ATLAS OF POLLEN AND SPORES OF THE FLORIDA EVERGLADES

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Abstract

An illustrated, descriptive atlas of pollen and spores from wetland plants of the Florida Everglades was compiled to facilitate identification of dispersed palynomorphs in sediments. The atlas includes 121 wetland species characteristic of eleven plant associations of the Florida Everglades including sloughs, sawgrass marshes, tree islands, wet prairies, cypress domes, mangrove forests, salt marshes, sawgrass ridges, beach/dune communities, pine flatwoods/dry prairies, and disturbed/developed sites. We include light micrographs and detailed descriptions of 121 species, 110 genera, and 63 families.

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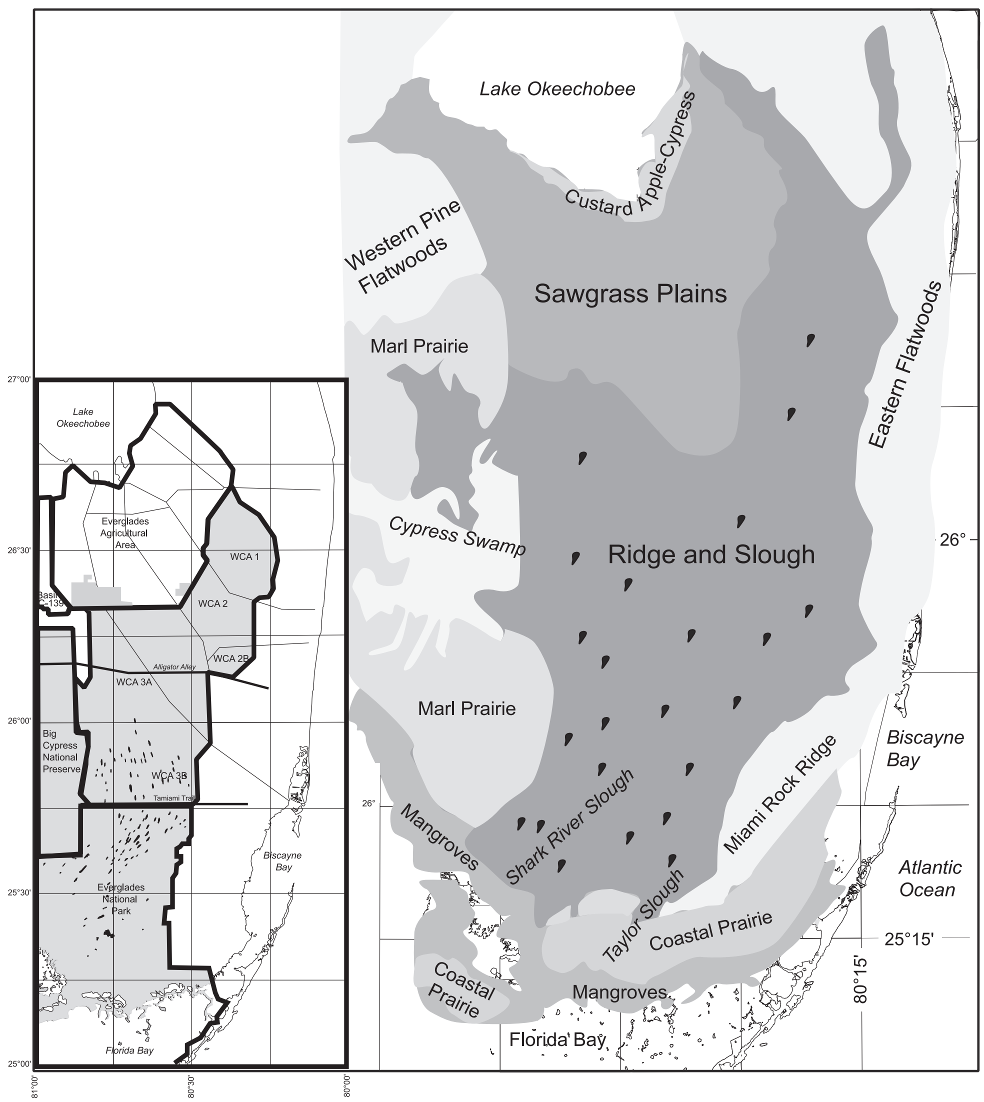
INTRODUCTION

Quantitative analysis of pollen assemblages from Holocene sediments provides the primary basis for interpretation of plant community response to climatic and anthropogenic environmental change (Kneller and Peteet, 1999; Watts, 1979; Davis, 1969; Willard et al., 2001a, 2003). Such analyses rely on accurate identification of fossil pollen for quantitative comparison with modern assemblages. Although a number of atlases illustrating pollen and spore morphology for taxa from the eastern and southeastern United States have been published (Jones et al., 1995; McAndrews et al., 1973; Richard, 1970 a, b, c; Lieux, 1980a, b, 1982, 1983; Lieux and Godfrey, 1982; Bassett et al., 1978), they focus primarily on tree and shrub taxa from upland sites. Recent restoration efforts in the greater Everglades ecosystem of south Florida has led to extensive paleoecological research in the vast wetland, and an extensive pollen reference collection has been assembled to facilitate identification of pollen from Everglades sediment cores. Taxa in the collection include a variety of trees, shrubs, herbs, floating aquatics, and ferns. This atlas, compiled from that collection, consists primarily of plants native to the Everglades, but some introduced species (notably *Casuarina equisetifolia*, *Melaleuca quinquenervia*, and *Schinus terebinthifolius*) occur commonly enough in the wetland to merit inclusion.

As defined here, the greater Everglades ecosystem extends from Lake Okeechobee in the north through the mangroves bordering Florida Bay in the south and from the developed region along the east coast of the peninsula through Big Cypress and mangrove forests in the west and southwest coast (Text-Fig. 1). The historic Everglades originally covered an area of approximately 12,000 km^2 (Davis et al., 1994), but rapid population growth, agricul-



Text-Figure 1. Pre-drainage distribution of vegetation types in the greater Everglades ecosystem (modified from McVoy et al., 2004). Inset map shows geographic boundaries of Everglades National Park, Big Cypress National Preserve, and the Water Conservation Areas. Shaded area in inset indicates the present extent of the Everglades wetland.

tural development, and associated changes in water management of the system during the 20th century have reduced wetland area by about half and altered the distribution of plant communities within the Everglades. About 850 plant species grow within the greater Everglades, aggregating into fewer than 20 plant communities, including sloughs, sawgrass marshes, cattail marshes, wet prairies, tree islands, cypress domes, mangrove forests, and salt marshes (Davis, 1943; Loveless, 1959; Gunderson, 1994; Kushlan, 1990). The distribution of plant species in the Everglades is controlled primarily by hydroperiod (annual duration of inundation), water depth, and substrate type (Table 1). In the natural Everglades system, water levels fluctuated seasonally with rainfall. Changes in water-management practices during the 20th century have greatly altered the original seasonal flow pattern through the Everglades and fragmented the system through construction of canals, levees, and water-control structures. In an effort to increase water supplies to restore the Everglades to a more natural state while still meeting other regional water needs, the United States Congress authorized the Comprehensive Everglades Restoration Plan (CERP) in 2000. Research is underway to ensure that restoration targets reflect the natural pre-drainage hydrology and ecology. This research includes paleoecological studies using the pollen record from sediment cores to document the distribution of pre-drainage wetland plant communities and their response to specific hydrological and environmental changes.

Table 1. Dominant plants and environmental parameters characteristic of main vegetational associations of greater Everglades ecosystem (Abrahamson and Hartnett, 1990; Kushlan, 1990; Loveless, 1959).

Vegetational association	Dominant Plants	Hydroperiod*	Water Depth	Substrate
Sawgrass Marsh – dense	*Cladium*	Moderate	Moderate	> 1 m peat
Sawgrass Marsh – sparse	*Cladium,* other Cyperaceae, Poaceae	Moderate	Moderate	< 1 m peat or marl
Wet Prairie	Cyperaceae, Poaceae, *Sagittaria, Nymphaea*	Short	Shallow	Marl, shallow peat
Slough	*Nymphaea, Utricularia, Nuphar, Panicum*	Long	Deep	> 1 m peat
Tree Islands	Subtropical hardwoods, *Salix, Cephalanthus, Magnolia, Persea, Annona, Morella,* Asteraceae, ferns	Short-moderate	Dry to moderate	Mineral soil–peat
Cypress Domes/Strands	*Taxodium, Acer, Fraxinus, Annona,* ferns,	Long	Moderate	Peat over sandy soils
	Epiphytes (bromeliads)			
Mangroves	*Rhizophora, Avicennia, Lagunularia, Conocarpus,* ferns	Coastal forests with saline influence		Peat
Salt Marshes	*Batis, Salicornia, Typha, Baccharis, Morella*	Transition between mangroves and fresh-water marshes		
	Cyperaceae, Poaceae, Convolvulaceae			
Beach–Dune Communiity	*Sabal palmetto, Casuarina, Conocarpus, Morella,* shrubs	Sand dunes and beach on coast		
Pine Flatwoods	*Pinus elliottii, Morella, Sabal palmetto,* Poaceae	Seasonal inundation	Dry to shallow	Sandy soil/ oolitic limestone
	Poaceae, *Sabal palmetto, Morella*	Wet only after heavy rains		Dry to shallow
Sawgrass-Shrub/Ridges	*Cladium; Crinum, Pontederia,* and *Cephalanthus* in transition zone adjacent to slough	Moderate	Moderate	0.5–1.5 m peat

* short hydroperiods = 0–3 months annual inundation; moderate = 3-9 months annual inundation; long = 9–12 months annual inundation.

Analysis of pollen assemblages from surface samples of sediment collected in different Everglades plant communities has shown that at least eleven types can be distinguished using pollen abundance (Willard et al., 2001b). This is possible because each community has a distinctive species composition (Table 2) and because pollen of most of these species is not transported far from its source. Through statistical comparison of surface and downcore assemblages, analogs for past plant communities are identified, and vegetational responses to environmental changes are reconstructed. These analyses rely on accurate identification of pollen, and the reference pollen collection that includes the most common wetland plants has been an important tool for Everglades paleoecological research.

MATERIALS AND METHODS

Pollen was isolated from flowers collected in the Everglades by the authors and from herbarium species in collections in herbaria at the National Museum of Natural History, George Mason University, Duke University, and the U.S. Geological Survey. Collection data are provided in Table 3. Before processing anther material for pollen, flowers were either pressed and dried on herbarium sheets or dehydrated with glacial acetic acid. Acetolysis of anther material followed procedures outlined by Traverse (1988): dehydration with glacial acetic acid, immersion in acetolysis solution (9 parts acetic anhydride : 1 part sulfuric acid) for 10 minutes in a boiling water bath, neutralization using repeated washes in deionized water, staining with Bismarck Brown, and mounting on microscope slides with glycerin jelly. When necessary, this material was supplemented with older reference material from the Duke University Wetland Center and earlier U.S. Geological Survey collections. It should be noted that use of different mounting media and processing techniques can affect palynomorph size, but overall morphology and relative size remain the same. Specimens were photographed under oil with an Olympus BX-50 with Nomarski optics and are illustrated at either 1000X or 400X (for larger palynomorphs).

Whenever possible, at least ten specimens from each species were measured for the appropriate dimensions. In most cases, measurements were made from digital images using the morphometrics package ImageJ (available via download at http://rsb.info.nih.gov/ij/). In a few cases, measurements were made using an ocular micrometer in the microscope.

The atlas includes 121 species, 110 genera, and 63 families of plants. Complete descriptions are arranged alphabetically by family, with pteridophytes first, followed by monocotyledonous plants, then dicotyledonous plants. Nomenclature follows USDA National Plants Database (USDA, NRCS, 2004). Photographic plates are arranged morphologically to facilitate identification. Amb or overall grain shape is first defined, followed by shape classes (i.e., prolate, oblate) as originally defined by Erdtman (1943, 1952). The shape classes are based on measurements of the polar axis (P) and equatorial diameter (E) and the resulting P/E ratio (see glossary). Mean dimensions are provided, followed by minima and maxima in parentheses. Aperture and sculpture characteristics for all described species are summarized in Table 4. In each description, exine thicknesses are given exclusive of positive sculpture. A glossary of palynological terminology is provided in Appendix 1.

SPORE AND POLLEN DESCRIPTIONS

PTERIDOPHYTA

Blechnaceae

Blechnum serrulatum L.C. Rich.
Plate 1: 1–5

Oval spore; long axis: 36.5 (31.5–42.5) μm; short axis: 26.8 (21.2–31.4) μm; monolete; laesura length: 17.3 (14.6–20.5) μm; maximum laesura width: 0.5 (0.4–0.7) μm; psilate with randomly scattered verrucae of various sizes (maximum diameter 1.5 μm); occasional exine thickening around laesura: 2.3 (2.2–2.5) μm (see Plate 1: 4); exine thickness: 1.4 (1.2–1.8) μm.

Osmundaceae

Osmunda regalis L.
Plate 2: 12–14

Spherical spore; maximum dimension: 89.0 (74.0–108.0) μm; trilete; laesura ray length: 26.1 (20.5–30.9) μm; maximum laesura ray width: 2.3 (1.6–3.2) μm; rugulate; exine thickness: 3.0 (2.5–3.5) μm.

Polypodiaceae

Phlebodium aureum (L.) J. Sm.
Plate 1: 6–8

Oval spore; long axis: 49.4 (44.0–59.1) μm; short axis: 31.2 (26.7–40.0) μm; monolete; laesura length: 19.4 (17.9–21.5) μm; maximum laesura width: 0.6 (0.5–0.8) μm; verrucate; verrucae height: 3.9 (2.4–4.8) μm; verrucae width: 5.8 (3.4–9.8) μm; exine thickness: 1.6 (1.1–1.9) μm.

Pteridaceae

Acrostichum danaeifolium Langsd. & Fisch.
Plate 2: 15–16

Table 2. Taxa included in the study and plant communities in which they are present. Presence data compiled from Alexander and Crook (1973), Austin et al. (1977), Goodrick (1974), Kushlan (1990), Loveless (1950), Riegel (1965), Richardson (1977), Wood and Tanner (1980), Willard et al. (2002).

Family	Genus and species	Sloughs	Sawgrass Marshes	Tree Islands	Wet Prairies	Cypress Domes	Mangrove forests	Salt Marshes	Sawgrass Ridges	Communities	Prairies	Sites
Acanthaceae	*Justicia americana*		X		X							
Aceraceae	*Acer rubrum*			X		X						
Alismataceae	*Sagittaria lancifolia*		X		X	X						
Alismataceae	*Sagittaria latifolia*		X		X	X						
Amaranthaceae	*Alternanthera philoxeroides*	X			X							X
Amaranthaceae	*Amaranthus australis*		X		X							
Anacardiaceae	*Schinus terebinthifolius*			X			X					
Anacardiaceae	*Rhus copallinum*			X		X	X					
Annonaceae	*Annona glabra*			X								
Apiaceae	*Cicuta maculata var. maculata*		X		X							
Apiaceae	*Hydrocotyle* sp.			X	X	X	X					
Aquifoliaceae	*Ilex cassine*		X	X	X							
Araceae	*Peltandra virginica*											X
Araceae	*Pistia stratiotes*			X						X		
Arecaceae	*Sabal palmetto*			X								
Asteraceae	*Ageratum conyzoides*											X
Asteraceae	*Ambrosia artemisiifolia*		X									
Asteraceae	*Ampelaster carolinianus*		X									
Asteraceae	*Baccharis* spp.		X									
Asteraceae	*Bidens alba*		X									
Asteraceae	*Bidens laevis*		X									
Asteraceae	*Borrichia frutescens*		X		X							X
Asteraceae	*Cirsium horridulum*		X		X							
Asteraceae	*Conoclinium coelestinum*		X									X
Asteraceae	*Eupatorium capilifolium*		X		X							
Asteraceae	*Eupatorium serotinum*			X								
Asteraceae	*Mikania scandens*		X		X							
Asteraceae	*Pluchea odorata*		X									X
Asteraceae	*Solidago sempervirens*											X
Asteraceae	*Sonchus oleraceus*											X
Asteraceae	*Sphagneticola trilobata*											X
Asteraceae	*Symphyotrichum elliottii*		X		X						X	
Asteraceae	*Tridax procumbens*											X
Asteraceae	*Youngia japonica*											X
Bataceae	*Batis maritima*			X				X				
Blechnaceae	*Blechnum serrulatum*										X	X
Boraginaceae	*Heliotropium polyphyllum*										X	
Brassicaceae	*Descurainia pinnata*			X		X	X					
Bromeliaceae	*Tillandsia balbisiana*			X								
Burseraceae	*Bursera simaruba*		X									
Caprifoliaceae	*Sambucus nigra* spp. *canadensis*										X	X
Caricaceae	*Carica papaya*									X		X
Casuarinaceae	*Casuarina equisetifolia*			X								X
Chenopodiaceae	*Salicornia bigelovii*						X	X		X		
Combretaceae	*Conocarpus erecta*						X					
Combretaceae	*Laguncularia racemosa*											X
Commelinaceae	*Commelina diffusa*		X							X		
Convolvulaceae	*Ipomoea pes-caprae*		X									

Table 2 (continued).

Family	Genus and species	Sloughs	Sawgrass Marshes	Tree Islands	Wet Prairies	Cypress Domes	Mangrove forests	Salt Marshes	Sawgrass Ridges	Communities	Prairies	Sites
Convolvulaceae	*Ipomoea sagittata*			X								X
Cucurbitaceae	*Melothria pendula*		X	X	X	X	X		X			
Cyperaceae	*Cladium mariscus* var. *jamaicense*				X							
Cyperaceae	*Cyperus haspan*				X							
Cyperaceae	*Eleocharis cellulosa*				X							
Cyperaceae	*Eleocharis elongata*				X		X					
Cyperaceae	*Rhynchospora colorata*				X							
Cyperaceae	*Schoenoplectus taberaemontani*									X		
Euphorbiaceae	*Chamaesyce hypericifolia*									X		
Euphorbiaceae	*Chamaesyce maculata*											X
Euphorbiaceae	*Phyllanthus tenellus*			X								
Euphorbiaceae	*Ricinus communis*			X								
Fabaceae	*Acacia angustissima*			X								
Fabaceae	*Apios americana*			X								
Fabaceae	*Cassia obtusifolia*			X								
Fabaceae	*Cassia occidentalis*											X
Fabaceae	*Desmodium paniculatum*											X
Fabaceae	*Vigna luteola*											X
Fagaceae	*Quercus laurifolia*			X	X	X						
Haloragaceae	*Myriophyllum* spp.											X
Haloragaceae	*Proserpinaca palustris*		X		X							X
Hippocrateaceae	*Hippocratea volubilis*			X								
Lentibulariaceae	*Utricularia foliosa*		X		X							
Liliaceae	*Crinum americanum*		X		X							
Loganiaceae	*Mitreola* sp.		X									
Lythraceae	*Lythrum alatum*			X								X
Malvaceae	*Sida cordifolia*											X
Moraceae	*Morus rubra*			X	X	X	X			X		
Myricaceae	*Morella cerifera*			X								
Myrtaceae	*Melaleuca quinquenervia*			X								
Myrtaceae	*Psidium guajava*				X							
Nymphaeaceae	*Nuphar luteum*		X		X							
Nymphaeaceae	*Nymphaea odorata*		X		X							
Onagraceae	*Ludwigia leptocarpa*			X					X			
Osmundaceae	*Osmunda regalis*				X							
Poaceae	*Andropogon glomeratus*		X							X		
Poaceae	*Andropogon virginicus*									X		
Poaceae	*Eragrostis elliottii*		X							X		
Poaceae	*Heteropogon contortus*		X		X					X		
Poaceae	*Panicum repens*		X									
Poaceae	*Pennisetum ciliare*										X	X
Poaceae	*Phragmites australis*										X	X
Poaceae	*Setaria parviflora*				X					X		
Poaceae	*Spartina alterniflora*							X				
Poaceae	*Zizaniopsis miliaceae*										X	X
Polygalaceae	*Polygala* sp.		X									
Polygonaceae	*Polygonum hydropiperoides*		X									
Polygonaceae	*Polygonum densiflorum*		X									

Table 2 (continued).

Family	Genus and species	Sloughs	Sawgrass Marshes	Tree Islands	Wet Prairies	Cypress Domes	Mangrove forests	Salt Marshes	Sawgrass Ridges	Communities	Prairies	Sites
Polypodiaceae	*Phlebodium aureum*			X								
Pontederiaceae	*Eichhornia crassipes*											X
Pontederiaceae	*Pontederia cordata*		X		X							
Pteridaceae	*Acrostichum danaeifolium*			X			X			X		
Pteridaceae	*Pteris longifolia*		X	X								
Pteridaceae	*Pteris vittata*			X								
Rhizophoraceae	*Rhizophora mangle*			X			X					
Rubiaceae	*Cephalanthus occidentalis*			X					X			
Salicaceae	*Salix caroliniana*			X	X	X			X			X
Salviniaceae	*Salvinia minima*		X									
Saururaceae	*Saururus cernuus*			X								
Scrophulariaceae	*Bacopa monnieri*		X		X							
Solanaceae	*Capsicum annuum*											X
Solanaceae	*Physalis pubescens*									X		
Solanaceae	*Solanum americanum*											X
Sterculiaceae	*Waltheria indica*										X	
Taxodiaceae	*Taxodium distichum*			X		X						
Thelypteridaceae	*Thelypteris kunthii*			X								
Typhaceae	*Typha domingensis*		X	X								
Typhaceae	*Typha latifolia*		X	X								
Ulmaceae	*Trema micranthum*			X								X
Urticaceae	*Boehmeria cylindrica*			X								
Verbenaceae	*Callicarpa americana*			X								
Verbenaceae	*Lantana camara*			X								X
Vitaceae	*Vitis rotundifolia* var. *munsoniana*			X								X

Rounded triangular spore; maximum dimension: 65.8 (53.0–77.0) µm; trilete; laesura ray length: 22.5 (18.8–24.8) µm; maximum laesura ray width: 3.4 (2.2–4.9) µm; psilate; exine thickness: 3.9 (3.1–4.9) µm.

Pteris longifolia L.
Plate 2: 17–19

Rounded triangular spore; maximum dimension: 81.6 (75.3–88.0) µm; trilete; laesura ray length: 29.2 (27.1–33.7) µm; maximum laesura ray width: 3.9 (2.7–5.0) µm; rugulate; ridge height: 7.6 (6.3–9.0) µm; ridge width: 5.2 (4.1–6.4) µm; exine thickness: 2.0 (1.9–2.3) µm.

Pteris vittata L.
Plate 2: 20–22

Rounded triangular spore; maximum dimension: 76.6 (66.4–85.5) µm; trilete; laesura ray length: 28.6 (25.7–31.6) µm; maximum laesura ray width: 3.7 (2.9–5.0) µm; rugulate; ridge height: 8.6 (6.9–11.1) µm; ridge width: 5.2 (3.9–6.6) µm; exine thickness: 2.1 (1.6–2.7) µm.

Salviniaceae
Salvinia minima Baker
Plate 2: 23–24

Rounded triangular microspore; maximum dimension: 68.0 (59.5–89) µm; trilete; laesura ray length: 27.4 (22.4–27.4) µm; maximum laesura ray width: 0.8 (0.5–1.1) µm; psilate; exine thickness: 3.8 (3.0–4.5) µm.

Thelypteridaceae
Thelypteris kunthii (Desv.) Morton
Plate 1: 9–11

Oval spore; long axis: 56.4 (50.8–64.2) µm; short axis: 40.4 (36.1–47.2); monolete; laesura length: 31.8 (19.8–

Table 3. Collection information and common names of taxa included in pollen atlas.

Family	Scientific Name & Authority	Common Name	Collection Site	Collection Date (D/M/YR)	Collector
Acanthaceae	*Justicia americana* (L.) Vahl	American water-willow	Columbus, OH	1956	C.J. Felix
Aceraceae	*Acer rubrum* L.	Red maple	US Rt. 192, Osceola Co., FL	11/19/73	T. Bradley
Alismataceae	*Sagittaria lancifolia* L.	Arrowhead	Elodea Cove, Prince Georges Co., MD	8/3/81	R. Reeves
Alismataceae	*Sagittaria latifolia* Willd.	Alligator weed	Berkely Co., SC	8/13/93	C. Horn
Amaranthaceae	*Alternanthera philoxeroides* (Mart.) Griesbach	Alligator weed	Berkely Co., SC	8/13/93	C. Horn
Amaranthaceae	*Amaranthus australis* (Gray) Sauer	Southern amaranth			
Anacardiaceae	*Rhus copallinum* L.	Flame leaf sumac			Johan Groot Pollen Colln. (4594/15459)
Anacardiaceae	*Schinus terebinthifolius* Raddi	Brazilian pepper	Palm Beach Co., FL	11/26/81	L. Abbott
Annonaceae	*Annona glabra* L.	Pondapple; custardapple	Coral Gables, Dade Co FL	5/27/90	C. Horn
Apiaceae	*Cicuta maculata* L. var. *maculata*	Water hemlock			
Apiaceae	*Hydrocotyle* sp. L.	Pennywort	Water Conservation Area 2A, FL	4/97	S. Cooper
Aquifoliaceae	*Ilex cassine* L.	Dahoon	Busch Blvd., Hillsborough Co., FL	4/28/78	D.W .Crewz
Araceae	*Peltandra virginica* (L.) Schott	Arrow arum;Tuckahoe	Laurens Co., SC	6/12/93	C. Horn
Araceae	*Pistia stratiotes* L.	Water lettuce	Vega Alta Municipality, Puerto Rico	1/11/88	T. Bradley
Arecaceae	*Sabal palmetto* (Walt.) Lodd. ex J.A. & J.H. Schultes	Cabbage palmetto	Bear Island, Colleton Co., SC	10/7/95	J. Albiston
Asteraceae	*Ageratum conyzoides* L.	Tropical whiteweed			
Asteraceae	*Ambrosia artemisiifolia* L.	Ragweed	Miami Dade Co Fl	11/28/81	L. Abbott
Asteraceae	*Ampelaster carolinianus* (Walt.) Nesom (synonym: *Aster carolinianus* (Walt.) Nesom)	Climbing aster	Sabal Minor, Vlusia, FL	11/19/64	T Bradley
Asteraceae	*Baccharis* sp. L	Groundsel tree	Brunswick Co., NC	9/6/63	
Asteraceae	*Bidens alba* (L.) DC.	Roerillo	Water Conservation Area 3A, FL	10/8/97	L. Weimer
Asteraceae	*Bidens laevis* (L.) B.S.P.	Smooth beggartick	Water Conservation Area 3A, FL	10/8/97	L. Weimer
Asteraceae	*Borrichia frutescens* (L.) DC.	Bushy seaside tansy	Glynn Co., GA	6/17/48	A. Cronquist
Asteraceae	*Cirsium horridulum* Michaux	Thistle	Spartansburg, Spartansburg Co., SC	4/22/95	C. Horn
Asteraceae	*Conoclinium coelestinum* (L.) DC.	Blue mistflower	Cape May Co., NJ	10/13/97	A. Powell
Asteraceae	*Eupatorium capilifolium* (Lam.) Small	Dog fennel	Osceola Co., FL	11/19/73	T. Bradley
Asteraceae	*Eupatorium serotinum* Michaux	Late-flowering thoroughwort	Harris Co., TX		
Asteraceae	*Mikania scandens* (L.) Willdenow	Climbing hempweed	Hillsborough Co., FL	10/6/97	A. P Robbins
Asteraceae	*Pluchea odorata* (L.) Cassini	Camphor weed	Bear Island Game Mgmt. Area, Colleton Co., SC	10/7/95	J. Albiston
Asteraceae	*Solidago sempervirens* L.	Seaside goldenrod	Alligator River @ Fort Landong, Terrel Co., NC		T. Bradley
Asteraceae	*Sonchus oleraceus* L.	Common sowthistle	Ranger Station, Key Largo, FL	2/27/97	D. Willard
Asteraceae	*Sphagneticola trilobata* (L.C. Rich) Pruski (synonym: *Wedelia trilobata* (L.) A.S. Hitchcock)	Bay Biscayne creeping-oxeye	Staniard Creek Set, N Andros Isl., Bahamas	6/15/95	T. Bradley
Asteraceae	*Symphyotrichum elliottii* (Torr. & Gray) Nesom (synonym: *Aster elliottii* (Torr. & Gray))	Elliott's aster			
Asteraceae	*Tridax procumbens* L.	Coatbuttons	U FL campus, Coral Gables, Dade Co., FL	5/22/90	C. Horn
Asteraceae	*Youngia japonica* (L.) DC.	Oriental false hawksbeard			
Bataceae	*Batis maritima* L.	Saltwort	Honolulu, HI	6/14/35	O. Degener
Blechnaceae	*Blechnum serrulatum* L.C. Rich.	Toothed midsorus fern	Water Conservation Area 3A, FL	10/8/97	L. Weimer
Boraginaceae	*Heliotropium polyphyllum* Lehm.	Pineland heliotrope	Monroe Co., FL	3/8/87	T. Bradley
Brassicaceae	*Descurainia pinnata* (Walt.) Britt.	Western tansymustard	Longwood, Seminole Co., FL	3/18/81	T. Bradley
Bromeliaceae	*Tillandsia balbisiana* J.A. & J.H. Schultes	Northern needleleaf	N Andros Isl., Bahamas	1/11/84	T. Bradley
Burseraceae	*Bursera simaruba* (L.) Sargent	Gumbo limbo	Charlie's Blue Hole North Andros Isl., Bahamas	5/23/97	T. Bradley
Caprifoliaceae	*Sambucus nigra* L. spp. *canadensis* (L.) R. Bolli (synonym: *Sambucus canadensis* L.)	Common elderberry	Seneca tow path, Montgomery Co., MD	6/22/69	M. E. Lokey

Table 3 (continued).

Family	Scientific Name & Authority	Common Name	Collection Site	Collection Date (D/M/YR)	Collector
Caricaceae	*Carica papaya* L.	Papaya	Oahu, HI	10/22/36	O. Degener
Casuarinaceae	*Casuarina equisetifolia* L (synonym: *Casuarina littorea* L. ex Fosberb & Sachet)	Australian pine	Lee Co., FL	12/1/78	G. Johnston
Chenopodiaceae	*Salicornia bigelovii* Torr.	Dwarf glasswort	Dade Co., FL	4/24/64	R.W. Stingelin
Combretaceae	*Conocarpus erecta* L.	Buttonwood			Johan Groot Pollen Colln. (5548/14844)
Combretaceae	*Laguncularia racemosa* (L.) Gaertner F.	White Mangrove	Alifia River, FL	2001	T.J. Smith
Commelinaceae	*Commelina diffusa* Burm. F.	Climbing dayflower			
Convolvulaceae	*Ipomoea pes-caprae* (L.) R. Br.	Bayhops	Momotombo, Nicuragua	8/6/1895	C.L. Smith
Convolvulaceae	*Ipomoea sagittata* Poiret	Glades morning glory	Pender Co., NC	6/30/63	T. Bradley
Cucurbitaceae	*Melothria pendula* L.	Guadeloupe cucumber			T. Bradley
Cyperaceae	*Cladium mariscus* ssp. *jamaicense* (Crantz) Kuekenth (synonym: *Cladium jamaicense* Crantz)	Sawgrass	Alligator River, Tyrrell Co., NC	10/4/63	T. Bradley
Cyperaceae	*Cyperus haspan* L.	Haspan flatsedge	Fowler Bluff, Levy Co., FL	9/1/90	T. Strong
Cyperaceae	*Eleocharis cellulosa* Torr.	Gulf Coast spikerush	Fairchild Tropical Garden, Dade Co., FL	5/29/90	C. Horn
Cyperaceae	*Eleocharis elongata* Chapman	Slim spikerush			
Cyperaceae	*Rhynchospora colorata* (L.) H. Pfeiffer (synonym: *Dichromena colorata* (L.) A.S. Hitchc.)	Starrush whitetop	Everglades National Park, FL	2/27/97	D. Willard
Cyperaceae	*Schoenoplectus taberaemontani* (K.C. Gmel.) Palla	Softstem bulrush	Polk Co., FL	12/14/79	A. Shuey
Euphorbiaceae	*Chamaesyce hypericifolia* (L.) Millspaugh	Spurge	Osceola Co., FL	11/19/73	T. Bradley
Euphorbiaceae	*Chamaesyce maculata* (L.) Small	Spotted sandmat	Clemson Univ. Campus, Pickens Co., SC		J. Albiston
Euphorbiaceae	*Phyllanthus tenellus* Roxb.	Mascarene Island leaf-flower	Pine Hill, Orangeburg Co., SC	8/17/86	C. Horn
Euphorbiaceae	*Ricinus communis* L.	Castor bean	150th Street, Miami, Dade Co., FL	11/28/81	L. Abbott
Fabaceae	*Acacia angustissima* (P. Mill.) Kuntze	Prairie acacia	Water Conservation Area 3A, FL	10/8/97	L. Weimer
Fabaceae	*Apios americana* Medicus	Groundnut	Betty's Island, Camden Co., NJ	9/4/94	C. Horn
Fabaceae	*Cassia obtusifolia* (L.) Irwin & Barneby	Septicweed	Eufala, AL		
Fabaceae	*Cassia occidentalis* (L.) Link	Java-bean	Water Conservation Area 2A, FL	9/97	S. Cooper
Fabaceae	*Desmodium paniculatum* (L.) DC.	Panicledleaf ticktrefoil	Den Hill, Montgomery Co., MD		T. Bradley
Fabaceae	*Vigna luteola* (Jacq.) Bentham	Cowpea	Lettuce Lake, Desoto Co., FL	11/10/77	A. Fulton
Fagaceae	*Quercus laurifolia* Michx.	Laurel oak			Johan Groot Pollen Colln. (1893/2591)
Haloragaceae	*Myriophyllum* sp. L.	Watermilfoil			
Haloragaceae	*Proserpinaca palustris* L.	Marsh mermaidweed	Hillsborough Co., FL	5/1/78	A. Shuey
Hippocrateaceae	*Hippocratea volubilis* L.	Medicine vine	Key Largo, FL	4/19/58	W.L. Stern
Lentibulariaceae	*Utricularia foliosa* L.	Leafy bladderwort	Water Conservation Area 2A, FL	4/97	S. Cooper
Liliaceae	*Crinum americanum* L.	Seven sisters	Water Conservation Area 2A, FL	6/97	S. Cooper
Loganiaceae	*Mitreola* sp. L.	Hornpod			
Lythraceae	*Lythrum alatum* Pursh	Winged lythrum	Grundy Co., IL	8/6/93	J. Slapcinsky
Malvaceae	*Sida cordifolia* L.	Ilima	Hillsborough Co., FL	10/20/77	B. Massetti
Moraceae	*Morus rubra* L.	Red mulberry	FL		
Myricaceae	*Morella cerifera* (L.) Small (synonym: *Myrica cerifera* L.)	Wax myrtle	St. Marys Co., MD		Reeves
Myrtaceae	*Melaleuca quinquenervia* (Cav.) Blake	Punk tree; Bottle-brush	North Andros Island, Bahamas	1/4/84	T. Bradley
Myrtaceae	*Psidium guajava* L.	Guava	Tobonuco	12/29/82	T. Bradley
Nymphaeaceae	*Nuphar lutea* (L.) Sm.	Cow lily; Spatter dock	Davis farm pond, Orangeburg Co., SC	5/27/91	C. Horn
Nymphaeaceae	*Nymphaea odorata* Aiton	Water lily	Dade Co., FL	6/30/92	C. Horn
Onagraceae	*Ludwigia leptocarpa* (Nutt.) Hara	Ludwigia	Edisto River, Colleton Co., SC	11/29/86	S. Reilly
Osmundaceae	*Osmunda regalis* L.	Royal fern	Lake Co., FL	3/27/67	T. Bradley

Table 3 (continued).

Family	Scientific Name & Authority	Common Name	Collection Site	Collection Date (D/M/YR)	Collector
Poaceae	*Andropogon glomeratus* (Walt.) Britton; Stern; & Poggenberg	Bushy bluestem	South Port, Brunswick Co., NC	9/6/63	T. Bradley
Poaceae	*Andropogon virginicus* L.	Broomsedge bluestem	Keysville, Charlotte Co., VA	10/23/88	T. Bradley
Poaceae	*Eragrostis elliottii* S. Wats.	Field lovegrass	Lazy Acres Campground, Cumberland Co., NC	10/13/96	M.T. Strong
Poaceae	*Heteropogon contortus* (L.) Beauv. Ex Roemer & J.A. Schultes	Tanglehead	Camino del Oeste, Pima Co., AZ	11/6/87	R. Canal
Poaceae	*Panicum repens* L.	Torpedo grass	Deer Field Beach, Broward Co., FL	7/2/81	B. Hansen
Poaceae	*Pennisetum ciliare* (L.) Link var. *ciliare* (synonym: *Cenchrus ciliaris* L.)	Buffelgrass	Guanica Municipality, Puerto Rico	11/17/78	T. Bradley
Poaceae	*Phragmites australis* (Cav.) Trin. ex Steud. (synonym: *Phragmites communis* Trin.)	Common reed			
Poaceae	*Setaria parviflora* (Poir.) Kergúelen (synonym: *Setaria geniculata* auct. non (Wild.) Beauv.)	Marsh bristlegrass	Four County Fish Hatchery, Newberry Co., SC	8/22/86	C.M. Horn
Poaceae	*Spartina alterniflora* Loisel.	Smooth cordgrass	Eastern Bay, Talbot Co., MD	10/10/87	C.K. Long
Poaceae	*Zizaniopsis miliacea* (Michx.) Doell & Aschers.	Giant cutgrass	Lake Moultrie, Berkeley Co., SC	9/6/63	T. Bradley
Polygalaceae	*Polygala* sp. L.	Polygala	Essex Co., VA	10/13/91	T. Bradley
Polygonaceae	*Polygonum densiflorum* Meisn.	Denseflower knotweed	Riverview, FL	5/3/96	D. Willard
Polygonaceae	*Polygonum hydropiperoides* Michaux	Swamp smartweed	Monroe Co., LA	11/14/69	D. Thomas
Polypodiaceae	*Phlebodium aureum* (L.) J. Sm.	Golden polypody			
Pontederiaceae	*Eichhornia crassipes* (Mart.) Solms	Water hyacinth	Water Conservation Area 2A, FL	11/95	S. Cooper
Pontederiaceae	*Pontederia cordata* L.	Pickerel weed			
Pteridaceae	*Acrostichum danaeifolium* Langsd. & Fisch.	Inland leatherfern	Bowen Sound	05/27/97	T. Bradley
Pteridaceae	*Pteris longifolia* L.	Longleaf brake			
Pteridaceae	*Pteris vittata* L.	Ladder brake			
Rhizophoraceae	*Rhizophora mangle* L.	Red mangrove	Big Pine Key, FL	6/24/56	G.K. Brigicky
Rubiaceae	*Cephalanthus occidentalis* L.	Button bush	Columbus, Lowndes Co., MS	7/31/86	C. Horn
Salicaceae	*Salix caroliniana* Michaux	Coastal plain willow	Orange Co., FL	3/20/81	J. Beckner
Salviniaceae	*Salvinia minima* Baker	Water spangles	Fairfax Co., Va	8/20/98	J. Murray
Saururaceae	*Saururus cernuus* L.	Lizard's tail	Fairfield Co., SC	32514	C. Horn
Scrophulariaceae	*Bacopa monnieri* (L.) Pennell	Water hyssop	Lake Co., FL	8/17/93	T. Strong
Solanaceae	*Capsicum annuum* L.	Cayenne pepper	St. Catherine Parish, Jamaica	11/23/75	T. Bradley
Solanaceae	*Physalis pubescens* L.	Husk tomato	Fairfax Co., VA	9/7/88	T. Bradley
Solanaceae	*Solanum americanum* P. Mill.	American black nightshade	Loudon Co., VA	9/25/97	D. Willard
Sterculiaceae	*Waltheria indica* L.	Waltheria	Fiesta Key, Dade Co., FL	11/21/73	T. Bradley
Taxodiaceae	*Taxodium distichum* (L.) Richards	Bald cypress	Spotsylvania Co., VA	9/23/70	T. Bradley
Thelypteridaceae	*Thelypteris kunthii* (Desv.) Morton	Kunth's maiden fern	Water Conservation Area 3A, FL	3/9/97	D. Willard
Typhaceae	*Typha domingensis* Pers.	Southern cattail	South of Gressitt, King and Queen Co., VA	10/9/82	T. Bradley
Typhaceae	*Typha latifolia* L.	Cattail			
Ulmaceae	*Trema micranthum* (L.) Blume	Jamaican nettletree	North Andros Island, Bahamas	8/9/96	T. Bradley
Urticaceae	*Boehmeria cylindrica* (L.) Sw.	False nettle			
Verbenaceae	*Callicarpa americana* L.	Beauty berry	Brooksville, Hernando Co., FL	30777	T. Bradley
Verbenaceae	*Lantana camara* L.	Lantana	North Andros Island, Bahamas	5/27/97	T. Bradley
Vitaceae	*Vitis rotundifolia* Michx. var. *munsoniana* (Simpson ex Munson) M.O. Moore (syn: *Vitis munsoniana* (Simpson ex Munson))	Munson's grape	Turkey Lake City Park, Orange Co., FL		J.Slapcinsky, J. Chick

Table 4. Aperture and ornamentation summary.

Scientific Name and Authority	Family	Aperture	Ornamentation	Micrograph
Acacia angustissima **(P. Mill.) Kuntze**	Fabaceae	inaperaturate	psilate	Plate 22: 366–367
Acer rubrum **L.**	Aceraceae	tricolpate	striate	Plate 11: 144–146
Acrostichum danaeifolium **Langsd. & Fisch.**	Pteridaceae	trilete	psilate	Plate 2: 15–16
Ageratum conyzoides **L.**	Asteraceae	tri-tetracolporate-syncolporate	echinate	Plate 13: 179–183
Alternanthera philoxeroides **(Mart.) Griesbach**	Amaranthaceae	inaperaturate	lophate	Plate 3: 28–30
Amaranthus australis **(Gray) Sauer**	Amaranthaceae	periporate	pitted	Plate 7: 100–101
Ambrosia artemisiifolia **L.**	Asteraceae	tricolporate	echinate	Plate 13: 184–187
Ampelaster carolinianus **(Walt.) Nesom (synonym:** ***Aster carolinianus*** **(Walt.) Nesom)**	Asteraceae	tricolporate	echinate	Plate 13: 188–192
Andropogon glomeratus **(Walt.) Britton; Stern; & Poggenberg**	Poaceae	monoporate	scabrate	Plate 4: 50–51
Andropogon virginicus **L.**	Poaceae	monoporate	psilate to nearly psilate	Plate 4: 52–53
Annona glabra **L.**	Annonaceae	monosulcate	reticulate	Plate 22: 379
Apios americana **Medicus**	Fabaceae	tricolporate	finely reticulate	Plate 17: 288–292
Baccharis **sp. L**	Asteraceae	tricolporate	echinate	Plate 13: 193–195
Bacopa monnieri **(L.) Pennell**	Scrophulariaceae	tricolporate	reticulate	Plate 18: 302–306
Batis maritima **L.**	Bataceae	stephanolcolporoidate	psilate	Plate 20: 336–339
Bidens alba **(L.) DC.**	Asteraceae	tricolporate	echinate	Plate 13: 196–198
Bidens laevis **(L.) B.S.P.**	Asteraceae	tricolporate	echinate	Plate 13: 199–201
Blechnum serrulatum **L.C. Rich.**	Blechnaceae	monolete	psilate	Plate 1: 1–5
Boehmeria cylindrica **(L.) Sw.**	Urticaceae	diporate	scabrate	Plate 6: 72–73
Borrichia frutescens **(L.) DC.**	Asteraceae	tricolporate	echinate	Plate 14: 202–205
Bursera simaruba **(L.) Sargent**	Burseraceae	tri-tetraporate	reticulate	Plate 6: 86–89
Callicarpa americana **L.**	Verbenaceae	tricolporate–colporoidate	reticulate	Plate 19: 324–328
Capsicum annuum **L.**	Solanaceae	tricolporate	pitted	Plate 16: 245–250
Carica papaya **L.**	Caricaceae	tricolporate	reticulate	Plate 17: 278–280
Cassia obtusifolia **(L.) Irwin & Barneby**	Fabaceae	tricolporoidate	rugulate	Plate 12: 167–169
Cassia occidentalis **(L.) Link**	Fabaceae	tricolporate	pitted	Plate 16: 257–259
Casuarina equisetifolia **L. (synonym:** ***Casuarina littorea*** **L. ex Fosberb & Sachet)**	Casuarinaceae	triporate	psilate	Plate 6: 80–81
Cephalanthus occidentalis **L.**	Rubiaceae	tricolporate	reticulate	Plate 18: 293–296
Chamaesyce hypericifolia **(L.) Millspaugh**	Euphorbiaceae	tricolporate	reticulate	Plate 18: 310–312
Chamaesyce maculata A64 **(L.) Small**	Euphorbiaceae	tricolporate	reticulate	Plate 18: 313–317
Cicuta maculata **L. var.** ***maculata*** **(synonym:** ***Cicuta mexicana*** **Coult. & Rose)**	Apiaceae	tricolporate	reticulate	Plate 19: 318–319
Cirsium horridulum **Michaux**	Asteraceae	tricolporate	echinate	Plate 14: 220–222
Cladium mariscus **ssp.** ***jamaicense*** **(Crantz) Kuekenth (synonym:** ***Cladium jamaicense*** **Crantz)**	Cyperaceae	ulcerate	finely scabrate	Plate 3: 44
Commelina diffusa **Burm. F.**	Commelinaceae	monosulcate	granulate	Plate 9: 119–122
Conocarpus erecta **L.**	Combretaceae	heterocolporate	psilate	Plate 21: 346–349
Conoclinium coelestinum **(L.) DC.**	Asteraceae	tricolporate	echinate	Plate 14: 206–210
Crinum americanum **L.**	Liliaceae	monosulcate	echinate	Plate 10: 128–130
Cyperus haspan **L.**	Cyperaceae	ulcerate	scabrate	Plate 3: 36–37
Descurainia pinnata **(Walt.) Britt.**	Brassicaceae	tricolpate	reticulate	Plate 11: 147–150
Desmodium paniculatum **(L.) DC.**	Fabaceae	tricolporate	rugulate	Plate 12: 170–174
Eichhornia crassipes **(Mart.) Solms**	Pontederiaceae	monosulcate	microverrucate	Plate 9: 117–118

Table 4 (continued).

Scientific Name and Authority	Family	Aperture	Ornamentation	Micrograph
Eleocharis cellulosa **Torr.**	Cyperaceae	ulcerate	scabrate	Plate 3: 43
Eleocharis elongata **Chapman**	Cyperaceae	ulcerate	scabrate	Plate 3: 40
Eragrostis elliottii **S. Wats.**	Poaceae	monoporate	coarsely scabrate	Plate 5: 61–63
Eupatorium capilifolium **(Lam.) Small**	Asteraceae	tricolporate	echinate	Plate 14: 211–215
Eupatorium serotinum **Michaux**	Asteraceae	tricolporate	echinate	Plate 14: 216–219
Heliotropium polyphyllum **Lehm.**	Boraginaceae	heterocolporate	psilate	Plate 21: 354–356
Heteropogon contortus **(L.) Beauv. Ex Roemer & J.A. Schultes**	Poaceae	monoporate	scabrate	Plate 4: 55–56
Hippocratea volubilis **L.**	Hippocrateaceae	triporate	reticulate	Plate 22: 374–375
Hydrocotyle **sp. L.**	Apiaceae	tricolporate	reticulate	Plate 19: 320–323
Ilex cassine **L.**	Aquifoliaceae	tricolporate	clavate	Plate 12: 175–178
Ipomoea pes–caprae **(L.) R. Br.**	Convolvulaceae	periporate	echinate	Plate 8: 108–109
Ipomoea sagittata **Poiret**	Convolvulaceae	periporate	echinate	Plate 8: 110–111
Justicia americana **(L.) Vahl**	Acanthaceae	diporate	reticulate	Plate 6: 77–79
Laguncularia racemosa **(L.) Gaertner F.**	Combretaceae	tricolporate	finely reticulate	Plate 17: 268–272
Lantana camara **L.**	Verbenaceae	tri-tetracolporate	pitted	Plate 16: 251–256
Ludwigia leptocarpa **(Nutt.) Hara**	Onagraceae	tricolporate	rugulate	Plate 22: 376–378
Lythrum alatum **Pursh**	Lythraceae	heterocolporate	striate	Plate 21: 357–360
Melaleuca quinquenervia **(Cav.) Blake**	Myrtaceae	syncolporate	psilate	Plate 21: 361–362
Melothria pendula **L.**	Cucurbitaceae	tricolporate	reticulate	Plate 19: 332–335
Mikania scandens **(L.) Willdenow**	Asteraceae	tricolporate	echinate	Plate 15: 223–225
Mitreola sp. **L.**	Loganiaceae	tricolporate	psilate	Plate 12: 158–159
Morella cerifera **(L.) Small (synonym: *Myrica cerifera* L.)**	Myricaceae	triporate	psilate	Plate 6: 82–85
Morus rubra **L.**	Moraceae	diporate	psilate	Plate 6: 69–71
Myriophyllum **sp. L.**	Haloragaceae	stephanoporate	psilate	Plate 7: 94–96
Nuphar lutea **(L) Sm.**	Nymphaeaceae	monosulcate	echinate	Plate 10: 131–132
Nymphaea odorata **Aiton**	Nymphaeaceae	monosulcate	clavate, gemmate, baculate	Plate 9: 123–127
Osmunda regalis **L.**	Osmundaceae	trilete	rugulate	Plate 2: 12–14
Panicum repens **L.**	Poaceae	monoporate	scabrate	Plate 4: 48–49
Peltandra virginica **(L.) Schott**	Araceae	inaperaturate	psilate	Plate 3: 27
Pennisetum ciliare **(L.) Link var. *ciliare* (synonym: *Cenchrus ciliaris* L.)**	Poaceae	monoporate	scabrate to microrugulate	Plate 4: 45–47
Phlebodium aureum **(L.) J. Sm.**	Polypodiaceae	monolete	verrucate	Plate 1: 6–8
Phragmites australis **(Cav.) Trin. ex Steud. (synonym: *Phragmites communis* Trin.)**	Poaceae	monoporate	scabrate	Plate 5: 64–66
Phyllanthus tenellus **Roxb.**	Euphorbiaceae	tri-tetracolporate	finely reticulate	Plate 16: 260–263
Physalis pubescens **L.**	Solanaceae	tricolporate	psilate	Plate 12: 164–166
Pistia stratiotes **L.**	Araceae	inaperaturate	psilate	Plate 3: 25–26
Pluchea odorata **(L.) Cassini**	Asteraceae	tricolporate	echinate	Plate 15: 229–232
Polygala **sp. L.**	Polygalaceae	heterocolporate	psilate	Plate 21: 350–353
Polygonum densiflorum **Meisn.**	Polygonaceae	periporate	reticulate	Plate 7: 104–105
Polygonum hydropiperoides **Michaux**	Polygonaceae	periporate	reticulate	Plate 7: 106–107
Pontederia cordata **L.**	Pontederiaceae	dicolpate	microrugulate	Plate 11: 138–139
Proserpinaca palustris **L.**	Haloragaceae	stephanoporate	rugulate	Plate 7: 97–99
Psidium guajava **L.**	Myrtaceae	syncolporate	scabrate	Plate 21: 363–365
Pteris longifolia **L.**	Pteridaceae	trilete	rugulate	Plate 2: 17–19
Pteris vittata **L.**	Pteridaceae	trilete	rugulate	Plate 2: 20–22
Quercus laurifolia **Michx.**	Fagaceae	tricolpate–tricolporoidate	scabrate	Plate 11: 140–143

Table 4 (continued).

Scientific Name and Authority	Family	Aperture	Ornamentation	Micrograph
***Rhizophora mangle* L.**	Rhizophoraceae	tricolporate	finely reticulate	Plate 17: 273–277
***Rhus copallinum* L.**	Anacardiaceae	tricolporate	reticulate	Plate 19: 329–331
***Rhynchospora colorata* (L.) H. Pfeiffer (synonym: Dichromena colorata (L.) A.S. Hitchc.)**	Cyperaceae	ulcerate	coarsely scabrate to microverrucate	Plate 3: 38–39
***Ricinus communis* L.**	Euphorbiaceae	tricolporate	reticulate	Plate 17: 281–283
***Sabal palmetto* (Walt.) Lodd. ex J.A. & J.H. Schultes**	Arecaceae	monosulcate	pitted to micropitted	Plate 9: 115–116
***Sagittaria lancifolia* L.**	Alismataceae	ulcerate	echinate	Plate 3: 31–32
***Sagittaria latifolia* Willd.**	Alismataceae	ulcerate	echinate	Plate 3: 33–35
***Salicornia bigelovii* Torr.**	Chenopodiaceae	periporate	micropitted	Plate 7: 102–103
***Salix caroliniana* Michaux**	Salicaceae	tricolporate	reticulate	Plate 18: 297–301
***Salvinia minima* Baker**	Salviniaceae	trilete	psilate	Plate 2: 23–24
***Sambucus nigra* L. spp. *canadensis* (L.) R. Bolli (synonym*: Sambucus canadensis* L.)**	Caprifoliaceae	tricolporate	reticulate	Plate 18: 307–309
***Saururus cernuus* L.**	Saururaceae	monosulcate	psilate	Plate 11: 136–137
***Schinus terebinthifolius* Raddi**	Anacardiaceae	tricolporate	finely reticulate	Plate 16: 264–267
***Schoenoplectus taberaemontani* (K.C. Gmel.) Palla (synonym: *Scirpus validus* Vahl)**	Cyperaceae	ulcerate	scabrate	Plate 3: 41–42
***Setaria parviflora* (Poir.) Kergúelen (synonym: *Setaria geniculata* auct. non (Wild.) Beauv.)**	Poaceae	monoporate	coarsely scabrate	Plate 4: 54
***Sida cordifolia* L.**	Malvaceae	periporate	echinate	Plate 8: 112–114
***Solanum americanum* P. Mill.**	Solanaceae	tricolporate–syncolporate	psilate	Plate 12: 160–163
***Solidago sempervirens* L.**	Asteraceae	tricolporate	echinate	Plate 15: 233–236
***Sonchus oleraceus* L.**	Asteraceae	lophate tricolpate	echinate	Plate 11: 151–153
***Spartina alterniflora* Loisel.**	Poaceae	monoporate	scabrate	Plate 5: 57–58
***Sphagneticola trilobata* (L.C. Rich) Pruski (synonym: *Wedelia trilobata* (L.) A.S. Hitchcock)**	Asteraceae	tri-tetracolporate	echinate	Plate 15: 242–244
***Symphyotrichum elliottii* (Torr. & Gray) Nesom (synonym: *Aster elliottii* Torr. & Gray)**	Asteraceae	tricolporate	echinate	Plate 15: 237–241
***Taxodium distichum* (L.) Richards**	Taxodiaceae	monoporate	scabrate	Plate 5: 67–68
***Thelypteris kunthii* (Desv.) Morton**	Thelypteridaceae	monolete	psilate with rugulate perispore	Plate 1: 9–11
***Tillandsia balbisiana* J.A. & J.H. Schultes**	Bromeliaceae	monosulcate	reticulate	Plate 10: 133–135
***Trema micranthum* (L.) Blume**	Ulmaceae	diporate	microrugulate	Plate 6: 74–76
***Tridax procumbens* L.**	Asteraceae	tri-tetracolporate	echinate	Plate 15: 226–228
***Typha domingensis* Pers.**	Typhaceae	monoulcerate	reticulate	Plate 22: 368–369
***Typha latifolia* L.**	Typhaceae	monoulcerate	reticulate	Plate 22: 370–373
***Utricularia foliosa* L.**	Lentibulariaceae	polycolporoidate	psilate	Plate 20: 340–341
***Vigna luteola* (Jacq.) Bentham**	Fabaceae	triporate	reticulate	Plate 6: 90–93
***Vitis rotundifolia* Michx. var. *munsoniana* (Simpson ex Munson) M.O. Moore (syn:*Vitis munsoniana* (Simpson ex Munson))**	Vitaceae	tricolporate	finely reticulate	Plate 17: 284–287
***Waltheria indica* L.**	Sterculiaceae	stephanocolporate	reticulate	Plate 20: 342–345
***Youngia japonica* (L.) DC.**	Asteraceae	lophate tricolpate	echinate	Plate 11: 154–157
***Zizaniopsis miliacea* (Michx.) Doell & Aschers.**	Poaceae	monoporate	psilate to finely scabrate	Plate 5: 59–60

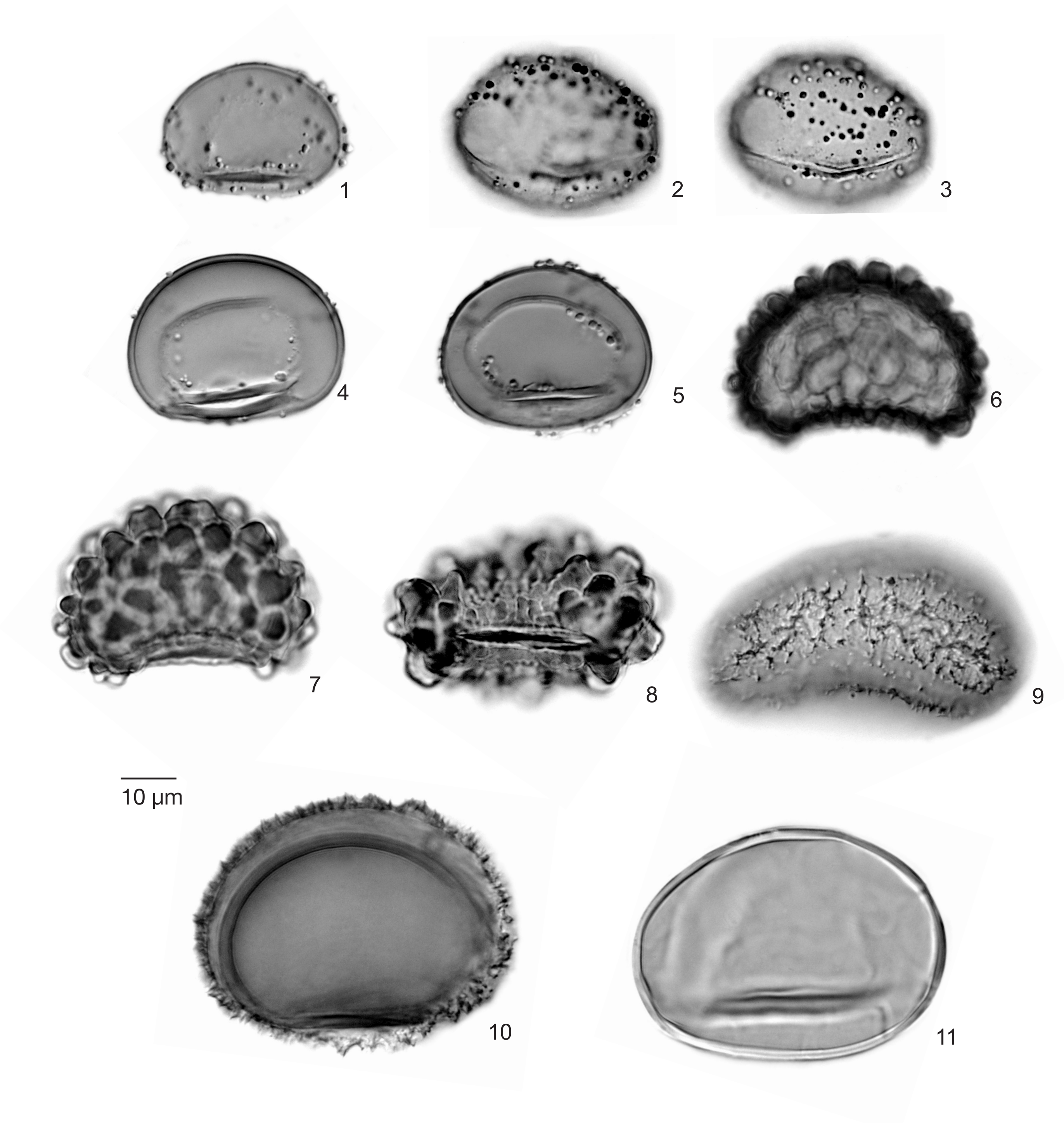


PLATE 1
Monolete Spores

1–5 *Blechnum serrulatum* (Blechnaceae)
6–8 *Phlebodium aureum* (Polypodiaceae)
9–11 *Thelypteris kunthii* (Thelypteridaceae)

39.5) µm; psilate or may bear rugulate perispore (see Plate 1: 9–10); exine thickness 2.1 (1.7–3.0) µm.

GYMNOSPERMAE

Taxodiaceae

Taxodium distichum (L.) L.C. Richards
Plate 5: 67–68

Spherical grain; maximum dimension: 26.2 (25.0–28.5) µm; monoporate; round pore at exit tip of papilla (see Plate 5: 68); papilla length: 4.0 (3.0–5.0) µm; papilla commonly not preserved in sedimentary record; pore diameter: 1.7 (1.0–2.0) µm; pollen grain typically torn with wedge–shaped tear as illustrated in Plate 5: 67; scabrate; exine thickness: 1.2 (1.0–2.0) µm.

ANGIOSPERMAE: MONOCOTYLEDONEAE

Alismataceae

Sagittaria lancifolia L.
Plate 3: 31–32

Spherical grain; maximum dimension: 25.5 (23.9–27.2) µm; ulcerate; aperture margins irregular; sparsely echinate; spine height: 1.1 (0.7–1.5) µm; spine width at base: 0.7 (0.5–0.8) µm; exine thickness: 1.3 (1.0–1.8) µm; tectate.

Sagittaria latifolia Willd.
Plate 3: 33–35

Spherical grain; maximum dimension: 29.2 (25.5–36.0) µm; ulcerate; aperture margins irregular; echinate; spine height: 1.3 (1.0–1.8) µm; spine width at base: 0.8 (0.6–1.1) µm; exine thickness: 1.8 (1.5–2) µm; tectate.

Araceae

Peltandra virginica (L.) Schott
Plate 3: 27

Spherical to oval grain; maximum dimension: 29.8 (23.6–33.9) µm; inaperturate; psilate; exine thickness: 1.3 (1.0–1.5) µm.

Pistia stratiotes L.
Plate 3: 25–26

Oval grain; long axis: 31.6 (26.0–37.5) µm; short axis: 19.9 (18.5–22.5) µm; inaperturate; psilate; exine thickness: 1.1 (1.0–1.5) µm.

Arecaceae

Sabal palmetto (Walt.) Lodd. ex J.A. & J.H. Schultes
Plate 9: 115–116

Oval grain; long axis: 38.2 (34.2–41.6) µm; short axis: 26.3 (22.3–29.9) µm; monosulcate; sulcus length: 28.4 (15.8–33.6) µm; pitted to micropitted; exine thickness: 2.0 (1.0–3.0) µm; tectate.

Bromeliaceae

Tillandsia balbisiana J.A. & J.H. Schultes
Plate 10: 133–135

Oval grain; long axis: 67.5 (62.7–70.3) µm; short axis: 39.5 (36.9–43.5) µm; monosulcate; sulcus length: 41.7 (40.2–43.1) µm; maximum sulcus width: 2.9 (2.9–3.1) µm; reticulate; homobrochate; exine thickness: 2.0 (1.9–2.3) µm.

Commelinaceae

Commelina diffusa Burm. F.
Plate 9: 119–122

Oval grain; long axis: 32.8 (25.0–39.0) µm; short axis: 25.2 (20.0–30.0) µm; monosulcate; sulcus with irregular margin (see Plate 9: 121, 122); sulcus length: 19.9 (17.0–24.0) µm; granulate; grana regularly distributed on surface (see Plate 9: 120); exine thickness: 1.6 (1.0–2.0) µm.

Cyperaceae

Cladium mariscus (L.) Pohl ssp. *jamaicense* (Crantz) Kuekenth
(synonym: *Cladium jamaicense* Crantz)
Plate 3: 44

Rounded triangular grain with characteristic elongated tip; maximum dimension: 68.1 (53.9–78.0) µm; ulcerate; aperture margins irregular; finely scabrate; exine thickness: 1.1 (0.9–1.3) µm.

Cyperus haspan L.
Plate 3: 36–37

Rounded triangular grain; maximum dimension: 23.8 (21.0–27.0) µm; ulcerate; aperture margins irregular; scabrate; exine thickness: 1.5 (1.2–1.9) µm.

Eleocharis cellulosa Torr.
Plate 3: 43

Rounded triangular grain; maximum dimension: 50.3 (47.0–54.0) µm; ulcerate; aperture margins irregular; scabrate; exine thickness: 1.0 (0.9–1.1) µm.

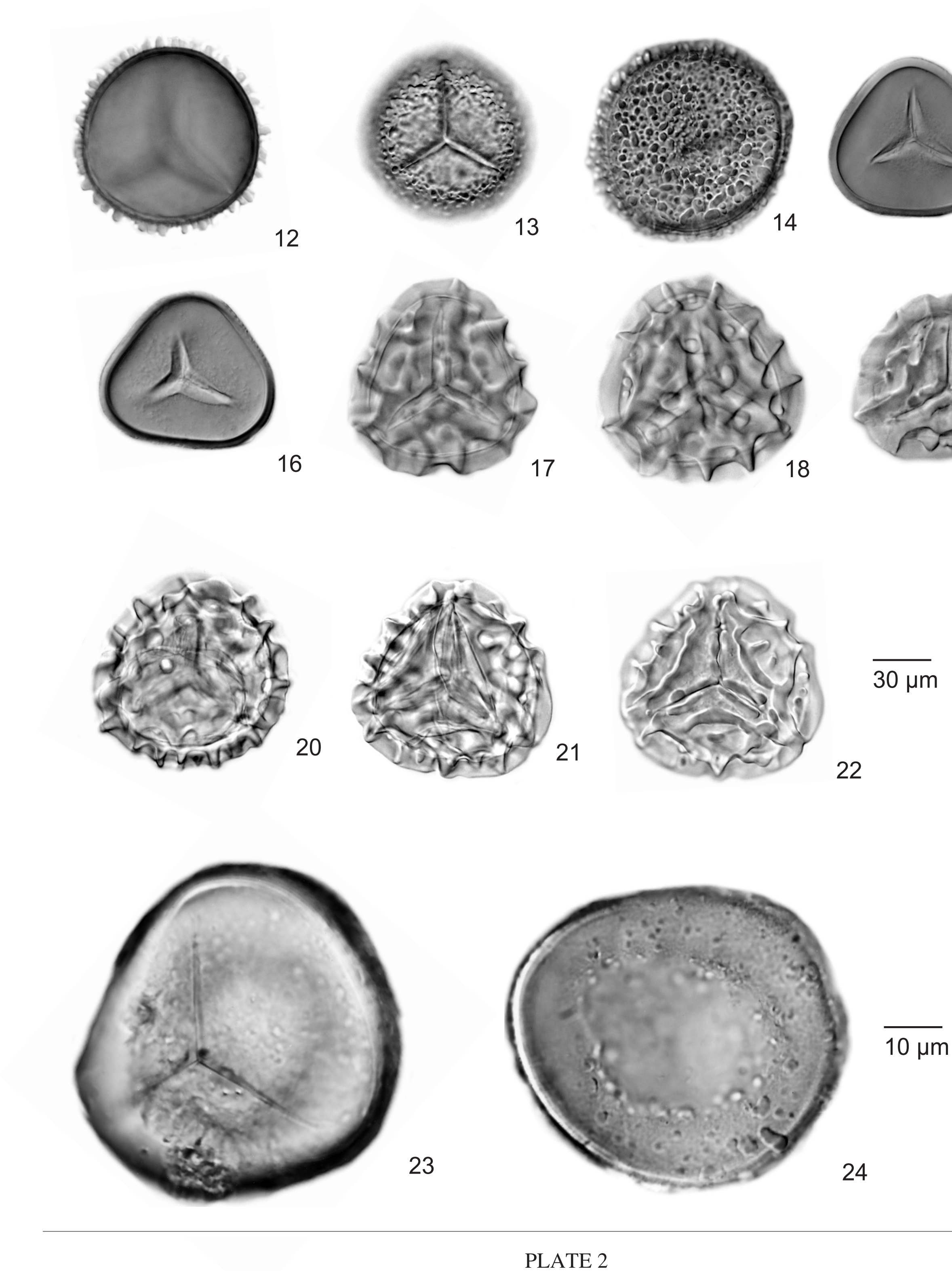


PLATE 2
Trilete Spores

12–14 *Osmunda regalis* (Osmundaceae)
15–16 *Acrostichum danaeifolium* (Pteridaceae)
17–19 *Pteris longifolia* (Pteridaceae)
20–22 *Pteris vittata* (Pteridaceae)
23–24 *Salvinia minima* (Salviniaceae)

Eleocharis elongata Chapman
Plate 3: 40

Rounded grain; maximum dimension: 43.1 (37.0–53.0) µm; ulcerate; aperture margins irregular; scabrate; exine thickness: 1.3 (1.0–1.5) µm.

Rhynchospora colorata (L.) H. Pfeiffer
(synonym: *Dichromena colorata* (L.) A.S. Hitchc.)
Plate 3: 38–39

Rounded triangular grain; maximum dimension: 29.6 (26.0–33.0) µm; ulcerate; aperture margins irregular; coarsely scabrate to microverrucate; exine thickness: 1.1 (0.8–1.3) µm.

Schoenoplectus taberaemontani (K.C. Gmel.) Palla
(synonym: *Scirpus validus* Vahl)
Plate 3: 41–42

Rounded triangular grain; maximum dimension: 33.9 (31.0–38.0) µm; ulcerate; aperture margins irregular with some sculptural elements within the ulcus; scabrate; exine thickness: 1.3 (1.0–1.5) µm.

Liliaceae
Crinum americanum L.
Plate 10: 128–130

Oval grain; long axis: 133.4 (128.4–138.3) µm; short axis: 75.6 (73.1–78.4) µm; monosulcate; sulcus length: 94.2 (68.0–115.0) µm; echinate (see Plate 10: 130); sculptural elements distributed sparsely in regularly spaced rows (see Plate 10: 129); spine height: 2.3 (2.2–2.4) µm; spine width at base: 1.7 (1.5–2.2) µm; exine thickness: 3.6 (3.1–4.4) µm.

Poaceae
Andropogon glomeratus (Walt.) Britton;
Stern; & Poggenberg
Plate 4: 50–51

Spherical grain; maximum dimension: 29.0 (25.0–35.0) µm; monoporate; round annulate pore; pore diameter: 2.5 (2.0–3.0) µm; annulus width: 2.3 (1.9–2.6) µm; scabrate; exine thickness: 1.5 (1.0–2.0) µm.

Andropogon virginicus L.
Plate 4: 52–53

Spherical grain; maximum dimension: 30.5 (28.0–35.0) µm; monoporate; round annulate pore with operculum; pore diameter: 3.5 (3.0–4.0) µm; annulus width 2.7 (2.5–3.0) µm; psilate to scabrate; exine thickness: 1.3 (1.0–1.5) µm.

Eragrostis elliottii S. Wats.
Plate 5: 61–63

Spherical grain; maximum dimension: 34.2 (29.0–33.0) µm; monoporate; round annulate pore; pore diameter: 2.2 (2.0–3.0) µm; annulus width: 1.9 (1.6–2.1) µm; coarsely scabrate; exine thickness: 0.8 (0.6–1.1) µm.

Heteropogon contortus (L.) Beauv.
Ex Roemer & J.A. Schultes
Plate 4: 55–56

Spherical grain; maximum dimension: 46.3 (39.0–48.5) µm; monoporate; round annulate pore; pore diameter: 3.3 (2–4) µm; annulus width: 3.7 (3.5–4.3); scabrate; exine thickness: 1.9 (1–2.5) µm.

Panicum repens L.
Plate 4: 48–49

Spherical grain; maximum dimension: 33.3 (27.0–40.0) µm; monoporate; round annulate pore with operculum often present; pore diameter: 2.5 (2.0–3.0) µm; annulus width: 2.6 (2.0–3.0) µm; scabrate; exine thickness: 1.1 (1.0–2.0) µm.

Pennisetum ciliare (L.) Link var. *ciliare*
(synonym: *Cenchrus ciliaris* L.)
Plate 4: 45–47

Spherical grain; maximum dimension: 36.5 (21.0–46.0) µm; monoporate; round annulate pore with operculum often present; pore diameter: 3.6 (2.5–5.0) µm; annulus width: 3.5 (2.75–4.0); scabrate to microrugulate; exine thickness: 1.4 (1.0–2.0) µm.

Phragmites australis (Cav.) Trin. ex Steud.
(synonym: *Phragmites communis* Trin.)
Plate 5: 64–66

Spherical grain; maximum dimension: 23.4 (21.9–26.5) µm; monoporate; round annulate pore with operculum often present; pore diameter: 1.9 (1.5–2.4) µm; annulus width: 1.9 (1.5–2.3) µm; scabrate; exine thickness: 1.2 (0.9–1.4) µm.

Setaria parviflora (Poir.) Kergúelen
(synonym: *Setaria geniculata* auct. non (Wild.) Beauv.)
Plate 4: 54

Spherical grain; maximum dimension: 43.7 (39.0–47.0) µm; monoporate; round pore; pore diameter: 3.7 (3.0–4.0) µm; annulus width: 3.3 (3.0–4.0) µm; scabrate; exine thickness: 1.5 (1.0–2.0) µm.

Spartina alterniflora Loisel.
Plate 5: 57–58

Spherical grain; maximum dimension: 37.6 (33.0–42.0) µm; monoporate; round annulate pore; pore diameter: 3.8 (3.0–4.0) µm; annulus width: 2.7 (2.0–3.0) µm; scabrate; exine thickness: 1.3 (1.1–1.5) µm.

Zizaniopsis miliacea (Michx.) Doell & Aschers.
Plate 5: 59–60

Spherical grain; maximum dimension: 37.2 (34.0–40.0) µm; monoporate; round annulate pore with operculum often present; pore diameter: 3.3 (2.0–4.0) µm; annulus width: 2.3 (2.0–3.0) µm; indistinct edge of annulus; psilate to finely scabrate; exine thickness: 1.1 (1.0–2.0) µm.

Pontederiaceae
Eichhornia crassipes (Mart.) Solms
Plate 9: 117–118

Oval grain; long axis: 61.5 (55.0–68.0) µm; short axis: 34.6 (30.0–45.0) µm; monosulcate; sulcus extending length of grain; microverrucate; exine thickness: 1.8 (1.0–3.0) µm.

Pontederia cordata L.
Plate 11: 138–139

Oval grain; long axis: 60.6 (45.0–72.0) µm; short axis: 26.8 (19.0–32.0) µm; dicolpate; colpus length: 56.1 (46.9–71.4) µm; microrugulate; exine thickness: 2.8 (2.0–3.0) µm.

Typhaceae
Typha domingensis Pers.
Plate 22: 368–369

Spherical grain (individual grain); planar tetrad but typically dispersed as individual grain; maximum dimension (individual grain): 25.6 (22.0–30.0) µm; monoulcerate; reticulate; exine thickness: 1.7 (1.0–2.0) µm.

Typha latifolia L.
Plate 22: 370–373

Spherical grain (individual grain); planar tetrahedral tetrad; usually dispersed as tetrahedral tetrads but occasionally dispersed as linear tetrads or monads; tetrad diameter: 60.5 (52.0–70.0) µm; maximum dimension (individual grain): 33.0 (27.0–38.0) µm; monoulcerate; reticulate; exine thickness: 1.1 (1.0–2.0) µm.

ANGIOSPERMAE: DICOTYLEDONEAE

Acanthaceae
Justicia americana (L.) Vahl
Plate 6: 77–79

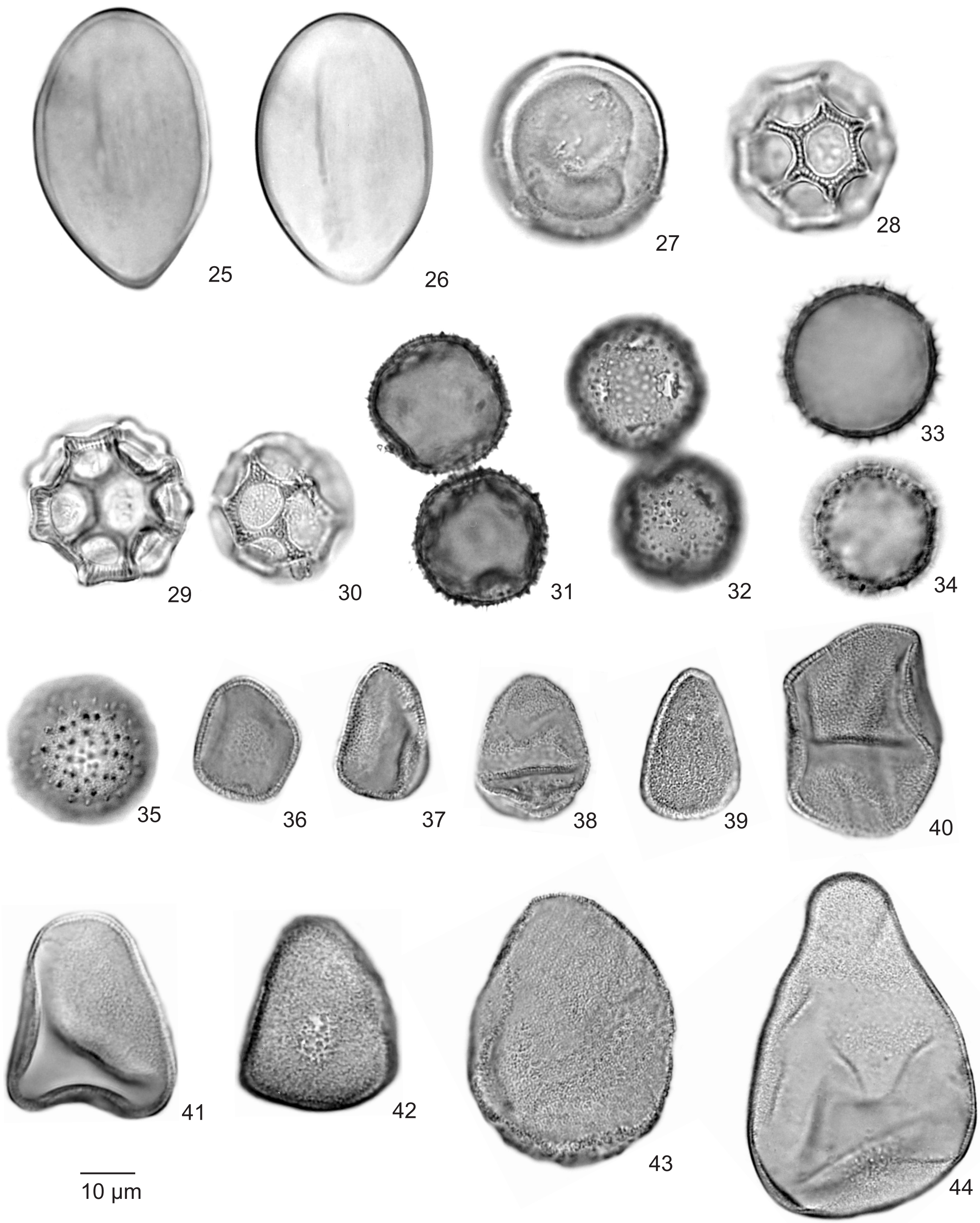
Prolate grain; P/E: 1.49 (1.40–1.63); polar axis: 38.6 (36.1–42.4) µm; equatorial axis: 25.9 (23.4–28.4) µm; diporate; oval pore; pore height: 3.8 (2.1–4.7) µm; pore width: 5.5 (3.2–7.1) µm; rounded areoles distributed in two ranks (4–6 each) on either side of pore (see Plate 6: 77); areole diameter: 3.4 (2.9–3.9) µm; reticulate; exine thickness: 2.4 (1.9–3.1) µm.

Aceraceae
Acer rubrum L.
Plate 11: 144–146

Circular amb; prolate grain; P/E: 1.33 (1.22–1.47); polar axis: 43.0 (39.0–46.0) µm; equatorial axis: 32.4 (30.0–34.0) µm; tricolpate; PAI: 0.19 (0.15–0.25); colpus length: 29.4 (23.8–34.1) µm; colpus width: 9.7 (6.0–15.0) µm; gaping colpi give grain its characteristic circular amb; striate; striae roughly parallel to polar axis; exine thickness: 1.3 (1.0–2.0) µm.

PLATE 3
Inaperturate Grains

25–26 *Pistia stratiotes* (Araceae)
27 *Peltandra virginica* (Araceae)
28–30 *Alternanthera philoxeroides* (Amaranthaceae)
31–32 *Sagittaria lancifolia* (Alismataceae)
33–35 *Sagittaria latifolia* (Alismataceae)
36–37 *Cyperus haspan* (Cyperaceae)
38–39 *Rhynchospora colorata* (Cyperaceae)
40 *Eleocharis elongata* (Cyperaceae)
41–42 *Schoenoplectus taberaemontani* (Cyperaceae)
43 *Eleocharis cellulosa* (Cyperaceae)
44 *Cladium mariscus* ssp. *jamaicense* (Cyperaceae)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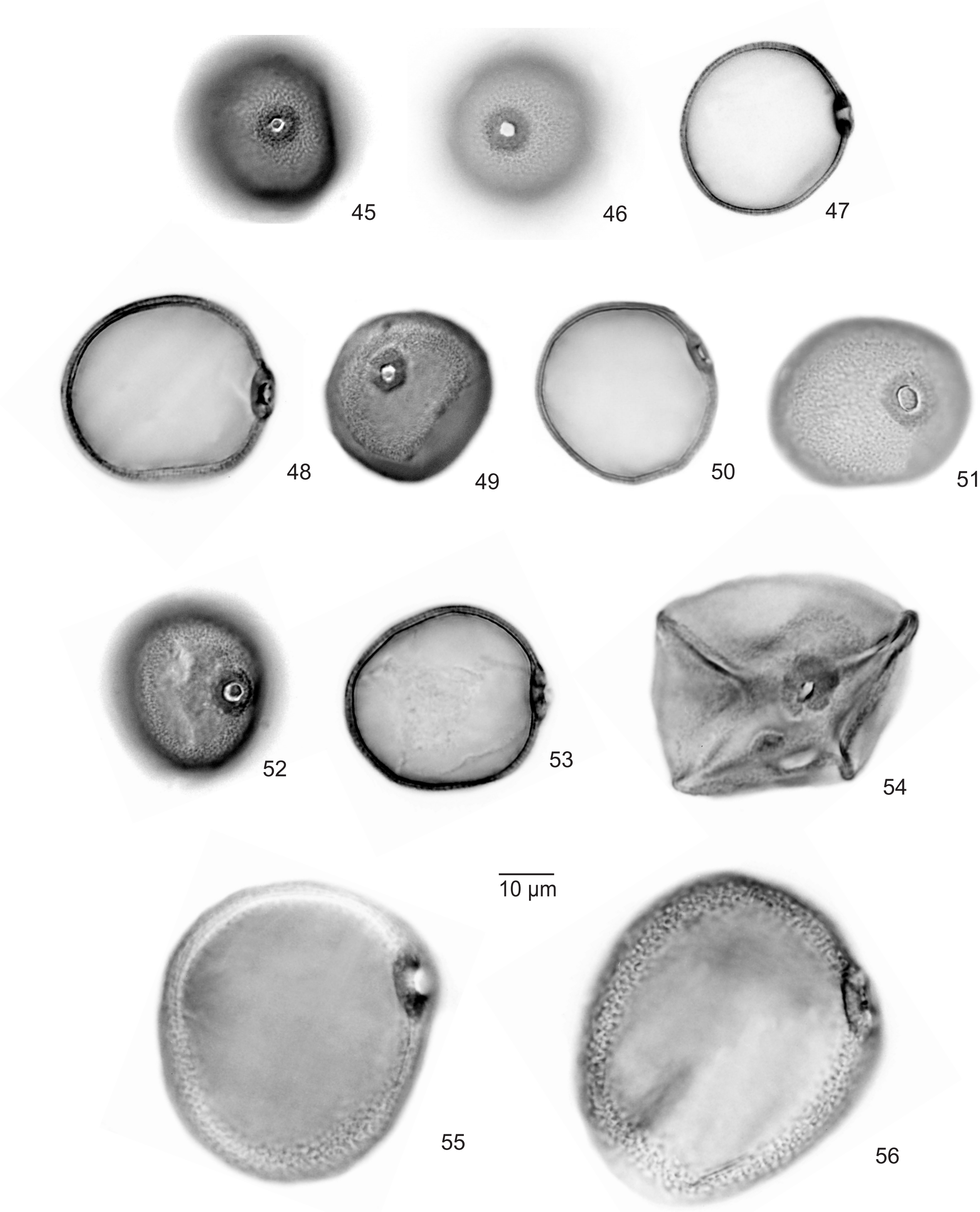


PLATE 4
Monoporate Grains

45–47 *Pennisetum ciliare* (Poaceae)
48–49 *Panicum repens* (Poaceae)
50–51 *Andropogon glomeratus* (Poaceae)
52–53 *Andropogon virginicus* (Poaceae)
54 *Seteria parviflora* (Poaceae)
55–56 *Heteropogon contortus* (Poaceae)

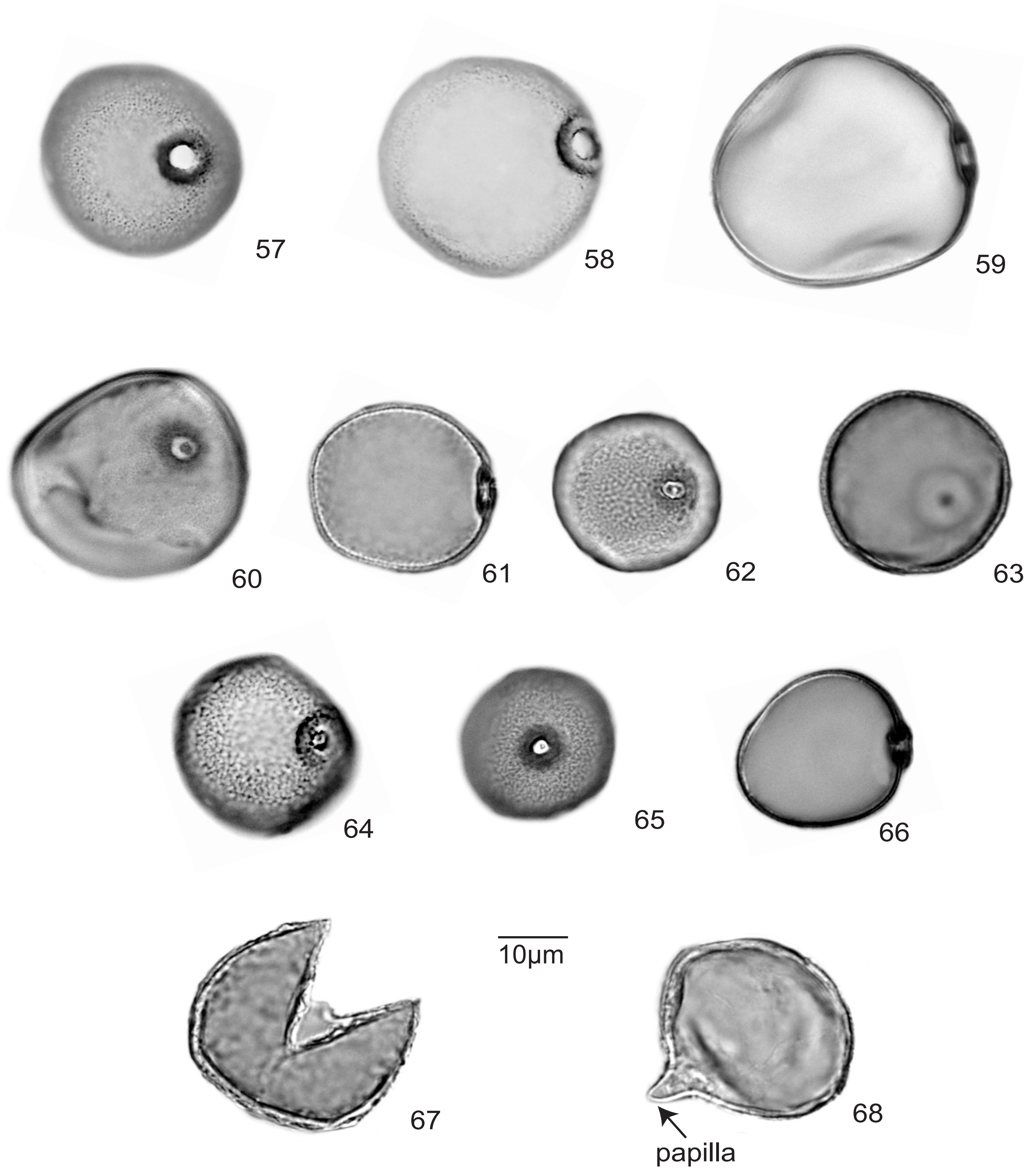


PLATE 5
Monoporate Grains

57–58 *Spartina alterniflora* (Poaceae)
59–60 *Zizaniopsis miliacea* (Poaceae)
61–63 *Eragrostis elliotti* (Poaceae)
64–66 *Phragmites australis* (Poaceae)
67–68 *Taxodium distichum* (Taxodiaceae)

Amaranthaceae
Alternanthera philoxeroides (Mart.) Griesbach
Plate 3: 28–30

Spherical grain; maximum dimension: 24.9 (23.0–29.0) µm; lophate; 7 round lacunae on face; lacuna diameter: 7.9 (6.3–9.6) µm; inaperaturate.

Amaranthus australis (Gray) Sauer
Plate 7: 100–101

Spherical grain; maximum dimension: 28.3 (26.0–30.0) µm; periporate; 62 (51–71) round pores; pore diameter: 2.8 (1.9–3.6) µm; pitted; exine thickness: 2.3 (1.7–2.7) µm.

Anacardiaceae
Schinus terebinthifolius Raddi
Plate 16: 264–267

Rounded triangular amb; subspheroidal grain; P/E: 1.09 (1.0–1.2); polar axis: 22.8 (21.0–26.0) µm; equatorial axis: 21.0 (20.0–23.0) µm; tricolporate; PAI: 0.12 (0.11–0.13); colpus length: 21.2 (18.6–24.0) µm; maximum colpus width: 1.1 (0.8–1.3) µm; lalongate pore constricted in center; pore height: 1.8 (1.3–2.4) µm; pore width: 7.7 (6.5–8.8) µm; finely reticulate; exine thickness: 1.2 (1.0–1.6) µm.

Rhus copallinum L.
Plate 19: 329–331

Prolate grain; P/E: 1.29 (1.23–1.40); polar axis: 45.6 (43.3–48.6) µm; equatorial axis: 35.3 (32.4–38.3) µm; PAI: 0.13 (0.05–0.17); tricolporate; colpus length: 35.8 (35.4–40.7) µm; colpus width: 2.0 (1.1–3.0) µm; lalongate pore with irregular edges; pore height: 2.6 (1.5–3.6) µm; pore width: 12.4 (10.7–15.6) µm; reticulate; exine thickens along colpus (see Plate 19: 329); exine thickness: 2.3 (1.9–2.9) µm.

Annonaceae
Annona glabra L.
Plate 22: 379

Oval grains (individual grains); dispersed in tetrahedral tetrad; tetrad diameter: 233.9 (218.0–260.0) µm; individual grain length: 144.4 (130.9–158.8) µm; individual grain width: 87.0 (67.4–99.3) µm; monosulcate; sulcus length: 135.6 (127.9–143.3) µm; maximum sulcus width: 26.8 (21.5–36.0) µm; reticulate; exine thickness: 4.7 (3.5–6.0) µm.

Apiaceae
Cicuta maculata L. var. *maculata*
(synonym: *Cicuta mexicana* Coult. & Rose)
Plate 19: 318–319

Prolate grain; P/E: 1.55 (1.15–1.9); polar axis: 30.7 (23.0–38.0) µm; equatorial axis: 20.0 (17.0–23.0) µm; tricolporate; colpus approximately length of grain; maximum colpus width: 0.9 (0.8–1.0) µm; lalongate pore; pore height: 2.6 (1.6–4.0) µm; pore width: 8.4 (4.5–13.2) µm; reticulate; exine thickness: 1.8 (1.3–2.1) µm.

Hydrocotyle sp. L.
Plate 19: 320–323

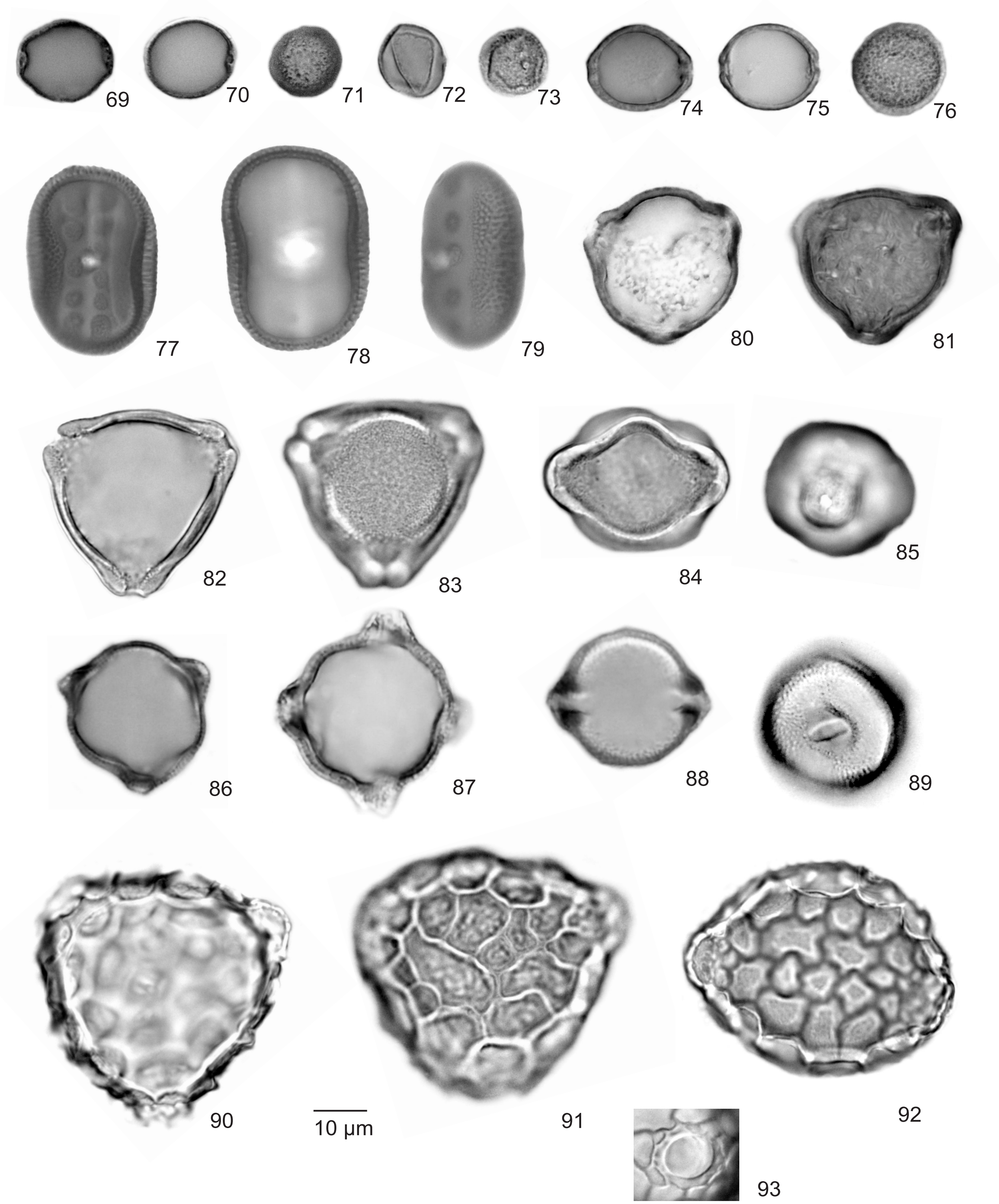
Prolate grain; P/E: 1.63 (1.48–1.71); polar axis: 35.0 (33.0–39.0) µm; equatorial axis: 21.6 (20.0–23.0) µm; tricolporate pollen; colpus approximately equal to length of grain; colpus width: 1.2 (1.0–2.0) µm; lalongate pore; pore height: 2.5 (1.7–3.4) µm; pore width: 9.1 (7.8–10.0) µm; reticulate; exine thickness: 1.8 (1.0–2.0) µm.

Aquifoliaceae
Ilex cassine L.
Plate 12: 175–178

Rounded triangular amb; subspheroidal grain; P/E: 1.06 (0.90–1.27); polar axis: 27.3 (26.1–28.8) µm; equatorial axis: 25.8 (24.0 –27.9) µm; tricolporate; PAI: 0.32 (0.29–0.40); colpus length: 17.5 (15.2–19.1) µm; maximum colpus width: 1.4 (1.1–1.7) µm; lalongate pore; pore height 3.8 (3.1–4.8) µm; pore width 7.2 (6.6–7.8) µm; clavate; clava height: 2.3 (1.8–2.7) µm; clava diameter decreases adjacent to colpi; exine thickness: 2.0 (1.8–2.3) µm.

PLATE 6
Diporate and Triporate Grains

69–71 *Morus rubra* (Moraceae)
72–73 *Boehmeria cylindrica* (Urticaeae)
74–76 *Trema micranthum* (Ulmaceae)
77–79 *Justicia americana* (Acanthaceae)
80–81 *Casuarina equisetifolia* (Casuarinaceae)
82–85 *Morella cerifera* (Myricaeae)
86–89 *Bursera simaruba* (Burseraceae)
90–93 *Vigna luteola* (Fabaceae)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Asteraceae

Ageratum conyzoides L.
Plate 13: 179–183

Circular amb; subspheroidal grain; P/E: 0.97 (0.90–1.0); polar axis: 18.9 (18.0–21.1) µm; equatorial axis: 19.4 (17.9–21.3) µm; tri–tetracolporate – syncolporate; colpus approximately equal to length of grain; maximum colpus width: 2.7 (2.0–3.0) µm; slit–like pore usually obscured by sculpture (see Plate 13: 183); pore height: 0.6 (0.5–1.0) µm; pore width: 5.2 (3.7–6.0) µm; echinate; spine height: 3.2 (2.7–3.7) µm; spine width at base: 2.1 (1.7–3.0) µm; exine thickness: 2.9 (2.5–3.6) µm; tectate.

Ambrosia artemisiifolia L.
Plate 13: 184–187

Trilobate amb; subspheroidal grain; P/E: 0.9 (0.8–0.9); polar axis: 24.9 (23.0–27.0) µm; equatorial axis: 26.9 (23.0–30.0) µm; tricolporate; colpus length: 4.8 (3.9–5.2) µm; maximum colpus width: 1.5 (1.1–2.1) µm; pore obscured by sculpture; echinate; spine height: 1.9 (1.5–2.3) µm; spine width at base: 2.1 (1.5–3.4) µm; exine thickness: 1.9 (1.5–2.2) µm; cavate; tectate.

Ampelaster carolinianus (Walt.) Nesom
(synonym: *Aster carolinianus* (Walt.) Nesom)
Plate 13: 188–192

Circular amb; subspheroidal to prolate grain; P/E: 1.1 (1.0–1.2); polar axis: 33.5 (28.0–39.0) µm; equatorial axis: 32.7 (26.0–38.0) µm; tricolporate; colpus length: 20 (16.0–24.0) µm; maximum colpus width: 4.1 (3.0–5.0) µm; lalongate pore typically constricted in center (see Plate 13: 192) and ends taper to points; pore height: 2.8 (1.4–3.5) µm; pore width 11.1 (10.1–12.5) µm; echinate; spine height: 4.1 (3.5–4.9) spine width at base: 4.1 (3.0–5.0) µm; exine thickness: 2.5 (2.1–3.1) µm; tectate.

Baccharis sp. L.
Plate 13: 193–195

Rounded triangular amb; subspheroidal grain; P/E: 1.07 (0.96–1.33); polar axis: 26.9 (23.7–33.5) µm; equatorial axis: 25.4 (21.2–34.9) µm; tricolporate; PAI: 0.36 (0.31–0.40); colpus length: 16.6 (14.0–20.0) µm; maximum colpus width: 1.4 (0.8–1.9) µm; lalongate pore typically constricted in center with ends tapering to points (see Plate 13: 194); pore height: 2.0 (1.4–2.9) µm; pore width: 10.0 (7.3–11.9) µm; echinate; spine height: 5.5 (4.6–6.4) µm; spine width at base: 3.2 (2.3–4.1) µm; exine thickness: 2.7 (2.3–3.0) µm; tectate.

Bidens alba (L.) DC.
Plate 13: 196–198

Circular amb; subspheroidal grain; P/E: 0.99 (0.98–1.04); polar axis: 33.7 (33.4–34.1) µm; equatorial axis: 34.8 (31.6–37.7) µm; tricolporate; colpus length: 9.8 (8.4–11.1) µm; colpus width 1.4 (1.3–1.5) µm; lalongate pore; pore tapered to point at ends; pore height: 1.7 (1.4–1.9) µm; pore width: 9.9 (9.2–10.7) µm; echinate; spine height: 4.9 (4.5–5.7) µm; spine width at base: 3.4 (3.0–3.9) µm; exine thickness: 3.5 (2.9–4.0) µm; tectate.

Bidens laevis (L.) B.S.P.
Plate 13: 199–201

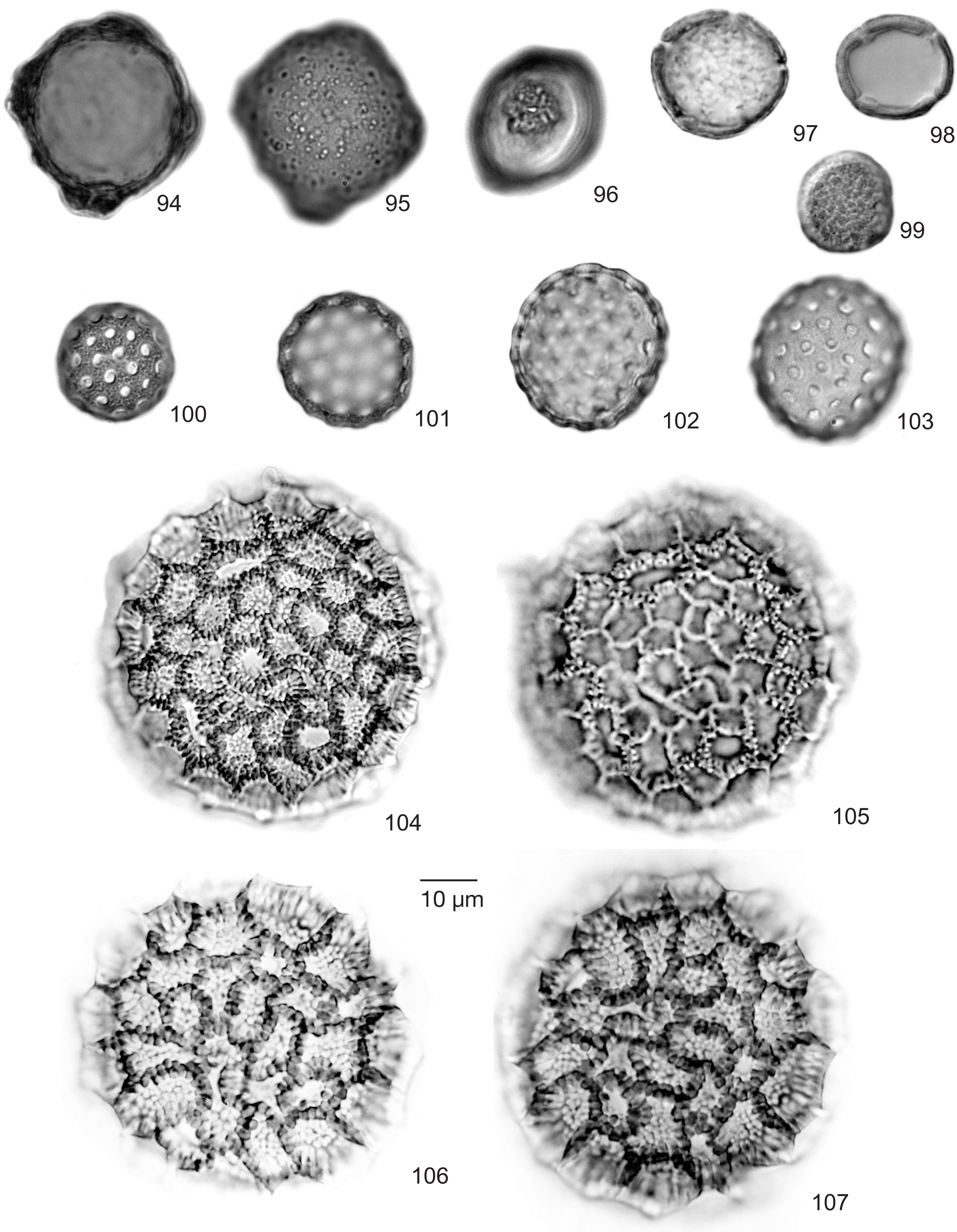
Circular amb; subspheroidal grain; P/E: 1.03 (0.97–1.08); polar axis: 46.1 (43.1–49.1) µm; equatorial axis: 44.5 (40.6–47.9) µm; tricolporate; colpus length: 14.1 (11.2–15.8) µm; maximum colpus width: 1.7 (1.1–2.0) µm; lalongate pore; pore tapered to point at ends; pore height: 2.1 (1.5–2.9) µm; pore width: 8.3 (6.1–11.6) µm; echinate; spine height: 7.7 (6.3–8.6) µm; spine width at base: 5.3 (4.6–6.0) µm; exine thickness: 4.4 (3.0–5.8) µm; tectate.

Borrichia frutescens (L.) DC.
Plate 14: 202–205

Circular amb; subspheroidal grain; P/E: 0.93 (0.89–0.98); polar axis: 27.2 (25.5–32.8) µm; equatorial axis: 29.6 (28.6–33.4) µm; tricolporate; colpus length: 13.8 (12.0–16.4) µm; maximum colpus width: 3.5 (2.9–4.3) µm; lalongate pore constricted in center and tapered at ends; pore height: 1.5 (1.2–1.9) µm; pore width: 9.5 (7.8–10.7) µm; echinate; blunt spines; spine height: 6.4 (5.1–7.7) µm; spine width at base: 2.9 (2.2–3.9) µm; exine thickness: 3.1 (2.4–3.8) µm; tectate.

PLATE 7
Stephanoporate and Periporate Grains

94–96 *Myriophyllum* sp. (Haloragaceae)
97–99 *Proserpinaca palustris* (Haloragaceae)
100–101 *Amaranthus australis* (Amaranthaceae)
102–103 *Salicornia bigelovii* (Chenopodiaceae)
104–105 *Polygonum densiflorum* (Polygonaceae)
106–107 *Polygonum hydropiperoides* (Polygonaceae)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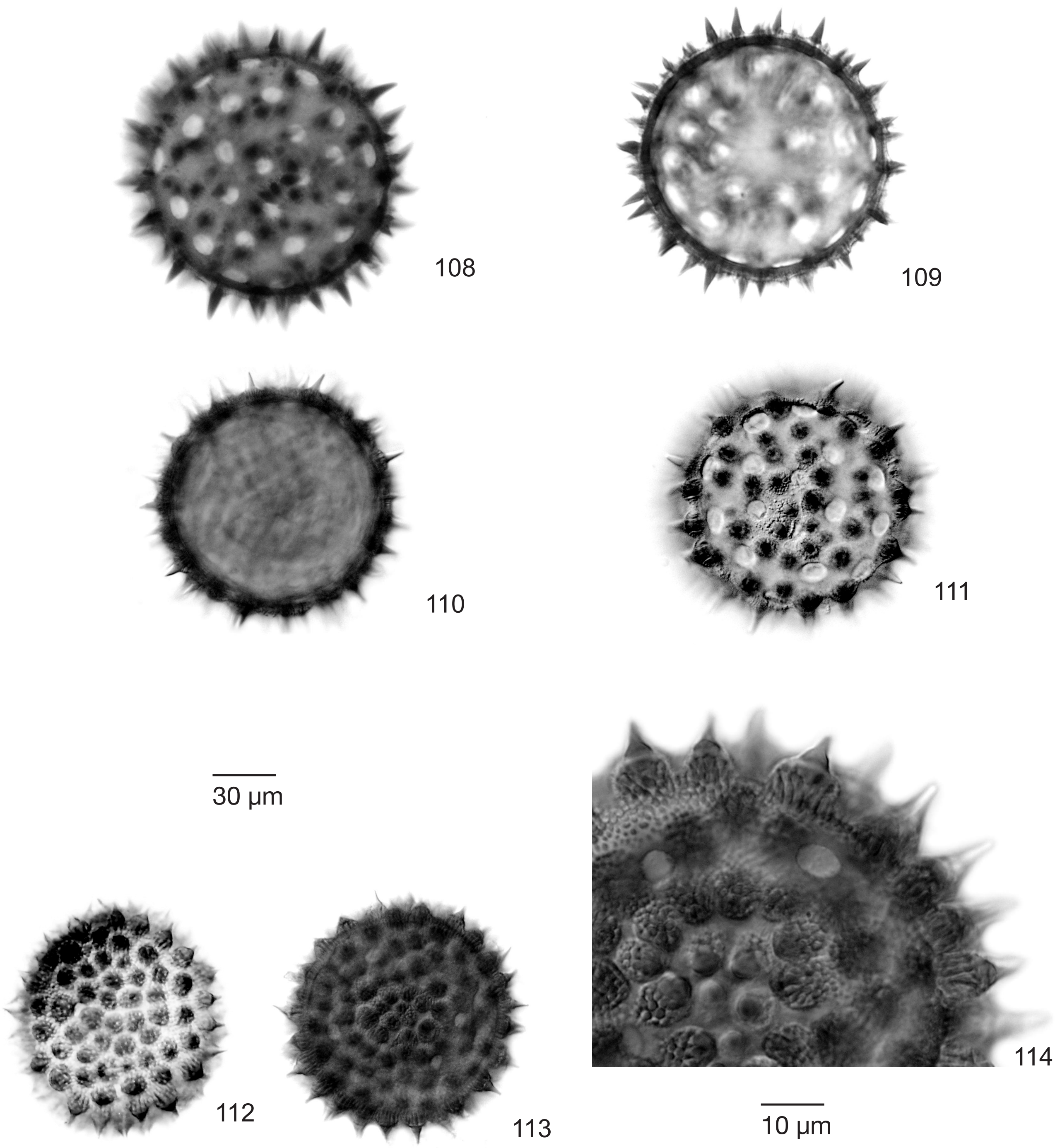


PLATE 8
Periporate Grains

108–109 *Ipomoea pes-caprae* (Convolvulaceae)
110–111 *Ipomoea sagittata* (Convolvulaceae)
112–114 *Sida cordifolia* (Malvaceae)

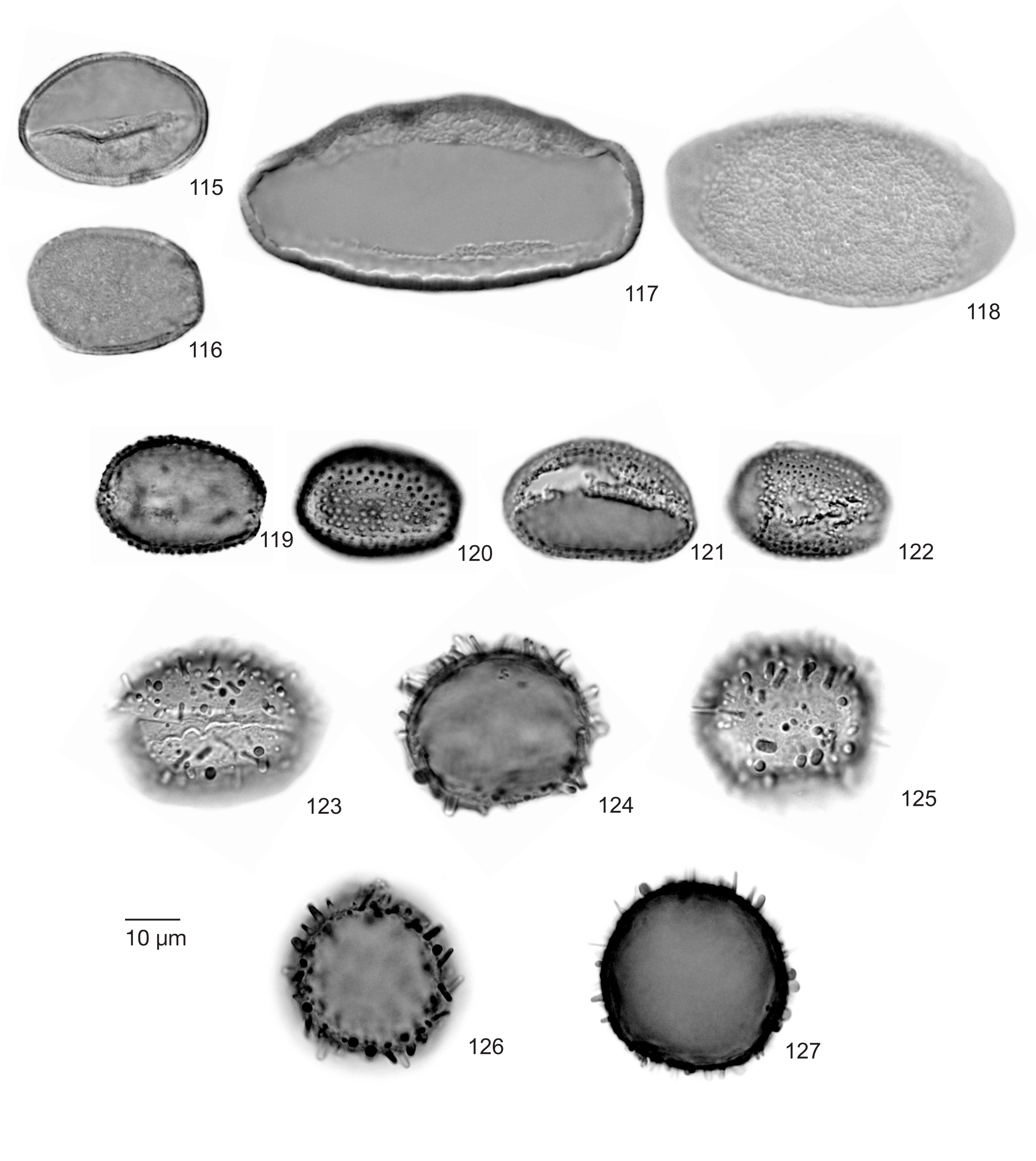


PLATE 9
Monosulcate Grains

115–116 *Sabal palmetto* (Arecaceae)
117–118 *Eichhornia crassipes* (Pontederiaceae)
119–122 *Commelina diffusa* (Commelinaceae)
123–127 *Nymphaea odorata* (Nymphaeaceae)

Cirsium horridulum Michaux
Plate 14: 220–222

Circular amb; subspheroidal grain; P/E: 0.90 (0.80–0.98); polar axis: 61.2 (55.0–65.0) µm; equatorial axis: 67.0 (60.0–72.0) µm; tricolporate; PAI: 0.49 (0.45–0.54); colpus length: 31.8 (30.0–35.0) µm; maximum colpus width: 4.2 (3.4–4.9) µm; lalongate pore constricted in center and tapered at ends; pore height: 3.9 (2.6–4.8) µm; pore width: 13.3 (11.4–14.9) µm; echinate; spine height: 5.9 (5.4–6.4) µm; spine width at base: 10.3 (8.8–11.8) µm; exine thickness: 4.6 (4.0–5.0) µm; tectate.

Conoclinium coelestinum (L.) DC.
Plate 14: 206–210

Rounded triangular amb; subspheroidal grain; P/E: 0.98 (0.90–1.10); polar axis: 22.8 (21.0–25.0) µm; equatorial axis: 23.3 (22.0–27.0) µm; tricolporate; PAI: 0.35 (0.29–0.41); colpus approximately length of grain; maximum colpus width: 3.5 (3.0–4.0) µm; lalongate pore tapered at ends; pore height: 1.2 (0.7–1.4) µm; pore width 5.5 (4.5–6.2) µm; echinate; spine height: 2.5 (1.8–2.8) µm; spine width at base: 1.9 (1.5–3.1) µm; exine thickness: 2.3 (1.9–2.7) µm; cavate; tectate.

Eupatorium capillifolium (Lam.) Small
Plate 14: 211–215

Rounded triangular amb; subspheroidal grain; P/E: 0.95 (0.90–1.2); polar axis: 20.0 (19.0–22.0) µm; equatorial axis: 20.8 (19.0–22.0) µm; tricolporate; colpus approximately length of grain; maximum colpus width: 3.3 (3.0–4.0) µm; lalongate pore constricted at center and tapered at ends; pore height: 2.1 (1.7–2.4) µm; pore width: 4.8 (4.1–5.6) µm; echinate; spine height: 2.3 (1.9–3.1) µm; spine width at base: 2.5 (2.0–3.0) µm; exine thickness: 3.5 (3.0–4.0) µm; tectate.

Eupatorium serotinum Michaux
Plate 14: 216–219

Circular amb; subspheroidal grain; P/E: 1.04 (0.95–1.08); polar axis: 23.2 (18.9–28.9) µm; equatorial axis: 23.1 (20.4–27.9) µm; tricolporate; colpus length: 18.9 (15.4–21.6) µm; maximum colpus width: 1.9 (1.1–2.8) µm; slit–like pore typically obscured by sculpture; pore height: 0.9 (0.6–1.3) µm; pore width: 4.4 (3.6–5.4) µm; echinate; spine height: 3.9 (3.2–4.7) µm; spine width at base: 2.8 (2.5–3.8) µm; exine thickness: 2.1 (1.5–2.9) µm; tectate.

Mikania scandens (L.) Willdenow
Plate 15: 223–225

Rounded triangular amb; subspheroidal grain; P/E: 0.96 (0.85–1.0) polar axis: 24.5 (23.9–25.0) µm; equatorial axis: 23.1 (20.8–24.6) µm; tricolporate pollen; PAI: 0.25 (0.21–0.29); colpus length: 8.7 (7.6–9.3) µm; maximum colpus width: 1.1 (0.9–1.2) µm; lalongate pore tapered at ends; pore height: 1.6 (0.9–2.2) µm; pore width: 2.8 (1.7–4.0) µm; echinate; spine height: 2.7 (2.2–3.2) µm; spine width at base: 1.7 (1.3–1.9) µm; exine thickness: 2.1 (1.2–2.4) µm; tectate.

Pluchea odorata (L.) Cassini
Plate 15: 229–232

Triangular amb; subspheroidal grain; P/E: 1.09 (0.95–1.14); polar axis: 28.9 (25.9–31.3) µm; equatorial axis: 29.7 (25.9–32.9) µm; tricolporate; colpus approximately length of grain; colpus width: 2.6 (2.4–2.7) µm; lalongate pore constricted in center and tapered at ends; pore typically is obscured by sculpture (see Plate 15: 230); pore height: 2.7 (2.6–2.8) µm; pore width: 7.1 (6.7–7.4) µm; echinate; spine height: 7.0 (6.6–7.8) µm; spine width at base: 5.4 (4.4–6.3) µm; exine thickness: 3.1 (2.2–3.9) µm; tectate.

Solidago sempervirens L.
Plate 15: 233–236

Rounded triangular amb; subspheroidal grain; P/E: 1.0 (0.96–1.07); polar axis: 31.6 (28.9–35.2) µm; equatorial axis: 30.7 (27.6–33.6) µm; tricolporate; PAI: 0.30 (0.26–0.36); colpus length: 18.4 (14.5–21.2) µm; maximum colpus width: 2.7 (2.3–2.9) µm; lalongate pore constricted in center and tapered at ends; pore height: 1.4 (1.1–1.7) µm; pore width: 10.4 (9.6–11.1) µm; echinate; spine height: 3.4 (2.8–4.7) µm; spine width at base: 4.3 (3.6–5.1) µm; exine thickness: 2.8 (2.4–3.7) µm; tectate.

Sonchus oleraceus L
Plate 11: 151–153

Square grain; maximum dimension 42.6 (37.9–49.4) µm; lophate tricolpate; colpus length: 5.1 (5.0–5.2) µm; colpus width: 3.6 (3.1–4.1) µm; echinate; spine height: 2.0 (1.6–2.6) µm; spine width at base: 1.1 (0.7–1.4) µm; lacuna length: 7.9 (5.8–11.8) µm; lacuna width: 7.3 (6.4–8.4) µm; 12–14 lacunae per grain; exine thickness: 4.3 (3.4–4.9) µm.

Sphagneticola trilobata (L.C. Rich) Pruski
(synonym:: *Wedelia trilobata* (L.) A.S. Hitchcock)
Plate 15: 242–244

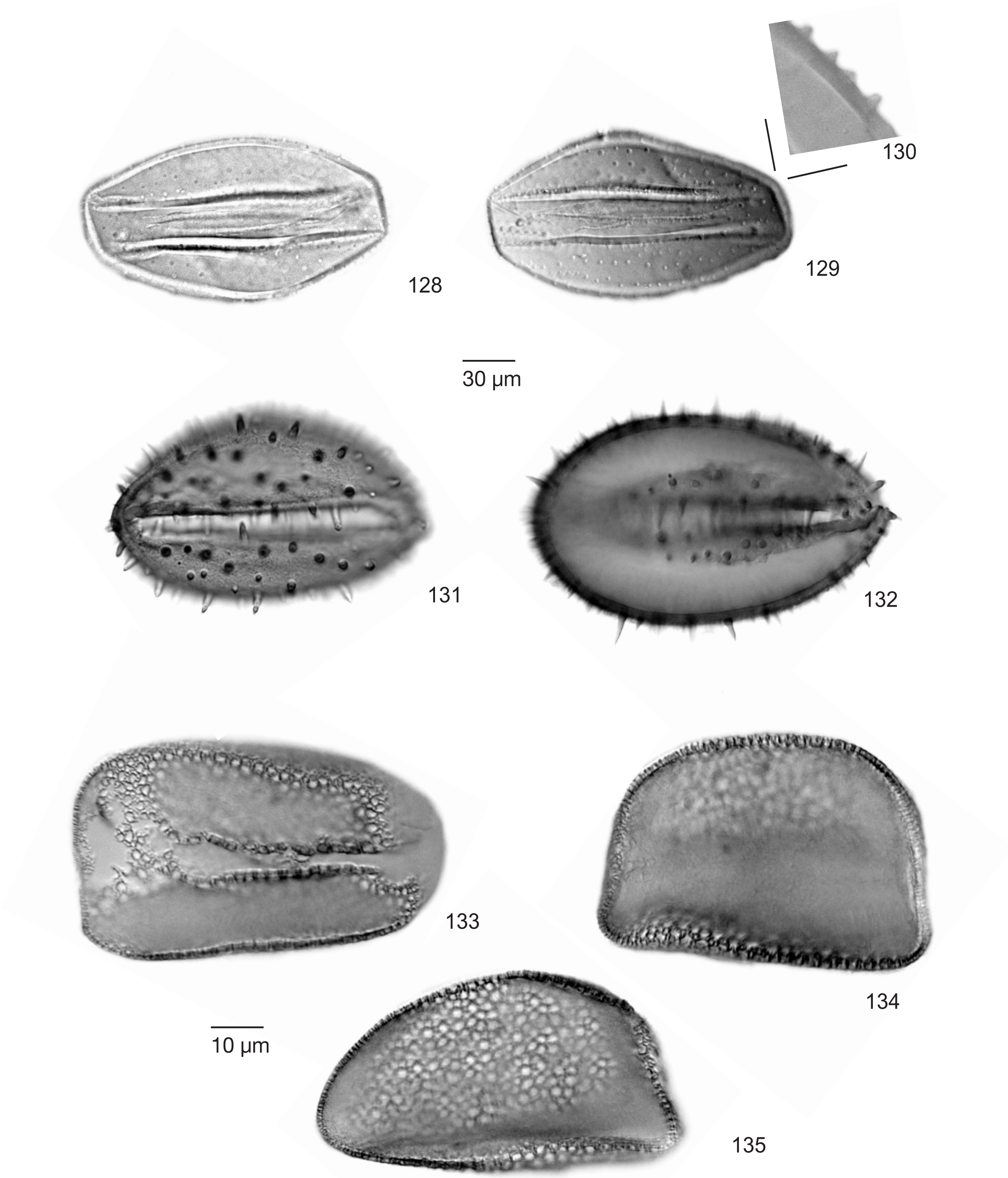


PLATE 10
Monosulcate Grains

128–130 *Crinum americanum* (Liliaceae)
131–132 *Nuphar lutea* (Nymphaeaceae)
133–135 *Tillandsia balbisiana* (Bromeliaceae)

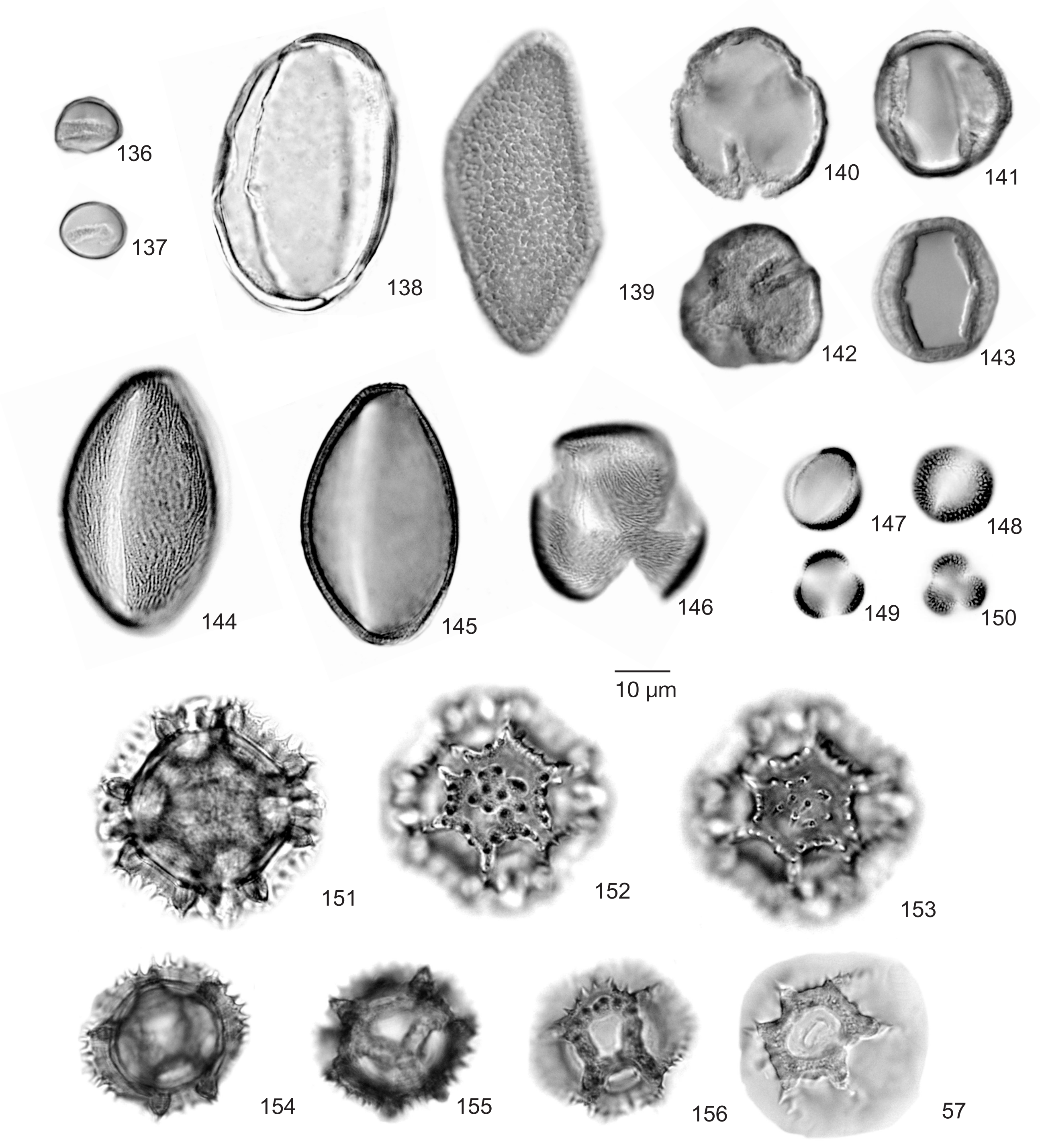


PLATE 11
Monosulcate, Dicolpate, and Tricolpate Grains

136–137 *Saururus cernuus* (Saururaceae)
138–139 *Pontederia cordata* (Pontederiaceae)
140–143 *Quercus laurifolia* (Fagaceae)
144–146 *Acer rubrum* (Aceraceae)
147–150 *Descurainia pinnata* (Brassicaceae)
151–153 *Sonchus oleraceus* (Asteraceae)
154–157 *Youngia japonica* (Asteraceae)

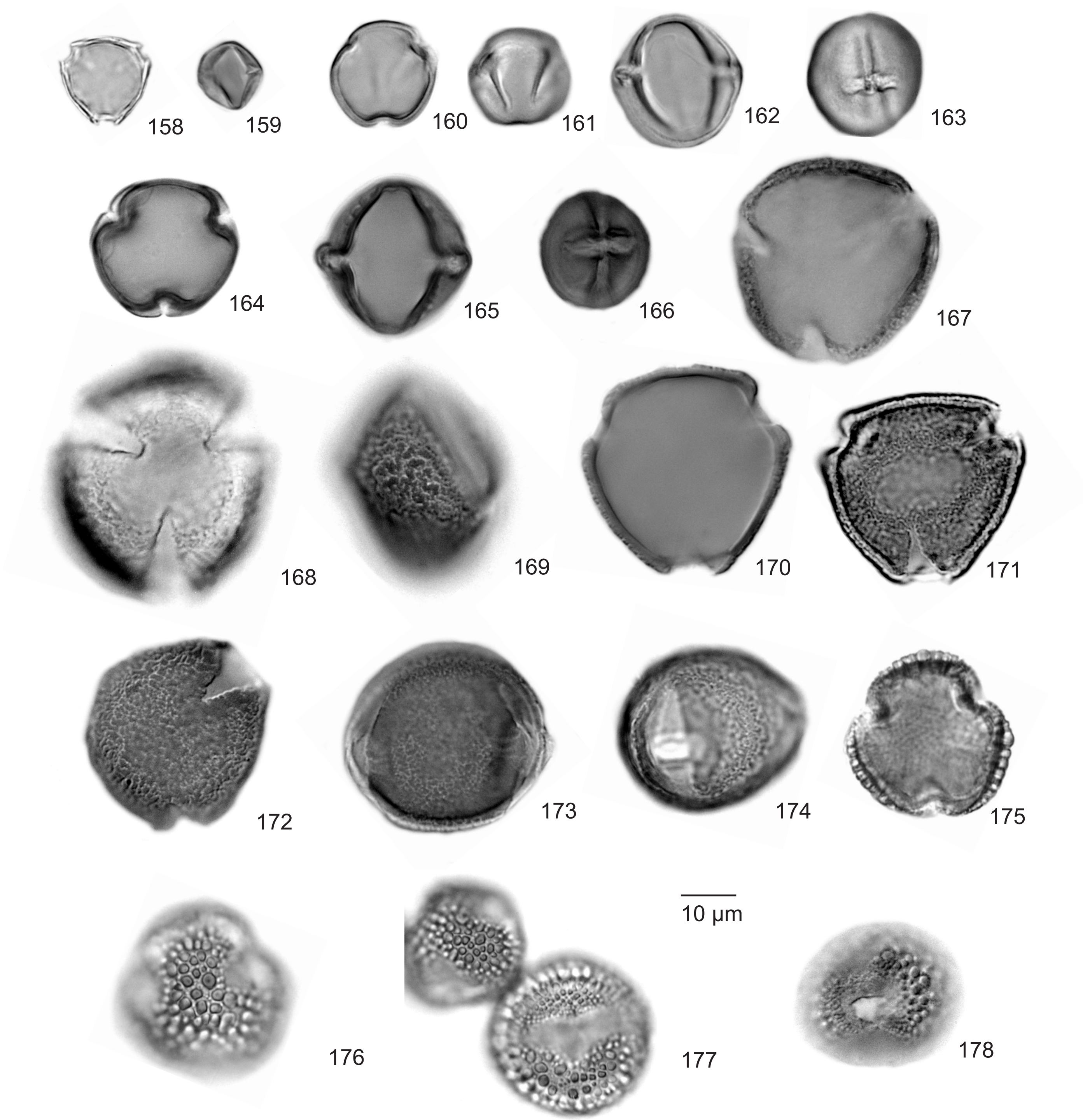


PLATE 12
Tricolporate Grains

158–159 *Mitreola* sp. (Loganiaceae)
160–163 *Solanum americanum* (Solanaceae)
164–166 *Physalis pubescens* (Solanaceae)
167–169 *Cassia obtusifolia* (Fabaceae)
170–174 *Desmodium paniculatum* (Fabaceae)
175–178 *Ilex cassine* (Aquifoliaceae)

Rounded triangular to rounded square amb; subspheroidal grain; P/E: 1.06 (1.05–1.08); polar axis: 39.9 (36.9–42.0) µm; equatorial axis: 36.4 (34.1–39.3) µm; tri–tetracolporate; colpus length: 13.9 (12.8–15.1) µm; maximum colpus width: 2.1 (1.9–2.5) µm; lalongate pore tapered at ends; pore height: 1.7 (1.2–2.3) µm; pore width: 8.7 (7.8–10.6) µm; echinate; spine height: 4.8 (4.3–5.3) µm; spine width at base: 3.5 (2.7–4.6) µm; exine thickness: 3.4 (2.7–4.6) µm; tectate.

Symphyotrichum elliottii (Torr. & Gray) Nesom
(synonym: *Aster elliottii* Torr. & Gray)
Plate 15: 237–241

Rounded triangular amb; subspheroidal to prolate grain; P/E: 1.09 (1.02–1.25); polar axis: 36.8 (35.5–39.5) µm; equatorial axis: 32.4 (29.5–36.2) µm; tricolporate; PAI: 0.29 (0.20–0.37); colpus length: 14.5 (9.7–18.1) µm; maximum colpus width: 2.0 (1.3–3.9) µm; lalongate pore constricted in center and tapered at ends; pore height: 1.7 (1.2–2.2) µm; pore width: 12.5 (10.2–14.1) µm; echinate; spine height: 3.9 (3.1–4.7) µm; spine width at base: 4.7 (3.7–5.2) µm; exine thickness: 2.3 (1.2–2.9) µm; tectate.

Tridax procumbens L.
Plate 15: 226–228

Rounded square amb; subspheroidal grain; P/E: 0.99 (0.87–1.07); polar axis: 26.1 (24.5–30.8) µm; equatorial axis: 26.4 (24.5–28.7) µm; tri–tetracolporate; colpus length: 10.8 (8.1–12.9) µm; maximum colpus width: 3.8 (2.9–4.5) µm; lalongate pore tapered at ends; pore height: 2.5 (1.9–3.6) µm; pore width: 10.1 (8.6–11.4) µm; echinate; spine height: 4.4 (3.8–4.9) µm; spine width at base: 1.5 (1.2–2.1) µm; exine thickness: 2.8 (2.5–2.9) µm; tectate.

Youngia japonica (L.) DC.
Plate 11: 154–157

Spherical grain; maximum dimension: 29.5 (27.3–32.5) µm; lophate tricolpate; colpus length: 5.9 (5.4–7.2) µm; colpus width: 1.8 (1.4–2.3) µm; echinate; spine height: 2.1 (1.6–2.6) µm; spine width at base: 0.9 (0.7–1.1) µm; lacuna length: 5.6 (4.3–7.3) µm; lacuna width: 7.0 (5.4–9.1) µm; 8 lacunae on grain; exine thickness: 3.5 (2.6–4.1) µm.

Bataceae
Batis maritima L.
Plate 20: 336–339

Tetralobate amb; subspheroidal–prolate grain; P/E: 1.2 (1.08–1.37); polar axis: 24.3 (22.9–26.2) µm; equatorial axis: 20.3 (17.8–223.5) µm; stephanocolporoidate; PAI: 0.37 (0.32–0.47); irregular colpus margin; colpus length: 14.8 (12.7–16.8) µm; maximum colpus width: 1.3 (0.8–1.7) µm; psilate; exine thickening at equator to form pore–like structure; exine thickness: 1.7 (1.1–2.2) µm.

Boraginaceae
Heliotropium polyphyllum Lehm.
Plate 21: 354–356

Circular amb; subspheroidal grain; P/E: 1.13 (1.0–1.25); polar axis: 30.7 (26.0–32.0) µm; equatorial axis: 26.9 (24.0–30.0) µm; heterocolporate; colpus length: 19.3 (16.8–21.9) µm; maximum colpus width: 1.3 (0.9–1.8) µm; pseudocolpus length: 17.3 (15.8–19.2) µm; maximum pseudocolpus width: 2.8 (1.9–3.7) µm; 4–5 pseudocolpi, round pore; pore height: 4.3 (3.1–5.7) µm; psilate; exine thickness: 1.4 (1.0–1.7) µm.

Brassicaceae
Descurainia pinnata (Walt.) Britt.
Plate 11: 147–150

Rounded triangular amb; subspheroidal grain; P/E: 1.1 (0.95–1.12); polar axis: 18.7 (18.0–19.0) µm; equatorial axis: 17.9 (17.0–19.0) µm; tricolpate; PAI: 0.22 (0.20–0.27) colpus approximately length of grain; maximum colpus width: 1.9 (1.3–2.5) µm; reticulate; heterobrochate; exine thickness: 1.9 (1.7–2.0) µm.

Burseraceae
Bursera simaruba (L.) Sargent
Plate 6: 86–89

Spherical grain; maximum dimension: 25.3 (22.0–31.0) µm; tri–tetraporate; aspidate pore; pore height: 2.2 (1.8–2.6) µm; pore width: 5.8 (4.3–7.9) µm; vestibulum height: 2.9 (2.5–3.1) µm; vestibulum width: 4.0 (3.3–4.6); reticulate often with striate appearance; exine thickness: 1.22 (0.98–1.80) µm.

Caprifoliaceae
Sambucus nigra L. spp. *canadensis* (L.) R. Bolli
(synonym: *Sambucus canadensis* L.)
Plate 18: 307–309

Triangular amb; subspheroidal to prolate grain; P/E: 1.15 (1.0–1.35); polar axis: 25.3 (22.0–27.0) µm; equatorial axis: 22.0 (20.0–24.0) µm; tricolporate; colpus approximately length of grain; maximum colpus width: 6.8 (5.0–8.0) µm; lalongate pore; pore height: 1.6 (1.2–2.3) µm; pore width: 5.6 (5.0–6.6) µm; reticulate; homobrochate; exine thickness: 0.9 (0.7–1.1) µm.

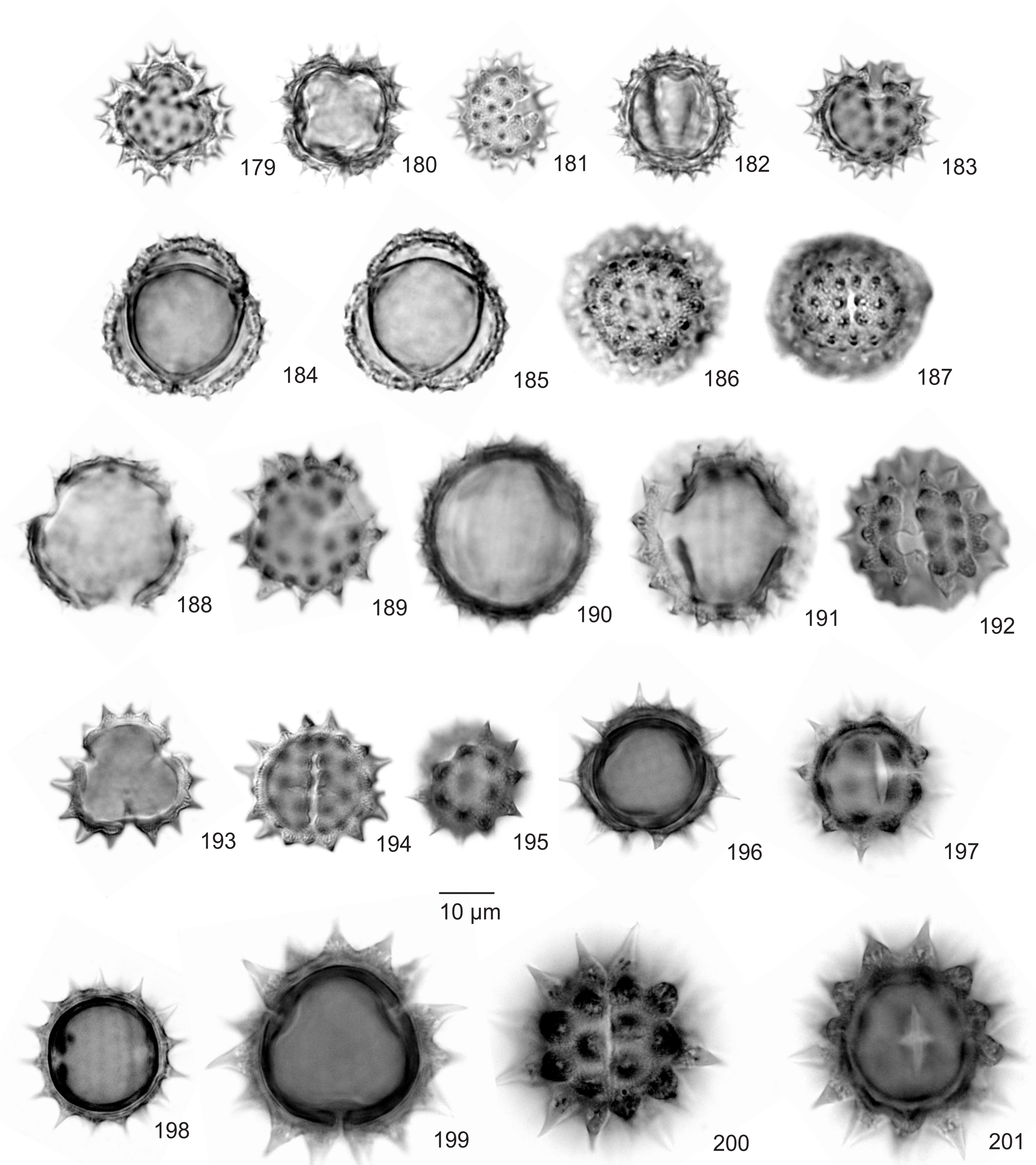


PLATE 13
Tricolporate Grains

179–183 *Ageratum conyzoides* (Asteraceae)
184–187 *Ambrosia artemisiifolia* (Asteraceae)
188–192 *Ampelaster carolinianus* (Asteraceae)
193–195 *Baccharis* sp. (Asteraceae)
196–198 *Bidens alba* (Asteraceae)
199–201 *Bidens laevis* (Asteraceae)

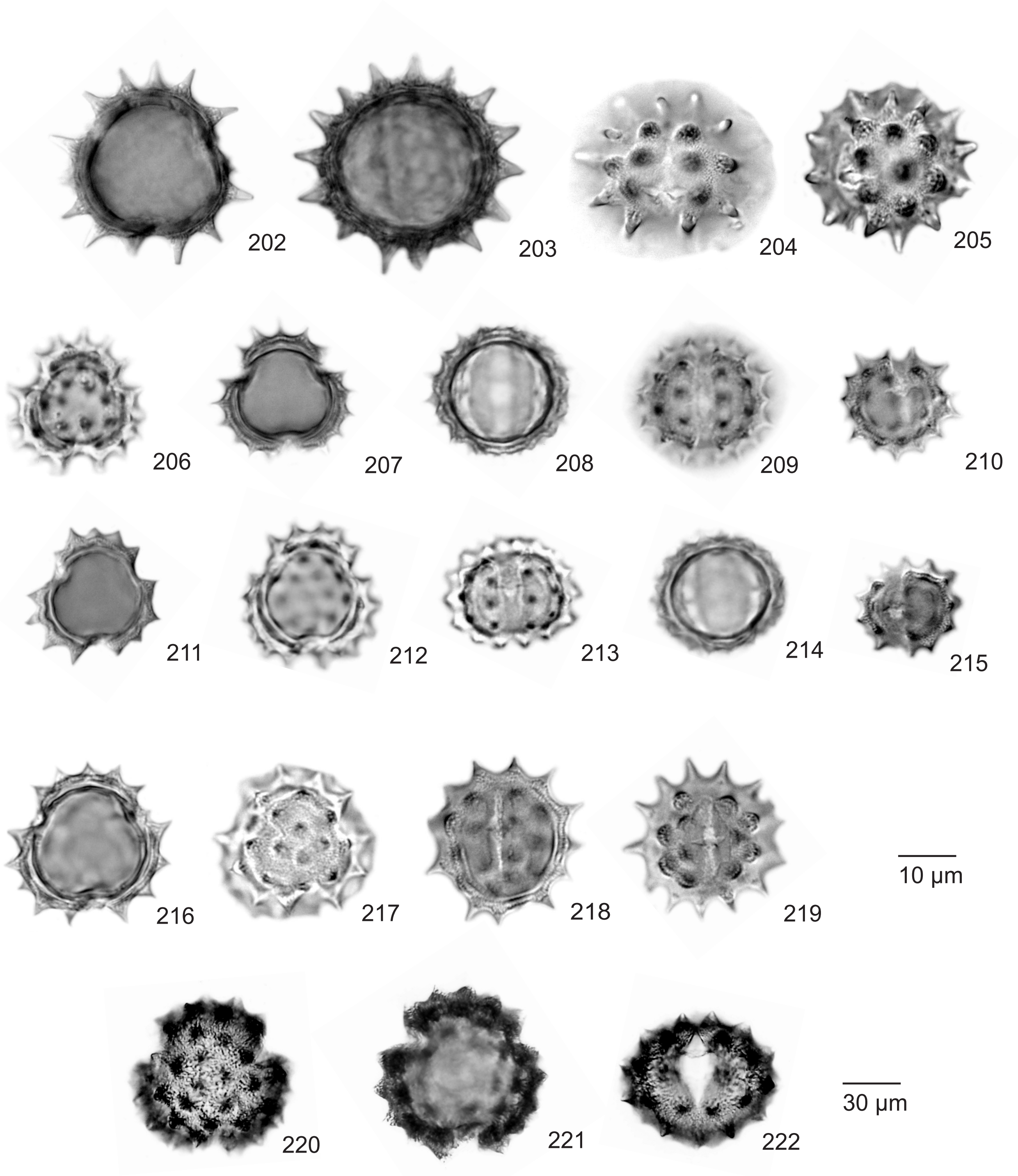


PLATE 14
Tricolporate Grains

202–205 *Borrichia frutescens* (Asteraceae)
206–210 *Conoclinium coelestinum* (Asteraceae)
211–215 *Eupatorium capilifolium* (Asteraceae)
216–219 *Eupatorium serotinum* (Asteraceae)
220–222 *Cirsium horridulum* (Asteraceae)

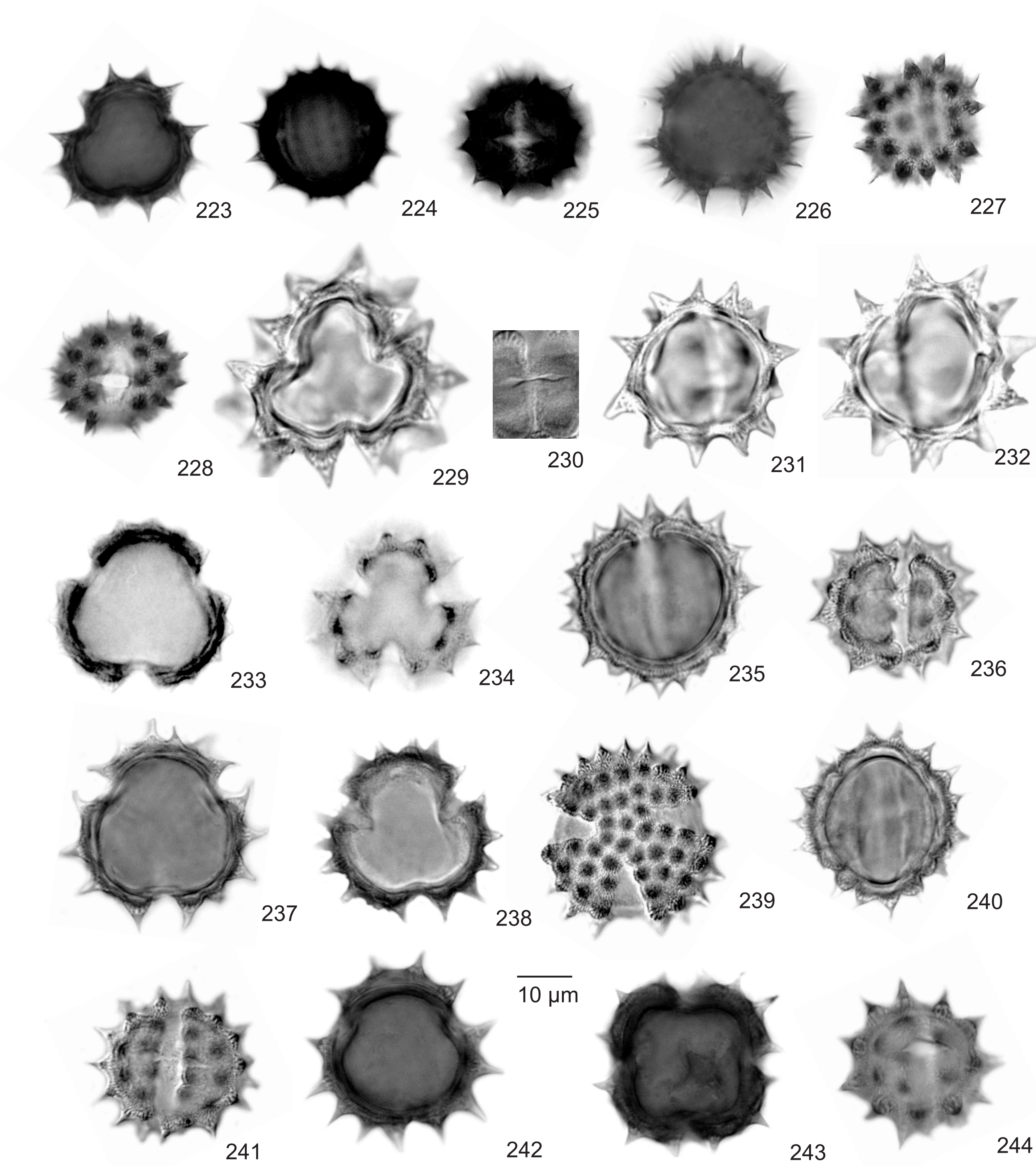


PLATE 15
Tricolporate Grains

223–225 *Mikania scandens* (Asteraceae)
226–228 *Tridax procumbens* (Asteraceae)
229–232 *Pluchea odorata* (Asteraceae)
233–236 *Solidago sempervirens* (Asteraceae)
237–241 *Symphyotrichum elliottii* (Asteraceae)
242–244 *Sphagneticola trilobata* (Asteraceae)

Caricaceae
Carica papaya L.
Plate 17: 278–280

Circular amb; subspheroidal grain; P/E: 1.13 (1.02–1.31); polar axis: 37.1 (34.7–39.6) µm; equatorial axis: 32.9 (26.4–35.8) µm; tricolporate; PAI: 0.31 (0.27–0.37); colpus length: 29.0 (26.6–32.2) µm; maximum colpus width: 2.1 (1.6–2.9) µm; lalongate pore; pore height: 3.6 (2.3–6.6) µm; pore width: 9.8 (6.5–13.4) µm; reticulate; exine thickness: 1.9 (1.5–2.5) µm.

Casuarinaceae
Casuarina equisetifolia L.
Casuarina littorea L. ex Fosberg & Sachet
Plate 6: 80–81

Spherical grain; maximum dimension: 31.2 (28.9–32.6) µm; triporate; round pores; pore diameter: 2.6 (1.7–2.9) µm; vestibulum height: 3.3 (2.9–4.1) µm; vestibulum width: 9.0 (8.2–10.4); Os: 10.7 (9.5–11.9) µm; psilate; exine thickness: 1.9 (1.7–2.1) µm; exine does not thicken over vestibula.

Chenopodiaceae
Salicornia bigelovii Torr.
Plate 7: 102–103

Spherical grain; maximum dimension: 29.4 (27.7–32.3) µm; periporate; 54 (45–74) round pores; pore diameter: 2.3 (2.1–2.7) µm; micropitted; exine thickness: 1.6 (1.2–2.0) µm.

Combretaceae
Conocarpus erecta L.
Plate 21: 346–349

Hexalobate grain; subspheroidal to prolate; P/E: 1.22 (1.08–1.43); polar axis: 14.3 (13.5–15.5) µm; equatorial axis: 11.9 (9.9–13.2) µm; heterocolporate; colpus approximately length of grain; maximum colpus width: 0.8 (0.6–1.0) µm; pseudocolpus approximately length of grain; maximum pseudocolpus width: 1.8 (1.4–2.0) µm; lalongate pore; pore constricted in center; pore height: 2.1 (1.5–2.8) µm; pore width: 3.8 (3.2–4.2) µm; psilate; exine thickness: 1.1 (0.7–1.5) µm.

Laguncularia racemosa (L.) Gaertner F.
Plate 17: 268–272

Subspheroidal to prolate grain; P/E: 1.21 (1.10–1.40); polar axis: 24.4 (22.5–27.6) µm; equatorial axis: 20.3 (15.8–22.9) µm; tricolporate; colpus length: 16.8 (17.4–21.8) µm; maximum colpus width: 1.2 (0.9–1.5) µm; oval pore; pore sometimes indistinct (see Plate 17, 268–269), however when present the pore extends laterally beyond colpus margins; finely pitted; exine thickness: 1.6 (1.2–1.7) µm.

Convolvulaceae
Ipomoea pes–caprae (L.) R. Br.
Plate 8: 108–109

Spherical grain; maximum dimension: 100.1 (92.5–111.5) µm; periporate; 44 (38–54) round pores; pore diameter: 5.7 (2.5–7.0) µm; echinate; spine height; 9.5 (6.9–10.9) µm; spine width at base: 4.1 (3.8–4.3) µm; exine thickness: 5.5 (4.0–6.5) µm.

Ipomoea sagittata Poiret
Plate 8: 110–111

Spherical grain; maximum dimension: 101.4 (91.1–108.7) µm; periporate; 29 (20–36) round pores; pore diameter: 7.7 (7.1–8.2) µm; echinate; spine height: 10.5 (9.4–11.7) µm; spine width at base: 9.3 (8.3–10.5) µm; exine thickness: 4.9 (2.9–6.5) µm.

Cucurbitaceae
Melothria pendula L.
Plate 19: 332–335

Rounded triangular amb; subspheroidal to oblate grain; P/E: 0.84 (0.76–0.90); polar axis: 35.8 (33.8–40.2) µm; equatorial axis: 42.4 (40.2–45.9) µm; tricolporate; colpus length: 24.7 (17.4–30.6) µm; maximum colpus width: 4.2 (3.5–4.5) µm; pore with irregular margin (see Plate 19: 333); pore height: 8.6 (4.7–12.5) µm; pore width: 7.6 (5.4–9.5) µm; reticulate; heterobrochate; exine thickness: 2.6 (2.1–3.0) µm.

Euphorbiaceae
Chamaesyce hypericifolia (L.) Millspaugh
Plate 18: 310–312

Rounded triangular amb; prolate grain; P/E: 1.34 (1.14–1.56); polar axis: 21.7 (19.2–24.6) µm; equatorial axis: 16.2 (14.4–18.6) µm; tricolporate; colpus approximately length of grain; maximum colpus width: 1.2 (0.9–1.5) µm; lalongate pore; pore height: 1.7 (1.1–2.1) µm; pore width: 5.9 (4.2–7.9) µm; reticulate; homobrochate; exine thickness: 2.7 (2.0–3.0) µm.

Chamaesyce maculata (L.) Small
Plate 18: 313–317

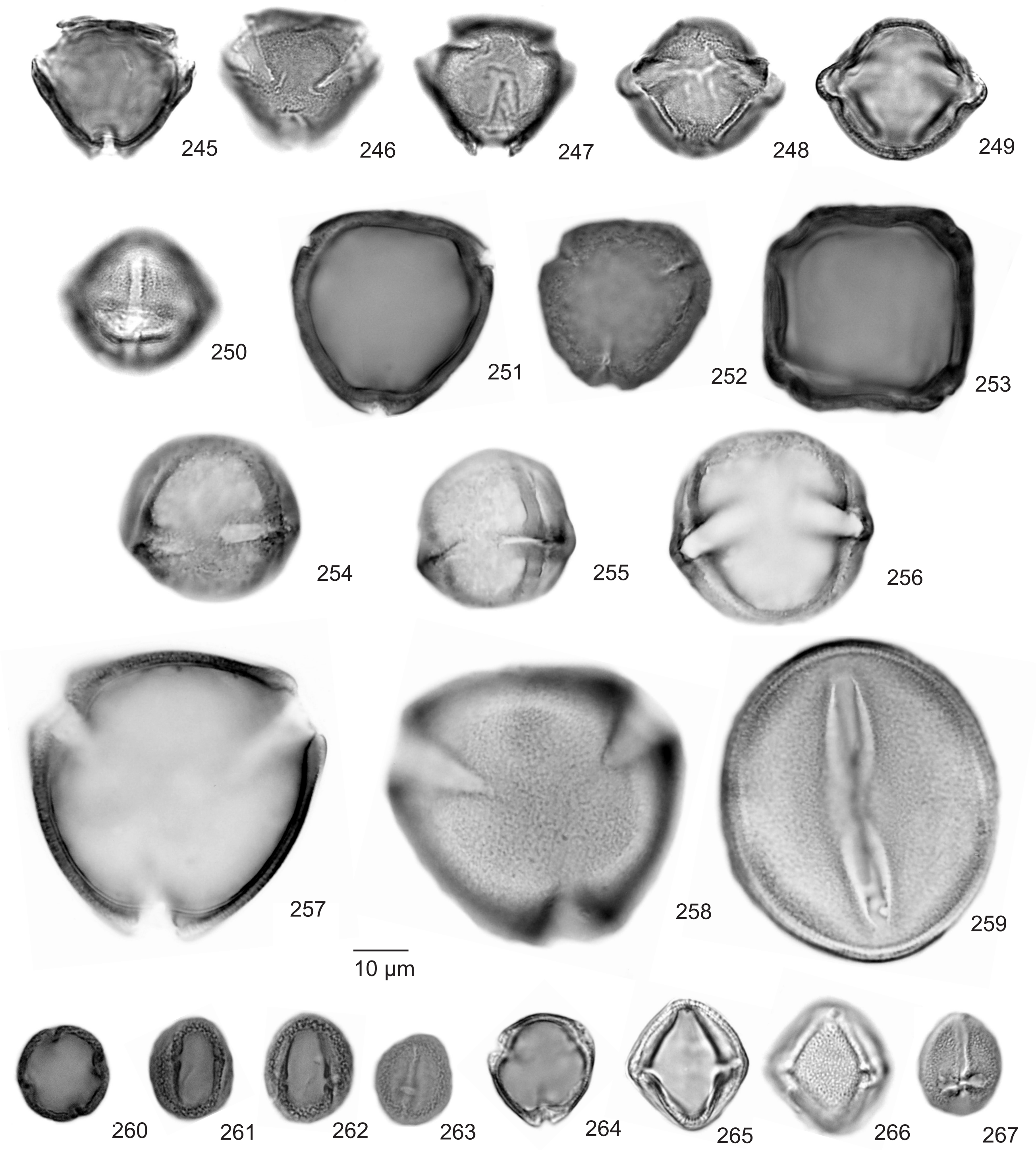


PLATE 16
Tricolporate Grains

245–250 *Capsicum annuum* (Solanaceae)
251–256 *Lantana camara* (Verbenaceae)
257–259 *Cassia occidentalis* (Fabaceae)
260–263 *Phyllanthus tenellus* (Euphorbiaceae)
264–267 *Schinus terebinthifolius* (Anacardiaceae)

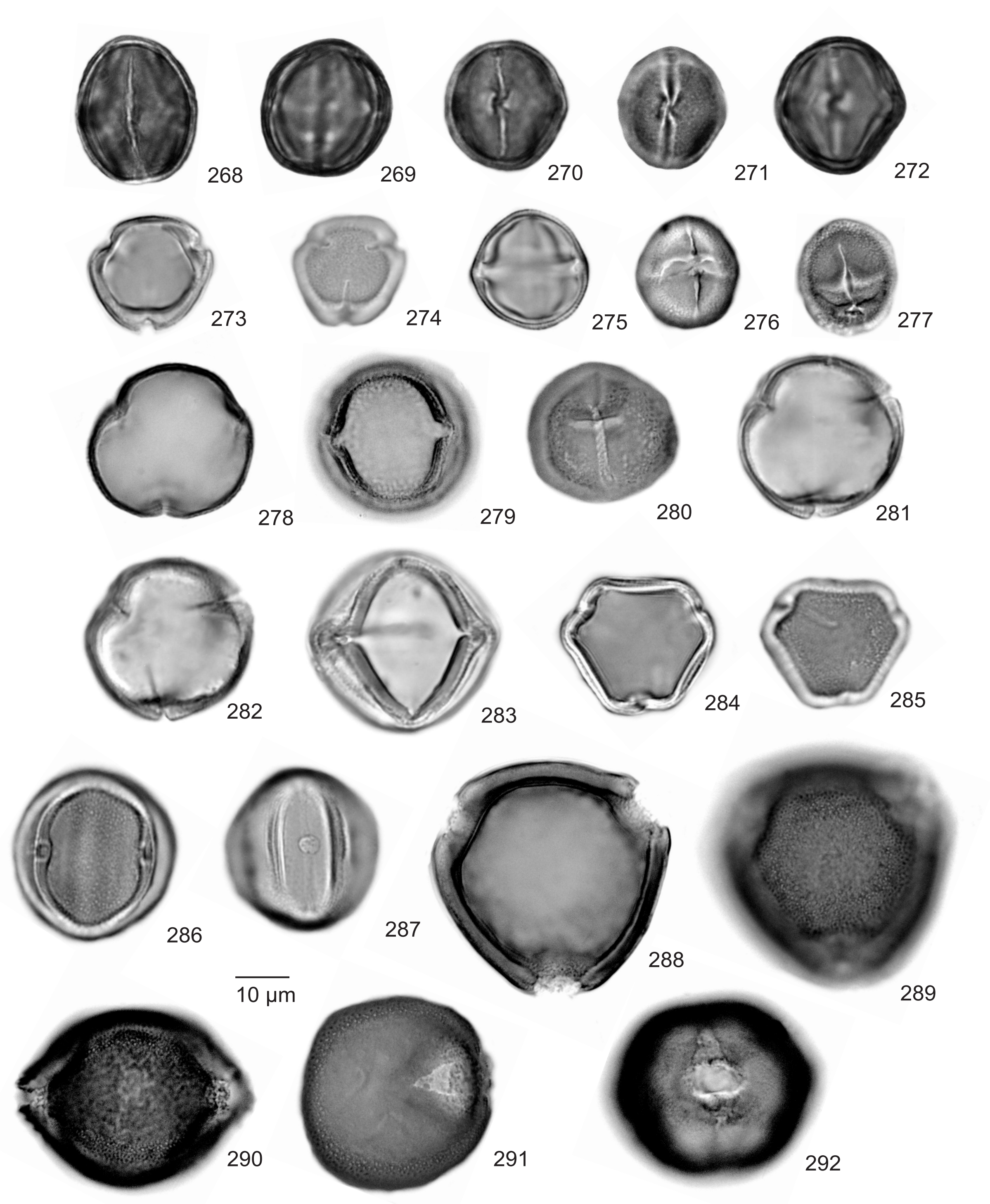


PLATE 17
Tricolporate Grains

268–272 *Laguncularia racemosa* (Combretaceae)
273–277 *Rhizophora mangle* (Rhizophoraceae)
278–280 *Carica papaya* (Caricaceae)
281–283 *Ricinus communis* (Euphorbiaceae)
284–287 *Vitis rotundifolia* var. *munsoniana* (Vitaceae)
288–292 *Apios americana* (Fabaceae)

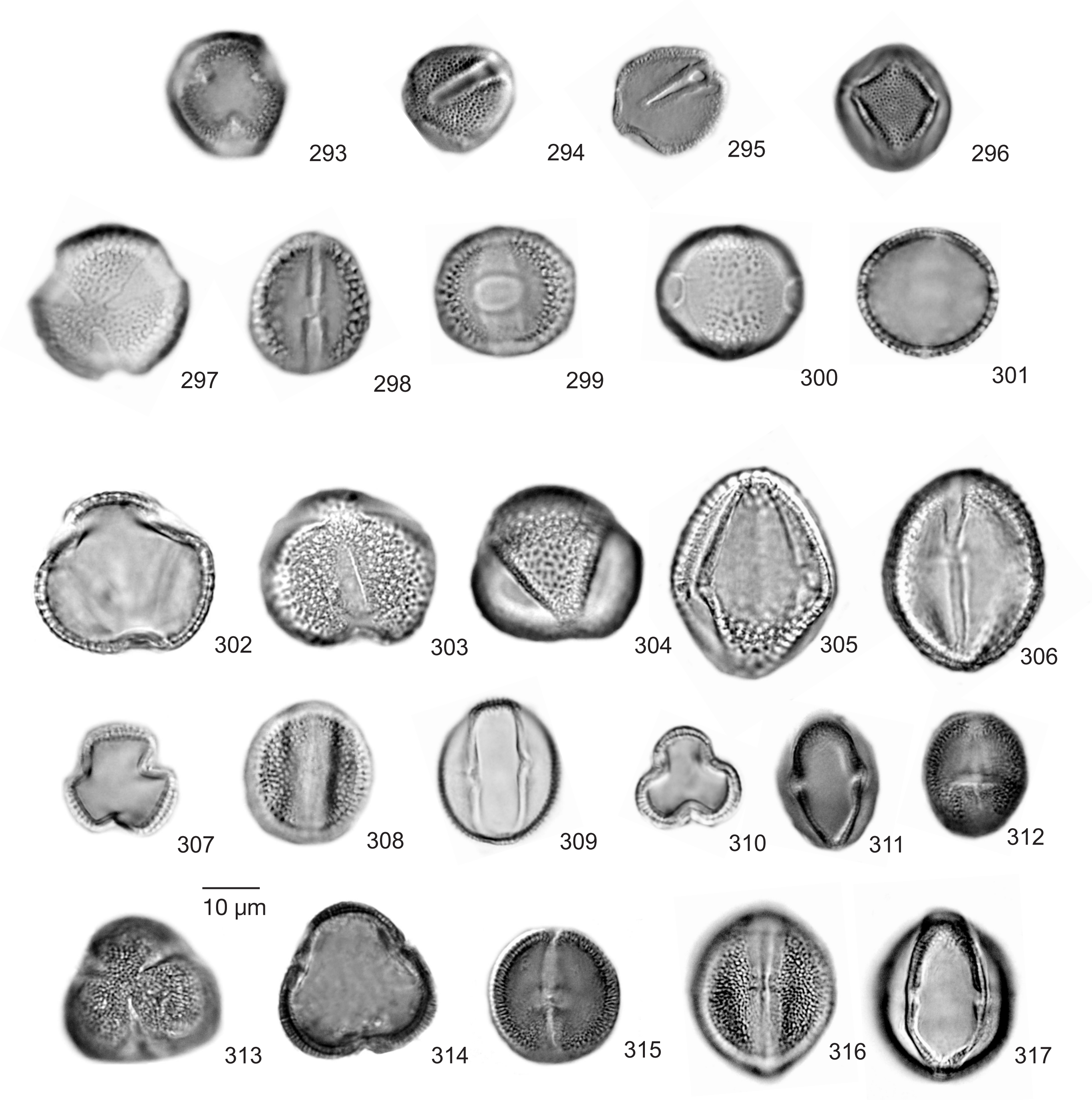


PLATE 18
Tricolporate Grains

293–296 *Cephalanthus occidentalis* (Rubiaceae)
297–301 *Salix caroliniana* (Salicaceae)
302–306 *Bacopa monnieri* (Schrophulariaceae)
307–309 *Sambucus nigra* spp. *canadensis* (Caprifoliaceae)
310–312 *Chamaesyce hypericifolia* (Euphorbiaceae)
313–317 *Chamaesyce maculata* (Euphorbiaceae)

Rounded triangular amb; subspheroidal to prolate grain; P/E: 1.21 (1.06–1.34); polar axis: 26.4 (23.4–30.1) μm; equatorial axis: 20.9 (19.9–24.0) μm; tricolporate; colpus approximately length of grain; maximum colpus width: 1.3 (0.6–2.6) μm; lalongate pore; pore commonly constricted slightly in center (see Plate 18: 315); pore height: 2.4 (1.6–2.9) μm; pore length: 6.7 (5.9–7.9) μm; reticulate; homobrochate; exine thickness: 2.2 (2.0–2.4) μm.

Phyllanthus tenellus Roxb.
Plate 16: 260–263

Spherical grain; subspheroidal to prolate; P/E: 1.20 (1.10–1.40); polar axis: 20.9 (19.0–23.0) μm; equatorial axis: 17.8 (16.0–20.0) μm; tri–tetracolporate; colpus length: 13.5 (11.8–16.7) μm; maximum colpus width: 1.0 (0.6–1.3) μm; pore obscure and lalongate; pore height: 0.9 (0.8–1.3) μm; pore length: 2.9 (2.2–3.6) μm; finely reticulate; exine thickness: 1.6 (1.3–1.9) μm.

Ricinus communis L.
Plate 17: 281–283

Circular amb; subspheroidal grain; P/E: 0.98 (0.97–1.00); polar axis: 35.3 (33.0–40.0) μm; equatorial axis: 33.7 (29.0–41.0) μm; tricolporate; colpus length: 28.8 (24.8–32.4) μm; maximum colpus width: 2.6 (2.0–3.0) μm; lalongate pore; in rare instances pores merge to form equatorial furrow; pore height: 2.6 (1.6–4.2) μm; pore length: 14.0 (11.3–19.5) μm; reticulate; exine thickness: 1.3 (1.2–1.4) μm.

Fabaceae

Acacia angustissima (P. Mill.) Kuntze
Plate 22: 366–367

Polyad; 8 grains per polyad; polyad diameter: 29.5 (27.5–32.0) μm; individual grain length: 14.3 (13.4–15.1) μm; individual grain width: 10.0 (8.9–12.7) μm; psilate; exine thickness: 1.2 (1.0–1.4) μm.

Apios americana Medicus
Plate 17: 288–292

Triangular amb; subspheroidal grain; P/E: 0.95 (0.89–1.10); polar axis: 40.6 (36.5–45.5) μm; equatorial axis: 42.7 (35.5–51.0) μm; tricolporate; colpus length: 23.9 (20.6–29.6) μm; maximum colpus width: 5.4 (4.3–6.8) μm; oval pore; pore height: 6.9 (4.1–10.5) μm; pore width: 10.2 (7.6–12.8) μm; finely reticulate; exine thickness: 3.1 (2.5–4.0) μm.

Cassia obtusifolia (L.) Irwin & Barneby
Plate 12: 167–169

Circular amb; subspheroidal; P/E: 1.06 (0.99–1.03); polar axis: 39.1 (37.6–41.3) μm; equatorial axis: 32.1 (31.0–33.0) μm; tricolporate; colpus length: 30.6 (27.8–33.2) μm; maximum colpus width: 6.2 (5.0–8.0) μm; round pore; pore diameter: 6.6 (5.9–7.3) μm; rugulate; exine thickness: 2.3 (2.0–3.0) μm.

Cassia occidentalis (L.) Link
Plate 16: 257–259

Rounded triangular amb; subspheroidal grain; P/E: 1.15 (1.04–1.23); polar axis: 59.8 (55.3–65.5) μm; equatorial axis: 52.0 (48.0–55.2) μm; tricolporoidate; colpus length: 37.7 (34.2–43.4) μm; maximum colpus width: 2.3 (1.6–3.6) μm; pitted; exine thickness: 3.1 (2.7–3.8) μm; exine thicker adjacent to colpus (see Plate 16: 259).

Desmodium paniculatum (L.) DC.
Plate 12: 170–174

Rounded triangular amb; subspheroidal grain; P/E: 0.94 (0.89–0.99); polar axis: 35.8 (33.8–38.9) μm; equatorial axis: 38.0 (34.1–41.8) μm; tricolporate; PAI: 0.49 (0.46–0.52); colpus length: 21.2 (15.7–27.8) μm; maximum colpus width: 3.2 (2.6–3.9) μm; lalongate pore; pore height: 6.1 (6.1–6.3) μm; pore width: 11.5 (10.7–12.7) μm; rugulate; exine thickness: 2.0 (1.9–2.1) μm.

Vigna luteola (Jacq.) Bentham
Plate 6: 90–93

Triangular grain; maximum dimension: 50.2 (44.0–56.0) μm; triporate; round pore (see Plate 6: 93); pore diameter: 8.1 (6.9–10.9) μm; reticulate; heterobrochate; muri width: 2.3 (2.0–3.0) μm; lumina range: 8.3 (4.0–15.0) μm; exine thickness 1.1 (0.8–1.5) μm.

Fagaceae

Quercus laurifolia Michx.
Plate 11: 140–143

Circular amb; subspheroidal to prolate; P/E: 1.13 (0.99–1.33); polar axis: 27.7 (25.3–31.6) μm; equatorial axis: 24.8 (21.2–28.0) μm; tricolpate–tricolporoidate; PAI: 0.33 (0.23–0.37); colpus length: 20.6 (17.9–24.1) μm; maximum colpus width: 1.9 (1.2–3.5) μm; scabrate; exine thickness: 2.3 (1.9–2.5) μm; exine thicker adjacent to colpus.

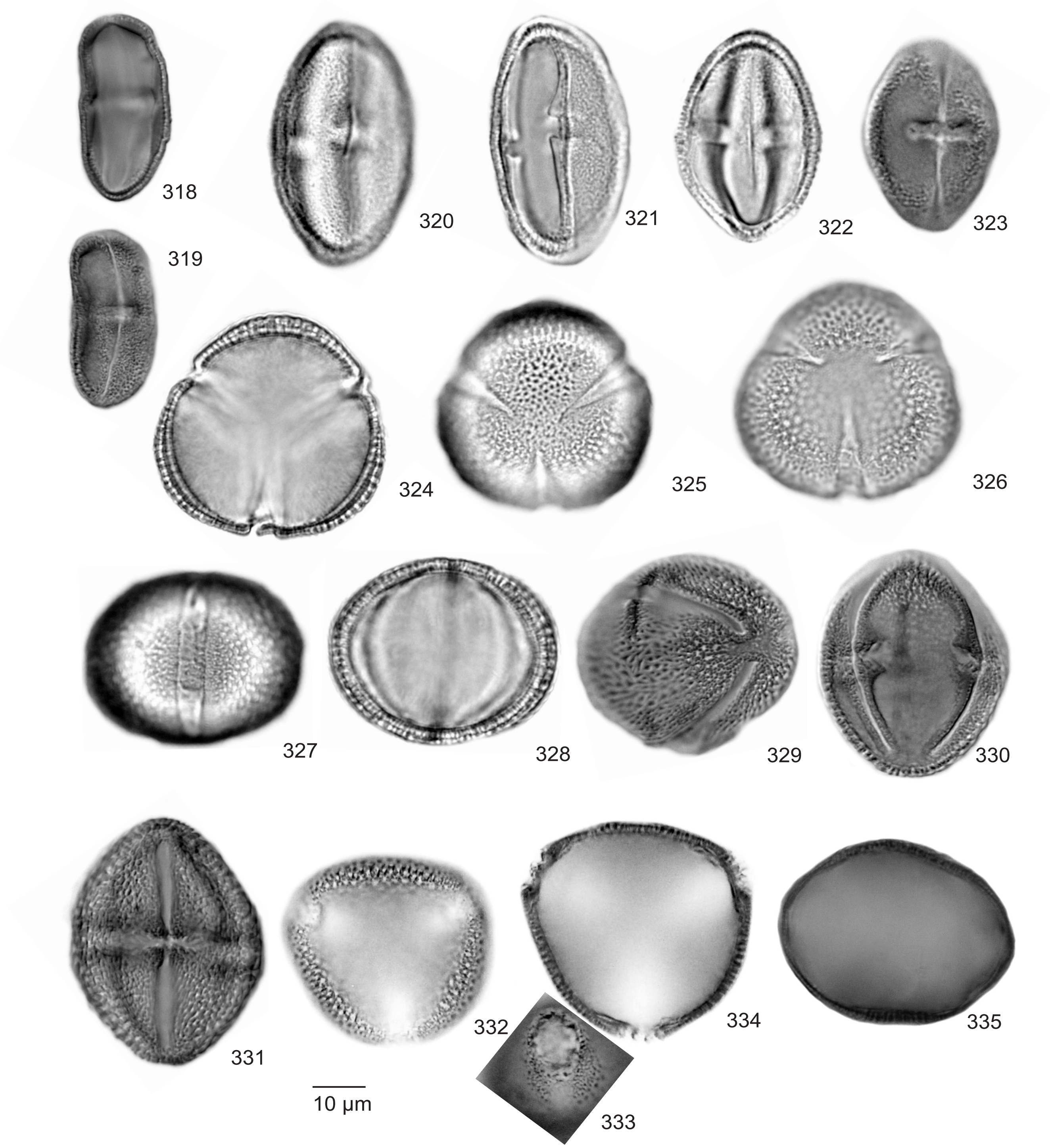


PLATE 19
Tricolporate Grains

318–319 *Cicuta maculata* var. *maculata (*Apiaceae)
320–323 *Hydrocotyle* sp. (Apiaceae)
324–328 *Callicarpa americana* (Verbenaceae)
329–331 *Rhus copallinum* (Anacardiaceae)
332–335 *Melothria pendula* (Curcurbitaceae)

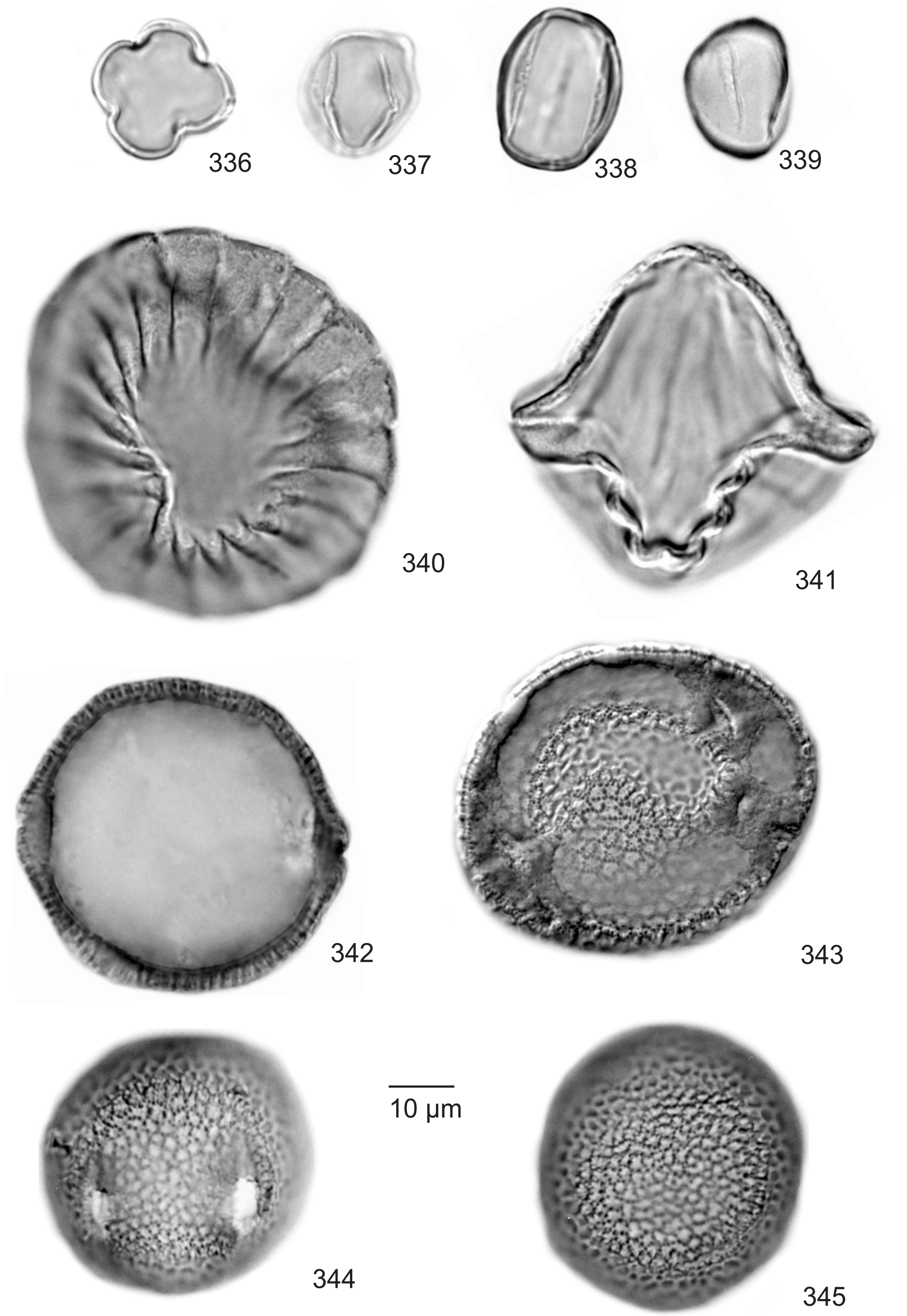


PLATE 20
Stephanocolporate Grains

336–339 *Batis maritima* (Bataceae)
340–341 *Utricularia foliosa* (Lentibulariaceae)
342–345 *Waltheria indica* (Sterculiaceae)

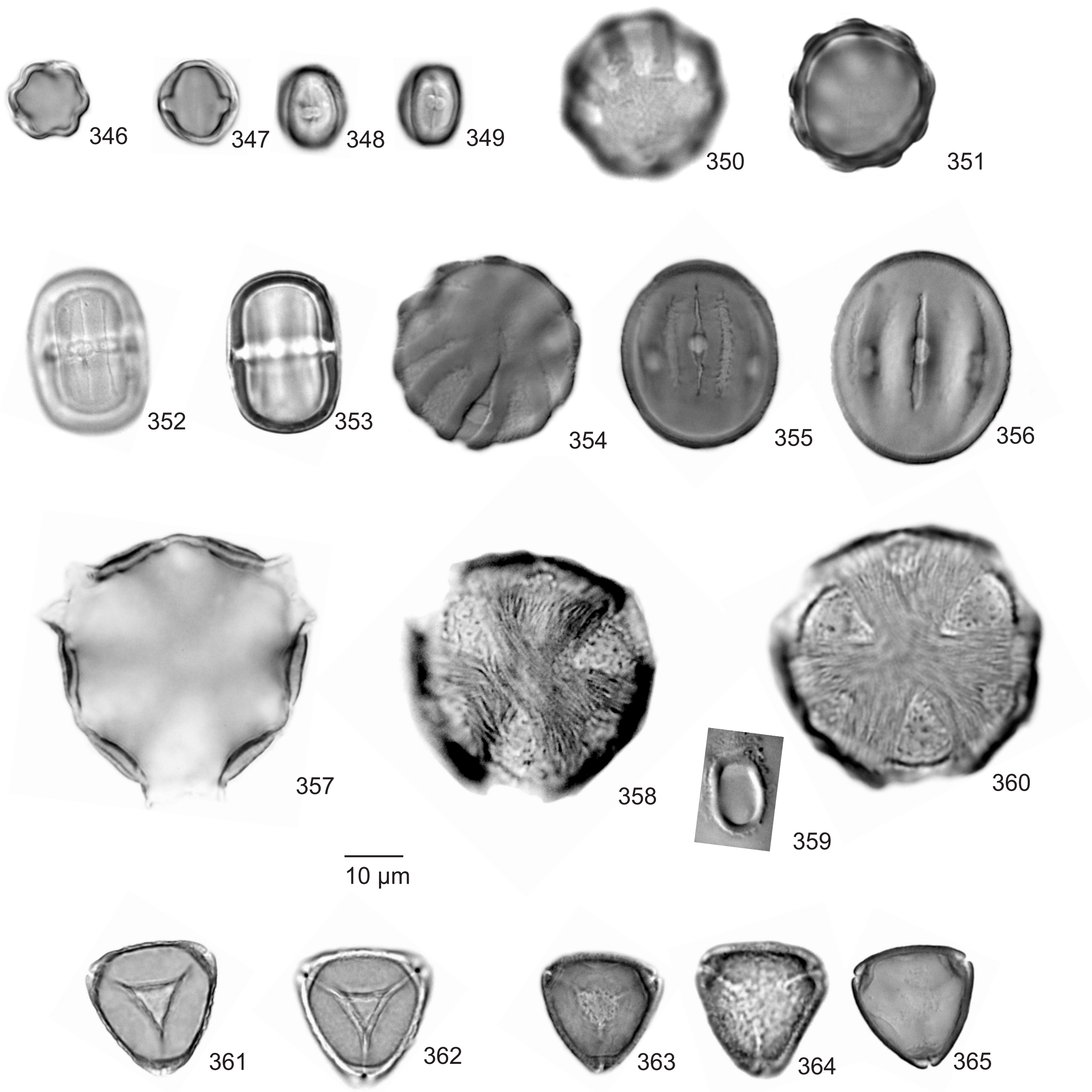


PLATE 21
Heterocolporate and Syncolporate Grains

346–349 *Conocarpus erecta* (Combretaceae)
350–353 *Polygala* sp. (Polygalaceae)
354–356 *Heliotropium polyphyllum* (Boraginaceae)
357–360 *Lythrum alatum* (Lythraceae)
361–362 *Melaleuca quinquenervia* (Myrtaceae)
363–365 *Psidium guajava* (Mytraceae)

Haloragaceae
Myriophyllum sp. L.
Plate 7: 94–96

Rounded grain; maximum dimension: 24.7 (21.2–28.7) µm; stephanoporate; 4 annulate pores; pore oval to round; maximum pore dimension: 1.9 (1.2–2.5) µm; annulus thickness: 2.9 (2.6–3.5) µm; annulus with irregular margins (see Plate 7: 96); psilate with irregularly scattered scabrae; exine thickness 1.8 (1.3–2.1) µm.

Proserpinaca palustris L.
Plate 7: 97–99

Spherical grain; maximum dimension: 20.6 (18.0–25.0) µm; stephanoporate; 4–5 round pores; pore diameter: 2.4 (1.0–3.5) µm; rugulate; exine thickness: 2.4 (1.5–3.0) µm.

Hippocrateaceae
Hippocratea volubilis L.
Plate 22: 374–375

Polyad consisting of 16 grains, maximum dimension of polyad: 61.7 (52.8–74.5) µm; individual grain maximum dimension: 19.5 (17.5–22.6) µm; triporate, round pore, pore diameter: 2.5 (2.3–2.9) µm; reticulate; homobrochate; exine thickness: 3.2 (2.8–3.6) µm.

Lentibulariaceae
Utricularia foliosa L.
Plate 20: 340–341

Spherical grain; subspheroidal; P/E: 0.93 (0.68–1.13); polar axis: 52.2 (40.0–60.0) µm; equatorial axis: 58.1 (53.0–64.0) µm; polycolporoidate; 18–20 colpi; distance between colpi: 7.6 µm; psilate; exine thickness: 1.6 (1.0–3.0) µm.

Loganiaceae
Mitreola sp. L.
Plate 12: 158–159

Rounded triangular amb; subspheroidal to prolate grain; P/E: 1.17 (1.06–1.46); polar axis: 13.7 (12.3–16.7) µm; equatorial axis: 11.7 (11.4–12.0) µm; tricolporate; PAI: 0.31 (0.22–0.37); colpus length: 10.7 (8.2–12.8) µm; maximum colpus width: 1.9 (1.5–2.5) µm; round pore; pore diameter: 2.1 (1.5–3) µm; psilate; exine thickness: 1.3 (1.0–1.5) µm.

Lythraceae
Lythrum alatum Pursh
Plate 21: 357–360

Rounded triangular amb; subspheroidal grain; P/E: 1.28 (1.27–1.29); polar axis: 32.7 (32.3–33.0); equatorial axis: 38.0 (35.0–40.0) µm; hetercolporate; 3 colpi and 3 pseudocolpi; colpus length: 29.1 (26.6–31.6) µm; maximum colpus width: 9.9 (7.0–13.0) µm; pore height: 9.5 (7.0–11.1) µm; pore width: 6.5 (5.8–6.8) µm; striate; striae parallel to polar axis; granulate colpus membrane; exine thickness: 2.5 (2.3–2.7) µm.

Malvaceae
Sida cordifolia L.
Plate 8: 112–114

Spherical grain; maximum dimension: 95.7 (85.0–107.0) µm; periporate; 8–12 round pores (see Plate 8: 114); pore diameter: 4.9 (3.5–6.0) µm; echinate; spine height: 8.2 (7.5–10) µm; spine width at base: 7.9 (7.1–9.4) µm; exine thickness: 2.7 (2.0–4.0) µm; tectate.

Moraceae
Morus rubra L.
Plate 6: 69–71

Spherical grain; maximum dimension: 15.7 (12.0–17.8) µm; diporate; round pore; pore diameter: 1.9 (1.5–2.4) µm; psilate; exine thickness: 1.0 (0.8–1.2) µm.

Myricaceae
Morella cerifera (L.) Small
(synonym: *Myrica cerifera* L.)
Plate 6: 82–85

Triangular grain; maximum dimension: 32.5 (29.5–35.5) µm; triporate; round pore; pore diameter: 3.0 (2.6–3.6) µm; vestibulum height: 4.7 (3.3–5.9) µm; vestibulum width: 7.8 (6.9–8.4) µm; granulations typically visible in vestibulum; Os: 9.2 (8.7–11.2) µm; psilate; exine thickness: 2.4 (2–2.7) µm.

Myrtaceae
Melaleuca quinquenervia (Cav.) Blake
Plate 21: 361–362

Triangular grain; maximum dimension: 25.5 (23.0–27.5) µm; parasyncolporate; pore diameter: 1.6 (1.0–2.0) µm; psilate; exine thickness: 1.3 (1.0–1.6) µm.

Psidium guajava L.
Plate 21: 363–365

Triangular grain; maximum dimension: 27.1 (22.5–31) µm; parasyncolporate; pore diameter: 1.5 (1.0–3.5) µm; exine thickness: 1.3 (1.0–1.5) µm; scabrate.

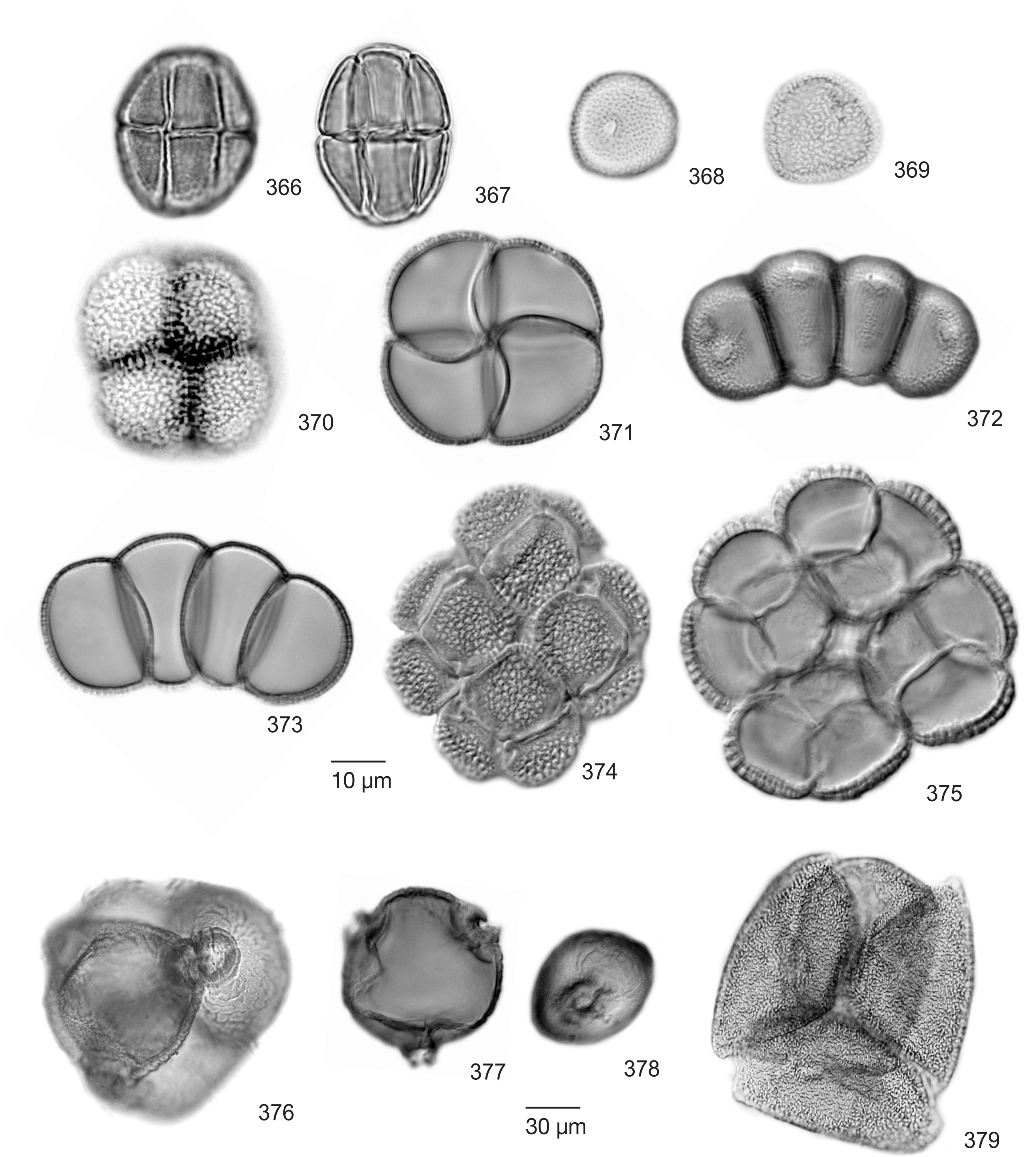


PLATE 22
Polyad Grains

366–367 *Acacia angustissima* (Fabaceae)
368–369 *Typha domingensis* (Typhaceae)
370–373 *Typha latifolia* (Typhaceae)
374–375 *Hippocratea volubilis* (Hippocrateaceae)
376–378 *Ludwigia leptocarpa* (Onagraceae)
379 *Annona glabra* (Annonaceae)

Nymphaeaceae
Nuphar lutea (L.) Sm.
Plate 10: 131–132

Oval grain; long axis: 62.2 (57.5–69.9) µm; short axis: 39.8 (33.8–43.7) µm; monosulcate; sulcus length: 50.1 (42.8–54.2) µm; maximum sulcus width: 3.7 (2.6–4.7) µm; echinate; spine height: 5.2 (3.8–6.1) µm; spine width at base 1.6 (1.3–2.1) µm; echinate; exine thickness: 2.1 (1.6–2.7) µm.

Nymphaea odorata Aiton
Plate 9: 123–127

Spherical to oval grain; maximum dimension: 31.8 (29.0–37.0) µm; monosulcate; sulcus approximately length of grain; clavate, gemmate, and baculate; sculptural element height: 3.0 (1.9–3.4) µm; exine thickness: 1.4 (1.0–2.0) µm.

Onagraceae
Ludwigia leptocarpa (Nutt.) Hara
Plate 22: 376–378

Rounded triangular grain (individual grain); maximum dimension (individual grain) 73.9 (64.8–82.2) µm; tetrahedral tetrad maximum dimension: 109.8 (102.1–114.5) µm; tricolporate; colpus length: 23.1 (20.7–25.5) µm; colpus width: 3.6 (2.9–4.7) µm; round aspidate pore; pore diameter: 2.8 (2.1–3.6) µm; vestibule height: 6.3 (4.5–8.8) µm; vestibule width: 7.1 (5.4–8.8) µm; viscin threads present, approximately 110–130 µm long; rugulate; exine thickness: 2.8 (2.5–3.8) µm.

Polygalaceae
Polygala sp. L.
Plate 21: 350–353

Multilobate amb; prolate grain; P/E: 1.41 (1.30–1.50); polar axis: 24.5 (22.2–25.7) µm; equatorial axis: 17.4 (16.4–18.5) µm; 7–10 colporate; colpus length: 14.9 (12.8–17.1) µm; maximum colpus width: 1.8 (1.3–2.4) µm; lalongate pores; occasionally fuse to form transverse furrow (see Plate 21: 353); pore height: 1.9 (1.6–2.1) µm; pore width: 4.1 (3.2–5.0) µm; psilate; exine thickness: 1.9 (1.8–2.2).

Polygonaceae
Polygonum densiflorum Meisn.
Plate 7: 104–105

Spherical grain; maximum dimension: 55.8 (44.0–75.0) µm; periporate; 10–12 round pores per grain; pore diameter: 4.4 (3.8–5.7) µm; reticulate; heterobrochate; muri width: 2.6 (2.0–3.0) µm; lumina range: 7.7 (4.0–13.0) µm; exine thickness: 4.1 (3.0–5.0) µm.

Polygonum hydropiperoides Michaux
Plate 7: 106–107

Spherical grain; maximum dimension: 54.9 (50.0–60.0) µm; periporate; 10–12 round pores per grain; pore diameter: 2.3 (1.5–2.8) µm; reticulate; heterobrochate; muri width: 3.1 (3.0–4.0) µm; lumina range: 7.2 (4.0–15.0) µm; exine thickness: 3.6 (3.0–5.0) µm.

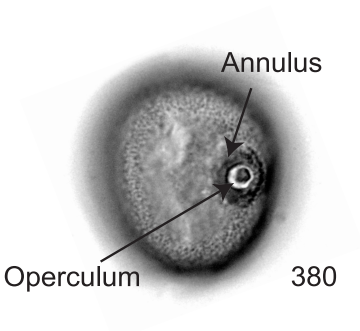
Rhizophoraceae
Rhizophora mangle L.
Plate 17: 273–277

Rounded triangular amb; subspheroidal to prolate grain; P/E: 1.22 (1.09–1.34); polar axis 23.7 (22.0–26.5) µm; equatorial axis: 19.5 (17.9–20.7) µm; tricolporate; PAI: 0.29 (0.25–0.35); colpus length: 17.0 (15.0–19.6) µm; maximum colpus width: 0.97 (0.6–1.2) µm; lalongate pore; pores may merge to form transverse furrow; pore height: 2.0 (1.5–2.5) µm; pore width: 10.6 (8.6–12.2) µm; finely reticulate; exine thickness: 1.5 (1.0–1.9) µm.

Rubiaceae
Cephalanthus occidentalis L.
Plate 18: 293–296

PLATE 23
Morphological features of palynomorphs

- 380 Annulus and Operculum
- 381 Os and Vestibulum
- 382 Diagram of aspidate grain showing os, pore, vestibulum, nexine, and sexine
- 383 Exine: Nexine and Sexine
- 384 Lophate pollen and lacuna
- 385 Equatorial view of tricolporate pollen with lalongate pore
- 386 Diagram of colporate pollen grain showing pore dimensions (h = pore height; w = pore width)
- 387 Reticulate sculpture: Lumen and Murus
- 388 Monolete spore with perisporium
- 389 Polar view of tricolpate grain showing polar area
- 390 Polar view of syncolporate pollen and apolcolpial field
- 391 Ulcus



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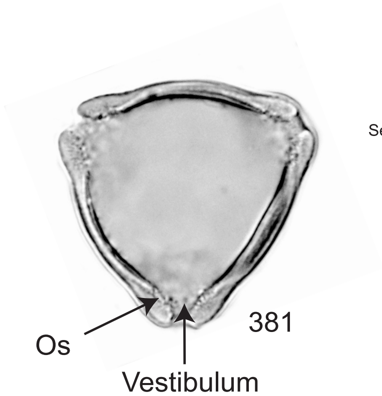

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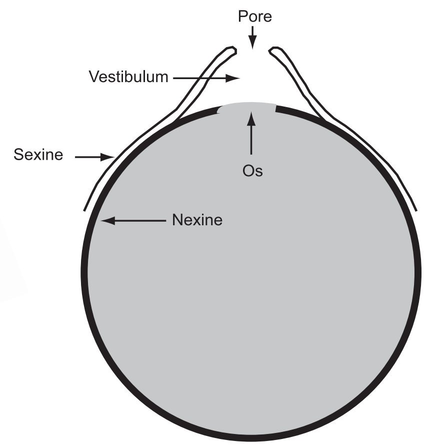

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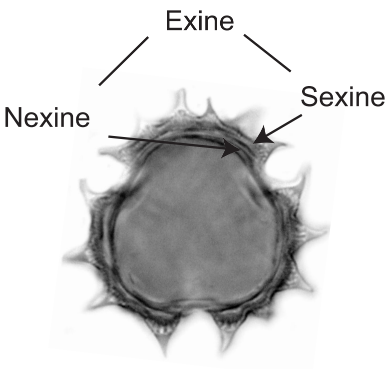

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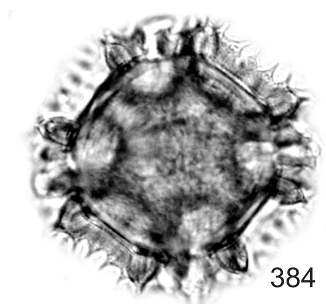
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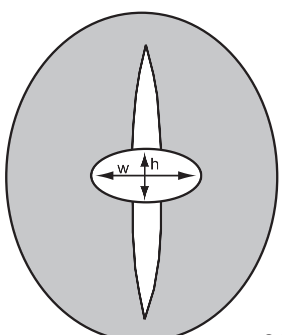

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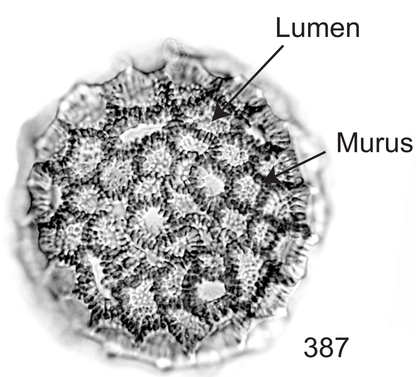

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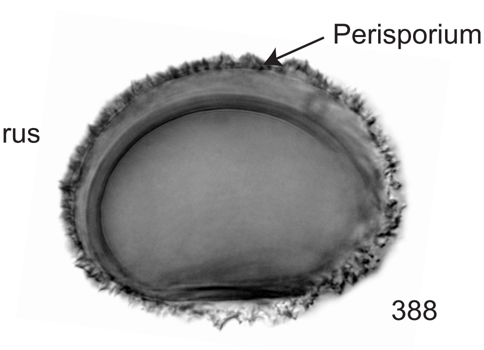

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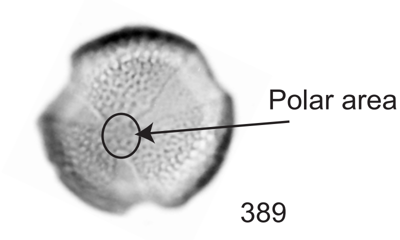

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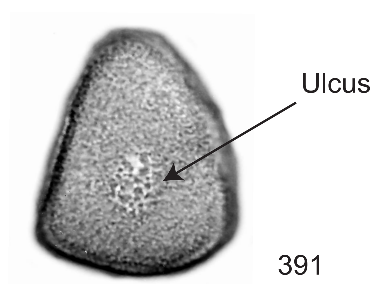

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Rounded triangular amb; subspheroidal grain; P/E: 0.97 (0.78–1.28); polar axis: 21.8 (20.0–23.0) µm; equatorial axis: 23.0 (18.0–27.5) µm; tricolporate; PAI: 0.23 (0.13–0.34); colpus length: 20.9 (19.8–24.4) µm; maximum colpus width: 2.1 (1.5–3.0) µm; round annulate pore; pore diameter: 2.9 (1.5–4.5) µm; annulus width: 1.9 (1.3–2.3); reticulate; homobrochate; exine thickness: 1.6 (1.0–2.0) µm; exine thickened into margo along colpus.

Salicaceae
Salix caroliniana Michaux
Plate 18: 297–301

Circular amb; subspheroidal grain; P/E: 0.91 (0.80–1.0); polar axis: 22.7 (20.5–25.0) µm; equatorial axis: 24.8 (22.0–27.5) µm; tricolporate; PAI: 0.17 (0.11–0.23); colpus length: 24.0 (19.1–27.2) µm; maximum colpus width: 5.7 (5.0–8.0) µm; oval pore; pore height: 4.7 (3.9–5.6) µm; pore width: 6.8 (5.0–8.5) µm; reticulate; heterobrochate; luminae smallest near apertures; exine thickness: 1.7 (1.5–2.0) µm.

Saururaceae
Saururus cernuus L.
Plate 11: 136–137

Oval grain; long axis: 17.8 (15.0–20.5) µm; short axis: 13.1 (10.5–15.0) µm; monosulcate; sulcus length: 8.3 (7.4–9.1) µm; maximum sulcus width: 2.6 (2.3–2.8) µm; psilate; exine thickness: 0.94 (0.7–1.1) µm.

Scrophulariaceae
Bacopa monnieri (L.) Pennell
Plate 18: 302–306

Rounded amb; subspheroidal; polar axis: 28.3 (26.0–31.5) µm; equatorial axis: 29.2 (26.5–31.0) µm; tricolporate; colpus length: 28.4 (26.8–30.3) µm; maximum colpus width: 5.6 (3.0–7.5) µm; round pore; pore diameter: 5.6 (3.0–8.0) µm; reticulate; homobrochate; exine thickness: 2.2 (2.0–2.5) µm.

Solanaceae
Capsicum annuum L.
Plate 16: 245–250

Triangular amb; subspheroidal grain; P/E: 0.95 (0.87–1.00); polar axis: 25.5 (23.0–27.0) µm; equatorial axis: 26.8 (25.0–30.0) µm; tricolporate; PAI: 0.23 (0.16–0.29); colpus length: 23.6 (20.2–26.6) µm; maximum colpus width: 2.9 (2.5–3.5) µm; lalongate pore; pore height: 6.1 (5.1–6.7) µm; pore width: 12.5 (10.4–15) µm; pitted; exine thickness: 1.3 (1.0–2.0) µm; occasional exine thickening adjacent to apertures (see Plate 16: 247).

Physalis pubescens L.
Plate 12: 164–166

Circular amb; subspheroidal grain; P/E: 1.02 (0.96–1.12); polar axis: 26.6 (25.0–29.0) µm; equatorial axis: 26.1 (25.0–28.0) µm; tricolporate; PAI: 0.19 (0.16–0.22); colpus length: 25.3 (22.2–29.4) µm; colpus width: 2.3 (1.9–2.6) µm; lalongate pore constricted in center (see Plate 12: 166); pore height: 2.1 (1.7–2.4) µm; pore width: 10.8 (10–11.9) µm; psilate; exine thickness: 1.2 (1.1–1.4) µm.

Solanum americanum P. Mill.
Plate 12: 160–163

Circular amb; subspheroidal to prolate grain; P/E: 1.05 (0.97–1.15); polar axis: 21.5 (17.1–25.5) µm; equatorial axis: 20.5 (15.3–24.4) µm; tricolporate–syncolporate; PAI: 0.14 (0.09–0.19); colpus length: 18.9 (15.2–22.0) µm; maximum colpus width: 2.0 (1.6–2.5) µm; lalongate pore constricted in center; pore height: 1.9 (1.4–2.8) µm; pore width: 7.7 (6.4–9.0) µm; psilate; exine thickness: 1.4 (1.0–2.2) µm.

Sterculiaceae
Waltheria indica L.
Plate 20: 342–345

Spherical grain; maximum dimension: 53.1 (46.0–58.0) µm; stephanocolporate; 8 colpi; colpus length: 11.8 (10.3–14.4) µm; maximum colpus width: 1.6 (1.0–2.2) µm; 8 lalongate pores; pore height: 3.2 (2.4–3.9) µm; pore width 7.7 (5.1–9.5) µm; reticulate; homobrochate; exine thickness: 2.4 (1.2–3.0) µm.

Ulmaceae
Trema micranthum (L.) Blume
Plate 6: 74–76

Spherical grain; maximum dimension: 19.3 (18.0–21.0) µm; diporate; round pore; pore diameter: 1.8 (1.5–2.0) µm; microrugulate; exine thickness: 1.4 (1.0–2.0) µm.

Urticaceae
Boehmeria cylindrica (L.) Sw.
Plate 6: 72–73

Spherical grain; maximum dimension: 14.3 (13.7–16.1) µm; diporate; round pore; pore diameter: 1.2 (1.1–1.3) µm; scabrate; exine thickness: 0.8 (0.7–0.9) µm.

Verbenaceae
Callicarpa americana L.
Plate 19: 324–328

Circular amb; subspheroidal grain; P/E: 1.02 (0.94–1.15); polar axis: 39.6 (37.0–44.0) μm; equatorial axis: 38.9 (37.0–41.0) μm; tricolporate–colporoidate; PAI: 0.24 (0.21–0.29); colpus length: 32.2 (28.3–37.2) μm; maximum colpus width: 3.0 (2.0–5.0) μm; reticulate; heterobrochate; exine thickness: 4.4 (4.0–5.0) μm; exine thickness greatest between colpi; tectate.

Lantana camara L.
Plate 16: 251–256

Triangular to square amb; subspheroidal grain; P/E: 0.93 (0.84–1.03); polar axis: 35.4 (33.0–40.0) μm; equatorial axis: 38.0 (33.0–43.0) μm; tri–tetracolporate; PAI: 0.26 (0.19–0.28); colpus length: 29.2 (24–35.8) μm; colpus width: 2.3 (1.9–3.0) μm; lalongate pores, almost merging to form transverse furrow; pores typically angled toward pole rather than being elongated equatorially (see Plate 16: 256); pore height: 3.1 (2.0–4.0) μm; pore width: 12.8 (10.0–16.0) μm; pitted; exine thickness: 2.0 (1.1–2.4) μm.

Vitaceae
Vitis rotundifolia Michx. var. *munsoniana*
(Simpson ex Munson) M.O. Moore
(synonym: *Vitis munsoniana* (Simpson ex Munson))
Plate 17: 284–287

Triangular amb; subspheroidal to prolate grain; P/E: 1.06 (0.94–1.19); polar axis: 24.5 (23.0–27.5) μm; equatorial axis: 23.3 (20.5–25.5) μm; tricolporate; PAI: 0.23 (0.19–0.27); colpus extends nearly the length of grain; maximum colpus width: 1.6 (1.0–2.0) μm; round pore; pore diameter: 2.7 (1.8–3.5) μm; finely reticulate; exine thickness: 1.2 (1.0–1.5) μm.

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APPENDIX 1. Glossary of palynological terms (modified from Punt et al, 1994; Traverse, 1988; Faegri and Iversen, 1975; Kremp, 1965).

Amb: Outline of a pollen grain or spore as viewed from directly above one of the poles (i.e., round amb, triangular amb).

Annulus: A ring bordering a pore of a pollen grain, in which the ektexine is modified (usually thickened) (Plate 23: 380).

Aperture: Modification of the exine of a pollen grain or spore that is the site of exit for the contents (e.g., laesura, colpus, pore).

Apocolpial field: A region at the pole of a parasyncolporate pollen grain, delimited by the margins of the anastomosing colpi (Plate 23: 390).

Areolae: Feature of ornamentation in which the sexine is composed of circular or polygonal areas.

Aspidate: Bearing the apertures on dome-like protrusions (e.g., *Ludwigia, Morella*) (Plate 23: 381, 382). Grains with an aspidate external form often are vestibulate internally.

Baculate: Sculpture of pollen and spores consisting of bacula, which are tiny rods (lacking thickenings or thinnings at either end). These vary widely in size and distribution (either clustered or isolated).

Cavate: Feature where a cavity (cavea) formed between two layers of the exine and extends to the colpus margin where the layers meet (e.g., *Ambrosia*).

Clavate: Sculpture of pollen and spores consisting of clavae, which are rods with enlarged, club-like ends.

Colporate: Pollen grain having both colpi and pores (or some other thinning of the exine) oriented along the equator.

Colporoidate: Pollen grain having colpi but a weakly developed pore.

Columella: Rod-like element of the sexine supporting a tectum. Pl. colummellae.

Colpus: Longitudinal furrow-like modification in the exine of pollen grains, associated with germination and often also important for harmomegathic swelling and shrinking. When used strictly, the colpus must be meridional and will cross the equator—thus restricting its use to dicotyledonous angiosperms. More loosely, the term is synonymous with sulcus. Pl. colpi.

Distal: The part of a spore or pollen grain that faces outward from the center of a tetrad.

Echinate: Sculpture of pollen and spores consisting of echinae (spines).

Equator: Imaginary line connecting points midway between poles of a spore or pollen grain.

Exine: The outer, very resistant layer of the two major layers forming the wall of spores and pollen, consisting principally of sporopollenin.

Gemmate: Sculpture of pollen and spores consisting of more or less spherical projections.

Harmomegathus: The membrane of a pollen grain aperture when it serves to accommodate, by expansion and contraction, changes in volume of the grain, which usually result from taking up or loss of water.

Heterobrochate: A term used for reticulate sculpture in which the lumina (and their enclosing muri) are of varying size across the palynomorph surface, typically in proximity to apertures (c.f., *Salix*).

Homobrochate: A term used for reticulate sculpture in which the lumina (and their enclosing muri) are of approximately uniform size across the palynomorph surface.

Heterocolporate: Pollen grains having pores in some colpi and not in others; with both simple and compound apertures.

Lacuna: In lophate grains, a depressed area surrounded by ridges (Plate 23: 384). Pl. lacunae.

Laesura: The scar on the proximal face of an embryophytic spore that marks the original contact with other members of the tetrad. It may be monolete, trilete, or rarely dilete. Pl. laesurae.

Lalongate: Term describing pore that is expanded along the equatorial axis of a pollen grain (typically tricolporate) (Plate 23, Figures 385, 386).

Lobate: An equatorially aperturate pollen grain with a lobed shape in polar view (e.g., *Conocarpus*).

Lophate: Pollen grains in which outer exine is raised in a pattern of ridges and surrounded by lacunae (Plate 23: 384).

Lumina: The depressions between muri of reticulate sculpture (Plate 23: 387).

Margo: An area of exine adjacent to the colpus that is differentiated from the remainder of the sexine either in ornamentation or in thickness.

Muri: The more or less vertical walls which form positive reticulate sculpture in pollen and spores (Plate 23: 387).

Nexine: The inner, non-sculptured part of the exine (Plate 23: 382, 383).

Oblate: The shape of a spore or pollen grain when the polar axis is shorter than the equatorial diameter.

Operculum: A thicker central part of a pore membrane of a pollen grain (Plate 23: 380).

Os: The inner aperture of a complex pore structure (Plate 23: 381, 382). Pl. Ora.

Parasyncolporate: Describing syncolporate pollen grains in which the apices of the colpi divide into two branches and anastomose toward the poles, delimiting an isolated area known as the apocolpial field (Plate 23: 390).

P/E ratio: The ratio of the length of the polar axis (P) to the equatorial diameter (E).

Papilla: A small protuberance.

Periporate: Pollen grains with many pores scattered over the surface.

Perisporium: An additional wall layer external to the exine in certain spores and pollen. It is composed of thin and loosely attached sporopollenin and is therefore not usually encountered in dispersed fossil palynomorphs. Syn. perispore, perine (Plate 23: 388).

Pitted: Sculpture of pollen and spores consisting of small depressions (pits) Syn. Foveolate.

Polar Area: The part of a pollen grain poleward from the ends of the colpi and their associated structures (Plate 23: 389).

Polar Area Index (PAI): The ratio between the diameter of the polar area of a pollen grain and the diameter of the grain.

Pole: The center of both the distal and proximal surfaces.

Pollen: The microgametophyte of seed plants, enclosed in the microspore wall. In fossil pollen, only the microspore wall, or exine, remains after lithification removes the microgametophyte and intine. Similarly, the exine is all that remains after acetolysis of modern pollen.

Pore: More or less circular to slightly oval thinnings or openings in the exine of pollen grains. Pores may occur alone or in assocation with colpi.

Prolate: The shape of a spore or pollen grain in which the polar axis is longer than the equatorial diameter.

Proximal: The part of a spore or pollen grains that faces towards the center of a tetrad.

Pseudocolpus: A colpus-like modification of the exine of pollen grains, differing from a true colpus in that it is never a site of pollen tube emergence.

Psilate: Sculpture type, in which the relatively smooth walls of pollen and spores lack prominent sculpture. The term also applies to exines with pits or reticula less than 1 μm in diameter.

Reticulate: A term for sculpture of pollen and spores consisting of a more or less regular network of ridges (muri). Such sculpture is a positive reticulum.

Rugulate: Sculpture type of pollen and spores consisting of wrinkle-like ridges that irregularly anastomose.

Scabrate: A term for sculpture of pollen and spores, consisting of more or less isodiametric projections (scabrae), less than 1 μm in diameter.

Sculpture: The surface relief, or topography, of a spore or pollen grain. Syn. Ornamentation.

Sexine: The outer, sculptured layer of the exine, which lies above the nexine (Plate 23: 382, 383).

Sporopollenin: The very resistant and refractory organic substance of which the exine and perine of pollen and spores are composed. Sporopollenin gives the palynomorph its extreme durability, being readily destroyed only by oxidation or prolonged high temperature. It is a probably a high-molecular-weight polymer of carotenoids.

Stephanocolporate: Pollen grains having more than three colpi, equatorially arranged and provided with pores.

Stephanoporate: Pollen grains having more than three pores, disposed on the equator.

Striate: A term for pollen sculpture characterized by multiple, more or less parallel grooves and ribs in the exine.

Subspheriodal: The shape of a spore or pollen grain in which the P/E ratio is 0.75–1.33.

Spheroidal: The shape of a spore or pollen grain in which the polar axis and equatorial diameter are approximately equal.

Sulcus: An elongate aperture in the exine of pollen grains. The term is usually restricted to a distal furrow of pollen grains with only one such aperture, when this furrow has the distal pole in its center.

Syncolpate: Of pollen grains in which the colpi join, normally near the pole (Plate 23: 390).

Tectate: A pollen grain whose sexine is supported by columellae, granules, or other elements.

Ulcus: A thin place in the exine, more or less pore-like, but irregular in outline, and often broken up into patches as in some Cyperaceae (Plate 23: 391). Pl. Ulci.

Vestibulum: In porate grains, the space between the external opening in the ektexine and the internal opening in the endexine of a pollen grain with a complex porate structure (Plate 23: 381, 382).

Viscin Threads: Threads made of sporopollenin that originate in the polar exine of a relatively limited number of angiosperms (Onagraceae, some legumes), functioning as attachment organs for dispersal by animal pollinators. One end is attached to the polar exine, and the other is free.