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Palynomorph census data from Pliocene strata of the U.S. Atlantic Coastal Plain (Massachusetts to central Florida)

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INTRODUCTION

This report is a preliminary summary of palynomorph census data obtained from 49 samples of Pliocene strata which crop out or occur in the subsurface, on the U.S. Atlantic Coastal Plain. These samples form a northeast-southwest oriented transect which extends from southern Massachusetts to central Florida. This study includes a preliminary comparison to an analogous modern pollen dataset (Litwin and Andrle, in prep.), which we recovered from shallow marine pollen samples of the Continental Margin Program dataset. These two transects form the database for a comparison study of climatic patterns for the Pliocene and the present day U.S. Atlantic Coast. This reconnaissance of Pliocene nearshore marine sediments, deposited during a time interval of global high-sea level (~3.0 Ma) and now exposed on and along the U.S. Atlantic Coastal Plain, is part of the U.S. Geological Survey's program to study the climatic and oceanographic conditions of the Pliocene, and is one of a series of open-file reports which makes available the datasets on which our multiple analyses are being performed. The multivariate analyses and comparison of this Pliocene shallow marine pollen dataset with an analogous modern shallow marine pollen dataset will be presented elsewhere.

MATERIALS AND METHODS

The dataset of Pliocene samples from emergent shallow marine strata, from which the palynomorphs were recovered and identified, was compiled from a number of previously studied Pliocene sites (Cronin, 1988; Cronin et al., 1984; Cronin et al., 1989; Cronin and Dowsett, 1990; Dowsett and Cronin, 1990).

The Pliocene localities used in this study are shown in Figure 1. Sample information for this dataset is presented in Table 1.

PLIOCENE PALYNOMORPH DATASET: U.S. ATLANTIC COASTAL PLAIN

Forty-nine Pliocene samples of emergent shallow marine strata (Fig. 1, Table 1) were selected as reconnaisance transect stations for this study. These samples contained an unoxidized silt fraction (the sediment most likely to contain preserved palynomorphs), were deposited in a shallow marine environment, and produced sufficient identifiable palynomorphs (300 specimens minimum) for pollen analyses. The stratigraphic units from which these samples were taken include an unnamed unit at Gay Head Cliffs (MA), the Yorktown Formation (VA), the Duplin Formation (NC), the Raysor Formation (SC, GA), and the Pinecrest beds (FL). Not all of these forty-nine samples represent deposition during the Pliocene maximum high sea stand (~3.0 Ma). Some of these samples are younger, especially those from the upper part of the Pinecrest beds (Jones et al., 1991), which are now believed to have been deposited approximately 2.5-2.0 Ma (Matuyama Chron).

Most of these samples contained sufficient pollen for study. Obtaining an effective separation of the organic debris (pollen, spores, and plant fragments) from the clay fraction in these samples was critical, however, for enough pollen to be recovered for counting. Processing procedures for these sediment splits have been summarized in Litwin and Andrle (in prep.). Census counts of 300 specimens were made on every sample, for a total of 14,700 specimens. Samples which produced fewer than 300 specimens were discarded as study sites. Sixty taxa and census categories (combinations of taxa) were used for these sample counts (Table 2). Conifer pollen frequently was encountered as broken specimens in these preparations. We have addressed the problem by counting these broken specimens (isolated sacci) as half-specimens (and conversely, have not counted isolated conifer corpi) in order to keep our counts consistent and reproduceable. The conifer saccus subtotal we obtained was added to the number

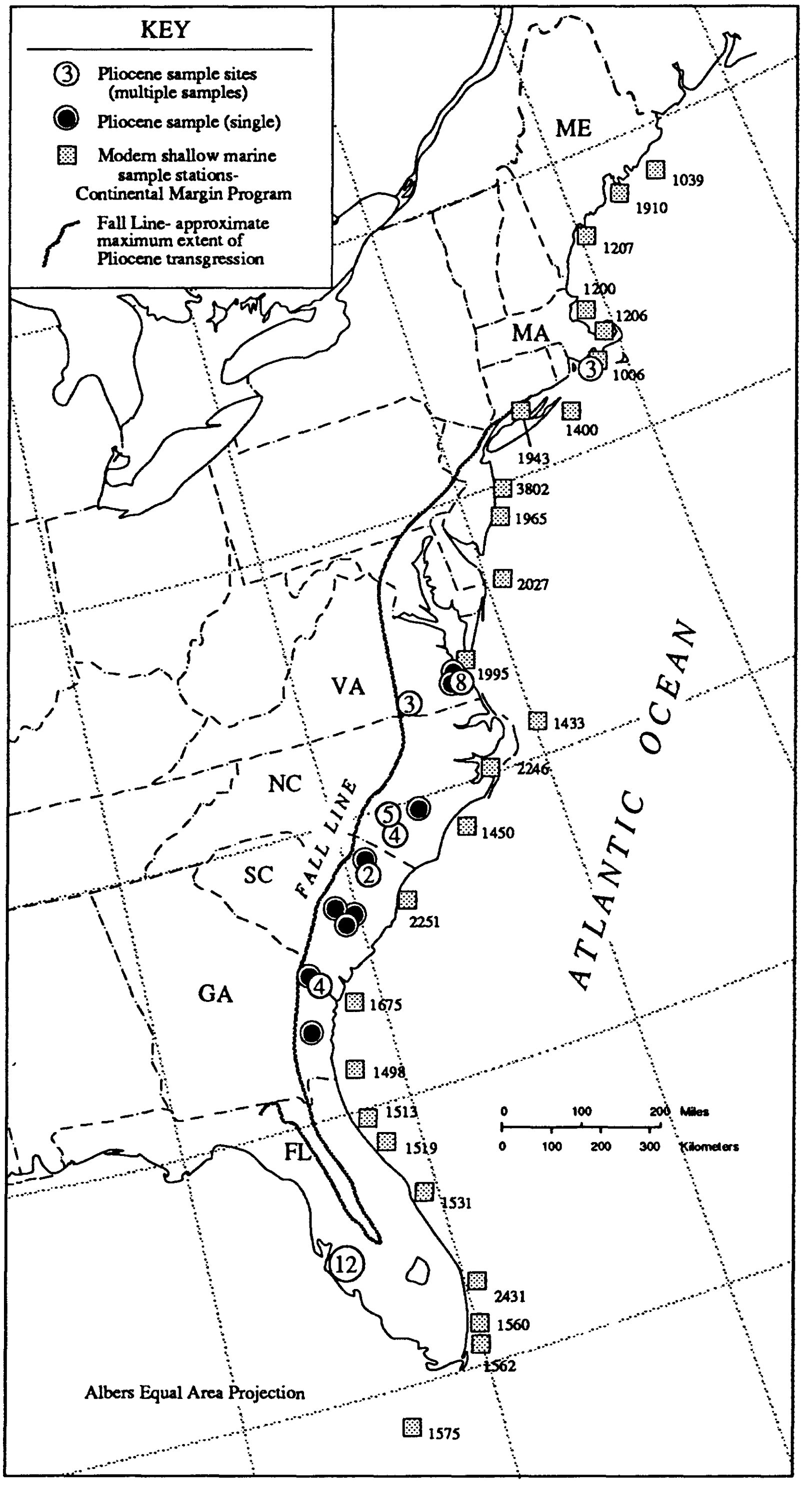

FIGURE 1. LOCALITY MAP: PLIOCENE SAMPLE SITES AND MODERN SHALLOW MARINE ANALOGUE SAMPLES

TABLE 1. PLIOCENE SAMPLE DATA (LOCATION, STRATUM)

SAMPLE	LATITUDE / LONGITUDE	STRATIGRAPHIC UNIT
mv8.1280	41° 21' 06" N / 70° 50' 00" W	unnamed unit (Gay Head Cliffs)
mv1.230	41° 21' 06" N / 70° 50' 00" W	unnamed unit (Gay Head Cliffs)
mv1.140	41° 21' 06" N / 70° 50' 00" W	unnamed unit (Gay Head Cliffs)
hd89.1	37° 14' 00" N / 76° 30' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.2	37° 14' 00" N / 76° 30' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.6	37° 04' 00" N / 76° 40' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.12	37° 07' 00" N / 76° 25' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.13	37° 07' 00" N / 76° 25' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.14	37° 07' 00" N / 76° 25' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.15	37° 07' 00" N / 76° 25' 00" W	Yorktown Fm. (Morgart's Beach member)
hd89.16	37° 07' 00" N / 76° 25' 00" W	Yorktown Fm. (Morgart's Beach member)
tc89.3	37° 14' 00" N / 76° 30' 00" W	Yorktown Fm. (lower)
tc89.4	37° 14' 00" N / 76° 30' 00" W	Yorktown Fm. (upper, Yadkin Pit)
la38	36° 41' 42" N / 77° 32' 20" W	Yorktown Fm. (upper)
la35	36° 41' 42" N / 77° 32' 20" W	Yorktown Fm. (upper)
tc78.223	34° 52' 38" N / 78° 04' 22" W	Duplin Fm. (Magnolia, N.C.)
r1721c	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.102	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.103	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.105	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.106	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.107	34° 42' 33" N / 78° 44' 11" W	Duplin Fm. (Robeson's Farm)
tc78.252	34° 35' 37" N / 78° 58' 45" W	Duplin Fm.
tc78.253	34° 35' 37" N / 78° 58' 45" W	Duplin Fm.
tc78.254	34° 35' 37" N / 78° 58' 45" W	Duplin Fm.
tc78.255	34° 35' 37" N / 78° 58' 45" W	Duplin Fm.
lb73.52	34° 19' 45" N / 79° 58' 00" W	Duplin Fm./Raysor Fm.
lb73.50	34° 19' 45" N / 79° 58' 00" W	Duplin Fm./Raysor Fm.
lb79.47	34° 01' 30" N / 79° 59' 00" W	Duplin Fm./Raysor Fm.
SU-2	34° 27' 54" N / 85° 17' 13" W	Raysor Fm.
tc78.269	33° 21' 36" N / 80° 13' 44" W	Raysor Fm.

TABLE 1. PLIOCENE SAMPLE DATA (CONT.)

SAMPLE	LATITUDE / LONGITUDE	STRATIGRAPHIC UNIT
PL1	32° 34' 12" N / 81° 21' 14" W	Raysor Fm.
PL2	32° 34' 12" N / 81° 21' 14" W	Raysor Fm.
PL3	32° 34' 12" N / 81° 21' 14" W	Raysor Fm.
PLB	32° 34' 12" N / 81° 21' 14" W	Raysor Fm.
CB2AB	32° 33' 57" N / 81° 20' 53" W	Raysor Fm.
DRTN	31° 39' 00" N / 81° 49' 45" W	Raysor Fm.
APAC1	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds (Matuyama chron)
APAC3	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds (Matuyama chron)
APAC4	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds (Matuyama chron)
APAC5	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC6	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC7B	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC7M	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC7T	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC8	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC9	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC10	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds
APAC11	27° 22' 02" N / 82° 27' 02" W	Pine Crest Beds

TABLE 2. CENSUS CODES AND IDENTIFICATION CATEGORIES

CODE	GENUS (FAMILY)	COMMON NAME
ABIES	*Abies*	firs
ACER	*Acer*	maples
ALNUS	*Alnus*	alders
AMBRO	*Ambrosia*	ragweed
ARTEM	*Artemesia*	sage
BETUL	*Betula*	birches
BOTRM	*Botrychium*	fern
BOTRS	*Botryococcus*	alga
CARYA	*Carya*	hickory
CASTA	*Castanea*	chestnut
CELTI	*Celtis*	hackberry
CH-AM	Chenopodiaceae + Amaranthaceae	goosefoot and pigweed families
COMPO	Compositae	daisy family
CORNU	*Cornus*	dogwood
CORYL	*Corylus*	hazelnuts
CYPER	Cyperaceae	sedge
EPHED	*Ephedra*	ephedra
ERICA	Ericaceae	heaths, laurels
FAGUS	*Fagus*	beech
FRAXI	*Fraxinus*	ash
GALIU	*Galium*	bedstraw (licorice)
GLEDI	*Gleditsia*	honey locust
GRAMI	Gramineae	grasses
ILEX	*Ilex*	holly
JUGLA	*Juglans*	walnut
LARIX	*Larix*	larch
LIQUI	*Liquidambar*	sweetgum
LYCOP	*Lycopodium*	clubmosses
MAGNO	*Magnolia*	magnolia
MENYA	*Menyanthes*	bog plants (Family Menyanthaceae)
MYRIC	*Myrica*	bayberry
MYRIO	*Myriophyllum*	submerged aquatics (Family Haloragaceae)
NYMPH	Nymphaceae	water lilies
NYSSA	*Nyssa*	water gum, cotton gum
OSMUN	*Osmunda*	fern
OS-CA	*Ostrya/Carpinus*	hophornbeam / hornbeam
PALMA	Palmae	palms, palmettos
PICEA	*Picea*	spruce
PINUS	*Pinus*	pines
PLANE	*Planera*	water elms
PLATA	*Platanus*	sycamores
POLYG	*Polyganum*	buckwheat (smartweed)
POPUL	*Populus*	poplar
PRUNU	*Prunus*	cherry, plum
PTERO	*Pterocarya*	walnut family (extinct)
QUER	*Quercus*	oak
RUBUS	*Rubus*	raspberry
SALIX	*Salix*	willow
SAMBU	*Sambucus*	elderberry
SAO	ferns (monolete)	
SARCO	*Sarcobatus*	greasewood
SCIAD	*Sciadopitys*	umbrella pine
SCO	ferns (trilete)	
SPHAG	*Sphagnum*	mosses
TCT	Taxodiaceae-Cupressaceae-Taxaceae	cypresses, cedars, junipers
TILIA	*Tilia*	basswood (linden)
TSUGA	*Tsuga*	hemlock
ULMUS	*Ulmus*	elms
UNKNO	unknown	
VITIS	*Vitis*	grape

of complete conifer pollen grains for a final total. For purposes of this study, pollen identifications were made to the generic level. In several cases identifications were feasible only to family level. The original preparations from which these census data were compiled are reposited in the Pliocene Reconstruction, Interpretation, and Synoptic Mapping (PRISM) collections database at the U.S. Geological Survey, Reston, VA.

DISCUSSION

Hazel (1970, 1988) pioneered the paleoclimatic interpretation of Pliocene strata cropping out on the U.S Atlantic Coastal Plain more than twenty years ago, in his studies on the marine Yorktown Formation. The more recent estimates of marine surface and bottom water temperatures for the middle Pliocene have been made on the basis of Q-mode factor analysis (and transfer functions) on planktic foraminifera and ostracode data (Cronin and Dowsett, 1990; Dowsett and Poore, 1990). These recent analyses have followed the quantitative analytical methods for paleotemperature estimation first used by Imbrie and Kipp (1971).

An accurate paleoclimatic analysis of the Pliocene marine pollen record relies on an accurate analogous assessment of the modern day relationship between the vegetational zones on the Atlantic Coastal Plain, the continental pollen record on the Coastal Plain, and the modern shallow marine pollen record. Eyre (1980) noted five major forest types (with gradations) between 46°-26° north latitude along the U.S. Atlantic Coast. These forest zones, from north to south, are: 1.) Spruce-Fir (*Picea- Abies*), 2) White Pine-Red Pine-Jack Pine (*Pinus strobus- P. resinosa- P. banksiana*), 3) Oak-Hickory (*Quercus- Carya*), 4) Loblolly Pine-Shortleaf Pine (*Pinus taeda- P. echinata*), and 5) Longleaf Pine-Slash Pine (*Pinus palustris- P. elliotti*). A sixth forest type, Oak-Gum-Cypress (*Quercus- Nyssa- Taxodium*), is interspersed locally in zones 4 and 5, but is established only along middle to southerly latitude river drainages, and extends inland to the Fall Line. Overall, the continental pollen record (Delcourt et al.,

1984) shows strong positive correlation with these sub-latitudinal forest zones. The relative abundance of the most common taxa preserved in modern shallow marine bottom sediments also appears to show a strong positive correlation to the major vegetational trends along the Atlantic Coast (Figure 2; Litwin and Andrle, in prep.), although, in the marine record, localized perturbations are superimposed on this regional trend. Several of these perturbations appear to be caused by proximity to major river discharge and seasonal pollination ("bloom" effects). Both factors probably alter the vegetational pollen signature locally and periodically.

Other factors must be considered in order to accurately assess the fossil pollen analogue, including offshore "drift" of the pollen signal, the effect on the coastal vegetation (and consequently the shallow marine pollen record) of foreshortening the Coastal Plain during an interval of high sea level, and the possibility of comparing diachronous samples along the Pliocene transect. At present we have noted no pronounced southerly displacement of the modern marine pollen assemblages with respect to their onshore counterparts (Figure 3; Litwin and Andrle, in prep., figure 3). Such displacement might be expected because of the southerly longshore currents (Labrador Current and Virginia Coastal Current) that exist today inshore from the Gulf Stream and which presumably existed after or began during the apparent intensification of the Gulf Stream approximately 3.0 Ma (Hazel, 1970; Cronin, 1988). The intensity of the orographic effect caused by foreshortening the Coastal Plain during global high sea level is at present unknown.

The problem of sample contemporaneity along the trend of the transect was constrained by several factors. We recognize that the high-frequency, low-amplitude temperature variations noted in deep sea core data by Poore et al. (1991) would not show at this reconnaissance scale of sampling, although they have noted that the amplitude of such variations is low. Recent correlation by Cronin (1991), on the basis of microfossil evidence in the stratigraphic intervals from which our samples were obtained,

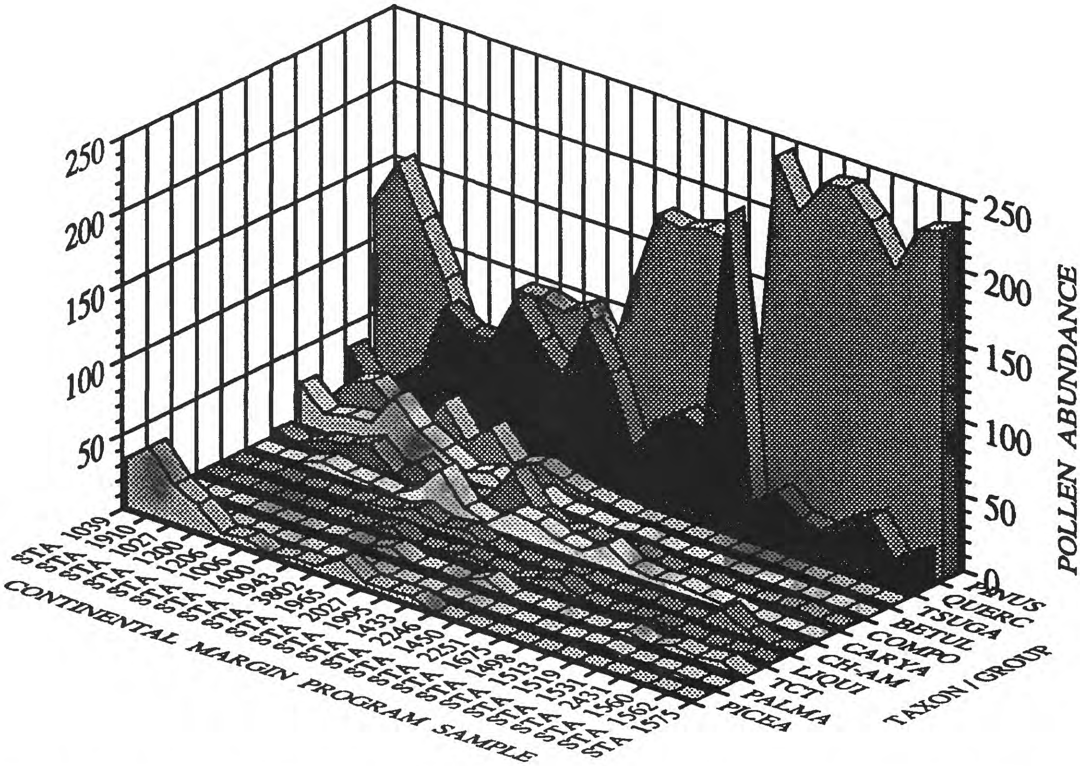

FIGURE 2A. PLOT OF ABUNDANCE OF SELECTED TAXA FOR ALL MODERN MARINE SITES (FROM LITWIN AND ANDRLE, 1992.)

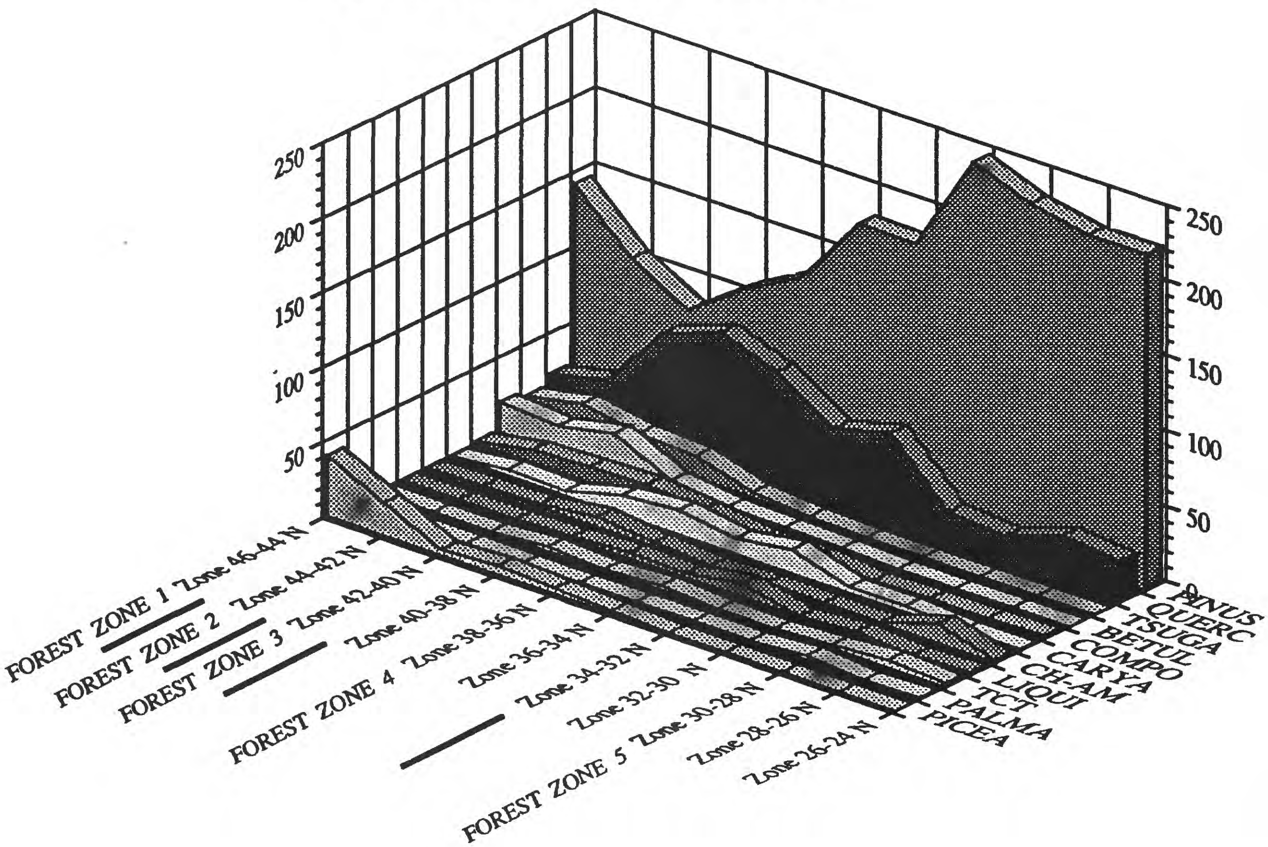

FIGURE 2B. PLOT OF ABUNDANCE OF TAXA (MODERN MARINE SITES) AVERAGED FOR LATITUDE (FROM LITWIN AND ANDRLE, 1992.)

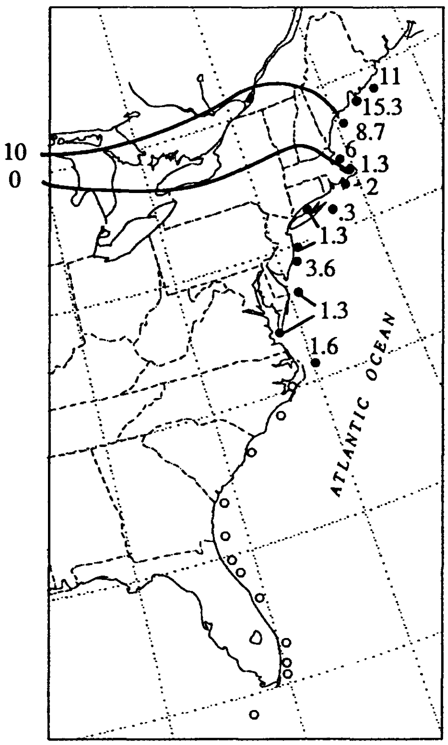

FIGURE 3A. PERCENT *Picea*

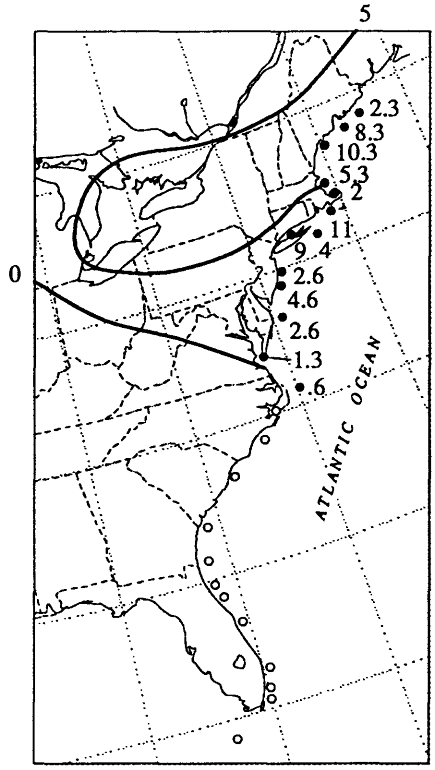

FIGURE 3B. PERCENT *Tsuga*

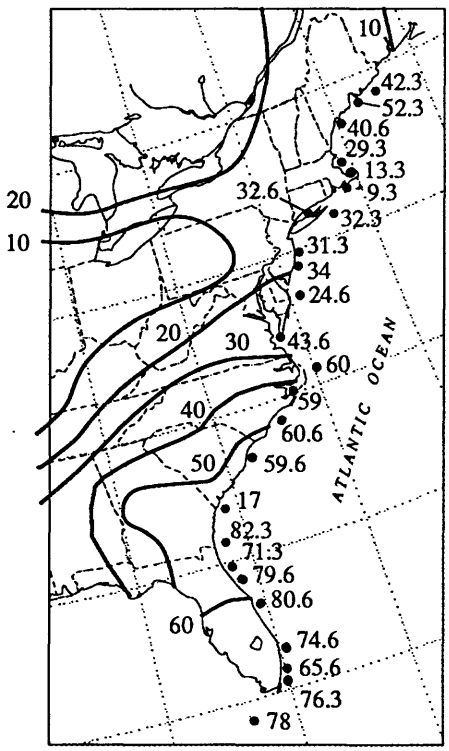

FIGURE 3C. PERCENT *Pinus*

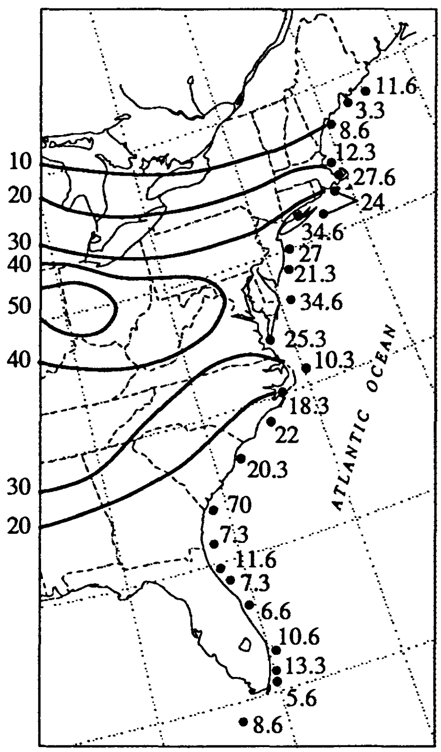

FIGURE 3D. PERCENT *Quercus*

FIGURE 3. COMPARISON OF CONTINENTAL POLLEN ISOPOLLS WITH POLLEN PERCENTAGES IN MODERN SHALLOW MARINE RECORD. ISOPOLLS FROM BARTLEIN ET AL. (1986). (OPEN CIRCLE DENOTES ABSENCE OF TAXON AT GIVEN CMP STATION)

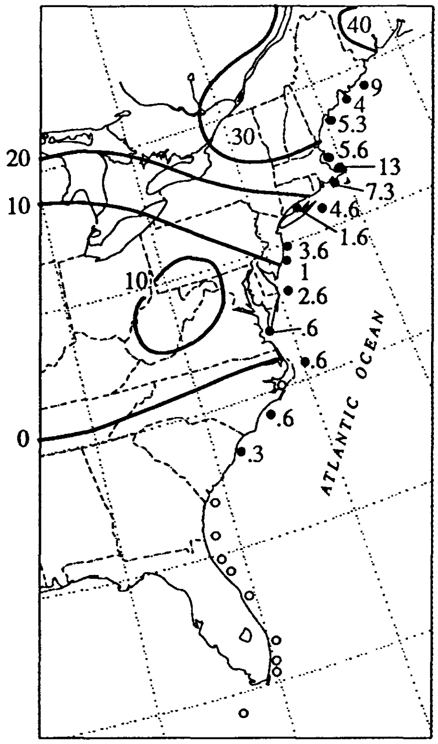

FIGURE 3E. PERCENT *Betula*

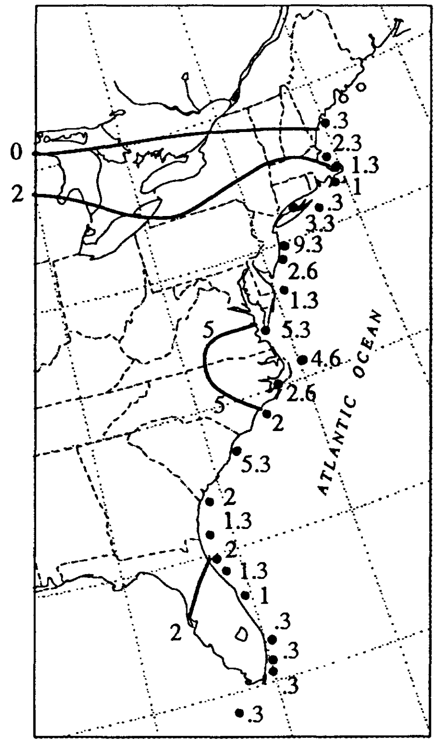

FIGURE 3F. PERCENT *Carya*

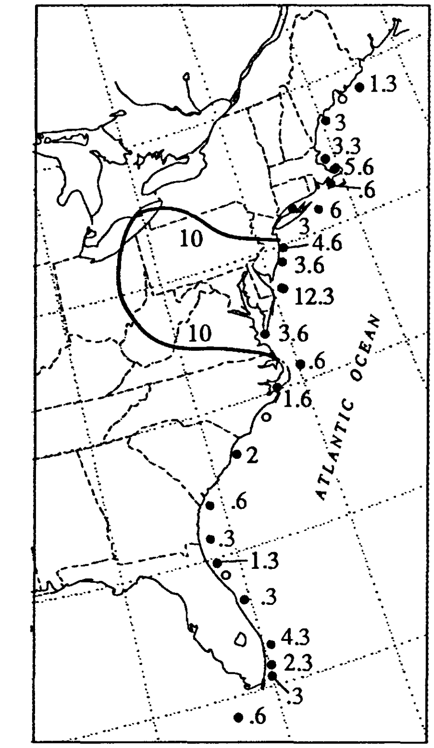

FIGURE 3G. PERCENT PRAIRIE FORBS
(*Artemesia* + Compositae +
Chenopodiaceae + Amaranthaceae)

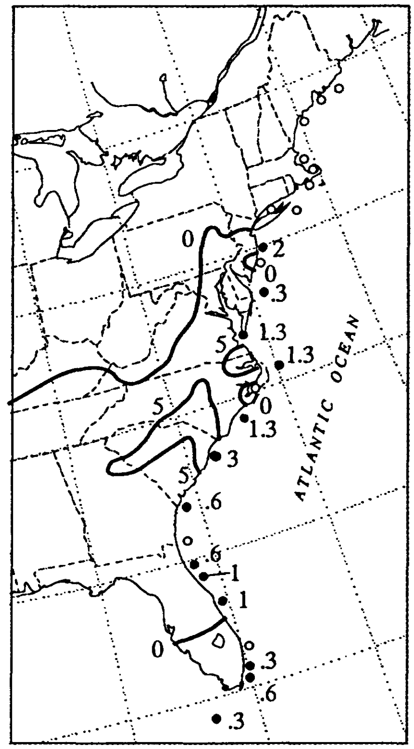

FIGURE 3H. PERCENT *Liquidambar*

suggests that the samples used for this study cluster at approximately 2.5-3.5 Ma. All appear to have been deposited seaward of, and during the formation of, the middle Pliocene Orangeburg Scarp and its lateral equivalents. The Orangeburg Scarp has been accepted as the approximation of the Pliocene shoreline at approximately 3.0 Ma (Dowsett and Cronin, 1990). Consequently, we believe that pollen assemblages from samples collected along the transect provide a first-order indication of the latitudinal vegetational zones present along the U.S. Atlantic Coast approximately 3.0 Ma. Figure 4 shows our preliminary plot of pollen abundance data from selected Pliocene sites and latitudinally averaged values of the same Pliocene pollen dataset (compare to Figure 2B).

Assessment of paleoshoreline position, sample time-equivalence, etc., is important for accurate extrapolation of Pliocene vegetational patterns and for accurate estimation of Pliocene temperature and precipitation values along the U.S. Atlantic Coast. The preliminary latitudinal trend in the Pliocene dataset shows a strong positive correlation to the established vegetation zones on the Atlantic Coastal Plain and to modern day continental pollen spectra. Although specific details of latitudinal shift of these zones currently are under study, preliminary analyses suggest that mid-Pliocene vegetational zones may have been cooler than those presently established along the U.S. Atlantic Coast. For example, pollen assemblages from samples of the upper part of the Morgart's Beach Member of the Yorktown Formation (southern Virginia) suggest that the mid-Pliocene coast was vegetated with oak-hickory forest rather than with loblolly-shortleaf pine forest (present day). Final interpretation of regional vegetational trends, however, will be deferred until our multivariate quantitative analyses of the Pliocene and modern shallow marine pollen datasets are complete; these results will be published formally elsewhere.

PRELIMINARY CONCLUSIONS

Preliminary analysis of the Pliocene sample transect and comparison with modern shallow marine pollen assemblages suggests that sub-latitudinal vegetation zones, analogous to those currently established on

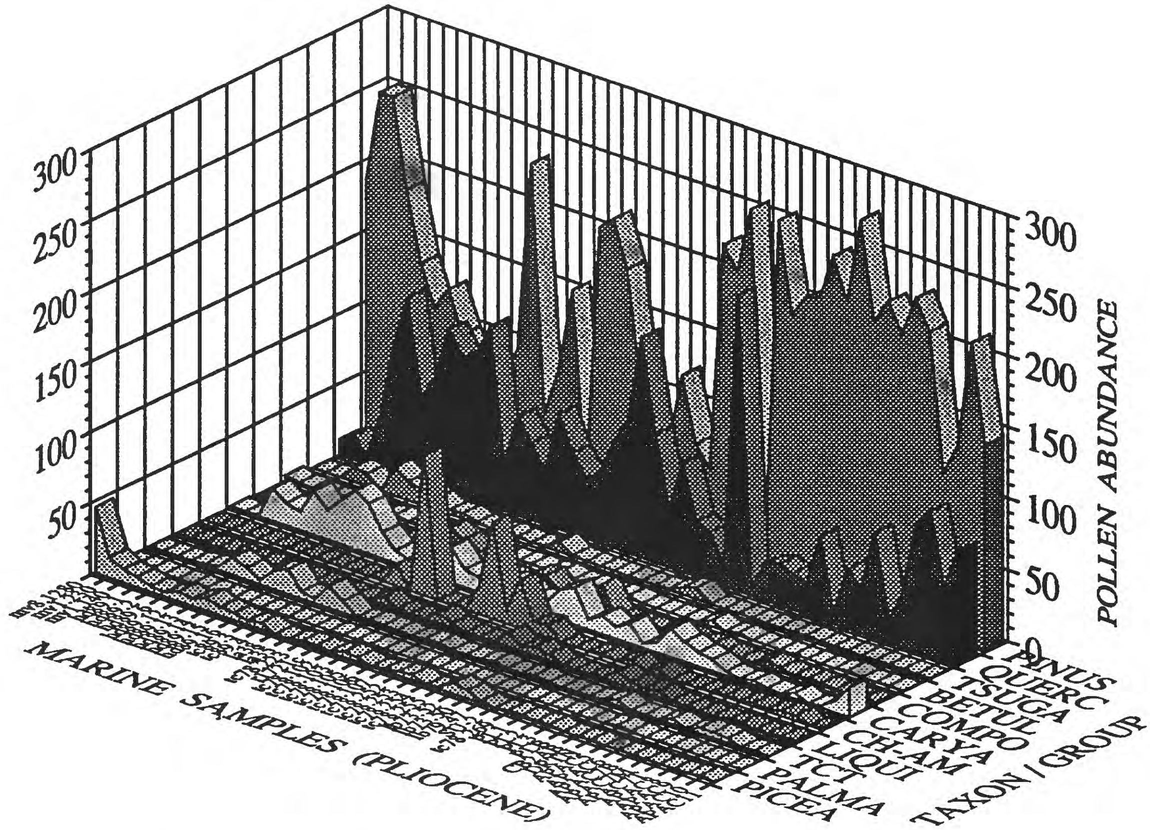

FIGURE 4A. PLOT OF RAW POLLEN DATA FROM SELECTED PLIOCENE SITES, THIS STUDY

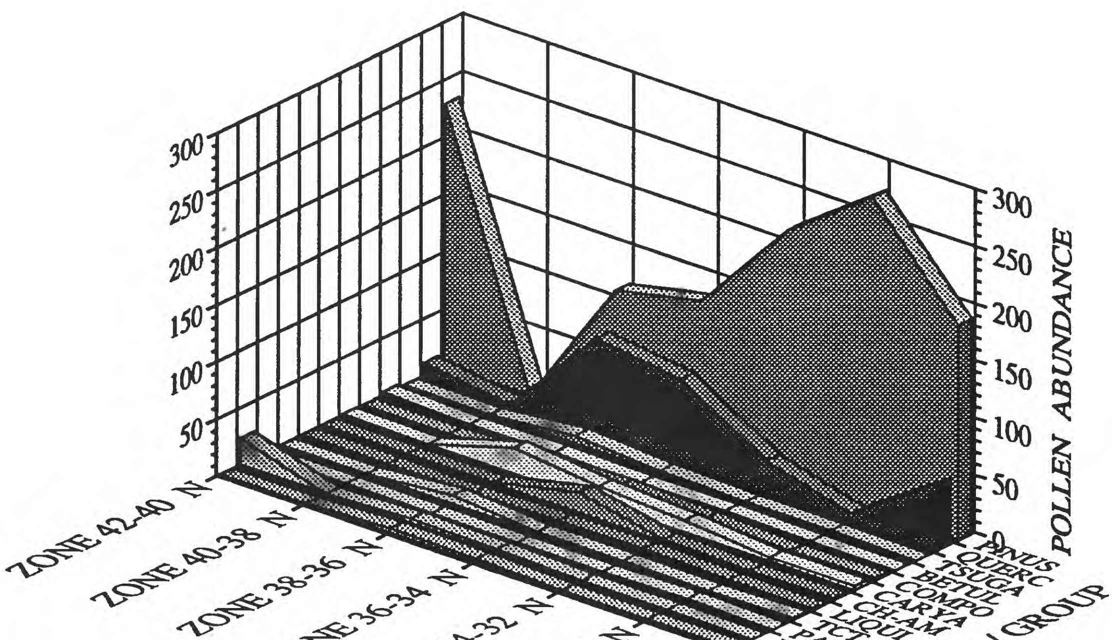

FIGURE 4B. LATITUDINALLY AVERAGED PLIOCENE POLLEN DATA, THIS STUDY (SEE ABOVE) the Atlantic Coastal Plain, were present on the Atlantic Coastal Plain during the middle Pliocene (~3.0 Ma). Qualitative comparison between the continental pollen record and the shallow marine pollen record (Litwin and Andrle, in prep.) suggests the following: 1) The nearshore marine record is more representative of onshore regional vegetational trends than of localized trends, although local trends can be recognized, and 2) the predominantly southerly longshore and coastal currents along the U.S. Atlantic Coast do not appear to have a noticeable effect on the southerly displacement of the marine pollen record relative to modern continental (onshore) records. Accordingly, we believe that the shallow marine pollen record can be used as an approximate indicator of onshore vegetational trends, and indirectly, of climatic trends. Pollen evidence from our Pliocene samples suggests, albeit preliminarily, that forest zones in the middle northerly latitudes in the mid-Pliocene may have been "cooler" floras (i.e., had a more northerly aspect) than those presently established along the U.S. Atlantic Coast at similar latitudes.

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TABLE 3. PLIOCENE PALYNOMORPH CENSUS DATA (RAW NUMBERS FROM COUNTS OF 300 PALYNOMORPHS PER SAMPLE)

	mv8.1280	mv1.230	mv1.140	hd89.1	hd89.2	hd89.6	hd89.12	hd89.13	hd89.14	hd89.15	hd89.16	tc89.3	tc89.4	la38	la35	tc78.223	r1721c
ABIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACER	1	0	1	6	5	2	0	8	6	3	11	7	3	1	3	2	3
ALNUS	0	0	0	0	2	2	1	0	2	1	1	1	0	12	5	1	4
AMBRO	1	0	0	0	0	1	0	0	0	1	2	0	0	2	2	2	4
ARTEM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
BETUL	4	2	2	0	1	2	0	0	2	1	2	0	0	0	0	0	0
BOTRS	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
BOTRM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARYA	1	0	1	23	16	13	31	21	31	41	35	18	9	5	19	15	24
CASTA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
CELTI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CH-AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15	0	98
COMPO	0	0	1	0	1	3	1	0	3	1	1	3	1	10	22	17	11
CORNU	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
CORYL	3	0	0	1	0	0	0	2	1	2	1	2	0	5	0	5	0
CYPER	0	1	1	1	0	0	0	2	0	0	0	0	0	15	0	1	0
EPHED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERICA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
FAGUS	0	0	0	3	5	0	2	5	1	5	3	0	0	1	0	2	3
FRAXI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 3. (cont.)

	mv8.1280	mv1.230	mv1.140	hd89.1	hd89.2	hd89.6	hd89.12	hd89.13	hd89.14	hd89.15	hd89.16	tc89.3	tc89.4	la38	la35	tc78.223	r1721c
GALIU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLEDI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAMI	0	1	1	0	0	0	0	2	1	4	0	0	0	19	39	2	13
ILEX	0	0	0	0	1	0	0	1	0	0	0	0	0	6	2	2	0
JUGLA	0	0	0	0	1	2	4	0	1	3	1	3	1	0	0	1	0
LARIX	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	4	0
LIQUI	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	5	0
LYCOP	0	0	0	0	0	0	0	1	0	0	2	1	2	0	0	0	0
MAGNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
MENYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRIC	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0
MYRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYMPH	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
NYSSA	0	0	0	1	0	0	3	2	1	1	1	0	1	0	0	2	4
OSMUN	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
OS-CA	0	0	0	2	1	1	0	0	1	0	0	2	0	0	0	0	0
PALMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PICEA	46	14	9	7	4	3	7	5	9	6	5	3	5	0	0	2	2
PINUS	186	250	250	188	140	112	128	99	76	90	79	101	236	62	95	157	21
PLANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PLATA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

TABLE 3. (cont.)

	mv8.1280	mv1.230	mv1.140	hd89.1	hd89.2	hd89.6	hd89.12	hd89.13	hd89.14	hd89.15	hd89.16	tc89.3	tc89.4	la38	la35	tc78.223	r1721c
POLYG	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	0	0
POPUL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRUNU	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	1
PTERO	0	0	0	4	5	5	1	0	2	2	0	0	0	0	0	0	0
QUERC	11	17	6	38	91	128	60	77	115	98	103	127	34	69	54	37	81
RUBUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	1	0	0	0	0	2	1	0	10	2	0	0
SAMBU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAO	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3	0
SARCO	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
SCIAD	0	1	0	0	0	1	10	20	10	0	6	3	1	0	1	0	0
SCO	19	4	11	0	5	0	1	1	3	0	3	3	0	7	1	6	4
SPHAG	6	6	7	0	0	0	2	2	0	3	0	1	1	3	1	0	0
TCT	0	0	0	0	1	3	12	8	3	13	17	5	3	15	8	0	2
TILIA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
TSUGA	0	0	0	10	9	0	20	13	11	8	3	4	1	0	1	1	0
ULMUS	0	1	2	1	0	0	0	0	0	1	2	0	0	0	0	2	1
UNKNO	21	2	8	15	11	20	14	29	19	11	17	12	1	45	22	28	21
VITIS	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
TOTAL	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

TABLE 3. (cont.)

	tc78.102	tc78.103	tc78.105	tc78.106	tc78.107	tc78.252	tc78.253	tc78.254	tc78.255	lb73.52	lb73.50	lb79.47	SU-2	tc78.269	PL1	PL2	PL3
ABIES	0	0	0	0	0	0	0	0	0	0	3	0	0	5	0	0	1
ACER	7	2	5	3	6	2	1	1	16	0	0	0	1	1	1	1	0
ALNUS	0	0	2	2	2	2	2	1	8	0	0	0	0	0	1	0	1
AMBRO	0	0	2	1	0	1	0	5	0	0	1	0	2	0	0	5	4
ARTEM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BETUL	0	1	0	2	0	1	0	1	2	0	0	0	0	0	4	0	2
BOTRS	0	0	0	0	0	0	0	0	0	1	0	0	0	8	0	0	0
BOTRM	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0
CARYA	12	10	2	14	18	10	10	21	26	7	13	8	14	3	7	20	14
CASTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CELTI	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
CH-AM	0	0	0	20	67	10	34	8	9	0	0	0	2	0	4	0	5
COMPO	2	3	2	10	12	3	4	9	19	0	1	1	0	6	4	2	3
CORNU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYL	0	0	0	1	0	2	0	3	2	0	1	0	14	0	13	8	3
CYPER	0	0	0	3	3	1	0	10	6	0	0	0	3	3	2	0	0
EPHED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ERICA	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
FAGUS	0	0	4	0	1	0	2	0	0	0	0	0	3	0	0	0	0
FRAXI	0	0	0	3	0	1	0	0	4	1	0	0	0	0	0	0	0

TABLE 3. (cont.)

	tc78.102	tc78.103	tc78.105	tc78.106	tc78.107	tc78.252	tc78.253	tc78.254	tc78.255	lb73.52	lb73.50	lb79.47	SU-2	tc78.269	PL1	PL2	PL3
GALIU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLEDI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAMI	1	0	1	2	9	3	1	6	8	0	3	0	2	0	2	0	0
ILEX	0	0	2	10	0	0	0	1	0	0	0	0	0	0	0	0	0
JUGLA	1	1	1	0	1	0	0	1	4	0	0	0	0	0	0	0	0
LARIX	0	0	0	3	0	5	7	0	0	0	1	0	0	1	0	0	0
LIQUI	0	0	7	3	0	0	0	9	3	6	4	0	0	0	1	8	4
LYCOP	1	0	0	1	0	3	2	1	0	0	0	0	0	0	0	0	0
MAGNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MENYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRIC	0	0	0	0	0	1	0	1	0	1	0	0	0	1	4	3	0
MYRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYMPH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYSSA	0	0	13	9	3	3	1	6	0	2	4	2	1	0	0	0	4
OSMUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OS-CA	0	0	1	0	0	0	0	0	0	0	1	0	0	0	6	2	0
PALMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PICEA	1	4	3	0	2	3	4	0	2	8	6	2	0	2	2	1	2
PINUS	208	217	185	106	61	70	122	77	63	225	210	256	18	255	192	207	211
PLANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATA	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0

TABLE 3. (cont.)

	tc78.102	tc78.103	tc78.105	tc78.106	tc78.107	tc78.252	tc78.253	tc78.254	tc78.255	lb73.52	lb73.50	lb79.47	SU-2	tc78.269	PL1	PL2	PL3
POLYG	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
POPUL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRUNU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTERO	0	2	0	1	1	2	1	2	2	0	0	0	0	0	0	0	1
QUERC	57	42	49	76	91	155	90	41	76	38	34	14	208	5	25	28	25
RUBUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	3	0	8	0	5	7	1	3	0	0	0	0	0	3
SAMBU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAO	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	2
SARCO	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
SCIAD	3	3	1	1	0	0	0	34	0	2	1	2	2	3	0	0	0
SCO	1	1	2	0	3	1	0	5	1	1	1	1	2	0	1	2	0
SPHAG	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
TCT	1	1	0	1	2	0	0	0	2	0	0	2	0	0	0	0	1
TILIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSUGA	1	7	1	0	0	0	0	0	0	1	5	8	0	0	0	0	0
ULMUS	0	0	2	2	0	0	6	14	1	0	0	0	1	1	6	6	3
UNKNO	3	5	15	21	17	12	5	37	32	5	8	4	24	5	24	7	10
VITIS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

TABLE 3. (cont.)

	PLB	CB2AB	DRTN	APAC1	APAC3	APAC4	APAC5	APAC6	APAC7B	APAC7M	APAC7T	APAC8	APAC9	APAC10	APAC11
ABIES	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
ACER	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0
ALNUS	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1
AMBRO	1	0	0	0	0	0	0	0	1	0	2	0	0	1	2
ARTEM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BETUL	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0
BOTRS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BOTRM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
CARYA	10	8	3	0	1	1	1	3	1	0	4	0	2	8	21
CASTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CELTI	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2
CH-AM	0	0	0	3	5	18	1	2	1	3	2	4	4	0	2
COMPO	2	0	0	0	4	0	5	3	1	2	2	1	0	1	1
CORNU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYL	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1
CYPER	0	0	0	0	2	0	0	0	1	0	8	0	0	1	2
EPHED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERICA	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0
FAGUS	0	0	0	0	0	1	0	0	0	0	0	0	0	3	2
FRAXI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 3. (cont.)

	PLB	CB2AB	DRTN	APAC1	APAC3	APAC4	APAC5	APAC6	APAC7B	APAC7M	APAC7T	APAC8	APAC9	APAC10	APAC11
GALIU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLEDI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAMI	0	0	0	0	2	1	0	2	2	0	2	3	3	1	7
ILEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUGLA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LARIX	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
LIQUI	3	4	1	0	0	1	0	0	0	0	2	0	1	2	2
LYCOP	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAGNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MENYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRIC	0	1	0	0	1	0	3	1	0	1	0	0	14	1	0
MYRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NYMPH	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
NYSSA	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0
OSMUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OS-CA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PALMA	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0
PICEA	0	0	1	0	3	1	0	0	0	0	0	0	0	2	0
PINUS	243	214	275	255	168	191	207	224	204	233	212	116	137	214	145
PLANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATA	0	0	0	0	1	0	0	0	0	0	2	0	0	0	7

TABLE 3. (cont.)

	PLB	CB2AB	DRTN	APAC1	APAC3	APAC4	APAC5	APAC6	APAC7B	APAC7M	APAC7T	APAC8	APAC9	APAC10	APAC11
POLYG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POPUL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRUNU	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0
PTERO	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
QUERC	21	57	7	2	85	58	41	32	73	16	38	89	101	52	80
RUBUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	1	0	11	1	0	0	0	0	4	0	0	1	1
SAMBU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAO	0	0	0	1	2	0	5	1	0	4	0	0	5	1	0
SARCO	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5
SCIAD	0	0	1	0	1	0	0	0	4	1	1	0	0	0	0
SCO	2	0	0	3	0	3	3	0	3	3	3	2	3	3	2
SPHAG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCT	4	0	0	0	0	7	0	4	0	4	4	3	0	1	0
TILIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSUGA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ULMUS	0	0	0	0	1	1	0	0	0	0	2	0	0	0	2
UNKNO	7	4	2	36	10	12	31	27	8	31	4	82	27	6	13
VITIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**