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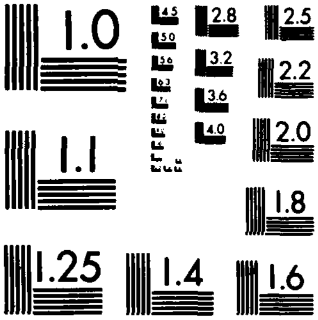

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US Army Corps
of Engineers

WETLANDS RESEARCH PROGRAM

TECHNICAL REPORT Y-84-1

DELINEATION OF WETLAND BOUNDARIES USING VEGETATION WITHIN THE ALTAMAHA RIVER BASIN OF GEORGIA

by

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April 1984

Final Report

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

This study develops a sound quantitative method for the assessment of the structure, location, and composition of transition zones adjacent to wetland communities in the Altamaha River Basin of Georgia. The resulting methods will be incorporated into a U. S. Army Corps of Engineers methodology for delineating wetlands.

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20. ABSTRACT (Continued).

Six sampling methods, three similarity indices, and four analytical strategies were investigated. Phase I of the study consisted of evaluation of sampling and analytical methods and selection of the best method. The best method proved to be the use of (a) 1- × 4-m contiguous quadrats for sampling along transects parallel to the moisture gradient and (b) Jaccard's community coefficients for data analysis.

Phase II of the study consisted of further evaluation of the best method. This method was found to be advantageous because:

a. It does not rely on the use of indicator species; plant associations are used instead.

b. It is uncomplicated, technically reproducible, and therefore amenable to the legal interpretation in defining wetland boundaries.

c. The procedures are well documented in the literature.

d. It is applicable to a variety of physiognomic types.

e. Minimal training is required for proper application of the method by field personnel.

SUMMARY

the Army, acting through the Corps of Engineers (COE),
ulating the disposal of dredged and fill material into
States, as a result of Federal Water Pollution Control
972 (PL 92-500). Critical to the implementation of any per-
Section 404 of PL 92-500 is the ability to locate the bound-
and transition zone communities. The distinctive character of
lts from the interactions of vegetation and soils with hydrologic
ll three of these factors should be considered when attempting
nd boundaries. This study develops a sound quantitative meth-
assessment of the structure, location, and composition of tran-
jacent to wetland communities in the Altamaha River Basin of
obtained will be used in conjunction with soil and hydrologic
techniques for wetland delineation.

rent sampling methodologies, three similarity indices, and four
tegies were investigated. All sampling methods involved ran-
ansects parallel to the wetness gradient.

ampling and data analysis produced a "best method" for transi-
ary determination using 1- by 4-m contiguous plots and Jaccard's
icient to compare wetland and upland end quadrats to all other
sects were analyzed individually to determine community bound-
row and variable nature of the transition zones encountered was
icant factor affecting the choice of methodologies.

method" described offers the following advantages:

t does not rely on the presence of "indicator" species; rather,
he boundaries are ecologically determined by the position of
he plant species comprising the wetland, upland, and transition
one communities.

t is uncomplicated, technically reproducible, and therefore ame-
able to the legal interpretation in defining wetland boundaries.

he field and statistical procedures are well documented in the
iterature.

he "best method" is applicable to a variety of physiognomic
ypes.

ield application is uncomplicated, and a minimum of training is
equired for proper implementation by field personnel.

PREFACE

At the request of the Office, Chief of Engineers, U. S. Army, the Environmental Laboratory (EL) of the U. S. Army Engineer Waterways Experiment Station (WES) conducted this research effort under the initial auspices of the Dredged Material Research Program (1978-1979) and later under the Dredging Operations Technical Support (DOTS) Program. This study is being published as part of the Wetlands Research Program (WRP). Technical monitors of the WRP for the Office, Chief of Engineers, were Dr. John R. Hall and Mr. Phillip C. Pierce.

The research was performed under Contract No. DACW39-78-C-0092 (entitled "Wetland Transition Zone Study Within the Altamaha River Basin of Georgia") by the Envirosphere Company of Atlanta, Ga. Authors of the report were Mr. Boyd F. Vaughan, Jr., Mr. Robert J. Cooper, Dr. Joel H. Braswell, and Dr. Robin Hart. Mr. Tom Mather provided valuable assistance in the field. Graphics were provided by Ms. S. L. Hull. Dr. Wilbur Duncan gave technical assistance in the identification of certain plant species. Dr. Robert Terry Huffman and Dr. Gary Tucker, Research Botanists, formerly of EL, developed the project's scope of work and provided valuable technical assistance throughout the study. Dr. D. R. Sanders, Sr., EL, was Leader, Wetlands Research Team, Wetland and Terrestrial Habitat Group, during the final review and publication of the report. The study was conducted under the general supervision of Dr. H. K. Smith, Environmental Resources Division (ERD), EL; Dr. C. J. Kirby, Chief, ERD, EL; and Dr. John Harrison, Chief, EL. Mr. Charles C. Calhoun was Program Manager, DOTS, and Dr. Smith was Program Manager, WRP.

The Commanders and Directors of WES during this study and the publication of this report were COL John L. Cannon, CE; COL Nelson P. Conover, CE; and COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASURMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
acres	0.4046873	hectares
cubic feet per second	0.02831685	cubic metres per second
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	2.54	centimetres
miles (U. S. statute)	1.609347	kilometres
square miles	2.589998	square kilometres

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* 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 $K = (5/9)(F - 32) + 273.15$.

BOUNDARIES USING VEGETATION WITHIN
RIVER BASIN OF GEORGIA

PART I: INTRODUCTION

Project Background

rtment of the Army, acting through the Corps of Engineers
le for regulating the disposal of dredged and fill material
nited States, as a result of the Federal Water Pollution
ts of 1972 (PL 92-500). Until 1975, however, the regula-
ected toward only navigable waters. Since that time, new
n provided for extending jurisdiction into all waters of
ncluding wetlands. Such jurisdication is essential to
ical, physical, and biological integrity of the Nation's

o the implementation of any permit program under Sec-
nition of the term "wetlands." Current COE rules and reg-
gister, 19 July 1977) define wetlands as:

> s that are inundated or saturated by surface or
> r at a frequency and duration sufficient to support,
> nder normal circumstances do support, a prevalence
> ion typically adapted for life in saturated soil
> . Wetlands generally include swamps, marshes, bogs,
> r areas.

tion, determination of an area as wetland is contingent
onship of soils and vegetation with the hydrologic regime.
re bordered by an area of transition from wetland to up-
problem exists in that the boundary of this transition
defined, since it shares species common to both sides of
. Determination of a wetland boundary requires examina-
on zone and its relation to the wetland areas. It was the
y to formulate a methodology for delineating the bound-
efining the transition zones present, and distinguishing
plands.

develops a sound quantitative methodology for the assess-
e and composition of transition zones adjacent to wetland

plant communities in the Altamaha River Basin of Georgia in an area extending from the Atlantic coast inland to Doctortown, Georgia. Wetlands boundaries can be defined by the change in species composition along the moisture gradient. This study compared different sampling methods to determine the most accurate and cost-effective procedure for delineating wetlands. Wetland types differing in physiognomy, salinity, degree of disturbance, and transition zone width were investigated to evaluate the general applicability of the different methodologies. The physiognomic types studied were a tree-dominated wetland, shrub-dominated wetland, graminoid marsh, flat, and open-water habitat with macrophytic vegetation.

5. The field sampling effort consisted of two phases. Phase I was the initial field application of the different methodologies, while Phase II was a field verification of the "best" methodology.

Description of Study Area

Location

6. The study area is composed of the Altamaha River Basin from the Atlantic coast inland to Doctortown, Georgia, including St. Simons Island and the system of estuaries and marshlands between the island and the coast. The Altamaha River, the headwaters of which originate in the Piedmont, is one of the two major river systems of the Atlantic drainage in Georgia. The Altamaha has the greatest discharge of any river along the Georgia coast. It has a drainage area of approximately 13,600 square miles* and an average discharge of 12,600 cfs (U. S. Geological Survey 1959). Several miles from the coast it divides into four distributaries (Darien, Butler, Champney, and South Altamaha Rivers) which empty into Altamaha and Doboy Sounds.

7. From the coast inland, the Altamaha is bordered by abandoned rice fields (to mile 13) which have a general elevation of 7 ft above low water. The general slope of the Altamaha is 0.7 ft per mile, but there are short segments less than 1 mile long where slopes reach 3 and 4 ft per mile. The sharpest curve has a radius of 200 ft and there are 50 curves with radii less than 500 ft (Wharton 1978).

Physiography and geology

8. Soils of the Piedmont Province are derived from pre-Cambrian

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* A table of factors for converting U. S. customary units of measurement to metric (SI) units is provided on page 4.

crystalline rocks. Marking the border between the Piedmont and Coastal Plain is the Fall Line, indicating the farthest advance of the sea late in the Mesozoic Era. The Coastal Plain is overlaid by many deposits caused by changes in sea level in the Tertiary and Quaternary Periods, with the most recent deposits located at the coast.

9. Formation of the barrier islands has been explained by several theories, the most commonly accepted of which attributes the phenomenon to dune formation, followed by severe flooding, which occurred at the end of the Pleistocene ice ages. The area landward of the largest and most stable dunes would therefore become a lagoon, eventually filling with sediment and evolving into a salt marsh. The coastal islands are of two ages. The older islands (e.g., St. Simons) were formed during the Silver Bluff Pleistocene submergence (25,000-36,000 years ago) described above. The newer islands (e.g., Sea Island) were formed 4000-5000 years ago during the Holocene (Hoyt 1967, 1968).

10. The lower Georgia Coastal Plain was developed as a result of a series of barrier island formations. Each series was followed by a recession of sea level, resulting in a series of terraces. The Wicomico shoreline, the oldest such terrace, was as much as 100 ft higher than the present shoreline. Subsequent barrier island formations were the Penholoway (75 ft above present sea level), Talbot (40-45 ft), Pamlico (25 ft), Princess Anne (15 ft), Silver Bluff (5 ft), and Holocene (Hoyt and Hails 1967).

11. Tidal marshes are formed in conjunction with barrier island development. The areas landward of the partially submerged dunes are subject to less disturbance than open waters, permitting clay and silt sediments to be deposited. This permitted extensive communities of salt-tolerant marsh plants, such as smooth cordgrass (*Spartina alterniflora*) to develop. Tidal action continually contributes new sediments at a very slow rate, and receding tides form an extensive drainage system of tidal creeks and rivers, creating a network of marsh islands throughout the estuarine system.

Climate

12. The coastal region of Georgia has a relatively moderate climate, with slightly lower average temperatures than on the mainland due to offshore winds. Winters are relatively short and mild. Mean minimum and maximum January temperatures are 44° F and 64° F, respectively. Mean minimum and maximum July temperatures are 72° F and 90° F, with mean annual rainfall approximately 52 in. Rain is most frequent in summer and early fall. The driest period is

November through February (Carter 1967). Tropical storms are common between August and October, yet in the period 1886-1968 only 56 reached hurricane magnitude and few have caused serious damage (Carter 1970).

Soils

13. Wetland soils are very poorly drained and are flooded periodically if not regularly. Largely a result of alluvial deposits, wetland soils are predominantly clays or silty clays, although they also contain some fine sand.

14. Swamp soils, associated with freshwater swamp forests, are located at higher elevations and are seldom covered by tidal waters. They are generally flooded in winter and spring and receive fresh deposits of sediments. The surface layer is generally black loam or clay loam, overlaying mostly dark-gray clay (Byrd et al. 1961).

15. Tidal marsh soils are covered twice daily by tides. Johnson et al. (1974) have summarized the sources of the sediments in the salt marsh as derived either from the continental shelf, the mainland rivers, the marsh itself, or organic deposits. Tidal marshes depend on upland freshwater sources for much of their nutrient and biological richness (Gosselink, Odum, and Pope 1973). Haines (1975) felt that substantial amounts of trace minerals, silicates, and organic nutrients could be contributed by freshwater discharge into tidal areas. The upper few centimetres of salt-marsh soils are usually brown. The lower portion is usually black with a nearly neutral pH. Sulfides, methane, and ferrous compounds are present due to the anaerobic conditions (Wharton 1978). High marsh sites tend to have more sand and less clay and organic matter than low marsh sites (Teal and Kanwisher 1961).

16. Wet alluvial soils (Byrd et al. 1961) occur at the mouth of the Altamaha River. They are covered by salt water at high tides and are swept by fresh water when the river is high. These soils are similar to tidal marsh soils but include periodic lenses of sand. The distribution of grain size is such that the coarser materials are located in the estuary and offshore delta areas, and finer materials accumulate in the tidal flats (Visher and Howard 1974).

17. The soils of St. Simons Island are characteristically strongly acidic, low in fertility, and either excessively drained (Lakewood Series) or poorly drained (Leon, Rutledge, Plummer Series).

Flooding history

18. Wetland plant communities are largely determined by the duration,

periodicity, and depth of flooding. On the Altamaha, flooding originates from two sources, river floodstage and tidal action.

19. The U. S. Soil Conservation Service has estimated that tidal marsh acreage in Glynn and McIntosh Counties is 78,936 and 83,132, respectively. Tidal waters inundate marsh areas twice daily, with tidal influence extending far upriver. The limit of inland tidal influence on the Altamaha River is estimated to be river mile 42 near the Long-McIntosh County line. The limit of salinity influence is located at approximately river mile 18.9 (Georgia Department of Natural Resources 1976). Thus some areas upriver experience daily water level fluctuations of fresh or brackish water, while others are affected only when spring or storm tides, augmented by onshore winds, inundate the floodplain with up to several feet of water. Similarly, higher areas of salt marsh, characterized by needlerush (*Juncus roemerianus*), are inundated with salt water only during extremely high tides.

20. Spring floods on the Altamaha inundate and flush the floodplain, providing the area with new sediments as well as transporting sediments to the estuary and beyond. River swamps are generally flooded by 1 or more feet of water for 6 months or more of the year (Bozeman and Darrell 1975). By holding for a time these overbank river flows, swamps may also increase shallow groundwater supplies. In times of dry weather, the shallow watertable aquifer feeds the river swamp (Georgia Department of Natural Resources 1976).

Vegetation

21. Wetland vegetation of the study area may be categorized as either swamp or marsh. Swamps are typically hardwood swamps associated with fresh water. Marshes may be either salt or fresh and are typically covered with herbaceous vegetation.

22. River swamp ecosystems are highly diverse, with the dominant species being water tupelo (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*) in extremely hydric conditions and overcup oak (*Quercus lyrata*), green ash (*Fraxinus pennsylvanica*), Carolina ash (*Fraxinus caroliniana*), and black gum (*Nyssa biflora*) in slightly less hydric conditions (Bozeman and Darrell 1975). Klawitter (1962) and Applequist (1959) also include red maple (*Acer rubrum*) as a major component of these communities.

23. Freshwater marshes occur primarily near the mouth of the Altamaha and extend for some distance upriver before being replaced by swamp forest. Much of the freshwater marsh area was once swamp forest that was cleared and

diked for the growing of rice. Shallow freshwater marshes contain a variety of species. The deeper freshwater marshes are more extensive, occupying an area of approximately 25,000 acres along the Georgia coast (Johnson et al. 1974). Sawgrass (*Cladium jamaicense*) is a dominant species in much of this area. Cattails (*Typha* spp.) are common along the deeper margins. As salinities increase to brackish conditions, giant cutgrass is replaced by big cordgrass (*Spartina cynosuroides*) and salt-marsh bulrush (*Scirpus robustus*).

24. Zonation in the salt marsh is primarily related to elevation, as it determines frequency, depth and duration of inundation, and soil salinity (Teal and Teal 1969). The most extensive monospecific marshes consist of smooth cordgrass, covering an area of 285,650 acres (Spinner 1969). Higher, infrequently flooded salt marshes contain needlerush.

PART II: METHODS

Selection of Sampling Locations

25. The study area consisted of the Altamaha River Basin inland to Doctortown, Georgia. Access problems and time considerations dictated that all sampling sites be located in the lower half of this area. The results are applicable to the entire basin since no major wetland types or salinity conditions were excluded by this approach. Potential sites were selected on the basis of access, vegetation homogeneity, and how well they represented the desired physiognomic type. Color-infrared aerial photographs and topographic maps (scale 1:24,000) were used to identify potential sites. Appropriate State agencies were consulted and a reconnaissance trip was made to each site before sampling commenced. A COE representative visited all sites prior to Phase I and II sampling and was given an opportunity to make recommendations concerning the candidate areas. Sampling locations are presented in Figures 1 and 2.

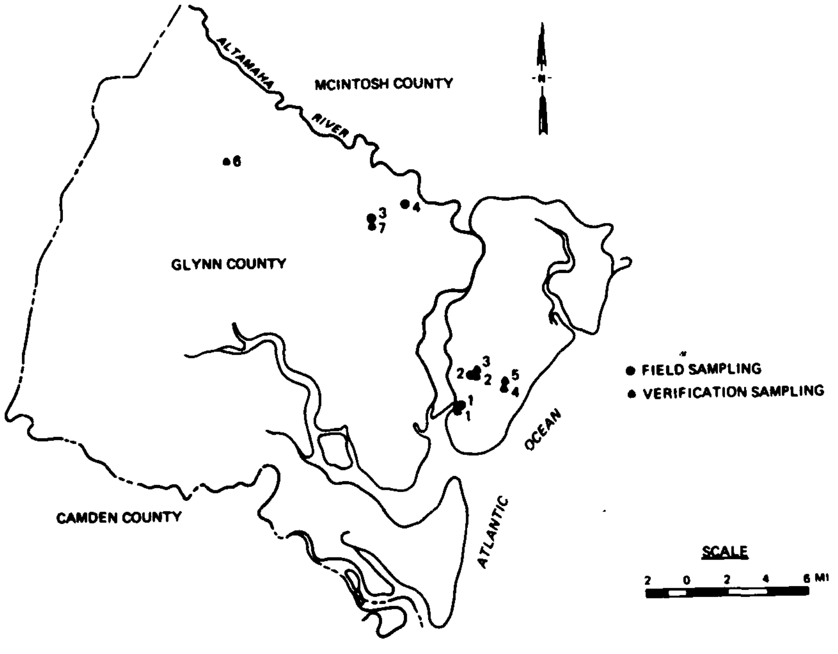

Figure 1. Sampling location for Glynn County, Georgia

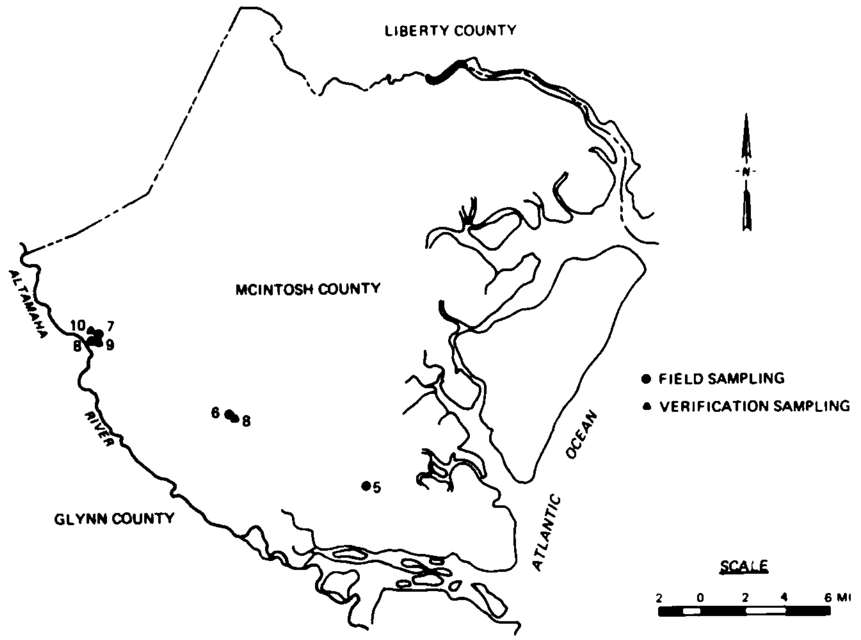

Figure 2. Sampling locations for McIntosh County, Georgia

Transect Location

26. Sampling area boundaries were established based on homogeneity of vegetation and accessibility. Transects were randomly located. Within a suitable sampling area there was an infinite number of transect locations. By breaking the shoreline into a finite number of nonoverlapping, 4-m-wide transects, the transects could be numbered and then selected randomly. Five transects were selected in this manner and were placed parallel to the moisture gradient with the aid of a compass. Gradient analysis requires that sampling units be parallel to the gradient being analyzed.

27. The first quadrat of each transect was placed at approximately the same distance into the wetland community. (In this report, quadrat refers to either a square or rectangular sampling area.) This was accomplished using a common point of reference for all transects. The point was defined as the uplandmost edge of the dominant wetland vegetation present. The transect followed the appropriate compass heading until a zone was reached which supported vegetation known not to tolerate saturated or flooded conditions for an extended period of time. Transect length ranged from 8 to 25 m, depending primarily on transition zone width. The same procedure was followed for both Phase I and II sampling.

Sampling Methodologies

28. All sampling was conducted by a project team consisting of two biologists. Five different sampling methodologies were examined during the Phase I sampling: (a) square quadrats randomly spaced along the transect, (b) square quadrats systematically spaced along the transect, (c) rectangular quadrats randomly spaced along the transect, (d) rectangular quadrats systematically spaced along the transect, and (e) line intercept. The quadrat spacing was dictated to a certain degree by the length of the transect being sampled. An attempt was made to place at least two quadrats in each vegetation zone (i.e., wetland, transition, and upland). However, the transition zones' narrow width often restricted the number of quadrats that could be placed within it. Quadrat size chosen is that customary for the stratum being considered and is presented in Table 1 (Mueller-Dombois and Ellenberg 1974).

Table 1

Sample Unit Sizes Used During Phase I and Phase II

		Sample Unit Size, m		
Communities	Strata	Line Intercept	Square	Rectangle
Phase I				
Salt Flat	Herbaceous	4	1 × 1	1/2 × 2
Disturbed Fresh water	Shrub	4	4 × 4	2 × 8
Marsh, Steep	Canopy	4	10 × 10	5 × 20
Swamp Forest (two transects)				
Gradual Swamp	Herbaceous	1	1 × 1	
Forest, Shrub	Shrub	1		1 × 4
Open Water, Freshwater Marsh, Saltwater Marsh, Steep Swamp Forest	Canopy	1		1 × 4
Phase II				
All Communities	Herbaceous		1 × 1	
	Shrub	Not Used		1 × 4
	Canopy			1 × 4

29. Transition zone width also imposed constraints on quadrat size. Sampling areas had to be large enough to include a representative sample of the most abundant species within the zone, yet be small enough so that each quadrat was fairly homogeneous and changes along the gradient were not obscured. Moreover, quadrat sizes used in transition zones set the size for quadrats in upland and wetland zones since valid comparisons of successive samples cannot be made between quadrats of unequal size. These five methods with the described sampling unit sizes were used in the first three communities sampled (salt flat, disturbed freshwater marsh, and two transects in the steep swamp forest). The tree canopy in the salt flat upland was measured in shrub plots because the upland was an island with insufficient area for replicate 100-m^2 plots. The line intercept method involved use of 4-m segments as the basic sampling unit during Phase I. This sampling methodology is described by Canfield (1941).

30. After sampling three communities, adjustments were made in the sampling methodology. The shrub, open water, freshwater marsh (undisturbed), saltwater marsh, gradual swamp forest, and steep swamp forest communities were sampled using both contiguous 1- by 4-m quadrats (1-m side parallel to the moisture gradient) with nested 1- by 1-m quadrats and the line intercept method. The 1- by 4-m quadrat size represents a compromise between obtaining the resolution desired in locating the transition zone boundary and assuring an adequate vegetation sample.

31. A transect was established by extending two 100-m tapes 4 m apart parallel to the moisture gradient from wetland to upland. Additional tapes were extended between the 100-m tapes at 1-m intervals to establish a 1- by 4-m sample plot. Trees and shrubs were sampled in the resulting sample plot, and herbaceous species were sampled in two 1- by 1-m plots adjacent to the longer tapes. This procedure was repeated for each 1-m interval along the transect.

32. The same 100-m tapes identified above also served as the base lines for sampling units used for the line intercept method. All species intercepting the tapes with a leaf or stem or vertical projection of a leaf or stem were included in the sampling. The time required to sample by each method was recorded, and the order of sampling was alternated in consecutive transects so that familiarity with transect vegetation would not bias the time each method required.

33. Elevations for Phase I were measured with a hand level and telescoping level rod. Measurements were taken every 1 m on each of the five transects sampled per wetland type. Elevations were measured to the nearest 0.05 ft. Where possible, elevations along a particular transect were taken from a single location. All elevations were relative, with the first elevation in the wetland representing zero. Elevations during Phase II sampling were taken only in the first and last quadrat, giving the total change in elevation for a transect.

Measures of Species Abundance

34. The abundance measure should be a sensitive indicator of the "importance" of a species. This measure helps delineate a zone or zones along a gradient where the species most successfully competes in comparison with other species present in the community.

35. Three measures of species abundance were considered during Phase I of the sampling effort: percent cover, diameter at breast height (canopy strata only), and stem counts (shrub strata only). Percent cover is defined as the percent of the ground within a quadrat intercepted by a projection of the canopy. Cover values were recorded for all herbaceous and shrub species rooted in the plot with an estimated cover of 5 percent or greater. All values were estimated to the nearest 5 percent. Diameters at breast height (dbh) were taken for the canopy stratum, while stem counts were made in the shrub stratum. This approach assured a certain flexibility during the data analysis phase at which time techniques using scaled values or a presence-absence representation could be investigated, since these required no additional field sampling.

36. Project team members made independent estimates of cover. Estimates usually agreed within 5 percent, with maximum differences seldom exceeding 10 percent. The strata measured were defined as follows:

a. Herbaceous stratum. All herbaceous and woody species equal to or less than 1 m in height.

b. Shrub stratum. Woody species with heights greater than 1 m and diameters (dbh) less than 5 cm.

c. Canopy stratum. Woody species with diameters (dbh) greater than or equal to 5 cm.

37. Phase II sampling used only percent cover as the measure of species abundance. Cover value estimates were made for all species with an estimated

cover of 5 percent or greater. Species which were not rooted in but had cover in a plot were included if the projection of the quadrat perpendicular to the moisture gradient would have included the plant.

Data Analysis

38. Beta diversity (BD) is defined as between-habitat diversity, or the degree of change in species composition of communities along a gradient (Whittaker 1975). Three different measures of beta diversity were investigated during the analysis of Phase I data.

39. Jaccard's (1901, 1912, 1928) community coefficient (CC) is based on the presence-absence relationship between the number of species common to two areas and the total number of species present:

$$\text{Jaccard CC} = \left(\frac{c}{a + b + c}\right) 100$$

where: c = the number of species common to both areas
a = the number of species unique to area a
b = the number of species unique to area b

40. A similar approach but one which incorporates importance values (percent cover for this report) for the various species is presented by Bray and Curtis (1957):

$$\text{Percent Similarity (PS)} = \sum_{i=1}^{n} \text{Min } (P_{ij})(P_{ik})$$

where P_{ij} and P_{ik} are the relative abundance values for species i in quadrats j and k (the quadrats being compared), and n is the number of species common to both quadrats. Relative abundance values were calculated in the following manner:

$$\begin{array}{l}\text{Relative abundance} \\ \text{for species } i\end{array} = \frac{\text{Percent cover for species } i \text{ in quadrat } j}{\text{Total percent cover for all species in quadrat } j}$$

This method gives more weight to the dominant species where the Jaccard community coefficient gives equal weight to all species.

41. Bratton (1975) offers this dynamic definition of BD:

$$B(g) = \sum_{i=0}^{n} B_i(g)$$

Where B(g) is BD at a point along the gradient, and $B_i(g)$ is the rate at which abundance of the i^{th} species is changing at point g . The total number of species present at point g is represented by n. This measure was approximated by summing the absolute change in abundance (i.e., cover values) of each species between two successive quadrats. The relative rate of change was calculated by dividing B(g) by the total species cover in the first of the two quadrats. A significant increase in the relative rate of change along the gradient should represent a change in community structure.

42. Two alternative strategies were utilized to delineate transition zone boundaries using the three BD indices described above. The first strategy involved calculating BD indices for successive pairs of quadrats. Thus 1 was compared to 2, 2 to 3, 3 to 4, etc. All three indices were examined using this approach. A second alternative compared all quadrats to the two end quadrats. Indices were calculated comparing 1 to 2, 1 to 3, etc., until 1 had been compared to all quadrats along the transect. Given a transect with 20 quadrats, the procedure was then reversed comparing 20 to 19, 20 to 18, and finally 20 to 1. Jaccard's CC along with percent similarity (Bray and Curtis 1957) were calculated using this second alternative.

43. Communities were analyzed both by combining the five transects into a composite transect and by analyzing individual transects. Species cover values for the composite were arrived at by averaging all cover values for a given species in a given quadrat for all five transects.

44. The different combinations of analytical strategies investigated are presented in Table 2. In certain instances analytical techniques were tried on only a portion of the data.

45. Mean, variance, standard deviation, and standard error of the mean were calculated for each species' cover values for a particular quadrat over the five transects or ten line intercepts sampled. Similarly numbered quadrats within a particular community were also compared using percent similarity. These simple statistics gave an indication of the between-transect variability in each community.

Table 2

Alternative Analytical Methods Investigated

	Jaccards' Community Coefficient	Percent Similarity (Bray and Curtis 1957)	Beta Diversity (Bratton 1975)
Phase I			
Successive Quadrats	*	*	*
Quadrats to End Quadrats	*	*	
Composite Transect	**	*	*
Individual Transect	*	**	
Phase II			
Successive Quadrats	*	*	
Quadrats to End Quadrats	*	*	
Composite Transect		*	
Individual Transect	*		

* All communities were analyzed.
** Selected communities were analyzed.

46. The analysis of Phase II data concentrated on a further investigation of Jaccard's community coefficient.

Voucher Specimens

47. Voucher specimens were collected of all dominant plant species in all communities sampled. The plants were pressed, dried, and sprinkled with paradichlorobenzene to prevent insect damage. Each plant was labeled as to scientific name, collection location, collector, and date of collection. Nomenclature followed Radford, Ahles, and Bell (1968) with updating by Wilbur H. Duncan, plant taxonomist at the University of Georgia.

PART III: RESULTS AND DISCUSSION

Sampling Methodologies

Quadrat shape and size

48. Data were analyzed after sampling three communities (salt flat, disturbed freshwater marsh, steep swamp forest). Significant differences between data from square and rectangular plots occurred only where a species was restricted to a narrow zone of the moisture gradient relative to plot size. *Nyssa biflora*, for example, was restricted to a narrow zone at the juncture of the open marsh with a wooded floodplain. This species was virtually absent in the rectangle, but did occur in the upper half of the square in the wetland zone (Table 3). *Liquidambar styraciflua* and *Pinus taeda* were more abundant in the upper half of the transition and upland zones, respectively, and were therefore both better represented in the square plots. The rectangular quadrats more closely defined vegetation zone boundaries where zones were narrow because they bordered shorter segments of the moisture gradient. However, as Tables 3, 4, and 5 illustrate, there were no significant differences between square and rectangular quadrats in number of woody individuals included or mean percent cover of herbaceous species.

49. The line intercept method did not differ greatly from the square and rectangular quadrats in the percent cover recorded for herbaceous species (Table 4). However, the number of woody plants included in the line intercept method was significantly (at least a factor of two and often much greater) lower than in either quadrat shape and did not adequately represent these species (Table 5). A much larger number of line intercepts would be required to get data equivalent to that obtained in a 10- by 10-m plot.

50. Time required for sampling square and rectangular quadrats did not differ greatly (Table 6). The line intercept method required approximately the same time in the predominantly herbaceous salt flat but less time in the disturbed freshwater marsh which had wooded transition and upland zones. This difference in sampling time can be attributed to the different number of trees present in the two communities. A large number of trees increased sampling time for rectangles and squares, while not significantly increasing the time required for the line intercept method due to the smaller number of trees included in the latter survey.

Table 3

Abundance of Tree Species in Square and Rectangular Quadrats in the Disturbed Freshwater Marsh

Species	Zone*	Square Quadrats		Basal Area, cm^2	Rectangular Quadrats		Basal Area, cm^2
		Frequency	Stems	Mean Values	Frequency	Stems	Mean Values
Nyssa biflora	WL**	4	3.2	348	1	0.8	31
	TZ	5	3.6	958	5	5.2	1029
Myrica cerifera	TZ	4	1.2	30	4	1.0	35
Liquidambar styraciflua	TZ**	3	1.2	301	3	0.6	88
	UL	4	1.0	127	3	1.0	184
Pinus taeda	UL**	4	2.0	1058	3	1.4	490
Quercus hemispherica	UL	3	1.2	637	4	2.8	856
Quercus nigra - hemispherica (hybrid)	UL	4	2.2	1044	4	2.4	1644

* WL = Wetland, TZ = Transition Zone, UL = Upland.

** Significant difference ($\alpha = 0.05$) between square and rectangular quadrats in at least one measure.

Table 4

Mean Percent Cover (±SEM) of Four Herbaceous Species and One Shrub Species

Community	Species	Zone*	Square	Rectangle	Line Intercept
Disturbed Freshwater Marsh	*Cladium jamaicense*	WL	45.0 ± 11.0	35.0 ± 14.0	36.0 ± 17.0
Disturbed Freshwater Marsh	*Pontederia cordata*	WL	7.0 ± 1.0	5.0 ± 0.0	8.0 ± 1.0
Disturbed Freshwater Marsh	*Eleocharis quadrangulata*	WL	33.0 ± 10.3	37.0 ± 9.8	25.0 ± 8.0
Salt Flat	*Salicornia virginia*	WL	21.0 ± 7.0	19.0 ± 3.0	15.0 ± 2.0
Steep Swamp Forest	*Myrica cerifera*	WL	7.0 ± 1.0	10.0 ± 3.0	1.0 ± 1.0

* WL = Wetland.

Table 5

Woody Individuals Included in Squares, Rectangles, and Line Intercept Sampling Units

Community	Zone*	Square Mean + SEM**	Rectangle Mean + SEM	Line Intercept Mean + SEM
Disturbed Freshwater Marsh	WL†	4.4 ± 1.9	0.8 ± 0.8	0.6 ± 0.4
	TZ	8.6 ± 1.4	9.3 ± 1.3	0.4 ± 0.2
	UL	9.4 ± 1.0	8.4 ± 1.2	0
Steep Swamp Forest	WL	16.0 ± 0.0	18.5 ± 3.5	2.3 ± 0.3
	TZ	17.0 ± 6.0	18.5 ± 4.5	3.5 ± 0.7
	UL	21.0 ± 4.5	12.5 ± 2.5	5.3 ± 0.75
Salt Flat	UL	0	0	0
	TZ	12.7 ± 2.4	15.0 ± 5.3	0.25 ± 0.25
	UL	13.8 ± 0.8	17.5 ± 2.5	0

* WL = Wetland, TZ = Transition, UL = Upland.
** SEM = standard error of the mean.
† Significant difference ($\alpha = 0.05$) between rectangle and square.

Table 6

Time Required to Sample All Strata

Community	Sampling Method (minutes ± SEM)		
	Square	Rectangle	Line Intercept
Disturbed Freshwater Marsh	12±4	16±2	5±1
Salt Flat	11±2	7±2	10±6

Preliminary results indicated that adjustments should be made in the sampling methodology. Random and systematic placement of quadrats were both inappropriate because of the narrow transition zones present and were eliminated from future sampling. Surveys taken in a 400-m^2 plot in the gradual swamp forest, a 250-m^2 plot in the freshwater marsh, and 100-m^2 plots in the disturbed freshwater marsh and steep swamp forest showed that the average tree density in the wooded areas of these communities was one individual per 10 m^2. However, the plot size required to adequately sample trees was too large to obtain the resolution desired in locating the transition zone boundaries. Therefore it was decided that the original quadrat sizes, while appropriate for sampling the various strata, would result in an unacceptable loss of resolution.

51. The five remaining communities plus the steep swamp forest were

sampled using both contiguous 1- by 4-m quadrats and the line intercept method. Preliminary results had indicated that the line intercept method did not adequately sample the canopy but still might be appropriate for measuring the herbaceous and shrub strata. The line intercept (sample unit size) was reduced from 4 to 1 m.

52. The most favorable sampling method was that which, considering the time spent sampling, gave the highest frequency of occurrence of species among the replicate transects and showed the lowest variability using the ratio of the standard error of the mean (SEM) to the mean as a variability indicator. The frequency of occurrence of woody species was highest in the 1- by 4-m quadrats (35). Herbaceous species were more frequently observed in the 1- by 1-m quadrats (25), while the line intercept method (5) was lower by a factor of five. The frequency data are presented by community in Table 7.

Table 7

Frequency of Occurrence of Woody and Herbaceous Species

	Method				
	Line Intercept		1- × 1-m quadrat		1- × 4-m quadrat
Community	Shrubs	Herbs	Shrubs	Herbs	Shrubs
Freshwater Marsh	1	1	1	12	4
Gradual Swamp Forest	1	-	1	0	6
Steep Swamp Forest	1	1	0	0	9
Open Water	1	2	1	6	4
Saltwater Marsh	0	1	1	4	6
Shrub	0	0	0	3	6
Total	4	5	4	25	35

53. The ratio of the SEM/mean for species which had a frequency of two or more was determined for each sampling method. A low ratio indicates low variability. Twenty shrub species had the lowest ratio in 1- by 4-m quadrats, while one species was lowest in line intercept segments (Table 8). Twelve herbaceous species showed the lowest ratio in 1- by 1-m quadrats, and two were lowest in the line intercept segments. Time differences observed during preliminary sampling were not observed during this latter stage of Phase I (Table 9) since fewer trees were included in the 1- by 4-m quadrats than in the 10- by

Table 8

Number of Woody and Herbaceous Species Showing the Lowest Variability (SEM)

	Method				
	Line Intercept		1- × 1-m quadrat		1- × 4-m quadrat
Community	Shrubs	Herbs	Shrubs	Herbs	Shrubs
Freshwater Marsh	0	2	0	7	5
Gradual Swamp Forest	1	-	0	-	2
Open Water	0	0	0	3	4
Shrub	0	0	1	2	5
Steep Swamp Forest	0	-	0	-	5
Saltwater Marsh	0	-	1	-	2
Total	1	2	2	12	20

Table 9

Sampling Time Required, in Minutes

Community	Quadrat (Mean + SEM)	Line Intercept (Mean + SEM)
Freshwater Marsh	34±3	34±1
Gradual Swamp Forest	20±2	18±1
Open Water	14±2	15±0
Shrub	15±2	16±2
Saltwater Marsh	22±2	29±2
Steep Swamp Forest	18±1	22±2

10-m quadrats, thus reducing the time spent measuring trunk diameters.

54. Since the 1- by 4-m quadrats sampled more woody species with a lower SEM/mean ratio than the line intercept method in approximately the same time, this method was judged superior for sampling the shrub and tree strata. The 1- by 1-m quadrat was the better sample size for herbaceous species for the same reasons. Therefore contiguous 1- by 4-m plots with nested 1- by 1-m quadrats was the "best" sampling method and was used in Phase II sampling.

Abundance measures

55. Separate analysis of strata resulted in the loss of valuable

information since transition zones proved to be areas of physiognomic as well as floristic change. A shift from predominantly herbaceous species to shrub and tree species comprised a critical part of some transition zones which could be characterized only if all strata were combined in the analysis. Two options were considered. First, an abundance measure could be employed that would represent all physiognomic forms. Or second, different abundance measures could be used for each stratum and standardized to an index of relative abundance before similarity comparisons were made.

56. Percent cover was the most flexible of the abundance measurements considered. It can be determined rapidly and represents the ability of a species to exploit space. Since species of all strata share this biological attribute, percent cover is appropriate for measuring all physiognomic forms. By using percent cover, the investigators retained the flexibility of using cover estimates or a simple presence/absence representation during data analysis.

57. Therefore, it was decided that percent cover was the most appropriate abundance measure for use in this study. Cover values for all strata were considered equal in "importance." A species' total cover in a quadrat was recorded as one measurement, even though it might appear in several different strata.

Data Analysis

58. The manner in which community composition changes along an environmental gradient and the manner in which different communities intergrade have resulted in several opposing schools of thought on the subject. For example, the "organismal" school holds that there is discontinuous variation in community composition along environmental gradients and that communities exhibit sharp boundaries along such gradients. The individualistic school holds that community composition varies gradually along environmental gradients, with continuous intergradation between communities (Cox 1980). Whittaker (1975), in his discussion of plant responses to elevational gradients, defines the principle of species individuality:

> Each species is distributed in its own way, according to its own genetic, physiological, and life cycle characteristics and its way of relating to both physical environment and interactions with other species; hence no two species are alike in distribution.

Similar responses were observed in this study. The observations of this study further agree with the principle of community continuity:

> The broad overlap and scattered centers of species populations along a gradient imply that most communities intergrade continuously along environmental gradients, rather than forming distinct, clearly separated zones.

59. In his work in the Great Smoky Mountains, Whittaker concluded that competition did not usually produce sharp boundaries between species populations and that evolution of species in relation to one another does not produce well-defined groups of species with similar distributions. Although discrete boundaries were sometimes observed by him and by the authors of this study, the causes of such boundaries are frequently explained by a sharp environmental discontinuity or by human disturbance. Also, pure stands of one species (e.g., *Juncus roemerianus*) may form a distinct community boundary. Overall, the authors of this study view the environmental gradient from wetland to upland as a line of continuously changing species that seldom exhibits a discrete, easily recognized boundary between associations.

60. Therefore in any classification system, the boundaries between community types will be more or less arbitrary, for these boundaries are determined by the characteristics chosen for classification and the ecologist's choice of where to place the boundaries. There is no single correct way to classify communities. A number of different classification systems have developed. Species dominance, strata structure, and species composition are among the more common community characteristics employed, with species composition being the most common. Species composition in the form of either percent cover or a presence-absence representation was the principal characteristic used for boundary determination in this study. The methods presented in Table 2 were those used for data analysis.

61. Not all of the species sampled were used in the analysis. Species present in both the first and last quadrat were excluded since these plants were not responding to the moisture gradient in an observable way and thus could not contribute to determining the transition zone boundary. Species appearing only once were also eliminated since distribution patterns are difficult to determine from a single occurrence. The chi-square contingency test was used to determine whether a species was randomly distributed or confined to a particular zone and statistically supported the elimination of the

species mentioned above (Ostle and Mensing 1975).

62. Three similar indices were initially investigated: Jaccard's (1901, 1912, 1928) community coefficient, percent similarity (Bray and Curtis 1957), and beta diversity as defined by Bratton (1975). Each index reflected the same general trends, with none emerging as clearly superior. However, Williams and Lambert (1959) suggest that for the recognition of associations, similarity in species combinations (i.e., presence or absence of particular species) is often considered more important than the quantitative contribution of each species. For this reason, Jaccard's community coefficient was chosen and is used in the data analysis for Phases I and II. This particular community coefficient along with its quantitative modifications are among the more widely used indices (Mueller-Dombois and Ellenberg 1974).

63. Transects were initially analyzed both singularly and collectively. The use of a composite required some assurance that the community had been adequately sampled since, theoretically, results should be applicable to the entire community. A low SEM would imply that the sample size was adequate to describe the vegetative community. However, cover estimate variability (as measured by standard error of the mean) was consistently high for a given species in a particular quadrat. This is understandable since a species' absence from only one of the five quadrats comprising the composite would almost automatically result in an unacceptably high SEM (an acceptable SEM was defined as being 10 percent or less of the mean); the number of transects required to reduce the SEM to the required level would be unacceptably high due to the man-hours required.

64. Application of composite results in the field also presents certain problems. The community boundaries determined apply to the composite and not to a particular transect. The critical quadrat or quadrats represent an idealized transition zone for the entire community which may not actually exist at any one particular point in the community. Therefore, the location of this critical zone on the ground would necessarily be somewhat arbitrary. The adopted alternative approach was to consider each transect as a discrete unit. Adequately describing the vegetative community is no longer a concern since each sampling unit is in effect a complete census of the area being analyzed. The boundaries determined by the analysis are a reflection of the biological conditions along a particular transect. The results can be taken and applied to the appropriate transect in the field.

65. A community's transition zone is determined by connecting the critical quadrats for each transect, thus establishing a critical line or zone. (Figure 3). The location of the transition zone will be most accurate at the points where the community was sampled (along the transects). The accuracy of the zone location between transects will be dependent on the uniformity of the zone in this area. The more homogeneous the area is between wetland and upland, the greater the expected accuracy.

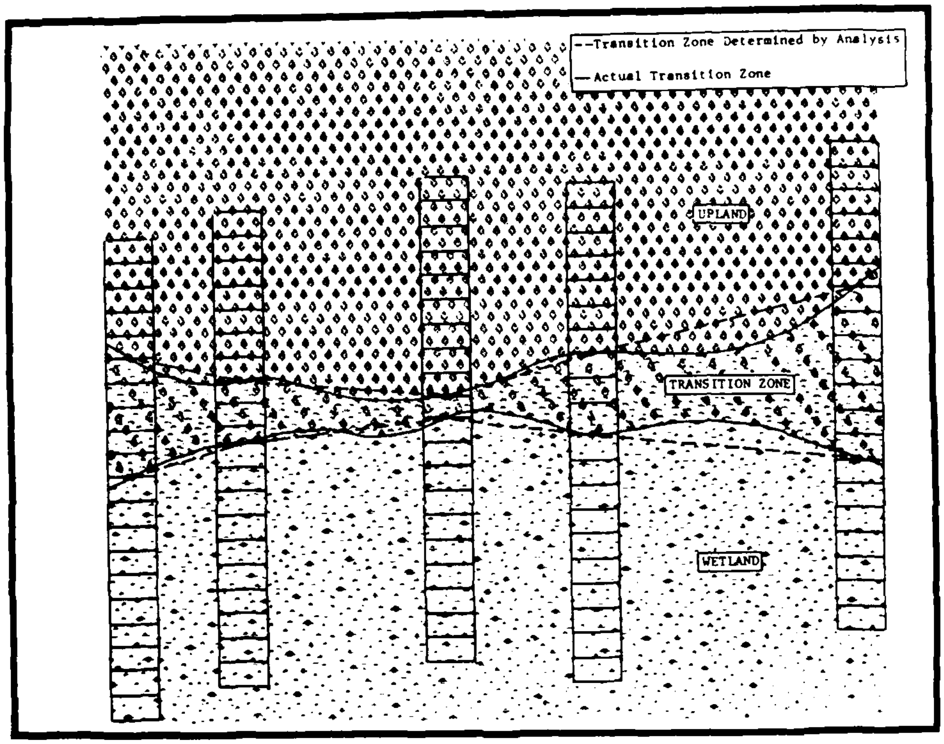

Figure 3. Field application of sampling results

66. The analysis of single transects results in certain irregularities which were partially smoothed out by combining quadrats 1 and 2, 3 and 4, etc. This increased the quadrat size from 1- by 4-m to 2- by 4-m. However, Phase II sampling utilized 1- by 4-m quadrats to retain the flexibility of returning to the smaller quadrats, if desirable.

67. It is difficult to determine the degree of similarity at which two samples should be considered from the same association. Jaccard's community coefficient (based on presence-absence data) rarely exceeds 50 or 60 percent. Neighboring communities within the same association often have less than

two-thirds of the species in common (Mueller-Dombois and Ellenberg 1974). Mueller-Dombois and Ellenberg (1974) state that from their experience, a Jaccard community coefficient of more than 25 percent but less than 50 percent (presence-absence data) indicates that samples are from the same association. For values greater than 50 percent they believe the high similiarity warrants classification beyond the association level. This was not the purpose of this study and, therefore, only the 25 percent figure was considered critical. Occasionally the Jaccard community coefficient would oscillate around the critical value when moving from the wetland or upland community into the transition zone. These aberrations were judged as representing either microhabitats or a continuation of the existing community, and the transition zone boundary was placed accordingly.

68. Community coefficients were calculated comparing both end quadrats, representing the wetland and upland communities, to all other quadrats. The transition zone boundary was defined as the quadrat or space between quadrats where the community coefficient becomes less than or equal to 25 percent. As a means of supporting the boundaries defined by this comparison, quadrat-to-quadrat coefficients were also calculated and the results compared. The critical point defined by the end quadrat comparison coincided with the lowest or second lowest quadrat-to-quadrat community coefficient in 75 percent of the cases. The close correlation of the two analytical approaches supports the contention that the transition zones identified are real and not mere artifacts of the methodology. Transition zone widths varied between transects within a particular community. Average slopes and transition zone widths for each community are presented in Table 10. The Jaccard community coefficients for all communities sampled during Phase I are presented in Appendix A.

69. There appears to be no correlation between transition zone width and slope (Table 10). The freshwater marsh had the smallest average slope and the second widest transition zones, while the open water community, which had the steepest slope, had a zone of intermediate width. One might have suspected that as the severity of the environmental gradient increased (i.e., slope), the width of the transition zone would decrease. However, this is not reflected by the data.

70. Three different transition zone forms were observed: (a) boundary a discrete line (Figure 4A), (b) boundary with no overlap (Figure 4B), and (c) boundary with overlap (Figure 4C). A line transition zone occurred when

Table 10

Community Slope and Transition Zone Characteristics

Community	Average Slope m rise/m run	Average Transition Zone Width, m	Transition Zone Width Variability m min - max
Saltwater Marsh	0.06	3.0	0 - 6
Steep Swamp Forest	0.17	1.6	0 - 4
Gradual Swamp Forest	0.08	9.4	1 - 18
Open Water	0.29	1.0	0 - 4
Shrub	0.03	0.2	0 - 1
Freshwater Marsh	0.02	3.4	1 - 7

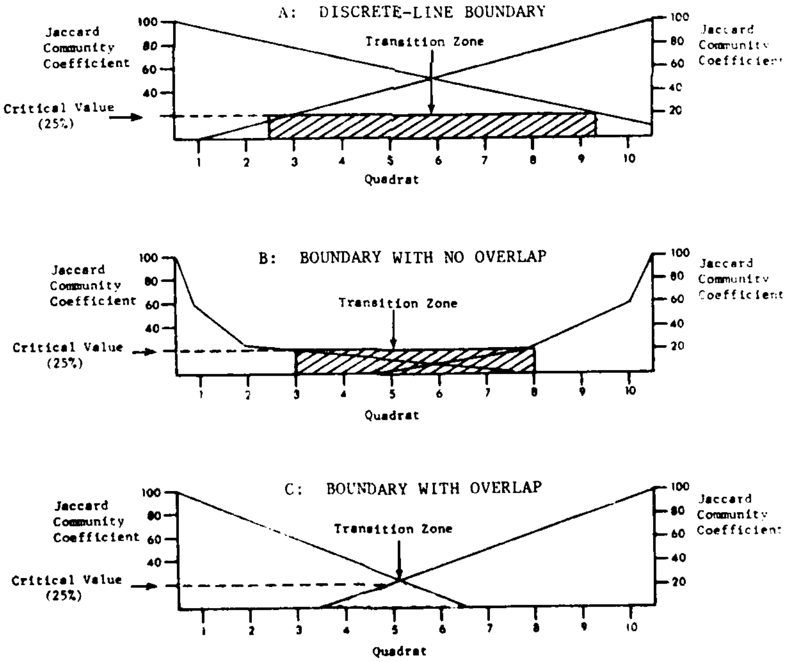

Figure 4. Three different configurations of the transition zone

Jaccard's community coefficient reached a critical value in the same quadrat for the quadrat-to-end quadrat comparison. This situation indicated an abrupt transition between upland and wetland communities, with no real transition zone being present. The shrub community provides a particularly good example of this transition zone. Transects 2, 3, 4, and 5 of the gradual swamp forest (Table A6) illustrate transition zones with boundaries that do not overlap. These zones are characterized by having few plant species in common with either the wetland or upland areas and should be viewed as separate communities with their own characteristic plant species. This was the transition zone type found most often in the communities sampled. The last situation involved transition zone boundaries which overlapped, and was observed infrequently. Transect 5 in the saltwater marsh community is an example of this situation. These zones have species in common with both wetland and upland areas and represent a "transition" between the two communities. Both transition zones B and C are an integral part of the wetland ecosystem. Therefore, the critical point would be the quadrat marking the upland edge of this zone.

71. Phase II data analysis revealed the same general patterns as Phase I. Transition zones again assumed one of the three forms previously described. Critical areas were wider for all communities in Phase II with the exception of the gradual swamp forest. The differences varied greatly, with some communities having similar average widths for both phases (saltwater marsh, steep swamp forest, and open water), while others changed by as much as a factor of 12. The patterns were similar, with the shrub and open water communities lowest in both phases. The widest transition zone in Phase II was located in the freshwater marsh, while in Phase I this community exhibited the second widest zone. In Phase I the gradual swamp forest was widest while having an intermediate width in Phase II. The saltwater marsh transition zone had an intermediate width for both. A summary of Phase II sampling results is presented in Table 11.

72. Transition zone widths vary greatly both within and between communities. This fact is a reflection of the highly variable nature of the transition zone in the field.

73. This method of determining transition zone boundaries allows the use of either composite transect analysis or analysis of individual transects. Composite transect analysis results in a line or zone of constant width, while analysis of individual transects results in a zone of varying widths.

Table 11

Minimum, Maximum, and Average Transition Zone Widths

Community	Transition Zone Width, m (min - max)	Average Transition Zone Width, m
Shrub (A)	1 - 8	4.0
Shrub (B)	0 - 6	2.4
Freshwater Marsh	7 - 16	12.6
Salt Flat (A)	8 - 14	10.8
Salt Flat (B)	0 - 11	4.4
Swamp Forest (A)	0 - 7	3.0
Swamp Forest (B)	0 - 3	3.2
Saltwater Marsh	1 - 9	3.6
Open Water (A)	0 - 3*	1.4
Open Water (B)	Not Calculated	Not Calculated

* The transition zone fell somewhere in a three-quadrat area occupied by a road passing through all transects, making a more precise determination impossible.

Individual transect analysis should be used when a high degree of resolution of zone boundaries is required. However, the use of greater numbers of transects will increase the cost of the determination.

74. The two analytical strategies used for transition zone determination were not as highly correlated in Phase II as they were in Phase I. For narrow transition zones (1 to 2 m), the two strategies defined the same boundary in 60 percent of the cases. Wide transition zones (greater than 2 m) agreed 52 percent of the time. In cases of disagreement the difference was normally not greater than 2 m. The complete results for Phase II are presented in Appendix B.

75. An idealized picture of plant distribution was constructed for each community by combining all five transects (Appendix C: Phase I, Appendix D: Phase II). This provides a generalized overview of the plant distribution encountered in each community and graphically illustrates many of the situations discussed in previous sections.

PART IV: CONCLUSIONS

76. In searching for the best method to define transition zone boundaries, six sampling methodologies, three indices of similarity, and four different analytical strategies were examined. The process is graphically presented in Figure 5.

77. Transition zone narrowness and an effort to improve boundary resolution resulted in the early elimination of four sampling methodologies. Contiguous plots improved boundary definition, while the 1- by 4-m quadrat size involved compromising between the resolution desired and the sampling area required. A strategy based on the analysis of individual transects was superior due to the inherent variability observed in transition zone width. This approach also provides the flexibility of establishing the resolution desired on a case-by-case basis. A two-person team could be expected to sample five to ten 25-m transects per day depending on the density of the vegetation. After the sampling area has been established, the suggested approach is as follows:

- a. Randomly locate transects within the sampling area.
- b. Record presence-absence data for plant species in contiguous 1- by 4-m quadrats along each transect.
- c. Calculate Jaccard community coefficients for each transect (quadrat to end quadrat).
- d. Locate critical quadrat(s) along each transect (Jaccard community coefficient less than or equal to 25 percent).
- e. Locate these critical points along the appropriate transects in the field.
- f. Connect the critical points laterally forming the boundaries of the transition zone.

In conclusion, the described "best method" offers the following advantages:

- a. It does not rely on the presence of "indicator" species; rather, the boundaries are ecologically determined by the position of plant species comprising the wetland, upland, and transition zone communities.
- b. It is uncomplicated, technically reproducible, and therefore amenable to the legal interpretation in defining wetland boundaries.
- c. The field and statistical procedures are well documented in the literature.
- d. The "best method" is applicable to a variety of physiognomic types.
- e. Field application is uncomplicated, and a minimum of training is required for proper implementation by field personnel.

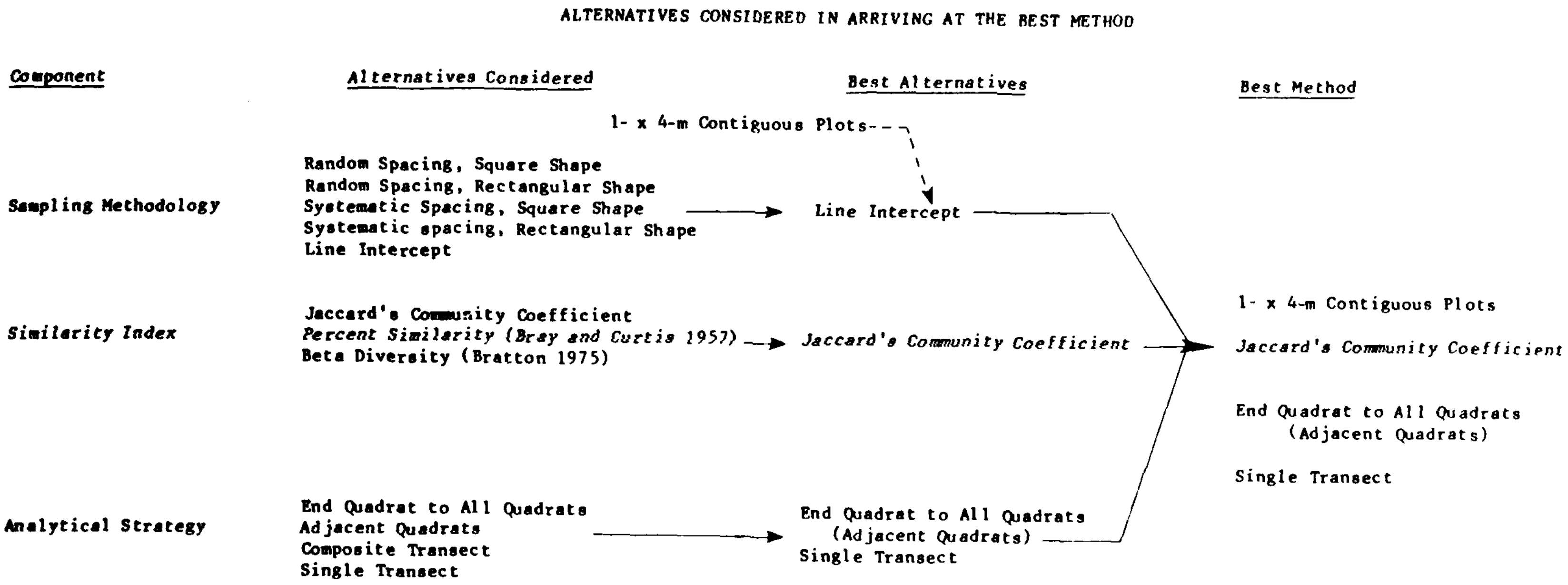

Figure 5. Alternatives considered in arriving at the "best method"

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APPENDIX A: JACCARD COMMUNITY COEFFICIENTS FOR PHASE I SAMPLING

Table A1

Jaccard Community Coefficients for the Steep Swamp Forest Community

Transect								
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		67	25	33	67	100	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	67	0	0	0	0	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	25	67	100	100	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		50	20	50	100	29	25
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	50	20	29	29	0	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	0	0	0	25	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		100	50	50	50	83	40
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	100	50	20	13	14	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	33	33	34	40	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		100	33	75	38	100	57
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	100	33	50	20	20	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	17	14	57	57	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		78	50	50	60	29	75
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	78	30	0	22	10	0
	Quadrats Compared	7,1	7.2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	9	13	20	14	75	100

Table A2

Jaccard Community Coefficients for the Salt Shrub Community

Transect								
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		67	57	67	80	17	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	67	29	50	60	0	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	0	0	0	67	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		50	83	50	38	57	60
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	50	60	60	13	0	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	13	0	0	29	60	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		60	60	50	25	57	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	60	100	50	0	0	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	0	0	29	67	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		100	50	57	50	63	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	100	50	43	11	10	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	0	13	11	25	33	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7
	Jaccard Community Coefficient		86	78	67	83	14	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7
	Jaccard Community Coefficient	100	86	67	71	57	13	0
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7
	Jaccard Community Coefficient	0	14	11	0	0	33	100

Table A3

Jaccard Community Coefficients for the Freshwater Marsh Community

Transect											
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		44	57	11	14	60	20	33	25	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	44	33	33	0	9	0	11	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	25	40	100	25	33	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		82	67	43	57	58	40	67	40	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	82	42	24	12	6	8	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	8	20	22	17	40	100	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		64	58	64	60	33	50	57	63	75
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	64	36	31	30	8	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	6	7	6	8	18	50	75	75	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		82	67	58	64	50	50	13	50	13
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	82	50	36	31	23	17	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	9	11	13	17	50	33	100
Transect (Continued)											
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		47	50	38	67	82	54	55	88	86
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	47	43	16	20	18	6	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	13	6	21	25	42	50	75	86	100

Table A4

Jaccard Community Coefficients for the Saltwater Marsh Community

Transect											
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		25	60	17	33	44	67	60	64	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	25	0	0	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	11	29	22	27	44	50	67	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		33	43	30	63	75	30	50	40	60
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	33	14	0	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	10	11	22	65	67	75	60	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		67	67	9	64	75	56	78	38	17
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	67	33	0	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	36	18	9	20	33	17	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		50	33	100	25	60	71	100	50	83
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	50	0	0	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	14	13	13	38	50	63	56	83	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		60	29	40	50	20	75	60	75	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	60	43	0	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	17	50	67	25	67	50	50	67	100

Table A5

Jaccard Community Coefficients for the Open Water Community

Transect									
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8
	Jaccard Community Coefficient		50	33	44	57	100	25	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
	Jaccard Community Coefficient	100	50	0	0	0	0	0	0
	Quadrats Compared	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
	Jaccard Community Coefficient	0	0	9	30	25	25	100	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8
	Jaccard Community Coefficient		75	20	17	50	60	60	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
	Jaccard Community Coefficient	100	75	0	0	0	0	0	0
	Quadrats Compared	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
	Jaccard Community Coefficient	0	13	40	67	50	50	50	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8
	Jaccard Community Coefficient		67	22	40	33	75	56	43
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
	Jaccard Community Coefficient	100	67	0	0	0	0	0	0
	Quadrats Compared	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
	Jaccard Community Coefficient	0	20	17	20	43	43	43	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8
	Jaccard Community Coefficient		50	14	57	83	50	67	63
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
	Jaccard Community Coefficient	100	50	0	0	0	0	0	0
	Quadrats Compared	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
	Jaccard Community Coefficient	0	0	22	43	38	33	63	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8
	Jaccard Community Coefficient		33	40	88	44	43	0	20
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
	Jaccard Community Coefficient	100	33	0	0	0	0	0	0
	Quadrats Compared	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
	Jaccard Community Coefficient	0	29	43	33	17	50	20	100

Table A6

Jaccard Community Coefficients for the Gradual Swamp Forest Community*

Transect													
1	Quadrats Compared	-	-	-	4,5	5,6	6,7	7,8	8,9	9,10	-	-	
	Jaccard Community Coefficient	-	-	-	50	67	67	67	50	25	-	-	
	Quadrats Compared	-	-	4,4	4,5	4,6	4,7	4,8	4,9	4,10	-	-	
	Jaccard Community Coefficient	-	-	100	50	75	50	75	40	0	-	-	
	Quadrats Compared	-	-	10,4	10,5	10,6	10,7	10,8	10,9	10,10	-	-	
	Jaccard Community Coefficient	-	-	20	0	0	0	0	25	100	-	-	
2	Quadrats Compared	-	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	-	-	
	Jaccard Community Coefficient	-	0	33	100	100	67	20	50	60	-	-	
	Quadrats Compared	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	-	-	
	Jaccard Community Coefficient	100	0	0	0	0	0	0	0	0	-	-	
	Quadrats Compared	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10	-	-	
	Jaccard Community Coefficient	0	0	0	0	0	0	40	60	100	-	-	
3	Quadrats Compared	-	-	-	4,5	5,6	6,7	7,8	8,9	9,10	-	-	
	Jaccard Community Coefficient	-	-	-	25	60	33	67	67	50	-	-	
	Quadrats Compared	-	-	4,4	4,5	4,6	4,7	4,8	4,9	4,10	-	-	
	Jaccard Community Coefficient	-	-	100	25	0	0	0	0	0	-	-	
	Quadrats Compared	-	-	-	10,4	10,5	10,6	10,7	10,8	10,9	10,10	-	-
	Jaccard Community Coefficient	-	-	-	0	0	20	50	33	50	100	-	-
4	Quadrats Compared	-	-	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient	-	-	40	60	75	60	67	67	60	33	50	25
	Quadrats Compared	-	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
	Jaccard Community Coefficient	-	100	40	17	20	14	14	0	0	14	17	0
	Quadrats Compared	-	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,11
	Jaccard Community Coefficient	-	0	0	0	0	0	0	0	0	20	25	100
5	Quadrats Compared	-	1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient	-	33	20	50	50	50	33	17	80	29	43	20
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	33	0	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,11
	Jaccard Community Coefficient	0	0	0	0	0	0	0	0	0	20	20	100

* Vegetation patterns made it necessary to adjust end quadrats to which comparisons were made.

APPENDIX B: JACCARD COMMUNITY COEFFICIENTS FOR PHASE II SAMPLING

Table B1

Jaccard Community Coefficients for the Swamp Forest (A) Community*

Transect													
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		67	67	25	50	33	33	67	25	40	50	25
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	67	33	25	25	0	25	0	25	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	20	33	20	25	50	75	25	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	
	Jaccard Community Coefficient		67	50	33	0	33	25	50	33	40	80	
	Quadrats Compared	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	-	
	Jaccard Community Coefficient	100	67	25	50	0	25	0	0	0	0	-	
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11	
	Jaccard Community Coefficient	0	0	0	0	25	40	25	20	50	80	100	
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	
	Jaccard Community Coefficient		100	50	33	100	100	50	67	75	75	67	
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	
	Jaccard Community Coefficient	100	100	50	0	0	0	0	0	0	0	0	
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11	
	Jaccard Community Coefficient	0	0	0	33	50	100	67	50	67	100		
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	
	Jaccard Community Coefficient		50	25	0	50	25	50	20	40	67	50	
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	
	Jaccard Community Coefficient	100	50	0	0	0	0	0	0	0	0	0	
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11	
	Jaccard Community Coefficient	0	0	0	33	25	20	20	20	40	50	100	
5	Quadrats Compared			2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	
	Jaccard Community Coefficient			100	0	0	100	50	33	60	80	25	
	Quadrats Compared		2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	
	Jaccard Community Coefficient		100	100	0	33	33	0	0	0	0	0	
	Quadrats Compared		11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11	
	Jaccard Community Coefficient		0	0	0	50	50	100	33	20	25	100	

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* Vegetation patterns made it necessary to adjust end quadrats to which comparisons were made.

Table B2

Jaccard Community Coefficients for the Freshwater Marsh Community

Transect													
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		100	31	54	42	44	44	63	17	0	33	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	100	38	21	8	9	8	8	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	9	13	0	0	0	0	33	33	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		50	38	50	40	29	40	40	33	29	17	25
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	50	33	27	20	11	14	11	11	10	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	15	0	22	0	17	0	0	0	17	25	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		43	50	75	50	43	33	20	43	33	0	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	43	22	13	13	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	13	0	17	0	33	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		75	33	50	33	50	27	14	33	17	0	0
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	75	22	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	0	0	0	25	0	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		75	57	43	45	70	56	25	75	40	75	40
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	75	43	13	10	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	11	0	8	11	25	50	40	50	40	100

Table B3

Jaccard Community Coefficients for the Shrub (A) Community

Transect											
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	50	100	25	67	0	60	60	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	50	50	0	0	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	0	0	20	33	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	67	67	67	50	50	60	60	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	67	33	25	20	25	17	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	0	0	20	33	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	40	17	67	50	60	75	60	60
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	40	20	25	17	17	20	14	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	17	40	20	60	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	25	40	60	50	100	67	67	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	25	40	50	33	33	25	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	0	0	33	50	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	100	0	33	67	50	100	100	20
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	100	0	25	33	20	20	20	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	25	0	20	20	20	100

Table B4

Jaccard Community Coefficients for the Shrub (B) Community

Transect												
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11
	Jaccard Community Coefficient		71	44	78	60	63	67	0	0	67	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11
	Jaccard Community Coefficient	100	71	44	36	30	20	10	0	0	0	0
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11
	Jaccard Community Coefficient	0	0	0	0	0	14	20	33	33	67	100
2*	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	-	-
	Jaccard Community Coefficient		83	63	50	29	25	0	0	50	-	-
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	-	-
	Jaccard Community Coefficient	100	83	50	42	13	20	20	0	0	-	-
	Quadrats Compared	9,1	9,2	9,3	9,4	9,5	9,6	9,7	9,8	9,9	-	-
	Jaccard Community Coefficient	0	0	0	0	0	0	0	50	100	-	-
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11
	Jaccard Community Coefficient		67	60	40	75	0	50	17	50	33	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11
	Jaccard Community Coefficient	100	67	33	50	33	14	0	0	0	0	0
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11
	Jaccard Community Coefficient	0	0	0	0	0	20	20	40	25	67	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11
	Jaccard Community Coefficient		67	100	57	50	20	0	33	33	33	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11
	Jaccard Community Coefficient	100	67	67	80	33	0	0	0	0	0	0
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11
	Jaccard Community Coefficient	0	0	0	0	0	0	33	33	33	100	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11
	Jaccard Community Coefficient		75	60	42	60	17	20	50	50	25	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11
	Jaccard Community Coefficient	100	75	80	42	17	33	0	0	0	0	0
	Quadrats Compared	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	11,9	11,10	11,11
	Jaccard Community Coefficient	0	0	0	0	0	20	100	50	33	67	100

* Vegetation patterns made it necessary to adjust end quadrats to which comparisons were made.

Table B5

Jaccard Community Coefficients for the Swamp Forest (B) Community

Transect											
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	20	25	50	33	33	13	50	38
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	20	0	0	20	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	13	33	17	29	57	38	38	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	60	75	100	50	40	42	33	44
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	60	40	40	17	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	11	13	13	29	42	56	44	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	100	100	33	100	50	50	50	40
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	100	100	33	33	33	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	40	40	40	40	40	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	50	50	67	67	67	50	100	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	50	33	25	33	25	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	25	50	25	50	100	100	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		80	29	60	100	50	67	33	67	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	80	42	14	14	14	17	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	33	50	50	50	25	67	100	100

Table B6

Jaccard Community Coefficients for the Salt Flat (A) Community

Transect													
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		40	57	57	60	67	33	50	33	60	40	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	40	14	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	33	0	0	20	33	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		67	33	67	60	50	50	67	25	100	40	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	67	17	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	25	33	0	0	50	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		40	57	57	60	67	33	67	33	43	17	25
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	40	14	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	0	0	14	33	25	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		33	71	43	75	33	25	40	75	20	33	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	33	14	0	0	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	0	25	20	33	100	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		60	83	71	83	60	67	100	33	67	40	75
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	60	50	29	14	0	0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	0	0	0	0	0	20	75	100

Table B7

Jaccard Community Coefficients for the Salt Flat (B) Community

Transect											
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		33	83	86	57	33	40	20	67	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	33	29	43	40	17	20	20	25	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	20	25	25	33	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		67	71	50	100	20	60	50	75	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	67	43	17	17	0	13	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	17	17	33	33	66	40	50	66	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		40	83	43	100	22	38	50	67	29
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	40	33	20	20	13	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	14	14	22	29	29	29	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		71	75	75	88	63	33	20	100	100
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	71	50	33	30	25	0	0	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	11	10	0	20	100	100	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10
	Jaccard Community Coefficient		100	75	33	50	50	100	50	40	0
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	75	25	20	14	14	13	0	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	0	0	0	0	20	0	100

Table B8

Jaccard Community Coefficients for the Openwater (A) Community

Transect							
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6
	Jaccard Community Coefficient		40	67	50	42	60
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6
	Jaccard Community Coefficient	100	40	50	14	0	0
	Quadrats Compared	6,1	6,2	6,3	6,4	6,5	6,6
	Jaccard Community Coefficient	0	14	25	42	60	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6
	Jaccard Community Coefficient		38	60	56	50	67
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6
	Jaccard Community Coefficient	100	38	22	13	0	0
	Quadrats Compared	6,1	6,2	6,3	6,4	6,5	6,6
	Jaccard Community Coefficient	0	8	20	25	67	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6
	Jaccard Community Coefficient		50	13	63	30	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6
	Jaccard Community Coefficient	100	50	13	11	0	0
	Quadrats Compared	6,1	6,2	6,3	6,4	6,5	6,6
	Jaccard Community Coefficient	0	20	13	11	50	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6
	Jaccard Community Coefficient		14	88	63	33	75
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6
	Jaccard Community Coefficient	100	14	13	0	0	0
	Quadrats Compared	6,1	6,2	6,3	6,4	6,5	6,6
	Jaccard Community Coefficient	0	11	10	14	75	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6
	Jaccard Community Coefficient		40	83	71	14	33
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6
	Jaccard Community Coefficient	100	40	33	33	0	0
	Quadrats Compared	6,1	6,2	6,3	6,4	6,5	6,6
	Jaccard Community Coefficient	0	0	0	17	33	100

Table B9

Jaccard Community Coefficients for the Saltwater Marsh Community

Transect											
1	WAS NOT ANALYZED										
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7			
	Jaccard Community Coefficient		100	50	33	13	50	57			
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7			
	Jaccard Community Coefficient	100	50	14	0	0	0	0			
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7			
	Jaccard Community Coefficient	0	0	13	50	43	57	100			
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7			
	Jaccard Community Coefficient		33	40	80	67	20	25			
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7			
	Jaccard Community Coefficient	100	33	25	20	20	0	0			
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7			
	Jaccard Community Coefficient	0	17	60	50	80	25	100			
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7			
	Jaccard Community Coefficient		75	60	80	57	71	67			
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7			
	Jaccard Community Coefficient	100	75	40	33	29	29	0			
	Quadrats Compared	7,1	7,2	7,3	7,4	7,5	7,6	7,7			
	Jaccard Community Coefficient	0	0	14	29	43	67	100			
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8*	8,9	9,10
	Jaccard Community Coefficient		100	67	33	43	43	71	50	43	60
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10
	Jaccard Community Coefficient	100	100	67	50	17	50	50	50	17	0
	Quadrats Compared	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8	10,9	10,10
	Jaccard Community Coefficient	0	0	0	25	33	11	25	29	60	100

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* Vegetation patterns made it necessary to extend the transect.

Table B10

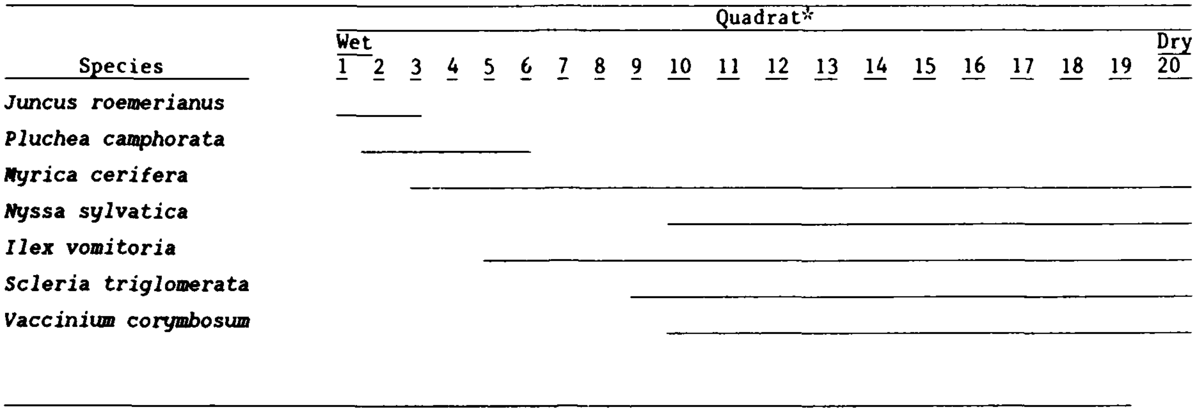
Jaccard Community Coefficients for the Openwater (B) Community

Transect													
1	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		17	50	67		ROAD			57	42	83	80
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	0	33	50		ROAD		0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	17	0	0		ROAD		57	60	67	80	100
2	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		33	75	50	50		ROAD		50	57	44	75
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	33	25	50	100	ROAD		0	17	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	13	11	0	0		ROAD	13	20	22	75	100
3	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		25	50	33	25		ROAD			67	80	80
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	25	20	33	0		ROAD		0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	13	11	0	0		ROAD		67	100	80	100
4	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		50	67	67		ROAD		40	60	50	60	50
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	50	33	50	ROAD		0	0	25	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	ROAD		60	50	33	43	50	100
5	Quadrats Compared		1,2	2,3	3,4	4,5	5,6	6,7	7,8	8,9	9,10	10,11	11,12
	Jaccard Community Coefficient		33	67	60		ROAD		42	71	38	22	57
	Quadrats Compared	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
	Jaccard Community Coefficient	100	33	33	20	ROAD		0	0	0	0	0	0
	Quadrats Compared	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8	12,9	12,10	12,11	12,12
	Jaccard Community Coefficient	0	0	0	0	ROAD		29	22	38	42	57	100

APPENDIX C: SPECIES DISTRIBUTION BY COMMUNITY FOR PHASE I SAMPLING

Figure C1

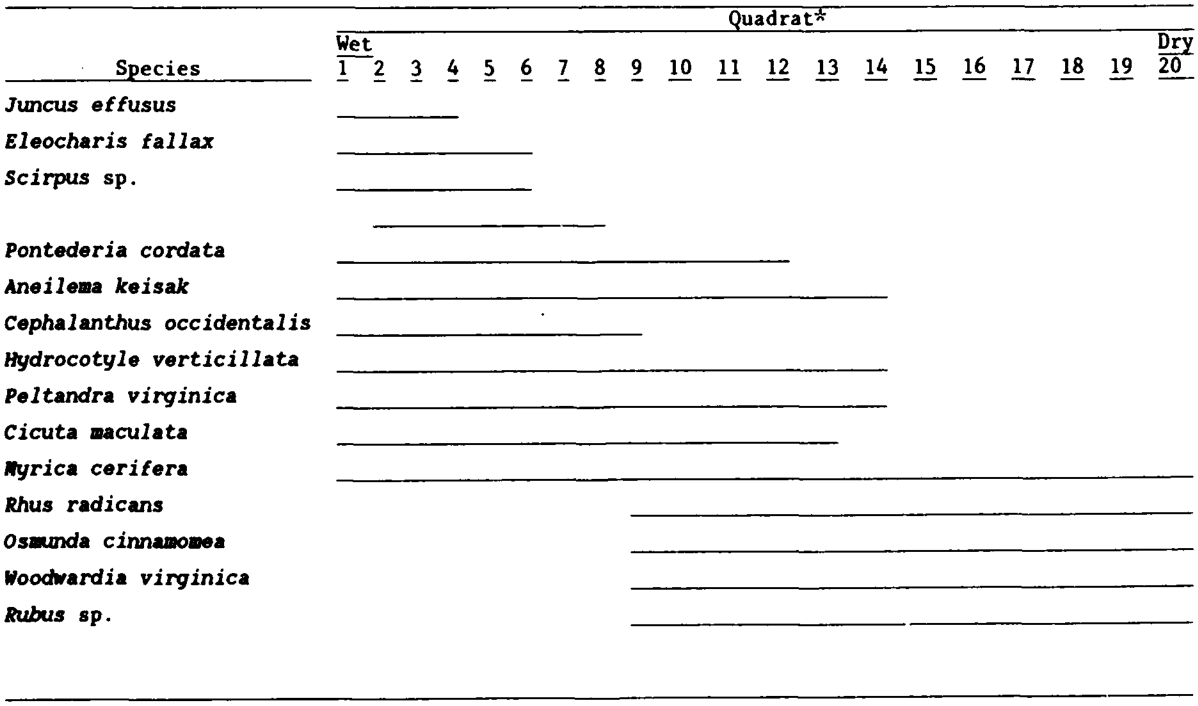
Species Distribution in the Saltwater Marsh Community



* Each quadrat number represents an interval of 1 m.

Figure C2

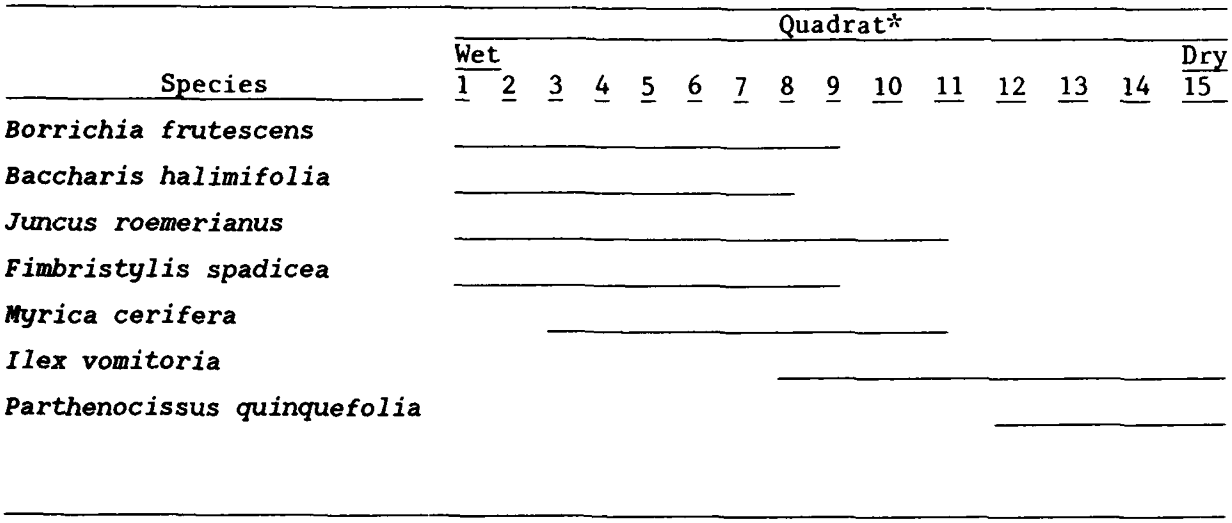
Species Distribution in the Freshwater Marsh Community



* Each quadrat number represents an interval of 1 m.

Figure C3

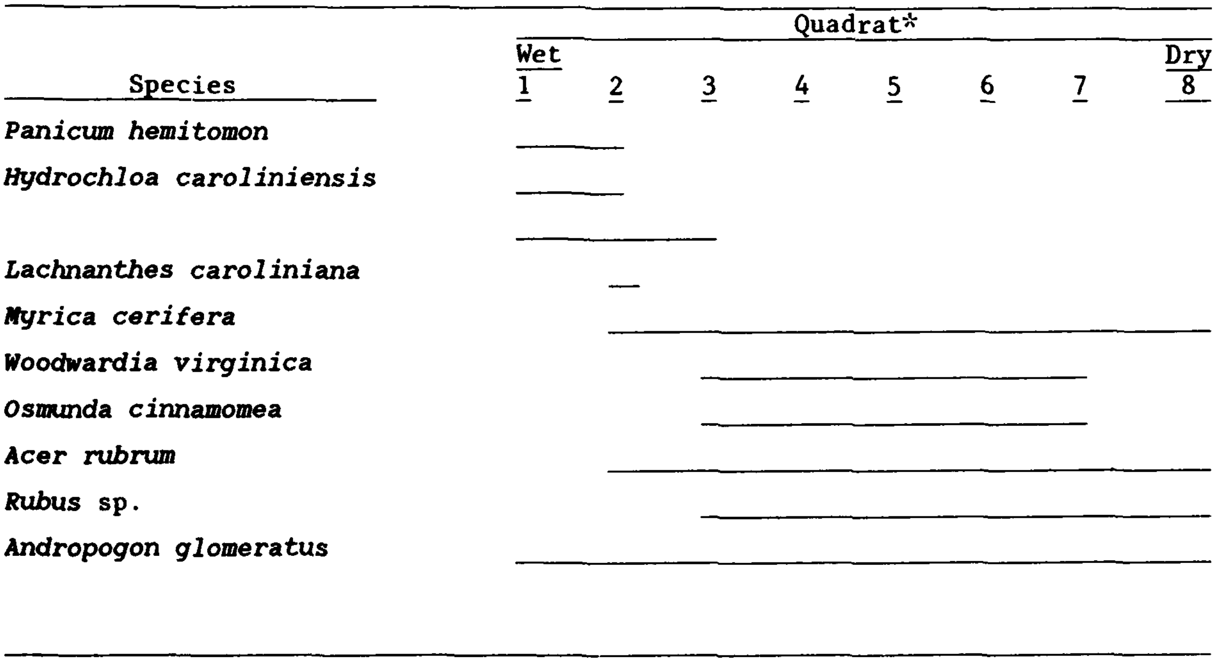
Species Distribution in the Shrub Community



* Each quadrat number represents an interval of 1 m.

Figure C4

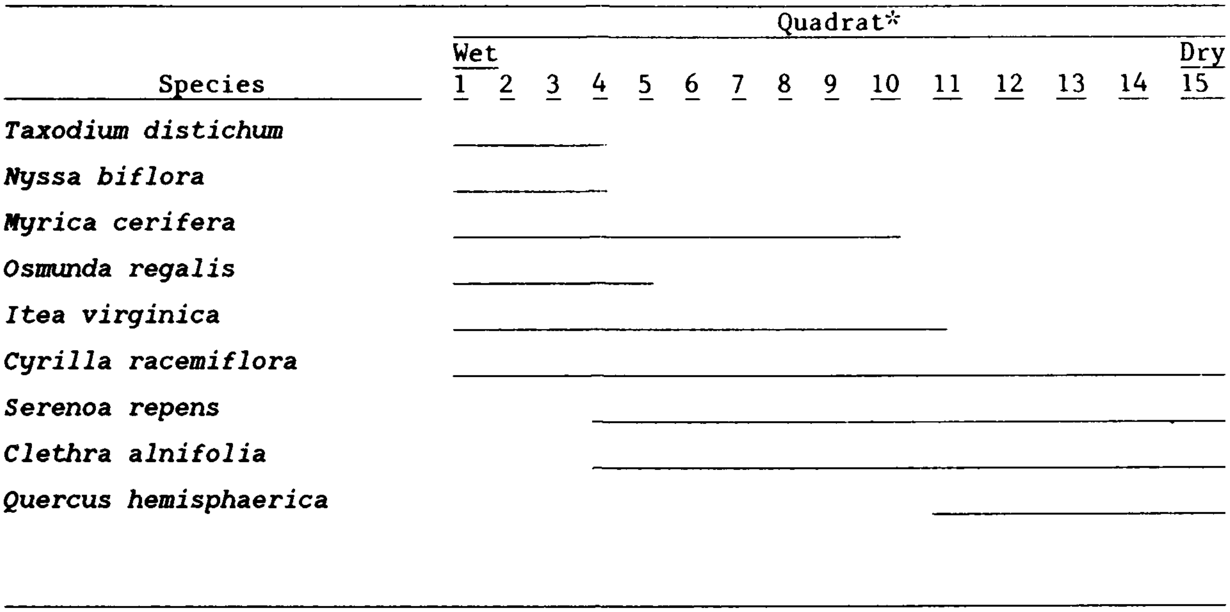
Species Distribution in the Openwater Community



* Each quadrat number represents an interval of 1 m.

Figure C5

Species Distribution in the Swamp Forest (Steep) Community

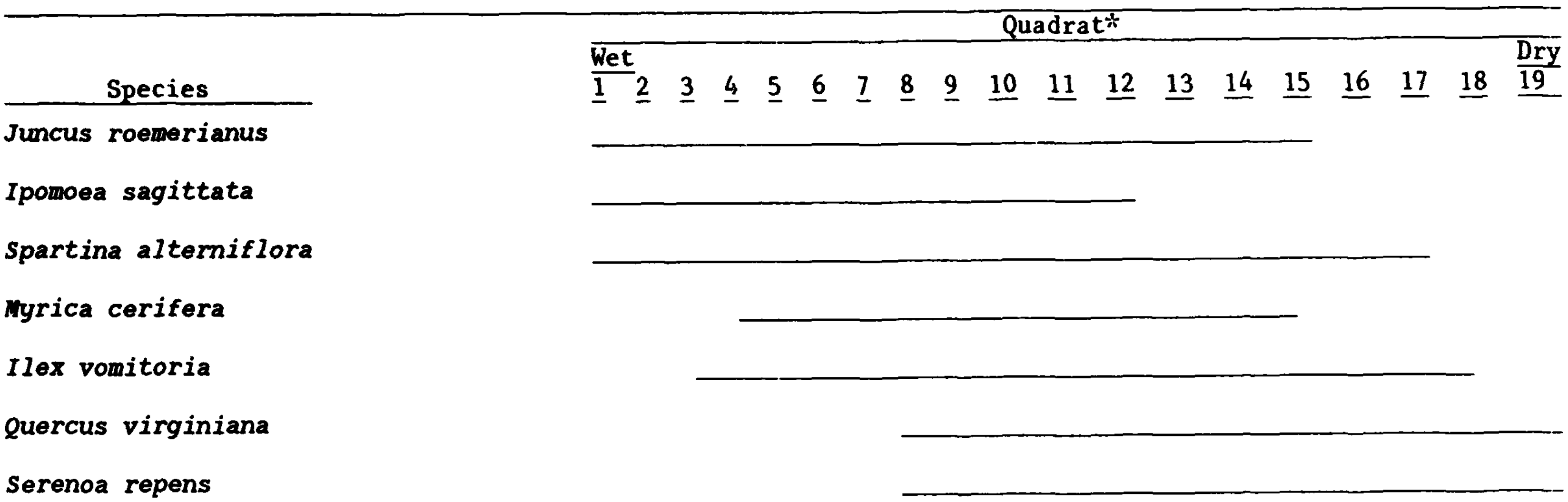


* Each quadrat number represents an interval of 1 m.

APPENDIX D: SPECIES DISTRIBUTION BY COMMUNITY FOR PHASE II SAMPLING

Figure D1

Species Distribution in the Saltwater Marsh Community



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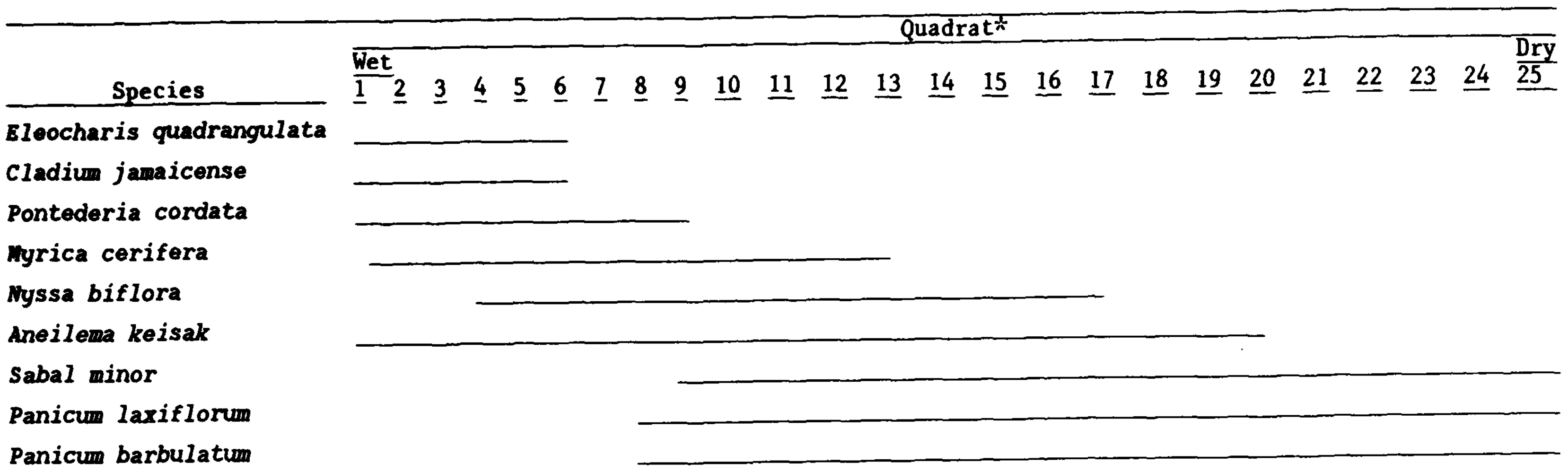
* Each quadrat number represents an interval of 1 m.

Figure D2

Species Distribution in the Freshwater Marsh (Disturbed) Community



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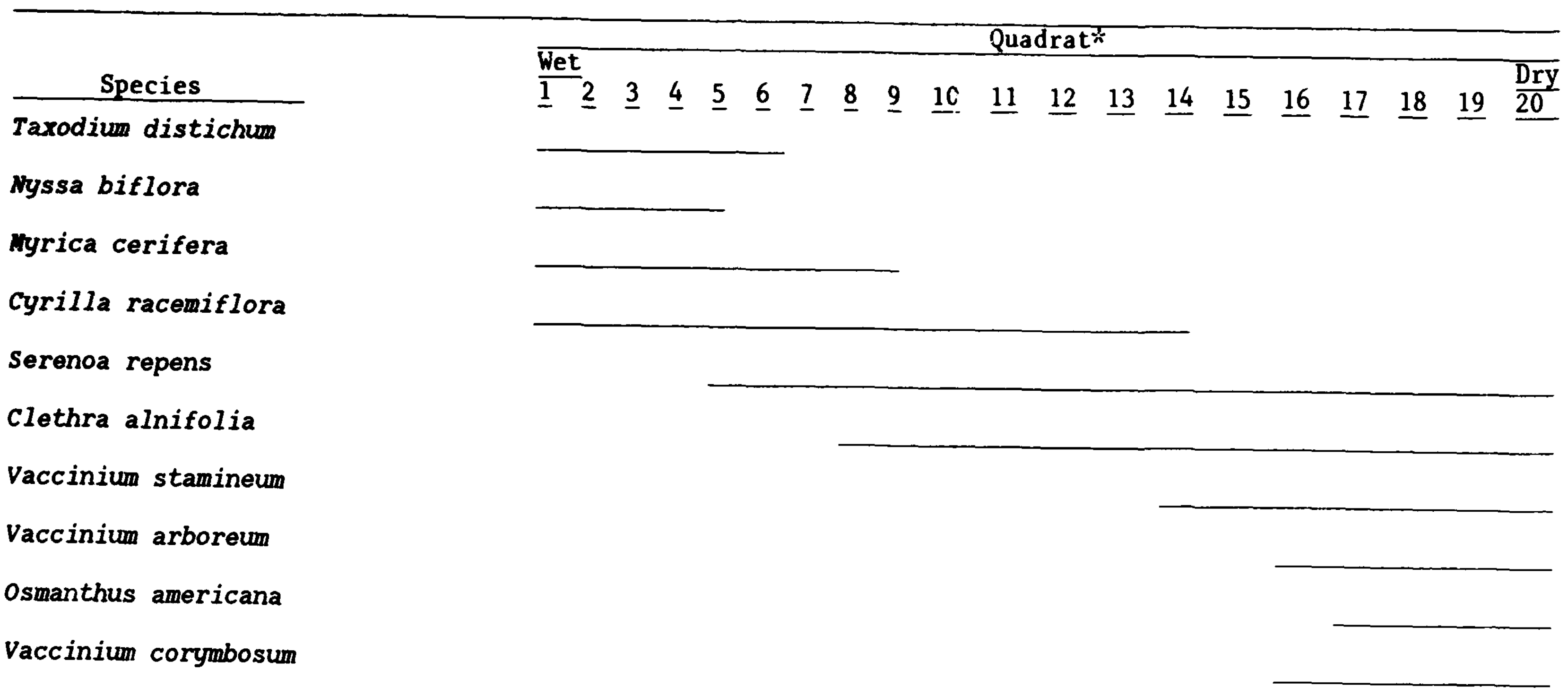
* Each quadrat number represents an interval of 1 m.

Figure D3

Species Distribution in the Swamp Forest (Steep) Community



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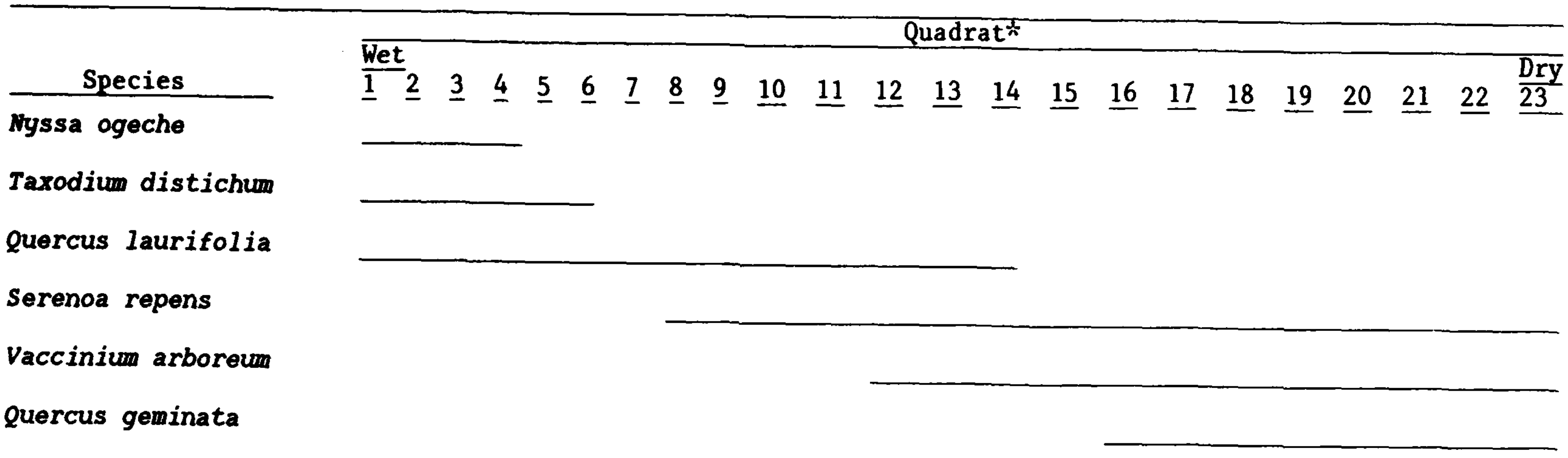
* Each quadrat number represents an interval of 1 m.

Figure D4

Species Distribution in the Swamp Forest (Gradual) Community



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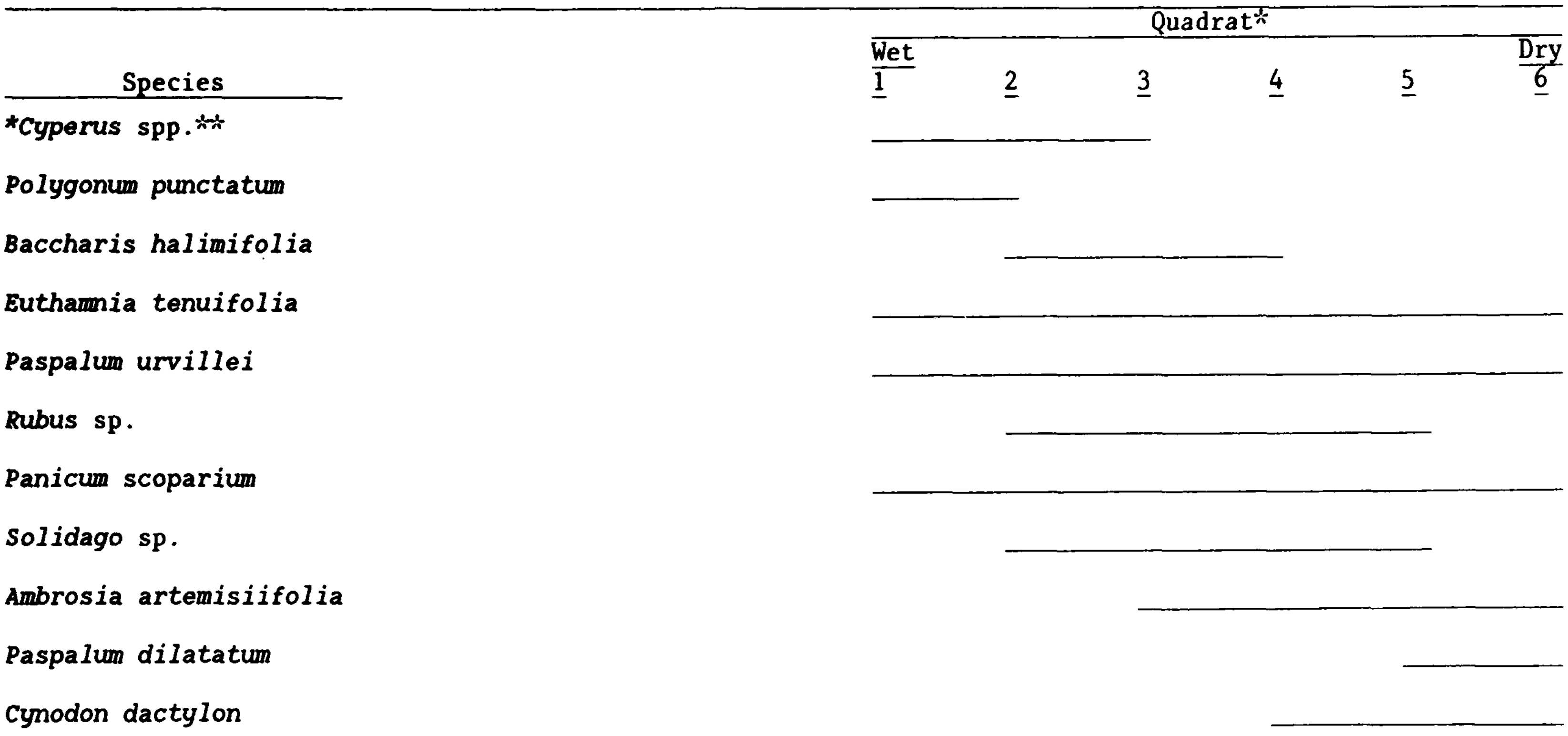
* Each quadrat number represents an interval of 1 m.

Figure D5

Species Distribution in the Openwater (A) Community



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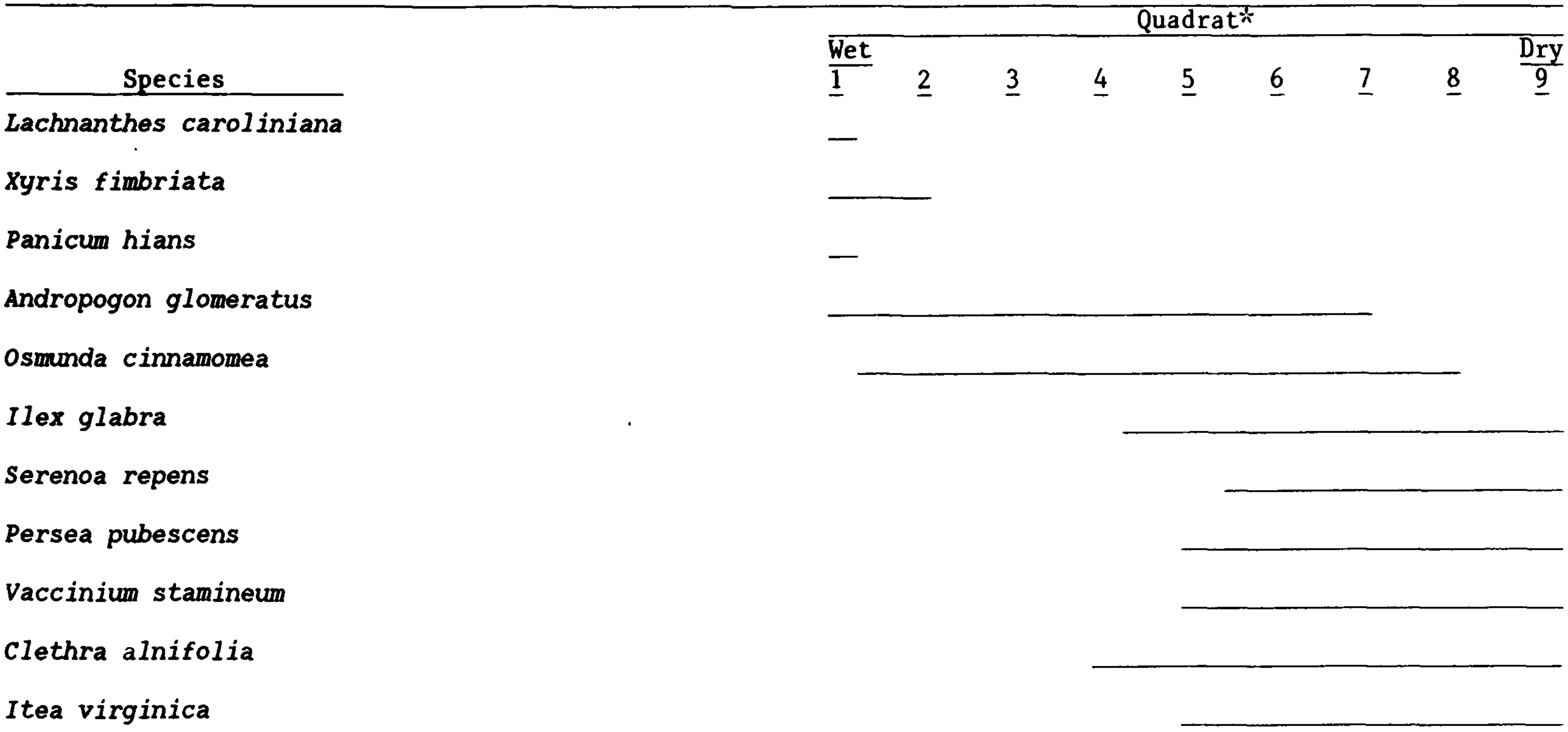
* Each quadrat number represents an interval of 1 m.

** Includes both *Cyperus polystachyos* and *Cyperus odoratus*.

Figure D6

Species Distribution in the Openwater (B) Community



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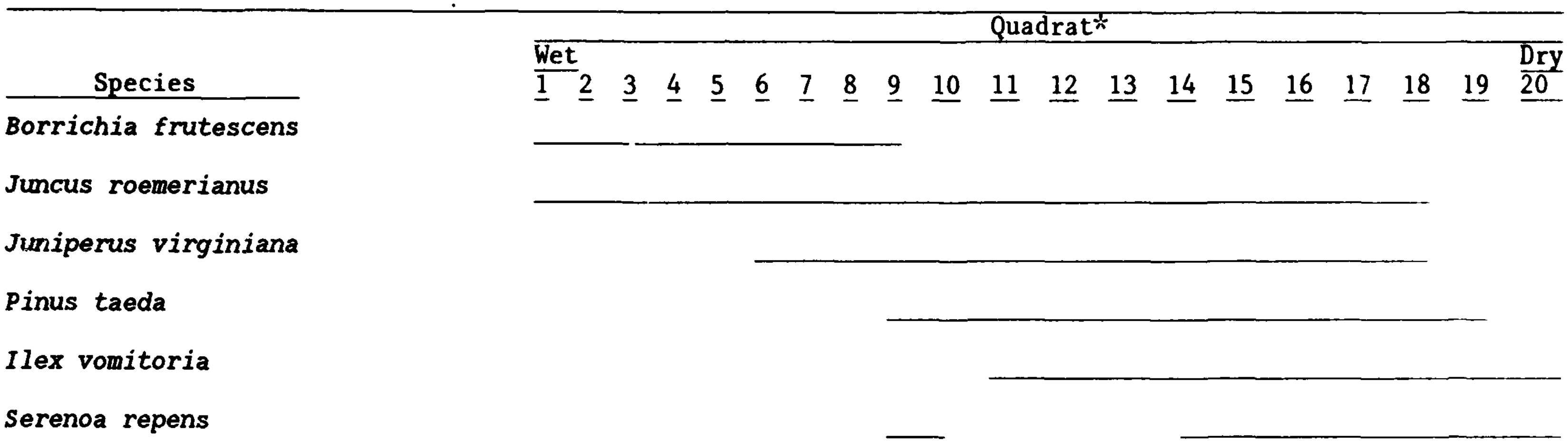
* Each quadrat number represents an interval of 1 m.

Figure D7

Species Distribution in the Shrub (A) Community

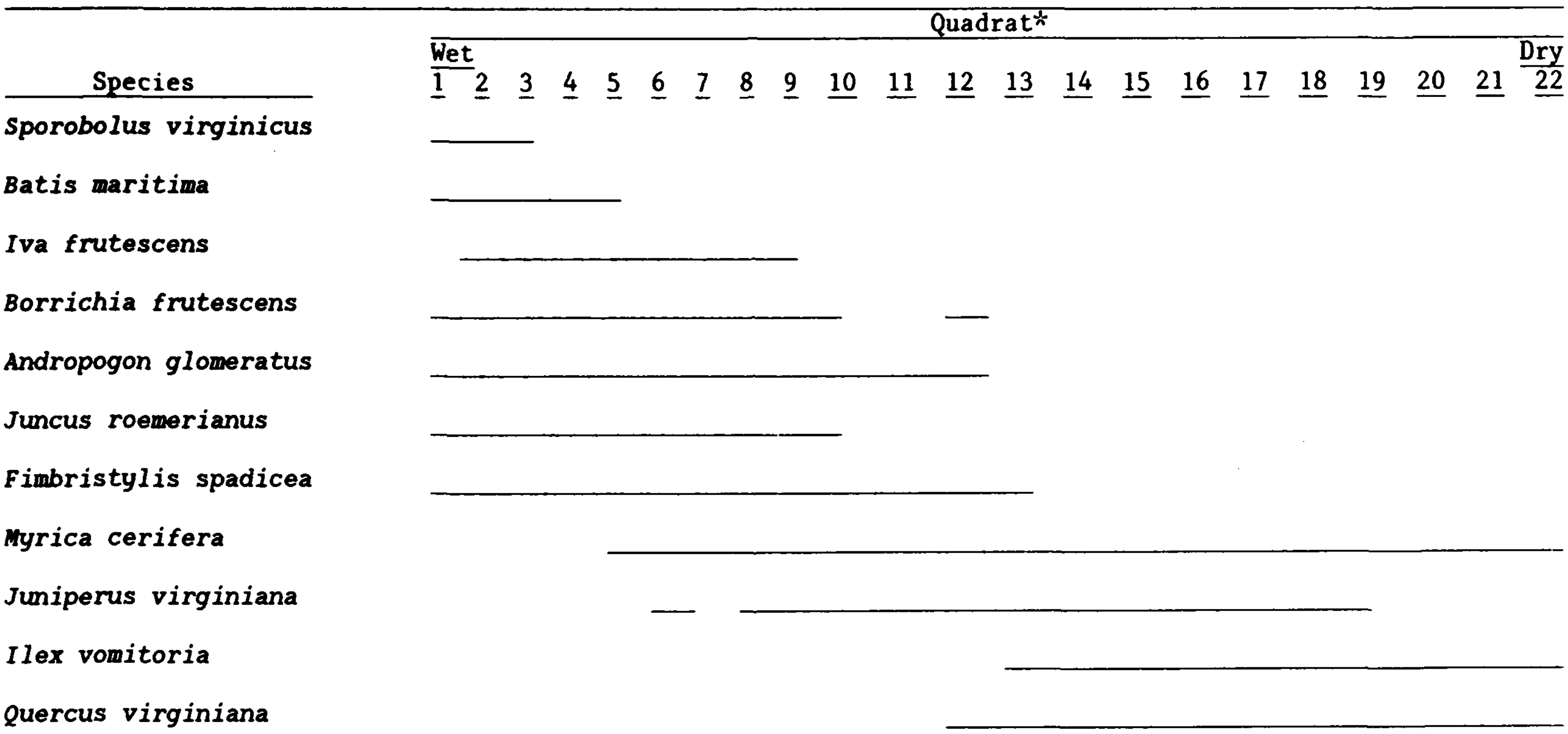


---

* Each quadrat number represents an interval of 1 m.

Figure D8

Species Distribution in the Shrub (B) Community



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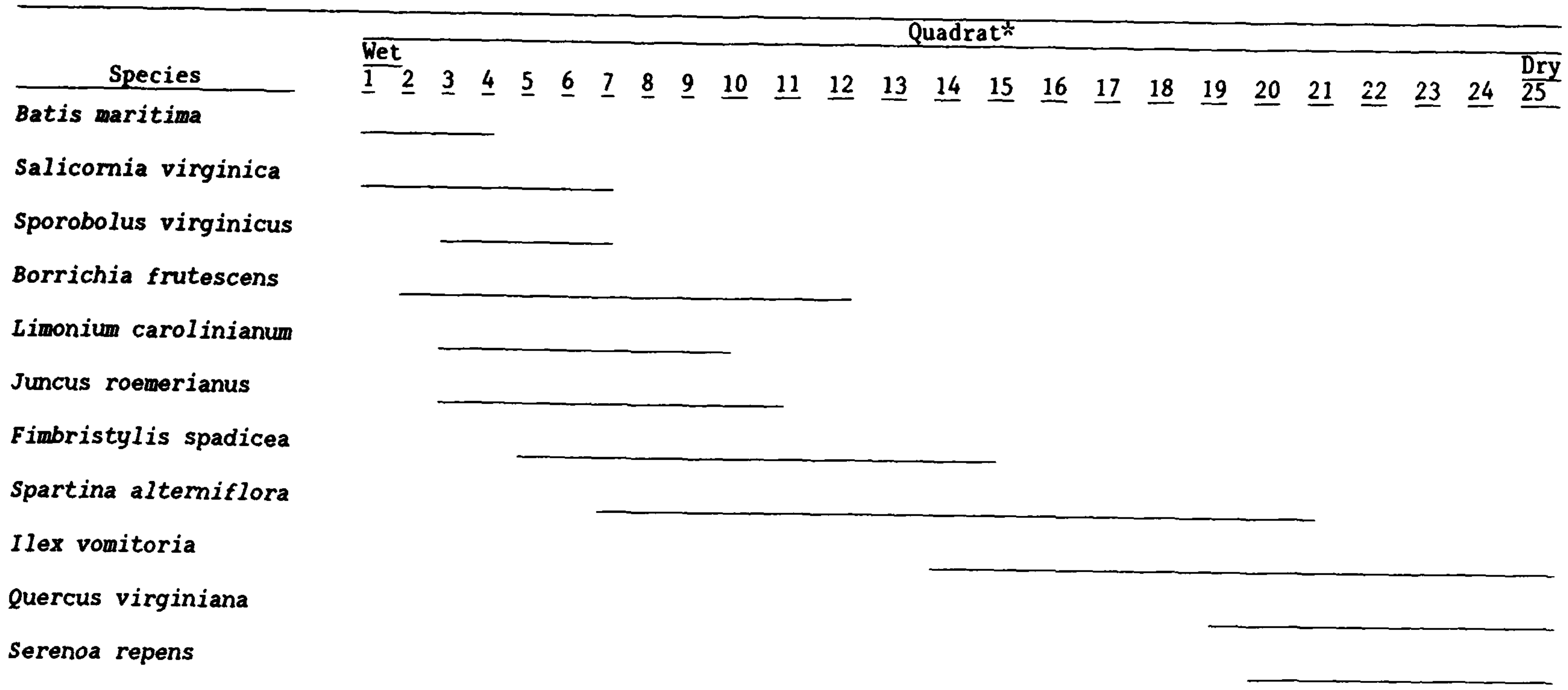
* Each quadrat number represents an interval of 1 m.

Figure D9

Species Distribution in the Salt Flat (A) Community



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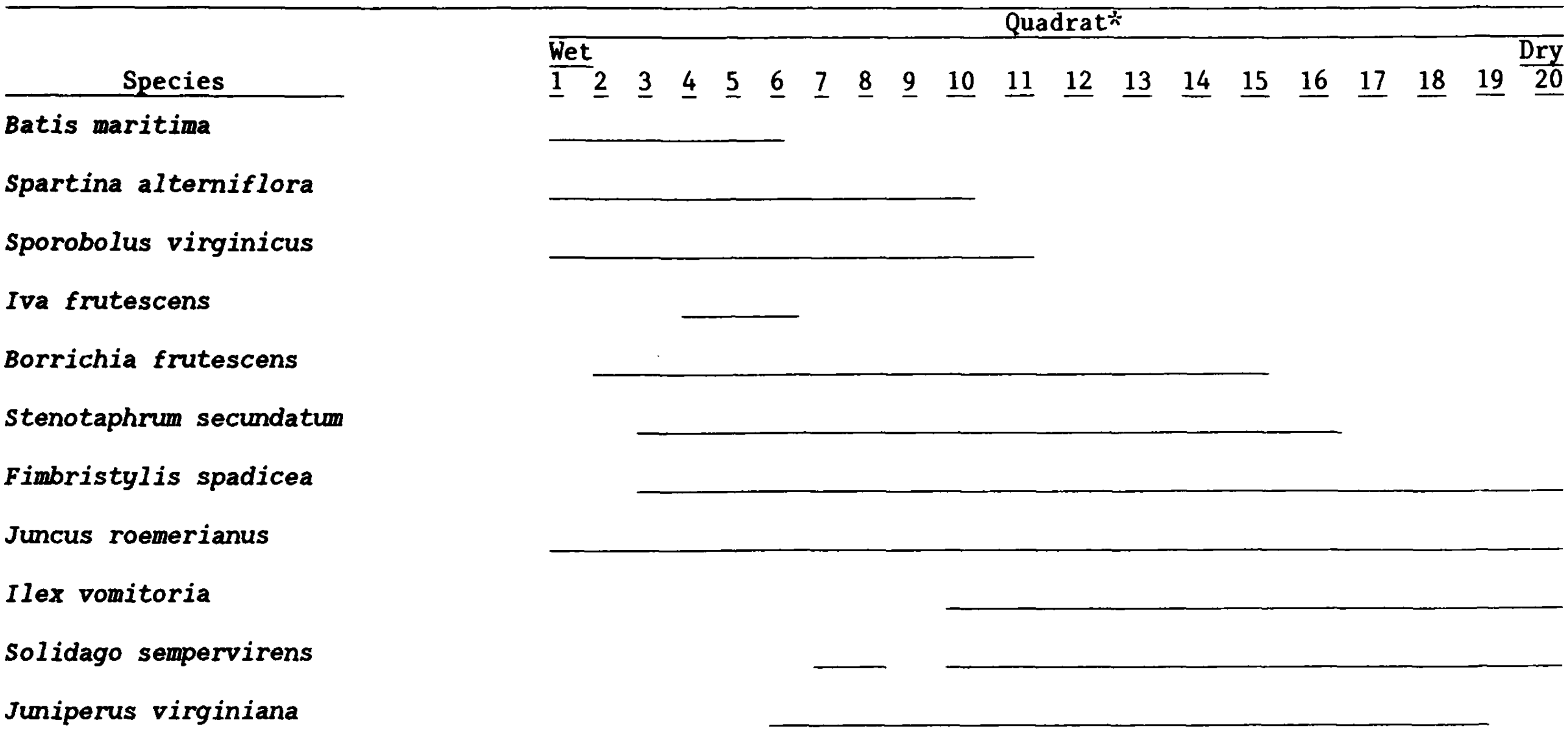
* Each quadrat number represents an interval of 1 m.

Figure D10

Species Distribution in the Salt Flat (B) Community



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* Each quadrat number represents an interval of 1 m.

APPENDIX E: NATIONAL WETLANDS INVENTORY (NWI) EQUIVALENTS OF WETLAND TYPES USED IN THIS REPORT

Table E1

National Wetlands Inventory (NWI) Equivalents of Wetland Types Used in This Report

Wetland Type	NWI Equivalent
Tidal marshes	Estuarine, Intertidal, Emergent, Persistent
Salt marshes	Estuarine, Intertidal, Emergent, Persistent
Salt flat	Estuarine, Intertidal, Emergent, Persistent
Brackish marsh	Estuarine, Intertidal, Emergent, Persistent
Freshwater marsh	Palustrine, Emergent, Persistent
Hardwood swamp	Palustrine, Forested, Broad-leaf Deciduous
River swamp	Palustrine, Forested, Broad-leaf Deciduous
Shrub	Palustrine, Scrub-Shrub, Broad-leaf Deciduous
Open water	Palustrine, Emergent, Persistent

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