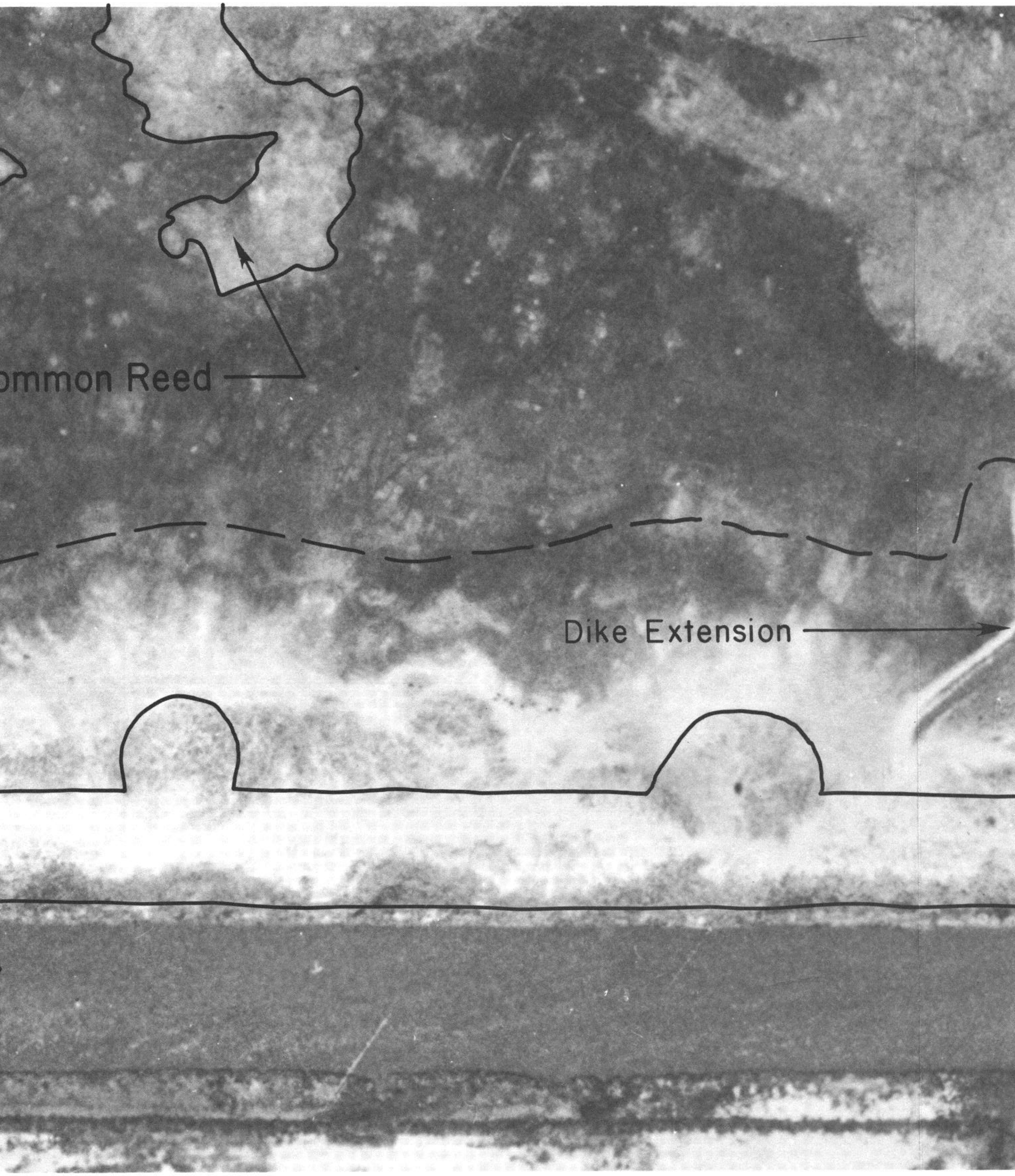
GULF INTRACOASTAL WATERWAY
HIGH ISLAND, TEXAS

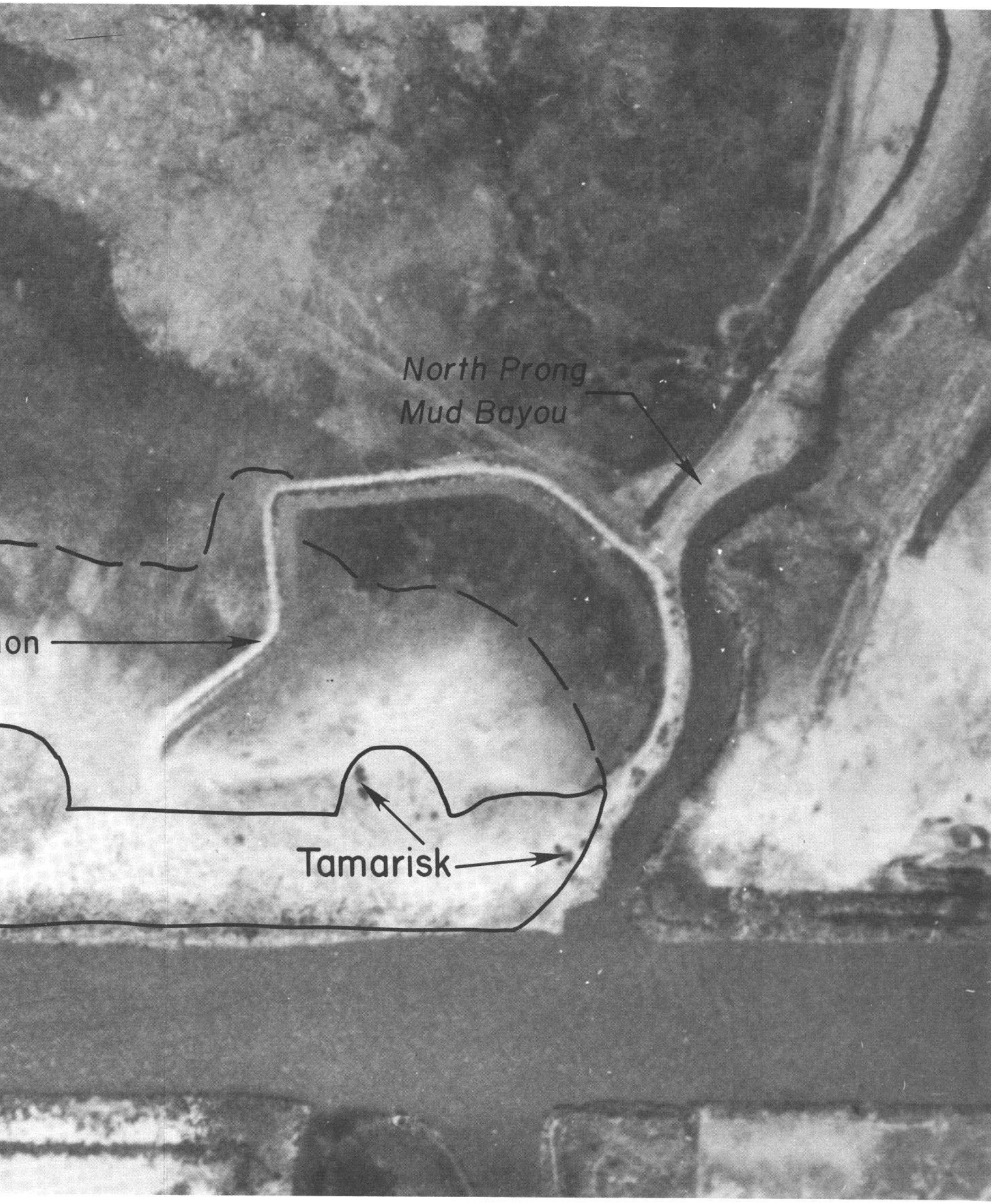
0 135 270 405
FEET (APPROX.)





Common Reed
erial Mounds and Ridge
OASTAL WATERWAY


ommon Reed
Dike Extension


North Prong
Mud Bayou
on
Tamarisk

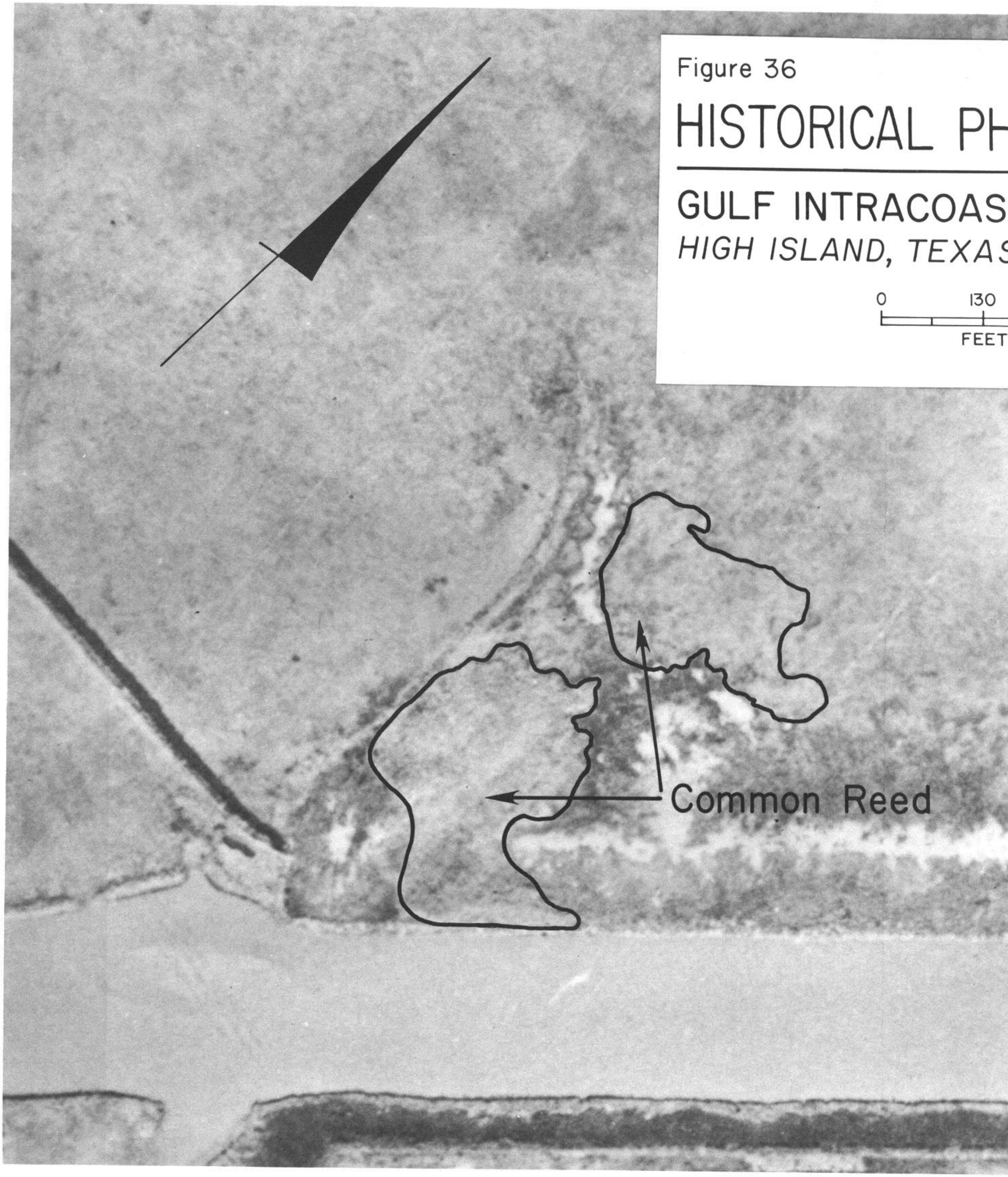
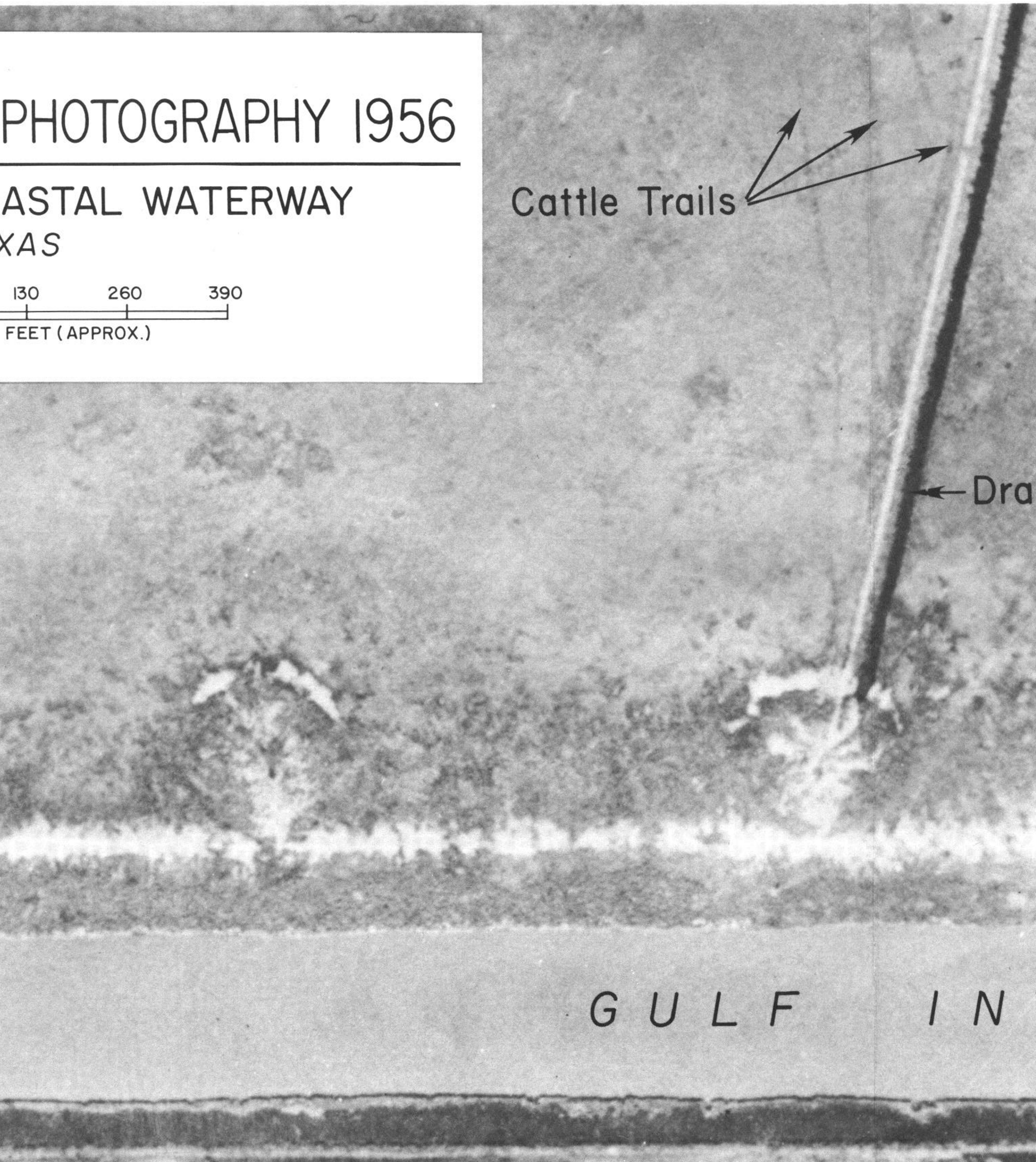
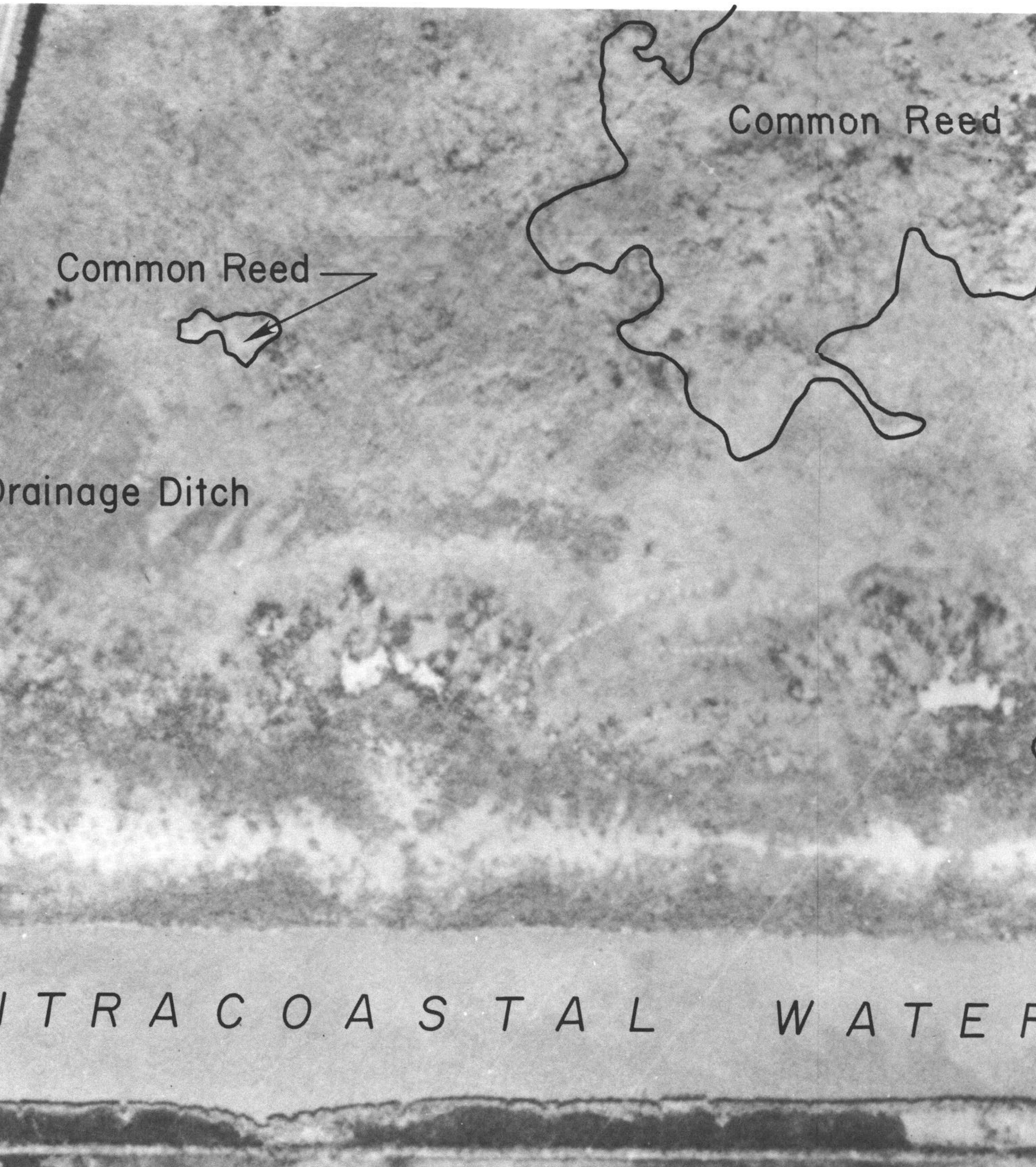
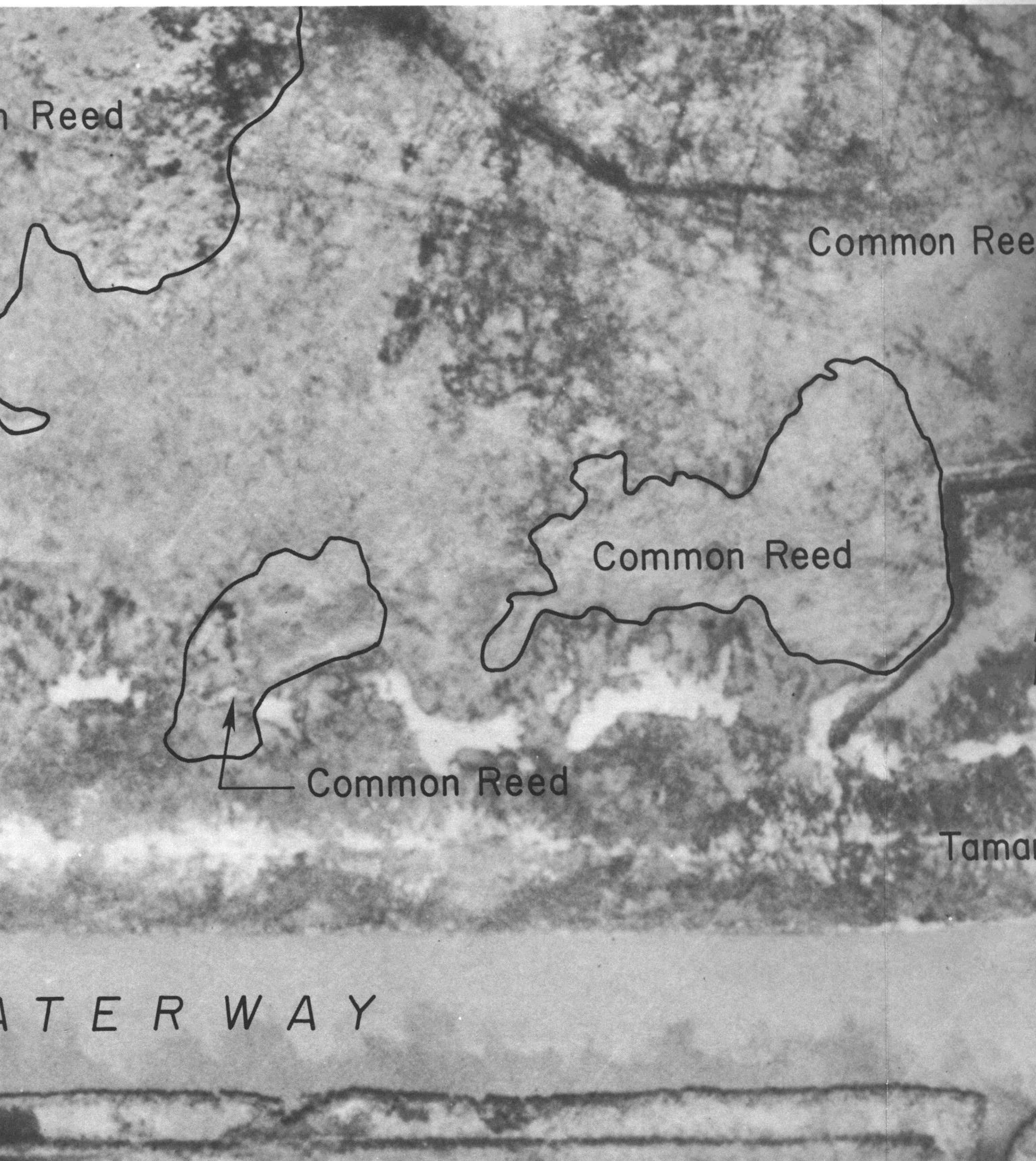


Figure 36
HISTORICAL PH
GULF INTRACOAS
HIGH ISLAND, TEXAS
0
130
FEET
Common Reed


PHOTOGRAPHY 1956
ASTAL WATERWAY
XAS
130
260
390
FEET (APPROX.)
Cattle Trails
Dra
G U L F I N


Common Reed
Common Reed
Drainage Ditch
TRACOASTAL WATER


n Reed
Common Ree
Common Reed
Common Reed
Tamar
ATERWAY

Common Reed
on Reed
North Prong
Mud Bayou
Tamarisk

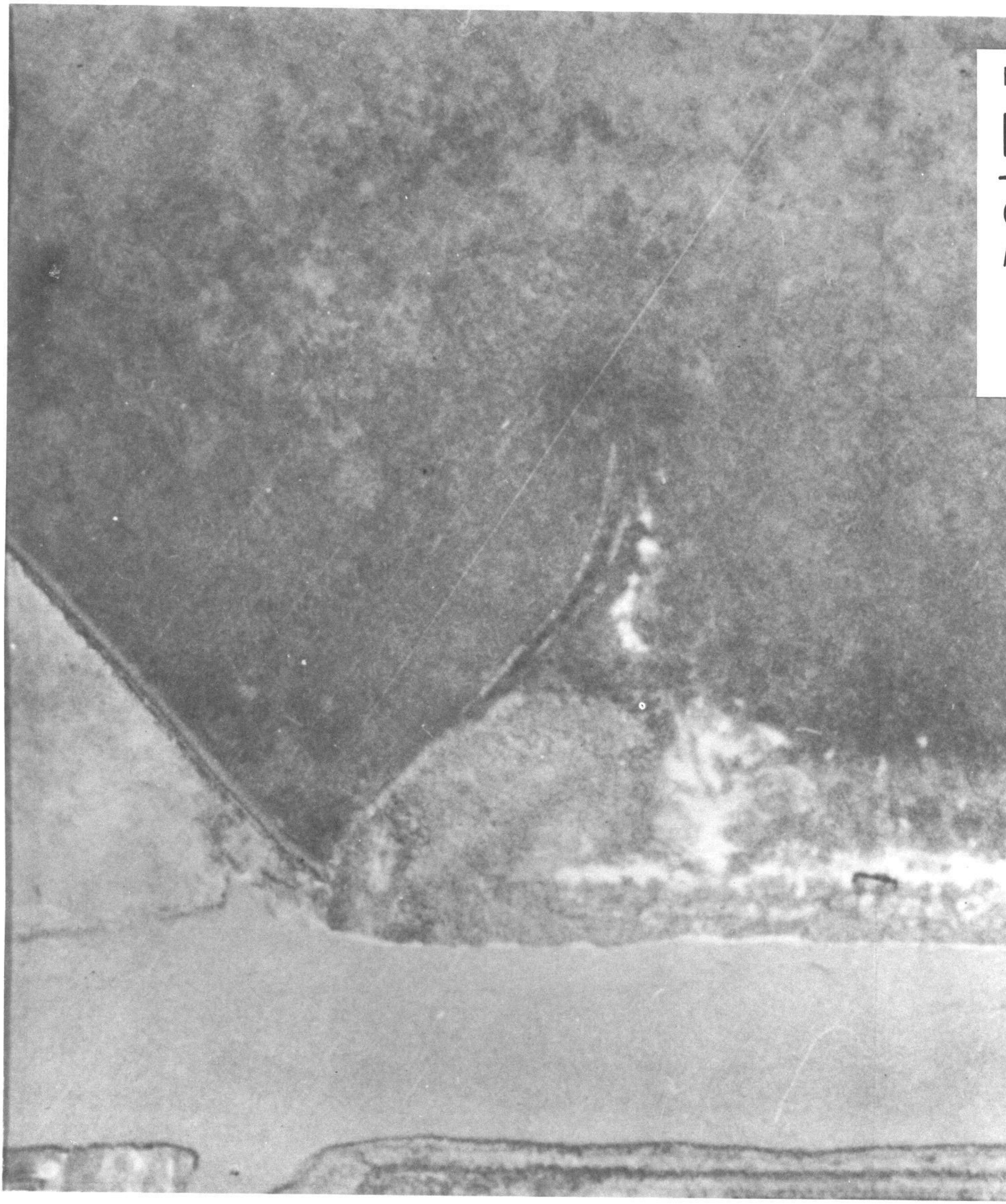
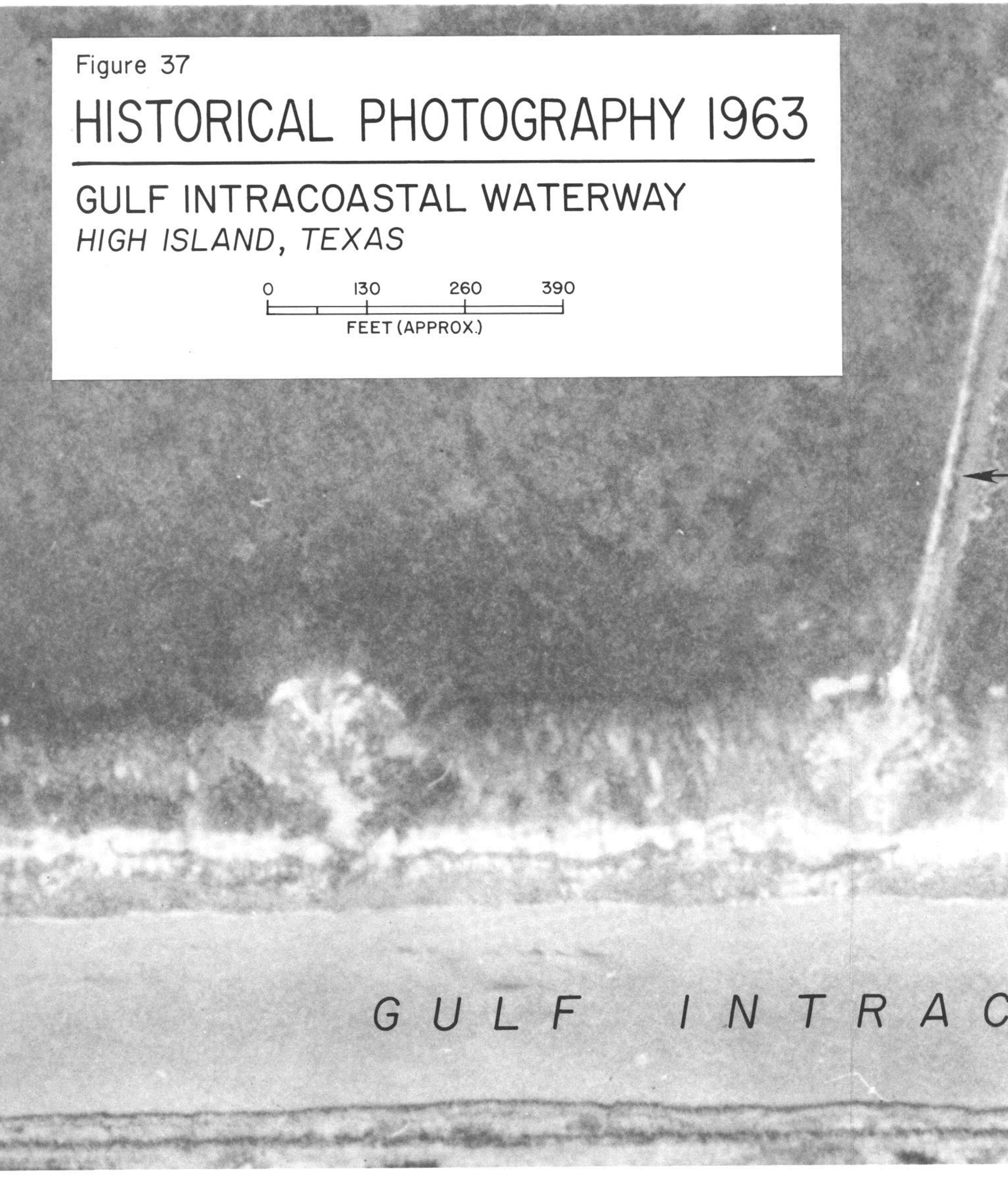


Figure 37

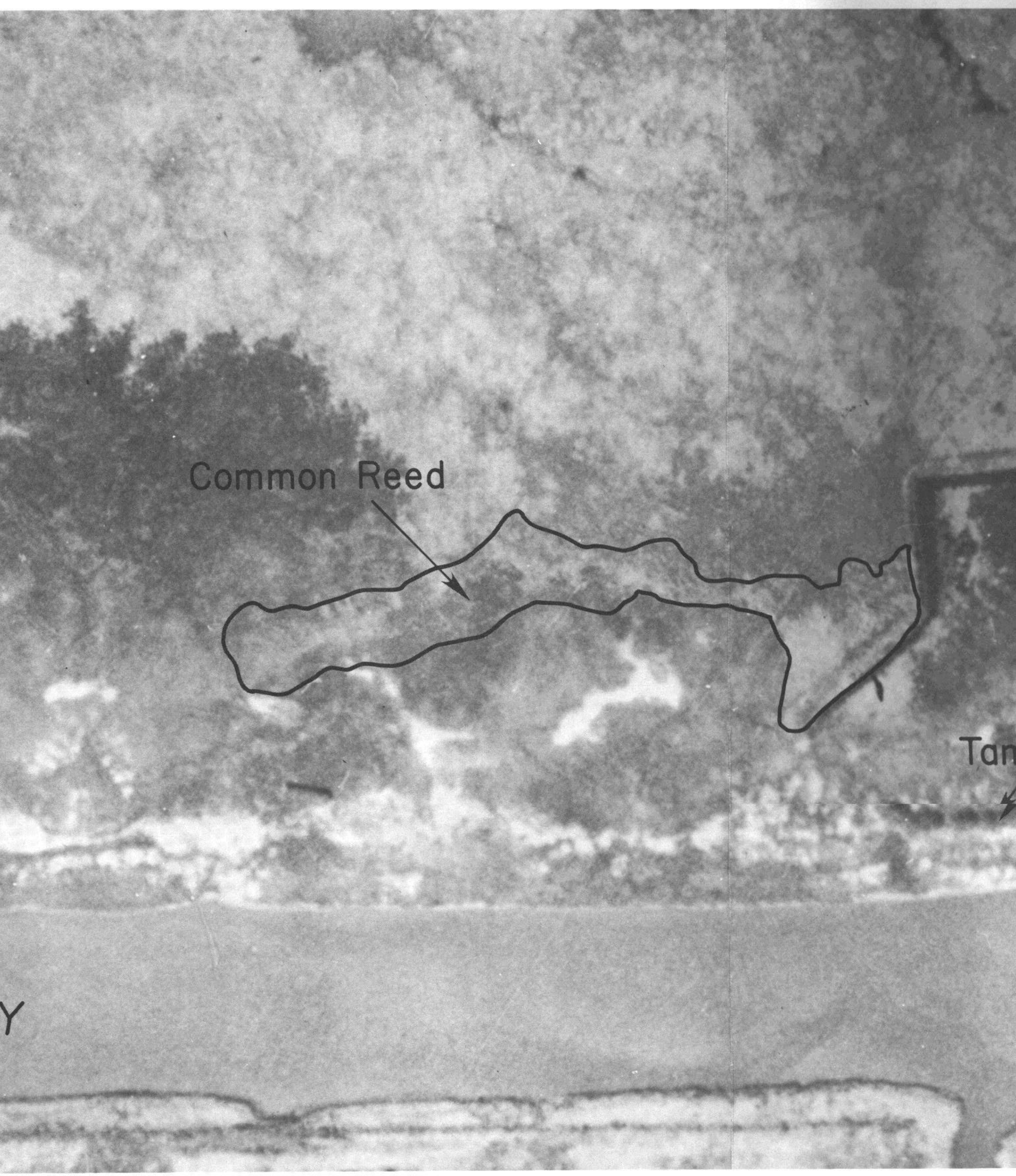
HISTORICAL PHOTOGRAPHY 1963

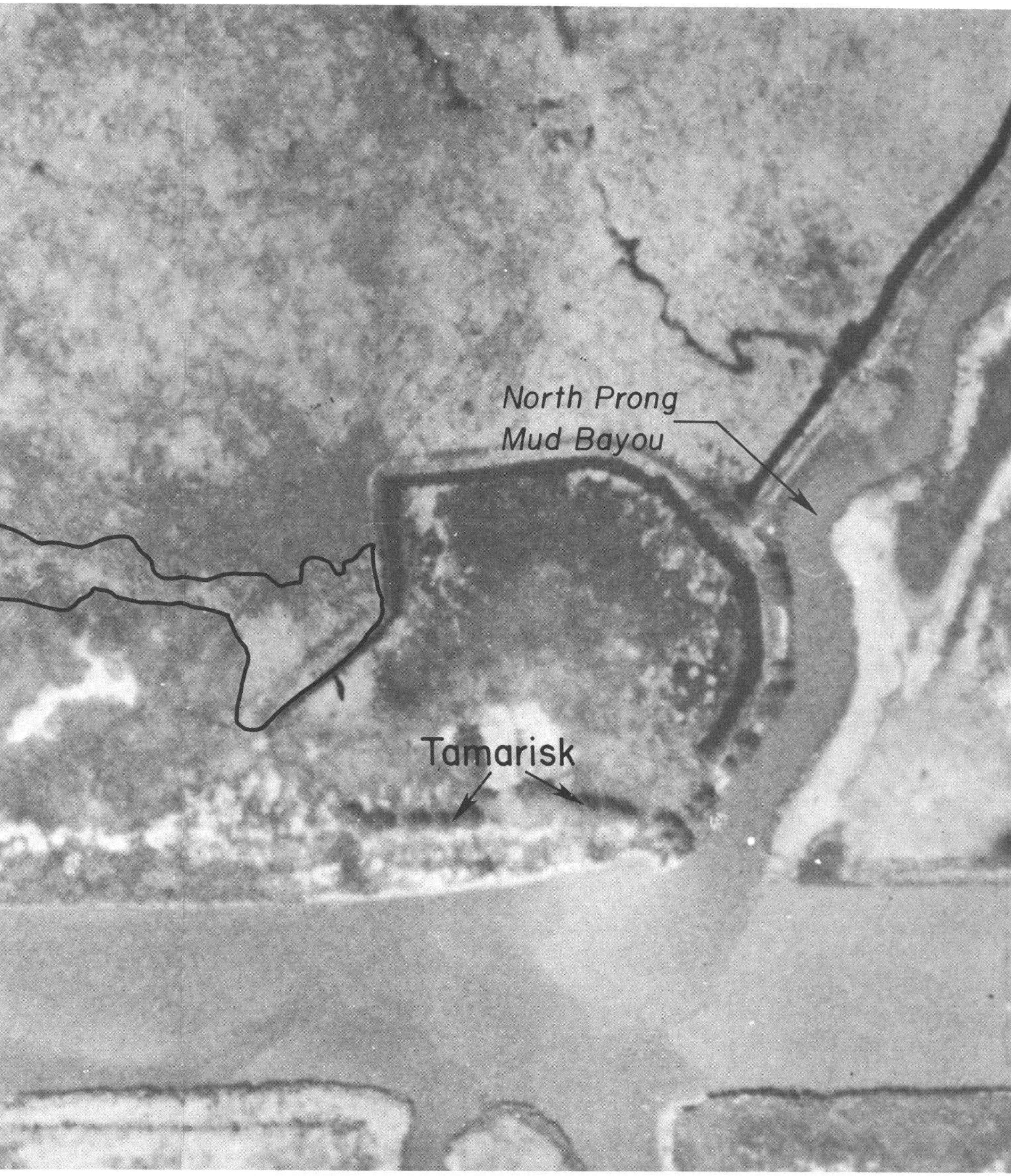
GULF INTRACOASTAL WATERWAY

HIGH ISLAND, TEXAS



rainage Ditch
OASTAL WATERWAY


Common Reed
Tan
Y


North Prong
Mud Bayou
Tamarisk

arborescent vegetation. Scattered trees along the ridge represent species also found on higher ground in and around the town of High Island, located on a topographic high caused by a salt dome extrusion. High Island is over a mile and a half from the site. Provided fire and grazing cease, a scattered canopy of live oak may someday develop.

201. Low areas of the study site may support heavier growths of common reed in the future. Unvegetated areas will eventually support a cover of herbaceous or shrubby growth.

202. Analysis of existing animal populations. Available literature (Shelford 1963, Cody 1968, Odum 1971, and Wiens 1973) indicates that vertebrate populations in prairie communities are commonly comprised of: (1) species with high reproductive potentials, (2) gregarious species, (3) numerous burrowing species, and (4) numerous herbivores. In addition, mammals tend to dominate, and breeding bird populations typically have low diversities and densities. Field investigations revealed that many of these general characteristics are applicable to the vertebrate populations found on the High Island study site.

a. Birds. Sixty-one species of birds were recorded at the High Island study site during the field surveys of August 1974, October 1974, and May 1975. Seventeen of these are year-round residents in the High Island area, 14 are winter visitants, 6 are summer residents, and 24 are spring-fall transients (Robbins et al. 1966 and U. S. Department of the Interior 1969). Resident status for each species is presented in Table 75.

Avian diversity was greatest on the High Island site in May 1975 and lowest in August 1974. Thirty-nine species were recorded in May 1975, 32 in October 1974, and 19 in August 1974. Migratory species accounted for 77, 59, and 42 percent of the recorded species during each respective sample period. Migratory species also comprised 72 percent of the total 61 bird species observed on the study area.

Table 75

General Characteristics and Field Observation Data Regarding the Avian Species Observed on the High Island Site

Species	Status[a]	Period Observed[b]	Habitat Preference[c]	Distribution on the Study Site by Plant Association[d]						
				T	SG	SS	R	TS	U	P
Great blue heron	Y	A, O	M	-	-	-	-	-	-	X
Green heron	Y	A, O, M	M	-	-	-	-	-	-	X
Snowy egret	Y	A, O, M	M	-	-	-	-	-	-	X
Louisiana heron	Y	O	M	-	-	-	-	-	-	X
Black-crowned night heron	Y	A, O, M	M	X	-	-	-	-	-	X
Marsh hawk	W	O, M	G	-	X	X	X	-	X	X
Bobwhite	Y	A	FE	-	-	X	-	-	-	-
Clapper rail	Y	A, O	M	-	-	-	-	-	-	X
Killdeer	Y	A	SG	-	-	-	-	-	X	-
Common snipe	W	O	M	-	-	-	-	-	X	X

[a]Status: Y=year-round residents; W=winter visitant; S=summer resident; T=spring-fall transient

[b]Period Observed: A=August 1974; O=October 1974; M=May 1975

[c]Habitat Preference: FE=forest-edge or hedgerow situations; W=woodlands; M=marshlands; G=medium to tall grasslands; SG=short grass prairies or sparsely vegetated areas

[d]Plant Association: T=tamarisk; SG=sea oxeye-gulf coast cordgrass; SS=silverling-saltmeadow cordgrass; R=common reed, TS=toothache tree-silverling; U=unvegetated; M=marshland; P=ephemeral ponds, drainage ditch, and bordering marsh vegetation

Table 75 (continued)

Species	Status	Period Observed	Habitat Preference	Distribution on the Study Site by Plant Association						
				T	SG	SS	R	TS	U	P
Black-necked stilt	S	M	M	-	-	-	-	-	-	X
Mourning dove	Y	O	FE	X	-	-	-	-	-	-
Yellow-billed cuckoo	S	O, M	W	X	-	-	-	-	-	-
Barn owl	Y	M	FE	X	-	-	-	-	-	-
Common nighthawk	S	A, M	SG	X	X	X	X	X	X	X
Ruby-throated hummingbird	T	A, O	FE	-	-	X	-	-	-	-
Belted kingfisher	W	O	FE	X	-	-	-	-	-	-
Common flicker	W	O	FE	X	-	X	-	-	-	-
Scissor-tailed flycatcher	S	A, O, M	FE	X	-	-	-	X	-	-
Eastern kingbird	S	A, M	FE	X	X	X	X	-	-	-
Western kingbird	T	A	FE	X	-	-	X	-	-	-
Great-crested flycatcher	T	M	W	X	-	-	-	-	-	-
Eastern phoebe	W	O	FE	X	X	X	-	-	-	-
Eastern wood pewee	T	M	W	X	-	-	-	-	-	-
Rough-winged swallow	T	A, M	FE	X	X	X	X	X	X	X
Barn swallow	T	M	FE	X	X	X	X	X	X	X
Tree swallow	T	A, O	FE	X	X	X	X	X	X	X
House wren	T	O	FE	-	-	X	X	-	-	-
Mockingbird	Y	O	FE	X	-	X	-	-	-	-
Gray catbird	T	O, M	FE	X	X	X	-	-	-	-
Brown thrasher	W	O	FE	X	-	X	X	-	-	-
Hermit thrush	W	M	W	X	-	-	-	-	-	-
Swainson's thrush	T	M	W	X	-	-	-	-	-	-
Blue-gray gnatcatcher	W	O	W	X	-	X	-	-	-	-
Ruby-crowned kinglet	W	M	W	X	-	X	-	-	-	-

Table 75 (continued)

Species	Status	Period Observed	Habitat Preference	Distribution on the Study Site by Plant Association: T	SG	SS	R	TS	U	P
Cedar waxwing	W	M	FE	-	-	X	-	-	-	-
Loggerhead shrike	Y	O	FE	X	-	X	-	-	-	-
Red-eyed vireo	T	M	W	X	-	-	-	-	-	-
Philadelphia vireo	T	O, M	FE	X	-	-	-	-	-	-
Black-and-white warbler	T	M	W	X	-	-	-	-	-	-
Prothonotary warbler	T	M	W	X	-	X	-	-	-	-
Yellow warbler	T	O, M	FE	X	-	X	-	-	-	-
Magnolia warbler	T	M	W	X	-	X	-	-	-	-
Yellow-rumped warbler	W	O	FE	X	X	X	X	X	-	-
Yellow-throated warbler	T	M	W	X	-	X	-	-	-	-
Chestnut-sided warbler	T	M	FE	X	X	X	-	-	-	-
Bay-breasted warbler	T	M	W	X	X	X	-	-	-	-
Common yellowthroat	Y	A, O, M	FE	-	-	X	X	X	-	-
American redstart	T	M	W	X	-	-	-	-	-	-
Eastern meadowlark	Y	A, O, M	G	-	X	X	-	-	-	-
Red-winged blackbird	Y	A, O, M	M	X	X	X	X	X	-	X
Orchard oriole	S	M	FE	X	-	X	X	X	-	-
Great-tailed grackle	Y	A, O, M	FE	X	X	X	X	X	-	X
Common grackle	Y	M	FE	X	X	X	X	X	-	X
Brown-headed cowbird	Y	A, O, M	FE	X	X	X	X	X	-	X
Scarlet tanager	T	M	W	X	-	-	-	-	-	-
Summer tanager	T	M	W	-	-	X	-	-	-	-
Cardinal	T	A, M	FE	-	-	X	X	-	-	-
Rose-breasted grosbeak	T	M	FE	X	-	X	-	-	-	-
Savannah sparrow	W	O	G	-	X	X	-	-	-	-

Table 75 (concluded)

Species	Status	Period Observed	Habitat Preference	Distribution on the Study Site by Plant Association						
				T	SG	SS	R	TS	U	P
Song sparrow	W	O	FE	-	X	X	X	-	-	-
Totals 61 species				42	18	36	18	12	7	17

The higher diversity of migratory species is characteristic of avian populations along the Gulf coast of Texas. For example, migrants comprise 80 percent of the 253 avian species recorded on the nearby Anahuac National Wildlife Refuge (U. S. Department of the Interior 1969), and 60 percent of the wintering birds on Welder Wildlife Refuge (Emlen 1972). The Gulf coast of Texas serves as a major departure and arrival point for birds migrating between North America and Central and South America.

Thirty-one of the 61 recorded bird species generally inhabit forest-edge or hedgerow situations*, 16 are commonly associated with woodlands, 9 generally occur in marshlands, 3 usually inhabit medium to sparsely vegetated areas (Table 75). Nearly all of the species associated with woodlands are transients.

The study site's tamarisk and silverling-saltmeadow cordgrass associations are utilized by the greatest diversity of bird species; 42 and 36 species were recorded in these habitats, respectively (Table 75). The high diversity in the silverling-saltmeadow cordgrass community is not surprising since it occupies 60 percent of the study site's upland acreage (Table 66) and because the dense grass mats provide an abundant food source and excellent cover. In contrast, the tamarisk association comprises only 1 percent of the site's upland acreage. However, trees are relatively scarce in wet prairies of east Texas. Where they occur a concentration of bird species may be found that utilizes trees for roosting, resting, singing, nesting, feeding, and perching.

Forty-three of the avian species recorded at the High Island site are commonly classified as insectivores, 7 are granivores, 1 is a frugivore, 7 prey on aquatic organisms, and 3 prey on terrestrial vertebrates. All insectivorous year-round

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*Hedgerow and forest-edge species occupy areas of trees or tall bushes for roosting, nesting, or singing, and open or shrubby areas for feeding.

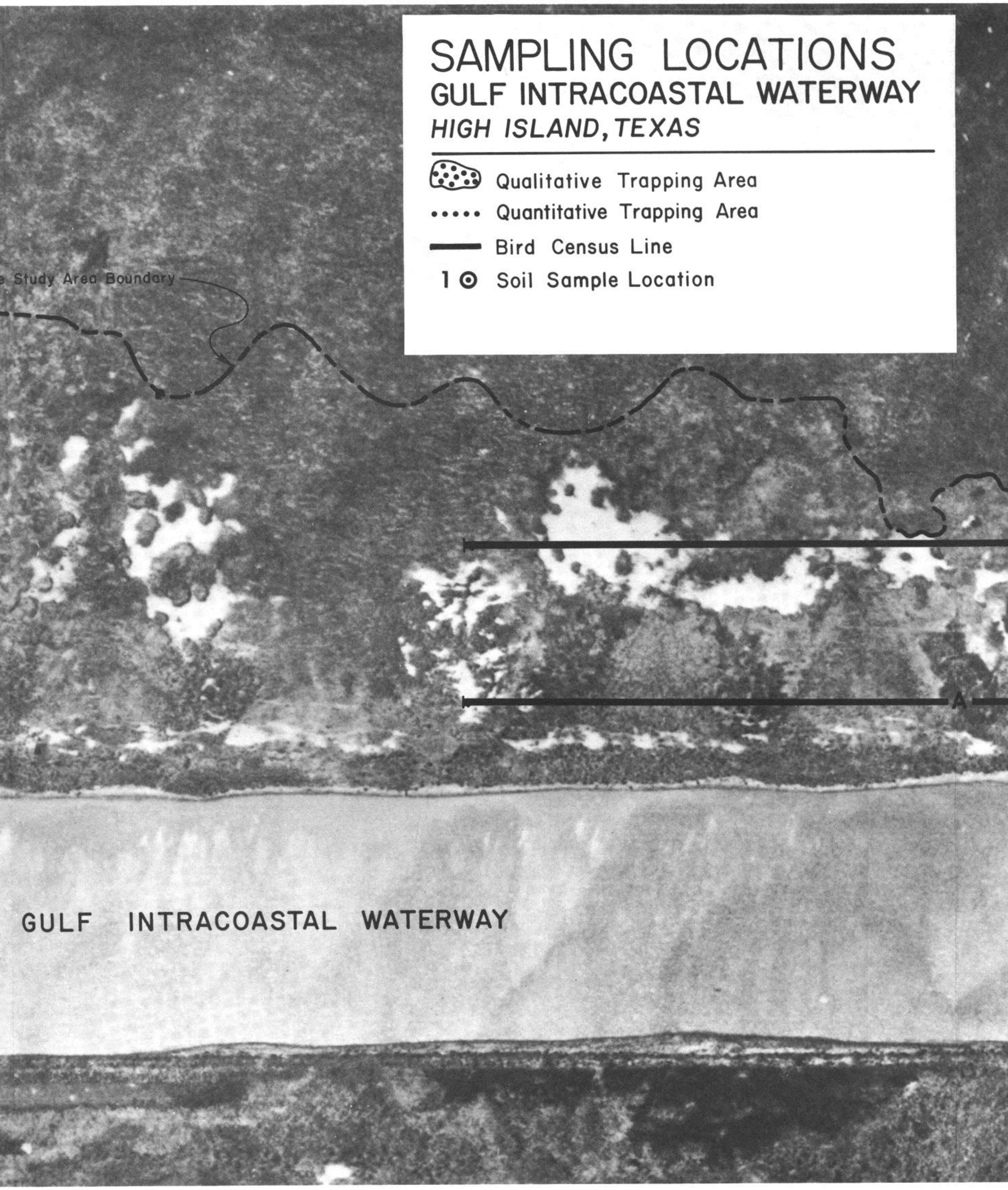
residents capture their prey on or very close to the ground surface. All recorded species that feed on bark insects, foliage insects, or flying insects are migratory. Consequently, avian pressures on the study site's bark, foilage, and flying insect fauna vary seasonally, whereas avian pressures on ground insects are fairly constant throughout the year. Distribution of year-round residents and migrants among the granivore and terrestrial vertebrate carnivore categories is about equal. Nearly all species that prey upon aquatic organisms are year-round residents, but much of their impact on the study site's food resources is seasonal and is associated with the presence of ephemeral ponds. Few individuals were seen preying upon aquatic organisms in the central drainage ditch.

A breeding bird census was performed on 32.8 acres of the High Island site in May 1975. Plant associations included in the censused area were silverling-saltmeadow cordgrass, sea oxeye-gulf coast cordgrass, common reed, unvegetated, and tamarisk (Figure 38).

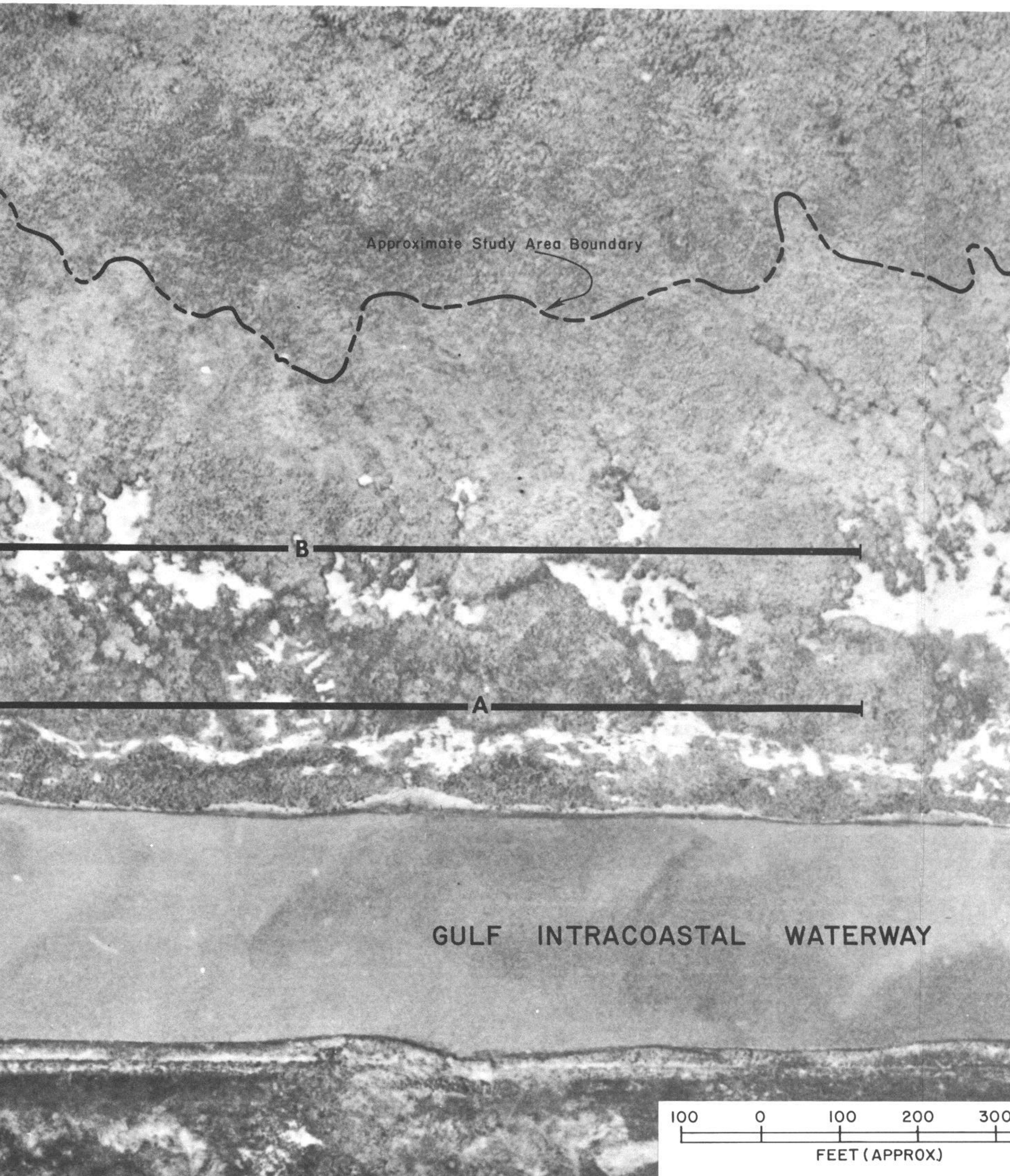
Seven bird species had established breeding territories in the censused area (Table 76). Four of these, the red-winged blackbird (Agelaius phoeniceus), common yellowthroat (Geothlypis trichas), eastern meadowlark (Sturnella magna), and brown-headed cowbird (Molothrus ater) are year-round residents while the remaining three species, the orchard oriole (Icterus spurius), eastern kingbird (Tyrannus tyrannus), and common nighthawk (Chordeiles minor) are summer residents. The seven species represented 30 percent of the year-round and summer residents recorded on the site.

The red-winged blackbird was the most abundant breeding species. This species is polygynous, and several females often establish nesting territories within a larger territory defended by a male. Polygyny is characteristic of passerine birds that occupy habitats in which food supply is abundant, but foraging areas and/or nesting sites are limited (Armstrong 1955, Orians 1961, Willson and Pianka 1963, and Holm 1973) or heterogeneously distributed (Zimmerman 1966 and Brown 1969). Vernon and Willson

Approximate Study Area B
4
GULF
HIGH ISLAND, TEXAS 1.5 MILES


SAMPLING LOCATIONS
GULF INTRACOASTAL WATERWAY
HIGH ISLAND, TEXAS
Qualitative Trapping Area
Quantitative Trapping Area
Bird Census Line
1 Soil Sample Location
Study Area Boundary
A
GULF INTRACOASTAL WATERWAY


B


Approximate Study Area Boundary
B
A
GULF INTRACOASTAL WATERWAY
100 0 100 200 300
FEET (APPROX.)

MUD
BAYOU
NORTH
PRONG
3
1
2
C
WATERWAY
100 200 300 400
FEET (APPROX)

Figure 38

Table 76

Breeding Bird Census Data for the High Island Site, May 1975

Species	Number of Breeding Territories on Census Area[a]	Estimated Number of Breeding Territories per 100 Acres
Red-winged blackbird	41	125
Common yellowthroat	6	18
Brown-headed cowbird	4[b]	12
Common nighthawk	3	9
Eastern meadowlark	1	3
Orchard oriole	1	3
Eastern kingbird	1	3
Totals	57	173

[a]The size of the censused area was 32.8 acres

[b]Figure is based on the average number of females observed per daily census trip

(1966) note that 14 of the 291 North American passerine birds are reported polygynous and 13 of these commonly breed in marshes, prairies, or savannah-like habitats.

Thirteen male red-winged blackbirds had established breeding territories on the censused area. Territory sizes ranged from 0.7 to 3.5 acres, while average territory size was 1.8 acres. Vegetation type and density are the major factors determining male territory size (Linsdale 1938, Orians 1961, Case and Hewitt 1963, and Holm 1973). Largest male red-winged blackbird territories were recorded in the silverling-saltmeadow cordgrass community where silverling bushes were widely scattered or where recent burns had occurred. Smallest territories were recorded in stands of common reed and an ephemeral pond area that was bordered by bulrush, saltmeadow cordgrass, silverling, and tamarisk.

Female red-winged blackbirds are generally inconspicuous during the breeding season, as they often remain hidden in dense shrub or herbaceous vegetation. Thus, determination of the number of females per male territory is often difficult. Harem sizes on the High Island site were determined by having one censuser walk ahead of a second and attempt to flush all females within a known male territory. Supportive information was obtained by an intensive effort to locate active nests. Forty-one females were found present on the census area based on the above methods. The number of females per male territory ranged from 1 to 6 with 3.2 being the average (Table 77). Average female-male ratios obtained in other studies are 1.61 and 2.75 (Smith 1943), 1.96 (Nero 1956), 3.72 and 2.84 (Orians 1961), 1.93 (Meanley and Webb 1963), 2.44 (Case and Hewitt 1963), 1.57 (Goddard and Board 1967), and 3.02 and 2.71 (Holm 1973).

Male red-winged blackbirds do not normally breed until they are 2 years old, though some may hold territories and, on rare occasions, breed when 1 year old (Beer and Tibbits 1950,

Table 77

Territory and Harem Sizes of Male Red-winged Blackbirds on the High Island Site, May 1975

Male Number	Territory Size (acres)	Harem Size
1	3.5	6
2	2.1	5
3	3.3	4
4	2.0	4
5	1.7	4
6	1.4	3
7	2.9	5
8	1.8	2
9	1.2	1
10	0.8	1
11	0.7	3
12	0.7	2
13	1.0	1
Mean	1.8	3.2

Wright and Wright 1944, Nero 1956, Orians 1961). Females, in contrast, regularly breed at 1 year of age (Orians 1961). The slow maturation of males tends to favor polygyny (Orians 1961). All of the 13 males that had established territories on the censused area had adult plumage and were assumed to be at least 2 years old.

Numerous territorial challenges between adult male red-winged blackbirds were witnessed during the breeding bird census. Many of these challenges were apparently between a male that had an established breeding territory and one that did not. Thus, it seems that there were more adult males than suitable habitat for territories. Similar findings have been reported by Orians (1961) and Holm (1973).

Thirty-seven red-winged blackbird nests were found on the censused area. All were located in silverling shrubs. A few were in the midst of dense silverling thickets or in single, isolated shrubs. Most, however, were usually along silverling thicket edges or in small clumps of these bushes. Nest heights ranged from 1 to 6 ft, but most were located at 3 to 4 ft. The lower nests were usually located in areas where silverling had recently sprouted from burned stems. Broomsedge straw was the most commonly used nest material. Five of the 37 nests were only partially constructed. Three of these showed no signs of progress during five days of observation and were probably false or abandoned nests.

Of the 32 completed nests, 2 contained 6 eggs, 12 contained 3 eggs, 3 contained 2 eggs, 6 contained 1 egg, and 9 had no eggs.* Time restraints prevented watching the nests until all eggs had hatched. Therefore, it is not known how many of these represented full egg sets. Data from Bent (1958), Orians (1961), Goddard and Board (1967), and Holm (1973) indicate that red-winged blackbird clutch sizes range from one to six with four being the

*These figures represent the maximum number of red-winged blackbird eggs found in each nest during the field survey.

most common. One of the 32 completed red-winged blackbird nests containing 3 eggs was infested with fire ants due to the presence of a cracked egg.

Seven of the 32 completed red-winged blackbird nests had been parasitized by brown-headed cowbirds; 2 of these nests contained 3 red-winged blackbird eggs after being parasitized; 1 had 2 eggs, 2 had 1 egg, and 2 had no eggs. In each case, the brown-headed cowbird had laid one egg. Red-winged blackbird females abandoned at least three of the nests after they were parasitized.

One red-winged blackbird nest contained 4 eggs on 18 May 1975 and 3 eggs on 20 May 1975. The missing egg could have been removed by a brown-headed cowbird. Bent (1919-1968) stated that cowbirds usually remove an egg one day prior to parasitizing the nest.

Clutches in three red-winged blackbird nests were destroyed by predators. Raided nests were located 3 to 5 ft above the ground. Meanley and Webb (1963), Holcomb and Twiest (1963), and Holm (1973) indicate that predation rates on red-winged blackbird nests decrease with increased height from the ground. Goddard and Board (1967), however, found the opposite to be true.

Hatching occurred in only one of the 32 nests during the breeding bird census. The nest contained four eggs, and all young hatched sometime between the mornings of 18 May and 20 May 1975. Other data on fledging success were not accumulated, but Goddard and Board (1967) reported that an average of 1.24 young fledged per nest in an Oklahoma red-winged blackbird population, and Holm (1973) reported that an average of 1.00 young fledged per nest in two Washington populations.

Red-winged blackbirds are highly gregarious during the non-breeding season and frequently travel, feed, and roost in large flocks. There is often a very pronounced segregation of sexes during this period (Orians 1961). Red-winged blackbirds and common and great-tailed grackles (*Quiscalus quiscula* and

Cassidix mexicanus) utilized the study site's tamarisk trees for communal night roosting. Most individuals left for feeding areas during the early morning. Some, however, remained and fed at the study site throughout the day. Many of those that left in early morning returned in the late morning to rest, preen, and sing before leaving for a second feeding period in mid-afternoon. Individuals returned and began congregating for roosting shortly before dusk.

Feeding areas of the red-winged blackbird may be located up to 20 miles from the roosting site (Orians 1961). These birds feed on grains and often cause serious destruction to rice crops. Greatest damage occurs during late summer when rice is in the milk stage (Orians 1961). Extensive rice fields lay to the immediate north and west of the study area.

Common yellowthroats were the second most abundant breeding species on the censused area. Six breeding territories were recorded and most were small in areal extent. Territory sizes ranged from 0.01 to 0.25 acre with 0.09 acre being the average. The largest common yellowthroat territories were located in the sea oxeye-gulf coast cordgrass community and in the recently burned regions within the silverling-saltmeadow cordgrass association. Smallest territories were located in stands of common reed and in tall, dense mats of saltmeadow cordgrass. Nests of this species were not found.

Three common nighthawk breeding territories were present in the census strip. All were located around sparsely vegetated areas. One nest containing two eggs was found in a shallow, sandy depression at the edge of an unvegetated area.

Portions of three eastern meadowlark breeding territories were located on the census strip. The territories were located in areas where saltmeadow cordgrass grew in dense mats. No nests of this species were located.

Orchard orioles and eastern kingbirds each had one breeding territory and nest on the breeding bird census plot. Silverling-saltmeadow cordgrass and tamarisk communities were included in both territories. The orchard oriole nest was located in a silverling shrub, 6 ft from the ground. The nest was constructed with saltmeadow cordgrass and contained no eggs when checked on 20 May 1975. The kingbird nest was secured to a horizontal branch of a tamarisk tree, approximately 15 ft from the ground. Twigs and grass stems were used for nest construction. The female kingbird was incubating a set of three eggs on 19 May 1975.

Fifty-seven breeding territories were present in the censused area and an estimated 173 territories were present per 100 acres of similar habitat. These breeding densities are typical of communities dominated by tall or medium grasses. For example, Goard (1974) estimated breeding densities in an Oklahoma tall grass prairie to be 132 territories per 100 acres; Cink (1974) estimated breeding densities in a Kansas tall grass prairie to be 100 territories per 100 acres; and Dresen (1974) estimated breeding densities in a Wisconsin grassland to be 226 territories per 100 acres.

No data were obtained on the study site's wintering avian population. However, Emlen (1972) studied wintering populations in seven plant associations on the Welder Wildlife Refuge in southern Texas, and his results are summarized as follows: (1) migratory species were more diverse than year-round residents, but densities were about equal and migratory species biomass was considerably less than that of year-round residents; (2) lowest bird diversities were recorded in the grassland habitats, but grasslands ranked second in total density and biomass; (3) densities of migratory species in the grasslands were much lower than densities of year-round residents; (4) densities for the grassland habitats averaged 456 individuals per 100 acres and for the total 7 plant associations, 371 individuals per 100 acres.

None of the 61 avian species recorded in the High Island site are classified endangered by the U. S. Department of the Interior (1974). Bobwhite (Colinus virginianus) and mourning dove (Zenaida macroura) are the only upland game birds on the study area. Neither species was common during the field surveys, and their potential as a hunting resource is probably limited.

b. Mammals. A minimum of 11 mammal species inhabit the High Island study site. Plant associations in which each species or their signs were observed are presented in Table 78. Life history information and general field notes are summarized in Appendix D.

Quantitative small mammal censuses were performed during the October 1974 and May 1975 field trips (Figure 38). Plant associations included in the trapped area were: silverling-saltmeadow cordgrass, sea oxeye-gulf coast cordgrass, tamarisk, and common reed. A summary of small mammal capture data is presented in Table 79.

Combined population densities for all small mammal species captured were estimated to range from 29 to 34 individuals per acre in October 1974, and 12 to 33 individuals per acre in May 1975. The hispid cotton rat (Sigmodon hispidus) was the most abundant small mammal on the sampled area. Cotton rat population densities were estimated to range from 23 to 25 individuals per acre in October 1974 and 9 to 22 individuals per acre in May 1975* (Tables 80 and 81).

For comparison, Burt and Grossenheider (1964) noted the average hispid cotton rat population density in grasslands ranges from 10 to 12 individuals per acre, while Cockrum (1962) indicated the mean was 7.5. Odum (1955), in an 11-year study of hispid

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*An estimate of 49 individuals per acre was recorded on 9 October 1974, but was considered invalid as it was an inflated estimate resulting from too few recaptures.

Table 78

Plant Associations in Which Mammals or Their Sign Were Observed at the High Island Site

Species	Plant Association[a]						
	T	SG	SS	R	TS	U	P
Nine-banded armadillo (*Dasypus novemcinctus*)	X	X	X	X	X	X	-
Rabbit (*Sylvilagus* sp. or spp.)	X	X	X	X	-	X	-
Marsh rice rat (*Oryzomys palustris*)	-	-	X	X	-	-	-
Hispid cotton rat (*Sigmodon hispidus*)	X	X	X	X	X	-	-
Fulvous harvest mouse (*Reithrodontomys fulvescens*)	-	X	X	X	-	-	-
Muskrat (skull) (*Ondatra zibethicus*)	-	-	-	-	-	-	X
Black rat (*Rattus rattus*)	X	-	-	-	-	-	-
Nutria (skull) (*Myocastor coypus*)	-	-	X	-	-	-	-
Coyote (tracks & scat) (*Canis latrans*)	X	X	X	-	-	X	-
Red wolf (tracks) (*Canus rufus*)	-	-	X	-	-	X	-
Raccoon (tracks) (*Procyon lotor*)	-	-	X	-	-	X	-

[a]T=tamarisk; SG=sea oxeye-gulf cordgrass; SS=silverling-saltmeadow cordgrass; R=common reed; TS=toothache tree-silverling-common reed; U=unvegetated; P=ephemeral ponds, drainage ditch, and bordering marsh vegetation

Table 79

Small Mammal Capture Data at the High Island Site October 1974 and May 1975[a]

	Hispid Cotton Rat Oct/May	Marsh Rice Rat Oct/May	Fulvous Harvest Mouse Oct/May	Black Rat Oct/May	Total Oct/May
Number of individuals captured	50/40	9/2	0/7	1/0	60/49
Number of recaptures	23/25	3/0	0/1	0/0	26/26
Total number of captures	73/65	12/2	0/8	1/0	86/75
Mortalities	0/5	0/0	0/0	0/0	0/5

[a]The total number of trap nights was 192 in October and 240 in May

Table 80

Population Estimates for Small Mammals on the High Island Site, October 1974[a]

Species	Population Estimates (individuals/acre)				
	9 Oct	10 Oct	11 Oct	Mean	95 Percent Confidence Limits[b]
Hispid cotton rat (*Sigmodon hispidus*)	49[c]	25	23	24	15-33[d]
Marsh rice rat (*Oryzomys palustris*)	2	4	8	5	1-9
Black rat (*Rattus rattus*)	0	1[e]	1[e]	1[e]	--
Total estimate for sampled species	--[f]	34	29	30	22-38

[a]Based on the Schnabel formula: $P = \frac{\Sigma(AB)}{\Sigma C}$ where: P=population estimate, A=total number of individuals captured in one day, B=total number of marked animals available for capture, and C=total number of marked animals captured in one day

[b]Around the mean of the estimates

[c]Inflated figure resulted from few recaptures

[d]Estimate for 9 October not included

[e]Number of individuals captured used for estimate

[f]Not calculated because of the inflated figure recorded for cotton rats

Table 81

Population Estimates for Small Mammals on the High Island Site, May 1975[a]

Species	Population Estimate (individuals/acre)					
	18 May	19 May	20 May	21 May	Mean	95 Percent Confidence Limits[b]
Hispid cotton rat (*Sigmodon hispidus*)	9	15	17	22	16	10-22
Fulvous harvest mouse (*Reithrodontomys fulvescens*)	2	2	3	4	2	0-5
Marsh rice rat (*Oryzomys palustris*)	0	1	1	2	1	--
Total estimate for sampled species	12	25	25	33	24	13-35

[a]Based on the Schnabel formula: $P = \frac{\Sigma(AB)}{\Sigma C}$ where: P=population estimate, A=total number of individuals captured in one day, B=total number of marked animals available for capture, and C=total number of marked animals captured in one day

[b]Around the mean of the estimates

cotton rats in the southeastern Piedmont of North Carolina found that densities may vary from 2 to 59 individuals per acre. Davis (1966) stated that in Texas and under favorable habitat and moisture conditions, cotton rat populations will occasionally increase to almost unbelievable numbers. For example, Davis noted that in 1958, when rains ended a prolonged drought, cotton rat populations reached densities of several hundred per acre in some optimum habitat areas.

The cotton rat population on the study site appeared to have a greater density during the fall census, possibly indicating a northern type of seasonal cycle.* Odum (1955) found cotton rats have a northern type seasonal cycle near Athens, Georgia. Odum stated, however, that the average weight of individuals increased during low density periods and decreased during peak densities; thus, the population had a relatively stable biomass. Unfortunately, weights were not recorded for individuals captured at the High Island study site.

Cotton rats were most abundant in the silverling-saltmeadow cordgrass and sea oxeye-gulf coast cordgrass habitats in October 1974, and capture ratios (number of individuals captured per 100 trap nights) within each habitat were nearly equal (Table 82). However, cotton rats were much more abundant in the sea oxeye-gulf coast cordgrass community than in the silverling-saltmeadow cordgrass community in May 1975, and capture ratios in the former more

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*In a northern type of seasonal cycle, peak population densities are reached in the fall and lowest densities in the spring because the major part of the breeding season occurs between these two periods. In a southern type of cycle, greatest densities are reached in late winter or early spring and lowest densities occur in late summer or fall; presumably, these are caused by the depressing effects of hot weather on natality during the midsummer (Odum 1955).

Table 82

Quantitative Small Mammal Capture Results by Plant Association at the High Island Site, October 1974 and May 1975

Species	Plant Association[a] SS	SG	T	R	Totals
Cotton rat					
(*Sigmodon hispidus*)					
October	33(41)[b]	22(42)	6(21)	12(37)	73(38)
May	22(19)	29(58)	6(17)	8(20)	65(27)
Total	55	51	12	20	138(32)
Marsh rice rat					
(*Oryzomys palustris*)					
October	5(6)	0	1	6(19)	12(6)
May	2	0	0	0	2
Total	7	0	1	6	14(3)
Fulvous harvest mouse					
(*Reithrodontomys fulvescens*)					
October	0	0	0	0	0
May	2	2	0	4(10)	8(3)
Total	2	2	0	4	8(2)
Black rat					
(*Rattus rattus*)					
October	0	0	1	0	1(1)
May	0	0	0	0	0
Total	0	0	1	0	1
All species					
October	38(47.5)	22(42)	8(28)	18(56)	86(45)
May	26(23)	31(62)	6(17)	12(30)	75(31)
Total	64(33)	53(52)	14(22)	30(42)	161(37)
Number of trap nights					
October	80	52	28	32	192
May	115	50	35	40	240
Total	195	102	63	72	432

[a]SS=silverling-saltmeadow cordgrass; SG=sea oxeye-gulf cordgrass; T=tamarisk; R=common reed

[b]Estimated number of captures per 100 trap nights is enclosed within parentheses; not calculated for less than five captures

than doubled those for the latter associations. High intraspecific population densities may have influenced the more equal distribution recorded in October.

Fewest cotton rats and lowest capture ratios were recorded in the tamarisk community during both censuses. The latter community is a marginal habitat for cotton rats as it contains a very sparse understory, thus little cover and food supply. The tamarisk community occurs as a very narrow stand; bait around the live traps may have influenced the movement of cotton rats into this habitat from adjacent communities.

Eighty-two percent of the cotton rats captured during the October census were adults, whereas during the May census 55 percent were adults (Table 83). Males were most abundant in October, while females were slightly more numerous in May. Adult sex ratios (males to females) for October and May were 100:71 and 83:100 respectively.

Cotton rats were reproductively active in May. Numerous juveniles at or near weaning age were captured, and one group of nestlings was found in the silverling-saltmeadow cordgrass community.

No cotton rats were recaptured a sufficient number of times to permit computation of home range size. Home ranges reported by other authors are 0.11 acre (Shadowen 1956), 0.21 to 0.25 acre (Provo 1957), and 0.44 to 0.85 acre (Cockrum 1962). Males tend to have a larger home range than females, and home ranges of both sexes tend to decrease in area with increased population densities (Provo 1957).

Odum (1955) and Provo (1957) indicated that cotton rats live only a short time in the wild and that a complete population turnover occurs about every six months. This is possibly the case at High Island as only 6 of the 50 individuals captured in October were recaptured in May.

Table 83

Age and Sex Composition of Small Mammals on the High Island Site, October 1974 and May 1975

	Hispid Cotton Rat Oct/May	Marsh Rice Rat Oct/May	Fulvous Harvest Mouse Oct/May	Black Rat Oct/May
AGE				
Total number of individuals captured	50/40	9/2	0/8	1/0
Number of adults	41/22	9/2	-/7	1/-
Number of immature	9/18	0/0	-/0	0/-
Percent adult	82/55	100/100	-/100	100/-
SEX				
Number of adult males	24/10	6/1	-/4	0/1
Number of adult females	17/12	3/1	-/3	1/-
Male: female sex ratio	100:71/ 83:100	100:50/ 100:100	-/100:75	-/-

Cotton rats are omnivores, eating plant foliage, seeds, roots, tubers, as well as insects, eggs, and chicks of ground-nesting birds. They may do considerable damage to nesting bobwhite populations (Stoddard 1931). When present in high densities, cotton rats may also girdle trees and shrubs, eating the bark at the ground level (Golly 1966).

Cotton rats are active during the day and night. In regions where they are the dominant small rodent, they often constitute the dietary mainstays of numerous diurnal and nocturnal raptors and carnivorous mammals and snakes.

Five cotton rat mortalities were recorded during the May 1975 trapping period. All five were caused by fire ants. The five cotton rats were believed to he healthy adults prior to their deaths, but were apparently unable to ward off the ant attacks because of their confinement within the traps. It seems probable that under natural situations, fire ants may occasionally attack stressed and sick cotton rats and their nestlings.

Marsh rice rats (*Oryzomys palustris*) and fulvous harvest mice (*Reithrodontomys fulvescens*) were also captured during the censuses, but densities were much lower than those recorded for hispid cotton rats (Table 82). Marsh rice rats prefer to inhabit wetter grasslands than hispid cotton rats. Nearly all rice rats captured were in the moister regions of the silverling-saltmeadow cordgrass community or in areas vegetated by common reed. Greater numbers of rice rats were captured in October than in May.

Rice rats were not reproductively active during the trapping censuses. The breeding period in Texas normally ranges from February to October (Svihla 1931 and Davis 1966). Females may have five or six litters per year and litter sizes may range from two to seven (Lowery 1974). Population densities of 0.2 to 7.2 individuals per acre have been reported for Breton Island, Louisiana (Negus et al. 1961). Home ranges in the same area averaged 0.51 acre for females and 0.81 acre for males (Negus et al. 1961).

Western cottonmouths (Agkistrodon piscivorus leucostoma) and barn owls (Tyto alba) are the chief predators of rice rats in coastal prairies. Food habits of rice rats are similar to those of cotton rats (Svihla 1931).

Fulvous harvest mice were captured only during the May census. They appeared more abundant in the common reed association, but were also captured in the silverling-saltmeadow cordgrass and sea oxeye-gulf cordgrass communities. Kaye (1959) and Golly (1962) noted that harvest mice and cotton rats frequently inhabit the same plant associations and that when cotton rat captures are high, harvest mice captures are low and vice versa. Kaye (1959) suggested that there may be some sort of antagonism between the two species.

Population densities of 18.9 individuals per acre have been recorded for fulvous harvest mice in the Baton Rouge area of Louisiana. Home ranges average 0.3 acre, being slightly greater for females than for males (Shadowen 1956). Chief predators in the coastal prairies are marsh hawks (Circus cyaneus), barn owls, and western cottonmouths (Svihla 1930 and Lowery 1974). Food of the harvest mouse consists primarily of seeds (Lowery 1974).

Qualitative sampling of small mammals was conducted in a water-hyssop habitat along an ephemeral pond in October 1974. Two cotton rats and six rice rats were captured during a total of 28 trap nights.

Rabbits were abundant and seen in nearly all plant associations on the study site during the three surveys. Range maps (Burt and Grossenheider 1964, Davis 1966) indicated that two species occur in the study area: the eastern cottontail (Sylvilagus floridanus) and swamp rabbit (S. aquaticus). Both have similar external appearance, making field identification difficult. Since no individuals were captured or collected, positive identification could not be made. Both species are probably present as both are abundant in the surrounding vicinity (U. S. Department of the Interior 1973a).

Swamp rabbits are more restricted to the wetter portions of coastal prairies, while eastern cottontails are ubiquitous (Davis 1966). Population densities of one individual per 4.5 acres are not uncommon for eastern cottontails along the Texas gulf coast (Davis 1966). A density of one individual per 7 acres has been reported for a swamp rabbit population in Brazos County, Texas (Davis 1966). Home ranges for both species may vary from 1 to 20 acres (Lowe 1958, Burt and Grossenheider 1964).

Rabbits feed extensively on grasses and may have a significant influence on grass seed dispersal on the High Island study site. Brown (1946, 1947), for example, studied a black-tailed jackrabbit (*Lepus californicus*) population in Kansas having a density of 3.5 individuals per acre and found that these animals deposited an average of 7.7 lb of seed per acre among their fecal pellets during the month of October.

Coyotes (*Canis latrans*) and red wolves (*C. rufus*) inhabit the study area and likely exert a major influence on the study site's rodent populations. Coyote tracks and scats were found in unvegetated areas and in silverling-saltmeadow cordgrass, sea oxeye-gulf cordgrass, and tamarisk communities. Scat contents invariably included remains of cotton rats and rabbits, probably major food items. An active coyote den was located in May 1975 at the base of a tamarisk tree. Breeding occurs from January to mid-May; young are born from April to June (Davis 1966).

Red wolf tracks were observed in unvegetated areas and in the silverling-saltmeadow cordgrass community. Plaster casts of the tracks were taken but, unfortunately, fragmented during transport. The red wolf is listed as endangered by the U. S. Department of the Interior (1974). Red wolf population declines have resulted from trapping, human pressures, and hybridization with dogs and coyotes (U. S. Department of the Interior 1973b). Most of the remaining red wolves are located in the coastal prairie of Chambers, Jefferson, and Liberty Counties, Texas (Riley and McBride 1972). Anahuac National Wildlife Refuge, located in the western portion of Chambers County, was established in part as a sanctuary for the red wolf.

An active red wolf den was found in May 1975 in the silverling-saltmeadow cordgrass community, about 75 ft east of a large dredged material disposal mound and 500 ft southwest of the drainage ditch. Red wolves commonly den in the slopes or crests of sand mounds in the Texas coastal prairies (Riley and McBridge 1972). Deposition of dredged material in mounds may, therefore, be beneficial to this species.

Red wolves breed in January and February, and pups are born in March and April. Average home range of an adult red wolf is 35 square miles. Nutria (*Myocastor coypus*), swamp rabbits, eastern cottontails, rice rats, cotton rats, and muskrats (*Ondatra zibethica*) are the principal food sources (Riley and McBride 1972). Remains of a nutria and muskrat were found on the study site in October 1974; these individuals were perhaps killed by red wolves.

Nine-banded armadillos (*Dasypus novemcinctus*) were recorded on the High Island site during all three field surveys, but never in great numbers. Burrows were found in the tamarisk and common reed communities. Evidence of where armadillos had probed the ground for food (insects) was noted in unvegetated areas, sea oxeye-gulf cordgrass, silverling-saltmeadow cordgrass, and toothache tree-silverling communities. Probing signs were also noted in several ant mounds within these habitats. The silty soils that occur on the High Island site may not be favorable for armadillo digging and probing activities and may be the major limiting factor affecting armadillo population densities. Davis (1966) noted that soil conditions are frequently the major limiting factor affecting densities along the Texas coast.

c. *Reptiles and amphibians*. Five species of reptiles and four species of amphibians were recorded on the High Island site during the field surveys. Nests and eggshells of unidentified turtles were also observed. Some of these may have been uncovered by predators.

Western cottonmouths and gulf coast ribbon snakes (*Thamnophis proximus orarius*) appeared to be the most abundant reptiles on the study area. Cottonmouths were particularly common around ephemeral ponds and in sparsely vegetated or unvegetated areas; the latter areas were utilized for sunning. Numerous cottonmouths were also seen along the GIWW channel banks, especially along low marshlands. Frequent ingresses and egresses of cottonmouths may occur between the study site and adjacent marshlands.

Cottonmouths often took refuge beneath clumps of gulf cordgrass when disturbed. Because of the effectiveness with which these grass clumps covered the cottonmouths (and other vertebrates as well), the species may have been even more common than was generally believed. On the study area, these snakes likely prey upon small mammals, amphibians, ground birds, and other reptiles.

Gulf coast ribbon snakes were found in the sea oxeye-gulf coast cordgrass and silverling-saltmarsh cordgrass communities, but appeared most numerous in the moister regions of the latter habitat. Nearly all ribbon snakes observed were resting on the lower branches of silverling bushes, particularly during early daylight hours. Because of their climbing ability, they are likely chief predators of red-winged blackbird and orchard oriole eggs. Other food items on the study area likely include amphibians and small rodents.

Gulf coast toads (*Bufo valliceps*) and eastern narrow-mouthed toads (*Gastrophryne carolinensis*) were the most abundant amphibians at the study area. Gulf coast toads were recorded in all habitats, but greatest numbers occurred in the drier, sparsely vegetated regions. Narrow-mouthed toads were most common in marsh vegetation around ephemeral ponds and drainage ditches and in the wetter areas of the silverling-saltmeadow cordgrass community. Choruses of both species were heard on rainy days during the August survey.

Other reptiles and amphibians inhabiting the study area and their distribution by plant associations are noted in Table 84. None of the reptiles and amphibians recorded on the High Island site are classified endangered by the U. S. Department of the Interior (1974). However, American alligators (Alligator mississippiensis), which are endangered, were seen in the adjacent GIWW. Alligators probably inhabit the drainage ditch which bisects the study site, as well as as some of the site's larger ephemeral ponds. Marshes and low silverling-ling-saltmeadow cordgrass habitats that border the ditch and ponds may occasionally be used for nesting. Most nesting occurs in June; young hatch in late August and September (Joanen 1969).

d. Immigration and colonization. The High Island study site is not isolated by any formidable barriers, consequently faunal immigration and colonization should not be retarded. Frequent ingresses and egresses likely occur between the study site and adjacent land.

Many of the faunal species that immigrate to the High Island site probably originate from adjacent grasslands. This should be especially true for species with a low degree of mobility, such as amphibians and small rodents.

203. Effects of fire and grazing on faunal populations. Vegetation height and density are critical factors affecting vertebrate populations in grasslands (Cody 1968). Fires and the effects of livestock may therefore have a very pronounced influence on native faunal populations.

204. Fires periodically occur in grasslands on the High Island site. When fires occur at frequent intervals, such as once every 1 to 2 years, a short grass situation is created. When fires occur less frequently, vegetation may be allowed to succeed to a tall grass or mixed tall grass-shrub stage.

205. Fires reduce grassland height and density and litter accumulated on the ground surface. Wildlife food supply and cover

Table 84

Distribution of Reptiles and Amphibians by Plant Association in the High Island Site

Species	Plant Association[a]						
	T	SG	SS	R	TS	U	P
				REPTILES			
Texas horned lizard (*Phrynosoma cornutum*)	-	X	-	-	-	X	-
Eastern garter snake (*Thamnophis s. sirtalis*)	-	-	X	-	-	-	-
Gulf coast ribbon snake (*Thamnophis proximus orarius*)	-	X	X	-	-	-	-
Gulf salt marsh snake (*Natrix fasciata clarki*)	-	X	-	-	-	-	-
Western cottonmouth (*Agkistrodon piscivorus leucostoma*)	-	X	-	X	X	X	X
Turtle (nests and eggs)	-	X	X	-	-	X	-
				AMPHIBIANS			
Gulf coast toad (*Bufo valliceps*)	-	X	X	-	-	X	-
Eastern narrow-mouthed toad (*Gastrophryne carolinensis*)	-	-	X	-	-	-	X
Green treefrog (*Hyla cinerea*)	-	-	X	-	-	-	-
Southern leopard frog (*Rana utricularia*)	-	-	X	-	-	X	X

[a]T=tamarisk; SG=sea oxeye-gulf cordgrass; SS=silverling-saltmeadow cordgrass; R=common reed; TS=toothache tree-silverling; U=unvegetated; P=ephemeral ponds, drainage ditches, and bordering marsh vegetation

are correspondingly diminished, although nutritional value of subsequent new vegetation growth may be quite high.

206. Approximately one-quarter of the western half of the study site burned during the winter of 1974-1975. New growth by May 1975 had reached approximately one-half to one ft in height. Faunal densities and diversities generally appeared lower than those in adjacent unburned grassland areas. For example, rabbit and cotton rat runways and scats were common in the tall-grass sectors of the study site, but uncommon or nonexistent in the burned area. Red-winged blackbirds and common yellowthroats established much larger breeding territories in the burned area than in adjacent communities, resulting in lower breeding densities per acre. Eastern meadowlarks were present in the tall-grass situations, but absent in the burned region. Meadowlarks had been observed in the latter region in October 1974, prior to the burn.

207. Species found in short-grass situations are often different than those found in tall-grass communities. Species that frequently inhabit short-grass areas and are present on the study site include the common nighthawk, killdeer (*Charadrius vociferus*), and Texas horned lizard. However, none of these were recorded in the burned area.

208. Grazing and trampling pressures exerted by livestock may produce similar effects on vegetation and native faunal population structures as those noted for fires. The extent, however, is largely determined by the livestock stocking rate.

209. Past patterns of animal succession. Portions of several dredged material mounds are presently unvegetated or sparsely vegetated. Vertebrates or their sign observed in these areas during the field surveys were killdeer, common nighthawks, rabbits, Texas horned lizards, turtles (eggshells), western cottonmouths, gulf coast toads, and southern leopard frogs. Western cottonmouths and southern leopard frogs are probably transients, but the remainder likely utilize the mounds for nesting, burrow construction, and/or

feeding. Killdeer, common nighthawks, rabbits, Texas horned lizards, turtles, and gulf coast toads probably utilized other dredged material mounds for similar purposes during unvegetated and sparsely vegetated seral stages.

210. Unvegetated and sparsely vegetated habitats are potential nesting sites for gulls and terns. Seven species occur in the Bolivar Peninsula area during the breeding season: laughing gulls (*Larus atricilla*), gull-billed terns (*Gelochelidon nilotica*), Forester's terns (*Sterna foresteri*), least terns (*Sterna albifrons*), royal terns (*Thalasseus maximus*), Caspian terns (*Hydroprogne caspia*), and black skimmers (*Rhynchops niger*) (U. S. Department of the Interior 1969). Some of these species perhaps nested on the dredged material mounds in the past, but none were noted during the present study.

211. Pioneer vertebrates mentioned in the preceding paragraphs likely emigrated and were replaced by other species from adjacent grasslands once vegetation on dredged material mounds became taller and more dense. Vertebrate species composition within these areas has probably experienced little further change.

212. *Future patterns of animal succession.* Vertebrate populations on the High Island site will not likely undergo much change in the future since it is doubtful that a closed canopy of arborescent vegetation will ever develop. Most changes should be related to the effects of fire and grazing livestock.

Potential Resources of Regional Upland Disposal Areas

213. The High Island site, and other disposal areas in the wet prairie region are presently supporting occasional short-term periods of grazing as well as irregular use as disposal areas. In addition, a few such disposal areas support thick growths of silverling and tamarisk that supply important resting and feeding habitat for migratory perching birds. High Island is an important resting and feeding area for spring migrants arriving from Central and South

America. Its importance is largely a result of the presence of the small stands of tamarisk trees.

214. Planting of tamarisk or other salt-tolerant tree species on dredged material would serve to enhance resting and feeding areas along the GIWW.

215. As has already been pointed out, suitable habitat may develop over dredged material to support portions of red wolf territories. The mounds of dredged material in which dens could be dug may be of particular value to this and other species.

Regional Sere for Upland Disposal Areas

216. In the wet prairie region, disposal areas composed of fine sandy to coarse silty dredged material will probably not advance beyond stages dominated by herbs and shrubs. Silverling, a shrub with wind-dispersed seeds, is a strong competitor in lower elevations of dredged material noted elsewhere in the region. Seeds of sea oxeye both float readily and can be transported on bird feathers. Both species are capable of withstanding the high content of soluble salts generally characteristic of dredged material in this area. These species probably constitute the long-term dominant woody plants of these soils.

217. Areas of coarser sand may eventually support scattered arborescent vegetation, but grasses, sedges, and rhizomatous shrubs can compete more successfully for water and nutrients, particularly under stresses imposed by fire, grazing, and continued disposal of dredged material.

Part VIII: Mott Island, Oregon

Description of Regional Setting

218. Mott Island is an artificial island near Columbia River mile 18, 0.5 miles east of Tongue Point near Astoria (Figure 39). The island, created by dredged material disposal operations, is surrounded by a riverine-estuarine environment within the greater Northern Coniferous Forest Biome (Odum 1971) and more regionally within the Coastal Ranges Physiographic Province (Franklin and Dyrness 1973).

219. Climatologically, the region is maritime. The weather is dominated by an eastward flow of moisture-laden air from the Pacific Ocean. The climate is temperate and the area experiences relatively small fluctuations in both diurnal and annual temperatures, receives large amounts of precipitation, and is subject to prolonged periods of heavy fog.

220. Temperatures and precipitation data described below were recorded at Astoria, Oregon, and are based on a 21-year record (U. S. Department of Commerce 1973a). The average annual mean temperature for the Astoria area is 50.5^{o}F. January, with a mean temperature of 41.2^{o}F, is the coldest month of the year. August is the warmest month with a mean temperature of 60.4^{o}F. The highest temperature recorded was 100^{o}F (July 1942). Mean annual precipitation for the station is 71.13 in. with 47 percent of all precipitation occurring during the late fall and early winter months. The driest period occurs during the summer months, when only 11 percent of the annual precipitation is experienced. The average number of frost-free days is 273 (U. S. Department of Agriculture 1965).

221. For the major part of the year, prevailing winds are from the southwest. From May through August the winds are out of the northwest. The annual mean wind speed is 8.4 mph. During the winter months, storms moving inland from the Pacific Ocean may move rapidly up the Columbia River Gorge. When these moist winds meet the cooler air flowing out of the gorge, high winds and turbulent weather result.

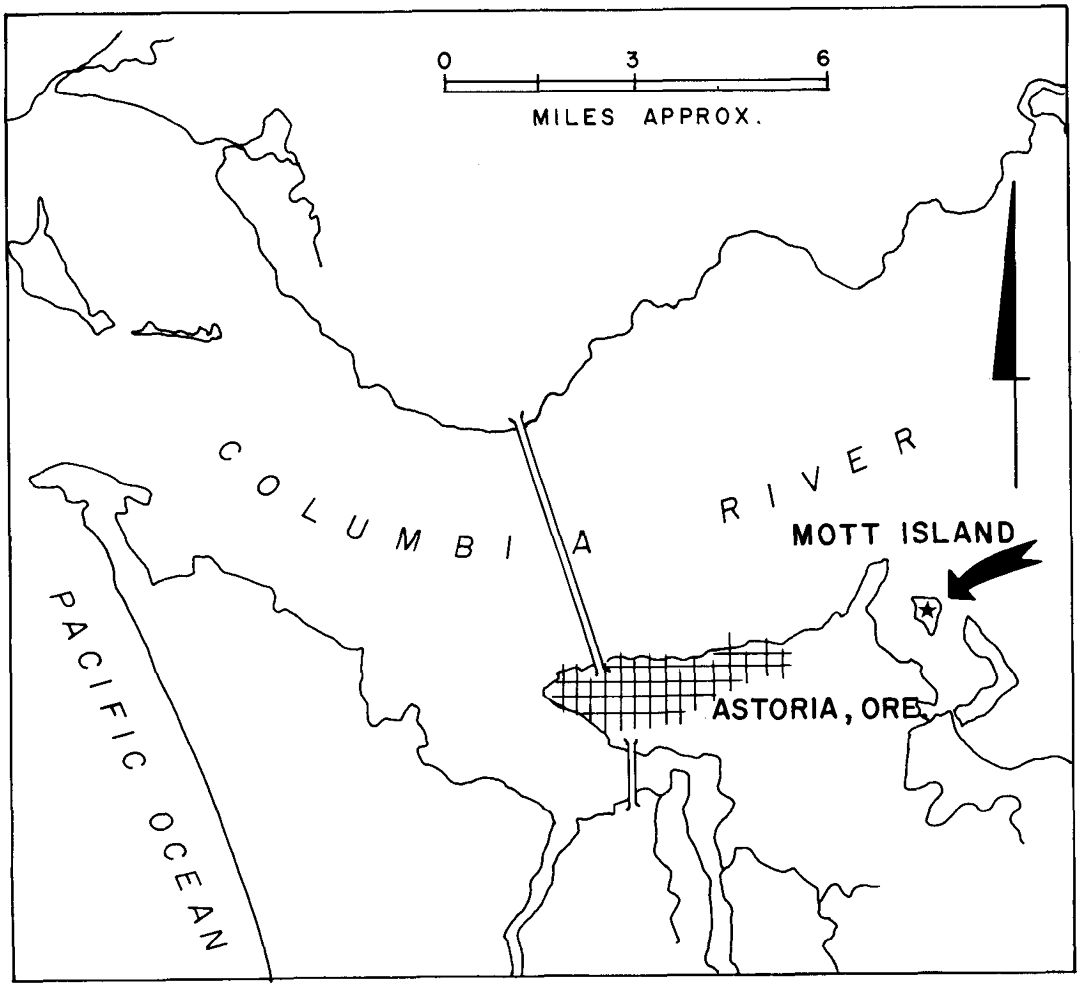

Figure 39 Vicinity Map, Mott Island, Oregon

Such storms moving up the Columbia River are responsible for winds greater than 50 mph, heavy precipitations, rough water, and extremely high tides. Winds of hurricane intensity (74 mph and over) strike the Oregon coast several times a year (Sternes 1960). Normal tidal flux is unequal semi-diurnal, and usually in excess of 8 ft.

222. Development of estuarine conditions in the Columbia River probably occurred following retreat of Pleistocene glaciation. During that period, many river mouths were drowned. Eroded materials released during the melting processes were washed into the Columbia River system and subsequently to the ocean, or else were deposited in newly created estuarine environments and have since been buried by more recent sediments. Landscapes probably contributing most to the Columbia River estuarine sediments are within the Columbia Basin, as depicted in Franklin and Dyrness (1973).

223. Forests of the western slopes of the Coastal Ranges are dominated by Sitka spruce (Picea sitchensis). Other common trees of mature forests are Douglas fir (Pseudotsuga menziesii), western red cedar (Thuja plicata), and western hemlock (Tsuga heterophylla). Early seral stages of these forests are dominated by red alder (Alnus rubra), a fast growing species that is usually peculiar to heavily disturbed soils and alluvial sands (Franklin and Dyrness 1973). Terraces along the Hoh River in Washington also support red alder in early seral stages. Alder eventually gives way to Sitka spruce, black cottonwood (Populus trichocarpa), and big-leaf maple (Acer macrophyllum) (Fonda 1974).

224. Little information has been gathered with respect to island habitats within the Columbia River estuary. More mature upland communities within the lower river basin, including island habitats, frequently support forests composed of Sitka spruce, cottonwood, and willows (Salix spp.), with early seral stages dominated by red alder.

225. Habitats similar to those on sandy dredged material occur on Oregon coastal dune systems. Dune deposits vary from dry to wet, with sand movement being strongly influenced by this gradient. Wiedemann

(1966) has described the coastal dune vegetation of the Oregon coast and outlined seres for development of vegetation on more stable sands of deflation plains. The most applicable sere begins at a meadow stage dominated by red fescue (*Festuca rubra*), hairgrass (*Aira praecox*), and cats-ear (*Hypochaeris radicata*). Development is toward a shrub stage where Hooker's willow (*Salix hookeriana*) dominates and in which seedlings of shore pine (*Pinus contorta*) and Sitka spruce occur. The young forest stage contains the same species, but overtopping of the willow by spruce and pine has occurred. The final major phase is a forest in which Sitka spruce dominates and little or no shrub and herb layers develop. Wiedemann (1966) also indicates that meadow stages or drier sands may be dominated by lupine (*Lupinus littoralis*), beachgrass (*Ammophila arenaria*), and a bluegrass (*Poa macrantha*).

History of the Disposal Area

226. Mott Island was created between 1946 and 1948 as a disposal area for dredged material removed from an inactive fleet berthing facility at Tongue Point. Dredging plans and drawings, obtained from the Portland District and dated 6 February 1946, show that the area was to be dredged to -20 ft mean low low water (mllw). The material to be removed was composed largely of silt and sand. The dredged material was placed on shoaled remains of a small disposal area south of the existing riprap jetting. The small disposal area shows on 1939 aerial photographs provided by the Portland District. It does not appear on aerial photographs for subsequent years.

227. In 1952, due to use of the berthed ships for grain storage, the facility was deepened to accommodate greater draft of loaded ships. Mott Island was again used as a disposal area, at least in part (Personal communication, 26 June 1975, J. E. Shelver, Field Office, Navigation Division of the Portland District Corps of Engineers, Astoria, Oregon).

228. Dredged material resulting from the 1946-48 disposal operation was planted in shore pine, scotchbroom (*Cytisus scoparius*), and beachgrass. Disposal in 1952 took place within a dike and destroyed much of the 1948 planting. Shore pine was least affected. A second planting in 1952 was limited to beachgrass. Wilbur Ternyik did the

planting following both disposal periods (Personal communication, 18 March 1975 and 26 June 1975, Wilbur Ternyik, Wave Beachgrass Nursery, Florence, Oregon).

Ecological Analysis

Physical characteristics

229. Topography. Mott Island was constructed to an elevation of +13 ft mllw during 1946-1948, according to project plans provided by the Portland District. Elevations attained by subsequent disposal in 1952 are not known, but the island now is probably as much as 10 to 15 ft higher. This estimate is based on height of the dike used during the last disposal period. This dike presently averages 6 to 8 ft in height above the base where shore pine was planted in 1948. The level of the dredged material inside the dike is still higher.

230. Containment of the dredged material was not entirely successful during the 1952 disposal operation. Configurations of the vegetation associations in three places on the island indicate movement of material to the outside of old dikes. Such areas show on the map (Figure 40) on the west, south, and east side of the island. Dike walls are not nearly so apparent in these areas and no dikes are apparent on the north end, except for a low ridge that extends southeastward from the south end of the jetty.

231. The concentric rings of vegetation visible on the biotic community map (Figure 40) reflect a gradual increase in soil moisture down slope from the center of the island. This gradient is a function of tidal flux and topography.

232. Soils. Three soil samples were taken at Mott Island. Data from analysis of these samples are presented in Table 85 and may be interpreted as reflecting generalized soil conditions at low, medium, and high topographic situations on the island.* Soil sample No. 2 was taken from the new disposal area on the island; samples No. 1 and 3 from the older area.

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*Soil sample locations are shown on Figure 45, occurring later in the text.

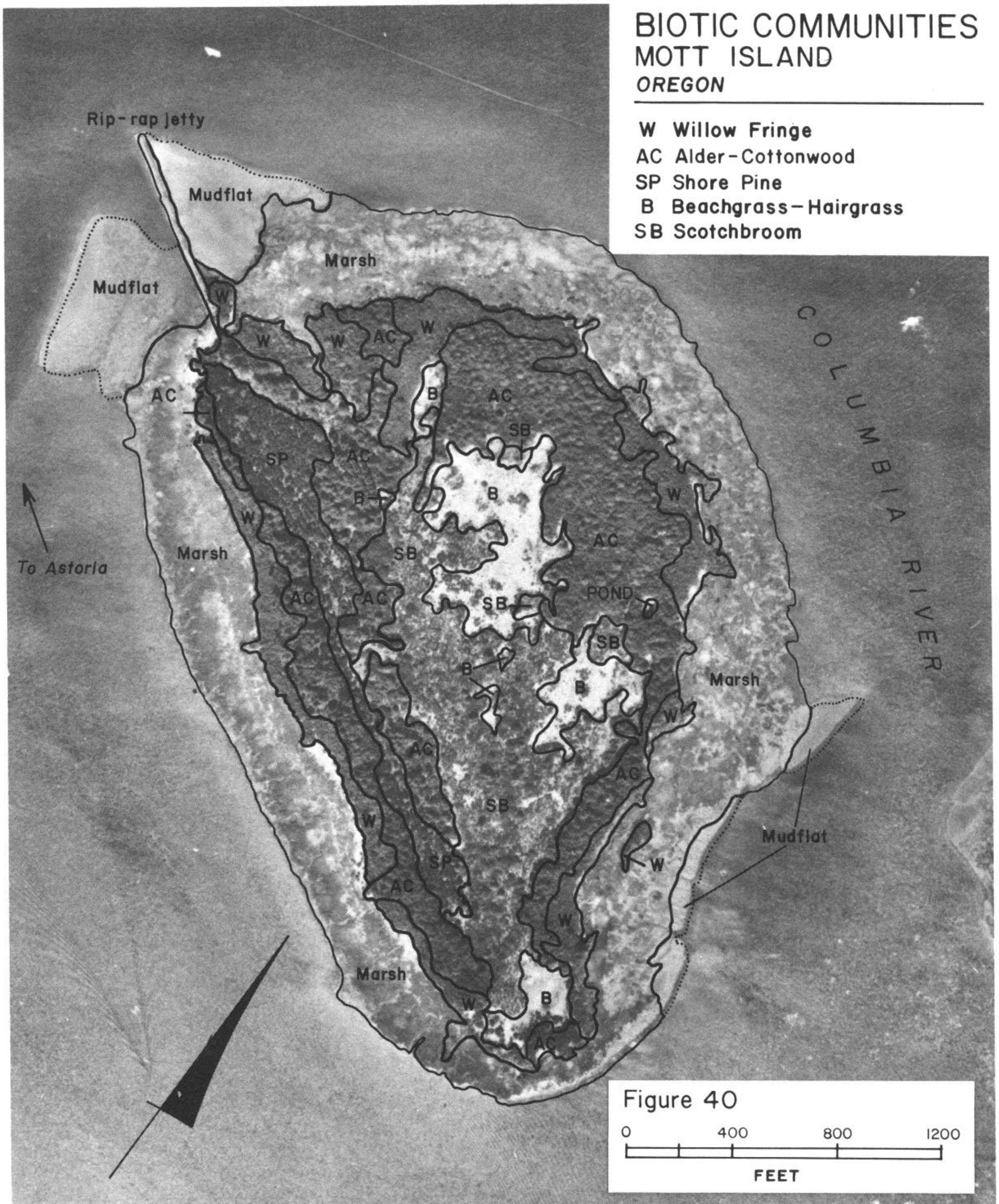
BIOTIC COMMUNITIES
MOTT ISLAND
OREGON
W Willow Fringe
AC Alder-Cottonwood
SP Shore Pine
B Beachgrass-Hairgrass
SB Scotchbroom
Rip-rap jetty
Mudflat
Mudflat
Marsh
W
AC
SP
B
SB
POND
To Astoria
COLUMBIA RIVER
Marsh
Mudflat
0
400
800
1200
FEET

Figure 40

Table 85

Physical Description of Mott Island Soils

Biotic Community	Sample Number	Sample Depth, cm	Depth to Water Table, cm	Particle-Size Distribution - Phi Scale[a] -1	0	1	2	3	4	5	6	7	8-14
Shore pine	1-1	0-15	-	0.4	0.2	0.4	5.8	48.6	27.4	13.6	2.0	1.0	0.6
	1-2	15-31	-	0.0	0.2	0.6	11.4	38.6	33.4	11.6	3.0	1.2	0.0
	1-3	31-61	197	0.0	0.2	0.2	2.4	36.2	42.6	14.2	4.0	0.2	0.0
Beachgrass-hairgrass	2-1	0-15	-	0.0	0.4	2.0	16.6	66.6	12.6	0.8	1.0	0.0	0.0
	2-2	15-31	-	0.0	0.2	0.2	12.0	70.8	12.4	1.0	2.6	0.8	0.0
	2-3	31-46	168	0.0	0.0	0.2	7.4	73.4	18.1	0.9	0.0	0.0	0.0
Alder-cottonwood	3-1	0-8	-	2.0	3.5	8.8	17.0	47.2	12.7	5.3	2.9	0.6	0.0
	3-2	8-31	-	0.0	0.0	0.2	7.8	62.0	27.0	0.8	1.4	0.4	0.4
	3-3	31-46	61	0.0	0.0	0.2	11.0	72.2	11.8	3.8	1.0	0.0	0.0

[a]Phi Scale	Wentworth Size
-1	Granule
0	Very coarse sand
1	Coarse sand
2	Medium sand
3	Fine sand
4	Very fine sand
5	Coarse silt
6	Medium silt
7	Fine silt
8-14	Very fine silt & clay

233. The soils have a very constant particle-size distribution. The majority of the material falls within the medium sand to fine sand texture category with a relatively small amount of coarse to medium silt. All of the profiles sampled are texturally similar.

234. Microclimate. Microclimate data taken at Mott Island indicate rapid diurnal fluctuations in relative humidity and temperature above the ground, and a wide variation between surface and subsurface soil temperatures (Table 86). The phenomenon of microclimate moderation by vegetation is readily apparent when comparing the data from the beachgrass-hairgrass and scotchbroom communities for 7 July 1974. Rapid fluctuations in relative humidity and surface temperatures are characteristic in the communities without arborescent vegetation. These fluctuations in July 1974 came as a result of intermittent showers and sunshine. During the October 1974 sampling period, morning relative humidities were higher and morning temperatures were lower, but inner soil temperatures remained relatively constant. Readings taken in the morning of 8 June 1975 reflect the non-stratification of temperature during early morning hours.

235. Bryophytes (mosses and liverworts), abundant in all communities on Mott Island, are extremely sensitive to microclimatic factors such as humidity and temperature. They tend to abound where moisture is high and temperatures are moderate and should show a decrease in abundance with wider microclimatic variation. This may be shown to be true when Total Relative Values* (TRV's) for bryophytes are examined from the various communities on the island (given later in Tables 89 through 95). Bryophyte cover decreases from willow fringe (TRV=59.8) to alder-cottonwood (TRV=39.6) to scotchbroom (TRV=32.3) to beachgrass-hairgrass (TRV=19.5). The TRV for bryophytes in the shore pine community is very similar to that for the alder-cottonwood community. For the most part, the shore pine plantation occupies a topographic position and moisture regime that would otherwise be occupied by

*Total Relative Value is defined as the sum of Relative Values of shrubs and herbs in the herb layer. Relative Values are the total cover percentages contributed by each species occurring within the sample plot (See Methodology, Part III).

Table 86

Microclimate Data, Mott Island

Date	Biotic Community	Time	Percent Relative Humidity[a]	Temperature (°C) 0.5 m	Litter Surface	Below Litter	-2 cm	-10 cm
7 Jul 1974	Shore pine	AM	72	18	15	15	14	13
	Beachgrass-hairgrass	PM	60	22	37	NA[a]	30	19
	Alder-cottonwood	PM	64	21	20	NA	16	13
	Scotchbroom	PM	80	16	19	19	18	19
16 Oct 1974	Scotchbroom	AM	94	13	14	13	13	12
	Alder-cottonwood	AM	83	15	14	14	13	13
	Scotchbroom	PM	75	18	16	15	13	12
	Beachgrass-hairgrass	PM	75	20	25	NA	17	13
		PM	NR[b]	20	25	20	17	13
	Alder-cottonwood	PM	80	16	14	14	13	12
		PM	60	17	15	14	14	13
8 Jun 1975	Willow fringe	AM	86	14	15	13	13	13
	Alder-cottonwood	AM	83	13	14	12	12	12
	Shore pine	AM	82	13	13	13	13	12
	Scotchbroom	AM	66	18	18	16	16	14

[a]NA=not applicable, litter layer absent

[b]NR=not recorded

alder-cottonwood. This relative position is reflected by a total TRV for mosses of 39.1.

Biological characteristics

236. Analysis of existing vegetation. The vegetation of Mott Island is zoned largely across the soil moisture gradient already discussed. In addition to topography and tidal flux, several other factors have had and are having a profound influence on the distribution of vegetation units on the island.

237. Plantations of shore pine, beachgrass, and scotchbroom have had a large effect on habitat availability. Shore pine, planted in 1948, presently occupies about 7.2 acres of the island (Table 87), beachgrass with its hairgrass (*Aira* spp.) associates occupies 10.1 acres, and scotchbroom covers 20 acres. Nearly half of the upland portion of the island is dominated by plants introduced for sand stabilization.

238. Bryophytes and lichens constitute a substantial percentage of cover throughout all communities. They occupy all moisture-holding surfaces including the surface of the soil, surfaces of decaying litter, and surfaces of both woody and herbaceous plant stems. The total contribution of these cryptogams to litter accumulation, though not measured, must be very great, particularly in communities dominated by arborescent vegetation.

239. The following biotic communities are dealt with in detail:

Willow fringe
Alder-cottonwood
Shore pine
Scotchbroom
Beachgrass-hairgrass

240. Marsh, though an important part of the total habitat complex, is not the subject of this study and will be discussed only briefly. Approximately 58 acres of tidal marsh surround the upland portions of Mott Island, contributing significantly to the overall island biota complex.

Table 87

Acreages of Biotic Communities, Mott Island

Biotic Community	Acres	Percent
Marsh	58.4	39.9
Willow fringe	17.3	11.8
Alder-cottonwood	33.5	22.9
Shore pine	7.2	4.9
Scotchbroom	20.0	13.6
Beachgrass-hairgrass	10.1	6.9
Total	146.5	100.0

241. As far as plant species are concerned, the tidal marsh is the most diverse assortment of species seen on the island. Unequal semi-diurnal tides influence growth and species content of tidal marsh. Generally the marsh can be divided into two portions, upper and lower, based on tidal flooding regimes. The lower marsh is dominated by common spike rush (Eleocharis palustris) along with canarygrass (Phalaris arundinacea). The upper marsh is dominated by Lyngby's sedge (Carex lyngbyei), and tapered rush (Juncus acuminatus) is a common associate. Small, isolated clones of Pacific willow (Salix lasiandra) occur in the upper portions of the higher marsh. Other plant species noted in the marsh are listed in Appendix E.

a. Willow fringe. Beginning as isolated clumps or clones in the upper marsh, Pacific willow forms a distinct zone of vegetation around Mott Island (Figure 40). The willow fringe occurs within the zone of normal high-tide flooding. Depth of waters at high tide may vary from more than half a meter at the outer edges to less than a decimeter at the inner edges. High tides normally reach the lower edges of the alder-cottonwood community, just above the willow fringe.

The ground in both the willow fringe and portions of the alder-cottonwood communities is heavily littered with floatable debris such as wood, bottles, styrofoam, and net buoys. A distinct zone of wrack composed largely of logs escaped from log rafts litters the upper marsh and lower willow fringe around the entire island.

Pacific willow is the dominant species in numbers of stems per hectare and basal area per hectare (Table 88). The nearly continuous willow understory is about 5 to 6.5 m high. Diameters of individual stems are usually less than 2 dm. The willow grows very thickly, and this considerably reduces light levels on the soil. The canopy overstory (or canopy) is composed of higher emergent red alder along with several higher individuals of Pacific willow. Absolute densities of these species are similar (Table 88).

Elderberry (Sambucus racemosa) and salmonberry (Rubus spectabilis) are the two most common shrubs in this community, but do

Table 88

Density, Basal Area, and Importance Values for Canopy and Understory Tree Species in the Willow Fringe Community of Mott Island

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value[c]
		Canopy			
Red alder (*Alnus rubra*)	129.65	3.2	53.6	74.4	128.0
Pacific willow (*Salix lasiandra*)	112.20	1.1	46.4	25.6	72.0
	241.85	4.3	100.0	100.0	200.0
		Understory			
Pacific willow (*Salix lasiandra*)	7614.15	11.3	94.3	92.7	187.0
Red currant (*Ribes sanguineum*)	229.20	0.5	2.9	4.1	7.0
Ash (*Fraxinus latifolia*)	114.60	0.2	1.4	1.6	3.0
Red alder (*Alnus rubra*)	114.60	0.2	1.4	1.6	3.0
	8072.55	12.2	100.0	100.0	200.0

[a] Stems per hectare

[b] Square meters per hectare

[c] Relative density plus relative basal area

not form a distinct shrub stratum under the Pacific willow. Occasional large individuals are widely scattered.

Other than bryophytes, the most abundant herb species are jewelweed (*Impatiens capensis*), scouring rush (*Equisetum telmateia*), and canarygrass (*Phalaris arundinacea*), a ubiquitous species throughout the island (Table 89). Skunk cabbage (*Lysichitum americanum*), though it was not encountered during quantitative sampling, is one of the more obvious species present. It is customarily found in the transition zone (ecotone) between marsh and willow fringe or, occasionally, between willow fringe and alder-cottonwood.

b. *Alder-cottonwood*. Red alder and black cottonwood (*Populus trichocarpa*) are the canopy dominants of the alder-cottonwood association, but alder stems number more than five and a half times those of cottonwood, and contribute three and a half times more basal area than cottonwood (Table 90). Willows (both *Salix lasiandra* and *S. hookeriana*) occur*, but do not reach the densities or importance attained by red alder and black cottonwood (Table 90). The understory is composed of the same species as the canopy.

Elderberry is more abundant in this community than in the willow fringe, particularly in the northeastern quadrant of the community. Throughout the eastern half of the island, the alder-cottonwood stands are more open, with a very distinct low shrub layer dominated by elderberry. This community in the western half of the island supports a greater abundance and diversity of shrub and herb species than is found in other parts of the island.

A few large individuals of both alder and cottonwood exceed 20 in. DBH. Based on growth time starting in 1948, 26 years have elapsed (to 1974) and growth of these large individuals has averaged

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*There may have been a problem in the field in distinguishing between *S. lasiandra* and *S. hookeriana*. The former is undoubtedly the canopy dominant in the willow fringe, but one or both could have appeared elsewhere, except in the scotchbroom community where only *S. hookeriana* was seen.

Table 89

Average Percent Cover and Relative Values for Herb and Shrub Species in the Herb Layer of the Willow Fringe Community of Mott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Jewelweed (*Impatiens capensis*)	21.5	23.7	22.8
Canarygrass (*Phalaris arundinacea*)	5.0	5.5	5.3
Scouring rush (*Equisetum telmateia*)	2.0	2.2	2.1
Creeping Charlie (*Glecoma hederacea*)	1.5	1.7	1.6
Forget-me-not (*Myosotis laxa*)	1.0	1.1	1.1
Small bedstraw (*Galium trifidum*)	1.0	1.1	1.1
Birdsfoot-trefoil (*Lotus corniculatus*)	0.5	0.6	0.5
Common vetch (*Vicia sativa*)	0.5	0.6	0.5
Felonwort (*Solanum dulcamara*)	0.5	0.6	0.5
Rush (*Juncus* sp.)	0.5	0.6	0.5
Bryophytes	56.5	62.3	59.8
	90.5	100.0	

[a]Average cover for all 0.5-m^2 quadrats

Table 89 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Shrubs:			
Salmonberry (*Rubus spectabilis*)	2.5	62.5	2.5
Elderberry (*Sambucus racemosa*)	1.0	25.0	1.1
Red currant (*Ribes sanguineum*)	0.5	12.5	0.5
	4.0	100.0	99.9

Table 90

Density, Basal Area, and Importance Values for Each Tree Species in the Canopy and Understory of the Alder-Cottonwood Community of Mott Island

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value[c]
		Canopy			
Red alder (*Alnus rubra*)	557.3	16.4	79.6	76.3	155.9
Black cottonwood (*Populus trichocarpa*)	98.8	4.5	14.1	20.9	35.0
Hooker's willow (*Salix hookeriana*)	32.8	0.3	4.7	1.4	6.1
Pacific willow (*Salix lasiandra*)	11.0	0.3	1.6	1.4	3.0
	699.9	21.5	100.0	100.0	200.0
		Understory			
Red alder (*Alnus rubra*)	1209.5	1.5	90.0	79.0	169.0
Hooker's willow (*Salix hookeriana*)	82.8	0.2	6.2	10.5	16.7
Black cottonwood (*Populus trichocarpa*)	51.0	0.2	3.8	10.5	14.3
	1343.3	1.9	100.0	100.0	200.0

[a] Stems per hectare [b] Square meters per hectare [c] Relative density plus relative basal area

0.77 in. per year of diameter increase. Good sites in Washington have been known to produce trees with a DBH of 11 in. in 30 years for red alder. In British Columbia, exceptional sites have produced 27-year-old black cottonwood trees with a DBH of 32.5 in. (U. S. Department of Agriculture 1965). Growth of red alder seems almost incredible on Mott Island, while growth of black cottonwood is certainly very good.

Understory stems of alder constitute 68 percent of the total density of alder, whereas cottonwood understory stems constitute only 34 percent of the total cottonwood stems (Table 90). It appears that alder may have had more of a chance to regenerate than cottonwood during some time in the past. Neither was present in the shrub layer, but neither competes well under shaded conditions (U. S. Department of Agriculture 1965).

Scattered, small colonies or individuals of species that occur as typical constituents in climax seral stages of spruce-fir forests elsewhere in the Pacific Northwest occur also on Mott Island in the alder-cottonwood and shore pine communities. Some of these species are Sitka spruce, western hemlock, sword-fern (*Polystichum munitum*), and candyflower (*Montia sibirica*), as well as many species of bryophytes. Sitka spruce and western hemlock individuals are young trees. None of these (except the bryophytes) were common enough to be encountered to any great extent during quantitative sampling. Sword-fern appears in the shore pine community, as it is more characteristically an herb of coniferous forests.

Two major variations occur within the defined limits of the alder-cottonwood forest. These variations are probably related to light availability and other factors of habitat suitability. Localized loss of canopy cover increases light penetration to the forest floor and permits development of herb thickets of jewelweed (*Impatiens capensis*), velvet-grass (*Holcus lanatus*), blackberry (*Rubus laciniatus*), slough sedge (*Carex obnupta*), bluegrass (*Poa* sp.), bentgrass (*Agrostis* sp.), hairgrass (*Deschampsia* sp.), another species of scouring rush

(Equisetum hyemale), thistle (Cirsium sp.), and others (Table 91). These species occur less frequently under a heavy canopy.

Another variation, possibly resulting from soil preferences and competitive ability, occurs at the northwestern end of the island where a young canopy dominated only by black cottonwood has become established. This stand results from vegetative reproduction from underground stem structures, and the resulting clone is probably spreading to points somewhat outside its optimum habitat. Most individuals in this area were within a 5 to 10 in. diameter class. Black cottonwood has a high vegetative reproductive capacity because of its ability to send up root suckers. This ability allows it to compete in dryer sands more satisfactorily than red alder.

c. Shore pine. Shore pine is planted on Mott Island. It was once more extensive than indicated by its present limits (Figure 40). Several scattered individuals still grow in the scotchbroom community, but are severely stunted.

Shore pine appears to have been most successful where it was planted within areas otherwise dominated by alder-cottonwood. Scattered individuals of cottonwood and alder occur (Table 92) within the shore pine plantation, and relative soil moisture regimes of the two communities are similar.

Shrub cover in the shore pine community is low. The largest portion of the shrub cover is contributed by scotchbroom, but it is usually spindly and of low vigor in shaded situations. Scotchbroom was originally planted with shore pine in 1948 as a windbreak, fire retardant, and nitrogen source for seedling shore pine. It has since been overtopped and shaded out by the pine and is only of minor importance in the shrub section of the herbaceous layer (Table 93).

Canarygrass, bentgrass, slough sedge, two scouring rushes, an unidentified grass, and bryophytes constitute 91 percent of the herbaceous cover in this community.

d. Scotchbroom. Scotchbroom is an introduced species of shrub used as an ornamental and a soil binder, particularly in sandy soils. On Mott Island, this clonal species forms a distinct community around the central portion of the island and occurs in scattered low

Table 91

Average Percent Cover and Relative Values for Herb and Shrub Species in the Herb and Shrub Layers of the Alder-Cottonwood Community of Mott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Bluegrass (*Poa* sp.)	8.0	12.9	11.9
Jewelweed (*Impatiens capensis*)	6.5	10.5	9.7
Slough sledge (*Carex obnupta*)	6.0	9.7	9.0
Velvet-grass (*Holcus lanatus*)	4.5	7.3	6.7
Scouring rush (*Equisetum hyemale*)	3.5	5.7	5.2
Scouring rush (*Equisetum telmateia*)	1.5	2.4	2.2
Cow parsnip (*Heracleum lanatum*)	1.5	2.4	2.2
Small bedstraw (*Galium trifidum*)	1.5	2.4	2.2
Felonwort (*Solanum dulcamara*)	1.0	1.6	1.5
Creeping buttercup (*Ranunculus repens*)	1.0	1.6	1.5
Canarygrass (*Phalaris arundinacea*)	0.5	0.8	0.8
Bryophytes	26.5	42.7	39.6
	62.0	100.0	

[a]Average cover for all 0.5-m^2 quadrats

Table 91 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Shrubs:			
Elderberry (*Sambucus racemosa*)	3.0	60.0	4.5
Salmonberry (*Rubus spectabilis*)	1.5	30.0	2.2
Evergreen blackberry (*Rubus laciniatus*)	0.5	10.0	0.8
	5.0	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Elderberry	2.2	5500.0	100.0

Table 92

Density, Basal Area, and Importance Values for Canopy Tree Species of the Shore Pine Community of Mott Island

Species	Density[a]	Basal Area[b]	Relative Density	Relative Basal Area	Importance Value[c]
Shorepine (*Pinus contorta*)	676.87	17.2	91.4	81.5	172.9
Black cottonwood (*Populus trichocarpa*)	40.80	3.3	5.5	15.6	21.1
Red alder (*Alnus rubra*)	14.45	0.4	2.0	1.9	3.9
Hooker's willow (*Salix hookeriana*)	8.50	0.2	1.1	1.0	2.1
	740.62	21.1	100.0	100.0	200.0

[a] Stems per hectare

[b] Square meters per hectare

[c] Relative density plus relative basal area

Table 93

Average Percent Cover and Relative Values for Herb and Shrub Species in the Herb and Shrub Layers of the Shore Pine Community of Mott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Canarygrass (*Phalaris arundinacea*)	10.90	13.3	12.8
Bentgrass (*Agrostis* sp.)	10.00	12.2	11.8
Slough sedge (*Carex obnupta*)	8.64	10.5	10.2
Unidentified grass	5.45	6.6	6.4
Scouring rush (*Equisetum telmateia*)	5.00	6.1	5.9
Scouring rush (*Equisetum hyemale*)	4.55	5.5	5.4
Felonwort (*Solanum dulcamara*)	0.91	1.1	1.1
Bluegrass (*Poa* sp.)	0.45	0.6	0.5
Velvet-grass (*Holcus lanatus*)	0.45	0.6	0.5
Fescue (*Festuca bromoides*)	0.45	0.6	0.5
Common vetch (*Vicia sativa*)	0.45	0.5	0.5
Creeping buttercup (*Ranunculus repens*)	0.45	0.5	0.5

[a]Average cover for all 0.5-m^2 quadrats

Table 93 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
	Herbaceous Layer		
Jewelweed (*Impatiens capensis*)	0.45	0.5	0.5
Sword-fern (*Polystichum munitum*)	0.45	0.5	0.5
Viburnum (*Viburnum* sp.)	0.45	0.5	0.5
Bryophytes	33.18	40.4	39.1
	82.23	100.0	
Shrubs:			
Elderberry (*Sambucus racemosa*)	1.36	50.0	1.6
Scotchbroom (*Cytisus scoparius*)	0.91	33.5	1.1
Salmonberry (*Rubus spectabilis*)	0.45	16.5	0.6
	2.72	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Scotchbroom (*Cytisus scoparius*)	0.91	2275.0	91.0
Salix hookeriana	0.09	225.0	9.0
	1.00	2500.0	100.0

vigor clumps throughout the rest of the island. The distinct community occurs, for the most part, within the confines of the newest disposal area.

The scotchbroom forms a low broken shrub canopy that varies between 1.5 and 2 m in height. From the sampling data, the average density is 11.5 stems/4 m^2, or 28,750 stems per hectare, but dense clumps alternate with openings because of the clonal nature of the species (Table 94). As far as is known, all scotchbroom (presently about 20 acres) has spread from centers not covered during the 1952 disposal.

The only other important constituents of the community are herbaceous. Hairgrass (*Aira praecox*), fescue (*Festuca bromoides*), velvet-grass, tansy ragwort (*Senecio jacobaea*), several other herbaceous flowering plants, and a growth of bryophytes that averages 33.5 percent of the herbaceous cover, compose the herb layer.

Other than decreases in herb cover due to the scotchbroom canopy, this community is very similar in species diversity to the beachgrass-hairgrass community.

e. Beachgrass-hairgrass. Beachgrass, two species of hairgrass, bryophytes, and lichens form over 80 percent of the cover in this relatively dry, open, sandy habitat (Table 95). Much of the soil surface bears only sparse cover of lichens and bryophytes. In spite of the high total average cover shown in Table 95, beachgrass is not thick.

Several areas within and along the margins of this community are possibly ephemeral pools. Stunted toad rush (*Juncus bufonius*), tufted hairgrass (*Deschampsia cespitosa*), and bentgrass (*Agrostis exarata*) grow in these depressions, often with several stems of a stunted willow. Due to the coarse texture of the soil below, these areas would probably hold water for only a short time during the periods of heaviest rainfall. The presence of scotchbroom in this community is sporadic and probably indicates a slow process of invasion.

Table 94

Average Percent Cover and Relative Values for Herb and Shrub Species in the Herb and Shrub Layers of the Scotchbroom Community of Mott Island

Species	Average Percent Cover[a]	Relative Value	Total Relative Value
	Herbaceous Layer		
Herbs:			
Hairgrass (*Aira praecox*)	13.5	14.8	14.3
Fescue (*Festuca bromoides*)	10.5	11.5	11.1
Velvet-grass (*Holcus lanatus*)	9.5	10.4	10.0
Tansy ragwort (*Senecio jacobaea*)	9.0	9.9	9.5
Hairgrass (*Aira elegans*)	5.0	5.5	5.3
Hawksbeard (*Crepis capillaris*)	4.0	4.4	4.2
Mouse-ear chickweed (*Cerastium vulgatum*)	3.0	3.3	3.2
Thistle (*Cirsium* sp.)	1.5	1.6	1.6
Beachgrass (*Ammophila arenaria*)	1.0	1.1	1.1
Northern silene (*Stellaria calycantha*)	1.0	1.1	1.1
False dandelion (*Agoseris heterophylla*)	1.0	1.1	1.1

[a]Average cover for all 0.5 m^2 quadrats

Table 94 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Asteraceae (species)	0.5	0.6	0.5
Fleabane (*Erigeron* sp.)	0.5	0.6	0.5
Lichens	0.5	0.6	0.5
Bryophytes	30.5	33.5	32.3
	91.0	100.0	
Shrubs:			
Scotchbroom (*Cytisus scoparius*)	3.0	85.7	3.2
Salmonberry (*Rubus spectabilis*)	0.5	14.3	0.5
	3.5	100.0	100.0

Species	#/4 m^2	#/ha	Relative Value
Shrub Layer			
Shrubs:			
Scotchbroom (*Cytisus scoparius*)	11.5	28,750.0	100.0

Table 95

Average Percent Cover and Relative Values for Herb and Shrub Species in the Herb and Shrub Layers of the Beachgrass-Hairgrass Community of Mott Island

Species	Average Percent Cover[a]	Relative Cover	Total Relative Value
	Herbaceous Layer		
Herbs:			
Beachgrass (*Ammophila arenaria*)	31.6	24.8	24.6
Hairgrass (*Aira praecox*)	22.6	17.8	17.6
Hairgrass (*Aira elegans*)	6.0	4.7	4.7
Velvet-grass (*Holcus lanatus*)	5.0	3.9	3.9
Hawksbeard (*Crepis capillaris*)	2.0	1.6	1.5
Fleabane (*Erigeron* sp.)	2.0	1.6	1.6
Tansy ragwort (*Senecio jacobaea*)	2.0	1.6	1.5
Asteraceae (species)	1.0	0.8	0.8
Pearly-everlasting (*Anaphalis margaritacea*)	1.0	0.8	0.8
Scouring rush (*Equisetum telmateia*)	1.0	0.8	0.8
False dandelion (*Agoseris heterophylla*)	1.0	0.8	0.8
Lichens	27.0	21.2	21.1
Bryophytes	25.0	19.6	19.5
	127.2	100.0	

[a]Average cover for all 0.5-m^2 quadrats

Table 95 (concluded)

Species	Average Percent Cover	Relative Value	Total Relative Value
Shrubs:			
Scotchbroom (*Cytisus scoparius*)	1.0	100.0	0.8
			100.0

Species	#/4 m^2	#/ha	Relative Value
	Shrub Layer		
Shrubs:			
Scotchbroom (*Cytisus scoparius*)	2.2	5500.0	100.0

242. <u>Seral relationships of vegetation</u>. Historical photography from 1948 shows Mott Island following completion of the first period of dredged material disposal (Figure 41). No particular vegetative features can be detected in the photography, but establishment of tidal marsh vegetation may have been under way. The approximate area of shore pine plantation drawn from the 1961 base (Figure 42) has been placed on the 1948 base, reflecting the shape of the island in 1948. No major features of upland seral stages can be interpreted.

243. By 1961, most of the communities presently existing had become established (Figure 42). The boundary between willow fringe and alder-cottonwood was not distinct. The large extent of low trees and shrubs in the northeast quadrant of the island was likely a mixture of red alder, black cottonwood, and Pacific willow. The most profound change was the addition of dredged material in 1952.

244. A dike line indicating the westward extent of 1952 dredged material placement follows very closely the eastern side of the shore pine plantation. Beachgrass was very extensive and scotchbroom had begun to invade to the northeast from the area that survived the second period of dredged material disposal. Beachgrass was, of course, replanted in 1952. Shore pine and scotchbroom were not.

245. There has been a progressive expansion by scotchbroom from 1952 to the present, and a nearly reciprocal decrease in areal extent of beachgrass. Areas of beachgrass seen in the field show very depauperate growth. Photography from 1968 (Figure 43) to the present (Figure 40) shows a continual northerly moving front of scotchbroom.

246. From 1961 to 1973 there was a slow but steady thinning of shore pine. Some of the thinning resulted from natural death of the pine, and some resulted from cutting of firewood by occasional campers. Holes created in the pine canopy allow more light to reach herb and shrub layers where young alder and cottonwood may occur.

247. Three lines of overall seral development of vegetation on Mott Island may be hypothesized (Figure 44). An early grass-sedge-shrub stage probably occurred naturally in lower areas of the island where planting failed in 1948 and 1952. Slough sedge, canarygrass,

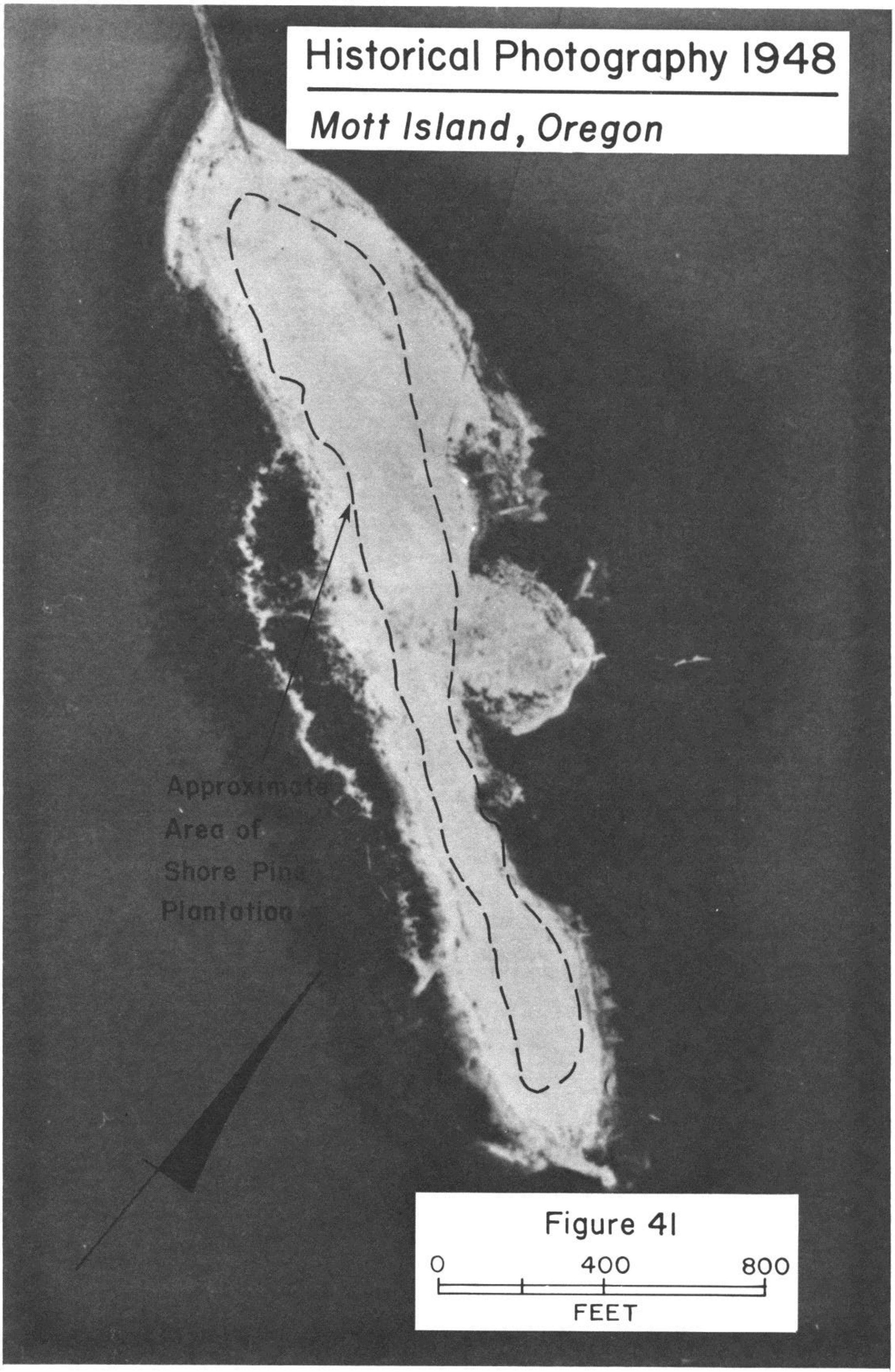
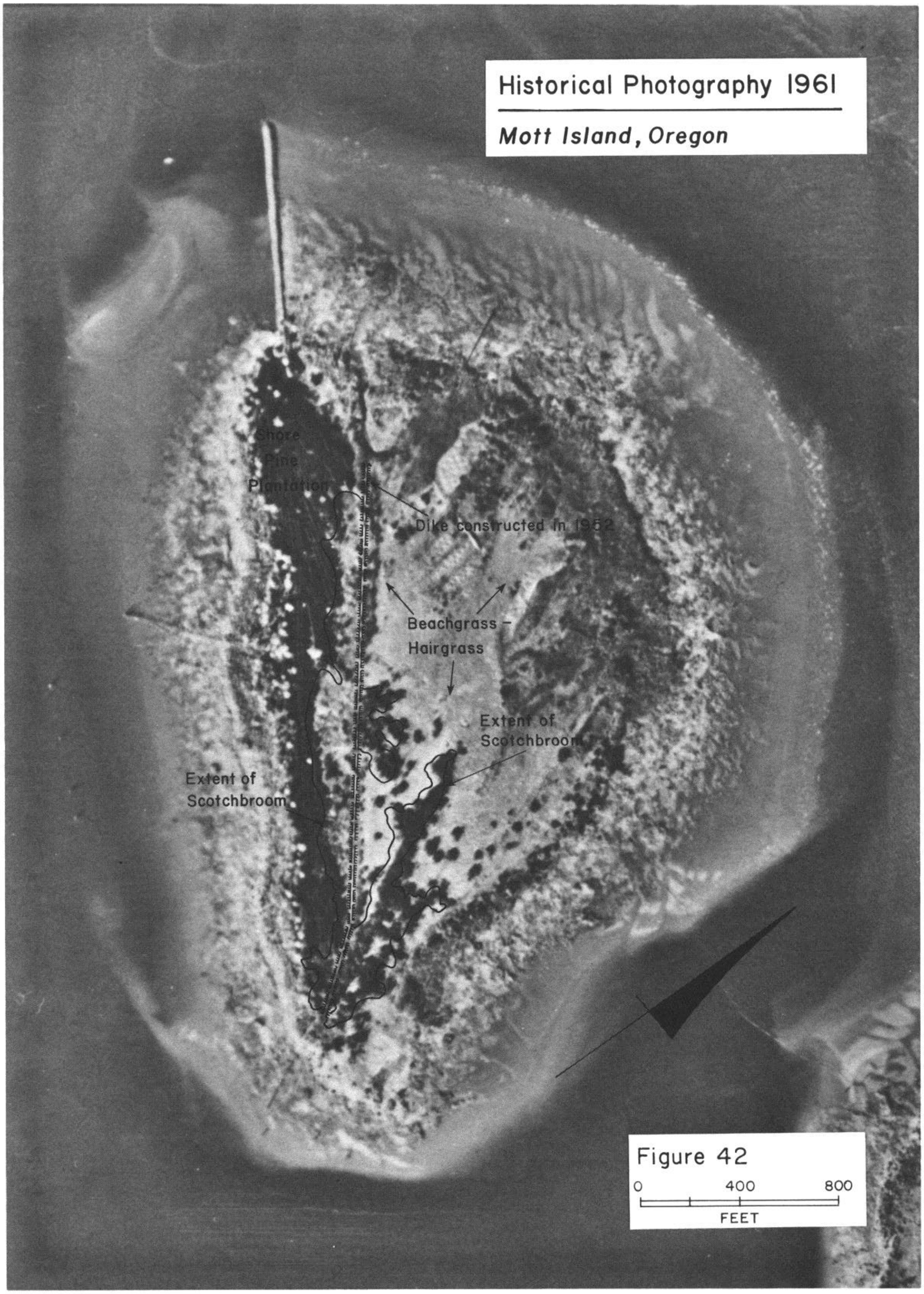

Historical Photography 1948
Mott Island, Oregon
Approximate
Area of
Shore Pine
Plantation
0
400
800
FEET

Figure 41



Historical Photography 1961
Mott Island, Oregon
Shore
Pine
Plantation
Dike constructed in 1952
Beachgrass -
Hairgrass
Extent of
Scotchbroom
Extent of
Scotchbroom
0
400
800
FEET

Figure 42


Historical Photography 1968
Mott Island, Oregon
Shore
Pine
Plantation
Dike constructed in 1952
Beachgrass–
Hairgrass
Extent of
Scotchbroom
0
400
800
FEET

Figure 43

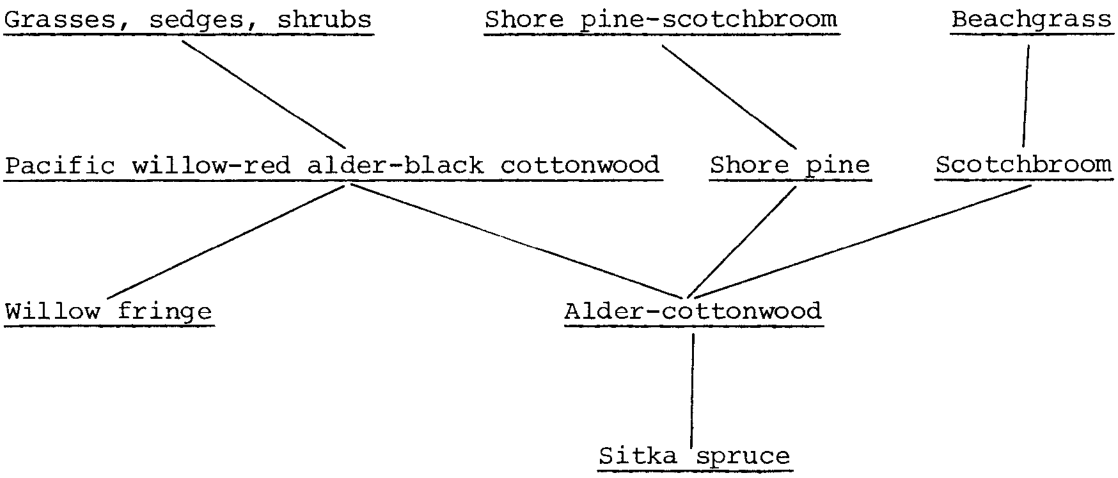


Figure 44. Hypothetical Seral Lines for Upland Dredged Material, Mott Island

velvet-grass, and Pacific willow were probably common. Black cottonwood and red alder were also likely present by this time. Red alder and black cottonwood presently dominate on mesic sites to the inside of the willow fringe. The present willow fringe is probably a remnant of an early Pacific willow-red alder-black cottonwood complex in which willow became dominant because of its ability to tolerate the more hydric conditions.

248. Shore pine and scotchbroom were planted together, but shore pine has largely shaded out the scotchbroom. There are strong indications that the shore pine canopy is being naturally thinned. Downed trunks and dead snags are frequent. As death occurs, more alder and cottonwood will probably invade the pine plantation. Cottonwood may be more common because of its ability to reproduce vegetatively.

249. Beachgrass is rapidly being replaced by scotchbroom. Somewhat more xeric conditions in the scotchbroom community may initially slow invasion by cottonwood and alder, but an alder-cottonwood community

will probably develop. Certain amounts of other arborescent species will be present due to the more well-drained soil. These may include big-leaf maple and vine-maple (Acer circinatum), but neither have been found on the island.

250. As alder-cottonwood spreads over the island, Sitka spruce and possibly western hemlock, both of which are now present on the island, will mature and become reliable seed sources for establishment of a greater density of individuals of these species. Until a seed source is located on the island, incorporation of Sitka spruce and western hemlock as canopy dominants will be rather slow. Presently, the closest seed sources are located on the mainland, about 0.8 km to the west. Westerly winds during fall and early winter probably bring in some seeds from Tongue Point, a topographically high peninsula west of the island. Success of seed dispersal to the island depends on local weather conditions following seed maturation. Thus far, success has been generally poor. Some seeds may have been carried to the island by water, but no individuals of either Sitka spruce or western hemlock were seen in the wrack zone.

251. Sitka spruce seedlings and young saplings found on Mott Island are between 1 and 6 to 8 years old. Within another 20 to 40 years, the older trees should mature and serve as a reliable seed source. In another 100 years, a more-or-less continuous canopy of Sitka spruce should have developed on the island. As Sitka spruce stands mature, old stands of red alder and black cottonwood will be replaced, except where openings are created in the conifer canopy.

252. Sitka spruce is a shallow rooting tree, particularly in wet soils (U. S. Department of Agriculture 1965). As trees reach a height in excess of the surrounding canopy, wind throw may constitute a hazard.

253. Analysis of existing animal populations.

a. Birds. Forty-five species of birds were identified on Mott Island during the three field surveys. Pellets from an unidentified large owl were also discovered during the October 1974 census. Life history information and observations notes for each species are given in Appendix E.

Sixty-four percent of the bird species recorded on Mott Island are listed as year-round residents in western Oregon, 27 percent are summer residents, 7 percent are winter visitants and 2 percent are spring-fall transients (Gabrielson and Jewett 1940) (Table 96). The high diversity of year-round residents is typical of avian populations in the Pacific northwest. Anderson (1972), for example, studied bird populations in Oregon white oak, Douglas fir, and western hemlock plant communities in the western part of the Willamette Valley and found that year-round residents comprise 45 to 70 percent of the avian populations within these habitats. Similar compositions for western Oregon are indicated by Gabrielson and Jewett (1940), MacArthur (1959), and Robbins et al. (1966). The mild winters of the Pacific northwest are generally thought to be a major factor influencing the abundance of year-round resident species (MacArthur 1959, Anderson 1972). MacArthur further noted that the mild winters allow for more stable environmental conditions and less seasonal variance in food supply.

The avian population on Mott Island experiences marked seasonal changes in composition despite the high percentage of year-round residents. Several species of year-round residents are nomadic and exhibit local seasonal migrations. Ruby-crowned (Regulus calendula) and golden-crowned kinglets (R. satrapa), dark-eyed juncos (Junco hyemalis), and winter wrens (Troglodytes troglodytes), for example, were common on the study site in October 1974 but much less common or absent in July 1974 and June 1975. Similarly, American goldfinches (Spinus tristis) and starlings (Sturnus vulgaris) were recorded during the summer surveys but were absent on the island during the fall census. Local migrations by year-round residents are often related to diet, roosting, and nesting requirements.

Other changes in seasonal composition are associated with

Table 96

General Characteristics and Field Notes Regarding the Avian Species Observed on Mott Island

Species	Resident Status[a]	Period Observed[b]	Food Preference[c]	Habitat Preference[d]
Mallard	Y	Jn	G-s	A
Red-tailed hawk	Y	O	CT	FE
Ring-necked pheasant	Y	Jl, O, Jn	G-l	FE
Common snipe	Y	O	I-g	M
Owl (sp.)	-	O	CT	-
Pygmy owl	Y	Jn	CT	W
Rufous hummingbird	S	Jn	I-f	FE
Belted kingfisher	Y	Jl, O, Jn	CA	FE
Common flicker	Y	O, Jn	I-b, g	FE
Downy woodpecker	Y	O, Jn	I-b	FE

[a] Y=year-round resident; W=winter visitant; S=summer resident; T=spring-fall transient

[b] Jl=July 1974; O=October 1974; Jn=June 1975

[c] I=Insectivore, b=bark insects, f=foliage insects, g=ground insects, a=flying insects; G=granivore, l=large seeds, s=small seeds; CT=terrestrial vertebrate carnivore; CA=aquatic invertebrate and vertebrate carnivore; S=scavenger

[d] FE=forest-edge or hedgerow situations; W=woodlands, G=grasslands, M=marshland, A=aquatic habitats

Table 96 (continued)

Species	Resident Status	Period Observed	Food Preference	Habitat Preference
Yellow-bellied sapsucker	Y	O	I-b	W
Willow flycatcher	S	Jn	I-a	FE
Western flycatcher	S	Jn	I-a	W
Barn swallow	S	Jl, Jn	I-a	FE
Violet-green swallow	S	Jl, Jn	I-a	FE
Common raven	Y	O, Jn	S	FE
Common crow	Y	Jl, O, Jn	S	FE
Black-capped chickadee	Y	Jl, O, Jn	I-f, b	W
Chestnut-backed chickadee	Y	O, Jn	I-f, b	W
Bushtit	Y	Jl, O	I-f, b	FE
Red-breasted nuthatch	Y	O	I-f, b	W
Brown creeper	Y	O, Jn	I-b	W
House wren	S	O	I-f	FE
Winter wren	Y	O	I-f	W
Bewick's wren	Y	Jl, O, Jn	I-f	FE
American robin	Y	Jl, O, Jn	I-g	FE
Swainson's thrush	S	Jl, Jn	I-g	W
Hermit thrush	W	O	I-g	W
Golden-crowned kinglet	Y	Jl, O, Jn	I-f	W
Ruby-crowned kinglet	W	Jl, O, Jn	i-f	W
Starling	Y	Jl, Jn	I-g	FE
Hutton's vireo	Y	Jl, O	I-f	W
Yellow warbler	S	Jl, Jn	I-f	FE
Townsend's warbler	T	O	I-f	W
Wilson's warbler	S	Jn	I-f	FE

Table 96 (concluded)

Species	Resident Status	Period Observed	Food Preference	Habitat Preference
Yellow-rumped warbler	Y	O	I-f	FE
Western meadowlark	Y	O	I-g	G
Brown-headed cowbird	S	Jn	I-g	FE
Black-headed grosbeak	S	Jn	G-l	W
American goldfinch	Y	O, Jn	G-s	FE
Rufous-sided towhee	Y	O	G-s	FE
Dark-eyed junco	Y	O	G-s	FE
Chipping sparrow	S	O	G-s	FE
White-crowned sparrow	Y	Jl, O, Jn	G-s	FE
Fox sparrow	W	O	G-s	FE
Song sparrow	Y	O, Jn	G-s	FE

the spring-fall migration of neotropical and nearctic species.* Greatest numbers of these birds generally migrate from, through, or into the study area in April, May, late August, September, and October (Gabrielson and Jewett 1940).

Twenty-seven of the bird species observed on Mott Island are commonly classified as forest-edge or hedgerow inhabitants,** 15 are woodland inhabitants, 1 is typically found in grasslands, 1 prefers marshlands, and 1 is primarily an aquatic community inhabitant (Table 96). Distributions of bird species by plant associations on Mott Island are presented in Table 97.

Eighteen avian species had established breeding territories on Mott Island in June 1975. Seventeen of these had full or partial territories on the breeding bird census plot (Tables 98 and 99) while one, Wilson's warbler (*Wilsonia pusilla*), had established territories on the island but outside of the sampled area. A few additional species, including the starling, black-capped chickadee (*Parus atricapillus*), chestnut-backed chickadee, brown creeper (*Certhia familiaris*), and American goldfinch, possibly breed on the island, but this was not confirmed. Of the 18 species, 10 are year-round residents and 8 are summer residents. Thus, only 36 percent of the year-round resident species and 59 percent of the summer resident species recorded on Mott Island are known breeding inhabitants. Failure of all year-round residents and summer residents to breed on Mott Island is likely due to lack of breeding habitat.

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*Neotropical species originate from South America, Central America (not including the Mexican highlands) and the West Indies. Nearctic species originate from North America and Greenland, south to and including the Mexican highlands (Pettingill 1970).

**Forest-edge and hedgerow species generally require trees or tall bushes for roosting, nesting, and singing and open or shrubby habitats for feeding. These habitats are frequently located in ecotones (i.e. transition zones between distinct plant communities). Narrow forest-edge and hedgerow habitats are present on Mott Island along the periphery of the scotchbroom community where the latter grades into the alder-cottonwood association. In many of these areas, the scotch-broom bushes are scattered and beachgrass and hairgrass are prevalent.

Table 97

Distribution of Bird Species by Plant Association on Mott Island Based on July 1974, October 1974, and June 1975 Field Investigations

Species	SP	B	SB	SB-AC ECO	AC	W	DP
	Plant Association[a]						
Mallard	-	-	-	-	-	X	-
Red-tailed hawk	-	X	X	X	-	-	-
Ring-necked pheasant	-	X	X	X	X	-	-
Common snipe	-	X	-	-	-	-	-
Owl (sp.)	X	-	-	-	-	-	-
Pygmy owl	X	-	-	-	-	-	-
Rufous hummingbird	-	-	-	X	X	-	-
Belted kingfisher	-	-	-	-	-	-	X
Common flicker	X	-	X	X	X	-	-
Downy woodpecker	X	-	-	X	X	-	-
Yellow-bellied sapsucker	X	-	-	-	-	-	-
Willow-flycatcher	-	-	-	X	-	-	-
Western flycatcher	X	-	-	-	X	-	-
Barn swallow	-	X	X	-	-	-	-
Violet-green swallow	-	X	X	-	-	-	-
Common raven	-	X	-	X	-	-	-
Common crow	X	X	X	X	X	X	-
Black-capped chickadee	X	-	-	-	X	X	-
Chestnut-backed chickadee	X	-	-	-	-	-	-
Bushtit	-	-	X	X	X	X	-
Red-breasted nuthatch	X	-	-	-	-	-	-
Brown creeper	X	-	-	-	-	-	-
House wren	-	X	X	-	-	-	-
Winter wren	X	X	X	X	X	X	-
Bewick's wren	X	-	-	-	X	-	-

[a]SP=Shore pine
B=Beachgrass-hairgrass
SB=Scotchbroom
SB-AC ECO=Scotchbroom-alder-cottonwood ecotone
AC=Alder-cottonwood
W=Willow fringe
DP=Tide-affected ditches and ephemeral ponds

Table 97 (concluded)

Species	SP	B	SB	SB-AC ECO	AC	W	DP
American robin	X	X	X	X	X	X	-
Swainson's thrush	X	-	-	X	X	-	-
Hermit thrush	X	-	-	-	X	-	-
Golden-crowned kinglet	X	-	-	X	X	X	-
Ruby-crowned kinglet	X	-	-	X	X	X	-
Starling	X	-	-	X	-	-	-
Hutton's vireo	X	-	-	-	X	-	-
Yellow warbler	-	-	-	X	X	X	-
Townsend's warbler	X	-	-	-	X	-	-
Wilson's warbler	-	-	-	-	X	-	-
Yellow-rumped warbler	-	-	-	-	X	-	-
Western meadowlark	-	X	-	-	-	-	-
Brown-headed cowbird	X	-	-	X	-	X	-
Black-headed grosbeak	-	-	-	X	X	-	-
American goldfinch	-	-	-	X	-	X	-
Rufous-sided towhee	-	-	-	-	-	X	-
Dark-eyed junco	X	X	X	X	X	X	-
Chipping sparrow	-	-	-	-	-	X	-
White-crowned sparrow	-	X	X	X	-	-	-
Fox sparrow	X	X	X	X	X	X	-
Song sparrow	X	X	X	X	X	X	-
Totals	25	15	14	23	24	16	1

(Columns SP through DP are grouped under the heading "Plant Association".)

Table 98

Breeding Bird Census Data, Mott Island

Species	Number of Breeding Territories on Census Plot[a]	Estimated Number of Breeding Territories per 100 Acres
Common crow	26[b]	86
Swainson's thrush	13	43
Song sparrow	10	33
Yellow warbler	9	30
White-crowned sparrow	8	26
Black-headed grosbeak	7	23
Western flycatcher	6.5	21
Bewick's wren	5	17
American robin	4	13
Willow flycatcher	2.5	8
Ring-necked pheasant	2	7
Downy woodpecker	1	3
Rufous hummingbird	1[c]	3
Brown-headed cowbird	1[c]	3
Mallard	1[b]	3
Pygmy owl	+[d]	--
Common flicker	+	--
Totals	97	319

[a]Sample plot size was 30.1 acres

[b]Figure based on number of nests within census plot

[c]Figure based on average number of females seen per daily census trip

[d]Indicates less than half the breeding territory present on the breeding bird census plot

Table 99

Minimum, Maximum, and Average Sizes of Bird Breeding Territories by Species on the Mott Island Census Plot

Species	Number of Individual Territories Mapped	Territory Size (acres)		
		Minimum	Maximum	Average
Swainson's thrush	9	0.06	0.76	0.25
Song sparrow	9	0.11	0.30	0.18
White-crowned sparrow	7	0.04	0.22	0.12
Black-headed grosbeak	7	0.53	1.04	0.80
Western flycatcher	6	0.38	1.34	0.76
Yellow warbler	6	0.42	0.88	0.59
Willow flycatcher	2	0.58	0.64	0.61

Results of the breeding bird census on Mott Island indicate that 319 breeding territories are present per 100 acres of habitat. For comparison, Goulden (1974) estimated avian breeding bird densities on a mature poplar-spruce island in British Columbia to be 122 territories per 100 acres. Archie and Hudson (1973, 1974) reported 90 to 131 territories per 100 acres in a mixed, coniferous, subalpine forest in Grant County, Oregon, and Anderson (1972) found a range of 77 to 556 territories per 100 acres in the western Willamette Valley vicinity. It should be noted that each territory is assumed to be occupied by one breeding pair at some time during the course of the breeding season.

Common crows (Corvus brachyrhynchos) were found to be the most abundant breeding bird on Mott Island: 26 nests of this species were located within the breeding bird census plot and 9 were found to the immediate north of the plot. Crow nests were not counted on the southern half of the island.

Crows were also common on the study site in July and October 1974. During the postbreeding period, they utilize the site for communal night roosting. Gabrielson and Jewett (1940) indicated that communal roosting is a relatively common occurrence on islands in the lower Columbia River, especially in the Astoria vicinity.

Twenty-eight bird species observed on Mott Island are primarily insectivores, 12 are herbivores, 4 are vertebrate carnivores, and 2 are scavengers (Table 96). Three of the four carnivores, the red-tailed hawk, pygmy owl, and an unidentified large owl, prey largely upon terrestrial vertebrates; the other carnivore, the belted kingfisher, feeds primarily on small fish. Avian species that feed upon terrestrial vertebrates are uncommon on Mott Island. The island is probably incapable of supporting a large number of raptors because of its small area and depauperate rodent, amphibian, and reptile populations. The abundance of crows on the island may also restrict the number of birds of prey; crows are noted harassers of raptors.

Mott Island is one of several islands included in the Lewis and Clark National Wildlife Refuge. The refuge was established to provide resting and feeding habitat for waterfowl migrating along the Pacific flyway (Marshall 1970). Waterfowl likely utilize the study site's marshes for resting and feeding, but utilization of upland habitats is probably restricted to occasional nestings by mallards. Two mallard nests were located in the willow fringe in June 1975. One of these appeared destroyed, possibly by crows that were nesting nearby.

None of the avian species recorded on Mott Island are classified endangered by the U. S. Department of the Interior (1974). The ring-necked pheasant (Phasianus colchicus) is the only upland game species inhabiting the island and is not present in sufficient numbers to withstand hunting pressures.

b. Mammals. Three species of mammals were found to inhabit Mott Island: nutria (Myocastor coypus), mule deer (Odocoileus hemionus), and a mole (Scapanus sp.). A fourth species, Townsend vole (Microtus townsendi), likely inhabits the study site but this was not confirmed. Life history information and general field notes regarding the island's mammalian inhabitants are presented in Appendix E.

Nutria and mule deer are the dominant mammals on Mott Island in terms of biomass and influence. Nutria were introduced into western Oregon in the late 1930's (Presnell 1958). These semiaquatic mammals typically inhabit marshlands but were abundant in all upland communities on the study site. Movement of nutria into upland habitats may be associated with high population densities. By inhabiting these non-typical communities, nutria are apparently filling voids created by the absence of smaller rodents or other competitor species. Muskrats (Ondatra zibethicus), which are also semiaquatic mammals that often occupy the same marshland habitats as nutria, were not observed on Mott Island. The abundance of nutria may have prevented the establishment of muskrat populations on the study site.

Nutria are grazing herbivores and were observed to feed upon the roots, leaves, and stems of grasses, sedges, and succulent forbs on Mott Island. Scouring rushes appeared to be a favored food plant and some small "eat out" areas were noted. Evans (1970) reported that an individual nutria will normally consume from 2.5 to 3.5 lb of vegetable matter per day.

Mule deer inhabiting the study site are of the subspecies O. h. columbianus and are commonly called Columbian black-tailed deer. Two individuals were observed on the study site in July and October 1974 and three were seen in June 1975.

Mule deer are browsing herbivores. Cowan (1941) in a study of mule deer in coastal British Columbia found that 67 percent of their annual diet is comprised of leaves and twigs of trees and shrubs, 15 percent consists of arboreal lichens, 11 percent consists of herbaceous plants, 5 percent consists of mushrooms, and 2 percent consists of grasses, sedges, and miscellaneous plants. Vascular plant species present on Cowan's study plots and also on Mott Island, their palatability to deer, and plant parts and time of year eaten are presented in Table 100. Many of the dominant plants on Mott Island are included in the list. It is interesting to note that few of the plants listed are utilized in the fall and winter. Cowan reported that 83 percent of the mule deer's diet in winter is comprised of Douglas fir branch tips and arboreal lichens. Cowan further stated that alder, willow, and grassland communities are generally utilized for only supplemental seasonal foraging and bedding. Based on this information, it seems likely that Mott Island's deer population is subject to seasonal fluctuations in numbers; that few individuals are stationary, year-round residents; and that deer move back and forth between Mott Island, the mainland, and nearby islands as a result of dietary requirements. Some density fluctuations may also occur during inclement weather when deer seek necessary shelter.

Deer browse signs were noted on scotchbroom, Sitka spruce seedlings, willow, red alder, black cottonwood, blackberry, salmonberry, and scouring rushes during the course of the three surveys. Some interspecific competition likely occurs between mule deer and nutria for some herbaceous plants. Dirks-Edmunds (1947) noted that trampling of plants is the chief damage inflicted by deer upon ground vegetation. Trails and bedding areas were obvious on Mott Island

Table 100

Palatability of Selected Plant Species on Mott Island as Deer Food[a]

Plant Species	Palatability	Plant Parts and Season Eaten
False dandelion (*Agoseris heterophylla*)	not palatable	never eaten
Pearly everlasting (*Anaphalis margaritacea*)	not palatable	never eaten
Red alder (*Alnus rubra*)	highly palatable	leaves, fruit-summer
Elderberry (*Sambucus racemosa*)	highly palatable	leaves-spring, summer
Candyflower (*Montia sibirica*)	slightly palatable	leaves-late spring
Creeping spike-rush (*Eleochris palustris*)	not palatable	never eaten
Scouring rush (*Equisetum hyemale*)	slightly palatable	young shoots-summer
Scotchbroom (*Cytisus scoparius*)	moderately palatable	flower, leaves-spring, summer, fall
Dutch clover (*Trifolium repens*)	moderately palatable	leaves-summer
Common vetch (*Vicia sativa*)	slightly palatable	leaves-summer
Red currant (*Ribes sanguineum*)	highly palatable	leaves-spring, summer
Sitka spruce (*Picea sitchensis*)	slightly palatable	new growth-early spring
Shore pine (*Pinus contorta*)	not palatable	never eaten
Western hemlock (*Tsuga heterophylla*)	not palatable	never eaten

[a]Based on Cowan (1941)

Table 100 (concluded)

Plant Species	Palatability	Plant Parts and Season Eaten
Bentgrass (*Agrostis exarata*)	moderately palatable	leaves-spring
Hairgrass (*Aira praecox*)	slightly palatable	leaves-early spring
Sheep sorrel (*Rumex acetosella*)	not palatable	never eaten
Fern (*Polystichum munitum*)	moderately palatable	new growth-summer
Creeping buttercup (*Ranunculus repens*)	highly palatable	leaves, stems-early spring
Salmonberry (*Rubus spectabilis*)	moderately palatable	leaves-summer
Black cottonwood (*Populus trichocarpa*)	moderately palatable	leaves-summer, fall
Pacific willow (*Salix lasiandra*)	highly palatable	leaves-summer
American brooklime (*Veronica americana*)	not palatable	never eaten

where scouring rushes were abundant. Numerous nutria trails were also present in these areas as well as in the beachgrass-hairgrass and marsh communities.

Nine deer skeletons and approximately 30 nutria skulls were found on Mott Island during the three surveys. Inspection of the skeletal remains revealed no evidence that the animals died from hunter-shooting or old age. Annual mortalities of white-tailed deer (*Odocoileus virginianus*) have been recorded on islands approximately 15 miles upstream from the study site and have resulted from food shortages (or low nutritional value of food material), inclement weather, disease, or a combination of these factors (Personal communication, 5 August 1975, David Fisher, Refuge Manager, Columbian White-tailed Deer National Wildlife Refuge, Cathlamet, Washington). Mortalities of mule deer and nutria on Mott Island may have been caused by similar circumstances.

Utilization of Mott Island for deer management has limited potential because of the island's small areal extent. Carrying capacities, even if optimal habitat conditions were present, could probably not exceed one deer per 15 to 20 acres (or a total population of 4 to 5 individuals if only upland acreage is considered). Greater population densities would likely cause overbrowsing of vegetation (Cowan 1941).

The nutria population on Mott Island is of sufficient density to withstand seasonal trapping. However, local residents generally regard the nutria as a nuisance rather than a resource. An average of $4.18 was paid per nutria pelt to trappers in Louisiana during the 1972-1973 trapping season (Lowery 1974).

Moles are fairly common in the study site's mesic woodlands as evidenced by their mounds and tunnel systems. These animals eluded capture efforts but tunnel diameters indicate they are a large mole species, possibly Townsend mole (*Scapanus townsendi*). Townsend moles feed primarily on arthropods and annelids.

Sixteen Townsend vole skulls were recovered from owl pellets gathered in the shore pine community in October 1974, and a vole-like creature was observed in the tree wrack zone along the island periphery in June 1975. No voles (or other small rodents) were captured during the trapping censuses performed in October 1974 and June 1975 (Figure 45), and no vole runways, tracks, or scats were observed during any of the three surveys. Voles, if present on Mott Island, probably have low population densities, and most or all voles eaten by the unidentified owl were likely captured on nearby islands or the mainland. Townsend voles inhabit a variety of plant associations but have a preference for moist grasslands. They would most likely establish initial populations in the island's marshlands.

A burrow system, much like that of a chipmunk's, was observed in the study site's alder-cottonwood community in October 1974 and again in June 1975. The burrow entrances showed no signs of activity and no chipmunks were sighted. Traps were placed around the burrow entrances in October and June, but no animals were captured. Chipmunks may have been present on the island in the past, but are presently regarded as very doubtful inhabitants.

None of the mammal species known to exist on Mott Island are classified endangered by the U. S. Department of the Interior (1974). White-tailed deer inhabiting islands upstream from the study site are of the endangered subspecies _O. v. leucurus_ (U. S. Department of the Interior 1974, 1975).* It has been rumored that some individuals may also be present on islands in the study site vicinity (Personal communication, 5 August 1975, David Fisher, Refuge Manager, Columbian White-tailed Deer National Wildlife Refuge, Cathlamet, Washington). However, the presence of white-tailed deer on Mott Island was not confirmed during the three field surveys.

c. Reptiles and amphibians. Northwestern garter snakes (_Thamnophis ordinoides_) and red-legged frogs (_Rana aurora_) were the

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*The islands have been incorporated into the Columbian White-tailed Deer National Wildlife Refuge.

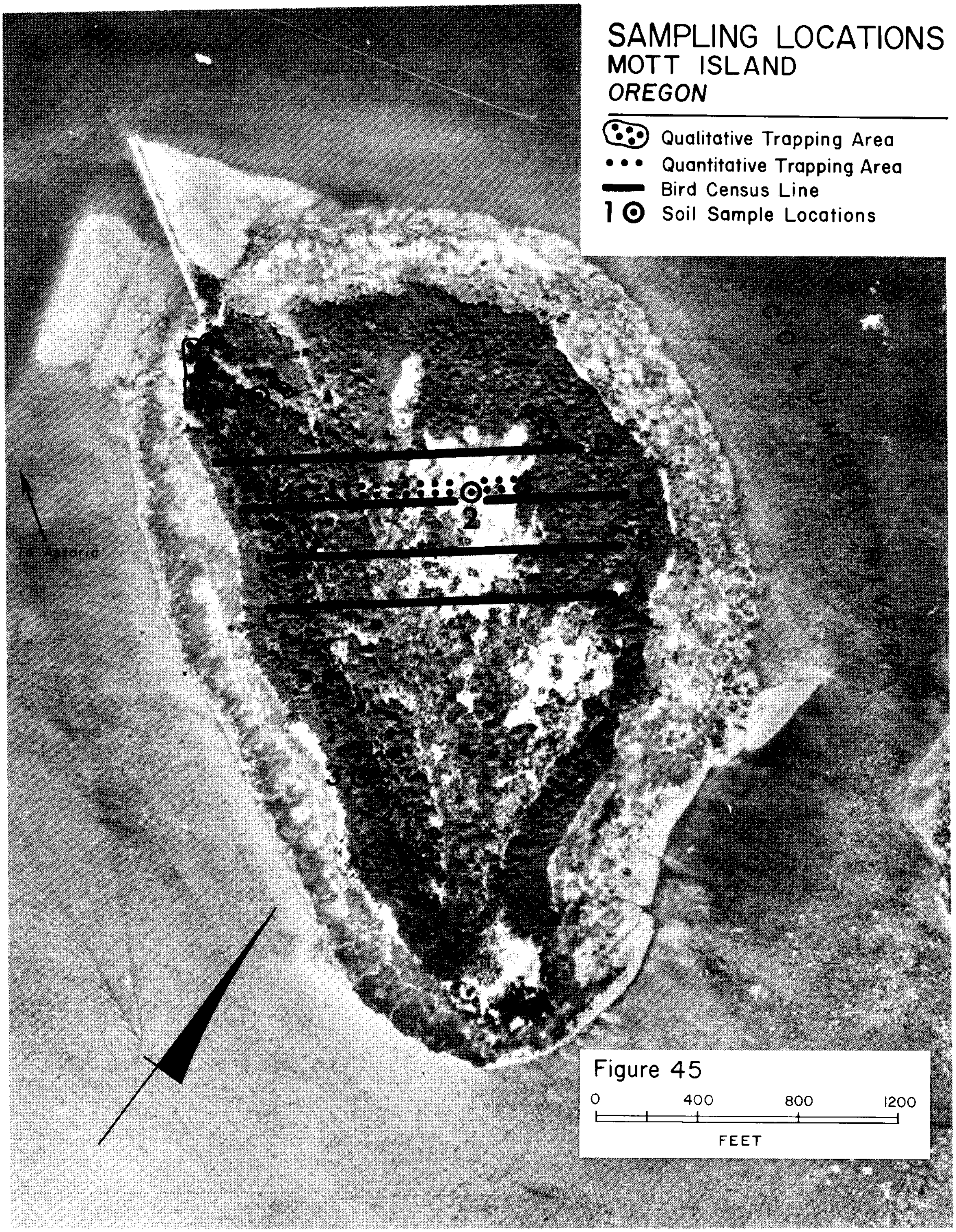
SAMPLING LOCATIONS
MOTT ISLAND
OREGON
Qualitative Trapping Area
Quantitative Trapping Area
Bird Census Line
1 Soil Sample Locations
To Astoria
COLUMBIA RIVER
0
400
800
1200
FEET

Figure 45

only reptile and amphibian species observed on Mott Island. Neither was common. Northwestern garter snakes were observed in the alder-cottonwood and scotchbroom communities whereas red-legged frogs were seen in an ephemeral pond.

d. Invertebrates. No systematic sampling was performed on the island's invertebrate populations. However, invertebrate populations on Mott Island generally appeared to be much less diverse than those found in the other four study sites, save possibly some of the outer islands in Hillsborough Bay. General field observations are noted below.

Banana slugs (*Ariolimax columbianus*) were common on the island during all three surveys and were observed in all habitats. Banana slugs are herbivorous. Cates and Orians (1975) indicated that scotchbroom, skunk cabbage, velvet-grass, sheep sorrel, buttercup, western spring beauty, and heartweed (*Polygonium persicaria*), all of which occur on Mott Island, are highly palatable to these invertebrates.

An outbreak of aphids (species unknown) occurred in the site's scotchbroom community in July 1974. The outbreak doubtless influenced the presence of some insectivorous avian species, especially barn swallows and violet-green swallows. Cabbage butterflies (*Pieris rapae*), alfalfa butterflies (*Colias eurytheme*), coppers (*Lycaena* spp.), noctuid mouths (Noctuidae), bees (Apidae), and several Hemipteran and Homopteran species were also fairly common in the scotchbroom community during the three field surveys.

Scale insects were common in the forested habitats on Mott Island and were preyed upon by chickadees, kinglets, and bushtits. Centipedes (*Strigamia* sp.) and pill millipedes (*Glomeris* sp.) were abundant beneath the leaf litter and debris within these wooded communities. Wolf spiders (Lycosidae) were frequently seen on the ground surface.

e. Immigration and colonization. Immigration to an insular situation by many animals is largely an opportunistic event. However, immigration may also be influenced by mainland faunal population and habitat characteristics. High intraspecific population densities, abundance and effectiveness of competitor species, or lack of preferred habitat on the mainland would tend to favor species immigration whereas the opposite conditions would not.

Methods by which animals may immigrate to an insular situation include flying, swimming, rafting on floating debris, accidental or purposeful introduction by man, or movement across land or ice bridges. Some animals may also walk across water barriers when shallow water conditions are created. All of these methods are viable for immigration to Mott Island except via land bridges which have never been known to connect the study site with nearby land masses (Personal communication, 23 July 1975, J. E. Shelver, Field Office, Navigation Division of the Portland District Corps of Engineers, Astoria, Oregon). Ice bridges are only a very remote possibility because of the extreme tidal flux and mild winters that occur in the lower Columbia River vicinity.

The minimum water barrier width separating Mott Island from the mainland is approximately 2150 ft. Lois Island, located east of the study site, provides an intermediate "stepping stone" between Mott Island and the mainland. The water barrier between Lois Island and Mott Island is roughly 1600 ft, and between Lois Island and the mainland is about 1500 ft. Water barrier widths may vary somewhat with tidal flux.*

Birds now inhabiting Mott Island have certainly crossed the water barrier by flying.** Northwestern garter snakes, red-legged frogs, nutria, and mule deer are excellent swimmers and likely reached the study site by this method. Some mule deer may have also walked

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*Water barrier widths were measured from 1973 aerial photographs.

**Ring-necked pheasants have been introduced into parts of western Oregon by the Oregon Game Commission but none have been stocked on Mott Island (Personal communication, 23 July 1975, J. E. Shelver, Field Office, Navigation Division of the Portland District Corps of Engineers, Astoria, Oregon).

across the water barrier between Lois Island and Mott Island when shallow water conditions existed.* Small mammals now present on the study site likely immigrated by means of rafting; these animals probably could not swim freely for longer than 5 to 10 minutes without becoming exhausted and drowning. The abundance of floating logs along the littoral zones of the Columbia River certainly increases rafting potentials. Invertebrates inhabiting Mott Island likely immigrated by flying, rafting, and accidental introduction by man.

Although the water barrier widths between Mott Island and nearby land masses range from 1500 to 2150 ft, effective distances are likely much greater for animal species that swim or raft to the study site because of tidal currents. Thus, the region from which these animals emigrate is probably upstream or downstream (depending on tidal stage) from Mott Island rather than from the nearest land masses. The distance that animals are moved depends on current patterns, current velocities, and, to some extent, animal size.

Colonization refers to the establishment of an animal population. Many animals may immigrate to an island but fail to establish populations because required habitats are unavailable or reproductive functions cannot be fulfilled. Furthermore, failures could be induced by predation, disease, food shortages, or inclement weather.

Once a species population becomes established on an island, it may also be subject to extinction by one of the above factors as well as intraspecific behavior effects (Chitty 1960, Christian and Davis 1964). Multiple invasions may occasionally be necessary to maintain an insular population.

Island size and habitats available largely determine the number of animal species that an island may support (Wilson 1961, Preston 1962, Grant 1966, MacArthur and Wilson 1967). Islands colonized by relatively few species are often unstable and populations are

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*Depth of the water barrier separating Lois Island and Mott Island occasionally falls to 1 to 2 ft during very low tides (Personal communication, 23 July 1975, J. E. Shelver).

frequently subject to extreme density fluctuations due to the lack of checks and balances in the form of predators, parasites, etc. (Elton 1958 and Grant 1966). When such fluctuations occur, random extinction is a hazard (Grant 1966).

Mott Island is ecologically young; vegetation has been present for little more than 30 years and arborescent communities have existed only since the late 1950's or early 1960's. Because of its youth and insular nature, it is not surprising that faunal colonization has thus far been limited primarily to highly mobile species (i.e. species capable of flight or excellent swimmers). Also because of its youth, it is possible that relatively few animal species have colonized the island in the past and been extirpated by one of the above-mentioned extinction processes.

Populations of additional animal species could exist on Mott Island. Notably lacking at the present are small rodents and associated carnivores. Establishment of additional animal species populations is likely necessary for the island to become a more stable, self-regulating ecosystem.

254. Past patterns of animal succession. Natural patterns of animal succession were probably accelerated in the initial years of the island's existence by the planting of shore pine, scotchbroom, and beachgrass. Faunal diversity has, in all likelihood, progressively increased from the time the island was created to the present. The exception is in 1952 and shortly thereafter when a dredged material disposal reverted a major portion of the island to an earlier seral stage.

a. Birds. Pioneer species, such as the killdeer, spotted sandpiper, and common nighthawk, were presumably the first avians to colonize Mott Island. These species would have likely remained and nested on the island until most unvegetated and sparsely vegetated areas were eliminated. Grassland species, like the savannah sparrow and western meadowlark, probably colonized the study site following the establishment of a medium to dense beachgrass ground cover. Mallards and perhaps a few western gulls may have also utilized the grassy areas for ground nesting purposes.* Hedgerow inhabitants, such as the white-crowned sparrow, bushtit, Bewick's wren, and common crow, likely established populations on Mott Island once the planted scotchbroom and shore pine reached shrub and small tree height. Additional hedgerow species, including the American goldfinch, willow flycatcher, yellow warbler, yellow-rumped warbler, and song sparrow, likely established populations when willows, alders, and cottonwoods reached similar vertical dimensions. Woodland and forest-edge species presently inhabiting Mott Island (Appendix E) were probably the last to establish populations on the island and did so once these communities developed. Encroachment of scotchbroom into the beachgrass community in the last two decades has presumably caused elimination or reduction in numbers of some grassland bird species, such as western meadowlarks.

b. Mammals. Nutria, probably the first mammals to establish populations on Mott Island, likely invaded when the marsh community emerged. Mule deer likely became established on the study site once woody vegetetation reached sufficient height to provide protective cover. Moles generally avoid xeric soils, and it is probable that the establishment of mole populations on Mott Island did not occur until mesic soils were created by development of arborescent vegetation. Townsend voles may presently be in the process of establishing a population on the study site.

c. Reptiles and amphibians. Most reptiles and amphibians are excellent swimmers and would not have too much difficulty crossing the water barrier to Mott Island. Red-legged frogs may have become established once the tidal marsh was present. They then probably moved upland to inhabit the island's ephemeral ponds. Northwestern garter snakes feed on frogs and slugs and likely colonized the island once these food sources were available.

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*Numerous species of gulls, terns, and sandpipers commonly utilize bare, sparsely vegetated, and grassland areas for nesting purposes along the North American east coast. However, no species of sandpipers, gulls, or terns, other than those mentioned in the above paragraph, are known to nest in the lower Columbia River vicinity (Gabrielson and Jewett 1940).

255. Future patterns of animal succession. Periods of greatest faunal diversities are generally correlated to periods of greatest vegetational diversities. On islands, however, the former may lag behind the latter because faunal colonization rates are slowed by the existence of water barriers. Vegetation on Mott Island is not expected to increase in diversity in the future. Faunal diversity, in contrast, will likely increase. The lag factor makes it difficult to predict exactly when greatest faunal diversities will occur.

a. Birds. Grassland species, such as the western meadowlark, will be eliminated as these communities are overtopped by shrublands and forest. Hedgerow and forest-edge species, which comprise the greatest percentage of avians now inhabiting Mott Island, will likely experience a sharp decline in numbers, and some will possibly be eliminated as the island becomes more forested. Avian species, such as the red-breasted nuthatch (*Sitta canadensis*), chestnut-backed chickadee (*Parus rufescens*), ruby-crowned and golden-crowned kinglets, pygmy owl (*Glaucidium gnoma*), and brown creeper, that prefer to inhabit coniferous woodlands will likely emigrate from the island if the shore pine dies out before stands of western hemlock and Sitka spruce are established. These birds will probably repopulate the island once coniferous woodlands are re-established. Additional coniferous forest inhabitants, such as the gray jay (*Perisoreus canadensis*), pine siskin (*Spinus pinus*), and red crossbill (*Loxia curvirostra*), may also invade. Deciduous woodland species now present on Mott Island should increase in numbers as the alder-cottonwood community increases in areal extent. Additional deciduous forest inhabitants, like the warbler vireo (*Vireo gilvus*) and white-breasted nuthatch (*Sitta carolinensis*), may also emigrate from nearby land masses to these communities. Deciduous forest species should later experience a reduction in numbers and will probably be eliminated as the alder-cottonwood gives way to western hemlock and Sitka spruce. Avian species, like the western tanager (*Piranga ludoviciana*), Steller's jay (*Cyanocitta stelleri*), and varied thrush (*Ixoreus naevius*) which inhabit woodlands in general, may immigrate to the island at any time in the future. General woodland inhabitants now present on the island, such as the hermit (Catharus guttatus) and Swainson's thrush (C. ustulatus), will likely remain. Species which prefer to inhabit mixed coniferous-deciduous woodlands, like the ruffed grouse (Bonasa umbellus) and solitary vireo (Vireo solitarius), may invade during sub-climax seral stages but will probably emigrate once the island's upland region becomes totally forested by Sitka spruce.

b. Mammals. Additional mammal species will almost certainly reach the island in the future. The pool of mammals available on nearby land masses consists of about 50 species with most preferring to inhabit woodland situations (Ingles 1965). Those mammals that inhabit woodlands in general, such as Virginia opossums (Didelphis marsupialis), bushytail woodrats (Neotoma cinerea), snowshoe hares (Lepus americanus), and western red-backed mice (Clethrionomys occidentalis), may establish populations on Mott Island at any time in the future. Ubiquitous species, such as the deer mouse (Peromyscus maniculatus), black rat (Rattus rattus), Norway rat (Rattus norvegicus), and house mouse (Mus musculus), may also establish populations on the island at any time in the future. Species that require coniferous habitats, like Douglas' squirrel (Tamiasciurus douglasii) and the dusky tree vole (Phenacomys silvicola), and immigrate prior to the establishment of these communities on Mott Island will likely fail or be able to establish only residual populations. Species that prefer to inhabit early seral stage communities, like the California ground squirrel (Citellus beecheyi), and immigrate to Mott Island should also fail or establish only residual populations. The presence of mouse, vole, squirrel, or rabbit populations may be necessary to support terrestrial mammal carnivores, such as the long-tailed weasel (Mustela frenata), striped skunk (Mephitis mephitis), and marten (Martes americana). Island size will likely prohibit carnivores that have large home ranges, such as the coyote (Canis latrans) and black bear (Ursus americanus), from existing exclusively on Mott Island. Invertebrate and small mammal populations inhabiting the study site's marshlands may provide an attractive food source for raccoons (Procyon lotor) and minks (Mustela vison); these carnivores may then utilize the island's upland habitats for resting, shelter, and breeding purposes.

Mammal species presently inhabiting the study site will likely remain when the climax community is established. Nutria, however, will probably become confined to the marshlands as plant succession on the upland areas causes grassy and herbaceous food sources to be shaded out by shrub and arborescent vegetation. Mule deer, which are forest-edge inhabitants, will probably become less numerous with the loss of early seral stage plant associations (i.e. scotchbroom and beachgrass-hairgrass). Townsend voles, if now present on the island, will likely remain and inhabit the site's marshlands.

c. Reptiles and amphibians. Additional reptiles and amphibians should also reach Mott Island in the future. Stebbins (1966) noted that 15 reptile and amphibian species inhabit nearby land masses in addition to the two species listed for Mott Island. Four of these, the pacific giant salamander (Rhyacotriton olympicus), tailed frog (Ascaphus truei), and bullfrog (Rana catesbeiana), will probably never establish populations on the upland portion of the study site because they require breeding habitats not present or predicted. Five of the remaining 11 species, the long-toed salamander (Ambystoma macrodactylum), rough-skinned newt (Taricha granulosa), northwestern salamander (Ambystoma gracila), ensatina (Ensatina eschscholtzi), and western toad (Bufo boreas), require ponded freshwater for reproduction and could establish populations on Mott Island if existing ephemeral ponds contained water for a sufficient length of time. Development of permanent ponds would, of course, increase the probability of their establishment. The remaining six species, the rubber boa (Charina bottae), common garter snake (Thamnophis sirtalis), northern alligator lizard (Gerrhonotus coeruleus), pacific tree frog (Hyla regilla), Dunn's salamander (Plethodon dunni), and western red-backed salamander (Plethodon vehiculum), are ubiquitous or general woodlands inhabitants and some of these could establish a population on Mott Island at any time in the future. Red-legged frogs currently present on Mott Island will likely remain in the upland sectors as long as ephemeral ponds are present. Northwestern garter snakes will also likely remain as long as densely vegetated areas and food sources exist.

Potential Resources of Regional Upland Disposal Areas

256. Mott Island and other nearby dredged material disposal islands are, individually, not of sufficient size to permit management of game species for hunting purposes except possibly for some small game birds. Management potential would be greater if the islands were managed collectively.

257. The abundance of crows and nutria on islands in the area may have detrimental effects on enhancement projects for ground nesting game birds and waterfowl. Crows and nutria are known to raid bird nests when they are available. Signs of such predation were seen on Mott Island.

258. With further research, use of upland portions of disposal islands for agricultural or forest products might be possible. Growth of nitrogen-fixing plant species is very successful on Mott Island. Pioneer species such as red alder that are capable of rapid growth on nutrient-poor sands could be grown commercially. Red alder is used as fuel in the local salmon-smoking industry.

259. Mott Island is ideally situated to serve as a combination education-research field station for studies of estuarine and island ecology. Clatsop Community College in Astoria might be able to make use of the island for training biology students.

260. Presently Mott Island is used occasionally for camping. Some hunting may have been done in the past.

261. Should the need arise, Mott Island and other such disposal areas might most economically be reused as disposal areas.

Regional Sere for Upland Disposal Areas

262. Sandy dredged material deposited in this region in such a way that an island habitat is created would be subject to the same general seral development exhibited on Mott Island. Seral stages represented by first herb, next shrub, and then tree species would develop in an order dependent upon relative microclimatic and moisture regimes.

263. Planting of scotchbroom, beachgrass, and shore pine on Mott Island represents a departure from the natural process of succession. Without planting of scotchbroom and beachgrass, hairgrass and fescue would probably dominate the more open, dryer areas of dredged material at the present. If seed sources were available, this open meadow situation would possibly be replaced by a shrub community in which any number of species could dominate. Three species mentioned by Wiedemann (1967) are probable: Hooker's willow (*Salix hookeriana*), wax myrtle (*Myrica californica*), and wintergreen (*Gaultheria Shallon*). Only the first was actually seen on the island. Stages following the shrub stage would be similar to those already predicted.

264. As has already been said, in the absence of shore pine plantation, this area would most likely be occupied by an alder-cottonwood canopy. No major changes would be expected in animal populations as a result of the deletion of beachgrass, scotchbroom, and shore pine from the sere.

Part IX: Conclusions and Recommendations

265. Ecological succession on upland dredged material substrates is subject to the same basic sets of factors affecting ecological succession along similar regional seres, but is modified by characteristics contributing to the insular nature of the site. These factors direct the course of plant associations, hence, the diversity and abundance of animal populations dependent upon them. In the case of true island, the insular nature of dredged material deposits is increased with increasing distance from the mainland or with increased effectiveness of water barriers such as currents and salinities. In the case of deposits on terrestrial landscapes, the insular nature of disposal areas is more subtly influenced by topography and texture of the substrate. In all cases, the availability of organisms and size and degree of permanence of the deposits are also limiting factors. The degree to which each of these factors limits or directs succession needs further investigation.

266. Potential regional seres for dredged material have been summarized at the conclusion of each of the five detailed site analyses. Potential also exists for changes in such seres with careful planning and design of disposal areas. Planned creation of habitat with active stocking from regional pools of biota and with cognizance of regional biophysical factors could enhance habitat and possibly biotic diversity on dredged material, or could hasten the course of succession and self-perpetuating biotic communities.

267. Biotic communities developing on dredged material need not be climax to be valuable habitat. Many organisms of concern are recognized as species characteristic of relatively young seral stages or seral stages maintained by climatic, edaphic, or extrinsic factors such as fire, flooding, or intermittent disposal. Depending on recognition of the most productive seral stages, the potential for habitat management on upland dredged material disposal areas is great.

268. Shapes and sizes of upland disposal areas may limit the range of possibilities for habitat management. For instance, islands

are not satisfactory for timber management but make excellent bird breeding habitats. Narrow linear disposal areas paralleling waterways are more suitable for hunting and timbering, as was the case at the WBPC site, than are islands. The biological needs of the region could well be used to direct, to some extent, the size, location, and configuration of disposal areas.

269. More critical site evaluations of dredged material biology could be generated by longer term sampling, more complete aerial photography, and more specific historical information. Even so, it would be difficult to develop generalizations on resources and successional trends that would apply in other areas in the region, largely because of variations in importance of biophysical factors from area to area.

270. Another valuable aid to understanding regional successional trends and resources would be more extensive travel and qualitative observation within each region after quantiative sampling has been completed at the specific site. The small amount of time available during the course of each field trip to inspect different seres as well as other seral stages on dredged material was extremely valuable to interpretation of site history.

271. Information regarding soil development would also be useful. Little is known about the soil developmental stages paralleling development of plant communities on upland dredged material. Though dredged material soils are not strictly classifiable, soils sampled most nearly resemble entisols due to lack of visible solum development. Research of soil development in upland dredged material would provide very important information toward understanding overall succession.

272. The study was pursued on the basis of only one sampling area for each region concerned. The smallness of this sample imposed limitations on interpretation at a regional level due to lack of wide variation in age, substrate characteristics, and climatic characteristics within the major biotic regions sampled. Major characteristics

constituting the biophysical aspects of disposal areas were not consistent from site to site, therefore there was very little basis for comparison (Table 101).

Table 101

Summary of Major Biophysical Characteristics of Five Upland Disposal Area Study Sites

Biophysical Characteristics	Site				
	Nott Island	Hillsborough Bay Islands	Whiskey Bay Pilot Channel	High Island-GIWW	Mott Island
Disposal area type	Mounds on natural island	Islands	Linear-unconfined	Linear-partially confined	Island
Climate	Temperate	Subtropical	Subtropical	Subtropical	Temperate
Substrate	Quartz sand	Marine calcareous sand	Deltaic silt & clay	Marine fine sand-coarse silt	Basaltic sand
Biotic region	Deciduous forest	Tropical moist hardwood	Bottomland hardwood	Wet prairie	Coniferous forest
Biotic accessibility[a]	Moderate	Low	High	Moderate	Low
Seral variation[b]					
Plants	Low	High	Low	High	Low
Animals	Moderate	Moderate	Low	Low	Moderate

[a]Facility (high, moderate, low) with which regional biota can immigrate and possibly become established

[b]Degree (high, moderate, low) to which dredged material seres differ from seres of other regional habitats

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Appendix A: Annotated Lists of Biota of Nott Island, Connecticut

1. Plant species nomenclature follows that used by Gleason and Cronquist 1963*. Species preceded by an asterisk (*) have been collected for voucher specimens.

2. References used to compile life history information about birds were Bent 1919-1968 and Robbins et al. 1966. Information about mammals was gathered from Burt and Grossenheider 1964. Life history data on reptiles is from Conant 1975.

3. Avian nomenclature is based on American Ornithologists' Union (AOU) 1957 and AOU 1973. Mammalian nomenclature is based on Jones et al. 1973. Names for reptiles are from Conant 1975.

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*Literature cited may be found at the end of the main text (pages 385-395.

Annotated List of Vascular Plant Species

Aceraceae

*Acer negundo L. Box elder. Scattered young trees in low areas of mixed woodlands.

*Acer saccharinum L. Silver maple. Along edges of northern tip of island near the river.

Alismataceae

Alisma plantago-aquatica L. Water-plantain. Marsh.

Sagittaria spatulata (J. G. Smith) Buch. Arrow-head. Marsh.

Anacardiaceae

*Rhus copallina L. Winged sumac. Frequently forming dense stands with false indigo, or scattered.

*Rhus glabra L. Smooth sumac. Most common on northern half of island in open areas.

Rhus radicans L. Poison-ivy. High climbing woody vine or ground cover. Mixed woodlands or shrubby areas.

*Rhus typhina L. Staghorn sumac. Common shrub of northern portions of the island.

Apiaceae

Sium suave Walt. Water parsnip. Marsh.

Apocynaceae

Apocynum cannabinum L. Indian hemp. One specimen, northern portion of island.

Asclepiadaceae

*Asclepias sp. Milkweed. Infrequent in open upland areas.

Asclepias syriaca L. Milkweed. Scattered in grassy, sandy openings.

Asteraceae

Achillea millefolium L. Yarrow. Two or three stands in the northern portion of the island.

*Anaphalis margaritacea (L.) Benth. & Hook. Pearly everlasting. Scattered in areas of moderately dry sandy soil in open situations.

Bidens sp. Spanish needle. Rare herb of open areas.

Cirsium sp. Thistle. Scattered in open dryer areas.

*Erechtites hieracifolia (L.) Raf. Fireweed. Old fields and woodland borders. Occasional in beachgrass.

Erigeron strigosus Muhl. Fleabane. Occasional weed of dry open areas.

Mikania scandens (L.) Willd. Bindweed. Throughout, but most common in low, open areas.

*Solidago rugosa Mill. Goldenrod. Throughout shrubby and grassy areas and important under black locust.

*Tanacetum vulgare L. Tansey. Woodland openings.

Balsaminaceae

Impatiens capensis Meerb. Jewel weed. Low shaded areas in shrubs.

Berberidaceae

Berberis thunbergii DC. Barberry. Waifed and escaped from cultivation. Scattered.

Betulaceae

*Alnus serrulata (Ait.) Willd. Alder. One stand over moist sand in the northern half of the island.

Bignoniaceae

Catalpa speciosa Warder. Catalpa. One specimen seen.

Boraginaceae

Myosotis laxa Lehm. Forget-me-not. Marsh.

Brassiaceae

Brassica nigra (L.) Koch. Mustard. Common in openings within false indigo.

Lepidium virginicum L. Peppergrass. Open edges in false indigo community.

Rorippa islandica var. hispida (Desv.) Butlers & Abbe. Marsh cress. Apparently lingering in sandy depressions once containing water. Rare.

Caprifoliaceae

Lonicera japonica Thunb. Japanese honeysuckle. Climbing vine in some open and partly shaded portions of the island.

Celastraceae

*Celastrus orbiculatus Thunb. Bittersweet. Common woody vine of woodlands.

Convolvulaceae

Ipomea sp. Morning glory. White-flowered species of low shrubby areas.

Cornaceae

*Cornus amomum Mill. Swamp dogwood. Occasional in low areas.

Cupressaceae

Juniperus virginiana L. Red cedar. Scattered individuals.

Cuscutaceae

Cuscuta sp. Dodder. Parasitic on vegetation in moist areas.

Cyperaceae

Carex annectans (Bickn.) Bickn. Alder community.

Carex scoparia Schnk. Nearly solid mats found in false indigo community.

*Cyperus dentatus Torr. Sedge. Dominant on dry, open sandy soil.

Cyperus filiculmis Vahl. Openings in false indigo.

Eleocharis halophila Fern. & Brackett. Spike rush. Marsh.

Scirpus cyperinus Pers. Wool grass. Marsh and sedge-cordgrass community.

Scirpus validus Vahl. Great bulrush. Marsh.

Equisetaceae

*Equisetum sp. Scouring rush. Moderately dry sandy soil.

Ericaceae

Vaccinium sp. One specimen.

Fabaceae

*Amorpha fruticosa L. False indigo. Major dominant shrub of lower areas of upland situations.

*Robinia pseudo-acacia L. Black locust. One stand near the central western portion of the island.

Fagaceae

Quercus nigra L. Water oak. One individual seen. DBH of 14.2 in. If identification is correct this constitutes a significant northward range extension.

*Quercus velutina Lam. Black oak. Scattered young individuals in open sandy soils.

Hypericaceae

Hypericum gentianoides (L.) BSP. St. John's wort. Dry, open areas.

*Hypericum mutilum L. St. John's wort. Moist, lightly shaded areas in false indigo and panic grass-goldenrod communities.

Juneaceae

Juncus bufonis L. Toad rush. Occasional in moist areas.

Juncus effusus L. Rush. Common wet to moist sand in openings.

Lamiaceae

Lycopus americanus Muhl. Water-horehound. Moist to wet shrubby areas.

Scutellaria galericulata L. Skullcap. Moist, sandy areas of the false indigo community.

Stachys sp. False indigo community.

Teucrium canadense L. Germander. Occasional through areas of less xeric sands.

Lythraceae

Lythrum alatum Pursh. Loosestrife. Marsh and other low areas.

Malvaceae

Hibiscus sp. Hibiscus. Marsh.

Myriaceae

*Myrica pensylvanica Loisel. Bayberry. Scattered clumps throughout the island.

Najadaceae

Najas gracillima (A.Br.) Magnus. Naiad. Aquatic.

Oleaceae

Fraxinus americana L. White ash. Scattered in wooded areas.

Oxalidaceae

Oxalis stricta L. Sorrel. Moist, shrubby edges.

Phytolaccaceae

Phytolacca americana L. Poke weed. Scattered to common in the false indigo community.

Platanaceae

Platanus occidentalis L. Sycamore. A few widely separated individuals.

Poaceae

Agrostis perennans (Walt.) Tuckerm. Bentgrass. Mesic, shaded areas.

Agrostis hyemalis (Walt.) BSP. Low, shaded areas.

Agrostis stolonifera L. Running bent. Openings in shrubby areas.

Agrostis tenuis Sibth. Rhode Island bent. Probably waifed and escaped in low to moist shaded areas.

*Ammophila breviligulata Fern. Beachgrass. Dominant grass of upland dry dredged material.

*Andropogon gerardi Vitm. Turkey foot. Small clumps near the western central edge of the island.

*Andropogon scoparius Michx. Little bluestem. A few scattered clumps near central western portion of the island.

*Cenchrus longispinus (Hach.) Fern. Sandspur. Occasional in open, dry dredged material.

*Eragrostis spectabilis (Pursh.) Steud. Lovegrass. Open, moderately dry soil.

Festuca rubra L. Red fescue. Common under shade in moist areas.

*Leptoloma cognatum (Schult.) Chase. Fall witch-grass. Open areas in false indigo and panic grass-goldenrod communities.

*Lolium perenne L. English rye grass. Most abundant herb under black locust stand.

*Panicum sp. Scattered mats in open areas.

Panicum anceps Michx. Scattered clumps in panic grass-goldenrod community.

*Panicum clandestinum L. Low, somewhat open areas. Common under black locust.

Panicum lanuginosum Ell. Abundant low panic grass in the northern half of the island.

*Panicum virgatum L. Panic grass. Dominant cespitose perennial of abandoned fields and dredged material.

Phragmites communis Trin. Common reed. Dense stands on dredged material and near marsh.

Poa pratensis L. Kentucky bluegrass. Under shrubs.

*Sorghastrum nutans (L.) Nash. Indian grass. Several clumps in eastern central portion of the island.

*Spartina pectinata Link. Cordgrass. Scattered in areas of dredged material dominated by a sedge-cordgrass community and along the margins of marsh, or elsewhere in moist, unshaded sands.

*Triplasis purpurea Beauv. Sandgrass. Dry sand.

Polygonaceae

*Polygonum punctatum Ell. Spotted knotweed. Scattered in moist areas. Scrambling and twining vine in shrubs and along woodland borders.

Rumex acetosella L. Red sorrel. Common low herb cover in panic grass-goldenrod community.

Polypodiaceae

Athyrium thelypteroides (Michx.) Desv. Occasional in moist shaded areas.

*Dennstaedtia punctilobula (Michx.) Moore. Hay-scented fern. Uncommon fern of mixed woodlands.

*Onoclea sensibilis L. Sensitive fern. Uncommon fern of low, dense thickets.

Rosaceae

Crataegus spathulata Michx. Crabapple. Dryish, open woodlands.

Potentilla norvegica L. Cinquefoil. Scattered mesic to somewhat xeric openings.

Prunus serotina Ehrh. Wild black cherry. Young and mature trees of northern end of island.

Rosa carolina L. Wild rose. Common in dense stands with false indigo.

*Rubus flagellaris L. Dewbery. Openings in false indigo community.

Spiraea tomentosa L. Hardhack. One individual in edge of alder stand.

Rubiaceae

Cephalanthus occidentalis L. Buttonbush. A very few scattered individuals.

Galium palustre L. Bedstraw. Low, moist shrubby areas and marshes.

Salicaceae

Populus grandidentata Michx. Large-toothed aspen. Mixed woodlands.

Salix nigra L. Black willow. Low, moist sand and marsh fringes. Frequently tree-sized.

Scrophulariaceae

Linaria vulgaris Nill. Butter-and-eggs. One area within a patch of dewberry at eastern side of island.

Mimulus ringens L. Monkey flower. Scattered in low, open habitats.

Verbascum thapsus L. Mullein. Weedy openings in northern half of island.

Simarubaceae

*Ailanthus altissima (Mill.) Swingle. Tree-of-heaven. Common tree of northern tip of island.

Typhaceae

Typha angustifolia L. Narrow-leaf cattail. Marsh.

Ulmaceae

*Celtis occidentalis L. Hackberry. Occasional in northern portion of the island.

*Ulmus americana L. American elm. Important woodland tree species.

Urticaceae

Boehmeria cylindrica (L.) SW. False nettle. Low, moist shrubby areas.

Vitaceae

Parthenoscissus quinquefolia (L.) Planch. Virginia creeper. Ground cover or high climbing woody vine of mixed woodlands.

Vitis labrusca L. Fox-grape. High-climbing woody vine of mixed woodlands.

Annotated List of Birds

Cygnus olor. Mute swan.

Mute swans are an introduced species from the Old World. They were observed utilizing aquatic habitat between Nott Island and the eastern shore of Connecticut River.

Branta canadensis. Canada goose.

Several individuals were seen utilizing shallow aquatic areas around the northern end of Nott Island. This species is reported to be breeding in the area, but nests or young were never seen.

Anas platyrhynchos. Mallard.

Mallards are year-round residents in the lower Connecticut River area. They were observed to utilize aquatic and marsh habitats adjacent to Nott Island for feeding. Two nests, one of which was active, were observed in July 1974 in the beachgrass community. The active nest contained 10 eggs. Food: primarily seeds of marsh plants and aquatic insects.

Falco sparverius. American kestrel.

American kestrels are year-round residents in the lower Connecticut River valley and are typically found in exposed forest-edge on hedgerow situations. They were especially common on Nott Island in September 1974, but none were observed in July 1974. Kestrels were seen in the black locust, alder, beachgrass, false indigo, and panic grass-goldenrod plant associations; isolated trees within these habitats were utilized for resting and as perches from which prey were hunted. Kestrels frequently nest in tree cavities. Four to five eggs are usually laid per nest. Egg dates in New England range from April to mid-June. Food: small vertebrates and insects (especially Orthopterans during summer).

Phasianus colchicus. Ring-necked pheasant.

Ring-necked pheasants are year-round residents in the lower Connecticut River area and typically inhabit hedgerow and forest-edge situations. One individual was observed in the panic grass-goldenrod community in September 1974. Ring-necked pheasants nest on the ground. Usually 10 to 12 eggs are laid per nest. Egg dates in New England range from mid-May through June. Food: seeds, fleshy fruits, and insects.

Colinus virginianus. Bobwhite.

Bobwhites are year-round residents in the lower Connecticut River area and generally are a hedgerow species. They were fairly common on the study site during both field surveys and were observed in the false indigo and panic grass-goldenrod habitats. Two active nests and one group of fledglings were found on the island in July 1974; two active nests were also found in September 1974. Egg dates in New England range from late May to mid-October. Bobwhites ordinarily lay 12 to 20 eggs per nest. Food: primarily plant seeds, fruits, leaves, buds, and tubers, but also insects, spiders, and myriapods.

Zenaida macroura. Mourning dove.

Mourning doves are year-round residents in the lower Connecicut River area and are a forest-edge species. These doves were seen on the study site during both surveys. They utilized isolated trees in the false indigo community for resting and unvegetated areas for sources of sand and gravel that are ingested to aid the bird's digestive processes. Nests of this species are loosely constructed platforms and usually are located in a conifer. Like the bobwhite, the mourning dove breeding season is quite long, ranging from April to August in New England. Two eggs are laid per nest. Food: seeds.

Tyto alba. Barn owl.

Barn owls are year-round residents in the lower Connecticut River area. They are classified as a forest-edge species and are frequently associated with agricultural areas. One individual was observed to roost in tall, isolated trees within the false indigo community during both field surveys. Pellets and carcasses collected from beneath the roosts included the remains of meadow voles, meadow jumping mice, crows, gulls, and fish. Five to seven eggs are laid per nest. Most nesting occurs in the late winter and early spring.

Archilochus colubris. Ruby-throated hummingbird.

Ruby-throated hummingbirds are summer residents in the lower Connecticut River area and are forest-edge inhabitants. Several individuals were observed on Nott Island in July 1974 and one was seen in September 1974. All sightings were recorded in the false indigo community. Most egg dates in New England are for late May through June. Usually two eggs are laid per nest. Food: insects that are attracted to flowers and flower nectar.

Megaceryle alcyon. Belted kingfisher.

Belted kingfishers are year-round residents in the study site vicinity and are commonly found in wooded edges along aquatic habitats. Individuals were observed during both field surveys. All individuals were observed perched in trees along the outer edge of the island's mixed woodland habitat. Presumably these trees were utilized for resting and as perches from which prey were hunted. Kingfishers commonly nest in perpendicular banks along water courses. Most egg dates in New England range from early May to early June. Five to eight eggs are usually laid per nest. Food: primarily small fish.

Colaptes auratus. Common flicker.

Common flickers are year-round residents in the lower Connecticut River area and are forest-edge inhabitants. One nest of this species was found in an isolated, dead tree within the false indigo community in July 1974. Several groups of fledglings were also observed. Most egg dates in New England range from early May through June. Six to eight eggs are normally laid per nest. Food: insects (especially Hymenopterans) and fleshy fruits.

Dendrocopus villosus. Hairy woodpecker.

Hairy woodpeckers are year-round residents in the study site vicinity and prefer to inhabit deciduous woodlands. One individual was observed on Nott Island during both surveys in the mixed woodland community. Egg dates in New England range from early May to early June. An average of four eggs are laid per nest. Food: insects (especially Cerambycid and Buprestid beetles and Hymenopterans), seeds, and fleshy fruits.

Tyrannus tyrannus. Eastern kingbird.

Eastern kingbirds are summer residents in southern Connecticut and prefer to inhabit very exposed forest-edge situations. They were common on Nott Island in July 1974 and were observed in the false indigo, black locust, common reed, alder, and panic grass-goldenrod communities. None were seen on the island in September 1974. Egg dates for New England range from late May to late June. An average of three eggs are laid per nest. Food: insects, especially Dipterans Hymenopterans.

Sayornis phoebe. Eastern phoebe.

Eastern phoebes are summer residents in the lower Connecticut River valley and prefer to inhabit very exposed forest-edge situations. They were fairly common on Nott Island in July 1974 and were observed in the false indigo, black locust, common reed, alder, and panic grass-goldenrod communities. None were seen on the study site in September 1974. Egg dates in New England range from late April to late June. An average of five eggs are laid per nest. Food: insects, especially Dipterans and Hymenopterans.

Epidonax sp.

An unidentified species of this genus was observed in the mixed woodlands community during July 1974.

Contopus virens. Eastern wood pewee.

Eastern wood pewees are summer residents in southern Connecticut and prefer to inhabit deciduous woodlands. A few individuals were observed in the mixed woodland and false indigo communities during both field surveys. Egg dates in New England range from early June to mid-July. Ordinarily, three eggs are laid per nest. Food: insects, especially Dipterns and Hymenopterans.

Hirundo rustica. Barn swallow.

Barn swallows are summer residents in the Nott Island area and generally prefer to inhabit open country or hedgerow situations. Barn swallows were abundant in July 1974 and foraged on flying insects over all of the island's communities. Barn swallows frequently nest beneath bridges, docks, or in farm or abandoned buildings. Egg dates in New England range from mid-May to early July. Four to five eggs are usually laid per nest.

Iridoprocne bicolor. Tree swallow.

Tree swallows are summer residents in the lower Connecticut River area and generally prefer to inhabit open country or hedgerow situations. Tree swallows were fairly common during both surveys and foraged on flying insects over all of the island's communities. Tree swallows frequently nest in tree cavities and bird nest boxes. Egg dates in New England range from May through June. Four to six eggs are regularly laid per nest.

Progne subis. Purple martin.

Purple martins are summer residents in the study site vicinity and prefer to inhabit open country or hedgerow situations. A few individuals were observed to forage over the project site in July 1974 but none ever alighted. Egg dates in New England range from late May to mid-June. An average of four to five eggs are laid per nest. Food: insects, particularly Hymenopterans, Dipterans, and Coleopterans.

Cyanocitta cristata. Blue jay.

Blue jays are year-round residents in southern Connecticut and are forest-edge inhabitants. One individual was observed in the mixed woodland community in September 1974. Egg dates in New England range from late April to mid-June. Four to five eggs are laid per nest. Food: seeds, fleshy fruits, and insects.

Corvus brachyrhynchos. Common crow.

Common crows are year-round residents in the project site vicinity and inhabit forest-edge and hedgerow situations. Individuals and small flocks were seen resting in isolated trees within the false indigo community during both field surveys. Egg dates in New England range from April to mid-June. Four to six eggs are ordinarily laid per nest. Crows are scavengers, feeding on every kind of digestible food.

Parus atricapillus. Black-capped chickadee.

Black-capped chickadees are year-round residents in the lower Connecticut River area and are woodland inhabitants. They were common on Nott Island during both field surveys and were observed feeding in small flocks in the mixed woodland and black locust communities. Egg dates in New England range from early May to early June. Five to ten eggs may be laid per nest. Nests are usually located in tree cavities. Food: insects (especially scale insects, aphids, Lepidopteran caterpillars, pupae, and eggs), spiders, spider eggs, berries (frequently those of _Myrica pensylvanica_ and _Rhus radicans_) and mast.

Troglodytes troglodytes. Winter wren.

Winter wrens are winter residents in southern Connecticut and generally prefer to inhabit mesic woodlands. Several individuals of this species were observed in the false indigo community in September 1974. Food: insects, especially Hemipterans, Coleopterans, Lepidopteran caterpillars, small Hymenopterans, and spiders.

Telmatodytes palustris. Long-billed marsh wrens.

Long-billed marsh wrens are summer residents in the study site vicinity and, as their name implies, are marshland inhabitants. One individual was observed in the common reed community in September 1974. Egg dates in New England range from late May to late June. An average of four eggs are laid per nest. Long-billed marsh wrens are polygynous. Food: insects and seeds.

Toxostoma rufum. Brown thrasher.

Brown thrashers are year-round residents in the Nott Island area and are forest-edge inhabitants. Individuals were observed in the black locust community during both surveys. Egg dates in New England range from mid-May to early July. Four to five eggs are usually laid per nest. Food: insects, mast, and berries.

Dumetella carolinensis. Gray catbird.

Gray catbirds are summer residents in the lower Connecticut River area and are forest-edge inhabitants. They were common on Nott Island in July 1974; none were observed on the island on September 1974. Individuals were observed in the false indigo, panic grass-goldenrod, mixed woodland, and alder communities. Egg dates in New England range from early May to mid-August. Two to five eggs are laid per nest. Food: fleshy fruits (with those of Celastris orbiculatus being a favorite) and insects (especially Hymenopterans, Coleopterans, Lepidopteran caterpillars, and Orthopterans).

Turdus migratorius. American robin.

Robins are year-round residents in southern Connecticut and are forest-edge inhabitants. A few individuals were observed in the false indigo and mixed woodland communities in July 1974; none were observed on the island in September 1974. Egg dates in New England range from late April to early July. An average of four eggs are laid per nest. Food: fleshy fruits, insects (especially Coleopterans and Lepidopteran caterpillars), and earthworms.

Sturnus vulgaris. Starling.

Starlings are year-round residents and are forest-edge inhabitants. A nest of this species was located in a dead tree in the false indigo community during the July 1974 field survey. The tree was previously used as a nesting site by a woodpecker. A few starlings were also seen on the island in September 1974. Four to six eggs are usually laid per nest. Food: insects (especially weevils and other Coleopterans), fleshy fruits, and seeds.

Vireo griseus. White-eyed vireo.

White-eyed vireos are summer residents in southern Connecticut and prefer to inhabit deciduous woodlands. Individuals were observed in the mixed woodland community in July 1974. Egg records in Connecticut range from mid-May to mid-June. An average of four eggs are laid per nest. Food: primarily insects.

Dendroica petechia. Yellow warbler.

Yellow warblers are summer residents in the Nott Island area and inhabit hedgerow and forest-edge situations. Individuals were observed in the false indigo and black locust communities in

July 1974. Egg dates in New England range from mid-May to late June. Four to five eggs are usually laid per nest. Food: primarily insects, especially Lepidopteran caterpillars.

Dendroica coronata. Yellow-rumped warbler.

Yellow-rumped warblers are spring-fall transients in the Nott Island area and are hedgerow inhabitants. A few individuals, apparently late or early migrants, were observed in July 1974 in the false indigo community. Food: insects, fleshy fruits (especially those of Myrica pensylvanica), and seeds.

Geothlypis trichas. Common yellowthroat.

Yellowthroats are summer residents in southern Connecticut and are hedgerow inhabitants. They were abundant on Nott Island during both surveys and were observed in all vegetated biotic communities. Egg dates in New England range from late May to late June. An average of four eggs are laid per nest. Food: insects.

Quiscalus quiscula. Common grackle.

Common grackles are year-round residents in the lower Connecticut River vicinity and inhabit forest-edge and hedgerow situations. Individuals were observed in the false indigo, mixed woodland, and alder communities in July 1974; none were observed on the island in September 1974. Egg dates in New England range from early May to mid-June. Four to five eggs are usually laid per nest. Food: insects, fleshy fruits, and seeds.

Cardinalis cardinalis. Cardinal.

Cardinals are year-round residents in the lower Connecticut River area and are forest-edge inhabitants. They were fairly common on the study site during both surveys and were observed in the false indigo, mixed woodland, and alder communities. Most nesting in New England occurs in April and May. Three to four eggs are commonly laid per nest. Food: seeds and fleshy fruits.

Spinus tristis. American goldfinch.

Goldfinches are year-round residents in the study site area and are hedgerow inhabitants. Several individuals were observed in the false indigo and mixed woodland communities in July 1974; none were observed on the island in September 1974. Egg dates in New England range from late July to late August. Four to six eggs are laid per nest. Food: primarily seeds and especially those of the aster family.

Melospiza melodia. Song sparrow.

Song sparrows are year-round residents in the Nott Island vicinity and prefer to inhabit hedgerow situations. They were abundant on the study site in July 1974 and fairly common in September 1974. Individuals were observed in the false indigo, panic grass-goldenrod, and alder communities. Most nesting in New England occurs in May and June. Three to six eggs are laid per nest. Food: seeds (often those of grasses) and insects.

Annotated List of Mammals

Blarina brevicauda. Short-tailed shrew.

Short-tailed shrews generally do not have very restrictive habitat preferences and may be found in a variety of situations. Individuals were captured in September 1974 with live traps in panic grass-goldenrod and common reed communities. Females captured were in lactating condition. Five to eight young are born per litter; short-tailed shrews have two to three litters per year. Food: primarily insects but occasionally other small vertebrates and bird eggs.

Scalopus aquaticus. Eastern mole.

Eastern moles prefer to inhabit moist, loamy soils. Tunnels of this species were observed in the false indigo and panic grass-goldenrod communities during both surveys. Eastern moles have one litter per year, usually in May in the northern United States. Four to five young are born per litter. Food: earthworms, larval insects, and plant tubers.

Peromyscus leucopus. White-footed mouse.

White-footed mice generally do not have very restrictive habitat preferences. Individuals were captured in the false indigo, panic grass-goldenrod, and mixed woodland communities in September 1974. None of the individuals captured were reproductively active. White-footed mice have two to four litters per year, usually from March to June in the northeast. Two to six young are born per litter. Food: plant seeds, fruits, roots, and tubers.

Microtus pennsylvanicus. Meadow vole.

Meadow voles prefer to inhabit mesic grasslands. They were the most abundant small mammals on Nott Island in September 1974. Individuals were captured in all vegetated communities but were most abundant in the false indigo and panic grass-goldenrod habitats. None of the adults captured appeared reproductively active. These animals are capable of breeding at any time of the year; one to nine young are born per litter. Food: plant foliage, roots, twigs, bark, and seeds.

Zapus hudsonius. Meadow jumping mouse.

Meadow jumping mice generally prefer to inhabit mesic grasslands. They were captured in the beachgrass, false indigo, and panic grass-goldenrod, common reed, and sedge-cordgrass communities on Nott Island in September 1974. Meadow jumping mice construct grass nests and hibernate from about October to May. Breeding commences upon emergence from hibernation. Females have two to three litters per year; four to five young are born per litter. None of the individuals captured were reproductively active. Food: plant foliage, stems, and seeds.

Procyon lotor. Raccoon.

Raccoons are typically found along aquatic habitats where wooded areas are nearby. Tracks of this species were observed in the unvegetated areas on the island upland sector during both field surveys. Raccoons have one litter per year, usually in the spring. An average of four young are born per litter. Food: small vertebrates, crustaceans, large insects, mast, and fleshy fruit.

Odocoileus virginianus. White-tailed deer.

White-tailed deer are typically forest-edge inhabitants. Individuals or their sign were observed in all habitats on Nott Island during the two field surveys. Breeding occurs in the fall and winter; young (usually two) are born in the spring or early summer. Food: plant foliage, twigs, and fruits.

Annotated List of Reptiles

Coluber constrictor constrictor. Northern black racer.

An individual of this species was observed in July 1974 in the panic grass-goldenrod biotic community. Northern black racers are carnivorous and on Nott Island their diet probably includes small mammals, birds, and other snakes.

Thamnophis sirtalis sirtalis. Eastern garter snake.

One individual was observed in the beachgrass community in September 1974. Food on Nott Island probably includes small mammals, birds, and insects.

Turtle.

Remains of a turtle nest and eggshells were found in an unvegetated area. Species of turtle is unknown.

Appendix B: Annotated Lists of Biota of Six Hillsborough Bay Islands, Florida

1. Plant species nomenclature follows that used by Long and Lakela (1971)* and Radford et al. (1968). Species preceded by an asterisk (*) have been collected for voucher specimens. Information about birds is from Dunstan and Lewis (1974). Avian nomenclature is based on American Ornithologists' Union (AOU) 1957 and AOU 1973. Mammals, reptiles, and amphibians are treated in the text and have been excluded from Appendix B.

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*Literature cited may be found at the end of the main text (pages 385-395).

Annotated List of Vascular Plant Species

Aizoaceae

Sesuvium portulacastrum L. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Occasionally found on beaches and overwashes.

Amaranthaceae

Amaranthus cannabinus (L.) J. D. Sauer. Water-hemp. Bird Island. Infrequent in marsh elder community.

Amaranthus hybridus L. Common pigweed. Bird Island. Infrequent in marsh elder community.

Amaranthus spinosus L. Spiny pigweed. Fish Hook Island. Scarce in paspalum-silverling community.

Amaranthus viridis Desf. Slender amaranth. Sunken Island. Scarce in paspalum community.

Philoxerus vermicularis (L.) R. Br. Saltweed. Fish, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout the tidal zone.

Amaryllidaceae

Crinum americanum L. String lily. Sunken Island. Scarce on beaches and overwashes.

Anacardiaceae

Schinus terebinthifolius Reddi. Brazilian pepper. Pine, Bird, and Sunken Islands. Occasional in cabbage palm community; abundant in lantana-cabbage palm, Brazilian pepper-cabbage palm, and Brazilian pepper communities.

Apiaceae

Hydrocotyle sp. Bird Island. Scarce in marsh elder community.

Apocynaceae

Vinca rosea L. Madagascar periwinkle. Sunken Island. Scarce on beaches and overwashes.

Arecaceae

Sabal palmetto (Walt.) Lodd. ex Schult. Cabbage palm. Gull, Bird, and Sunken Islands. Abundant in lantana-cabbage palm, Brazilian pepper-cabbage palm, and cabbage palm communities.

*Washingtonia robusta Wendl. Washington palm. Sunken Island. Scarce in silverling and Brazilian pepper-cabbage palm communities.

Asclepiadaceae

Cynanchum palustre (Pursh) Heller. Vine milkweed. Pelican Point Island. Abundant on beaches and overwashes.

Asteraceae

Ambrosia artemisiifolia L. Common ragweed. Bird Island. in beggartick-ragweed and croton-dayflower communities.

Baccharis halimifolia var. angustior DC. Silverling. Fish Hook, Gull, Pine, Bird, and Sunken Islands. Abundant in paspalum-silverling and silverling communities.

*Bidens pilosa L. Beggartick. Fish Hook, Gull, Bird, and Sunken Islands. Abundant in beggartick-ragweed, beggartick-lantana, and lantana-cabbage palm communities.

Conyza canadensis var. pusilla (Nutt.) Cron. Dwarf horsewood. Fish Hook, Gull, and Bird Islands. Occasional throughout uplands.

Erigeron strigosus Muhl. Daisy fleabane. Bird Island. Scarce in croton-dayflower community.

Eupatorium capillifolium (Lam.) Small. Dogfennel. Fish Hook, Gull, Pine, Bird, and Sunken Islands. Occasional throughout uplands.

Eupatorium compositifolium Walt. Dogfennel. Fish Hook Island. Scarce in paspalum community.

Heterotheca subaxillaris (Lam.) Britt. & Rusby. Golden aster. Fish Hook, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout uplands.

*Iva frutescens L. Marsh elder. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout tidal zone.

Lactuca graminifolia Michaux. Wild lettuce. Fish Hook and Gull Islands. Infrequent in paspalum-silverling and silverling communities.

Lygodesmia aphylla (Nutt.) DC. Flowering straws. Gull and Pine Islands. Infrequent in paspalum community.

Pyrrhopappus carolinianus var. *georgianus* (Shinners) Ahles. False dandelion. Fish Hook and Pine Islands. Infrequent in paspalum-silverling and croton-dayflower communities.

**Solidago sempervirens* var. *mexicana* (L.) Fern. Goldenrod. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout tidal zone and on beaches and overwashes.

**Sonchus asper* (L.) Hill. Spiny sowthistle. Fish Hook, Gull, Pine, and Sunken Islands. Occasionally found throughout uplands.

**Wedelia trilobata* (L.) Hitchc. Fish Hook and Sunken Islands. Occasional in paspalum community.

Avicenniacea

**Avicennia germinans* (L.) Stern. Black mangrove. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout tidal zone.

Bataceae

**Batis maritima* L. Saltwort. Fish Hook, Gull, and Pelican Point Islands. Occasional throughout tidal zone.

Boraginaceae

**Heliotropium curassavicum* L. Seaside heliotrope. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Occasional throughout tidal zone.

Brassicaceae

Lepidium virginicum L. Pepper grass. Bird Island. Scarce in croton-dayflower community.

Cactaceae

Opuntia stricta var. *dillenii* Haw. Opuntia. Pine and Sunken Islands. Infrequent in paspalum community.

Caprifoliaceae

Sambucus canadensis L. Elderberry. Bird Island. Infrequent in beggartick-lantana and beggartick-ragweed communities.

Casuarinaceae

*Casuarina equisetifolia Forst. Australian pine. Fish Hook, Gull, Pelican Point, Pine, and Sunken Islands. Occasional throughout uplands.

Chenopodiaceae

Atriplex arenaria Nutt. Orach. Fish Hook, Gull, Pelican Point, and Pine Islands. Occasional on beaches and overwashes.

Chenopodium ambrosioides L. Goosefoot. Fish Hook, Pelican Point, Pine, and Bird Islands. Occasional throughout uplands.

Salicornia virginica L. Saltwort. Fish Hook Island. Occasional throughout tidal zone.

Suaeda linearis (Ell.) Moq. Sea blite. Fish, Gull, Pelican Point, and Bird Islands. Abundant on beaches and overwashes.

Suaeda maritima (L.) Dumort. Sea blite. Fish, Gull, and Pelican Point Islands. Occasional on beaches and overwashes.

Combretaceae

*Conocarpus erecta L. Buttonwood. Fish Hook, Pelican Point, Pine, Bird, and Sunken Islands. Occasional throughout tidal zone.

*Laguncularia racemosa Gaertn. f. White mangrove. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout tidal zone.

Commelinaceae

Commelina diffusa Burm. f. Dayflower. Bird Island. Abundant throughout tidal zone.

Convolvulaceae

Dichondra carolinensis Michaux. False pennywort. Pine Island. Scarce in paspalum community.

*Ipomoea pes-caprae (L.) Sweet. Railroad vine. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant on beaches and overwashes.

Ipomoea sagittata Cav. Glades morning glory. Pine Island. Occasional in paspalum community.

Ipomoea tuba (Schlect.) G. Don. Moonflower. Pelican Point, Pine, Bird, and Sunken Island. Abundant on beaches and overwashes.

Cucurbitaceae

*Momordica charantia L. Wild balsam apple. Pine, Bird, and Sunken Islands. Abundant in beggartick-lantana and lantana-cabbage palm communities.

Cymodoceaceae

*Syringodium filiforme Kuetz. Manatee grass. Sunken Island. Abundant in pond community.

Cyperaceae

*Cyperus iria L. Galingale. Fish Hook and Bird Islands. Occasional in paspalum community.

*Cyperus ligularis L. Galingale. Pine, Bird, and Sunken Islands. Occasional throughout tidal zone.

Scirpus sp. Gull, Pine, and Bird Islands. Infrequent throughout tidal zone.

Euphorbiaceae

Acalypha rhomboidea Raf. Three-seeded mercury. Bird Island. Occasional in croton-dayflower community.

Chamaesyce hirta (L.) Millsp. Spurge. Fish Hook Island. Infrequent in paspalum community.

Chamaesyce sp. Spurge. Fish Hook and Bird Islands. Infrequent in paspalum and croton-dayflower communities.

Croton glandulosus L. Croton. Bird Island. Abundant in croton-dayflower community.

Croton punctatus Jacq. Croton. Bird Island. Abundant in croton-dayflower community.

Euphorpia sp. Spurge. Bird Island.

Phyllanthus carolinensis Walt. Fish Hook and Pine Islands. Occasional in paspalum community.

Poinsettia cyathophora (Murr.) Kl. & Gke. Poinsettia. Pine and Bird Islands. Occasional in croton-dayflower and natal grass communities.

Fabaceae

*Caesalpinia crista L. Gray nicker. Gull, Pelican Point, Pine Bird, and Sunken Islands. Occasional in paspalum-silverling, cabbage palm, and lantana-cabbage palm communities.

Canavalia maritima (Aubl.) Thouars. June bean. Fish Hook, Pelican Point, and Pine Islands. Infrequent on beaches and overwashes.

Cassia occidentalis L. Coffee senna. Bird Island. Abundant in beggartick-ragweed community.

*Dalbergia ecastophyllum (L.) Benth. Dalbergia. Fish Hook, Gull, Pelican Point, Pine, Bird, Sunken Islands. Occasional throughout uplands.

Melilotus alba Desv. Sweet clover. Fish Hook Island. Scarce in paspalum community.

Parkinsonia aculeata L. Fish Hook, Gull, and Bird Islands. Scarce in paspalum and beggartick-ragweed communities.

Sophora tomentosa L. Necklace pod. Fish Hook and Pine Islands. Infrequent in paspalum community.

*Vigna luteola (Jacq.) Benth. Cow pea. Fish Hook, Gull, Pine, Bird, and Sunken Islands. Abundant in paspalum community and on beaches and overwashes.

Liliaceae

Yucca aloifolia L. Spanish dagger. Fish Hook Island. Scarce in paspalum community.

Malvaceae

*Kosteletzkya virginica (L.) Presl. Salt marsh mallow. Bird Island. Scarce in marsh elder community.

Urena lobata L. Caesar weed. Sunken Island. Scarce in lantana-cabbage palm community.

Moraceae

Ficus aurea Nutt. Strangler fig. Bird Island. Scarce in cabbage palm community.

Ficus carica L. Fig. Sunken Island. Scarce in lantana-cabbage palm community.

Morus rubra L. Red mulberry. Bird Island. Scarce in cabbage palm community.

Myrtaceae

**Psidium guajava* L. Guava. Sunken Island. Scarce in lantana-cabbage palm community.

Nyctaginaceae

Boerhaavia diffusa L. Red spiderling. Fish Hook, Gull, and Pine Islands. Infrequent in paspalum-silverling and silverling communities.

Oleaceae

Forestiera segregata (Jacq.) Krug & Urban. Ligustrum. Bird Island. Scarce in cabbage palm community.

Onagraceae

Gaura angustifolia Michaux. Southern gaura. Fish Hook and Bird Islands. Occasional in paspalum and beggartick-ragweed communities.

Oenothera humifusa Nutt. Sea-side evening primrose. Fish Hook, Gull, Pine, and Bird Islands. Abundant throughout uplands.

Oxalidaceae

Oxalis stricta L. Yellow sorrel. Fish Hook Island. Scarce in paspalum-silverling community.

Passifloraceae

Passiflora suberosa L. Passion flower. Bird Island. Abundant in beggartick-ragweed and cabbage palm communities.

Phytolaccaceae

Phytolacca americana L. Poke weed. Pine and Bird Islands. Occasional in natal grass and croton-dayflower communities.

Poaceae

Andropogon virginicus L. Broom sedge. Fish Hook, Gull, Pine, and Bird Islands. Occasional throughout uplands.

Cenchrus sp. Croton-dayflower community of Bird Island.

Cenchrus echinatus L. Sandspur. Fish Hook, Gull, Pelican Point, Pine, and Bird Islands. Abundant throughout uplands.

Cenchrus incertus M. A. Curtis. Sandspur. Fish Hook and Pine Islands. Occasional throughout uplands.

Cenchrus longispinus (Hack.) Fern. Sandspur. Fish Hook Island. Infrequent in paspalum community.

Chloris glauca (Chapm.) Wood. Finger grass. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout uplands.

Chloris petraea Swartz. Finger grass. Fish Hook, Gull, and Pine Islands. Occasional throughout uplands.

Cynodon dactylon (L.) Pers. Bermuda grass. Gull Island. Occasional on beaches and overwashes.

Dactyloctenium aegyptium (L.) Richt. Crowfoot grass. Gull Island. Occasional in silverling community.

Digitaria sanguinalis (L.) Scop. Crabgrass. Gull Island. Infrequent in silverling community.

Eleusine indica (L.) Gaertn. Goose grass. Pine Island. Infrequent in natal grass community.

Eragrostis ciliaris (L.) R. Br. Lovegrass. Fish Hook and Bird Islands. Infrequent in paspalum and croton-dayflower communities.

Panicum sp. Panic grass. Fish Hook Island. Scarce in paspalum-silverling community.

Paspalum setaceum Michaux. Fish Hook Island. Scarce in paspalum-silverling community.

Paspalum urvillei Steud. Vasey grass. Fish Hook Island. Scarce in paspalum-silverling community.

*Paspalum vaginatum Sw. Paspalum. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout tidal zone.

Rhynchelytrum roseum (Nees) Stapf. & Hubb. Natal grass. Fish Hook, Gull, Pine, and Bird Islands. Abundant throughout uplands.

Setaria geniculata (Lam.) Beauv. Foxtail grass. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Occasional throughout uplands.

Spartina alterniflora Loisel. Smooth cordgrass. Bird Island. Scarce along edge of mangrove community.

**Spartina patens* (Ait.) Muhl. Saltmeadow cordgrass. Fish Hook, Pelican Point, Pine, and Bird Islands. Occasional on beaches and overwashes, and in marsh elder and paspalum communities.

**Sporobolus poiretii* (R. & S.) Hitchc. Smutgrass. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Abundant throughout uplands.

**Sporobolus virginicus* (L.) Kunth. Virginia dropseed. Fish Hook, Pelican Point, Pine, and Bird Islands. Abundant in mangrove, paspalum, and marsh elder communities.

Sporobolus sp. Bird Island. Scarce in croton-dayflower community.

Stenotaphrum secundatum (Walt.) Kuntze. St. Augustine grass. Sunken Island. Abundant in marsh elder and paspalum communities.

Triplasis purpurea (Walt.) Chapm. Sand grass. Pine Island. Scarce in natal grass community.

Uniola paniculata L. Sea oats. Fish Hook, Gull, Pelican Point, and Pine Islands. Occasional on beaches and overwashes.

Portulacaceae

Portulaca oleracea L. Purslane. Pine and Bird Islands. Infrequent in croton-dayflower and natal grass communities.

Portulaca pilosa L. Rose-purslane. Fish Hook, Gull, Pelican Point, Pine, Bird, and Sunken Islands. Occasional throughout uplands.

Rhizophoraceae

**Rhizophora mangle* L. Red mangrove. Fish Hook, Gull, Pelican Point, Bird, and Sunken Islands. Abundant throughout tidal zone.

Rubiaceae

Chiococca alba (L.) Hitchc. Snowberry. Bird Island. Scarce in cabbage palm community.

Richardia brasiliensis (Moq.) Gomez. Bird Island. Scarce in croton-dayflower community.

*Ricinus communis L. Castor bean. Sunken Island. Scarce in paspalum community.

Rutaceae

Citrus sp. Gull and Bird Islands. Scarce in silverling and beggartick-lantana communities.

Solanaceae

Physalis viscosa var. elliottii (Kunze) Waterfall. Ground cherry. Pine and Bird Islands. Occasional in natal grass and croton-dayflower communities.

Solanum americanum Mill. Nightshade. Pine and Bird Islands. Occasional throughout uplands.

Theaceae

*Thespesia populnea (L.) Solander ex Correa. Seaside mahoe. Pine and Sunken Islands. Scarce in mangrove community.

Ulmaceae

Celtis laevigata Willd. Sugarberry. Bird Island. Scarce in cabbage palm community.

Verbenaceae

*Lantana camara L. Shrub verbena. Fish Hook, Pine, Bird, and Sunken Islands. Abundant throughout uplands.

Lantana involucrata L. Lantana. Fish Hook Island. Scarce in paspalum-silverling community.

Lantana ovatifolia Britt. Lantana. Bird and Sunken Islands. Infrequent in lantana-cabbage palm and cabbage palm communities.

Lippia nodiflora L. Capeweed. Fish Hook, Pine, Bird, and Sunken Islands. Occasional on beaches and overwashes.

Annotated List of Birds[a]

Species	Common name	Resident Status[b]	Distribution and Utilization by Island[c]: Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island
Podiceps auritus	Horned grebe	W	f		f	f		
Pelacanus occidentalis	Brown pelican	Y	r,f,n	r,f	r,f	r,f	r,f	r,f
P. erythrorhynchos	White pelican	W	r,f	f			r	r
Fregata magnificens	Magnificent frigatebird	W					soaring	
Phalacrocorax auritus	Double-crested cormorant	Y	r,f,n	r,f	r,f	r,f	r,f	r,f
								r
Anas fulvigula	Mottled duck	Y	r,f		f		f	
A. acuta	Pintail	W	r,f	r,f			r	
A. americana	American wigeon	W	r,f	r,f				
A. clypeata	Northern shoveler	W	r,f					
A. discors	Blue-winged teal	W	r,f					
A. carolinensis	Green-winged teal	W	r,f					
Aythya valisineria	Canvasback	W		f				
A. affinis	Lesser scaup	W	r,f	r,f	r,f	r,f	r,f	r,f
Mergus serrator	Red-breasted merganser	W	r,f	r,f	r,f	r,f	r,f	r,f
Cathartes aura	Turkey vulture	Y	r,f	r,f	r,f	r,f	r,f	r,f
Coragyps atratus	Black vulture	Y	r,f	r,f				
Circus cyaneus	Marsh hawk	W					f	
Haliaeetus leucocephalus	Bald eagle	Y	f					
Pandion haliaetus	Osprey	Y	r		r	r		
Casmerodius albus	Great egret	Y	r,f,n	f	f	f		

[a] Based on Dunstan and Lewis (1974)

[b] Y = Year-round resident; W = winter resident; S = summer resident; T = transient

[c] r = resting; f = feeding; n = nesting

Annotated List of Birds (continued)

Species	Common Name	Resident Status	Distribution and Utilization by Island: Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island
Egretta thula	Snowy egret	Y	r,f,n	r,f	f		f	
Bubulcus ibis	Cattle egret	Y	r,f,n				f	f
Ardea herodias	Great blue heron	Y	r,f,n	r,f	r,f	f	f	f
Dichromanassa rufescens	Reddish egret	Y	r,f,n	f	f	f	f	
Hydranassa tricolor	Louisiana heron	Y	r,f,n	r,f,n	f			
Florida caerulea	Little blue heron	Y	r,f,n	r,f,n				
Butorides virescens	Green heron	Y	r,n					
Nycticorax nycticorax	Black-crowned night heron	Y	r,f,n	r,f,n				
Nyctanassa violacea	Yellow-crowned night heron	Y	r,f,n	r,f,n				
Mycteria americana	Wood stork	Y	r,f					
Plegadis falcinellus	Glossy ibis	Y	r,f,n	r,f,n				
Eudocimus albus	White ibis	Y	r,f	r,f,n	f	f	f	
Ajaia ajaja	Roseate spoonbill	W	r,f					
Phoenicopterus ruber	American flamingo	T	f					
Rallus longirostris	Clapper rail	Y	f		f	f		
Gallinula chloropus	Common gallinule	Y					f	
Fulica americana	American coot	W	f					
Haematopus palliatus	American oystercatcher	Y	f	r,f,n	r,f,n	r,f,n	r,f	r,f
Himantopus mexicanus	Black-necked stilt	S	f		f			
Pluvialis squatarola	Black-bellied plover	W	r,f	r,f	r,f	r,f	r,f	r,f
Charadrius semipalmatus	Semipalmated plover	W	r,f	f				
C. wilsonia	Wilson's plover	Y	r,f	f	r,f,n		f	
Limosa fedoa	Marbled godwit	W	f		r,f	r,f		
Actitis macularia	Spotted sandpiper	W	f					
Catoptrophorus semipalmatus	Willet	Y	r,f,n	r,f,n	r,f,n	r,f	r,f	r,f,n

Annotated List of Birds (continued)

Species	Common Name	Resident Status	Distribution and Utilization by Island: Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island
Tringa melanoleuca	Greater yellowlegs	W	f		f			
Tringa flavipes	Lesser yellowlegs	W	f					
Limnodromus griseus	Short-billed dowitcher	W	r,f		r,f			
L. scolopaceus	Long-billed dowitcher	W	r,f	f				
Arenaria interpres	Ruddy ternstone	W	f	f	f		f	f
Calidris canutus	Red knot	T	r,f	r,f	r,f	r,f		f
C. alpina	Dunlin	W	r,f	r,f	r,f		f	
C. alba	Sanderling	W	f	f	r,f	r,f	r,f	r,f
C. minutilla	Least sandpiper	W	r,f	r,f	r,f	r,f		
C. pusillus	Semipalmated sandpiper	W	r,f	r,f	r,f	r,f		
C. mauri	Western sandpiper	W	r,f	r,f	r,f	r,f		
Larus marinus	Great black-backed gull (rare)	T			f			
L. argentatus	Herring gull	W	r,f	r,f	r,f	r,f	r,f	r,f
L. delawarensis	Ring-billed gull	W	r,f	r,f	r,f	r,f	r,f	r,f
L. atricilla	Laughing gull	Y	r,f	r,f,n	r,f	r,f,n	r,f,n	r,f
L. philadelphia	Bonaparte's gull	W	r,f	r,f	r,f	r,f	r,f	r,f
Sterna albifrons	Least tern	S	r,f	r,f	r,f	r,f	r	r,f
S. hirundo	Common tern	T	r,f	r,f	r		r	r,f
S. fosteri	Forster's tern	W	r,f	r,f	r	r	r,f	r,f
Thalasseus sandvincensis	Sandwich tern	W	r,f	r,f	r	r	r,f	r,f
T. maximus	Royal tern	W	r,f	r,f	r	r	r,f	r,f
Hydroprogne caspia	Caspian tern	Y	r,f		r		r,f,n	r,f
Chlidonias niger	Black tern	T	r,f	r,f	r		r,f	
Rynchops niger	Black skimmer	Y	r,f	r,f	r,f			r
Zenaida macroura	Mourning dove	Y	r,f	r,f	r,f			

Annotated List of Birds (concluded)

Species	Common Name	Resident Status	Distribution and Utilization by Island: Bird Island	Sunken Island	Fish Hook Island	Gull Island	Pelican Point Island	Pine Island
Columbina passerina	Ground dove	Y	r,f,n	r,f,n	r,f,n	r,f,n	r,f,n	
Chordeiles minor	Common nighthawk	S			r,f,n			f
Megaceryle alcyon	Belted kingfisher	W	r,f	r,f	r,f	r,f	r,f	
Corvus ossifragus	Fish crow	Y	r,f,n	r,f,n	r,f	r,f,n	r,f	r,f
Mimus polyglottos	Mockingbird	Y	r,f,n	r,f,n				
Toxostoma rufum	Brown thrasher	Y	f					
Lanius ludovioianus	Loggerhead shrike	Y	f	f	f			
Dendroica discolor	Prairie warbler	Y	f,n					
Agelaius phoeniceus	Red-winged blackbird	Y	r,f,n	r,f,n	r,f,n	r,f,n	r,f,n	r,f,n
Cardinalis cardinalis	Cardinal	Y	f					
Pipilo erythropthalmus	Rufous-sided towhee	Y	f,n	r,f,n				

Appendix C: Annotated Lists of Biota of Whiskey Bay Pilot Channel, Louisiana

1. Plant species nomenclature follows that used by Gleason and Cronquist 1963* and Radford et al. 1968. Species preceded by an asterisk (*) have been collected for voucher specimens.

2. References used to compile life history information about birds were Bent 1919-1968, Lowery 1960, and Robbins et al. 1966. Information about mammals was gathered from Burt and Grossenheider 1964, Neal 1967, Roberson 1967, and Lowery 1974. Life history data on reptiles and amphibians were collected from Huheey and Stupka 1967, Leviton (1970?), Stewart 1968, Cochran and Goin 1970, and Conant 1975.

3. Avian nomenclature is based on American Ornithologists' Union (AOU) 1957 and AOU 1973. Mammalian nomenclature is based on Jones et al. 1973. Names for reptiles and amphibians are from Conant 1975.

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*Literature cited may be found at the end of the main text (pages 385-395).

Annotated List of Vascular Plant Species

Aceraceae

*Acer negundo L. Box elder. Abundant in woodlands along SR 975.

*Acer rubrum L. Red maple. Abundant canopy tree in forest along SR 975.

Anacardiaceae

*Rhus radicans L. Poison ivy. Very abundant, especially on larger trees, in all habitats except depressions along SR 975.

Apiaceae

*Hydrocotyle verticillata Thunberg. Pennywort. Infrequent in moist depressions, dominated by cypress between SR 975 and Whiskey Bay Pilot Channel.

Sanicula canadensis L. Snakeroot. Willow-cottonwood forest.

Sanicula marilandica L. Snakeroot. Occasional in willow-cottonwood forest.

Trepocarpus arethusae. Nuttall. Infrequent in deep shaded depressions near cypress sloughs.

Aquifoliaceae

*Ilex decidua Walter. Possum haw. Infrequent in low woods along SR 975.

Asclepiadaceae

Matelea decipiens (Alexander) Woodson. Roadside thickets.

Aspidiaceae

*Thelypteris normalis (C. Chr.) Moxley. Abundant on slopes of dredged material along SR 975.

Aspleniaceae

*Asplenium platyneuron (L.) Oakes. Ebony spleenwort. Infrequent on slopes of dredged material along SR 975.

Asteraceae

*Ambrosia artemisiifolia L. Ragweed. Abundant weed of roadsides and clearings along SR 975.

*Ambrosia bidentata Michaux. Southern ragweed. Abundant weed along roadsides and in clearings along SR 975.

*Ambrosia trifida L. Ragweed. Very abundant along SR 975.

*Aster vimineus Lam. Aster. Infrequent roadside weed along SR 975.

*Baccharis halimifolia L. Silverling. Occasional in clearings and along edges of woodlands by SR 975.

*Cirsium sp. Thistle. Infrequent, usually individually spaced plants on slopes of dredged material along SR 975.

*Elephantopus nudatus Gray. Elephant's foot. Infrequent in woods on slopes of dredged material along SR 975.

Erigeron sp. Daisy fleabane. Southern ragweed community.

Eupatorium album L. Southern ragweed community, roadsides, and open woods.

*Eupatorium capillifolium (Lam.) Small. Dog fennel. Abundant weed of clearings and roadsides along SR 975.

*Eupatorium coelestinum L. Ageratum. Weed of clearings along SR 975.

*Eupatorium rugosum Houttuyn. White snakeroot. Abundant throughout woods on dredged material.

*Eupatorium serotinum Michaux. Weed of clearings and roadsides along SR 975.

*Lactuca floridana (L.) Gaertner. Wild lettuce. Occasional in moist habitats, mostly in shade along SR 975.

*Mikania scandens (L.) Willd. Climbing hempweed. Infrequent in moist depressions along SR 975.

*Pluchea camphorata (L.) DC. Marsh fleabane. Moist cypress depression west of SR 975.

*Solidago altissima L. Goldenrod. Common weed of clearings along SR 975.

Solidago sp. Goldenrod. Roadsides.

Sonchus asper (L.) Hill. Spiny-leaved sow-thistle. Moist roadsides and ditches.

*Spilanthes americana var. repens (Walter) A. H. Moore. Abundant in one small area of a cypress pool west of SR 975.

*Vernonia altissima Nuttall. Ironweed. Mostly in moist areas along SR 975.

Betulaceae

Betula nigra L. River birch. On and near Whiskey Bay Pilot Channel banks.

Ostrya virginiana (Miller) K. Koch. Ironwood. Bottomlands, usually on sandy alluvium.

Bignoniaceae

*Campsis radicans (L.) Seemann. Trumpet creeper. Abundant in roadside thickets along SR 975.

Bromeliaceae

*Tillandsia usneoides L. Spanish moss. Infrequent, mostly in sweetgum trees in moist habitats along SR 975.

Caprifoliaceae

Sambucus canadensis L. Elderberry. Wet ditches and roadside thickets.

Cornaceae

*Cornus drummondii C. A. Meyer. Rough-leaved dogwood. Very abundant along roadsides and common in woods along SR 975.

Cupressaceae

*Juniperus virginiana L. Red cedar. A single tree found along SR 975.

Cyperaceae

Carex sp. Sedge. Well-drained sites, mostly in willow-cottonwood community.

Scirpus cyperinus (L.) Kunth. Ditches and cattail ponds.

Ebenaceae

*Diospyros virginiana L. Persimmon. Single small tree found along SR 975, but should be more abundant.

Euphorbiaceae

Euphorbia sp. Spurge. Roadsides and ditches.

Fabaceae

Amorpha fruticosa L. Indigo-bush. Thickets, edge of bottomland woods.

Apios americana Medicus. Groundnut. Thickets along roadsides.

*Cassia fasciculata Michaux. Partridge pea. Fairly abundant along SR 975.

Desmanthus illinoensis (Michaux) Macm. Prairie-mimosa. Roadsides.

Desmodium glabellum (Michaux) DC. Beggar lice. Southern ragweed community.

*Desmodium sp. Beggar lice. Occasional in clearings and common along SR 975.

*Neptunia lutea (Leavenw.) Benth. Frequent along edge of road and occasional in clearings along SR 975.

*Rhynchosia minima (L.) DC. Clambering vine of roadsides along SR 975.

*Sesbania exaltata (Raf.) A. W. Hill. Infrequent in clearings and along roadsides along SR 975.

Trifolium repens L. White clover. Southern ragweed community.

Vicia sp. Vetch. Roadsides.

Fagaceae

Quercus shumardii Buckl. Shumard oak. Well-drained willow-cottonwood sites.

Quercus laurifolia Michaux. Laurel oak. Roadsides, frequently along edge of depressions.

*Quercus nigra L. Water oak. Single tree along SR 975.

Quercus nuttallii Palmer. Nuttall's oak. Willow-sycamore mixed forest community.

Quercus phellos L. Willow oak. Bottomlands.

*Quercus virginiana Miller. Live oak. Infrequent along SR 975.

Hamamelidaceae

*Liquidambar styraciflua L. Sweetgum. Abundant canopy tree in woodlands along SR 975.

Hypericaceae

*Hypericum hypericoides (L.) Crantz. St. John's-wort. Infrequent in thickets and clearings in woods along SR 975.

Hypericum sp. St. John's-wort. Occasional in willow-cottonwood community.

Juglandaceae

Carya cordiformis (Wang.) K. Koch. Bitternut hickory. Infrequent in bottomlands.

Lamiaceae

*Lycopus rubellus Moench. Water horehound. Occasional in moist ditches, margins of ponds, and cypress sloughs along SR 975.

Monarda punctata L. Horsemint. Southern ragweed community.

Lauraceae

*Lindera benzoin (L.) Blume. Spicebush. Infrequent on slopes of dredged material along SR 975.

Moraceae

*Morus rubra L. Red mulberry. Single small tree found in edge of woods along SR 975.

Myricaceae

*Myrica cerifera L. Wax myrtle. Abundant tall shrub in depressions of woods along SR 975.

Oleaceae

*Fraxinus pennsylvanica Marshall. Green ash. Occasional canopy tree in woods along SR 975.

Onagraceae

Ludwigia palustris (L.) Ell. False loosestrife. Cattail ponds.

Oenothera speciosa Nuttall. Evening primrose. Roadsides and along margin of southern ragweed community.

Ophioglossaceae

Botrychium virginianum (L.) Swartz. Rattlesnake fern. Infrequent in willow-cottonwood community.

Orchidaceae

*Spiranthes ovalis Lindl. Lesser ladies tresses. Twelve plants found in deep shaded depression along SR 975.

Platanaceae

*Platanus occidentalis L. Sycamore. Abundant tree in low places along SR 975.

Poaceae

*Andropogon virginicus L. Broomsedge. Clearings and roadsides along SR 975.

Microstegium vimineum (Trinius) A. Camus. Occasional in bottomland woods.

*Oplismenus setarius (Lam) R. & S. Infrequent in small colonies in deep shade on slopes of dredged material along SR 975.

Polypodiaceae

*Polypodium polypodioides (L.) Watt. Resurrection fern. Epiphytic on live oak along SR 975.

Rhamnaceae

*Berchemia scandens (Hill) K. Koch. Rattan vine. Abundant throughout woods along SR 975.

Rosaceae

Crataegus flabellata (Bosc.) K. Koch. Hawthorn. One large shrub found in willow-sycamore mixed forest.

Rubus argutus Link. Blackberry. Very abundant along roadside.

*Rubus trivialis Michaux. Dewberry. Frequent in thickets and occasional in woods along SR 975.

Rubiaceae

*Cephalanthus occidentalis L. Buttonbush. Abundant but restricted to wet depressions, usually with bald cypress, west of SR 975.

Diodia teres Walter. Poor Joe. Occasional in southern ragweed community.

Rutaceae

*Zanthoxylum clava-herculis L. Hercules'-club. A single tree in roadside thicket along SR 975.

Salicaceae

*Populus deltoides Marshall. Cottonwood. Very abundant canopy and understory tree in forest along SR 975.

Salix interior Rowlee. Sandbar willow. Scattered but thick colonies of this willow along SR 975, mostly in full sunlight around ponds and wettest ditches.

Salix nigra Marshall. Black willow. The dominant willow of Atchafalaya bottomlands.

Scrophulariaceae

Gratiola neglecta Torrey. Hedge hyssop. Around margins of cattail ponds.

Taxodiaceae

*Taxodium distichum (L.) Richard. Bald cypress. Locally abundant around pools and floodplain depressions.

Typhaceae

Typha latifolia L. Cattail. Small ponds along SR 975.

Ulmaceae

*Celtis laevigata Willd. Sugarberry. Abundant in low places of bottomland forest along SR 975.

Ulmus americana L. American elm. Occasional in low places along SR 975.

*Ulmus rubra Muhl. Red elm. Infrequent in bottomlands.

Urticaceae

*Boehmeria cylindrica (L.) Swartz. False nettle. Infrequent around moist cypress depressions between SR 975 and Whiskey Bay Pilot Channel.

Verbenaceae

Verbena brasiliensis Vellozo. Vervain. Southern ragweed community and roadsides.

Violaceae

Viola sp. Violet. Infrequent in deep shade of willow-cottonwood community.

Vitaceae

*Ampelopsis arborea (L.) Koehne. Pepper-vine. Abundant along edges of woods, and many seedlings in deep shade of forest along SR 975.

*Ampelopsis cordata Michaux. Vine, mostly along edge of woods, SR 975.

Parthenocissus quinquefolia (L.) Planchon. Virginia creeper. Frequent vine throughout woods.

Annotated List of Birds

Aix sponsa. Wood duck.

Wood ducks are year-round residents in Louisiana and usually inhabit woodland ponds. Several pairs were flushed from temporary ponds within the willow-cottonwood and willow-sycamore community in May 1975. A portion of one breeding territory was present on one of the breeding bird census plots. Wood duck nests are usually located in old tree cavities where 10 to 15 eggs may be deposited. Food: primarily vegetable matter, such as small plants and seeds.

Cathartes aura. Turkey vulture.

Turkey vultures are year-round residents in Louisiana and are considered a forest-edge species. They were observed soaring over the southern ragweed community during each visit. Turkey vulture nests are frequently located in hollow logs. One to three eggs are laid per nest. Food: carrion.

Coragyps atratus. Black vulture.

Black vultures are year-round residents in Louisiana and are considered a forest-edge species. They were observed soaring over the southern ragweed community on each visit. Like the turkey vulture, the black vulture often nests in hollow logs. One to three eggs are laid per nest. Food: carrion.

Ictinia misisippiensis. Mississippi kite.

Mississippi kites are common summer residents in Louisiana and inhabit deciduous forests located near streams and rivers. Five adults and several immatures were observed feeding on cicadas and dragonflies in July 1974. Two active nests that were situated in cottonwood trees approximately 60 to 70 ft from the ground were located in May 1975. Portions of two breeding territories were present on the breeding bird census plots. Nests usually contain one or two eggs. Food: primarily cicadas and dragonflies; occasionally some small vertebrates are taken.

Accipiter cooperii. Cooper's hawk.

Cooper's hawks are uncommon year-round residents in Louisiana and are associated with woodlands. One individual soared over the southern ragweed community in search of prey during the May 1975 field trip. A nest of sticks is usually constructed in the crotch of a tree 25 to 30 ft from the ground; clutches contain three to six eggs. Food: birds and small mammals.

Circus cyaneus. Marsh hawk.

Marsh hawks are winter residents in Louisiana that appear during the first week of September and depart the last of April or the first of May. They are grassland inhabitants. One individual was observed hunting prey in September 1974 along SR 975 and the powerline corridor near the southern entrance to the study site. Food: Small mammals.

Buteo jamaicensis. Red-tailed hawk.

Red-tailed hawks are year-round residents in Louisiana which nest in woodlands and feed in open areas. Several individuals were seen soaring over the southern ragweed community in search of prey during the July 1974 survey. Red-tailed hawks construct large nests of twigs and sticks near the tops of tall trees. Two eggs are invariably laid per nest. Food: small mammals, reptiles, and birds.

Buteo lineatus. Red-shouldered hawk.

Red-shouldered hawks are year-round residents in Louisiana and are associated with forest edges especially along marsh and aquatic communities. Three individuals were observed on the study site in May 1975; a portion of one breeding territory was present on one of the breeding bird census plots. Nests are usually 25 to 50 ft from the ground and are located in the crotch of a tree; clutch sizes range from two to four. Food: small mammals, snakes, and frogs.

Colinus virginianus. Bobwhite.

Bobwhites are year-round residents in Louisiana and are a forest-edge species. One individual was heard on the study site in July 1974; no bobwhites were observed or heard on September 1974 and May 1975 field trips. Nests are located on the ground; 12 to 20 eggs are laid per nest. Food: seeds and insects.

Bubulcus ibis. Cattle egret.

Cattle egrets are year-round residents in Louisiana and are commonly found in grasslands. Cattle egrets were observed feeding along roadsides near the southern entrance to the study area in July and September 1974. These birds commonly nest in colonies. Food: insects and small vertebrates.

Ardea herodias. Great blue heron.

Great blue herons are year-round residents in Louisiana and prefer to inhabit marshlands. One individual was observed feeding in a pond within the southern ragweed community in May 1975. Great blue herons commonly nest in colonies; four eggs are usually laid per nest. Food: primarily fish but also frogs, snakes, and occasionally small mammals.

Butorides virescens. Green heron.

Green herons are summer residents in Louisiana, arriving the last of March and departing by mid-November. Marshlands are generally their preferred habitat. Green herons were observed on the study site in May 1975. One active nest containing three chicks was present within the willow-sycamore community on census plot C. Another was suspected in a willow-sycamore community located just beyond the border of census plot B. Lone nests are not unusual, but this species normally nests in small colonies. Food: aquatic invertebrates and fish.

Charadrius vociferus. Killdeer.

Killdeer are year-round residents in Louisiana and prefer to inhabit open, sparsely vegetated areas. This species was observed on all field trips and was most common along roadsides near the southern entrance to the study area. Nests are usually located in a shallow, sandy depression; an average of four eggs are laid per nest. Food: primarily ground insects.

Coccyzus americanus. Yellow-billed cuckoo.

Yellow-billed cuckoos are common summer residents in Louisiana, usually arriving in early April and departing in November. Woodlands are their preferred habitat. Individuals were observed on all field trips to the study area but appeared less common in September 1974 than in July 1974 and May 1975. Three breeding territories and two nests were located on the breeding bird census plots. The nests were fragile platforms of sticks and twigs and were about 10 to 15 ft above the ground. Contents were not checked but yellow-billed cuckoos normally lay two to six eggs per nest. Food: primarily caterpillars and other insects.

Otus asio. Screech owl.

Screech owls are common year-round residents in Louisiana and generally inhabit woodlands. Although screech owls were never sighted on the study area, one individual was heard during the early morning hours in May 1975. The owl is an early nester, usually laying four to six eggs in a tree cavity in March or early April. Food: primarily small rodents but also small birds, reptiles, and insects.

Strix varia. Barred owl.

Barred owls are year-round residents in Louisiana and prefer to inhabit moist deciduous woodlands. A fledgling, apparently feeding, was observed along the edge of SR 975 on the night of 9 May 1975. Individuals were also heard calling from woodlands on the southwest side of the study area during the May 1975 survey. The barred owl is an early nester, usually laying two to four eggs in a tree cavity in January or February. Food: primarily small mammals.

Chordeiles minor. Common nighthawk.

Common nighthawks are summer residents in Louisiana, first arriving in mid-April and departing by late October. This species is commonly associated with open and sparsely vegetated areas. Individuals were observed foraging over the southern ragweed community in May 1975. Nests invariably contain two eggs and are located in a slight depression on the ground surface. Food: primarily flying insects.

Chaetura pelagica. Chimney swift.

Chimney swifts are common summer residents in Louisiana which first appear during the last of March and depart the last of October. They are regarded as a forest-edge species. Swifts were observed flying and feeding over the southern ragweed community during all field visits. Natural nest sites are located in hollow trees. No swifts were recorded on the breeding bird census plots. Clutches contain three to six eggs. Food: primarily flying insects.

Archilochus colubris. Ruby-throated hummingbird.

Ruby-throated hummingbirds are summer residents in Louisiana that normally arrive in early March and depart in late October. They are a forest-edge species and were observed on the study site in May 1975. Three breeding territories were present on the breeding bird census plots. Their tiny nests are usually located on a horizontal limb that is either over or close to water; two eggs are commonly laid per nest. Food: small insects attracted to flowers and flower nectar.

Colaptes auratus. Common flicker.

Flickers are year-round residents of Louisiana and prefer to inhabit forest-edge situations. They were observed on the study site during all three surveys. A partial territory was located on the breeding bird census plots. This species uses tree cavities for nesting purposes. Clutch sizes range from six to eight. Food: primarily bark insects and ants.

Dryocopus pileatus. Pileated woodpecker.

Pileated woodpeckers are year-round residents of Louisiana and are associated with woodlands. They were observed on the study site during all field visits. A portion of one breeding territory was within one of the breeding bird census plots. Pileateds construct nesting cavities in the trunk of a dead tree; usually four to five eggs are laid per nest. Food: primarily bark insects and fruits.

Centurus carolinus. Red-bellied woodpecker.

Red-bellied woodpeckers are year-round residents in Louisiana and prefer to inhabit woodlands. They were observed along the forest edge and in the woodlands on all of the field trips. A partial territory was present on one of the May 1975 breeding bird census plots. This species may construct its own nest cavity in a dead tree or may occupy an old nest cavity constructed by another woodpecker; clutch size may range from three to eight. Food: primarily ants, beetles, and fruits.

Melanerpes erythrocephalus. Red-headed woodpecker.

Red-headed woodpeckers are year-round residents in Louisiana and prefer open deciduous forests. This species was observed along the forest edge on all visits to the study site. No breeding territories were located on the May 1975 census plots. Nest cavities are constructed in dead trees; four to seven eggs are usually laid per nest. Food: ants, wasps, beetles, and other insects and fruits.

Dendrocopos villosus. Hairy woodpecker.

Hairy woodpeckers are year-round residents in Louisiana and prefer deciduous and mixed woodlands. They were observed on all field trips and were most conspicuous along the forest edge where a number of nesting cavities were seen. A partial breeding territory was located on one of the May 1975 breeding bird census plots; clutch sizes range from three to six. Food: primarily beetles and ants.

Dendrocopos pubescens. Downy woodpecker.

Downy woodpeckers are year-round residents in Louisiana and prefer to inhabit open woodlands and forest edges. This species was observed on all field trips in the woodlands, but was more commonly observed along the forest edge. One partial territory was present on the breeding bird census area. Nest cavities are constructed in dead trees and usually harbor four to six eggs. Food: primarily ants, beetles, caterpillars, and some fruits.

Myiarchus crinitus. Great crested flycatcher.

Great crested flycatchers are summer residents in Louisiana, usually arriving the last of March and departing by mid-October. They prefer to inhabit deciduous and mixed forests. This species was observed along the forest edge during the May 1975 field trip; no breeding territories were noted on the census plots. Nests are usually constructed in a tree cavity; clutch size may range from four to eight. Food: moths, butterflies, grasshoppers, crickets, katydids, and beetles.

Empidonax virescens. Acadian flycatcher.

Acadian flycatchers are summer residents in Louisiana, normally arriving in early April and departing in October. Deciduous floodplain forests are their preferred habitat. This species was observed on the study site during the May 1975 visit. Two breeding territories were located on census plot A and both were near areas of standing water. The acadian flycatcher is the only member of the genus _Empidonax_ that breeds in Louisiana. The nest is cup-shaped and is placed between the forks of limbs, up to 20 ft from the ground; clutch sizes range from two to four. Food: primarily wasps, bees, ants, and beetles.

Hirundo rustica. Barn swallow.

Barn swallows are transients and can be seen migrating through Louisiana from mid-March through mid-May and from August through early November. They are regarded as a forest-edge species.

Barn swallows foraged over the southern ragweed community in May 1975. Food: primarily flying insects.

Progne subis. Purple martin.

Purple martins are summer residents in Louisiana, usually arriving in February and departing by October. They were observed foraging over the southern ragweed community and perching on power transmission lines during the July and September 1974 field surveys. No martins were observed during the May 1975 field trip. Natural nesting sites are tree cavities and cliff sides. Clutch sizes range from three to eight. Food: primarily flying insects.

Cyanocitta cristata. Blue jay.

Blue jays are year-round residents in Louisiana and are a forest-edge species. They were observed on all three visits to the study area. During the winter months the population of local blue jays is augmented by northern migrants. No breeding territories were located in the May 1975 breeding bird census plots. Nests are constructed at heights ranging from 10 to 20 ft. Clutches usually contain four to six eggs. Food: insects, seeds, fruits, mast, and small vertebrates.

Corvus ossifragus. Fish crow.

Fish crows are year-round residents and are usually associated with forest-edge situations located near streams, lakes, and marshes. Individuals were observed on the study area during all three visits. This species usually nests in small colonies within a woodland habitat. The nest is constructed at heights ranging from 5 to 90 ft. Clutches usually contain four to five eggs. No crows were found to be breeding on the May 1975 census plots. Food: carrion, eggs, young birds, small mammals, and fruits borne by such plants as holly, dogwood, and catbrier.

Parus carolinensis. Carolina chickadee.

Carolina chickadees are year-round residents in Louisiana and prefer to inhabit wooded areas. Individuals were seen during all visits. They were observed in family groups in May 1975, suggesting that nesting had been completed prior to the survey. Nests are constructed in tree cavities; clutches contain five to eight eggs. Food: primarily moths, caterpillers, and true bugs.

Parus bicolor. Tufted titmouse.

Tufted titmice are year-round residents and commonly inhabit deciduous forests. This species was observed on the study site during all visits. No breeding territories were located on the breeding bird census plots, but the species may have completed nesting prior to survey. Nests are usually constructed in old tree cavities that have been created by woodpeckers; clutches contain three to five eggs. Food: insects, especially caterpillars and wasps.

Thryothorus ludovicianus. Carolina wren.

Carolina wrens are year-round residents in Louisiana and prefer to inhabit the understory of woodlands. They were observed on the study site during all three surveys. Three breeding territories were located on the breeding bird census plots. This species nests in a variety of places, such as in stumps, roots, dense undergrowth, and crotches of trees; clutch sizes range from four to six. Food: mainly insects (such as beetles) and spiders, and occasionally small vertebrates such as tree frogs, lizards, and small snakes.

Mimus polyglottos. Mockingbird.

Mockingbirds are year-round residents in Louisiana and are forest-edge inhabitants. They were uncommon on the study area and were observed only during the July 1974 survey. Nests are usually constructed within dense shrubs and contain three to five eggs. The nesting period usually begins in February and may extend to August. Several broods may be raised during the nesting season. Food: insects, such as grasshoppers and beetles, and fruits.

Dumetella carolinensis. Gray catbird.

Gray catbirds are transients in the study site vicinity and are generally found in forest-edge situations. They were observed on the study area during the September 1974 and May 1975 surveys. Food: primarily ground insects and fruits (such as those of greenbrier, honeysuckle, and pokeweed).

Toxostoma rufum. Brown thrasher.

Brown thrashers are year-round residents in Louisiana that prefer to inhabit forest-edge situations. One brown thrasher was observed on the study site in September 1974. Nests may be constructed low to the ground in dense vegetation or in trees at heights up to 20 ft; clutches normally contain four to five eggs. Food: primarily insects such as beetles and caterpillars, and fruit.

Hylocichla mustelina. Wood thrush.

Wood thrushes are common summer residents that prefer to inhabit deciduous woodlands. They normally arrive the last of March and migrate southward in November. Wood thrushes were observed on the study site during all three surveys. Four breeding territories were present on the breeding bird census plots. One nest was found during the July 1974 survey and another was found in May 1975; the nest found in July contained three altricial young. Food: insects and fruit.

Polioptila caerulea. Blue-gray gnatcatcher.

Blue-gray gnatcatchers are year-round residents in southern Louisiana and prefer to inhabit woodlands. They were observed on the study site during all three surveys. No breeding territories were present on the breeding bird census plot areas. However, nesting may have been completed prior to the survey; egg laying is usually completed by mid-April. Nests may be constructed at varying heights, are quite small and difficult to find. Clutch sizes range from four to five. Food: primarily insects.

Vireo griseus. White-eyed vireo.

White-eyed vireos can be observed throughout the year in southern Louisiana, but are uncommon during the winter months. They are generally associated with woodlands and were present on the study site during all three surveys. White-eyed vireos were the most abundant breeding species on the breeding bird census plots. Nests may be located in shrubs or trees, 3 to 20 ft from the ground; clutches range from three to five. Food: primarily insects.

Vireo flavifrons. Yellow-throated vireo.

Yellow-throated vireos are summer residents in Louisiana and may be found in a variety of woodland habitats. This species normally arrives in mid-March and departs in October. Several yellow-throated vireos were observed in the woodlands during the September 1974 field trip. None were observed in July 1974 or May 1975. The majority of nests are built 20 ft or higher from the ground. Clutch sizes may range from three to five but four is the usual. Food: primarily moths and butterflies.

Vireo olivaceus. Red-eyed vireo.

Red-eyed vireos are common summer residents in Louisiana and inhabit deciduous woodlands. This species usually arrives in the last half of March, staying through the last of October. Red-eyed vireos were observed within the woodland and forest-edge communities on all field trips. Nine and one-half breeding territories were present on the breeding bird census plots. A small pensile nest hung from a fork of a tree 10 ft from the ground on census plot A. No eggs were present but this species normally lays three to four eggs per nest. Food: caterpillars and other insects.

Protonotaria citrea. Prothonotary warbler.

Prothonotary warblers are summer residents in Louisiana that arrive in mid-March and depart during the last of September. Wooded swamps are their preferred habitat. Prothonotary warblers were uncommon during the field trips in July and September 1974, but were abundant in May 1975. Thirteen and one-half breeding territories were present on the breeding bird census plots and most were near areas of standing water. Three nests were found on plot A; two were in small saplings, 10 to 15 ft above the ground and one was in a dead snag 2 ft above a pool of water One of the nests contained three eggs, one contained two eggs plus one brown-headed cowbird egg, and one contained no eggs. Food: primarily insects.

Helmitheros vermivorus. Worm-eating warbler.

Worm-eating warblers are uncommon transients that migrate through Louisiana from late March through early May. They are generally seen in woodland habitats. One individiual was observed in the willow-cottonwood community on 14 May 1975. Food: insects.

Limnothlypis swainsonii. Swainson's warbler.

Swainson's warblers are summer residents in Louisiana and prefer to inhabit wooded swamplands. This species arrives during the last of March or the first week of April and departs by late September. They were observed on the study site during the May 1975 survey. Two partial territories were present on the breeding bird census plots. Nests are usually constructed in shrubs three to five ft above the ground. Three eggs are commonly laid per nest. Food: caterpillars and other insects.

Parula americana. Northern parula.

Northern parulas are summer residents in Louisiana, arriving in late February or early March and departing by late October. They generally prefer woodlands. Northern parulas were present on the study site during all three surveys. Nine breeding territories were established on the breeding bird census plots. Nests are constructed within hanging spanish moss; clutches usually contain four to five eggs. Food: primarily insects.

Geothlypis trichas. Common yellowthroat.

Common yellowthroats are year-round residents in southern Louisiana and prefer moist thickets or shrubby areas. They were observed on the study site during each field visit. Three territories were present on the breeding bird census plots. Nests are usually a few inches from the ground. Clutch size is usually four to five. Food: primarily insects.

Icteria virens. Yellow-breasted chat.

Yellow-breasted chats are summer residents in Louisiana that arrive in mid-April and depart by October. Dense thickets are their preferred habitat. Individuals were observed on the study area during all three surveys. Twenty-two breeding territories were located within the breeding bird census plots. Three nests were found along SR 975 in July 1974. Clutches usually contain five eggs. Food: primarily insects and fruits.

Oporornis formosus. Kentucky warbler.

Kentucky warblers are summer residents in Louisiana, usually arriving in mid-March and departing by October. Habitat preference is moist deciduous forests. This species was observed in the woodlands during all field trips, but was most abundant during the July and September 1974 visits. They were observed only on the last few days of the May 1975 survey. Their cup-shaped nest is usually constructed very low to the ground; clutch size is usually four to six. Food: primarily insects and some fruits.

Wilsonia citrina. Hooded warbler.

Hooded warblers are common summer residents in Louisiana, arriving in early March and departing in October. They are woodland inhabitants. Individuals were observed on the study site during each field visit. Eight breeding territories were located on the breeding bird census plots. One nest was found on plot C in a wax myrtle. Its contents were not checked but hooded warblers commonly lay four to five eggs per nest. Food: primarily insects.

Agelaius phoeniceus. Red-winged blackbird.

Red-winged blackbirds are year-round residents in Louisiana and prefer marshlands. They were present on the study site during each visit. During the winter months, red-wings from the more northern regions augment the resident population. A partial breeding territory was located on one of the breeding bird census plots. Nests may be located in a variety of locations. Clutches contain three to five eggs. Foods: seeds and insects.

Quiscalus quiscula. Common grackle.

Grackles are year-round residents in Louisiana and prefer to inhabit forest-edge situations. This species was observed on the study site during all field trips. No grackles were noted to have breeding territories on the census plots. Nests are located in a variety of situations and may occur in small colonies or singly. Clutches normally contain four to five eggs. Food: primarily insects, such as beetles.

Molothrus ater. Brown-headed cowbird.

Brown-headed cowbirds are common year-round residents in Louisiana and prefer to inhabit forest-edge situations. This species was observed on all field trips to the study area. Nests are not constructed by the cowbird; the female lays her eggs, usually one at a time, in an active nest of a different species. Food: primarily grasshoppers, ants, wasps, flies, and caterpillars.

Icterus spurius. Orchard oriole.

Orchard orioles are summer residents in Louisiana, arriving in late March and departing in October. They are a forest-edge species and were seen on the study site during the May 1975 survey. Two breeding territories were on the breeding bird census plots. Pendulous nests are constructed at heights ranging from 3 to 70 ft. Clutch size usually ranges from four to six. Food: insect larvae, grasshoppers, beetles, and some fruit.

Piranga rubra. Summer tanager.

Summer tanagers are summer residents in Louisiana, arriving the last of March and departing by October. They are commonly found in woodland situations. A few summer tanagers were seen on the study site in May 1975. A partial breeding territory was present on one of the breeding bird census plots. Nests are usually constructed near the outer extremity of a horizontal limb at heights of 20 to 30 ft. Clutch sizes generally range from three to five. Food: primarily moths and caterpillars.

Cardinalis cardinalis. Cardinal.

Cardinals are year-round residents in Louisiana and generally prefer to inhabit woodlands in the southeast. They were observed on the study area during each visit. Seventeen and one-half breeding territories were present on the breeding bird census plots. Three nests were found in May 1975. One contained four eggs; contents in the others were not checked. Food: seeds, fruits, and insects.

Passerina cyanea. Indigo bunting.

Indigo buntings are summer residents in Louisiana and appear in large flocks from early April through the first part of May. Southward migration occurs from September through the first three weeks of October. Indigo buntings prefer to inhabit forest edges. They were observed on the study site during each visit. Eleven breeding territories were located on the breeding bird census plots. Nests are usually constructed in low bushes or trees; three to four eggs are commonly laid per nest. Food: seeds and insects.

Passerina ciris. Painted bunting.

Painted buntings are common summer residents in Louisiana which first appear in April and stay through October. This species prefers to inhabit forest-edge situations. They were seen on each visit to the study site although relative abundance appeared greater during May 1975 than in July and September 1974. Six and one-half breeding territories were present on the breeding bird census plots. Nests are cup-shaped and are constructed in a shrub or a low tree; clutches usually contain four to five eggs. Food: seeds and insects.

Pipilo erythrophthalmus. Rufous-sided towhee.

Rufous-sided towhees are year-round residents in the study site vicinity and prefer to inhabit forest-edge situations. They were present on the study site during each visit. Four and one-half breeding territories were present on the breeding bird census plots. Nests are usually constructed only a few feet off the ground; clutches contain two to six eggs. Food: seeds, fruits, and ground insects.

Annotated List of Mammals

Dasypus novemcinctus. Nine-banded armadillo.

Armadillos prefer to inhabit moist woodlands. They were common on the study site during each visit. Burrows were observed around the edges of dredged material disposal mounds. Breeding occurs in July and August; uterine implantation of embryos is usually delayed for several months. Litters, except in rare instances, consist of four young of the same sex. Food: insects, especially beetles and ants.

Sylvilagus aquaticus. Swamp rabbit.

Swamp rabbits prefer to inhabit bottomland forests. They were common in the study site's woodlands during each survey. Road-side habitats were utilized for feeding. Swamp rabbits construct grass nests in shallow depressions on the ground surface. Litter sizes range from one to six. Breeding occurs throughout the year but the peak period occurs from February to May. Food: herbaceous vegetation, especially grasses and sedges.

Sciurus carolinensis. Gray squirrel.

Gray squirrels are woodland inhabitants but are relatively uncommon on the Whiskey Bay site due to the absence of many preferred food plants. A melanistic individual was observed in the willow-sycamore community in July 1974. Leaf nests are constructed during the warmer months, while tree cavities are used during colder periods. Breeding may occur all year but peaks commonly occur from December to February and May to August. Gestation is usually 44 days and the average litter size is three. Food: mast, fungi, and fleshy fruits.

Oryzomys palustris. Marsh rice rat.

Rice rats prefer to inhabit moist grasslands. Individuals were captured in the southern ragweed community in May 1975. Females may have several litters per year; two to seven young are born per litter. Food: seeds and occasionally insects.

Reithrodontomys fulvescens. Fulvous harvest mouse.

Harvest mice are commonly found in grasslands. One individual was captured in May 1975 in a young willow thicket along the Whiskey Bay Pilot Channel. Breeding occurs from February to October; two to five young are born per litter. Food: primarily seeds.

Peromyscus leucopus. White-footed mouse.

White-footed mice commonly inhabit deciduous woodlands in Louisiana. They are the most abundant small rodent in the study site's willow-cottonwood and willow-sycamore communities. The species is most frequently found around fallen and rotting debris within these habitats. Nests are commonly constructed under logs and at the base of stumps but during flood periods may be placed in arboreal situations. Peak breeding occurs in the late fall and early winter. Litter sizes range from two to six. Food: plant seeds, roots, tubers, and occasionally insects.

Sigmodon hispidus. Hispid cotton rat.

Cotton rats are denizens of grasslands. Individuals were captured in the southern ragweed community in May 1975. Females may breed throughout the year; litter sizes range from five to seven. Food: primarily seeds but also insects and occasionally small vertebrates.

Neotoma floridana. Eastern woodrat.

Woodrats prefer to inhabit deciduous woodlands in the southeast. Three individuals were captured on the study site in May 1975. One was located around fallen debris. Woodrats construct large nests of twigs and sticks. Nests are usually located at the base of a tree or stump but may be placed in an arboreal situation during flood periods. Females may have two to three litters per year; two to four young are born per litter. Food: seeds, fleshy fruits, roots, and foliage.

Ursus americanus. Black bear.

In Louisiana, the black bear is confined to large areas of bottomland hardwood forests. Signs of black bear were observed in the willow-cottonwood community in September 1974. Numerous decaying logs were ripped open and uplifted in an apparent attempt to find insect larvae or small mammals. Black bears have been observed on the study site in the past by Louisiana Fish and Wildlife Commission personnel. Home ranges of the black bear average 13,795 acres. Hollow logs and tree cavities are utilized for denning. Females are reproductively active at three years of age and breed every alternate year. Two cubs are usually born per litter. Food: acorns, fruits, small mammals, and insects.

Procyon lotor. Raccoon.

This species inhabits woodlands, swamps, and marshes throughout Louisiana. Raccoon signs were common in the willow-sycamore and willow-cottonwood communities during each survey. Hollow trees are utilized for denning. Raccoons mate once a year, usually in December or January; two to seven young are born in May or April. Food: crawfish, fish, frogs, rodents, insects, and fleshy fruits.

Lynx rufus. Bobcat.

Bobcats are woodland inhabitants. One individual was frequently seen crossing SR 975 near the southern entrance to the study area. Bobcats breed from mid-winter to early spring; one to five young are born per litter. Food: primarily small mammals and birds.

Odocoileus virginianus. White-tailed deer.

This species occurs throughout Louisiana, inhabiting woodlands and adjacent open areas. Deer were observed on the study site during each visit, and the existing population is estimated to have a density of one individual per 15 acres. White-tailed deer normally breed from September to early December throughout most of their geographic range. However, in bottomland hardwood forests in Louisiana, the breeding period sometimes extends into late December and January. The late breeding may be an adaptive feature to allow parturition of young to occur at a more favorable time in the spring (i.e. following the recession of flood waters). Two fawns are usually born per litter though only one may be born during high population densities. Food: leaves and twigs of shrubs and trees, fungi, lichens, and mast.

Annotated List of Reptiles and Amphibians

Terrapene carolina triunguis. Three-toed box turtle.

This species typically inhabits woodland situations. Two individuals were observed in the willow-sycamore community in May 1975. Nesting occurs in late spring or early summer. Eggs are placed in a shallow depression that is subsequently covered by the female. Food: fruits, succulent vegetation, and insects.

Chrysemys scripta elegans. Red-eared turtle.

Red-eared turtles are denizens of marshes and quiet bodies of water. Individuals were observed basking around ponds along SR 975 during the July and September 1974 surveys. Nesting occurs in spring; eggs (about 10) are deposited in a shallow depression that is subsequently covered by the female. Incubation takes about 10 weeks. Food: insects, small fish, and some plant matter.

Anolis carolinensis carolinensis. Green anole.

A ubiquitous species that was common on the study site during each visit. A viable anole egg was found in the willow-cottonwood community in July 1974. Food: insects.

Leiolopisma laterale. Ground skink.

Ground skinks are woodland inhabitants. They were observed among the leaf litter in the willow-cottonwood and willow-sycamore community during each survey. Eggs are laid in a shallow depression and usually guarded by the female. Clutches contain one to five eggs. Food: insects.

Natrix sp. Water snake.

An unidentified species of water snake was observed in the willow-cottonwood community in July 1974. Water snakes prey upon fish, frogs, salamanders, and crawfish.

Thamnophis sirtalis sirtalis. Eastern garter snake.

Eastern garter snakes prefer moist woodlands but may be found in a variety of habitats. One individual was observed in the willow-cottonwood in September 1974. Eastern garter snakes are viviparous and litter sizes usually range from 13 to 18. Food: insects, frogs, lizards, and small mammals.

Opheodrys aestivus. Rough green snake.

Rough green snakes are commonly found among vines and shrubs in moist woodlands. One individual was captured in May 1975 while crossing SR 975. Females lay four to seven eggs in mid-summer. Food: primarily crickets, grasshoppers, caterpillars, and spiders.

Farancia abacura reinwardti. Western mud snake.

Mud snakes commonly inhabit bottomland hardwood forests. Two were captured in May 1975 while crossing SR 975. Females lay 15 or more eggs in damp soil and under debris in early summer. Food: salamanders and fish.

Elaphe obsoleta spiloides x *E. o. lindheimeri*. Louisiana rat snake.

The Louisiana rat snake is a hybrid of the Texas rat snake and the gray rat snake. One individual was captured in the willow-cottonwood community in July 1974 and taken to Louisiana State University for positive identification. Rat snakes are oviparous. Food: lizards, frogs, rats, mice, and small birds.

Lampropeltis getulus holbrooki. Speckled kingsnake.

Speckled kingsnakes may be found in a variety of habitats but are generally more common in woodlands in the Louisiana area. One individual was captured while crossing SR 975 in May 1975. Speckled kingsnakes are oviparous. Food: primarily other snakes.

Agkistrodon piscivorous leucostoma. Western cottonmouth.

A common denizen of swamps and marshes in Louisiana. Western cottonmouths were observed on each visit to the study area. They were most frequently seen in the willow-sycamore community, especially around pools of standing water. One to 15 young are born in August or September. Food: fish, frogs, and small mammals.

Bufo valliceps. Gulf coast toad.

Gulf coast toads inhabit a variety of habitats. They were especially common in the woodlands of Whiskey Bay. A few individuals were also present in the southern ragweed community. Strings of eggs are deposited in ponded water. Breeding likely occurs in all months of the year. Food: insects.

Hyla cinerea. Green treefrog.

Green treefrogs may be found in just about any damp or wet habitat. They are common in the woodlands on the Whiskey Bay site and were recorded during each survey. Breeding usually occurs from March to October. Eggs are laid in ponded water. Food: insects.

Hyla squirrella. Squirrel treefrog.

Squirrel treefrogs occupy the same habitats as green treefrogs but are commonly found at greater heights from the ground. They were common on the study site during each visit. Breeding usually occurs from April through August. Eggs are deposited singly in ponded water. Food: insects.

Gastrophryne carolinensis. Eastern narrow-mouthed toad.

These toads inhabit the ground surface of moist woodlands and marshlands. They were common in the willow-cottonwood and willow-sycamore communities during each field survey. Breeding occurs between May and September. Eggs float in a film on the surface of ponds. Food: primarily ants, termites, and small beetles.

Rana clamitans clamitans. Bronze frog.

Bronze frogs are commonly found along pond margins and wooded streams. They were observed around standing pools of water within the woodlands at Whiskey Bay in May 1975. Breeding occurs from April through August. Eggs are laid in ponded water. Food: insects.

Rana catesbeiana. Bullfrog.

Bullfrogs prefer larger bodies of water than most other frogs. Individuals were heard calling from a pond within the southern ragweed community during all surveys. Breeding occurs between

February and October. Permanent bodies of water are required for breeding; young may spend two winters as a tadpole. Food: insects and other frogs.

Rana utricularia. Southern leopard frog.

Leopard frogs are common in shallow-water habitats and frequently wander overland during non-breeding periods. They were observed in the woodlands and ponds during each survey. Some breeding may occur during each month of the year. Eggs are laid in ponded water. Food: insects.

Appendix D: Annotated Lists of Biota of High Island - GIWW, Texas

1. Plant species nomenclature follows that used by Correll and Johnston 1970*. Species preceded by an asterisk (*) have been collected for voucher specimens.

2. References used to compile life history information about birds were Bent 1919-1968, Robbins et al. 1966, and U. S. Department of the Interior 1969. Information about mammals was gathred from Burt and Grossenheider 1964, Davis 1966, and Lowery 1974. Life history data on reptiles and amphibians were collected from Cochran and Goin 1970, and Conant 1975.

3. Avian nomenclature is based on American Ornithologists' Union (AOU) 1957 and AOU 1973. Mammalian nomenclature is based on Jones et al. 1973. Names for reptiles and amphibians are from Conant 1975.

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*Literature cited may be found at the end of the main text (pages 385-395).

Annotated List of Vascular Plant Species

Aquifoliaceae

Ilex vomitoria Ait. Yaupon. Several individuals along ridge near waterway.

Asteraceae

Ambrosia psilostachya DC. Western ragweed. Throughout the moderately dry portions of the site. Particularly apparent in the fall.

Baccharis halimifolia L. Silverling. Common shrub in all portions of the site.

Borrichia frutescens (L.) DC. Sea oxeye. Abundant throughout the entire site.

Erigeron strigosus Willd. Fleabane. Scattered through more well-drained sections of the site.

Eupatorium serotinum Michs. Boneset. Moderately dry sections of the site. Very common.

Euthamia leptocephala (T. & G.) Green. Lower to mid portions of the sea oxeye-gulf cordgrass zone.

Gaillardia pulchella Foug. Seaside daisy. Open dry, to sparsely vegetated areas.

Gnaphalium purpureum L. Rabbit tobacco. Dry, open areas.

Helenium amarum (Raf.) Rock. Sneezeweed. Open dry areas of uplands.

Iva sp. Marsh elder. Seen largely in the northeastern sections of the site over moderately well drained soils.

Machaeranthera phyllocephala (DC.) Shinners. Camphor daisy. Abundant throughout more open portions of the site.

Pluchea purpurascens (SW.) DC. Camphor daisy. Scattered in open portions of silverling-saltmeadow cordgrass.

Solidago altissima L. Goldenrod. Most common in upper portions of silverling-saltmeadow-cordgrass, but scattered elsewhere.

Solidago sempervirens L. Goldenrod. Upper portions of silverling-saltmeadow cordgrass and along the main ridge and lumps.

Boraginaceae

*Heliotropium curassavicum L. Seaside heliotrope. Scattered throughout lower portions of the site.

Brassicaceae

Lepidium virginicum L. Pepper grass. Edges of unvegetated areas and scattered elsewhere.

Caryophyllaceae

*Spergularia marina (L.) Griseb. Saltmarsh sand spurry. Spring annual of otherwise unvegetated areas.

Convolvulaceae

Cuscuta obtusiflora H.B.K. Dodder. Parasitic vine on plants of low areas. Not common.

Cyperaceae

*Cyperus articulatus L. Scattered in thicker stands of Spartina patens.

Cyperus virens Michx. Scattered in low, grassy areas.

*Scirpus acutus Muhl. Hard-stem bulrush. Scattered in silverling-saltmeadow cordgrass.

*Scirpus americanus var. longispicatus Britt. Commonly with salt-meadow cordgrass in wet prairie-like portions of the site.

Scirpus maritimus L. Salt marsh bulrush. Typical wet prairie species of low areas.

Scirpus validus Vahl. Great bulrush. Wet soil near ephemeral ponds.

Euphorbiaceae

*Euphorbia sp. Spurge. Low herb of moderately moist areas under shrub cover, or in somewhat open situations.

Fabaceae

Acacia farnesiana (L.) Willd. Huisache. No more than three individuals along edge of waterway on ridge.

Shrankia microphylla (Sm.) Macbr. Sensitive brier. Low creeping vine of open, xeric areas.

Sesbania drummondii (Rydb.) Cory. Rattlebush. Along highest ridge. Only four or five individuals seen.

Quercus virginiana Mill. Live oak. One or two individuals along waterway on the ridge.

Gentianaceae

Sabatia arenicola Greenm. Rose-gentian. Dryer areas within open grassland.

*_Sabatia campestris_ Nutt. Rose pink. Moist to somewhat xeric soil. Usually mixed with various grasses.

Hypericaceae

Hypericum drummondii (Grev. & Hook.) T. & G. Nits-and-lice. Moderately dry soil along ridge.

Juncaceae

Juncus sp. Rush. Low areas.

Juncus effusus L. Soft rush. Scattered in low, moist areas.

Juncus tenuis Willd. Slender rush. Scattered clumps in low, open areas.

Linaceae

Linum sp. Flax. Scattered herb of low areas.

Lythraceae

Lythrum lanceolatum Ell. Loosestrife. Low open areas near pond.

Onagraceae

Oenothera sp. Evening primrose. Lower portions of ridge.

Oxalidaceae

Oxalis sp. Sourgrass. Under tamarisk and other lightly shaded situations.

Phytolaccaceae

*_Rivina humilis_ L. Pigeon-berry. Characteristic shrub-vine under a canopy of tamarisk.

Plantaginaceae

Plantago aristata Michx. Buckthorn. Open or recently burned areas.

Poaceae

Agrostis sp. Bentgrass. Dryer, open areas.

*Andropogon glomeratus (Walt.) B.S.P. Broomsedge. Common broomsedge in lower communities of the site.

*Andropogon ternarius Michx. Splitbeard bluestem. Common broomsedge of upland portions of the site.

Aristida longespica Poir. Along ridge in open dry soil.

*Aristida oligantha Michx. Prairie three-awn. Scattered or occasionally subdominant in higher-drier portions of the site.

*Distichlis spicata (L.) Greene. Saltgrass. At margins of sparsely vegetated low areas.

Eragrostis capillaris (L.) Nees. Lacegrass. Scattered in dry soils.

*Muhlenbergia capillaris (Lam.) Trin. Hair-muhly. Low tufted grass found scattered in more upland portions of the site.

Panicum sp. Panic grass. Along the dredged material ridge.

*Paspalum vaginatum SW. Paspalum. Commonly found with Distichlis spicata, and, in the vegetative state, difficult to distinguish from this species.

*Phragmites communis Trin. Common reed. Scattered dense stands in upland and lowland sections of the site.

*Poa sp. Bluegrass. Scattered in open areas.

*Polypogon monspeliensis (L.) desf. Rabbitfoot grass. Low, moist areas. Mixed with Paspalum vaginatum, saltgrass, and saltmeadow cordgrass.

Setaria glauca (L.) Beauv. Little foxtail grass. Lower areas, often mixed with other grasses. Typical in openings within common reed.

*Spartina patens (Ait.) Muhl. Saltmeadow cordgrass. Common grass dominating lower portions of the site.

Spartina spartinae (Trin.) Hitchc. Gulf cordgrass. Throughout the site.

*Sporobolus asper (Michx.) Kunth. Drop-seed. Commonly occurring along the higher, well-drained portion of the site.

Polygonaceae

*Persicaria punctata (Ell.) Small. Spotted knotweed. Saturated soil near pond.

Primulaceae

Anagallis arvensis L. Scarlet pimpernel. Creeping herb of low areas, usually in openings.

Rosaceae

Rubus sp. Under tamarisk.

Rutaceae

**Zanthoxylum clava-herculis* L. Toothache tree. Approximately 30 trees at southwestern end of the site.

Scrophulariaceae

**Bacopa monnieri* (L.) Wettst. Water-hyssop. Margins of pond at northeastern end of site.

Solanaceae

Physalis pubescens L. Downy ground cherry. Moderately xeric openings or under light shrub shade.

**Solanum americanum* Mill. Nightshade. Scattered in well-drained areas.

Tamaricaceae

**Tamarix gallica* L. Tamarisk. A line of several trees at northeast end of the site.

Verbenaceae

**Phyla incisa* Small. Texas frogfruit. Forming mats over wet soil near pond.

**Verbena* sp. Verbena. Open, dryer areas.

Annotated List of Birds

Ardea herodias. Great blue heron.

Great blue herons are year-round residents of southeastern Texas and are typically found in marshlands. A few were seen around ephemeral ponds on the High Island study site during the August and October 1974 surveys. Great blue herons commonly nest in colonies atop the highest vegetation. Egg dates are generally from April through June. Four eggs are usually laid per nest. Food: primarily fish but also frogs, snakes, and occasionally small mammals.

Eutorides virescens. Green heron.

Green herons are year-round residents along the Texas coast and are commonly found in marshlands. A few were seen around ephemeral ponds on the High Island study site during all three surveys. Green herons usually nest close to water in small colonies. Egg dates for Texas range from April through June. Four eggs are usually laid per nest. Food: aquatic invertebrates and fish.

Egretta thula. Snowy egret.

Snowy egrets are year-round residents along the Texas gulf coast and are typically found in marshlands. Individuals were seen along a drainage ditch and ephemeral ponds during all three surveys. Snowy egrets commonly nest in colonies with other herons. Egg dates for Texas are from April through June. Nests usually contain four or five eggs. Food: aquatic invertebrates, small fish, and frogs.

Hydranassa tricolor. Louiana heron.

Louisiana herons are year-round residents along the Texas coast and are usually found in marshlands. One was seen around an ephemeral pond during the October 1974 survey. Louisiana herons nest in mixed rookeries with other herons and egrets. Egg dates for Texas are from April through June. Four or five eggs are normally laid per nest. Food: aquatic invertebrates, fish, and frogs.

Colinus virginianus. Bobwhite.

Bobwhites are year-round residents in Texas and are found in forest-edge and hedgerow situations. One was heard in the silverling-salt meadow cordgrass plant association during August 1974. Bobwhites typically nest on the ground, among grass or under bushes, and usually lay 10 to 15 eggs. Egg dates for Texas are from March through August. Food: primarily seeds, grains, and some insects.

Nycticorax nycticorax. Black-crowned night heron.

Black-crowned night herons are year-round residents along the gulf coast and are commonly associated with marshlands. Two pairs were seen roosting in the study site's tamarisk trees in October and August 1974 and several were seen in tamarisk trees just beyond the study area in May 1975. Individuals were seen feeding around ephemeral ponds during all surveys. Nests are usually in trees but also in grasses. Three to five eggs are usually laid per nest. Food: fish and aquatic invertebrates.

Circus cyaneus. Marsh hawk.

Marsh hawks are winter visitants in southeastern Texas and are usually seen flying low over grasslands. Several individuals were seen hunting prey on the study area during October 1974 and May 1975. Food: small mammals, frogs, snakes, birds, and insects.

Rallus longirostris. Clapper rail.

Clapper rails are year-round residents along the gulf coast and are associated with marshlands. They were common in August and October 1974 along a large ephemeral pond at the east end of the study site. Nests are typically built on the ground among clumps of marsh grasses. Nine to 12 eggs are usually laid per nest. Food: aquatic invertebrates, fish, and plants.

Charadrius vociferus. Killdeer.

Killdeers are year-round residents in southeastern Texas and typically inhabit short grass prairies or sparsely vegetated areas.

A few were seen in unvegetated areas in August 1974. Nests are simple depressions in open ground. Four eggs are usually laid per nest. Food: insects, particularly Coleopterans, Lepidopteran caterpillars, Orthopterans, Hymenopterans, and Hemipterans.

Capella gallinago. Common snipe.

Common snipe are winter visitants throughout Texas and are typically found in marshlands. A few individuals were observed probing for food in unvegetated areas and around ephemeral ponds during the October 1974 survey. Food: earthworms, Coleopteran larvae, and snail larvae.

Himantopus mexicanus. Black-necked stilt.

Black-necked stilts are summer residents along the Texas gulf coast and usually found in marshlands. A flock of five were seen during the May 1975 survey in a large ephemeral pond at the east end of the study site. Nests are typically built of twigs on the ground. Four eggs are usually laid per nest. Food: aquatic invertebrates.

Zenaida macroura. Mourning dove.

Mourning doves are year-round residents of Texas and are usually associated with forest-edge or hedgerow situations. One pair was seen roosting in tamarisk trees during the October 1974 survey. Nests are loosely constructed platforms usually placed in trees. Egg dates for Texas range from February through September. Two eggs are usually laid per nest. Food: seeds and grains.

Coccyzus americanus. Yellow-billed cuckoo.

Yellow-billed cuckoos are summer residents in Texas and prefer forest-edge situations. Several were seen in tamarisk trees during the October 1974 and May 1975 surveys. Nests are often loosely constructed platforms placed in trees. Egg dates for Texas range from March through June. Three or four eggs are usually laid per nest. Food: insects, especially Lepidopteran caterpillars.

Tyto alba. Barn owl.

Barn owls are year-round residents along the Texas coast. One individual was seen roosting in a tamarisk tree during the May 1975 survey. Nesting locations are quite variable, ranging from hollow trees to church steeples. Five to seven eggs are commonly laid per nest. Egg dates for the southern U. S. range from March to December. Food: small mammals.

Chordeiles minor. Common nighthawk.

Common nighthawks are summer residents in Texas. They are common on the High Island study site and are nesting residents. Individuals were observed foraging over all biotic communities during the August 1974 and May 1975 surveys. Two eggs are usually laid on the bare ground. Egg dates for Texas range from April through June. Food: insects, especially Hymenopterans, Coleopterans, Orthopterans, and Dipterans.

Archilochus colubris. Ruby-throated hummingbird.

Ruby-throated hummingbirds are spring and fall transients in southeastern Texas and are usually found in forest-edge situations. They were uncommon during the August and October 1974 surveys and were seen flying over the silverling-salt meadow cordgrass and common reed plant associations. Food: insects attracted to flowers and flower nectar.

Megaceryle alcyon. Belted kingfisher.

Belted kingfishers are winter visitants along the Texas gulf coast. Several were seen during the October 1974 survey in tamarisk trees from which prey were hunted. Food: primarily small fish.

Colaptes auratus. Common flicker.

Common flickers are winter visitants to southeastern Texas and are usually found near forest-edge situations. They were seen foraging in the tamarisk and silverling-salt meadow cordgrass habitats in October 1974. Food: insects (especially Coleopterans and Hymenopterans) and fruits.

Muscivora forfic. Scissor-tailed flycatcher.

Scissor-tailed flycatchers are summer residents in Texas and are usually found in forest-edge situations. Though uncommon on the High Island study site they were observed in the tamarisk and toothache tree-silverling habitats during all surveys. None nested in the study site but one breeding pair was located near the swing bridge on TX 124. Nests are loosely constructed and placed in trees. Four to six eggs are usually laid per nest. Egg dates for Texas range from April through July. Food: insects, especially Orthopterans.

Tyrannus tyrannus. Eastern kingbird.

Eastern kingbirds are summer residents along the gulf coast of Texas and inhabit forest-edge and hedgerow situations. They were common in the study area in August 1974 and May 1975 and are a nesting resident. One nest, containing three eggs, was found in a tamarisk tree. Food: insects, especially Hymenopterans and Dipterans.

Tyrannus verticalis. Western kingbird.

Western kingbirds are spring and fall transients in southeastern Texas and usually occur in forest-edge situations. One individual was seen in the tamarisk and common reed community during the August 1974 survey. Food: insects, especially Hymenopterans and Dipterans.

Myiarchus crinitus. Great crested flycatcher.

Great crested flycatchers are spring and fall transients along the Texas gulf coast and are commonly found in woodlands. During the May 1975 survey, they were fairly common on the High Island study site in the tamarisk community. Food: insects, especially Orthopterans, Lepidopterans, Hemipterans, and Hymenopterans.

Sayornis phoebe. Eastern phoebe.

Eastern phoebes are winter visitants to southeastern Texas and are usually found in forest-edge and hedgerow situations. This species was fairly common during the October 1974 survey. Phoebes were seen perching in tamarisk, silverling-salt meadow cordgrass, and sea oxeye-gulf coast cordgrass communities. Food: insects especially Hymenopterans and Dipterans.

Contopus virens. Eastern wood pewee.

Eastern wood pewees are spring and fall transients of southeastern Texas and prefer woodlands. One individual was seen in the tamarisk community during the May 1975 survey. Food: insects, especially Dipterans and Hymenopterans.

Stelgidopteryx ruficollis. Rough-winged swallow.

Rough-winged swallows are spring and fall transients in the study area and are regarded as a forest-edge and hedgerow species. This species was common and foraged over all biotic communities during the August 1974 and May 1975 surveys. Food: insects, especially Dipterans.

Hirundo rustica. Barn swallow.

Barn swallows are spring and summer transients of eastern Texas and are regarded as a forest-edge and hedgerow species. This species was common in May 1975 and were seen foraging on insects over all communities. Food: insects, especially Hymenopterans and Dipterans.

Iridoprocne bicolor. Tree swallow.

Tree swallows are spring and fall transients throughout Texas and are regarded as a forest-edge and hedgerow species. This species was common during the August and October 1974 surveys and foraged for insects over all biotic communities. Food: insects (especially Dipterans) and fruits.

Troglodytes aedon. House wren.

House wrens are spring and fall transients in the study area and inhabit forest-edge and hedgerow situations. Small groups of these birds were observed foraging in the silverling-salt meadow cordgrass and common reed communities on the High Island study site during October 1974. Food: insects, especially Orthopterans and Coleopterans.

Mimus polyglottos. Mockingbird.

Mockingbirds are year-round residents of southeastern Texas and are typically found in forest-edge and hedgerow situations. One individual was seen on the High Island study site during October 1974. Nests are usually built low in trees. Egg dates for Texas range from March through August. Four or five eggs are normally laid per nest. Food: insects (especially Coleopterans and Orthopterans) and fruits.

Dumetella carolinensis. Gray catbird.

Gray catbirds are spring and fall transients in the study area and prefer forest-edge and hedgerow situations. A few individuals were seen foraging in the tamarisk, sea oxeye-gulf cordgrass and silverling-salt meadow cordgrass communities in October 1974 and May 1975. Food: fruits and insects (particularly Hymenopterans, Coleopterans, Lepidopteran caterpillars, and Orthopterans).

Toxostoma rufum. Brown thrasher.

Brown thrashers are winter visitants along the Texas gulf coast and are usually found in forest-edge situations. This species was fairly common on the study site in October 1974 and was observed foraging in the tamarisk, silverling-salt meadow cordgrass, and common reed communities. Food: insects, fruits, and mast.

Catharus guttatus. Hermit thrush.

Hermit thrushes are winter visitants throughout Texas and are associated with woodlands. A few individuals were present in May 1975 and were seen only in the tamarisk community. Food: insects (especially Coleopterans and Hymenopterans) and fleshy fruits.

Catharus ustulatus. Swainson's thrush.

Swainson's thrushes are spring and fall transients throughout Texas and are typically found in woodlands. A few individuals were seen in May 1975 in the tamarisk community. Food: insects (especially Hymenopterans) and fleshy fruits.

Polioptila caerulea. Blue-gray gnatcatcher.

Blue-gray gnatcatchers are winter visitants to southeastern Texas and prefer woodlands. This species was fairly common on the High Island study site during the October 1974 survey and was observed foraging in the tamarisk and silverling-salt meadow cordgrass communities. Food: insects, particularly Hymenopterans and Dipterans.

Regulus calendula. Ruby-crowned kinglet.

Ruby-crowned kinglets are winter visitants to Texas and are usually found in woodlands. One individual was observed in the tamarisk community during May 1975. Food: insects, especially Hymenopterans, scale insects, and aphids.

Bombycilla cedrorum. Cedar waxwing.

Cedar waxwings are winter visitants to Texas and are usually seen in forest-edge and hedgerow situations. A small flock of this species was observed in the silverling-salt meadow cordgrass community during May 1975. Food: berries and insects.

Lanius ludovicianus. Loggerhead shrike.

Loggerhead shrikes are year-round residents in Texas and commonly inhabit forest-edge and hedgerow situations. This species was uncommon on the High Island study site and was observed during the October 1974 survey. Nests are built in trees with dense foliage. Egg dates for Texas range from March to June. Four or five eggs are usually laid per nest. Food: insects, small birds, reptiles, and spiders.

Vireo olivaceus. Red-eyed vireo.

Red-eyed vireos are spring and fall transients in the study area and are typically associated with woodlands. A few individuals were seen foraging among tamarisk trees during May 1975. Food: caterpillars and other insects.

Vireo philadelphicus. Philadelphia vireo.

Philadelphia vireos are spring and fall transients of southeastern Texas and prefer forest-edge and hedgerow situations. This species was uncommon on the High Island study site during the October 1974 and May 1975 surveys. Food: insects, especially Lepidopteran caterpillars, Coleopterans, Hymenopterans, and Dipterans.

Mniotilta varia. Black and white warbler.

Black and white warblers are spring and fall transients in the study area and are typically found in woodlands. One individual was seen in the tamarisk community on the High Island site during May 1975. Food: insects, especially Coleopterans, Lepidopteran caterpillars, and Hymenopterans.

Protonotaria citrea. Prothonotary warbler.

Prothonotary warblers are spring and fall transients in the study area and prefer woodlands. Five individuals were seen on the High Island study site during May 1975. One was in the tamarisk community and four were in the silverling-salt meadow cordgrass community. Food: insects, particularly Hymenopterans and Coleopterans.

Dendroica petechia. Yellow warbler.

Yellow warblers are spring and fall transients along the Texas gulf coast and are usually found in forest-edge situations. This species was fairly common in the tamarisk and silverling-salt meadow cordgrass communities on the High Island study site in October 1974 and May 1975. Food: primarily insects, especially Lepidopteran caterpillars.

Dendroica magnolia. Magnolia warbler.

Magnolia warblers are spring and fall transients along the gulf coast of Texas and typically inhabit woodlands. This species was fairly common in tamarisk and silverling-salt meadow cordgrass communities in May 1975. Food: insects, especially Coleopterans, and Dipteran larvae.

Dendroica coronata. Yellow-rumped warbler.

Yellow-rumped warblers are winter visitants to southeastern Texas and are usually found in forest-edge and hedgerow situations. This species was common in tamarisk, sea oxeye-gulf cordgrass, silverling-salt meadow cordgrass, common reed, and toothache tree-silverling communities in October 1974. Food: insects and fleshy fruits.

Dendroica _dominica_. Yellow-throated warbler.

Yellow-throated warblers are spring and fall transients in the study area and are usually associated with woodlands. This species was fairly common in the tamarisk and silverling-salt meadow cordgrass communities in May 1975. Food: insects, especially Coleopterans and Lepidopteran larvae.

Dendroica _pensylvanica_. Chestnut-sided warbler.

Chestnut-sided warblers are spring and fall transients of eastern Texas and are commonly found in forest-edge and hedgerow situations. Two individuals utilized the tamarisk, sea oxeye-gulf cordgrass, and silverling-salt meadow cordgrass communities for feeding purposes in May 1975. Food: insects, especially Lepidopteran larvae and Hymenopterans.

Dendroica _castanea_. Bay-breasted warbler.

Bay-breasted warblers are spring and fall transients of eastern Texas and are frequently found in woodlands. This species was common on the High Island study site during May 1975, and individuals were seen foraging in tamarisk trees and dense stands of silverlings. Food: insects, especially Lepidopteran larvae, Hymenopterans, and Coleopterans.

Geothlypis _trichas_. Common yellowthroat.

Common yellowthroats are year-round residents of southeastern Texas and prefer forest-edge and hedgerow situations. This species was common on the High Island study site in October 1974 and May 1975, but less common in August 1974. They are a breeding resident. Nests are built in low vegetation near wet situations. Egg dates range generally from April through July. Four eggs are usually laid per nest. Food: insects, particularly Orthopterans and Hymenopterans.

Setophaga _ruticilla_. American redstart.

American redstarts are spring and fall transients in Texas and are commonly found in woodlands. One individual was observed in the tamarisk community in May 1975. Food: insects, especially Lepidopteran caterpillars and Dipterans.

Sturnella magna. Eastern meadowlark.

Eastern meadowlarks are year-round residents throughout Texas and are grassland inhabitants. This species was a breeding resident on the study site in May 1975. Nests are usually constructed on the ground with surrounding grasses pulled together as a dome over the nests. Egg dates for Texas range from April through May. Five eggs are most common per nest. Food: insects (particularly Lepidopteran caterpillars, Coleopterans, and Orthopterans), and seeds (particularly grasses).

Agelaius phoeniceus. Red-winged blackbird.

Red-winged blackbirds are year-round residents throughout Texas and are commonly associated with marshlands. This species was abundant on the study site during each visit and was the most abundant nesting resident. Tamarisk trees were used for communal roosting in October 1974. Numerous nests were found in silverling bushes. Four eggs are usually laid per nest. Food: seeds (especially those of grasses) and insects.

Icterus spurius. Orchard oriole.

Orchard orioles are summer residents in eastern Texas and typically inhabit forest-edge and hedgerow situations. Two breeding pairs were present on the study site in May 1975; one was located in the breeding bird census area. One nest, constructed of salt meadow cordgrass, was found in a silverling bush. Its contents were not checked, but clutches usually contain four or five eggs. Food: insects (especially Orthopterans and Coleopterans) and fruit.

Cassidix mexicanus. Great-tailed grackle.

Great-tailed grackles are year-round residents along the Texas coast and are usually found in forest-edge and hedgerow situations. This species was common during all three surveys. In October 1974 great-tailed grackles were observed roosting in mixed colonies with red-winged blackbirds in tamarisk trees. Nests are deep basket-shaped constructions usually built in low vegetation near wet situations. Three to five eggs are usually laid per nest.

Food: generally a grain eater in fall and winter and a flesh eater the rest of the year; Orthopterans, Coleopterans, aquatic invertebrates, fish, and frogs.

Quiscalus quiscula. Common grackle.

Common grackles are winter visitants to southeastern Texas and are usually found in the forest-edge or hedgerow situations. This species was common in October 1974 and was observed in all but one biotic community. Food: primarily insects (especially Coleopterans).

Molothrus ater. Brown-headed cowbird.

Brown-headed cowbirds are year-round residents throughout Texas and are usually found in forest-edge and hedgerow situations. This species was a common breeding resident on High Island during May 1975. Female cowbirds lay their eggs in nests of other avian species; red-winged blackbird nests on the High Island site were frequently parasitized by this species. Each female lays four or five eggs. Egg laying coincides greatly with the range of egg dates for those species that cowbirds parasitize. Food: insects (especially Hymenopterans, Hemipterans, Dipterans, and Coleopterans), seeds, and grain.

Piranga olivacea. Scarlet tanager.

Scarlet tanagers are spring and fall transients in eastern Texas and are usually found in woodlands. Two individuals of this species were seen in tamarisk trees in May 1975. Food: insects, especially Lepidopterans and Coleopterans.

Piranga rubra. Summer tanager.

Summer tanagers are spring and fall transients in the study area and prefer woodlands. One individual of this species was seen in the silverling-salt meadow cordgrass community in May 1975. Food: primarily moths and caterpillars.

Cardinalis cardinalis. Cardinal.

Cardinals are spring and fall transients of southeastern Texas and are usually found in forest-edge and hedgerow situations. Cardinals were uncommon on the High Island site during August

1974 and May 1975 surveys. Food: seeds and fleshy fruits.

Pheucticus ludovicianus. Rose-breasted grosbeak.

Rose-breasted grosbeaks are spring and fall transients in eastern Texas and are usually found in forest-edge and hedgerow situations. This species was common in the tamarisk and silverling-salt meadow cordgrass communities in May 1975. Food: grains, fruits, and insects (particularly Hymenopterans, Coleopterans, and Dipterans).

Passerculus sandwichensis. Savannah sparrow.

Savannah sparrows are winter visitants throughout Texas and are associated with grasslands. This species was common in the sea oxeye-gulf coast cordgrass and silverling-salt meadow cordgrass communities in October 1974. Food: seeds and insects.

Melospiza melodia. Song sparrow.

Song sparrows are winter visitants throughout Texas and inhabit forest-edge and hedgerow situations. This species was common in the sea oxeye-gulf coast cordgrass, silverling-salt meadow cordgrass, and common reed communities in October 1974. Food: seeds (especially those of grasses) and insects.

Annotated List of Mammals

Dasypus novemcinctus. Nine-banded armadillo.

Armadillos prefer moist woodlands. Burrows of this species were observed in the tamarisk and common reed biotic communities. Diggings for food were observed in unvegetated areas and in the sea oxeye-gulf coast cordgrass, toothache tree-silverling, and silverling-salt meadow cordgrass habitats. Breeding occurs in July and August; usually four young of the same sex are born per litter. Food: insects, especially beetles and ants.

Sylvilagus spp. Rabbits.

Rabbits were abundant on the study site during all field surveys. Positive identification was not determined, but it is probable that both the eastern cottontail (*S. floridanus*) and swamp rabbit (*S. aquaticus*) are present as both are abundant in the surrounding vicinity. Both species may breed throughout most of the year. Females of both species may have several litters per year. Litter sizes of eastern cottontails range from one to eight and of swamp rabbits from one to five. Food: primarily grasses and seeds for both species.

Oryzomys palustris. Marsh rice rat.

Rice rats prefer moist grasslands and are common in the study site's silverling-salt meadow cordgrass and common reed communities. Females may have several litters per year; two to seven young are born per litter. Food: seeds and occasionally insects.

Sigmodon hispidus. Hispid cotton rat.

A grassland inhabitant and extremely abundant in the study site's silverling-salt meadow cordgrass and sea oxeye-gulf coast cordgrass communities. Most cotton rats captured in May 1975 were infested with fleas. Cotton rats were reproductively active during the May 1975 survey. Females may have several litters per year; litter sizes usually range from five to seven. Food: primarily seeds but also insects and occasionally small vertebrates.

Reithrodontomys fulvescens. Fulvous-harvest mouse.

Harvest mice are commonly found in grasslands. Several individuals were captured on the study site in May 1975. Breeding occurs from February to October; two to five young are born per litter. Food: primarily seeds.

Ondatra zibethicus. Muskrat.

A common denizen of coastal marshes. One skull of this species was found October 1974 along the drainage ditch that bisects the study site. Muskrats may breed throughout the year. Breeding females may produce two or more litters a year with litter sizes averaging about six. Food: aquatic and marsh vegetation but also clams, frogs, and fish on occasion.

Rattus rattus. Black rat.

A ubiquitous species. One individual was trapped in the project's tamarisk biotic community in October 1974. They may breed throughout the year but peaks usually occur in February, March, May, and June. An average of seven young are born per litter. Food: vegetal matter.

Myocastor coypus. Nutria.

An inhabitant of marshes and swamps. One nutria skull was found in the silverling-salt meadow cordgrass community in October 1974. Nutria may breed throughout the year. Females produce two to three litters per year; an average of five young are born per litter. Food: consists of aquatic and marsh vegetation and is often carried to a feeding station.

Canis latrans. Coyote.

Coyotes inhabit a variety of habitats but are most common in prairies. Scats and tracks were observed on the study site during each visit. An active den was found in May 1975. Coyotes breed from January to mid-May; young are born from April to June. Coyotes are opportunistic and feed on almost anything animal or vegetable; small rodents and rabbits are mainstays, however.

Canis rufus. Red wolf.

An endangered species that is almost entirely restricted to the coastal prairies along the Texas gulf coast. Tracks and an active den were observed on the study site in May 1975. Red wolves breed in January and February; pups are born in March and April. Food: nutria, rabbits, rice rats, cotton rats, and muskrats.

Procyon lotor. Raccoon.

Raccoons commonly feed along aquatic situations and den in tree cavities. Tracks of this species were observed in an unvegetated area in October 1974. Breeding usually occurs in December or January; two to seven young are born in May or April. Raccoons are omnivorous. Animal food includes large insects and almost any small vertebrate. Plant food consists primarily of mast and berries.

Annotated List of Reptiles and Amphibans

Phrynosoma cornutum. Texas horned lizard.

A diurnal lizard typical of flat, open terrain. They were frequently observed sunning in unvegetated and sparsely vegetated areas around the edges of dredged material mounds during each survey. Texas horned lizards have the startling ability to spurt blood from the eyes, which is used to scare off would-be predators. Food: insects (especially ants) and spiders.

Thamnophis sirtalis sirtalis. Eastern garter snake.

Eastern garter snakes prefer moist habitats but may be found in a variety of situations. One individual was observed in the silverling-salt meadow cordgrass community in August 1974. These snakes are viviparous and litter sizes usually range from 13 to 18. Food: on High Island probably includes frogs, toads, small mammals, and birds.

Thamnophis proximus orarius. Gulf coast ribbon snake.

These serpents are commonly found in grasslands and shrublands located near water. They were common on the study site in May 1975. Adept at climbing bushes, they may commonly raid the nests of red-winged blackbird, orchard oriole, and other avian species found within these habitats. Other prey items likely include amphibians and small rodents. Young (4 to 27) are usually born in July and August, although several were seen on the study site in May.

Natrix fasciata clarki. Gulf salt marsh snake.

A snake commonly found in coastal prairies and marshes. One individual was captured in the sea oxeye-gulf coast cordgrass community in May 1975. Food: frogs, fish, and crawfish.

Agkistrodon piscivorus leucostoma. Western cottonmouth.

A common denizen of swamps and marshes, western cottonmouths were common on the study site during each field survey. They were fond of sunning in open, bare areas and frequently took refuge beneath clumps of gulf cordgrass when disturbed. One to 15 young are born in August or September. Food: fish, frogs, and small mammals.

Turtles.

Numerous turtle nests and eggshells were found on the High Island site in May 1975. Some of these were probably uncovered by predators.

Bufo valliceps. Gulf coast toad.

Gulf coast toads inhabit a variety of habitats. They were present in all communities on the High Island site but appeared most abundant in unvegetated and sparsely vegetated areas within the sea oxeye-gulf coast cordgrass community. Strings of eggs are deposited in ponded water. Breeding likely occurs in all months of the year. Food: insects.

Gastrophryne carolinensis. Eastern narrow-mouthed toad.

These toads commonly inhabit the ground surface of moist woodlands and marshlands. They were abundant in the wetter portions of the silverling-salt meadow cordgrass community. Ephemeral ponds and the centrally located drainage ditch are utilized for egg deposition and larval development. Breeding occurs from May to September. Food: primarily ants, termites, and small beetles.

Hyla cinerea. Green treefrog.

Green treefrogs may be found in just about any damp or wet habitat. One individual was observed in a silverling bush in October 1974. Breeding usually occurs from April through August. Eggs are deposited singly in ponded water. Food: insects.

Rana utricularia. Southern leopard frog.

Leopard frogs are common in shallow-water habitats and are capable of tolerating more brackish conditions than other frogs. Leopard frogs frequently wander into upland habitats during non-breeding periods. They were observed in ephemeral ponds, drainage ditchs, unvegetated and silverling-salt meadow cordgrass habitats during the field surveys. Several were also seen along the banks of the GIWW. Some breeding may occur during each month of the year. Food: insects.

Appendix E: Annotated Lists of Biota of Mott Island, Oregon

1. Plant species nomenclature follows that used by Hitchcock and Cronquist 1973*. Species preceded by an asterisk (*) have been collected for voucher specimens.

2. References used to compile life history information about birds were Gabrielson and Jewett 1940, Bent 1919-1968, and Robbins et al. 1966. Information about mammals was gathered from Ingles 1965, Burt and Grossenheider 1964, and Lowery 1974. Life history data on reptiles and amphibians were collected from Stebbins 1966 and Stewart 1968.

3. Avian nomenclature is based on American Ornithologists' Union (AOU) 1957 and AOU 1973. Mammalian nomenclature is based on Jones et al. 1973. Names for reptiles and amphibians are from Stebbins 1966.

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*Literature cited may be found at the end of the main text (pages 385-395).

Annotated List of Vascular Plant Species

Alismataceae

Alisma plantago-aquatica L. Waterplantain. Marsh.

Apiaceae

Heracleum lanatum Michx. Cow-parsnip. Large, characteristic herb of the alder-cottonwood community.

Lilaeopsis occidentalis Coult. & Rose. Lilaeopsis. Marsh.

Sium suave Walt. Water-parsnip. Marsh.

Araceae

Lysichitum americanum Hulten & St. John. Skunk cabbage. Marsh, willow fringe, and lower edges of alder-cottonwood.

Asteraceae

Achillea millefolium L. Common yarrow. Scattered in moister portions of scotchbroom and beachgrass-hairgrass communities.

Agoseris heterophylla (Nutt.) Greene. False dandelion. Scotchbroom community.

**Anaphalis margaritacea* (L.) B. & H. Pearly-everlasting. Dry sands of beachgrass-hairgrass community.

Cirsium sp. Thistle. Common in scotchbroom community and occasional in woodland openings.

Crepis capillaris (L.) Walls. Hawksbeard. Open dry areas.

Erigeron sp. Daisy. Scotchbroom community.

Grindelia integrifolia var. *macrophylla* (Greene) Cronq. Resinweed. Marsh.

Senecio jacobaea L. Tansey ragwort. Common herb of open areas in dryer soil.

Balsaminaceae

Impatiens capensis Meerb. Jewelweed. Important herb of willow fringe, alder-cottonwood, and scattered elsewhere in lower areas.

Betulaceae

**Alnus rubra* Bong. Red alder. Dominant in alder-cottonwood and scattered in willow fringe.

Boraginaceae

Myosotis laxa Lahm. Forget-me-not. Minor herb or more open areas in willow fringe. Common in marsh.

Callitrichaceae

Callitriche fassettii Schotsman. Water-starwort. Marsh.

Caprifoliaceae

Sambucus racemosa L. Elderberry. Common understory shrub in alder-cottonwood.

Viburnum sp. Viburnum. Scattered in the shore pine community.

Caryophyllaceae

Cerastium vulgatum L. Mouse-ear chickweed. Scotchbroom.

Montia sibirica (L.) Howell. Candyflower. Occasional in alder-cottonwood.

Stellaria calycantha (Ledeb.) Bong. Northern silene. Scotch-broom community.

Cyperaceae

Carex lyngbyei Hornem. Lyngby's sedge. Dominant of upper marsh and outer edges of willow fringe.

*Carex obnupta Bailey. Slough sedge. Common in woodland openings.

Carex phyllomanica W. Boott. Coastal stellate sedge. Marsh.

Eleocharis palustris (L.) R. & S. Creeping spike-rush. Marsh.

Scirpus cyperinus (L.). Kunth. Wool-grass. Marsh.

Scirpus olneyi Gray. Oleny's bulrush. Marsh.

Scirpus validus Vahl. Bulrush. Marsh.

Equisetaceae

*Equisetum hyemale L. Scouring rush. Common perennial herb of alder-cottonwood and shore pine communities.

Equisetum telmateia Ehrh. Scouring rush. Common in lower communities; scattered in scotchbroom and beachgrass-hairgrass.

Fabaceae

*Cytisus scoparius (L.) Link. Scotchbroom. Planted and now an established dominant of the scotchbroom community. Scattered depauperate stems in woodlands.

Lathyrus palustris L. Marsh pea. Marsh.

Lotus corniculatus L. Birdsfoot-trefoil. Unshaded edges of willow fringe and marsh.

Trifolium hybridum L. Alsike clover. Marsh.

Trifolium repens L. Dutch clover. Marsh and moist edges of woodlands.

Trifolium wormskjoldii Lehm. Springbank clover. Marsh.

Vicia sativa L. Common vetch. Lower, moist communities.

Grossulariaceae

Ribes sanguineum Pursh. Red currant. Scattered in willow fringe.

Juncaceae

*Juncus bufonius L. Toad rush. Low depressions near margins of beachgrass-hairgrass community.

Juncus sp. Rush. Unknown species scattered in willow fringe.

Lamiaceae

Glecoma hederacea L. Creeping Charlie. Minor groundcover herb of the willow fringe.

Oleaceae

Fraxinus latifolia Benth. Ash. Scattered in wet portions of willow fringe.

Orchidaceae

Habenaria dilatata (Pursh) Hook. Bog candle. Marsh.

Pinaceae

*Picea sitchensis (Bong.) Carr. Sitka spruce. Scattered immature individuals.

*Pinus contorta Dougl. Shore pine. Plantation.

*Tsuga heterophylla (Raf.) Sarg. Western hemlock. A very few scattered immature individuals in alder-cottonwood.

Poaceae

*Agrostis sp. Bentgrass. Common grass of open areas in shore pine.

Agrostis exarata ssp. minor (Hook.) Hitchc. Bentgrass. Low area near margin of beachgrass-hairgrass community.

*Aira elegans Willd. Hairgrass. Important grass of both beachgrass-hairgrass and scotchbroom communities.

*Aira praecox L. Hairgrass. Important grass of open areas in scotchbroom and throughout the beachgrass-hairgrass communities.

*Ammophila arenaria (L.) Link. Beachgrass. Planted and once dominant over much of the island. Dominant of beachgrass-hairgrass community.

*Calamagrostis sp. Open sandy soil.

Deschampsia caespitosa (L.) Beauv. Tufted hairgrass. Low areas at margins of beachgrass-hairgrass community.

Festuca bromoides L. Fescue. Common under scotchbroom and scattered in the shore pine community.

*Holcus lanatus L. Velvet-grass. An abundant herb in unshaded areas.

*Phalaris arundinacea L. Canarygrass. Common to important grass in all lower communities.

Poa sp. Bluegrass. Dominant herb of the alder-cottonwood community.

Polygonaceae

Polygonum sp. Knotweed. Marsh.

Polygonum persicaria L. Heartweed. Marsh.

Rumex sp. Open areas and under edges of scotchbroom thickets.

Rumex acetosella L. Sheep sorrel. Edges of scotchbroom and beachgrass-hairgrass communities.

Polypodiaceae

*Athyrium felix-femina (L.) Roth. Lady fern. Woodlands.

Dryopteris austriaca (Jacq.) Woynar. Mountain wood-fern. Shore pine community.

*Polystichum munitum (Kaulf.) Presl. Sword-fern. Largely a fern of conifer forests; found in association with shore pine on Mott Island.

Ranunculaceae

Caltha biflora DC. Marsh marigold. Marsh.

Ranunculus repens L. Creeping buttercup. Open to somwhat shaded areas in shore pine and alder-cottonwood.

Ranunculus sceleratus L. Buttercup. Marsh.

Rosaceae

Potentilla pacifica Howell. Pacific silverweed. Alder-cottonwood and marsh.

Rubus laciniatus Willd. Evergreen blackberry. Woodland openings, particularly in alder-cottonwood.

Rubus spectabilis Pursh. Salmonberry. Common perennial herb in forest openings and edges.

Rubus ursinus Cham. Schlecht. Woodlands.

Rubiaceae

Galium trifidum L. Small bedstraw. Shaded portions of willow fringe and alder-cottonwood community.

Salicaceae

*Populus trichocarpa T. & G. Black cottonwood. Sub-dominant of the alder-cottonwood community and scattered elsewhere; sometimes forming a monotypic canopy.

*Salix hookeriana Barratt. West coast willow. Scattered in upland and tidal shrub thickets and edges of open areas.

*Salix lasiandra Benth. Pacific willow. Dominant in willow fringe or clones in upper marsh.

Scrophulariaceae

Digitalis purpurea L. Foxglove. Several individuals seen in scotchbroom community.

Mimulus guttatus DC. Monkey-flower. Marsh.

Parentucellia viscosa (L.) Car. Yellow parentucellia. Low areas near edge of beachgrass-hairgrass community.

Veronica americana Schwein. American brooklime. Marsh.

Solanaceae

Solanum dulcamara L. Felonwort. Uncommon herb in Mott Island communities. Several stands on rip-rap jetty.

Annotated List of Birds

Anas platyrhynchos. Mallard.

Mallards are year-round residents in western Oregon and inhabit marshlands and aquatic communities. The species utilizes the study site for nesting purposes. One nest with four eggs was found in the willow fringe community in June 1975. A second nest, also seen in the willow fringe zone in June, appeared destroyed, possibly by crows that were nesting nearby. Food: aquatic plant seeds and aquatic insects.

Buteo jamaicensis. Red-tailed hawk.

Red-tailed hawks are year-round residents in western Oregon and typically are forest-edge inhabitants. They are uncommon on Mott Island. Two individuals were observed on the study site during the October 1974 census; one individual was perched atop a tree in the scotchbroom-alder-cottonwood ecotone and the other was circling over the scotchbroom and beachgrass-hairgrass habitats in search of prey. No individuals were observed on the site in July 1974 or June 1975. No nests of this species were found on the island. These birds usually nest from mid-March to mid-June in Oregon; two to three eggs are laid per nest. Food: primarily rodents.

Phasianus colchicus. Ring-necked pheasant.

Pheasants are fairly common year-round residents on Mott Island. They generally prefer to inhabit grasslands and hedgerow habitats. Several individuals were observed in the study site's beachgrass-hairgrass and scotchbroom communities and scotchbroom-alder-cottonwood ecotone during the three field surveys. One individual was also observed in the willow fringe in June 1975. The species nests on the study site and two breeding pairs were present on the breeding bird census plot; 10 to 12 eggs are laid per nest. Ring-necked pheasants are an introduced species and have been regularly stocked in recent years by the Oregon Game Commission. They have not been stocked on Mott Island (Personal communication, 23 July 1975, J. E. Shelver, Field Office Manager, Navigation Division of the Portland District Corps of Engineers, Astoria, Oregon). Food: seeds, berries, and insects.

Capello gallinago. Common snipe.

Snipe are year-round residents in western Oregon and generally prefer to inhabit moist grasslands. Two individuals were observed probing for food in the beachgrass-hairgrass community on Mott Island during October 1974. None were seen on the site in July 1974 or during the June 1975 breeding bird survey. Nestings in Oregon have been recorded in May; usually four eggs are laid per nest. Marshlands are preferred for nesting. Food: earthworms, Coleopteran larvae, and snail larvae.

Owl

Pellets from a large owl were found in the shore pine community during the October 1974 survey. Pellets contained skeletal remains of Microtus townsendii and Scapanus sp.

Glaucidium gnoma. Pygmy owl.

Pygmy owls are year-round residents in western Oregon and characteristically inhabit coniferous forests. These birds are relatively uncommon on Mott Island. A portion of one breeding territory was located in the shore pine community. Nests of this species are often located in abandoned woodpecker holes and usually four eggs are laid per nest. Food: small vertebrates and insects.

Selasphorus rufus. Rufous hummingbird.

Rufous hummingbirds generally prefer to inhabit forest-edge communities. They are a summer breeding resident on Mott Island but are not especially common. One breeding pair was located on the breeding bird census plot in the alder-cottonwood community. Another breeding pair was observed near the breeding bird census plot in the scotchbroom-alder-cottonwood edge. Most nesting in Oregon occurs in May; two eggs are laid per nest. Food: insects attracted to flowers and flower nectar.

Megaceryle alcyon. Belted kingfisher.

Kingfishers are fairly common year-round residents in western

Oregon but are relatively uncommon on Mott Island. Individuals were observed perching in cottonwood trees along ephemeral ponds and a tide-affected ditch during all three surveys. Kingfishers nest in burrows located in perpendicular stream banks. Such nesting habitat is not present on Mott Island and thus the species is not believed to be a breeding resident. Nesting in Oregon occurs from mid-May through June; clutch sizes range from five to eight. Food: primarily small fish.

Colaptes auratus. Common flicker.

Flickers are year-round residents in western Oregon and generally prefer to inhabit forest-edge situations. They were common on Mott Island in October 1974 and fairly common in June 1975; none were seen in July 1974. Individuals were observed in the alder-cottonwood, scotchbroom, and shore pine habitats and scotchbroom-alder-cottonwood ecotone. A portion of one breeding territory was present on the breeding bird census plot. Nests are usually located in old stumps and trees. Most nesting by this species in western Oregon occurs in May; five to nine eggs are laid per nest. Food: insects (Coleopterans and Hymenopterans) and fruits.

Dendrocopus pubescens. Downy woodpecker.

Downy woodpeckers are year-round residents in western Oregon and generally prefer to inhabit forest-edge situations. These birds are fairly common on Mott Island. Individuals were observed foraging in the study site's shore pine and alder-cottonwood communities in October 1974. One breeding pair and nest site were present on the June 1975 breeding bird census plot. The nest site was in an old stump located in the scotchbroom-alder-cottonwood ecotone. Old nest sites were also observed in dead shore pines. Three to six eggs are laid per nest. Food: insects, fleshy fruits, and seeds.

Sphyrapicus varius. Yellow-bellied sapsucker.

The yellow-bellied sapsucker is a year-round resident in western Oregon and generally inhabits woodlands and ecotones. One individual was observed foraging in the study site's shore pine community in October 1974. No individuals were observed in July 1974 or June 1975 and thus the species is not regarded as a breeding resident. Food: insects (especially Hymenopterans, Dipterans, and Coleopterans), fleshy fruits, and tree cambium, bast, and sap.

Empidonax traillii. Willow flycatcher.

Willow flycatchers are summer residents in western Oregon and generally prefer to inhabit edges of moist to wet forests. They were fairly common on Mott Island in June 1975. One partial and two full breeding territories fell within the breeding bird census plot. All territories were located in the scotchbroom-alder-cottonwood ecotone and the two full territories encompassed 0.64 and 0.58 acre, respectively. Nesting in Oregon occurs in June and July with two to four eggs laid per nest. Food: insects, especially Hymenopterans.

Empidonax difficilis. Western flycatcher.

Western flycatchers are summer residents in western Oregon and generally prefer to inhabit moist deciduous woods. They were common on Mott Island in June 1975. Six and one-half breeding territories were established on the breeding bird census plot. All of these were located primarily in the alder-cottonwood community, frequently where openings in the tree canopy occurred and a low shrub understory was present. A portion of one territory extended into the shore pine community, while portions of others occasionally included some willow fringe habitat. Average territory size was 0.76 acre. A nest of this species was found in a cottonwood tree about 15 ft from the ground. Its contents were not checked, but western flycatchers usually lay three to four eggs. Food: insects, especially Hymenopterans and Dipterans.

Hirundo rustica. Barn swallow.

Barn swallows are summer residents in western Oregon and generally prefer to inhabit open country. Flights of individuals were observed preying upon flying aphids over the scotchbroom and beachgrass-hairgrass communities in July 1974 and Hymenopterans and Dipterans in June 1975. A colony of barn swallows was nesting beneath the docks at Tongue Point in June 1975. No individuals were observed nesting on Mott Island.

Tachycineta thalassina. Violet-green swallow.

Violet-green swallows are summer residents in western Oregon and generally prefer to inhabit open country. Flights of individuals were observed preying upon flying aphids over the scotchbroom and beachgrass-hairgrass communities in July 1974 and Hymenopterans and Dipterans in June 1975. Individuals were nesting beneath the docks at Tongue Point in June 1975. No individuals were observed nesting on Mott Island.

Corvus corax. Common raven.

Ravens are fairly common year-round residents in western Oregon. They are, however, relatively uncommon on Mott Island. Less than 10 individuals were recorded on the study site in October 1974 and only two in June 1975; no individuals were sighted in July 1974. All ravens observed were perching in trees in the scotchbroom-alder-cottonwood ecotone or foraging on the ground in the beachgrass-hairgrass community. Ravens are early nesters and generally prefer to nest on cliffsides. Nesting in Oregon occurs from late March to mid-May; clutch sizes range from five to seven. They are not regarded as breeding residents on Mott Island because suitable nesting habitat is not present. Carrion comprises a substantial part of the raven's diet. Ravens also prey upon waterfowl and marsh bird nestlings and eggs. The remainder of their diet includes insects, small mammals, fleshy fruits, and seeds.

Corvus brachyrhynchos. Common crow.

Common crows are year-round residents in western Oregon and typically inhabit forest-edge areas. They are the most abundant nesting species on Mott Island. Twenty-six nests were located on the breeding bird census plot but most young had already fledged by June. Twenty-two of the nests were located in shore pines;

the remainder were in alder or cottonwood trees. Four to eight eggs are laid per nest. Following the nesting season, crows wander widely in search of food. In fall and winter, these birds form large night-roosting colonies. One roost of approximately 150-200 individuals was observed in the alder-cottonwood community during the field survey. Food habits of the common crow are similar to those of the raven, although crows tend to eat less carrion. Individuals were observed feeding in all upland habitats on Mott Island.

Parus atricapillus. Black-capped chickadee.

Black-capped chickadees are year-round residents in western Oregon. The species inhabits coniferous and deciduous forests, although the latter are more preferred. These birds are common on Mott Island and were observed during all three surveys. Black-capped chickadees were found to inhabit the study site's alder-cottonwood, shore pine, and willow fringe communities. No breeding territories or nests were found on the June 1975 breeding bird census plot, but nearly all black-capped chickadees observed during this period were foraging in family groups thereby indicating that nesting had been completed prior to our visit. These birds commonly nest in tree cavities. Nesting records for western Oregon range from late April to mid-June; four to nine eggs are laid per nest. Food: insects (especially scale insects, aphids, Lepidopteran caterpillars, pupae, and eggs), spiders, spider eggs, berries, and mast.

Parus rufescens. Chestnut-backed chickadee.

Chestnut-backed chickadees are year-round residents in western Oregon. They generally prefer to inhabit coniferous forests. Chestnut-backed chickadees are fairly common on Mott Island and were observed during the October 1974 and June 1975 field surveys. All individuals sighted were in the study site's shore pine habitat. No breeding territories or nests were found on the June 1975 breeding bird census plot but chestnut-backed chickadees were usually seen feeding in family groups thereby indicating that nesting had been completed prior to our visit. These birds commonly nest in tree cavities. Available literature indicates that most nesting by this species in western Oregon occurs in May; four to nine eggs are laid per nest. Food habits of this species are similar to those of the black-capped chickadee.

Psaltriparus minimus. Bushtit.

Bushtits are year-round residents in western Oregon and generally prefer to inhabit hedgerow communities. Bushtits were fairly common in the study site's willow fringe, alder-cottonwood, and scotchbroom habitats and scotchbroom-alder-cottonwood ecotone in July and October 1974. None were observed, however, in June 1975. These birds normally nest from mid-May to mid-June in western Oregon; six to eight eggs are laid per nest. Food: primarily insects (especially aphids and scale insects) and spiders.

Sitta canadensis. Red-breasted nuthatch.

Red-breasted nuthatches are year-round residents in western Oregon and generally prefer to inhabit coniferous forests. They are not common on Mott Island and were observed only during the October 1974 survey. These birds were observed in mixed flocks with chickadees and all sightings were in the shore pine community. Most nesting in Oregon by this species occurs in May; four to eight eggs are laid per nest. Food: seeds (especially those of pine trees) and insects.

Certhia familiaris. Brown creeper.

Brown creepers are year-round residents in western Oregon. They inhabit deciduous and coniferous forests but generally have a preference for the latter. These small birds were observed in the shore pine habitat on Mott Island during October 1974 and June 1975. They did not appear common but this may have been somewhat biased because of their inconspicuousness. No territorial males or nests were recorded during the June 1975 breeding bird survey and thus the species is regarded as a questionable breeding resident. Brown creepers nest from May through June in western

Oregon. Nests are commonly located behind flaking bark. Clutch sizes range from five to nine. Food: insects, especially Coleopterans (weevils in particular), Hymenopterans, and Lepidopteran caterpillars.

Troglodytes aedon. House wren.

House wrens are summer residents in western Oregon and generally inhabit forest-edge and hedgerow situations. A few individuals, apparently migrating to their wintering grounds, were observed in the scotchbroom and beachgrass-hairgrass communities on Mott Island in October 1974. No house wrens were observed on the study site in July 1974 or June 1975. Nesting in Oregon occurs primarily in June; five to seven eggs are laid per nest. Food: insects, particularly Orthopterans and Coleopterans.

Troglodytes troglodytes. Winter wren.

Winter wrens are year-round residents in western Oregon and generally prefer to inhabit mesic woodlands. These birds were common on the study site in October 1974 and were observed in all upland communities. No individuals were observed on the island during the July 1974 and June 1975 field surveys. Winter wrens have been noted to nest in April and May in western Oregon and may have completed nesting prior to our breeding bird survey. Five to seven eggs are laid per nest. Food: insects, especially Hemipterans, Coleopterans, Lepidopteran caterpillars, small Hymenopterans, and spiders.

Thryomanes bewickii. Bewick's wren.

Bewick's wrens are year-round residents in western Oregon and generally inhabit forest-edge and hedgerow situations. They are relatively common on Mott Island and were observed during all three surveys. Five breeding territories were present on the breeding bird census plot. Most of these were located around brush piles and windthrow within the alder-cottonwood and shore pine communities. No nests were located, but most nesting generally occurs in May; clutch sizes usually range from five to seven. Food: insects.

Turdus migratorius. American robin.

Robins are year-round residents in western Oregon and generally are a forest-edge species. These birds are common on Mott Island and were observed in all habitats during the three field surveys. Four breeding territories were located on the breeding bird census plot and two pairs were seen constructing nests in the alder-cottonwood community. Nest dates in Oregon range from mid-April to mid-July. Two and sometimes three broods are raised per mating season. Clutches range from three to five. Food: fleshy fruit, insects (especially Coleopterans and Lepidopteran caterpillars), and earthworms.

Catharus guttatus. Hermit thrush

Hermit thrushes are winter residents in western Oregon and generally are a woodland species. These birds were faily common on Mott Island in October 1974 and were observed in the shore pine and alder-cottonwood communities. Food: insects (especially Coleopterans and Hymenopterans), and fleshy fruits.

Catharus ustulatus. Swainson's thrush.

Swainson's thrushes are summer residents in western Oregon and generally are woodland inhabitants. These birds were observed July 1974 and June 1975 in the study site's alder-cottonwood and shore pine and scotchbroom-alder-cottonwood ecotone. They were frequently seen around brush piles and windthrow within these habitats. Swainson's thrushes are an abundant breeding resident on Mott Island. Thirteen breeding territories were located on the breeding bird census plot; average territory size was 0.25 acre. Nest dates in Oregon range from late May to mid-July. Clutches range from four to five. Food: insects (especially Hymenopterans) and fleshy fruits.

Regulus satrapa. Golden-crowned kinglet.

Golden-crowned kinglets are year-round residents in western Oregon. They generally inhabit deciduous and coniferous forests although the latter are preferred, especially during the nesting season. Golden-crowned kinglets form flocks in winter. These birds were abundant on the study site in October 1974 and were observed in the shore pine, alder-cottonwood, and willow fringe communities, and scotchbroom-alder-cottonwood ecotone. They were relatively uncommon in July 1974 and June 1975, presumably because most had migrated to spruce, fir, and hemlock habitats on nearby mountains for nesting purposes. No territorial males or nests were observed on the island during the breeding bird census. Nest dates in Oregon range from May to July; 5 to 10 eggs are laid per nest. Food: insects, especially Hymenopterans, scale insects, and aphids.

Regulus calendula. Ruby-crowned kinglet.

Ruby-crowned kinglets are winter residents in western Oregon. They inhabit deciduous and coniferous woodlands although the latter are generally preferred. These birds were abundant in the study site's shore pine, alder-cottonwood, and willow fringe communities and scotchbroom-alder-cottonwood ecotone in October 1974, and were often in mixed flocks with golden-crowned kinglets. A few winter stragglers were also seen on the study site in July 1974 and June 1975. Food: insects, especially Hymenopterans, scale insects, and aphids.

Sturnus vulgaris. Starling.

Starlings are year-round residents in western Oregon and prefer to inhabit forest-edge communities. They are relatively uncommon on Mott Island. Individuals were observed in the scotchbroom-alder-cottonwood ecotone and shore pine community during July 1974 and June 1975 surveys; none were observed in

October 1974. The species is a questionable breeding resident on the study site. No territorial males or nests were observed during the breeding bird census, but several adults were, however, accompanied by juveniles. Four to seven eggs are laid per nest. Food: insects (especially Coleopterans), fleshy fruits, and seeds.

Vireo huttoni. Hutton's vireo.

Hutton's vireos are year-round residents in western Oregon and generally prefer to inhabit evergreen woodlands and coniferous forests. They are not common on Mott Island. Individuals were observed in the shore pine and alder-cottonwood communities in July and October 1974. None were observed on the site during the June 1975 breeding bird survey. Food: insects, particularly Hemipterans, Lepidopteran caterpillars, and Coleopterans.

Dendroica petechia. Yellow warbler.

Yellow warblers are summer residents in western Oregon and typically are hedgerow inhabitants. They were observed in July 1974 and June 1975 in the study site's willow fringe and alder-cottonwood communities and scotchbroom-alder-cottonwood ecotone. The species is a very common breeding resident on Mott Island; nine breeding territories were established on the breeding bird census plot. Average territory size was 0.59 acre. Nest dates in Oregon range from May through June; two to six eggs laid per nest. Food: insects, especially Lepidopteran caterpillars.

Dendroica townsendi. Townsend's warbler.

Townsend's warblers are spring-fall transients in western Oregon and generally prefer to inhabit coniferous woodlands. Individuals were observed feeding in the upper tree canopy layers within the shore pine and alder-cottonwood habitats on Mott Island during the October 1974 survey. Food: insects, especially stink-bugs and scale insects.

Dendroica coronota. Yellow-rumped warbler.

Yellow-rumped warblers are year-round residents in western Oregon and typically inhabit hedgerow situations. They were fairly common on Mott Island in October 1974 and were observed foraging in the alder-cottonwood community. None were seen on the island in July 1974 or June 1975 and the species is not regarded as a likely breeding resident. Nesting occurs in May and June in Oregon; four to five eggs are laid per nest. Food: insects and fleshy fruits.

Wilsonia pusilla. Wilson's warbler.

Wilson's warblers are summer residents in western Oregon and generally inhabit hedgerow communities. They were uncommon on the study site in June 1975 and all individuals seen were in the alder-cottonwood community. One male of this species was consistently seen on the breeding bird census plot, but never sung its territorial song. A few territorial males were heard, however, in the alder-cottonwood community located off the census plot. Wilson's warblers nest in June in western Oregon; clutch sizes range from two to four. Food: insects, especially Hemipterans and Hymenopterans.

Sturnella neglecta. Western meadowlark.

Western meadowlarks are year-round residents in western Oregon and are grassland inhabitants. They are uncommon on Mott Island. Individuals were flushed from the site's beachgrass-hairgrass community in October 1974. None were observed on the island in July 1974 or June 1975, and thus they are a doubtful breeding resident. Nesting records for Oregon date from late April to mid-June. Three to seven eggs are laid per nest. Food: insects (particulary Lepidopteran caterpillars, Coleopterans, and Orthopterans) and seeds (with those of Poaceae being favored).

Molothrus ater. Brown-headed cowbird.

Brown-headed cowbirds are summer residents in western Oregon and generally prefer to inhabit hedgerow communities. The species is uncommon on Mott Island and was observed only during the June 1975 census. Most individuals were observed in the scotchbroom-alder-cottonwood ecotone; a few were seen in shore pine and willow fringe habitats. Female cowbirds lay their eggs in nests of other avian species. Sparrows, warblers, vireos, and blackbirds are most frequently parasitized. Yellow warblers and white-crowned sparrows are probably the most frequently parasitized species on Mott Island as they are the more common nesting species in the scotchbroom-alder-cottonwood ecotone. Food: seeds and insects.

Pheucticus melanocephalus. Black-headed grosbeak.

Black-headed grosbeaks are summer residents in western Oregon and generally prefer to inhabit open, deciduous woodlands. These birds are a common breeding resident on Mott Island and were observed in the study site's alder-cottonwood and scotchbroom-alder-cottonwood ecotone in June 1975. Seven breeding territories were established on the breeding bird census plot. Average territory size was 0.80 acre. No nests were located, but nesting occurs in May and June; generally three to four eggs are laid per nest. Food: seeds, fleshy fruits, insects (especially Lepidopteran caterpillars), and spiders.

Spinus tristis. American goldfinch.

American goldfinches are year-round residents in western Oregon and generally prefer to inhabit hedgerow communities. Individuals were observed in the scotchbroom-alder-cottonwood ecotone and willow fringe community in October 1974 and June 1975. Goldfinches are late nesters and males were just beginning to establish territories on the last days of June 1975 breeding bird survey. Nest dates in Oregon range from mid-June to mid-July; three to five eggs are laid per nest. Food: primarily seeds, with those of Asteraceae being favored.

Pipilo erythropthalmus. Rufous-sided towhee.

Towhees are year-round residents in western Oregon and generally inhabit forest-edge habitats. They are uncommon on Mott Island. One individual was observed in the study site's willow fringe community in October 1974. None were observed in July 1974 or June 1975; thus, the species is a doubtful breeding resident. Nesting records for Oregon range from May through June; four to five eggs are laid per nest. Food: primarily seeds and beetles.

Junco hyemalis. Dark-eyed junco.

Juncos are year-round residents in western Oregon. They generally inhabit coniferous forest edges during the nesting season, but are often ubiquitous at other seasons. Juncos were abundant on Mott Island in October 1974 and were seen in all upland habitats. None were observed in July 1974 and June 1975, apparently because the island does not have suitable breeding habitat. Nesting records in Oregon range from May to mid-July; four to five eggs are laid per nest. Food: seeds and insects.

Spizella passerina. Chipping sparrow.

Chipping sparrows are summer residents in western Oregon and typically inhabit hedgerow situations. A few individuals, apparently migrating to their wintering grounds, were observed in the willow fringe habitat on Mott Island in October 1974. None were seen on the site in July 1974 and June 1975. Most nesting by this species in Oregon occurs in June; three to five eggs are laid per nest. Food: seeds and insects.

Zonotrichia leucophrys. White-crowned sparrow.

White-crowned sparrows are year-round residents in western Oregon and generally prefer to inhabit hedgerow communities. They were common on Mott Island during the July 1974 and June 1975 surveys, and fairly common during the October 1974 census. Eight breeding territories were located on the breeding bird census plot. The territories were located in the scotchbroom and beachgrass-hairgrass habitats and scotchbroom-alder-cottonwood ecotone. Average territory size was 0.22 acre. Most nest construction by this species in western Oregon occurs in May; three to five eggs are laid per nest. Food: primarily seeds.

Passerella iliaca. Fox sparrow.

Fox sparrows are winter residents in western Oregon and are generally forest-edge inhabitants. These birds were very common on Mott Island in October 1974 and were observed in all upland habitats. Food: seeds, fleshy fruits, and insects.

Melospiza melodia. Song sparrow.

Song sparrows are year-round residents in western Oregon and generally prefer to inhabit hedgerow communities. These birds were common in all upland habitats on Mott Island in Ocbober 1974, but were more restricted to woodland situations having dense understories or brush piles in June 1975. Ten breeding territories were established on the breeding bird census plot. Average territory size was 0.18 acre. Nests in western Oregon have been found from mid-April to mid-July. One nest possibly made by this species was located in the study site's willow fringe habitat in June 1975. No eggs were present, but song sparrows usually lay four to five eggs per nest. Food: seeds (especially those of Poaceae) and insects.

Annotated List of Mammals

Scapanus sp. Mole.

Numerous mole tunnels and mounds were observed in the alder-cottonwood, shore pine, and beachgrass-hairgrass communities. In addition, mole skeletal remains were found in owl pellets located in the shore pine habitat. Tunnel diameters suggest that the species is a large mole, possibly the Townsend mole (*S. townsendi*). Townsend moles are in breeding condition in February. Young (usually 3) are born in March. About 80 percent of the Townsend mole's diet consists of insects and earthworms; the remainder includes roots, seeds, and other plant material.

Microtus townsendi. Townsend vole.

Sixteen skulls of the species were recovered from owl pellets found in the shore pine habitat in October 1974. A vole-like creature was also observed among the tree wrack strewn along the island periphery in June 1975. No individuals were captured in traps set during the October and June trapping censuses. Runways and other signs were not observed. Voles, if present on Mott Island, probably have low population densities; most or all voles eaten by the unidentified owl were likely captured on nearby islands or the mainland. Townsend voles occupy a variety of habitats but have a preference for moist grasslands. They would most likely establish initial populations in the island's marshlands.

Myocastor coypus. Nutria.

Nutria are the most abundant mammals on Mott Island. They normally inhabit marshlands but were found in all habitats on Mott Island during the three surveys. High population densities may have caused nutria to move into the site's upland communities. Numerous nutria skulls were found on the island during the three visits. Mortalities may have been caused by food shortages (or low nutritional value of available foods), disease, adverse weather, or a combination of these factors. Nutria may breed during all months; one to nine young are born per litter. A few burrow systems were observed on the site; most of these were located in old dikes built for dredged material disposal. It is presumed that additional burrows may be located in the rock jetty on the north side of the island. Nutria are grazing herbivores.

Eutamias sp. Chipmunk.

A burrow system, much like that of a chipmunk's, was observed in the study site's alder-cottonwood community in October 1974 and June 1975. The burrow entrances showed no signs of activity and no chipmunks were ever sighted. These animals may have been present on the island in the past but are presently regarded as very doubtful inhabitants.

Odocoileus hemionus. Mule deer.

Two mule deer were observed on Mott Island in July and October 1974; three were seen in June 1975. Mule deer likely move back and forth between Mott Island, the mainland, and other nearby islands. Seasonal fluctuations in numbers may occur in response to dietary and shelter requirements. Nine deer skeletons were found on Mott Island during the three surveys. Mortalities were probably caused by food shortages (or low nutritional value of available foods), disease, adverse weather, or a combination of these factors. Usually two young are born in June. Mule deer are browsing herbivores.

Annotated List of Reptiles and Amphibians

Thamnophis ordinoides. Northwestern garter snake.

Northwestern garter snakes generally prefer to inhabit thickets. Three individuals were observed on Mott Island in October 1974; two were in the alder-cottonwood habitat while the third was seen in the scotchbroom community. Another was seen at the rip-rap jetty in July 1974. These snakes hibernate from October to March in Oregon. Most breeding takes place in mid-March to April and most young are born in mid-August; 3-18 young are born per litter. Food: slugs, earthworms, salamanders, and frogs.

Rana aurora aurora. Red-legged frog.

Red-legged frogs were observed in an ephemeral pond on Mott Island during the June 1975 field survey. The breeding period is short and usually lasts only 1 to 2 weeks, sometime between January and March. Red-legged frogs are insectivorous.

In accordance with ER 70-2-3, paragraph 6c(1)(b), dated 15 February 1973, a facsimile catalog card in Library of Congress format is reproduced below.

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