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Palynological characterization of a diverse desertic ecosystem: The Peruvian *Lomas*

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ABSTRACT

The Pacific coastal Peruvian landscapes are dominated by desert and dry-forest biomes, which have undergone shifts in extent and floral composition in response to Plio-Pleistocene climatic fluctuations. Within this context, the coastal *Lomas* develop as seasonal vegetation patches, renowned for their high endemism, rich floral diversity, and essential ecosystem services. Despite growing within the desert biome, the *Lomas* exhibit characteristic elements and vegetation structure typical of a dry-forest biome, evidencing an active species migration between xeric biomes. However, assessing the historical evolution of this arid flora and, by extension, the coastal desert landscape, presents challenges. The scarcity of continental sedimentary records and a lack of extended and well-described palynological references impede these efforts. In response to this, our study offers a thorough morphological review of the *Lomas* palynoflora, encompassing over 194 genera from 76 families, representing approximately 80% of the known *Lomas* flora. Our review includes at least one species per

reviewed genus, featuring 37 palynomorphs from endemic species (18.5% of the studied flora). This palynological characterization aims to serve as accessible reference material for investigating the historical and long-term evolution of the coastal dry flora. Furthermore, these findings facilitate the analysis of honeys and bee floral foraging patterns, as well as the study of animal-plant or human-plant interactions from middens and archaeological remains.

Keywords: coastal lomas, fog oasis, desert, dry forest, pollen morphology

1. Introduction

Along the western coast of South America spans a continuous (hyper)arid belt stretching 3500 km from northern Peru to Chile (6-30 °S; Houston 2006; Dillon 1997; Dillon et al. 2003), encompassing both the Atacama Desert and the Peruvian Desert. In the central Peruvian region (8-16 °S), these hyper-arid settings receive a mean annual precipitation (MAP) ranging from 0 to 10 mm and experience average annual temperatures of approximately 18-20 °C (Rundel et al. 1991; Tovar et al. 2018). The climatic regime is characterized by a constant temperature inversion generated by the Humboldt Current and the seasonal position of the South Pacific anticyclone, resulting in a seasonal coastal climate. During the austral summer months (DJF), fog-humidity originates in the early morning and rises as air masses warm, forming light showers locally called "*garúa*". In contrast, during the austral winter months (JJA), thick stratus cloud banks form below 1000 meters above sea level (masl), creating a fog-zone that increases local moisture availability and serves as an important source of humidity for these hyper-arid biomes (Dillon 1989; Dillon and Rundel 1990; Galán de Mera 2011; Trujillo and Rodríguez 2011; Reynel et al. 2013). Experimental studies on fog-derived water collection in lowland Peruvian settings indicate average water accumulation of up to 224 mm/yr (ranging from 4.7 to 785.3 mm/yr; Gonzales et al. 2023). This seasonal fog-driven moisture fosters the development of isolated but diverse vegetation patches known as *Lomas* (Weberbauer 1945; Rundel et al. 1991; Rundel and Dillon 1998; Dillon et al. 2003; Pinto et al. 2006), which typically grow from 400 to 1000 masl.

Although, the climatic conditions of the *Lomas* ecosystem are primarily influenced by the northward flowing cold-waters of the Humboldt Current, changes in precipitation patterns

and the availability of fog-derived moisture during both extreme phases of the El Niño-Southern Oscillation (ENSO) cycle (i.e., warm and wet phase during El Niño and cold and dry phase during La Niña) also impact the greening of the *Lomas* (e.g., Dillon and Rundel 1989; Manrique et al. 2010; Eichler and Londoño 2013). These changes are known to alter the regular reproduction and seedling cycles, thereby promoting vegetation expansion and persistence, as well as affecting food web dynamics (Oka and Ogawa 1984; Ferreyra 1957, 1993; Vincenti 2004; Eichler and Londoño 2013; Santa Cruz et al. 2020; Gonzáles et al. 2023).

The *Lomas* formations are characterized by the seasonal growth of diverse flora, containing abundant endemic flora. *Lomas* vegetation is highly dynamic, with some species remaining consistent every year while others fluctuate, appearing and disappearing with the seasons (Dillon et al. 2011). Some studies suggest that up to 30 % of the Peruvian coastal plant species are found exclusively within this biome (Ferreyra 1957, 1961, 1983, 1993; Rundel et al. 1991; Cano et al. 1999; León et al. 1997). Their vegetation comprises ca. 1200 species of tracheophytes (including pteridophytes and spermatophytes), classified into 83 families and 347 genera. The majority of the vegetation corresponds to herbs (80%), with species such as *Nolana humifusa*, *Ismene amancaes*, and *Begonia octapetala*. However, few arborescent species (e.g., *Schinus molle*, *Myrcianthes ferreyrae*, *Sapindus saponaria*), seasonal shrubs (e.g., *Heliotropium arborescens*, *Tournefortia schomburgkii*, *Croton alinifolius*), cacti (e.g., *Neoraimondia arequipensis*, *Echinopsis chalaensis*), and epiphytic ferns (e.g., *Hemionitis nivea*, *Blechnum occidentale*, *Ophioglossum crotalophoroides*) can also be found (Weberbauer 1945; Cano et al. 1999; León et al. 2002; Dillon et al. 2011; Schulz et al. 2011; Stotz et al. 2021).

Modern *Lomas* vegetation, although part of the coastal desert, is compositionally closely linked to the Peruvian dry forest biome (Whaley, 2019), particularly to the flora of the seasonal dry forests of the northern and central Peruvian coasts (Linares-Palomino, 2022). This vegetation shares the distribution of ecologically important native trees, such as *Caesalpinia spinosa*, two species of *Neltuma* (ex-*Prosopis*), and *Carica candicans* (Dillon et al. 2011). Despite these floristic similarities, the origin, extent, and ecological evolution of the *Lomas* vegetation remain uncertain. It is unclear whether these vegetation communities exclusively result from long-term adaptations to aridity and/or CO₂ changes, or correspond to relict vegetation from the lowland dry forests (e.g., López et al. 2006; Gonzales et al. 2023). Some authors suggest that its origin is related with an Andean uplift pulse during the Pliocene

(4-3 Ma; Hartley and Chong 2002; Hartley 2003), whereas others propose that it may have arisen during the late Miocene (8 Ma; Gonzales et al. 2023). Regardless of its origin, the *Lomas* formations play a critical role as habitats and corridors for several wild species, such as guanacos, desert foxes, and condors (Moat et al. 2021).

These unique ecosystems have also been fundamental in shaping South American human history and coastal settlements from the Middle Preceramic period (c. 8000-4500 B.P.) to the present (e.g., Beresford-Jones et al. 2015; Moat et al. 2021). They provide shelter, essential resources for sustenance (potato, pumpkin, papaya), abundant fuel material, and venues for a variety of human activities (Engel 1973; Rundel et al. 1991; Beresford-Jones et al. 2015; Marcone et al. 2023). As a result, historical and modern anthropogenic activities have exerted continuous pressure on the *Lomas* ecosystem. Overgrazing and constant extraction of resources, especially wood, have affected the natural balance of this ecosystem, putting its diversity at risk (Arana and Salinas 2005; Nieuwlands and Mamani 2017). In more recent times, continuous and accelerated unplanned urban expansion is reducing their natural extension, posing an additional threat to these fragile vegetation patches (Dall’Orso and Román 2019; Alonso and Solórzano 2021).

Despite its ecological importance, the palynological characteristics of the Peruvian coastal *Lomas* flora remain unexplored (Engel 1973). Existing works addressing the palynological spectrum of the Peruvian xeric flora have either focused on specific taxonomic groups or are limited to the most common species (Schneider et al. 2009; Douglas and Freyre 2010; Finot et al. 2018). This work aims to fill this knowledge gap by presenting a comprehensive and taxonomically-updated palynological record encompassing over 194 genera from 76 families, including 37 endemic species from two of the most diverse Peruvian *Lomas* (Lachay and Atiquipa; Fig. 1). This review will serve as a primary reference for future (paleo)palynological studies, particularly those focused on dry environments and the evolution of flora in the western Andes. Future efforts will be focused on completing the characterization of the *Lomas* palynoflora at the genus level by describing the remaining 153 genera.

2. Material and methods

2.1. Study area and sample origin

Our study area encompasses flora from two of the largest and most diverse *Lomas* across the Peruvian coasts (Fig. 1): Lachay [11°20’48’’ S - 77°19’45’’ W] and Atiquipa

[15°45'35'' S - 74°21'34'' W]. The former has an extension of 5070 ha and an altitude of 350 masl hosting 146 plant species, grouped in 124 genera and 52 families. The latter, has an extension of 19,028.02 ha and rises to an elevation of 800 masl, accommodating 350 species, grouped in 236 genera and 78 families (Dillon et al. 1997; Cano et al. 1999; León et al. 2002; Talavera et al. 2017; Moat et al. 2021; Gonzalez et al. 2023). We collected over 251 vegetative samples *ex situ* from the Herbarium at the National History Museum of the Universidad Nacional Mayor de San Marcos (MHN-UNMSM), following standard protocols for pollen grain and spore extraction (Jarzen and Jarzen 2006). Only georeferenced material was sampled, and all botanical names were updated using the Rpackage *taxize* (Chamberlain and Boettiger 2017). Last botanical name update was carried out on May 1st, 2024. Appendix 1 contains a comprehensive inventory list of sampled specimens, including information on herbarium vouchers and whether they produced positive or negative palynological results.

2.2. Sample preparation and housing

We followed a modified four-step palynological protocol proposed by Riding (2021) for sporomorphs sample preparation. Firstly, we collected and cleansed samples, removing any excess of organic material and placing the anthers in a 2 mL Eppendorf tube. Secondly, we subjected the samples to an oxidative process with a 50% KOH solution (1.5 mL) at 100 °C for two hours to eliminate any residual organic material. Thirdly, we stopped the KOH reaction by centrifuging the samples for five minutes at 2500 rpm, followed by decanting and adding distilled water three times. Finally, we dehydrated the samples by adding five drops of xylene and mounted them using Canada Balsam as a medium. The slides were then dried at 50 °C for twenty-four hours.

The samples are housed at the Biogeosciences Laboratory of the Universidad Peruana Cayetano Heredia (UPCH), where they will constitute a palynological reference collection of the Peruvian *Lomas*. A replica of all samples will also be available for public access at the Herbario Sur Peruano (HSP) of the Instituto Científico Michael Owen Dillon (IMOD) in Arequipa, the region where the most diverse *Lomas* (Atiquipa) is located.

2.3. Palynomorph characterization: Imaging, description, and morphometric measurements

Pollen and spores were described and photographed using a Nikon Eclipse Ci microscope and a TOUPCAM™ E3ISPM camera at 40X and 100X magnification. We attempted to capture images from polar and equatorial views for pollen grains and proximal and distal views for spores. To ensure consistent terminology in our descriptions, we used Punt et al. (2007) as our primary glossary reference. Palynomorph sizes were classified according to Erdtman (1952). Morphometric information complementing our descriptions was obtained by taking measurements of at least twenty individuals (n=20) per taxa (Appendix 2). These measurements included taxonomic characters such as the length and width ranges of palynomorphs, aperture length, wall thickness (exine or sclerine), and sculptural elements among others. Some of these characters were measured by using the ToupView software for more exactitude on the smallest structures. Additionally, we followed descriptive parameters from Heusser (1971), Silva-Caminha et al. (2010) and Fontes et al. (2020), who compared morphological characteristics with related taxa. Appendix 3 contains a summary table detailing key morphological features. High resolution photos of any specimen are available upon request.

3. Results

This catalog describes 202 palynomorph types belonging to 200 species, 194 genera and 76 families. Typically, each genus corresponds to at least one palynomorph. However, exceptions include *Melochia* and *Waltheria* within the Malvaceae family, which are heterostylous species, each having two pollen types. Species are alphabetically organized according to family and genus names, starting with gymnosperms (n=1 species), followed by angiosperms (n=180 species), and concluding with pteridophytes (n=19 species). Palynological descriptions are presented in the following order: species name, unit, symmetry, polarity, shape and amb, palynomorph size, exine or sporoderm details, and aperture details, concluding with notable key morphological remarks. We have added an indication next to the names of endemic species and when describing the palynological features of a species for the first time (n=114; Appendix 1), to the best of our knowledge. In addition to the positively recovered and described palynomorphs, 51 additional herbarium specimens yielded negative results (Appendix 1). Appendix 3 contains a summary table detailing key morphological features per specimen, which serve as a search index by morphology.

3.1. Palynological descriptions

GYMNOSPERMS

EPHEDRACEAE Dumort.

Species: *Ephedra americana* Humb. & Bonpl. ex Willd. (Plate 1, 1-5)

Description: Monad, bilateral symmetry, apolar, circular amb, ellipsoidal outline in equatorial view, prolate shape. Medium size (25-35 μm). Eutectate exine of 1 to 1.3 μm thick. Slightly visible nexine. Tectum of 0.5 to 0.7 μm thick. Inconspicuous columellae. Plicate, 10 to 12 plicae extending from pole to pole, and 5 to 6 μm wide. Plicae's surface is psilate. Inaperturate.

Remarks: Ellipsoidal outline. Inaperturate. There are weak exine zones between plicae, almost looking like a "pseudo-colpi".

ANGIOSPERMS

ACANTHACEAE Juss.

Species: *Dicliptera tomentosa* (Vahl) Nees. (ex-*Dicliptera ruiziana*) (Plate 1; 6-10)

-Endemic species for Peru-

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate to perprolate shape. Medium to large size (35-56 μm). The exine is semitectate, about 3 μm thick, with conspicuous columella ranging from <1 to 1.5 μm , tectum of about 1 μm . The ornamentation is reticulate heterobrochate, with lumina getting smaller towards the apocolpium. Muri reduce its thickness in the same direction. Tricolporate. Simple ectocolpi about 35 to 50 μm long and 7 to 12 μm wide, reaching the apocolpium zone, with rounded endings. Circular to slightly lalongate endopores, about 5 to 10 μm wide. Parallel to colpori, there are weakened exine zones ("pseudocolpi") on each side of the aperture. Pseudocolpi are as long as colpori but narrower, 2 to 3 μm wide.

Remarks: Elliptical outline. Medium to large size. Reticulate, heterobrochate. Tricolporate with one pseudocolpi each side the aperture. This is the only morphotype within the *Lomas* flora that is reticulate and has two pseudocolpi features along each aperture.

Species: *Dyschoriste repens* (Nees) Kuntze (Plate 1; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Medium to large size (45-57 μm). Exine is tectate perforate, about 2 to 2.2 μm thick. Slightly visible nexine (0.5 μm). Tectum is 0.5 μm thick.

Conspicuous columellae of 1 to 1.2 μm high. Punctate. Luminae 0.5 μm wide or less.

Tricolporate. Simple ectocolpi about 30 to 45 μm long and 3 to 4 μm wide, reaching the apocolpium zone, with acute endings. Circular endopores, 4 to 5 μm of diameter. At the mesocolpium, there are 5 to 6 “pseudocolpi” parallel to the apertures, giving the grain an appearance of having plicae or being heterocolpate. Pseudocolpi are about 1 μm wide.

Remarks: Elliptical truncate outline. Medium to large size. Punctate. Tricolporate with pseudocolpi (5-6) in between. Number of pseudocolpi between apertures (5 - 6), in conjunction with the punctate ornamentation are diagnostic characteristics for this genus (within the *Lomas* flora).

AIZOACEAE Martinov

Species: *Sesuvium portulacastrum* (L.) L. (Plate 1; 16-20)

Description: Monad, radial symmetry, isopolar, circular amb, prolate shape. Small to medium size (20-30 μm). Semitectate exine, about 1 to 1.2 μm thick. Tectum of 0.5 μm , columellae conspicuous, about 0.5 μm high. Punctate. Puncta ranges from 0.5 to 0.8 μm wide, fusing at the apocolpium zone, where wider lumina are found. Smaller lumina occur in the mesocolpium zone. Tricolpate. Simple colpi and pontoperculate, reaching the apocolpium zone, its length ranges from 17 to 28 μm long, and its width, 5 to 8 μm wide. Colpi with irregular margins. The pontoperculum is ornamented (punctate) but is not always preserved.

Remarks: Small to medium size. Punctate, wider puncta at the apocolpium zone and narrow towards the aperture. Tricolpate. Pontoperculate.

Species: *Tetragonia crystallina* L'Hér. (Plate 1; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, spheroidal shape. Medium size (28-33 μm). Semitectate exine, 2 to 2.2 μm thick. Slightly visible nexine (0.5 μm). Tectum is 0.5 to 0.7 μm thick, columellae conspicuous, 0.8 to 1 μm high. Foveolate. Foveolae of variable width, about 0.7 to 2 μm wide, spread uniformly across the surface. Tricolpate. Colpi is marginate, about 18 to 22 μm long and 3 to 5 μm wide.

Remarks: Medium size. Foveolate. Lumina of variable size widespread across the whole surface. Tricolpate.

ALSTROEMERIACEAE Dumort.

Species: *Alstroemeria paupercula* Phil. (ex-*Alstroemeria violacea*) (Plate 1; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Large size (60-95µm). Eutectate exine, getting slightly thicker towards the equator, about 2 to 2.3 µm thick. Visible nexine of 0.5 µm thick. Tectum about 0.5 to 0.7 µm thick. Conspicuous columellae of 1 µm high. Striate. Striae concentrically arranged from the equator to poles. Monosulcate. Sulcus is marginate, as large as the grain itself, ranging from 50 to 90 µm long and 3 to 5 µm wide. Sulcus with irregular margins and rounded ending.

Remarks: Large size. Heteropolar, ellipsoidal amb, reniform shape. Thick exine. Unique monocotyledonous pollen grain with striate ornamentation within the analyzed *Lomas* flora. Large-size grain. Striae form unusual and irregular projections.

Species: *Bomarea ovata* (Cav.) Mirb. (Plate 1; 31-35)

-Endemic species for the Atiquipa *Lomas*-

Description: Monad, bilateral symmetry, ellipsoidal amb, reniform shape. Medium to large size (40-70 µm). Semitectate exine is about 2 µm thick. Visible nexine about 0.5 µm thick. Tectum is about 0.5 µm thick. Conspicuous columellae are about 1 µm high. Exine gets thicker towards the equator. Reticulate heterobrochate, lumina with irregular shapes, ranging from 1 to 2 µm wide, with muri of 0.5 to 0.7 µm wide. Luminae get narrower towards the aperture and the poles. Monosulcate. Slightly marginate sulcus with irregular borders, passing to the distal face (longicolpate). Sulcus ranges from 38 to 60 µm long and 4 µm wide.

Remarks: Wider lumina and thicker exine towards the equator. Sulcus length, reaching distal face (longicolpate).

AMARANTHACEAE Juss.

Species: *Alternanthera halimifolia* (Lam.) Standl. ex Pittier (Plate 1; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size grain (10-15 µm). Semitectate exine about 2 µm thick. Tectum of 1 µm thick, conspicuous columella ranging from 0.5 to 0.8 µm high. Lophate, metareticulate (each aperture is enclosed by the lumina's murus). Luminae resemble a pentagonal to hexagonal shape, of 4 to 5 µm width. Simplecolumellate muri of 1 µm wide, with compactly arranged columellae. Pantoporate (20-25 pores), with small circular pore per lumina. Pores are almost filling the lumina space, having 3.5 to 4 µm in diameter.

Remarks: Small size. Lophate. The relation between each laguna and the apertures resembles a metareticulate condition. However, the murus of the lophae is more compact and homogenous in shape than in the case of *Kallstroemia* and *Tribulus* (see Zygophyllaceae family). Pantoporate (20-25 pores).

Species: *Amaranthus spinosus* L. (Plate 2; 1-5)

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size (10-15 μm). Eutectate exine of 1 to 1.2 μm thick. Not visible nexine. Tectum of 0.5 to 0.7 μm thick, inconspicuous columellae of less than 0.5 μm high. Exine is slightly depressed around the aperture. Psilate - scabrate. Pantoporate (40-50 pores). Costate circular pores of 2 to 3 μm in diameter. Costa is about 0.7 μm thick. Pores separated by 2 to 3 μm .

Remarks: Small size. Psilate to scabrate. Exine's contour has an "undulated" appearance, given the depression of the exine towards the aperture. Pantoporate (40-50 pores).

Species: *Atriplex imbricata* (Moq.) D. Dietr. (Plate 2; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size (15-20 μm). Semitectate exine of 1.8 to 2 μm thick. Slightly visible nexine of 0.5 μm . Tectum of 1.5 μm thick and conspicuous columellae ranging from 0.8 to 1 μm high. Foveolate. Circular foveolae about 0.7 to 1 μm wide, densely dispersed across the surface. Pantoporate (25 pores). Costate circular pores, about 3 μm in diameter. Costa is 1 μm thick. Pores separated by 3 to 5 μm .

Remarks: Small size. Tectum and costa are thicker than in the case of *Amaranthus*, visible columellae. *Atriplex* has less number of pores and greater distances between apertures. Pantoporate (25 pores).

Species: *Chenopodium petiolare* Kunth (Plate 2; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size (18-20 μm). Eutectate exine, 2 μm thick. Slightly visible nexine of 0.3 to 0.5 μm thick. Tectum 0.5 to 0.7 μm thick, inconspicuous columellae of 1 μm high. Psilate to slightly scabrate. Pantoporate (30 pores). Simple circular pores of 2 μm in diameter. Each pore connects to others by a very thin "path", resulting from a weakening of the exine's thickness. This connection opens the possibility of having a perisyncolporate condition, rather than pantoporate one.

Remarks: Small size. Simple pores. Presence of a “connecting path” between apertures. Likely having a perisyncolporate condition.

Species: *Gomphrena meyeniana* Walp. (Plate 2; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Medium size (28-40 μm). Semitectate exine, about 3 to 4 μm thick. Visible nexine of 0.5 μm . Tectum of 0.5 μm , very conspicuous columellae of 1.5 to 2.5 μm height. Lophate, metareticulate. Lophae are 4 to 6 μm wide, with a pentagonal to hexagonal shape. Some grains that experience turgidity may display lophae of irregular shapes. Simplicolumellate muri is 1.2 μm wide. Pantoporate (20-25 pores). Inconspicuous circular pores of 4 to 5 μm in diameter, having almost the same size as the lumina.

Remarks: Medium size. Lophate, metareticulate. In contrast to *Alternanthera*, this grain is larger, exine has a less compacted appearance.

Species: *Guilleminia densa* (Willd. ex Schult.) Moq. (Plate 2; 21-25)

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size (15-20 μm). Semitectate exine of 1.8 to 2 μm thick. Visible nexine of 0.3 to 0.5 μm . Tectum is 0.5 μm thick. Columellae ranges from 0.5 to 0.7 μm high. Lophate and metareticulate. Lophae are 3 μm wide, with variable shapes varying from circular to hexagonal shapes. Simplicolumellate muri, with a compact appearance of about 1 μm thick. Pantoporate (50 pores). Simple, small circular pores, ranging from 1 to 1.5 μm in diameter. Pores are inconspicuous.

Remarks: Small size. Lophate, metareticulate. In contrast to *Alternanthera* and *Gomphrena*, this pollen grain has more lacunae, smaller muri and high number of pores.

AMARYLLIDACEAE J.St.-Hil.

Species: *Clinanthus incarum* (Kraenzl.) Meerow (Plate 2; 26-30)

-Endemic species for Peru-

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Large size (50-75 μm). Semitectate exine, about 1.5 μm thick. Exine thickness increases towards the distal face of the grain, due to an increase of columellae. Tectum of 0.5 to 0.7 μm high, conspicuous columellae of 1 to 1.2 μm high. Reticulate, heterobrochate. Lumina are 0.5 to 5 μm wide, with irregular shapes and getting smaller toward the axes of the grain, turning into small puncta of about 0.5 μm wide. Change in lumina's size is sharp, and occurs close to the

margin. Simplicolumellate muri is about 0.7 μm wide. Monosulcate. Simple sulcus, about 45 to 65 μm long and 3 to 5 μm wide. Not found in polar view.

Remarks: Large size. ellipsoidal amb, reniform shape. Reticulate, heterobrochate. Simplicolumellate. Morphotype similar to *Bomarea* (Alstroemeriaceae) but differing in exine thickness and lumina/muri ratio. *Clinanthus* has wider luminae.

Species: *Ismene amancaes* (Ruiz & Pav.) Herb. (Plate 2; 31-35)

-Endemic species for Peru-

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Very large size (110-125 μm). Semitectate exine of 5 to 6 μm , losing thickness toward the axes of the grain, reaching 1 μm of thickness at that point. Conspicuous nexine at the lateral axes. Tectum ranges from 1 μm at the axes to 3 to 3.5 μm thick at the central part of the grain. Conspicuous columellae, varying in shape and size from baculae of 1 μm high to clavae of 2 μm high. Reticulate, with free-standing columella looking like a bacula of 2 μm high. Simplicolumellate muri of 2 μm thick and very irregular shape. The lumina's width is about 1 to 5 μm with very irregular shapes. Ornamentation changes are abrupt, occurring close to margins. Monosulcate. Inconspicuous sulcus, ranging from 75 to 90 μm in length and about 5 to 7 μm wide.

Remarks: Very large size. Reticulate, heterobrochate. Luminae's decreasing towards the lateral axes of the grain, leaving only free-standing columellae or bacula-like structures, which get thinner towards the poles.

Species: *Allium neapolitanum* Cirillo (ex-*Nothoscordum inodorum*) (Plate 2; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (32-40 μm). Semitectate exine, homogeneously thick, about 1 to 1.2 μm thick. Slightly visible nexine of 0.5 μm . Tectum is 0.5 μm thick and the conspicuous columellae are 0.5 to 0.7 μm high. Reticulate (slightly heterobrochate). Lumina are about 0.5 to 1 μm wide, sometimes getting smaller towards the aperture. Simplecolumellate muri, 0.5 μm thick or even less. Monosulcate. Simple irregular sulcus, 28 to 37 μm long and about 6 to 8 μm wide.

Remarks: Large size. Reticulate (slightly heterobrochate). Among the reticulated monocotyledonous pollen grains, *Nothoscordum* has the smoother reticula shape and the smallest lumina/muri ratio.

Species: *Pyrolirion tubiflorum* (L'Hér.) M.Roem. (Plate 3; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Large size (70-80 μm). Semitectate exine, about 2 μm thick. Very thin nexine. Tectum is 1 to 1.2 μm thick. Columella are about 1 to 1.3 μm high. Reticulate and slightly heterobrochate. Lumina of irregular shapes, wider at the equator (4 to 5 μm) and getting smaller close to the axis (about 2 μm wide). Simplecolumellate muri, about 1 μm thick. Monosulcate. Marginate sulcus of 62 to 70 μm long and 5 μm wide. Not found in polar view.

Remarks: Large size. heteropolar, ellipsoidal amb, reniform shape. Reticulate, (slightly) heterobrochate. Lumina with irregular shapes. Lumina size does not reduce as much as in *Clinanthus*.

Species: *Stenomesson miniatum* (Herb.) Ravenna (Plate 3; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Large size (60-65 μm). Semitectate exine of 1 to 1.5 μm thick, getting slightly thicker towards the axis. Slightly visible thin nexine (0.2 μm). Tectum is 0.5 μm thick, conspicuous columellae of 0.8 to 1 μm high, reducing in size towards the axes. Reticulate heterobrochate. Lumina's width is about 3 to 4 μm in the central part of the grain, and gets considerably smaller towards the axis, approximately 1 μm . Lumina with irregular shapes. Simplicolumellate thin muri of 0.5 μm wide. Monosulcate. Marginate sulcus of 50 to 62 μm long and 2 to 3 μm wide, exceeding the proximal face of the grain, with acute endings.

Remarks: Large size. heteropolar, ellipsoidal amb, reniform shape. Reticulate heterobrochate. Lumina gets considerably smaller towards the axis. Morphology similar to *Clinanthus* (Amaryllidaceae).

ANACARDIACEAE R.Br.

Species: *Schinus molle* L. (Plate 3; 11-15)

Description: Monad, radial symmetry, isopolar, subtriangular amb, oblate spheroidal shape. Small to medium size (20-25 μm). Eutectate exine, about 1 to 1.5 μm thick. Visible nexine. Tectum is 0.5 μm thick. Visible but indistinct columellae of 0.8 to 1 μm high. Striato-reticulate, striae are 0.3 to 0.5 μm thick, running from pole to pole, and forming small lumina of about 0.3 to 0.8 μm wide. Tricolporate. Marginate ectocolpi, reaching the poles (18 to 20 μm long and 3 to 4 μm wide), with rounded endings. Ectocolpi have a characteristic exine thickening at the apocolpium zone. Lalongate endoapertures, costate, 7 to 10 μm wide and 3 μm high. Exine separates towards the endoaperture, forming a fastigium about 0.7 to 1 μm high, which in polar view gives the grain an internal circular shadow.

Remarks: Small size. Exine thickening in polar view. Striato-reticulate. Ectocolpi with a thickening at the apocolpium zone. Tricolporate. Fastigiate.

APIACEAE Lindl.

Species: *Daucus montanus* Humb. & Bonpl. ex Schult. (Plate 3; 16-20)

Description: Monad, radial symmetry, isopolar, prolate shape. Medium size (25-35 μm). Tectate perforate exine, about 1.5 to 2 μm thick. Visible nexine (1 μm). Tectum about 0.3 to 0.5 μm thick. Conspicuous columellae of 0.5 μm . Punctate. Circular puncta of 0.3 to 0.6 μm in diameter. Tricolporate. Marginate brevicolpi are 17 to 22 μm long and 2 μm wide, not reaching the apocolpium zone, with acute endings. Costate lalongate endopores, about 3 μm high 5 to 6.5 μm wide. Endocosta gives the grain an “ear-like” appearance in equatorial view. Not found in polar view.

Remarks: Medium size. Aperture morphology (brevicolpate and endocostate ear-like appearance). Also, the well-marked punctate pattern, in contrast to other observed Apiaceae genera, permits to identify *Daucus*. Tricolporate, margined brevicolpi.

Species: *Domeykoa amplexicaulis* (H. Wolff) Mathias & Constance (Plate 3; 21-25)

-Endemic species for Arequipa, Peru-

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, prolate shape. Medium size (28-35 μm). Tectate perforate exine, about 1.3 μm thick. Visible nexine about 0.5 μm . Tectum is 0.5 μm thick. Conspicuous columellae of about 0.5 to 0.7 μm high. Punctate. Circular puncta less than 0.5 μm wide. Tricolporate. Marginate ectocolpi of about 26 to 32 μm long and 1.5 to 2 μm wide. Colpi almost reach the apocolpium zone. Costate lalongate endopores of 3 μm high and 5 to 6 μm width. Not found in polar view.

Remarks: Medium size. Prolate. Punctate ornamentation, being less conspicuous than in *Daucus*. Tricolporate. Colpus length (almost reaching the apocolpium zone).

Species: *Eremocharis ferreyrae* Mathias & Constance (Plate 3; 26-30)

-Endemic species for Arequipa, Peru-

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, prolate shape. Medium size (27-33 μm). Tectate perforate exine about 1.3 μm thick. Slightly visible nexine. Tectum is about 0.7 μm thick. Conspicuous columellae of 0.5 μm high. Punctate. Circular puncta are less than 0.5 μm

in diameter. Tricolporate. Marginate ectocolpi of 25 to 28 μm long and about 1 to 2 μm wide. Colpi run over 2/3 of the grain surface. Costate lalongate endopores of 3 μm high and 6 to 8 μm wide. The protuberance formed by the endopore is poorly pronounced. Not found in polar view.

Remarks: Medium size. Prolate. Tricolporate. The protuberance formed by the endopore is less pronounced in contrast to *Domeykoa*. Colpi length, being larger than in *Daucus* but shorter than in *Domeykoa*.

Species: *Eryngium foetidum* L. (Plate 3; 31-35)

Description: Monad, radial symmetry, isopolar, truncate ellipsoidal outline in equatorial view, prolate shape. Medium size (35-40 μm). Tectate perforate exine, of 1.3 μm thick. Slightly visible nexine. Tectum is about 0.7 μm thick. Slightly conspicuous columellae about 0.5 μm high. Punctate. Circular puncta of less than 0.5 μm diameter. Tricolporate. Marginate ectocolpi of 30 to 36 μm long and about 0.5 to 1 μm wide. Ectocolpi reach the apocolpium zone. Costate lalongate endopores about 2 to 3 μm high and about 6 to 10 μm wide. Not found in polar view.

Remarks: Medium size. Truncate ellipsoidal outline in equatorial view, prolate shape. Tricolporate. Ectocolpi's length.

APOCYNACEAE Juss.

Species: *Asclepias curassavica* L. (Plate 3; 36-40)

Description: Pollinium, bilateral symmetry, heteropolar, ovate and "tear-like" shape. Pollinium length is 920 to 970 μm ; and its width is about 330 to 350 μm . Corpusculum oblong and heart-shaped, smooth surface, about 410 μm long and 200 μm wide. The caudicles are attached at the back of the corpusculum and are 700 to 715 μm long. The pollen cell is symmetrical, apolar, circular amb, spheroidal shape. Large size (80-85 μm). Eutectate exine, about 3 μm thick. Visible nexine of 1 μm thick. Tectum about 1 μm thick. Inconspicuous columellae. Psilate to scabrate. Inaperturate.

Remarks: Large pollinium, compacted pollen grains show a more spherical shape compared to *Philibertia*. Individual grains are psilate to scabrate and inaperturate.

Species: *Philibertia solanoides* Kunth (Plate 4; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Pollinium, bilateral symmetry, heteropolar, ovate and "tear-like" shape. Pollinium length is 550 to 570 μm ; and its width is about 100 μm . Corpusculum oblong and arrow-shaped, rugate surface, about 200 μm long and 110 μm wide. The caudicles are

attached laterally to the corpusculum, its surface is verrucate and are about 50 μm long. The pollen cell is asymmetrical, apolar, irregular amb, and irregular shape. Medium size pollen grains (40-50 μm). Eutectate exine, about 2.5 to 3 μm thick, inconspicuous columellae. The exine ornamentation is psilate to scabrate. Pollen grains are inaperturate.

Remarks: Smaller pollinium than *Asclepias*, differing in point of attachment of the claudicles, the shape of the corpusculum, ornamentation of claudicles and corpusculum, and the asymmetrical shape of pollen grains. Individual grains are psilate to scabrate and inaperturate.

ASPARAGACEAE Juss.

Species: *Echeandia eccremorrhiza* (Ruiz & Pav.) ined. (ex-*Anthericum eccremorrhizum*) (Plate 4; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, ellipsoidal amb, reniform shape. Large size (55-60 μm). Semitectate exine, about 1 μm thick. Not visible nexine. Tectum is 0.3 μm thick. Small conspicuous columellae of 0.5 μm high. Reticulate heterobrochate. Irregular lumina of 0.5 to 1 μm wide, getting smaller towards the lateral axes, turning into small puncta. Simplicolumellate muri of 0.5 μm wide. Monosulcate. Marginate sulcus with rounded endings, about 46 to 50 μm long and 5 to 7 μm wide.

Remarks: Large size. Reticulate heterobrochate. Thin exine compared to other monocotyledonous pollen grains observed within the *Lomas*. Marginate monosulcus with rounded endings.

Species: *Furcraea andina* Trel. (Plate 4; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Tetrad, radial symmetry, ellipsoidal amb, decussate shape. Pollen grains of medium to large size (65-78 μm). Semitectate exine, about 3.5 μm thick. Visible nexine of 1 μm thick. Tectum is about 1.5 μm thick and conspicuous columellae of 2 to 2.3 μm high. Reticulate heterobrochate. Irregular lumina of 2 to 5 μm wide getting slightly smaller towards the aperture (1 μm). Simplicolumellate muri of 1.2 to 1.5 μm . Monosulcate. Irregular simple sulcus, with rounded endings, is about 53 to 60 μm long and 7 to 10 μm wide.

Remarks: Tetrad. Within the Asparagaceae family, it is the only specimen for the *Lomas* flora that presents pollen in tetrads as dispersal units. Medium to large size grains. Thick exine. Reticulate heterobrochate ornamentation pattern.

Species: *Oziroë biflora* (ex-*Fortunate biflora*) (Ruiz & Pav.) Speta (Plate 4; 16-20)

Description: Monad, bilateral symmetry, ellipsoidal amb, reniform shape. Large size (50-60 μm). Semitectate exine about 1.5 μm thick. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Reticulate heterobrochate. Circular lumina, varying in size from 0.7 to 2 μm . Luminae turn into small foveolae towards the aperture. Some wider lumina are randomly dispersed between the small ones. Simplicolumellate muri about 0.5 μm wide. Monosulcate. Simple irregular sulcus, which has almost the length of the grain, about 47 to 50 μm long and 5 μm wide. Sulcus gets narrow at the center of the grain.

Remarks: Large size. Rounded shape lumina; with scarce wider lumina in contrast to the densely dispersed smaller ones. Monosulcate. Simple irregular sulcus. . Differs from *Anthericum* in the ornamentation pattern.

Species: *Pasithea caerulea* (Ruiz & Pav.) D.Don (Plate 4; 21-25)

Description: Monad, radial symmetry, heteropolar, subtriangular amb, triangular obtuse convex in equatorial view, oblate shape. Medium size (30-35 μm). Semitectate exine of 1.3 to 1.5 μm thick. Slightly visible thin nexine of 0.3 to 0.5 μm . Exine gets slightly thicker towards the mesocolpium zone. Tectum is about 0.5 μm thick. Conspicuous columellae of 0.5 μm high. Reticulate heterobrochate. Lumina of 0.7 to 1.2 μm wide, getting smaller towards the aperture and at the center of the distal face. Trichotomosulcate. Simple sulcus. Each arm of the sulcus is about 12 to 15 μm long and 4 to 5 μm wide, getting narrower toward the endings. Sulcus forms an arrow-like shape.

Remarks: Medium size. Subtriangular amb. Equatorial outline is triangular obtuse convex. Trichotomosulcate with simple sulcus. Trichotomosulcate. Simple sulcus. Aperture features and ornamentation pattern are diagnostic characteristics for this genus.

ASTERACEAE Bercht. & J.Presl

Species: *Acmella ciliata* (Kunth) Cass. (Plate 4; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical in equatorial view, prolate spheroidal shape. Medium size (27-32 μm). Tectate perforate exine, about 2 μm thick. Visible nexine of 1 μm thick. Tectum is less than 0.5 μm thick. Conspicuous columellae of about 0.7 μm high. Echinate. Pointed pluricolumellate echinae of 4 to 5 μm high, with hook-like shape. Very thin at the top and wider at the base (3 μm). Exine surface between the base of the echinae is punctate (0.5 μm). Tricolporate. Simple ectocolpi of 17 to 20 μm long and 3 to 7 μm wide with acute endings. Simple elongate endopores of 4 to 5 μm high and 8 to 9 μm wide. Endopores are not conspicuous at equatorial view.

Remarks: Medium size. Echinate with a punctate interechinae surface. Echinae in *Acmella* are very thin, with hook-like shape at their tips.

Species: *Artemisia absinthium* L. (Plate 4; 31-35)

Description: Monad, radial symmetry, circular amb, elliptical in equatorial view, oblate shape. Small size (15-18 μm). Eutectate exine, about 3 to 4 μm thick. Visible nexine. Tectum is 1.2 to 1.5 μm thick and the columella are 1.5 μm high. Exine's thickness decreases towards the apertures. Microechinate, each echinus is less than 0.5 μm high. Tricolporate. Simple irregular ectocolpi of 12 to 15 μm long, with rounded endings, reaching the apocolpium zone. Lalongate endopores slightly costate, about 3 μm high and 5 to 6 μm wide.

Remarks: Small size. Microechinate ornamentation, as well as the costate endopore are diagnostic characters for this genus. This morphotype is not the usual for the Asteraceae family. *Ophryosporus* is similar in shape, differing in length of the echinae and the costate endopore.

Species: *Bidens pilosa* L. (Plate 4; 36-40)

Description: Monad, radial symmetry, circular to slightly subtriangular amb, elliptical in equatorial view, prolate spheroidal shape. Small size (20-25 μm). Eutectate exine, about 2 to 3 μm thick. Visible nexine of 0.5 μm . Tectum is 0.5 μm thick. Columella of 1 to 2 μm high. Echinate. Conical echinae of 2 μm high and 1.5 μm wide at its base, also pluricolumellate; separated from each other by 2 to 3 μm . Tectum surface between echinae is scabrate. Tricolporate. Simple brevicolpi of 13 to 18 μm long and 3 to 4 μm wide, with acute endings. Costate lalongate endopores, laterally acute, resembling an "eye". Endopores of 3 μm high and 5 to 6 μm wide.

Remarks: Small size. circular to slightly subtriangular amb. Echinate. Tricolporate. Conspicuous endopore, resembling an "eye" in conjunction with the ectocolpi.

Species: *Burnellia fasciculata* (Wedd.) Mesfin & D.J. Crawford (ex-*Coreopsis fasciculata* Wedd.) (Plate 5; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical to elliptical truncate outline in equatorial view, prolate spheroidal shape. Medium size (25-30 μm). Eutectate exine of 2.2 to 2.5 μm thick. Visible nexine. Tectum of 1 μm thick. Conspicuous columellae of 1.5 to 2 μm high. Echinate. Conical pluricolumellate echinae (4 to 5 columellae). Echinae are 4 to 5 μm high, broad at the base gradually tapering towards the apex with a more or less acute tip, about 3 to 4 μm high. Surface between echinae is punctate. Tricolporate. Irregular and slightly marginate ectocolpi of 17 to 20 μm getting narrow towards the apocolpium zone. Ectocolpi running along 2/3 of the grain. Simple circular endopores of 4 to 6 μm in diameter.

Remarks: Small size. Elliptical to elliptical truncate outline in equatorial view. Conical shape of the echinae with 4 to 5 columellae at the base. Tricolporate. Marginate irregular ectocolpi.

Species: *Cotula australis* Hook. F. (Plate 5; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, triangular obtuse convex amb, circular to elliptical outline in equatorial view, prolate spheroidal shape. Small to medium size (20-26 μm). Eutectate two-layered exine of variable thickness (2 to 3.5 μm). Visible nexine about 0.2 to 0.5 μm . Tectum is 0.5 to 0.7 μm thick. Conspicuous digitate columellae of variable height (1 to 2.8 μm). Columellae strongly decrease in size towards the aperture. Echinate. Conical pluricolumellate echinae (5 to 7 columellae). Echinae about 2.5 to 3 μm long and 2 μm wide at the base. Psilate surface between echinae. Columellae's capita are notoriously conspicuous and spread across the surface, giving the appearance of a negative reticulum. Tricolporate. Simple irregular ectocolpi of 15 to 18 μm long and 4 to 5 μm wide. Long ectocolpi, even reaching the apocolpium zone. Constricted circular endopores of 3 to 4 μm in diameter. Inconspicuous endopores in equatorial view.

Remarks: Small size. Triangular obtuse convex amb. Tricolporate. Constricted endopores. This genus exhibits characteristic ornamentation and exine patterns among representatives of the Asteraceae family found in the *Lomas* flora.

Species: *Flaveria bidentis* (L.) Kuntze (Plate 5; 11-15)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, spheroidal shape. Medium size (25-28 μm). Tectate perforate exine, about 3 μm thick. Tectum of 1 μm thick. Conspicuous columellae of 1.5 μm high. Echinate. Conical pluricolumellate echinae of 3 to 4 μm high and 3 μm wide, with a circular hollow space at the center of the echinae's base. Surface between echinae is punctate. Tricolporate. Simple irregular long ectocolpi about 15 to 18 μm long and 5 to 6 μm wide. Ectocolpi with acute endings. Circular simple endopores of 4 to 6 μm in diameter.

Remarks: Medium size. Echinate. The hollow circular space at the center of the echinus base is a diagnostic feature for this genus. Tricolporate.

Species: *Grindelia glutinosa* (Cav.) Mart. (Plate 5; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Medium size (27-32 μm). Tectate perforate exine, about 3 to 3.2 μm thick. Visible nexine. Tectum is 1 μm thick. Conspicuous columellae of 1 to 1.2 μm high.

Echinate. Pluricolumellate echinae of 4 μm wide at its base and 4 to 5 μm long. Echinae get thinner towards the tip (1 μm wide), remembering the shape of the Eiffel's Tower. Each echinus has 3 to 5 columellae at its base. Tricolporate to syncolporate. Simple irregular ectocolpi of 25 to 32 μm long and 3 to 5 μm wide, getting narrow towards the ending. Some grains can be syncolporate. Circular endopores of 4 to 5 μm in diameter.

Remarks: Medium size. Tricolporate to syncolporate. Echinate. Echinae's shape (resembling the Eiffel's Tower).

Species: *Onoseris odorata* Hook. & Arn. (Plate 5; 21-25)

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, triangular to lobate amb, elliptical outline in equatorial view, perprolate shape. Large size (65-77 μm). Eutectate exine of 5 to 6 μm thick. Visible nexine. Tectum is 2 to 2.5 μm thick. Digitate columellae of 2 to 3 μm high, decreasing in size towards the aperture and the apocolpium zone. Microechinate. Microechinae broad at the base with a blunted tip (0.5 to 0.7 μm high) sparsely spread across the surface. Fossulate. Fossulae are 1 μm wide and about 3 to 5 μm long. Longer fossulae are placed at the intercolpium zone. Tricolporate. Long marginate ectocolpi of 45 to 55 μm long and 2 to 5 μm wide. Margo with psilate surface. Endoaperture is inconspicuous due to the thick pollen wall (constricted pore). Difficult to find a perfect polar view.

Remarks: Large size. Lobate amb. Microechinate. Tricolporate. Along with *Trixis*, this is the other perprolate Mutiosioid (Asteraceae) pollen grains. In contrast to *Trixis*, the exine is thicker in *Onoseris*, microechinate.

Species: *Ophryosporus peruvianus* (J.F.Gmel.) R.M.King & H.Rob. (Plate 5; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, oblate spheroidal shape. Small size (14-17 μm). Eutectate exine, about 3 to 3.2 μm thick. Visible nexine of 0.5 μm thick. Tectum is 1 μm thick. Columellae are 1.5 to 1.8 μm high. Cavate exine. Microechinate. Echinae are less than 0.5 μm high. The space between echinae is psilate. Echinae gives an undulated appearance to the exine's contour. Echinae's morphology is difficult to characterize given their size. Tricolporate. Marginate ectocolpi of 3 to 4 μm wide and 12 to 15 μm long with acute endings. Ectocolpi run 2/3 of the grain. Costate alongate endopores of 2 μm high and 4 to 5 μm wide.

Remarks: Small size. Cavate. Microechinate. Echinae gives an undulated appearance to the exine's contour. Space between echinae is psilate.

Species: *Philoglossa peruviana* D. C. (Plate 5; 31-35)

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, spheroidal to oblate shape. Medium size (30-38 μm). Eutectate exine of 2.5 to 3 μm thick. Visible nexine. Tectum about 0.7 to 1 μm thick. Conspicuous columellae of 1 to 1.5 μm high. Exine of variable size, due to columellae increase at the base of the echinae. Echinate. Thorn-like shaped echinae of 4 to 5 μm long, wider at the base (4 μm), getting strongly narrow towards the tip. Each echinus is supported concentrically by 6 to 7 columellae. Space between echinae is psilate. Tricolporate. Simple irregular ectocolpi of 18 to 25 μm long and about 5 to 8 μm wide. Ectocolpi endings are rounded and wide open. Simple circular endopores about 6 to 7 μm in diameter. Endopores are difficult to notice.

Remarks: Medium size. Echinate. Echinae's shape with a thickening of the exine under each echina. Columellae concentrically organized at the base of each echinus. Tricolporate.

Species: *Polyachyrus annus* I.M.Johns (Plate 5; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, circular elliptical outline in equatorial view, spheroidal shape. Medium size (25-33 μm). Eutectate exine of 3.5 μm thick. Visible thick nexine. Tectum of 0.5 μm . Conspicuous columellae of 2.5 to 3 μm high, decreasing in size towards the aperture, increasing at the mesocolpium and apocolpium (crescentic). Fossulate. Larger fossulae are located at the mesocolpium zone, about 2 to 2.5 μm long and 1 μm wide, while the smaller fossulae, at the apocolpium zone are about 1 to 1.5 μm long. Tricolporate. Marginate ectocolpi of 5 to 7 μm wide and 22 to 27 μm long with rounded endings. Simple lalongate endopore, about 2 μm high and 4 to 6 μm wide.

Remarks: Medium size. Circular amb. Circular elliptical outline. Exine thickening pattern (crescentic). Fossulate ornamentation. Columellae decreasing in size towards the aperture, increasing at the mesocolpium and apocolpium (crescentic).

Species: *Proustia cuneifolia* D.Don (Plate 6; 1-5)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, oblate spheroidal shape. Medium size (38-45 μm). Eutectate exine about 3.5 to 5 μm thick. Visible nexine (1 μm). Tectum is 1 μm thick. Conspicuous columellae about 2 to 3 μm high. Columellae decrease towards the apertures and the apocolpium. Fossulate. Larger fossulae (2 to 3 μm long and 1 μm wide) are mainly located at the mesocolpium zone, and the smaller ones (1.5 μm long) are placed at the apocolpium zone. Tricolporate. Marginate ectocolpi with rounded endings, about 32 to 42 μm long and 4 to 6 μm wide. Colpi almost reach the apocolpium zone. Costate lalongate endopores of 4 to 5 μm high and 8 to 12 μm wide, with the extremes of each pore being acute. Endopore generate a triangular shadow inside the grain.

Remarks: Medium size. Exine thickness pattern. Similar morphology to *Polyachyrus* but differing in mean size and density of the fossulae. Endopore generate a triangular shadow inside the grain. Tricolporate. Endopore generate a triangular shadow inside the grain.

Species: *Lomanthus mollendoensis* (Cabrera) B.Nord. (ex-*Senecio mollendoensis*) (Plate 6; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

-Endemic species for the Atiquipa Lomas (Arequipa, Peru)-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Medium size (30-37 μm). Tectate - perforate exine of 2 to 2.5 μm thick. Visible nexine. Tectum of 0.5 to 0.7 μm thick. Conspicuous columellae of 1 to 1.5 μm high, slightly reduced towards the aperture (rapid change). Echinulate. Small conical echinae of 2 to 2.5 μm high, wider at the base (3 μm). Scarce echinae. The space between echinae is punctate. Tricolporate to syncolporate. Marginate ectocolpi is 5 to 8 μm wide and 27 to 35 μm long, getting narrow at the apocolpium zone. Simple circular endopore, 5 to 8 μm in diameter. Endopores inconspicuous at equatorial view.

Remarks: Medium size. Tricolporate to syncolporate. Echinulate. Scarce echinae's density. Columellae size reduces towards the apertures and the apocolpium.

Species: *Sonchus oleraceus* L. (Plate 6; 11-15)

Description: Monad, radial symmetry, isopolar, hexagonal amb, rectangular obtuse convex outline in equatorial view, oblate shape. Medium size (27-36 μm). Eutectate exine of 3 μm thick. Visible nexine. Tectum is 0.3 to 0.5 μm thick. Conspicuous thin columellae of 2 μm high. Echinolophate. Small conical echinae of 1.2 to 1.5 μm high and slightly wider at the base (2 μm), getting thinner at the tip (0.7 μm wide). In lateral view, echinae seem to be densely distributed, however in plant view they are sparsely distributed. Rectangular obtuse lophae at the mesocolpium zone, about 9 to 13 μm long and 7 to 10 μm wide, whilst the ones at the apocolpium zones are smaller and square-like, about 3 to 5 μm long and 4 μm wide. However, the abporal lacunae are usually rounded, about 2 to 4 μm wide. Also, the ridges surrounding each lacuna are 2 μm wide. Tricolporate. Marginate ectocolpi of 15 to 20 μm long and 2 to 3 μm wide, getting narrow towards the apocolpium zone. Simple circular endopores of 6 to 8 μm diameter, sometimes slightly lalongate. Difficult to find in equatorial view.

Remarks: Medium size. Echinolophate. Lophae with variable shapes features. Rectangular obtuse lophae at the mesocolpium zone, smaller and square-like at the apocolpium zone. However, abporal lacunae are often rounded.

Species: *Stevia ovata* Willd. (Plate 6; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, spheroidal shape. Small size (18-23 μm). Eutectate exine of 2.5 μm thick. Visible nexine. Tectum of 0.3 to 0.5 μm thick. Slightly conspicuous columellae of 1.5 μm high. Echinulate. Conical homogeneous echinae of 2 μm long, wider at the base (2.5 μm). The distance between each echina is about 2 μm . In lateral view, echinae seem to be densely distributed, however in plant view they are sparsely distributed. Space between echinae is psilate to slightly scabrate. Tricolporate. Marginate ectocolpi of 15 to 20 μm long and 5 μm wide with rounded endings. Lalongate endopores of 3 to 4 μm high and 6 to 7 μm wide, with acute lateral endings.

Remarks: Small size. Conical echinae in *Stevia* are very homogeneous and close to each other in contrast to other specimens from the Asteraceae family. Tricolporate.

Species: *Trixis cacalioides* D.Don (Plate 6; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, perprolate shape. Medium to large size (35-56 μm). Eutectate exine of 3 to 3.5 μm thick, containing two tectum layers (tectum and internal tectum). Visible nexine. "Sexine 1" of 1.2 μm thick, including a tectum of 0.5 μm thick and small conspicuous columellae of 0.5 μm high. "Sexine 2" of 2 to 2.3 μm thick, containing an internal tectum of 0.5 μm thick and large conspicuous columellae of 1.2 to 1.5 μm high. Inner columellae reduce in size towards the apocolpium zone. Fossulate. Larger sinuous to U-shaped fossulae, located at the center of the mesocolpium zone, about 1 μm wide and 2.5 μm long. Fossulae lose length (0.7 to 1 μm wide and 1 μm long) and muri lose width towards the apocolpium zone. Tricolporate. Marginate ectocolpi of 4 to 6 μm wide and 30 to 45 μm long, Margo of 2.5 to 3 μm wide, with scabrate surface. Constricted lalongate endopores of 2 to 3 μm wide and 8 to 12 μm high. Endopores are difficult to notice. Not found in polar view.

Remarks: Medium to large size. Perprolate shape. Presence of a tectum and an internal tectum. Fossulate ornamentation pattern (sinuous to u-shaped fossulae). Large size variability. Wider margo than in *Onoseris*.

Species: *Aldama lanceolata* (Britton) E.E.Schill. & Panero (ex-*Viguiera lanceolata*) (Plate 6; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, spheroidal shape. Small to medium size (20-26 μm). Tectate perforate exine of 2.5 to 3

µm. Visible and thick nexine. Tectum of 0.5 µm thick. Slightly conspicuous columellae of 1 µm high. Echinate. Pluricolumellate conical echinae (4 to 5 columellae) of 4 to 4.5 µm long, also wider at its base (2 to 2.3 µm) with a hollow circular space at the center. Space between echinae is punctate. Tricolporate. Simple ectocolpi of 15 to 18 µm long and 5 to 6 µm wide. Simple lalongate endopores of 3 to 5 µm high and 7 to 8 µm wide, with acute endings.

Remarks: Small size. Thick nexine. Pluricolumellate conical echinae. Similar to *Flaveria*, but the hollow space at the center of the base of the echinae are less wide than in *Vigueria*, also differing in the exine pattern. Tricolporate.

Species: *Villanova oppositifolia* Lag. (ex-*Vasquezia oppositifolia*) (Plate 6; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, oblate spheroidal shape. Small to medium size (20-27 µm). Tectate perforate exine of 2.5 µm thick. Visible nexine (1 µm). Tectum about 0.5 µm thick. Conspicuous columellae of 1 µm high. Echinate. Pluricolumellate conical to hook-shaped echinae of 3 to 4 µm high, wider at the base (3.5 to 4.2 µm). Columellae arranged concentrically at the base of echinae. Space between echinae is punctate. Tricolporate. Marginate ectocolpi of 18 to 22 µm long and 3 to 4 µm wide, getting narrow towards the apocolpium zone. Endopores are lalongate, about 4 to 5 µm high and 8 to 10 µm wide. The extremes of each pore are acute, getting narrow at its ending.

Remarks: Small to medium-size grain. Circular amb. Circular outline in equatorial view. Oblate spheroidal shape. Echinate. Conical to hook-shaped echinae. Space between echinae is punctate. Tricolporate, marginate.

Species: *Wedelia hoffmanniana* Bruns (Plate 6; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, oblate shape. Small size (18-24 µm). Tectate - perforate exine, about 2.5 to 3 µm thick. Visible nexine. Tectum of 0.7 µm thick. Conspicuous columellae of 1 to 1.5 µm high. Echinate. Pluricolumellate conical to thorn-like echinae of 3.2 to 4 µm long. The base of each echinus is about 1.8 to 2 µm wide. Columellae arranged concentrically at the base of the echinae. Space between echinae is punctate. Columellae arranged concentrically at the base of each echinus. Tricolporate and brevicolpate. Simple irregular ectocolpi of 14 to 18 µm long and 2 to 4 µm wide, getting narrow towards the endings. Endopores are circular, about 4 µm of diameter.

Remarks: Small size. Brevicolpate. Echinata. Pluricolumellate conical to thorn-like echinae. Similar to *Flaveria* and *Vigueria* in shape but the ectocolpi are shorter in *Wedelia*.

BEGONIACEAE C.Agardh

Species: *Begonia octopetala* L'Hér. (Plate 7; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Small size (12-22 μm). Eutectate exine of 1 μm thick. Slightly visible nexine. Tectum is 0.5 μm thick. Inconspicuous columellae (less than 0.5 μm high). Striate. Long continuous thin striae (less than 0.5 μm wide). Striae run homogeneously from pole to pole. Ornamentation pattern is subtle. Tricolporate. Slightly marginate ectocolpi with acute endings about 2 to 3 μm wide and 10 to 20 μm long, reaching the apocolpium zone. Costate alongate endopores of 2 to 3 μm high and 4 to 6 μm wide. Exine separates towards the apertures forming small fastigia (0.5 μm high).

Remarks: Small size. Striate, inconspicuous columellae Subtle ornamentation pattern. Tricolporate. Well-defined endocostae and fastigia.

BIGNONIACEAE Juss.

Species: *Argylia radiata* (L.) D.Don (Plate 7; 6-10)

Description: Monad, radial symmetry, pentagonal amb, elliptical truncate outline in equatorial view, prolate shape. Large size (75-80 μm). Semitectate exine of 2.5 to 3 μm thick. Visible nexine, increasing in thickness at the mesocolpium zone. Tectum is 0.5 μm thick. Conspicuous columellae of 1.5 to 1.7 μm high. Columellae with visible capita. Reticulate. Heterobrochate reticulum, with irregular lumina (1 to 3 μm wide). Simplicolumellate muri of 0.5 μm . Muri around each lumina are composed of 3 to 5 columellae. Tricolpate. Pontoperculate. Simple irregular ectocolpi of 60 to 65 μm long and about 30 to 35 μm wide. Colpi's length is 2/3 of the grain. Pontopercula are as wide as the apertures, about 15 to 25 μm but getting thinner at the attachment point (apocolpium). Pontopercula gives the impression of a geminicolpate condition (stephanocolpate).

Remarks: Large size. Pentagonal amb, elliptical truncate outline in equatorial view. Pontoperculate, giving the impression of a stephanocolpate condition. Difference in width between mesocolpium and pontoperculum helps identifying this condition.

Species: *Tourrettia lappacea* (L'Hér.) Willd. (Plate 7; 11-15)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Large size (50-55 μm). Eutectate exine of 1.7 to 2 μm thick. Slightly visible nexine. Thin tectum of 0.2 to 0.3 μm thick. Conspicuous columellae of 0.7 to 1 μm high. Fossulate. Fossulae of 0.3 to 0.5 μm wide with variable shape. Larger fossulae of 1 to 1.2 μm long, C-shaped, or worm-like, whilst the smaller ones are circular to linear, about 0.5 to 0.7 μm long. Tricolpate. (Pont)operculate. Simple irregular colpi of 42 to 46 μm long and 3 to 10 μm wide, with rounded endings. The exine at the attachment area between colpi and opercula has an irregular pattern.

Remarks: Large size. Circular amb, elliptical outline in equatorial. Fossulate. Fossulae with variable shape. Tricolpate. (Pont)operculate.

BORAGINACEAE Juss.

Species: *Tournefortia schomburgkii* A. DC. (Plate 7; 16-20)

Description: Monad, radial symmetry, isopolar, circular amb, circular to elliptical outline in equatorial view, oblate spheroidal shape. Medium size (30-35 μm). Eutectate exine of 2 to 2.5 μm thick. Visible nexine (1 μm thick). Tectum of 0.5 to 0.7 μm thick. Columellae are about 0.5 to 0.8 μm high. Exine thickens towards the aperture. Verrucate. Irregular verrucae of 1 to 3 μm wide and 1 μm high, not homogeneous. Tricolporate to stephanocolporate (4 colpi). Marginate ectocolpi with acute endings, about 2 to 4 μm wide and about 27 to 30 μm long. Margo with psilate ornamentation. Costate circular endopores about 4 to 5 μm in diameter.

Remarks: Medium size. Ornamentation pattern is verrucate (irregular size). Variable number of apertures (3 to 4 colpi).

BRASSICACEAE Burnett

Species: *Brassica rapa* L. (Plate 7; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, oblate shape. Small size (15-22 μm). Semitectate exine of 2 μm thick. Visible nexine. Tectum is about 0.3 to 0.7 μm thick. Conspicuous columellae are 0.7 to 1 μm high. Columellae decrease in size towards the apertures. Reticulate heterobrochate. Larger irregular luminae located at the mesocolpium zone (1.2 to 1.5 μm wide). Smaller irregular luminae placed at the apocolpium zone, about 0.5 to 1 μm . Simplicolumellate muri of 0.5 to 0.6 μm wide. Tricolpate. Simple irregular colpi with rounded endings, about 8 to 15 μm long and 4 μm wide.

Remarks: Small size. Reticulate heterobrochate. Simplicolumellate muri. Columellae decreasing towards the apertures. Tricolpate.

Species: *Capsella bursa-pastoris* (L.) Medik. (Plate 7; 26-30)

Description: Monad, radial symmetry, isopolar, circular amb, circular to elliptical outline in equatorial view, oblate spheroidal shape. Small size (13-18 μm). Semitectate exine of 1.5 μm thick. Visible nexine. Tectum of 0.4 to 0.5 μm thick. Small conspicuous columellae of 0.3 to 0.5 μm high. Columellae decrease in size towards the apertures. Reticulate heterobrochate. Larger irregular luminae are located at the mesocolpium zone, about 0.7 to 1 μm wide, whilst the smaller ones are placed at the mesocolpium zone (0.5 μm wide), with a more circular shape, resembling a puncta. Simplicolumellate muri of 0.5 μm thick and. Tricolpate. Simple irregular colpi with rounded endings, about 4 to 5 μm wide and 10 to 15 μm long.

Remarks: Small size. Reticulate heterobrochate. Tricolpate. Similar features than in *Brassica*.

Species: *Lepidium chichicara* Desv. (Plate 7; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (16-22 μm). Semitectate exine of 1.5 μm thick. The tectum is about 0.5 μm thick and the columellae are 0.7 to 1 μm high. Columellae decrease in size towards the apertures. Reticulate heterobrochate. Larger irregular luminae located at the mesocolpium zone, about 1 to 1.5 μm wide, whilst the smaller ones are placed at the apocolpium zone, being about 0.5 to 0.7 μm . Simplicolumellate muri of 0.3 to 0.5 μm wide. Tricolpate. Simple colpi with rounded endings of 2 to 3 μm wide and 12 to 17 μm long.

Remarks: Small size. Reticulate heterobrochate. Simplicolumellate muri. Tricolpate. Similar morphology as in *Brassica*.

Species: *Lobularia maritima* (L.) Desv. (Plate 7; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, subprolate to prolate shape. Small to medium size (10-27 μm). Semitectate exine of 2 to 2.5 μm thick. Visible nexine (0.7 to 0.8 μm thick). Tectum of 0.3 to 0.5 μm thick. Conspicuous columellae are 0.8 to 1 μm high. Columellae decrease in size towards the apertures. Reticulate and heterobrochate. Larger lumina located at the mesocolpium zone, about 1.5 to 2 μm wide, having a pentagonal shape, whilst the smaller ones are about 0.8 to 1 μm wide with more variable and heterogeneous shapes. Simplicolumellate muri of 0.3 to 0.5

µm wide. Tricolpate. Simple colpi with rounded endings, about 2 to 3 µm wide and about 10 to 25 µm long.

Remarks: Small to medium size. Elliptical truncate outline in equatorial view. Reticulate heterobrochate. Well-defined individual columella. Tricolpate.

Species: *Mathewsia peruviana* O.E.Schulz (Plate 8; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, circular to subtriangular amb. Medium size (25-30 µm). Semitectate exine of 3.5 µm thick. Visible nexine. Thin tectum of 0.3 µm thick. Conspicuous columellae of 2.5 µm high. Sexine is considerably thicker than nexine. Reticulate. Heterobrochate. Irregular lumina of 1 to 4 µm wide. Simplicolumellate muri of 0.5 to 0.7 µm wide. Inaperturate.

Remarks: Medium size. Reticulate heterobrochate. Inaperturate.

Species: *Mostacillastrum gracile* (Wedd.) Al-Shehbaz (ex-*Sisymbrium gracile*) (Plate 8; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical to elliptical obtuse outline in equatorial view, prolate spheroidal shape. Small to medium size (20-30 µm). Semitectate exine of 2 to 2.5 µm thick. Visible nexine. Thin tectum, less than 0.5 µm thick. Conspicuous columellae of 1 to 1.5 µm high. Columellae sharply decrease in size towards the apertures. Sexine is considerably thicker than nexine. Reticulate. Heterobrochate. Luminae's shapes are irregular. Larger luminae located at the mesocolpium zone (1.5 to 2 µm wide) and smaller ones at the apocolpium zone (0.7 to 1 µm wide). Simplicolumellate muri of 0.5 µm wide. Tricolpate. Simple long colpi with acute endings about 20 to 28 µm long and 2 to 5 µm wide. Slightly irregular colpi, constricted at the equator (in equatorial view). Presence of colpi membranes.

Remarks: Medium size. Ornamentation pattern is reticulate heterobrochate.. Tricolpate. Presence of colpi membranes.

BROMELIACEAE Juss.

Species: *Puya ferruginea* (Ruiz & Pav.) L.B.Sm. (Plate 8; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (40-45 μm). Semitectate exine of 1.2 to 1.5 μm thick. Visible nexine. Thin tectum of 0.2 to 0.3 μm thick. Conspicuous columellae of 0.7 to 0.8 μm high. Columellae decrease in size towards the lateral axes of the grain. Reticulate. Heterobrochate. Luminae with variable shapes. Larger luminae of 2 to 2.5 μm , located at the center of the distal and equatorial faces, getting smaller towards the lateral axes of the grain (0.5 to 1 μm wide). Simplicolumellate muri of 0.5 to 0.7 μm wide. Monosulcate. Marginate sulcus with rounded endings about 5 μm wide, and 32 to 38 μm long.

Remarks: Medium size. ellipsoidal amb, reniform shape. Reticulate heterobrochate.. Exine decreases in thickness. Monosulcate.

Species: *Tillandsia latifolia* Meyen (Plate 8; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (35-40 μm). Semitectate exine of 2 to 2.2 μm . Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm high. Reticulate. Heterobrochate. Luminae with variable shape and size. Larger luminae located at the center of the distal face and the equator (1.5 to 2 μm wide). Luminae decrease in width towards the aperture and the lateral axes of grain (0.7 to 1 μm). Simplicolumellate muri of 0.3 to 0.5 μm wide. Monosulcate. Simple to slightly marginate sulcus with rounded endings, about 30 to 37 μm long and 5 to 7 μm wide. Irregular sulcus constricted at the center.

Remarks: Medium size. ellipsoidal amb, reniform shape. Monosulcate. Irregular sulcus. Exine with constant thickness compared to *Puya*.

CACTACEAE Juss.

Species: *Armatocereus matucanensis* Backeb. (Plate 8; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate spheroidal shape. Large size (77-95 μm). Semitectate exine of 2 μm thick. Visible nexine. Tectum is 0.5 μm thick. Visible but not differentiated columellae about 1 μm high. Foveolate and microechinate. Circular foveolae at the apocolpium zone (1 μm in diameter), fusing at the mesocolpium zone (1.5 μm long) with a worm-like shape. Small conical microechinae of 0.8 to 1 μm high, sparsely dispersed across the surface. Tricolpate.

Slightly marginate ectocolpi with acute endings of 18 to 25 μm wide in polar view, and 68 to 85 μm long. In equatorial view, colpi seem to be constricted.

Remarks: Large size. Elliptical truncate outline in equatorial view. Foveolate and microechinate. Characteristic microechinae density and shape. Constricted condition of the aperture in equatorial view.

Species: *Borzacactus fieldianus* Britton & Rose (Plate 8; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for the Peruvian desert-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical to elliptical truncate outline in equatorial view, prolate shape. Large size (55-68 μm). Tectate perforate to 1.7 to 2 μm thick. Visible nexine. Tectum of 0.5 to 0.6 μm thick. Visible but not differentiated columellae of 0.8 to 1 μm high. Punctate and microechinate. Circular puncta of less than 1 μm , widely dispersed. Small conical microechinae about 0.3 to 0.5 μm high, sparsely distributed across the surface. Tricolpate. Marginate irregular colpi with acute endings, of 8 to 15 μm wide in polar view, and 45 to 50 μm long in equatorial view. Colpi seem to be constricted in equatorial view.

Remarks: Large size. Punctate and microechinate. Tricolpate. In contrast to *Armatocereus*, perforations (puncta) are considerably smaller, as well as the size of the microechinae.

Species: *Corryocactus brachypetalus* (Vaupel) Britton & Rose (Plate 8; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, circular amb, elliptical truncate outline in equatorial view, prolate shape. Medium to large size (45-55 μm). Semitectate exine of 2 μm thick. Visible nexine (1 μm thick). Tectum of 0.5 to 0.7 μm thick. Conspicuous columellae of 0.5 μm high. Columellae decrease in size towards the apertures. Foveolate. Circular foveola of 1 μm of diameter, widely dispersed across the surface. Some foveolae fuse at the apocolpium zone (1.2 to 1.5 μm wide). Tricolpate. Marginate colpi with acute endings, about 10 to 15 μm wide in polar view, and 40 to 48 μm long. In the equatorial view, colpi seem to be constricted.

Remarks: Medium to large size. Foveolate. Tricolpate. In contrast to *Armatocereus* and *Borzacactus*, this genus lacks microechinate ornamentation (in light transmitted microscopy).

Species: *Cumulopuntia sphaerica* (C.F.Först.) E.F.Anderson (Plate 8; 36-40)

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Large size (87-97 μm). Semitectate exine of 3 μm thick. Visible nexine. Tectum of 0.8 to 1 μm thick. Conspicuous columellae of 1 to 1.2 μm high. Columellae slightly decrease in size towards the apertures. Foveolate. Circular foveola of 1 to 1.2 μm in diameter, but getting smaller towards the aperture, turning into puncta (less than 1 μm in diameter). Simplicolumellate muri of 0.5 to 0.7 μm wide. Pantoporate (15-20 pores). Simple circular to elongated pores, about 9 to 12 μm in diameter. Some pores are slightly lalongate, giving the appearance of a brevicolpus.

Remarks: Large size. Foveolate. Ornamentation pattern. Pantoporate, 15-20 pores slightly lalongate.

Species: *Trichocereus macrogonus* (Salm-Dyck) Riccob. (ex-*Echinopsis peruviana*) (Plate 9; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Large to very large size (90-110 μm). Semitectate exine of 2 μm thick. Visible nexine (1 μm thick). Tectum is 0.5 to 0.7 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Exine sharply reduces in thickness towards the apertures. Foveolate and microechinate. Irregular foveolae of 1 to 1.2 μm wide, dispersed across the surface. Within the foveolae, there are dispersed puncta of less than 0.8 μm of diameter. Small conical microechinae of 1 μm high, sparsely distributed across the surface. Tricolpate. Simple to slightly marginate colpi with acute endings, about 70 to 83 μm long and 33 to 40 μm wide in polar view, but 8 to 10 μm wide in equatorial view.

Remarks: Large to very large size. Foveolae arrangement. Tricolpate. Simple to slightly marginate colpi.

Species: *Haageocereus acranthus* (Vaupel) Backeb. (Plate 9; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Large size (65-73 μm). Semitectate exine of 2 to 2.3 μm thick. Visible nexine. Tectum is 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.8 μm high. Foveolate and echinate. Circular foveolae of 1 μm of diameter, widely dispersed across the surface. Within foveolae, there are puncta of less than 0.8 μm . Small conical echinae of 1 μm high, densely dispersed. Tricolpate. Slightly marginate colpi with acute endings, about 36 to 45 μm long and about 15 to 18 μm wide in polar view. Colpi seem to be constricted in equatorial view.

Remarks: Large size. Thick exine. Ornamentation pattern with dense presence of echinae across the surface. Foveolate and echinate. Tricolpate.

Species: *Loxanthocereus sextonianus* (Backeb.) Backeb. (ex-*Loxanthocereus gracilis*) (Plate 9; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, spheroidal to prolate shape. Large size (65-70 μm). Tectate perforate exine of 2 to 2.2 μm thick. Visible nexine (1 μm). Tectum is about 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Sexine sharply decreases towards the apertures. Punctate and echinate. Circular puncta of 0.5 to 0.7 μm of diameter, dispersed across the surface. Conical echinae of 1 to 1.2 μm high, sparsely dispersed across the surface (spaced 4 to 5 μm). Tricolpate. Marginate colpi of rounded endings, about 5 to 15 μm wide, and 52 to 67 μm long. Colpi seem to be constricted in equatorial view. Very reduced apocolpium zone.

Remarks: Large size. Punctate and echinate. Tricolpate. Similar to *Haageocereus*, but differing in the density of the echinae (less dense for this genus), rounded endings of the colpi, and sexine thickness decrease.

Species: *Neoraimondia arequipensis* (Meyen) Backeb. (Plate 9; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical acuminate outline in equatorial view, prolate shape. Large size (57-65 μm). Tectate perforate exine of 1.7 to 2 μm . Visible nexine. Tectum is 0.5 μm thick. Visible but not differentiated columellae of 0.5 to 0.7 μm high. Punctate. Circular to irregular puncta of 0.3 to 0.7 μm in diameter, densely dispersed across the surface. Tricolpate. Marginate colpi with acute endings, about 53 to 60 μm long and 10 to 15 μm wide at polar view and 4 to 6 μm at equatorial view. Colpi seem to be constricted in equatorial view.

Remarks: Large size. Punctate. Tricolpate. Similar to *Corryocactus* but differing in exine thickness, diameter of the perforation (puncta) pattern, and the equatorial outline.

Species: *Opuntia stricta* (Haw.) Haw. (Plate 9; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Large size (63-72 μm). Semitectate exine of 4 μm thick. Visible nexine. Tectum is 0.5 to 0.7 μm thick. Conspicuous columellae of 2 to 2.2 μm high. Columellae sharply decrease in size towards the apertures. Columellae with flat capita. Reticulate (negative reticulum). Heterobrochate. Square-like lumina of 1 to 1.5 μm wide but getting smaller towards the aperture. Simplicolumellate muri of 0.5 μm wide. Pantoporate (10 to 12 pores). Circular to slightly elongated ectopores, about 12 to 15 μm of diameter. Costate circular to elongated endopores of 15 to 18 μm in diameter. Apertures are considerably separated (8 to 10 μm). Some pores are slightly lalongate, giving the appearance of a brevicolpus. The exine slightly separates towards the apertures forming fastigia (0.5 μm high).

Remarks: Large size. Ornamentation pattern is reticulate (negative reticulum). Pantoporate (10 to 12 pores). Wide distance between apertures. Costate endopores. Presence of fastigia.

Species: *Haageocereus bylesianus* (Andreae & Backeb.) Lodé (ex-*Pygmaeocereus bylesianus* Andreae & Backeb). (Plate 9; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, cuadrangular amb. Large size (70-75 μm). Tectate perforate to semitectate, about 2.5 μm thick. Visible nexine. Tectum of 0.5 to 0.7 μm thick. Visible but not differentiated columellae of 0.5 to 0.7 μm high. Sexine slightly decreases towards the apertures. Regular weakened exine areas at the apocolpium zone. Punctate and microechinate. Circular to irregular puncta of 0.5 μm of diameter. Also, across the surface there are foveolae of less than 1 μm of diameter. Echinae are about 0.5 μm high, densely widespread across the surface. Stephanocolpate (4 to 5 colpi). Simple colpi with acute endings about 18 to 22 μm wide and 50 to 55 μm long. Not found in equatorial view.

Remarks: Large size. cuadrangular amb. Punctate and microechinate. Stephanocolpate (4 to 5 colpi). Only stephanoaperturate genus for the Cactaceae family. In contrast to other genera, the echinae are smaller, less than 1 μm high.

Species: *Weberbauerocereus rauhii* Backeb. (Plate 9; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Large size (57-65 μm). Semitectate exine about 3 μm thick. Visible thick nexine about 1.2 μm thick. Tectum is 0.5 μm thick. Columellae are about 1.3 μm high. Sexine decreases towards the apocolpium zone. Foveolate and echinate. Circular foveola of 1 μm in diameter, abundant at the apocolpium zone. Puncta within foveolae less than 0.7 μm . Conical echinae are less than 1 μm high, about 0.5 to 0.8 μm . Some echinae have rounded tips. Densely distributed echinae. Tricolpate. Simple colpi of 48 to 55 μm long, with rounded endings; about 12 to 20 μm wide in polar view, and 3 to 5 μm in equatorial view. Reduced apocolpium zone.

Remarks: Large size. Foveolate and echinate. Tricolpate. Simple colpi. Ornamentation pattern, with densely distributed echinae.

CALCEOLARIACEAE Raf. ex Olmstead

Species: *Calceolaria tripartita* Ruiz & Pav. (Ex *Calceolaria pinnata*) (Plate 9; 36-40)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, oblate spheroidal shape. Small size (15-20 μm). Semitectate exine of 1 μm thick. Tectum of less than 0.5 μm thick. Conspicuous columellae of 0.5 to 0.6 μm high. Microreticulate. Homobrochate. Circular lumina of 0.5 to 0.7 μm wide. Simplicolumellate muri of 0.5 μm wide or less. Tricolporate. Marginate ectocolpi with rounded endings, about 10 to 12 μm long and 3 to 5 μm wide. Costate circular endopores about 4 to 5 μm in diameter. Besides, the exine starts to separate near the apertures, forming fastigia of 0.5 μm high.

Remarks: Small size. Microreticulate. Homobrochate. Tricolporate. Well-defined marginate ectocolpi and costate endopores, in conjunction with the circular microreticulated ornamentation pattern and the presence of fastigia.

CAMPANULACEAE Juss.

Species: *Lobelia decurrens* Cav. (Plate 10; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate to elliptical emarginate outline in equatorial view, oblate to prolate shape. Medium size (25-32 μm). Tectate perforate exine of 1.5 μm thick. Visible nexine, not reaching the ectoapertures. Tectum of 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Punctate. Circular puncta of less than 0.5 μm in diameter, widely dispersed across the surface. Tricolporate. Simple long ectocolpi with rounded endings, about 22 to 25 μm long and 3 to 5 μm wide. Very small apocolpium zone. Costate lalongate endopores of 5 μm high and 7 to 8

µm wide. Exine separates towards the apertures, forming fastigia with the nexine not reaching the endoaperture (Atrium-like feature).

Remarks: Medium size. Punctate. Tricolporate. The well-defined stratification of the exine, reduced apocolpium zone, and the almost projectate endopore due to the fastigial are diagnostic characteristics for this genus. Fastigia with atrium-like features.

CAPPARACEAE Juss.

Species: *Morisonia petiolaris* (Kunth) Christenh. & Byng (ex-*Capparis prisca*) (Plate 10; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate spheroidal shape. Medium size (25-28 µm). Tectate - perforate exine of 2 µm thick. Visible nexine, being more conspicuous close to the apertures. Tectum of 0.5 to 0.7 µm. Slightly conspicuous columellae of 0.5 to 0.8 µm high. Exine gets thicker at the apocolpium zone and the apertures (2.5 to 2.7 µm), and thinner towards the mesocolpium. Punctate and scabrate. Circular puncta of less than 0.5 µm of diameter, densely concentrated at the apocolpium zone. The space between puncta is scabrate. Large scabra of 1 to 1.5 µm long, densely located at the mesocolpium zone. Tricolporate to stephanocolporate (4 colpi). Slightly marginate ectocolpi with rounded endings, about 20 to 24 µm and 5 µm wide. Very long colpi, leaving a very reduced apocolpium zone. Costate lalongate endopores of 4 to 5 µm high and 7 to 10 µm wide. Exine slightly separates towards the apertures, forming small fastigia.

Remarks: Medium size. Punctate and scabrate. Tricolporate to stephanocolporate (4 colpi). This grain can be recognized by the distribution of the puncta and scabrae across the surface, associated with the notorious thickening of the exine at the apocolpium zone, the aperture type with prominent endopores, and aperture number (3 to 4).

CAPRIFOLIACEAE Juss.

Species: *Valeriana chaerophylloides* Sm. (Ex-*Astrephia chaerophylloides*) (Plate 10; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, ellipsoidal truncate outline in equatorial view, oblate spheroidal shape. Medium size (36-48 µm). Tectate perforate exine of 2 to 2.5 µm thick. Exine thickness increases at the base of supracteal elements. Visible

nexine (0.7 to 1 μm thick) . Tectum of 0.5 to 0.7 μm thick. Slightly conspicuous columellae of 0.8 to 1 μm , tectum about 1 μm . Punctate and echinate. Circular puncta of less than 0.5 μm in diameter, widely distributed across the surface. Conical echinae of 0.7 to 1 μm high, densely distributed. Tricolpate to stephanocolpate (4 brevicolpi). Marginate brevicolpi with rounded endings, about 10 to 15 μm long and 3 to 7 μm wide. Ornamented aperture membrane

Remarks: Variable medium to large size grain and aperture number (3 to 4). Punctate and echinate. Tricolpate to stephanocolpate (4 brevicolpi). The ornamentation pattern composed of puncta and echinae is similar to the one found in the Cactaceae family. However, *Valeriana* has marginate brevicolpi, ornamented aperture membrane and well-defined and widely distributed conical echinae.

CARICACEAE Dumort.

Species: *Vasconcellea candicans* (A.Gray) A.DC. (Plate 10; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, bilateral symmetry, heteropolar, subtriangular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (35-40 μm). Tectate - perforate exine of 2 μm thick. Visible nexine. Tectum is 0.5 μm thick. Inconspicuous or densely accommodated columellae of 1 μm high. Psilate and locally punctate. Circular puncta of less than 0.5 μm in diameter are located at the apocolpium zone. Tricolporate and syncolporate. Marginate ectocolpi with rounded endings, about 32 to 37 μm long and 3 to 7 μm wide. Ectolpi with well-defined margo of 1 to 1.3 μm thick. Constricted colpi in equatorial view. Colpi fuses in only one pole, making the grain heteropolar. Costate lalongate endopores lalongate, about 3 to 4 μm high and 12 to 16 μm wide. Endopore with acute lateral axes. Exine separates towards the apertures, forming fastigial. Presence of an aperture membrane (slightly ornamented).

Remarks: Medium size. Bilateral symmetry. Heteropolar, subtriangular amb. Psilate and locally punctate. Puncta is located only in the apocolpium zone. Tricolporate and syncolporate. Syncolporate in only one pole.

CARYOPHYLLACEAE Juss.

Species: *Cerastium glomeratum* Thuill. (Plate 10; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Medium size (34-40 μm). Semitectate exine of 3 to 3.2 μm thick. Visible nexine. Tectum is 1 μm thick. Conspicuous columellae of 1 to 1.7 μm high. Columellae decrease towards the apertures. Microreticulate. Heterobrochate. Circular to irregular lumina of 0.7 to 1 μm in diameter. Simplicolumellate muri of 0.5 μm wide. Pantoporate (15 pores). Simple circular ectopores of 4 to 6 μm in diameter. Operculated ectopores. Opercula with gemmate-like ornamentation. Costate circular endopores of 4 to 5 μm in diameter.

Remarks: Medium size. Microreticulate. Heterobrochate. Circular to irregular luminae. Pantoporate (15 operculated pores). Gemmate-like opercula. Costate endopores.

Species: *Drymaria divaricata* Kunth. (Plate 10; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Medium size (30-37 μm). Tectate - perforate exine of 2 to 2.2 μm thick. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm thick. Columellae slightly decrease in size towards the apertures. Fossulate. Circular to irregular fossulae of 0.5 to 0.7 μm in diameter. Larger ones are worm-like shaped, about 0.7 μm wide and 1 μm long. Pantoporate (15 to 18 pores). Simple circular pores, about 3 to 5 μm in diameter. Simple to costate endopores.

Remarks: Medium size. Fossulate. Notorious differentiation between larger and smaller luminae. Pantoporate (15 to 18 pores). In contrast with *Cerastium*, the pores of *Drymaria* are not operculate.

Species: *Paronychia setigera* (Gillies ex Hook. & Arn.) F.Herm. (Plate 10; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Small size (15-18 μm). Tectate - perforate exine of 1.5 μm of thick. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Columellae slightly decrease in size towards the apertures. Punctate. Circular puncta of less than 0.5 μm of diameter, densely dispersed across the surface. Pantoporate (up to 12 pores). Simple circular ectopores of 3 to 4 μm in diameter. Circular costate endopores, about 5 to 7 μm of diameter. The exine separates towards the apertures, forming vestibula.

Remarks: Small size. Punctate. Pantoporate (up to 12 pores). Wide pore size in relation to the grain. Presence of vestibula.

Species: *Silene gallica* L. (Plate 10; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Medium size (30-40 μm). Semitectate exine of 3.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 2 to 2.2 μm high. Columellae slightly decrease in size towards the aperture. Reticulate. Homobrochate. Square-like homogeneous lumina of 1 to 1.2 μm wide. Simplicolumellate muri of 0.5 μm wide. Constant lumina/muri ratio. Pantoporate (25 - 30 pores). Annulate circular ectopores, about 4 to 5 μm in diameter. Costate circular endopores, slightly smaller than the ectopores (3 μm in diameter).

Remarks: Medium variable size. Ornamentation pattern (constant lumina/muri ratio). Pantoporate (25 – 30 circular pores). Annulate ectoaperture.

Species: *Spergularia congestifolia* I.M.Johnst. (Plate 11; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, oblate spheroidal shape. Small size (18-21 μm). Tectate - perforate exine of 1.3 to 1.5 μm thick. Slightly visible nexine. Tectum is 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Columellae slightly decrease in size towards the apertures. Punctate. Circular puncta of 0.3 to 0.5 μm in diameter, homogeneously dispersed across the surface. Tricolpate. Simple irregular colpi with rounded endings, about 5 μm wide and 14 to 16 μm long. Nexine does not reach the apertures, forming an atrium-like feature. Aperture membrane slightly ornamented.

Remarks: Small size. Ornamentation pattern (punctate). Tricolpate. (irregular colpi). Atrium-like feature. Aperture membrane slightly ornamented.

Species: *Stellaria ovata* Willd. ex D.F.K.Schltl. (Plate 11; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular to slightly hexagonal amb. Medium size (30-40 μm). Tectate - perforate exine of 3 μm thick. Visible nexine. Tectum 0.5 μm thick. Conspicuous columellae of 2 μm high. Columellae decrease in size towards the apertures. Punctate and gemmate. Circular puncta of 0.3 to 0.5 μm in diameter, densely dispersed across the surface. Rounded gemmae of 1 μm high are sparsely dispersed across the surface, but getting smaller towards the apertures. Pantoporate (12 to 15 pores). Simple circular ectopores of 4 to 6 μm in diameter. Operculate ectopores. Opercula with gemmate

ornamentation, gemmae clustered in groups of 5 to 7. Costate circular endopores, same width as the ectopores (4 to 5 μm in diameter).

Remarks: Medium size. Circular to slightly hexagonal amb. Punctate and gemmate, gemmae clustered in groups of 5 to 7.. Pantoporate (12 to 15 operculated pores). Simple endospores, costate endospores.

CELASTRACEAE R.Br.

Species: *Maytenus orbicularis* (Humb. & Bonpl. ex Schult.) Loes. (ex-*Maytenus octogona*) (Plate 11; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (12-18 μm). Tectate - perforate exine, about 1.5 to 2 μm thick. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Columellae decrease in size towards the apertures. Microreticulate. Circular lumina of 0.3 to 0.5 μm in diameter, densely dispersed across the surface. Tricolporate. Marginate ectocolpi with acute endings, about 2 to 2.5 μm wide and 9 to 14 μm long. Wide apocolpium zone. Colpi constricted at the equator. Geniculate in equatorial view. Costate lalongate endopores, about 5 to 6 μm high and 2 μm wide. Difficult to find in polar view.

Remarks: Small size. Geniculate in equatorial view. subtriangular amb, elliptical truncate outline in equatorial view, Microreticulate. Tricolporate. Lalongate endopores.

CLEOMACEAE Airy Shaw

Species: *Cleome chilensis* DC. (Plate 11; 16-20)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical to elliptical truncate outline in equatorial view, oblate shape. Small size (12-15 μm). Tectate perforate exine of 1.2 to 1.5 μm thick. Visible nexine. Tectum is 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Microreticulate. Circular lumina of 0.3 to 0.7 μm in diameter, densely dispersed across the surface. Tricolporate. Marginate ectocolpi with rounded endings, about 2 μm wide and 8 to 10 μm long. Reduced apocolpium zone. Costate lalongate endopores, about 3 to 4 μm high and 6 to 8 μm wide. The exine's slightly separates towards the apertures forming fastigia.

Remarks: Small size. Ornamentation pattern is microreticulate. Tricolporate. Reduced apocolpium zone. Fastigiate.

COMMELINACEAE Mirb.

Species: *Commelina tuberosa* L. (ex-*Commelina fasciculata*) (Plate 11; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, bilateral symmetry, heteropolar, reniform shape. Medium size (35-42 μm). Eutectate exine of 1 to 1.5 μm thick, getting slightly thicker towards the distal face. Not visible nexine. Tectum is 0.5 to 0.7 μm thick. Inconspicuous columellae. Sexine increases in thickness at the distal face. Echinate. Conical echinae with variable height. Larger echinae are 2 to 2.5 μm high, wider at its base (3 μm), densely dispersed across the surface. Smaller echinae (1 to 1.5 μm high) located at the aperture's margin and at the distal face. Change from larger to smaller echinae is sudden. Monosulcate. Simple sulcus with rounded endings, about 4 to 8 μm wide and 33 to 42 μm long, with rounded endings.

Remarks: Medium size. heteropolar, reniform shape. Echinate. Conical echinae with variable height. Simple monosulcus. This genus represents the only monocotyledonous - monosulcate pollen grain with echinate ornamentation within the studied *Lomas* flora.

CONVOLVULACEAE Juss.

Species: *Cuscuta grandiflora* Kunth (Plate 11; 26-30)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical to elliptica truncate outline in equatorial view, prolate shape. Medium size (25-35 μm). Semitectate exine of 2 to 2.5 μm . Visible nexine. Tectum is 0.5 to 0.7 μm thick. Conspicuous columellae of 1 to 1.3 μm high. Columellae slightly decrease in size towards the apertures and the equator. Reticulate. Heterobrochate. Irregular lumina of 1 to 1.5 μm wide, aleatory dispersed across the surface. Luminae reduce in width towards the apertures. Simplicolumellate muri is 0.5 wide. Tricolpate. Simple colpi with acute endings, about 23 to 30 μm of length, and 5 to 8 μm wide. Small apocolpium zone.

Remarks: Medium size. Reticulate. Heterobrochate. Decreasing pattern of columellae towards the apertures and the equator. Tricolpate. Small apocolpium zone.

Species: *Dichondra microcalyx* (Hallier f.) Fabris (Plate 11; 31-35)

Description: Monad, radial symmetry, isopolar, subtriangular to circular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (25-35 μm). Tectate perforate exine, 2 to 2.2 μm thick. Visible and well-defined nexine (0.5 μm). Tectum of 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm high. Foveoreticulate. Heterobrochate. Circular lumina of 0.5 to 1 μm in diameter. The smaller ones, located at the apocolpium zone, whilst larger lumina, at the mesocolpium zone. Tricolpate. Marginate colpi with rounded endings, about 3 to 5 μm wide and 22 to 33 μm long. Wide apocolpium zone.

Remarks: Medium size. subtriangular to circular amb, elliptical truncate outline in equatorial view, prolate shape. Foveoreticulate. Heterobrochate. Visible nexine thicker than the tectum. Ornamentation pattern. Tricolpate.

Species: *Evolvulus villosus* Ruiz & Pav. (Plate 11; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, circular amb. Medium size (30-37 μm). Tectate perforate exine about 2 μm thick. Visible and well-defined nexine. Tectum of 0.3 to 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Columellae slightly decrease in size towards the aperture. Foveolate. Circular foveolae of about 0.5 μm in diameter. Foveolae get slightly denser towards the apertures. Pantocolpate (12 - 15 apertures). Simple brevicolpi with acute endings, about 7 to 10 μm long and 2 μm wide, arranged in groups of 5 with an H-like pattern.

Remarks: Medium size. Apolar. Foveolate. Pantocolpate (12 - 15 apertures), with simple brevicolpi arranged in groups of 5 with the exine depressing close the apertures.

Species: *Ipomoea dumetorum* Willd. (Plate 12; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Medium to very large size (85-105 μm). Semitectate exine, 6.5 to 7 μm thick. Very thick nexine (5.7 to 6 μm). Tectum of 0.3 to 0.5 μm thick. Conspicuous columellae of 0.5 μm high. Echinata - Reticulate. Large conical echinae of 8 to 12 μm high, are wider at the base (3 to 4 μm) thinning towards the tip (2 μm). Six of the larger echinae are arranged hexagonally around the aperture. Smaller echinae (1 to 1.5 μm high) are present between the larger ones, delimiting an hexagonal lumina (lophate) of 16 to 20 μm wide. Simplicolumellate muri of 2.5 μm wide. Pantoporate (about 50 pores). Simple circular pores of 5 μm in diameter. There is one pore per lumen (metareticulate).

Remarks: Very large size. Thick nexine. Complex echinate-reticulate ornamentation (Lophate, metareticulate). Echinae arranged in a hexagonal shape forming a wide lumina around the aperture. Pantoporate (about 50 pores).

Species: *Jacquemontia unilateralis* (Roem. & Schult.) O'Donnell (Plate 12; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Large size (48-55 μm). Eutectate exine, about 3.5 to 4 μm thick, getting thinner towards the aperture (2 μm). Visible nexine. Tectum about 0.6 to 0.7 μm thick. Digitate columellae of 2 to 2.5 μm high, branched into 2 to 3 arms. Microechinate. Microechinae of 0.5 μm or less. Microechinae

probably correspond with the columellae's capita. Pantocolpate (12 brevicolpi). Simple brevicolpi are about 10 μm long and 3 to 4 μm wide. Brevicolpi with rounded endings, disposed in groups of 5 forming an H-like shape.

Remarks: Large size. Digitate columellae with projections above tectum (Microechinae). As in *Evolvulus*, brevicolpi are arranged in an H-like shape but differ in the shape of the aperture's endings.

CUCURBITACEAE Juss.

Species: *Cucumis sativus* L. (Plate 12; 11-15)

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical to elliptical acuminate outline in equatorial view, spheroidal to oblate shape. Medium to large size (40-60 μm). Tectate perforate exine, 2 to 2.5 μm thick. Visible thick nexine (0.7 μm). Tectum of 0.5 to 0.7 μm thick and conspicuous columellae, about 1 to 1.2 μm high. Microreticulate. Small circular luminae of less than 0.5 μm in diameter, densely dispersed across the surface. Triporate. Annulate circular ectopore, of 10 to 13 Circular μm in diameter. Costate circular endopores of similar size. Costae are considerably thick. Exine separates towards the apertures, forming vestibula of 1.2 to 1.5 μm high.

Remarks: Medium to large size. Thick nexine. Densely microreticulate ornamentation, presence of a thick costa and a conspicuous vestibulate condition. Triporate.

Species: *Cyclanthera mathewsii* Arn. ex A.Gray (Plate 12; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, hexagonal amb, elliptical acuminate outline in equatorial view, oblate shape. Medium size (42-50 μm). Semitectate exine, about 4 to 4.2 μm . Visible nexine (1 to 1.2 μm thick). Tectum of 1 μm thick. Conspicuous columellae of 2 μm high. Columellae decrease in size towards the apertures. Exine with a crescentic pattern. Fossulate. Irregular fossulae. Larger fossulae (about 4 μm) are predominant at the apocolpium and mesocolpium zones. Fossulae strongly reduce in size towards the aperture margin and less sharply to the aperture endings. Stephanocolporate (5 apertures). Marginate ectocolpi of 43 to 50 μm long and 2 to 6 μm wide. Ectocolpi with acute endings. Costate alongate endopores, about 4 to 5 μm high and 8 to 10 μm wide. Costae, about 1.5 to 2 μm thick. Exine separates close the apertures, forming fastigia of 1.5 μm high. Medium size apocolpium zone. Difficult to observe in equatorial view.

Remarks: Large size. Hexagonal amb. Exine with a crescentic pattern. Fossulae's pattern. Stephanocolporate (5 apertures). Endopores with thick costae and conspicuous fastigia.

Species: *Sicyos baderoa* Hook. & Arn. (Plate 12; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, oblate shape. Large size (60-86 μm). Intectate exine, 1.5 to 1.7 μm thick. Visible nexine (0.5 to 0.7 μm thick). Echinulate and locally granulate at the apertures' margin. Conical echinae are 4 to 6 μm high, slightly wider at its base, separated by 1 to 3 μm . Echinae's distribution has an irregular pattern. Stephanocolpate (8 apertures). Marginate irregular colpi with rounded endings, about 36 to 60 μm long and 8 to 12 μm wide. Presence of an ornamented aperture membrane. Medium size apocolpium zone.

Remarks: Large size with thin exine. Stephanocolpate (8 apertures), echinate and locally granulate (at colpi). Presence of an ornamented aperture membrane.

CYPERACEAE Juss.

Species: *Cyperus laxis* Lam. (Plate 12; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, asymmetrical, heteropolar, sub-circular to quadrangular amb, square-like shape. Small size (22-27 μm). Tectate perforate exine, about 1 μm thick. Slightly visible thin nexine. Tectum about 0.2 μm thick and conspicuous columellae of 0.5 μm high. Exine gets slightly thinner reaching the aperture zone. Punctate to microreticulate. Circular puncta/lumina of less than 0.5 μm in diameter. Pantocolpate. (4-5 colpi). Simple irregular (pseudo)apertures of 3 to 5 μm long and 3 to 3.5 μm wide.

Remarks: Small size. Dense punctate to microreticulate ornamentation. Pantocolpate. (4-5 colpi).

Species: *Cyperus odoratus* L. (ex-*Torulinium odoratum* (L.) S.S.Hooper) (Plate 12; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, asymmetrical, apolar to heteropolar, sub-triangular amb, square-like shape. Small to medium size (20-27 μm). Tectate perforate exine of 1.2 to 1.5 μm thick. Visible nexine. Tectum about 0.3 to 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm high. Punctate. Very small puncta, less than 0.5 μm in diameter. Pantoporate (3-4 pores). Simple circular and operculate(?) (pseudo)apertures of 3 to 5 μm in diameter. Presence of

aperture membranes with granulate ornamentation. The (pseudo)apertures are distributed as in a “pantoaperturate” condition.

Remarks: Small size. Punctate. (Pseudo)apertures with pantoporate condition and presence of granulate aperture membranes. The (pseudo)apertures are distributed resembling a “pantoaperturate” condition.

EUPHORBIACEAE Juss.

Species: *Euphorbia serpens* Kunth (ex-*Chamaesyce serpens* (Kunth) Small) (Plate 12; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical acuminate outline in equatorial view, prolate shape. Medium size (25-32 μm). Tectate perforate exine about 2 to 2.2 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm high, increasing in height towards the equator (crescentic pattern).

Fossureticulate. Circular to irregular lumina of 0.5 to 1 μm wide, heterogeneously dispersed across the surface. Tricolporate. Planaperturate. Marginate ectocolpi with rounded endings, about 20 to 27 μm long and 2 to 4 μm wide. Notorious margo of 1 to 1.5 μm wide. Costate alongate endopores of 2 to 4 μm high and 7 to 10 μm wide. Projected mesocolpium. Large apocolpium zone.

Remarks: Medium size. Fossureticulate with crescentic pattern. Circular and irregular lumina across the surface. Tricolporate. Planaperturate. Projected mesocolpium gives the grain the subtriangular amb. Ectocolpi with wide margo and costate endopores.

Species: *Croton alnifolius* Lam. (Plate 13; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Large size (50-58 μm). Intectate exine of 1 to 1.2 μm thick. Visible thin nexine about 0.5 μm thick. Inconspicuous capitate columellae. Gemmate to clavate. Triangular gemmae are about 1.2 to 1.5 μm high and 1.5 μm wide. Pluricolumellate gemmae to clavae-like structures form groups of 5 to 6 in a ring-like accommodation (Croton pattern). Inaperturate. Exine's surface with few and small weakening zones.

Remarks: Large size. Inaperturate. Croton-pattern. Pluricolumellate gemmae to clavae-like structures. In contrast to *Jatropha*, this grain is smaller.

Species: *Euphorbia peplus* L. (Plate 13; 6-10)

Description: Monad, radial symmetry, isopolar, circular to subtriangular amb, circular outline in equatorial view, oblate spheroidal shape. Medium size (25-32 μm). Semitectate exine of 2 μm thick. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 1 μm high. Collumellae decrease gradually in size towards the apertures and the apocolpium zone. Reticulate. Heterobrochate. Irregular luminae of 1 to 1.5 μm wide aleatorily dispersed across the surface, decreasing in size towards the apertures. Tricolporate. Marginate ectocolpi about 23 to 30 μm long and 5 to 7 μm wide, getting narrow towards the apocolpium zone. Ectocolpi with rounded endings, getting narrow at the central part. Simple lalongate endopores of 4 μm high and 7 to 8 μm wide. In the equatorial view the grain is geniculate, forming a bulge related to the ectoaperture. Exine separates towards the aperture, forming a small fastigia (0.5 μm). Medium size apocolpium zone.

Remarks: Medium size. Reticulate. Heterobrochate. Ornamentation pattern (change in luminae's width). Tricolporate. Marginate ectocolpi. Geniculate in equatorial view.

Species: *Jatropha macrantha* Müll.Arg. (Plate 13; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb, spheroidal shape. Large size (93-100 μm). Intectate exine about 1 to 1.2 μm thick. Visible thin nexine about 0.5 μm thick. Inconspicuous columellae. Gemmate. Pluricolumellate gemmae-like structures about 2 to 2.3 μm high form groups of 5 to 6 in a ring-like accommodation (Croton pattern). Triangular elements vary from 2 to 3 μm wide. Inaperturate. Exine's surface with pronounced weakening zones.

Remarks: Large size. Gemmate. Pluricolumellate gemmae-like structures. Inaperturate. Thicker exine and wider exine's weakening zones than in *Croton*.

FABACEAE Lindl.

Species: *Hoffmannseggia miranda* Sandwith (Plate 13; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, obtuse convex amb, ellipsoidal outline in equatorial view, prolate spheroidal shape. Large size (50-70 μm). Semitectate exine of 3.5 to 4 μm thick. Visible nexine, slightly decreasing in thickness towards the apertures. Tectum of 0.5 μm . Conspicuous uniform columellae of 2 to 2.5 μm high. Reticulate. Homobrochate. Circular to irregular lumina of 1 to 1.2 μm of width. Simplicolumellate, well-developed muri of 0.5 μm wide. Tricolporate. Strongly marginate ectocolpi of 48 to 65 μm long and 10 to 12 μm wide. Margo is 1.5 to 1.7 μm wide. In polar view, two bulges delimit the ectocolpi.

Costate projected circular endopores of 7 to 9 μm in diameter. Medium to small size apocolpium. Difficult to find in equatorial view.

Remarks: Large size. Exine thickness. Reticulate. Homobrochate. Tricolporate. In polar view, two bulges delimit the ectocolpi providing a very characteristic pattern around the apertures. Strongly marginate ectoaperture.

Species: *Mimosa albida* Humb. & Bonpl. ex Willd. (Plate 13; 21-25)

Description: Tetrahedral tetrad of very small size (7-10 μm). Pollen grains with radial symmetry, isopolar, circular amb. Very small size pollen grains (less than 5 μm). Eutectate exine of 0.5 to 0.6 μm thick. Not visible nexine. Inconspicuous tectum and columellae. Psilate. Inaperturate.

Remarks: Dispersal unit. Small size of the tetrad and pollen grains. Inaperturate. Psilate grains

Species: *Neltuma juliflora* (Sw.) Raf. (ex-*Prosopis juliflora*) (Plate 13; 26-30)

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical emarginate outline in equatorial view, peroblate shape. Medium size (30-37 μm). Tectate perforate exine of 1.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Inconspicuous columellae of less than 0.5 μm high. Sexine decreases in thickness towards the apertures. Punctate to microreticulate. Small circular luminae of less than 0.5 μm in diameter widely dispersed across the surface. Tricolporate. Marginate ectocolpi with rounded endings, about 30 to 35 μm long and 5 to 6 μm wide. Simple circular (8 μm in diameter) to slightly lalongate endopores (6 μm high and 8 μm wide). Exine separates towards the aperture, forming small fastigia. Reduced apocolpium zone. Difficult to find in equatorial view.

Remarks: Medium size. Elliptical emarginate outline. Inconspicuous columellae. Tricolporate. Fastigiate. Punctate to microreticulate.

Species: *Parkinsonia aculeata* L. (Plate 13; 31-35)

Description: Monad, symmetry radial, isopolar, circular amb, elliptical outline in equatorial view, prolate shape. Medium size (30-35 μm). Semitectate exine of 1.5 to 2 μm thick. Visible thin nexine. Tectum of 0.3 to 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm high. Columellae sharply decrease in size towards the apertures and slightly towards the apocolpium zone. Reticulate. Heterobrochate. Larger pentagonal lumina are 1 to 1.5 μm wide, distributed across the intercolpium zones. Smaller lumina are located next to the aperture (0.5 μm wide or less). At the apocolpium, the reductional pattern of luminae's size forms a well-defined triangular zone. Simplicolumellate muri of 0.5 μm wide. Tricolporate. Strongly marginate ectocolpi of 23 to 28 μm long and 2 to 8 μm wide, with rounded endings. Indistinct endopores about 4 to 5 μm high and 2 to 3 μm wide. Aperture membrane is psilate

and associated with the endopores. Endopores are difficult to observe in equatorial view. Medium size apocolpium.

Remarks: Medium size. Reticulate. Heterobrochate. Larger pentagonal lumina at intercolpium zones. Tricolporate. Aperture membrane.

Species: *Senna birostris* (Dombey ex Vogel) H.S.Irwin & Barneby (Plate 13; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, heteropolar, subtriangular amb, ellipsoidal or obtuse outline in equatorial view, oblate shape. Medium size (33-40 μm). Tectate perforate exine of 1.5 μm thick. Visible thin nexine, reducing in thickness at the mesocolpium zone. Tectum of 0.3 μm thick. Columellae of 0.5 μm high. Microreticulate. Irregular luminae of 0.5 to 0.7 μm wide, homogeneously dispersed across the surface. Tricolporate to syncolporate at only one pole. Marginate ectocolpi with rounded endings about 36 to 40 μm long and 4 to 8 μm wide. Costate lalongate projected endopores of 4 to 6 μm high and 10 to 12 μm wide. Geniculate in equatorial view.

Remarks: Medium size. Heteropolar. Microreticulate ornamentation. Syncolporate at only one pole. Projected endopores.

Species: *Tara spinosa* (Molina) Britton & Rose (ex- *Caesalpinia spinosa*) (Plate 14; 1-5)

Description: Monad, radial symmetry, isopolar, circular amb, circular to elliptical outline in equatorial view, oblate spheroidal shape. Medium size (40-50 μm). Semitectate exine of 3 to 3.5 μm . Visible nexine (1 to 1.5 μm), thicker than tectum (0.5 to 0.8 μm). Conspicuous columellae of 1 to 1.2 μm high, increasing in size towards the apertures. Reticulate-fossulate. Reticulum present at the intercolpium. Heterobrochate with irregular luminae shapes. Larger lumina of 1 to 1.7 μm distributed across the intercolpium but decreasing towards the apocolpium. Simplicolumellate muri is about 0.5 to 0.7 μm wide. Fossulate at margo's surface, with fossulae of 0.7 to 1 μm , close to the apertures. Tricolporate. Marginate ectocolpi with rounded endings, about 38 to 45 μm long and 9 to 10 μm wide. Ectocolpi with well-developed margo (1.5 μm). In polar view, two small bulges delimit the ectocolpi. Simple lalongate endopores of 9 to 13 μm of high and 3 to 5 μm of wide.

Remarks: Medium size. Reticulate-fossulate. Tricolporate. Simple lalongate endopores. Morphologically similar to *Hoffmannseggia*, differing in size, exine thickness and ornamentation pattern.

Species: *Trifolium repens* L. (Plate 14; 6-10)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate spheroidal shape. Medium size (25-30 μm). Semitectate exine of 1.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm high, decreasing in size towards the aperture. Reticulate. Heterobrochate. Irregular lumina of 0.7 to 1.2 μm wide, dispersed aleatory across the surface. Simplicolumellate muri of 0.5 μm wide. Tricolporate. Marginate ectocolpi with acute endings, about 20 to 27 μm long and 2 to 5 μm wide. Margo of 2 to 2.5 μm wide, with psilate ornamentation. Costate alongate endopores of 4 to 5 μm high and 5 to 8 μm wide. Wide open endopores. Difficult to find in polar view.

Remarks: Medium size. Prolate spheroidal shape. Reticulate. Heterobrochate, simplicolumellate muri. Tricolporate. . Aperture features (Psilate wide margo).

Species: *Vachellia macracantha* (Humb. & Bonpl. ex Willd.) Seigler & Ebinger (Plate 14; 11-15)

Description: Polyad of large size (60-80 μm). Pollen grains with radial symmetry, apolar, quadrangular amb. Medium size pollen grain (23-30 μm). Polyad is composed of 16 units (8 at the center and 8 laterally arranged). Tectate perforate exine of 1 to 1.5 μm . Visible nexine. Tectum is 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm . Punctate to scabrate. Circular puncta of less than 0.5 μm in diameter spread across the surface. At the polyad's polar view, dense scabrae can be observed. Inaperturate. Difficult to find in equatorial view.

Remarks: Dispersal unit. Large size polyad. Medium size pollen units. Ornamentation pattern of individual grains is punctate to scabrate. Inaperturate grains.

FRANKENIACEAE Desv.

Species: *Frankenia chilensis* C.Presl ex Schult. & Schult.f. (Plate 14; 16-20)

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, spheroidal shape. Large size (53-60 μm). Eutectate exine of 1.5 to 2 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae 0.8 to 1 μm high. Columellae's capita surpass the tectum layer, giving the appearance of microechinae. Gemmate to slightly clavate. Small gemmae/clavae of less than 1 μm high, about 1 to 1.2 μm wide are located at the apocolpium zone. Gemmae/clavae decrease in width towards the mesocolpium zone and the apertures. Tricolpate. Simple irregular colpi with rounded endings and membranous structure, about 50 to 57 μm long and 10 to 13 μm wide. Colpi's membrane is granulate.

Remarks: Large size. Gemmate to slightly clavate. Tricolpate. Ornamented aperture's membrane.

GERANIACEAE Juss.

Species: *Erodium cicutarium* (L.) L'Hér. (Plate 14; 21-25)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, oblate spheroidal shape. Large size (50-60 μm). Semitectate exine of 5 to 5.5 μm thick. Visible thick nexine (1 to 1.5 μm). Tectum of 1 μm thick. Conspicuous columellae of 3 μm . Striato-reticulate (Heterobrochate). Striae are cross-linked, forming reticulae in the grooves. Lumina's size is variable, about 1 to 2 μm , and the muri (striae) thickness is about 1.2 μm . Striae becomes denser at the apocolpium zone, reducing luminae's size. Tricolporate. Simple brevicolpi with rounded endings, about 13 to 15 μm long and 5 to 8 μm wide. Simple circular endopores of 4 to 5 μm in diameter. Large apocolpium zone. Endoapertures difficult to observe in equatorial view.

Remarks: Large size. Striato-reticulate. Heterobrochate. Brevicolpate. Slightly inconspicuous endopores.

Species: *Geranium limae* R.Knuth (Plate 14; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, oblate shape. Large size (53-68 μm) Semitectate exine of 7 μm thick. Visible nexine (2 μm thick). Tectum of 2 μm thick. Conspicuous columellae of 3 μm high. Columellae's capita are notoriously wide. Reticulate, homobrochate. Pentagonally shaped lumina of 2 μm of width. Simplicolumellate muri of 1 μm of thickness. Lumina are delimited by 5 to 6 columellae. Tricolporate to stephanocolporate (4 colpori). Simple irregular brevicolpi with acute endings, about 15 to 20 μm long and 7 to 8 μm wide. Simple circular to slightly lalongate endopores of 4 to 5 μm in diameter. Large apocolpium zone. Endoapertures difficult to observe in equatorial view.

Remarks: Large size. Exine thickness. Reticulate, pentagonally shaped luminae. Tricolporate to stephanocolporate (4 colpori). Brevicolpate.

HELIOTROPIACEAE Schrader, *nom. cons.*

Species: *Heliotropium arborescens* L. (Plate 14; 30-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical truncate outline in equatorial view, oblate spheroidal shape. Small to medium size (20-26 μm). Eutectate exine of 1.5 μm thick. Visible nexine. Tectum of 0.3 to 0.5 μm thick. Inconspicuous columellae. Exine increases in thickness towards the apocolpium zone and colpori. Psilate. Heterocolpate (3 colpori + 3 colpi). Simple ectocolpi of 18 to 23 μm long and 3 to 5 μm wide. Colpori have acute endings, whilst colpi have rounded endings. Costate circular to

slightly lalongate endopores of 5 to 8 μm wide. Reduced apocolpium zone. Exine separates towards the apertures, forming fastigia of 1.5 μm high.

Remarks: Small to medium size. Heterocolpate. Presence of fastigia. Psilate. Exine with variable thickness, with inconspicuous columellae..

KRAMERIACEAE Dumort.

Species: *Krameria lappacea* (Dombey) Burdet & B.B.Simpson (Plate 14; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, circular outline in equatorial view, spheroidal shape. Medium size (40-45 μm). Eutectate exine of 1.5 to 2 μm thick. Visible nexine (1.2 μm thick). Tectum of less than 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm of high. Striate. Striae of about 0.7 μm wide, larger than the grain itself, covering the intercolpium zone. Striae merge with each other at the apocolpium zone but get parallel to each other at the equator. Tricolporate. Simple ectocolpi with acute endings, about 38 to 42 μm long and 5 to 8 μm wide. Psilate aperture membrane. Costate lalongate endopores of 5 μm high and 10 to 12 μm wide. Endopores are wide, almost forming a cingulum. Large apocolpium zone. The exine separates towards the apertures forming fastigia of 1.5 μm high.

Remarks: Medium size. Striate. Striae merge at the apocolpium zone but run parallel at the equator. Tricolporate. Wide endopores, almost endocingulate. Fastigate.

LAMIACEAE Martinov

Species: *Hyptis uncinata* Benth. (Plate 15; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, elliptical amb, rectangular obtuse outline in equatorial view, oblate shape. Medium size (25-38 μm). Semitectate exine of 2 μm thick. Visible nexine (0.5 μm thick). Tectum of 0.3 to 0.5 μm . Conspicuous columellae of 1 to 1.2 μm high. Columellae strongly reduce in size towards the apertures. Reticulate. Homobrochate. Irregular-shaped lumina of 1 to 1.2 μm wide. Simplicolumellate muri of 0.7 μm thick. Stephanocolpate (6 colpi). Marginate colpi with acute endings, about 20 to 25 μm long and 3 to 5 μm wide. 1.2 to 1.7 μm thick. Margo's surface is psilate. Colpi and aperture membrane are projected. Medium size apocolpium zone.

Remarks: Medium size. Elliptical amb, rectangular obtuse outline in equatorial view. Reticulate. Homobrochate. Irregular shape but constant wide. Stephanocolpate (6 colpi).

Margo's surface. Presence of a projected aperture membrane, generating a particular outline in equatorial view.

Species: *Lepechinia lamiifolia* (Benth.) Epling (Plate 15; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, elliptical amb, elliptical convex outline in equatorial view, oblate spheroidal shape. Medium size (30-42 μm). Semitectate exine of 1.5 to 2 μm thick. Visible thin nexine. Tectum of 0.3 to 0.5 μm thick. Conspicuous columellae of 0.7 to 1 μm high. Columellae slightly decrease in size towards the apertures. Reticulate. Heterobrochate, Irregular lumina of 1 to 3 μm wide. Larger lumina located at the mesocolpium zone. Simplicolumellate muri of 1 μm wide. Stephanocolpate (6 colpi). The distribution of colpi may also suggest a "trigeminate" type of aperture (grains with colpi arranged in trios). Long marginate colpi with acute endings, about 27 to 38 μm long and 4 to 5 μm wide. Irregular margo's surface is psilate to scabrate. Projected margo. Apertures have a mirror rather than symmetrical distribution, having three apertures per meridional face. Small to medium size apocolpium.

Remarks: Medium size. Reticulate. Heterobrochate. Ornamentation pattern. Stephanocolpate (6 colpi). Apertures have a mirror rather than symmetrical distribution. The distribution of colpi may also suggest a "trigeminate" type of aperture (grains with colpi arranged in trios).

Species: *Minthosachys mollis* (Benth.) Griseb. (ex-*Minthostachys tomentosa*) (Plate 15; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, elliptical amb, circular to slightly elliptical outline in equatorial view, oblate spheroidal shape. Small size (22-35 μm). Tectate perforate exine of 1.5 to 2 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 0.5 to 0.8 μm high. (Micro)reticulate to fossulate. Heterobrochate. (Micro)reticulate at the mesocolpium zone and fossulate towards the apocolpium zone. Irregular lumina of 0.5 to 0.7 μm wide. Small elongated lumina are located at the apocolpium zone, increasing in width towards the mesocolpium zone. Simplicolumellate muri of less than 0.5 μm wide. Stephanocolpate (6 colpi). Marginate colpi with acute endings, about 18 to 25 μm long and 3 to 5 μm wide. Thin margo. Medium size apocolpium zone.

Remarks: Small size. Ornamentation pattern is (micro)reticulate to fossulate. Heterobrochate.. Stephanocolpate (6 colpi). Thin margo.

Species: *Salvia rhombifolia* Ruiz & Pav. (Plate 15; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, elliptical amb, elliptical outline in equatorial view, oblate shape. Medium size (32-42 μm). Semitectate exine of 1 μm thick. Visible thin nexine. Tectum about 0.2 μm thick. Conspicuous columellae of 0.5 μm high. Columellae decrease in size towards the apertures. Reticulate. Heterobrochate. Irregular lumina of variable size. Smallest lumina (0.7 to 1 μm wide) are located at the apocolpium zone, increasing in size towards the mesocolpium zone (3 to 4 μm wide). Smaller luminae also extend to the widest areas between apertures. Simplicolumellate muri of 0.5 μm wide. Stephanocolpate (6 colpi). The distribution of colpi may also suggest a “trigeminate” type of aperture (grains with colpi arranged in trios). Marginate colpi with acute endings, about 26 to 36 μm long and 3 to 5 μm wide. Granulate margo. Apertures have a mirror rather than symmetrical distribution, having three apertures per meridional face. Small to medium size apocolpium.

Remarks: Medium size. Reticulate. Heterobrochate. . Stephanocolpate (6 colpi). Granulate margo. Apertures have a mirror rather than symmetrical distribution, having three apertures per meridional face.

Species: *Stachys peruviana* Dombey ex Benth. (Plate 15; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, circular amb, circular outline in equatorial view, oblate spheroidal shape. Small to medium size (22-27 μm). Tectate perforate exine of 1 to 1.2 μm thick. Visible thick nexine. Nexine is thicker than sexine. Tectum of 0.3 μm thick. Slightly conspicuous columella of 0.5 μm high. Sexine decreases in thickness towards the apertures. Microreticulate. Heterobrochate. Irregular lumina of less than 1 μm wide. Smaller luminae (less than 0.5 μm), resembling puncta, located at the apocolpium zone and next to the apertures. Luminae slightly increase in size towards the mesocolpium zone. Tricolpate. Marginate colpi with acute endings, about 16 to 22 μm long and 4 to 9 μm . Slightly projected margo with psilate surface, about 0.3 to 0.5. Small apocolpium zone.

Remarks: Small to medium size. Microreticulate. Heterobrochate. Nexine is thicker than sexine. Tricolpate. Marginate colpi. Slightly projected margo with psilate surface.

LOASACEAE Juss.

Species: *Loasa nitida* Desr. (Plate 15; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, circular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (18-20 μm). Tectate perforate exine of 1 to 1.2 μm thick. Visible thin nexine. Nexine produces an internal shadow with a globular shape. Tectum of less than 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm of height. Punctate to microreticulate. Circular to irregular luminae of less than 0.5 μm wide, dispersed across the surface. Tricolporate. Marginate ectocolpi of acute endings, about 15 to 20 μm long and 7 to 8 μm wide. Costate lalongate endopores, about 4 to 5 μm high and 5 to 7 μm wide. Endoapertures are difficult to observe in equatorial view, yet they are very well defined in polar view. Exine separates towards the apertures, forming a well-defined fastigia (1 μm). Reduced apocolpium zone.

Remarks: Small size. Thick exine. Punctate to microreticulate. Tricolporate. Aperture features. Well-defined fastigia. Endoapertures are difficult to observe in equatorial view, yet they are very well defined in polar view.

Species: *Nasa urens* (Jacq.) Weigend (Plate 15; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, circular amb, elliptical truncate outline in equatorial view, prolate shape. Small to medium size (20-25 μm). Tectate perforate exine of 1 to 1.5 μm thick. Slightly visible nexine. Nexine produces an internal shadow with a triangular to hexagonal shape. Tectum of 0.3 to 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Sexine decreases towards the apertures. Microreticulate. Homobrochate. Irregular lumina of 0.3 to 0.5 μm wide. Simplicolumellate muri of less than 0.5 μm wide. Tricolporate. Slightly marginate ectocolpi with acute endings, about 18 to 23 μm long and 5 to 9 μm wide. Costate lalongate endopores of 5 to 6 μm high and 8 to 10 μm wide. Endopores are difficult to observe in equatorial view. The exine separates towards the apertures, forming fastigia (1.5 μm). Reduced apocolpium zone.

Remarks: Small to medium size. Microreticulate. Homobrochate. Tricolporate. Reduced apocolpium zone. Well-defined fastigia, wider than in *Loasa*.

Species: *Presliophytum arequipense* Weigend (Plate 15; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, subtriangular amb, elliptical acuminate obtuse outline in equatorial view, peroblate shape. Small size (11-17 μm). Eutectate exine of 1 μm thick. Not visible nexine. Tectum of 0.3 μm thick. Inconspicuous columellae, less than 0.5 μm high. Exine decreases towards the aperture. Psilate. Presence of well-developed interloculum.

Tricolporate. Simple ectocolpi with rounded endings, about 10 to 16 μm and 5 μm wide. Costate lalongate endopores of 2 to 3 μm high and 5 to 7 μm wide. Small apocolpium zone.

Remarks: Small size. Peroblate shape, elliptical acuminate obtuse outline in equatorial view. Psilate ornamentation. Tricolporate. Simple ectocolpi. In contrast to *Loasa* and *Nasa*, this genus is not fastigiate. Presence of well-developed interloculum.

MALVACEAE Juss.

Species: *Abutilon bivalve* (Cav.) Dorr (ex-*Bastardia bivalvis*) (Plate 16; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, spheroidal shape. Large size (93-100 μm). Tectate perforate exine of 2.5 μm thick. However, sexine reaches 4 μm in thickness at zones with supratectal elements. Visible nexine. Tectum is 0.5 μm thick. Conspicuous columellae of 1.3 μm high, but increasing towards the position of supratectal elements, being about 2 μm high. Echinate and punctate. Conical to hook-like echinae of 5 to 6 μm high, pluricolumellate at the base, supported by 4 or 5 μm columellae. The space between echinae is densely punctate. Circular to irregular puncta of less than 0.5 μm in diameter. Tricolporate. Simple brevicolpi with acute endings, about 10 to 13 μm long and 5 μm wide. Ectocolpi are difficult to observe. Costate circular endopores, about 8 to 10 μm in diameter. Difficult to find a perfect polar or equatorial view. Exine with a weakening zone with a groove-like appearance.

Remarks: Large size. Echinate and punctate. Conical to hook-like echinae. Tricolporate. Inconspicuous brevicolpi. Costate endopores.

Species: *Cristaria multifida* (Dombey ex Cav.) Cav. (Plate 16; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, circular amb, circular outline in equatorial view, spheroidal shape. Large size (55-63 μm). Semitectate exine of 2 μm thick but getting 4 μm below supratectal elements. Visible thick nexine (1 μm). Tectum of 0.3 to 1 μm thick. Conspicuous columellae of 0.7 to 2 μm high, increasing in size towards supratectal elements. Echinate and foveoreticulate. Conical echinae of 4 to 5 μm high, wider at the base (2 μm) and getting thinner towards the tip. Pluricolumellate echinae, supported by 6 to 7 columellae. Circular to irregular lumina of 0.7 μm to 1.2 μm wide. Negative reticulum. Tricolporate. Simple brevicolpi with acute endings of 8 to 10 μm long and 2 to 3 μm wide. Inconspicuous ectocolpi. Costate circular endopores of 6 to 8 μm in diameter. Difficult to find a perfect polar or equatorial view. Exine with a weakening zone with a groove-like appearance.

Remarks: Smaller in size in comparison to *Abutilon*. Ornamentation pattern (Echinate and foveoreticulate). Inconspicuous brevicolpi. Costate endopores. Exine with a weakening zone with a groove-like appearance.

Species: *Fuertesimalva chilensis* (A.Braun & C.D.Bouché) Fryxell (Plate 16; 11-15)

Description: Monad, radial symmetry, apolar, circular amb. Large size (58-65 μm). Tectate perforate exine of 2.5 μm thick but getting thicker (3.5 μm) below supratectal elements. Visible well-defined nexine (1.5 μm thick). Tectum of 0.5 μm thick. Conspicuous columellae of 0.5 to 1.5 μm high. Sexine increases in thickness below supratectal elements. Echinate and punctate. Acicular echinae of 4 to 5 μm high and slightly wider at the base. Pluricolumellate echinae, supported by 3 to 4 columellae. Irregular puncta less than 0.5 μm wide. Puncta are densely dispersed across the surface. Some puncta are elongated, resembling a fossulae. Pantocolporate (9 colpi). Simple constricted ectobrevicolpi with acute endings, about 6 to 9 μm long and 2 μm wide. Costate circular endopores of 4 to 5 μm in diameter. Difficult to find a perfect polar or equatorial view. Exine with a weakening zone with a groove-like appearance.

Remarks: Large size. Echinate and punctate. Acicular echinae. Pantocolporate (9 colpi). Inconspicuous brevicolpi. Costate endopores. Exine with a weakening zone with a groove-like appearance.

Species: *Gaya atiquipana* Krapov. (Plate 16; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for the region of Arequipa, Peru-

Description: Monad, radial symmetry, apolar, circular amb. Large size (95-107 μm). Tectate perforate exine of 3 μm thick, in but getting thicker (6 μm) below supratectal elements. Visible nexine (1 μm thick). Tectum of 0.5 μm thick. Conspicuous columellae of 1.5 to 4.5 μm high. Columellae increase in size below supratectal elements. Echinate and punctate. Conical to slightly acicular echinae of 5 to 6 μm , wider at the base (1.5 μm), getting thinner towards the tip. Echinae with a well-developed base. Pluricolumellate echinae supported by 5 to 6 μm columellae. Irregular puncta of 0.5 to 0.7 μm wide, dispersed across the surface. Pantocolporate (12 colpi). Simple ectobrevicolpi with acute endings about 10 to 12 μm long and 3 to 4 μm wide. Brevicolpi are difficult to observe. Costate circular endopores width is about 7 to 12 μm in diameter, separated from each other by 7 to 10 μm of distance. Exine with a weakening zone with a groove-like appearance.

Remarks: Large size. Echinate and punctate. Echinae with a well-developed base. Exine under echinae gets thicker. Pantocolporate (12 colpi).

Species: *Malva parviflora* L. (Plate 16; 21-25)

Description: Monad, radial symmetry, apolar, circular amb. Large size (90-100 μm). Tectate perforate exine of 5 μm thick. Visible and well-developed nexine (4 μm thick). Tectum of 0.5 μm thick. Conspicuous columellae of 0.5 μm high. Columellae slightly increase in size below supratectal elements. Echinate and punctate. Conical echinae of two sizes. Larger ones of 5 to 6 μm high. Slightly wider at the base. Smaller ones of 1 μm high, sparsely dispersed. The largest echinae are pluricolumellate, supported by many columellae (indistinct number). Circular puncta of less than 0.5 μm in diameter, densely dispersed across the surface. Pantoporate (30 to 40 pores). Simple circular ectopores of 3 to 4 μm in diameter. Costate circular endopores of 3 to 4 μm in diameter.

Remarks: very large size. Thick nexine. Sexine pattern. Echinate and punctate with conical echinae having two different sizes. Aperture number (30 to 40 pores).

Species: *Melochia pyramidata* L. (Plate 16; 25-30)

-This genus presents heterostyly in their flowers and pollen dimorphism. Two existing pollen morphotypes are described for the genus-

Description (1): Monad, radial symmetry, isopolar, subtriangular amb, elliptical truncate outline in equatorial view, prolate spheroidal to oblate spheroidal shape. Medium size (30-35 μm). Semitectate exine of 1.5 μm thick. Visible nexine. Tectum of 0.3 μm thick. Conspicuous columellae of 0.7 μm high. Columellae slightly decrease towards the apertures. Reticulate. Heterobrochate. Irregular lumina of 0.7 to 1.5 μm wide. Larger lumina are located at the apocolpium zone, sharply decreasing to the mesocolpim zone. Simplicolumellate muri of 0.3 to 0.5 μm wide. Tricolporate. Marginate ectocolpi with rounded endings, about 18 to 22 μm long and 2 to 8 μm wide in polar view. Colpi seem to be constricted in equatorial view (2 μm). Costate lalongate endopores of 3 to 5 μm high and 8 to 10 μm wide. Exine separates towards the apertures forming fastigia (0.8 to 1 μm high). Medium to small apocolpium zone.

Remarks: Medium size. Variable shape (prolate spheroidal to oblate spheroidal). Reticulate, heterobrochate. Tricolporate. Fastigiate. Medium to small apocolpium zone.

Description (2): Monad, radial symmetry, isopolar, circular to slightly subtriangular amb, circular to elliptical truncate or acuminate outline in equatorial view, spheroidal to oblate. Medium to large size (45-60 μm). Tectate perforate exine of 2 to 2.2 μm thick. Visible nexine (1 μm). Tectum of less than 0.5 μm thick. Slightly conspicuous columellae, about 0.7 to 1 μm . Sexine decreases towards the apertures. Microechinate and punctate. Small conical microechinae of 0.5 μm high or less, densely dispersed across the surface. Circular puncta about 0.3 to 0.7 μm in diameter, widely dispersed. Tricolporate. Simple irregular brevictocolpi with acute endings, about 20 to 22 μm long and 3 to 5 μm wide in polar view. Brevicolpi seem to be constricted, about 1.5 to 2 μm wide in equatorial view. Costate lalongate endopores of 4 μm of height and 8 to 10 μm of width. Endopores have a well-defined rectangular shape. Exine separates towards the apertures forming fastigia (0.5 μm high).

Remarks: Medium to large size. Variable shape (circular to elliptical truncate or acuminate). Microechinate and punctate. Tricolporate. Brevicolpate. Rectangular lalongate endopores. Fastigiate.

Species: *Palaua rhombifolia* Graham (Plate 16; 31-35)

Description: Monad, symmetry radial, apolar, amb circular. Medium size (40 to 45 μm). Tectate perforate exine of 2 μm thick but getting thicker (3.5 μm) below supratectal elements. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae 0.7 to 2 μm high, increasing in size below supratectal elements. Echinate and punctate. Conical to acicular echinae of 3 to 3.5 μm high, slightly wider at the base (2 μm). Pluricolumellate echinae, supported by 5 to 6 columellae. Circular puncta of 0.5 to 0.7 μm in diameter, widely dispersed across the surface. Pantocolporate (5 to 7 colpori). Simple small brevicolpi with acute endings, about 3 to 4 μm long and 1 to 2 μm wide. Costate circular endopores of 3 to 6 μm in diameter. Colpori are notoriously separated (about 10 to 20 μm). Exine with a weakening zone with a groove-like appearance.

Remarks: Medium size. Echinate and punctate. Pantocolporate (5 to 7 colpori). Brevicolpi. Conical to acicular echinae. Exine with a weakening zone with a groove-like appearance.

Species: *Sida acuta* Burm.f. (Plate 16; 36-40).

Description: Monad, radial symmetry, apolar, circular amb. Large size (60-65 μm). Tectate perforate exine of 2.5 μm thick, getting thicker (4 μm) below supratectal elements. Visible thick nexine (1.5 μm). Tectum of 0.5 μm thick, Conspicuous columellae of 0.5 μm high but increasing in size (2 μm) below supratectal elements. Echinate and punctate. Densely distributed echinae. Hook-like to slightly acicular echinae of 4 to 5 μm high, wide at the base (3 μm). Pluricolumellate echinae, supported by 4 to 5 columellae. Circular puncta of 0.5 μm in diameter, densely dispersed across the surface. Pantoporate (5 to 7 pores). Simple circular ectopores of 4 to 5 μm in diameter. Costate circular endopores of 4 to 5 μm in diameter. Pores are separated by 10 to 15 μm .

Remarks: Large size. Echinate and punctate. Echinae's shape. Pantoporate (5 to 7 pores). Densely distributed echinae.

Species: *Fuertesimalva peruviana* (L.) Fryxell (ex-*Urocarpidium peruvianum* (L.) Krapov.) (Plate 17; 1-5)

Description: Monad, radial symmetry, apolar, circular amb. Medium size (45-50 μm). Tectate perforate exine of 3.5 μm , getting thicker (4 μm) below supratectal elements. Visible nexine. Sexine thicker than nexine. Tectum of 0.5 μm thick. Conspicuous columellae about 2 μm high, increasing in size below supratectal elements (2.5 μm). Echinate and punctate. Conical echinae of 3 to 3.5 μm high, wider at the base (2 μm). Pluricolumellate echina, supported by 5 to 6 columellae. Circular puncta of 0.5 μm in diameter, densely dispersed across the

surface. Pantocolporate (at least 5 colpi). Simple brevicolpi with acute endings, about 3 to 4 μm long and 2 μm wide. Ectocolpi are difficult to observe. Costate circular endopores, about 3 to 5 μm in diameter. Apertures are notoriously separated from each other, about 25 to 30 μm .

Remarks: Medium size. Echinulate and punctate. Pantocolporate (at least 5 colpi). Brevicolporate. Apertures are notoriously separated.

Species: *Waltheria ovata* Cav. (Plate 17; 6-10)

-This genus presents heterostyly in their flowers and pollen dimorphism. Two existing pollen morphotypes are described for the genus-

Description (1): Monad, radial symmetry, isopolar, quadrangular amb, elliptical truncate to acuminate outline in equatorial view, oblate spheroidal to prolate shape. Medium size (32-40 μm). Semitectate exine of 1.5 to 2 μm thick. Visible nexine. Tectum of 0.3 to 0.5 μm thick. Conspicuous capitate columellae of 0.7 to 1 μm high. Reticulate. Heterobrochate. Irregular to square-like luminae of 1 to 2 μm wide. Larger lumina are located at the apocolpium zone, getting smaller towards the mesocolpium zone and the apertures. Simplicolumellate muri of 0.5 to 0.7 μm . Stephanocolporate (4 colpi). Marginate ectocolpi with acute endings, about 20 to 25 μm long and 3 to 5 μm wide in polar view. Ectocolpi is slightly constricted (1 to 2 μm wide) at the equator. Costate elongate endopores of 4 μm high and 7 to 8 μm wide. Exine separates in two layers towards the apertures, forming fastigia of 0.3 to 0.5 μm high. Wide apocolpium zone.

Remarks: Medium size. Quadrangular amb. Variable outline in equatorial view. Reticulate pattern with visible capita. Stephanocolporate (4 colpi). Marginate ectocolpi. Fastigate.

Description (2): Monad, radial symmetry, isopolar, circular amb, elliptical acuminate outline in equatorial view, prolate shape. Medium size (43-55 μm). Tectate perforate exine of 2 μm thick. Visible nexine, decreasing in thickness towards the apertures. Tectum of 0.3 μm thick. Slightly conspicuous columellae of 1 μm high. Microechinate and punctate. Small conical microechinae of 0.3 to 0.5 μm high, sparsely distributed across the surface. Circular puncta of 0.5 μm in diameter, densely dispersed across the surface. Stephanocolporate (5 colpi). Simple brevicolpi with acute endings, about 18 to 20 μm long and 3 to 4 μm wide. Costate circular endopores of 6 to 8 μm in diameter. Exine slightly separates towards the apertures, forming fastigia of 0.3 to 0.5 μm high.

Remarks: Medium size. Circular amb, Microechinate and punctate. Stephanocolporate (5 colpi). Circular fastigate endopores.

MONTIACEAE Raf.

Species: *Calandrinia alba* (Ruiz & Pav.) DC. (Plate 17; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, circular amb. Medium size (43-50 μm). Semitectate exine of 3 to 3.5 μm . Slightly visible nexine. Tectum of 1 μm thick. Conspicuous columellae of 1.5 to 2 μm high, decreasing in size towards the apertures. Reticulate. Heterobrochate. Irregular luminae of variable size, about 0.5 to 2.2 μm wide. Luminae heterogeneously dispersed across the surface but getting smaller towards the apertures. Pantocolpate (10 to 12 colpi). Marginate brevicolpi with acute endings, about 12 to 17 μm long and 2 to 3 μm wide. Operculate brevicolpi. When present, opercula are granulate. Colpi arranged in groups of five, forming an H-like pattern.

Remarks: Medium size. Reticulate. Heterobrochate. Pantocolpate. Aperture arrangement (H-like pattern). Operculate brevicolpi (10 to 12 colpi). When present, opercula are granulate.

Species: *Cistanthe calycina* (Phil.) Carolin ex Hershk. (Plate 17; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate to elliptical acuminate outline in equatorial view, prolate shape. Medium size (38-45 μm). Semitectate exine of 3 μm . Visible and well-defined nexine (1 μm), slightly decreasing towards the apertures. Tectum of 1 μm . Conspicuous columellae of 1 to 1.2 μm high, rapidly reducing in size towards the aperture. Foveoreticulate. Circular to irregular lumina of 0.5 to 1.5 μm wide. Small circular foveolae are densely located at the mesocolpium zone. Larger foveolae are spread at the apocolpium zone, where some of these resemble a fossula-like shape. Tricolpate. Strongly marginate colpi with rounded endings, about 35 to 40 μm long and 8 to 16 μm wide in polar view. Granulate margo. Granula decreases in size to the outer part of the apertures. Colpi is constricted in equatorial view. Presence of a granulate aperture membrane. Reduced apocolpium zone.

Remarks: Medium size. Variable outline. Columellae rapidly decrease towards the aperture. Foveoreticulate. Tricolpate. Strongly marginate colpi with granulate margo.

MYRTACEAE Juss.

Species: *Myrcianthes ferreyrae* (McVaugh) McVaugh (Plate 17; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical acuminate outline in equatorial view, oblate shape. Small size (15-22 μm). Eutectate exine of 0.7 to 1 μm . Slightly visible nexine, located exclusively at the mesocolpium zone. Tectum of 0.3 μm thick. Inconspicuous columellae. Sexine decreases in thickness towards the aperture. Psilate. Tricolporate. Parasyncolporate. Anguloaperturate. Marginate ectocolpi completely fused at the apocolpium zone, about 15 to 22 μm long and 2 to 3 μm wide. Irregular apocolpial field. Costate circular endopores of 3 to 5 μm in diameter.

Remarks: Small size. Triangular amb. Elliptical acuminate outline in equatorial view. Triangular amb. Nexine location. Tricolporate. Parasyncolporate. Anguloaperturate. Irregular apocolpial field.

NYCTAGINACEAE Juss.

Species: *Boerhavia coccinea* Mill. (Plate 17; 26-30)

Description: Monad, radial symmetry, apolar, circular amb. Large size (55-60 μm). Tectate perforate exine of 6 μm of thick. Visible thick nexine 5 μm . Nexine is thicker than sexine. Tectum of 1 thick. Slightly conspicuous columellae of 1 μm high. Echinate and punctate. Small conical echinae of 1.5 to 2 μm high, wider at the base. Echinae are densely distributed. Circular puncta of 0.5 to 0.7 μm in diameter, sparsely dispersed across the surface. Pantoporate (about 15 pores). Simple circular ectopores of 5 to 6 μm in diameter. Simple circular endopores of same proportions than ectopores.

Remarks: Large size. Nexine thickness. Ornamentation pattern is echinate and punctate. Conical echinae. Pantoporate (about 15 pores).

Species: *Mirabilis prostrata* (Ruiz & Pav.) Heimerl (Plate 17; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Large size (77-82 μm). Tectate perforate exine of 6 μm thick. Visible thick nexine (3 μm). Tectum of 1 μm thick. Conspicuous columellae of 2 μm high. Echinate and punctate. Small acicular echinae of 1.5 to 2 μm high, slightly wider at the base. Echinae are densely distributed. Circular puncta of 0.5 μm in diameter, sparsely dispersed across the surface. Pantoporate (about 20 pores). Simple circular ectopores of 5 to 6 μm in diameter. Costate circular endopores of same proportions than ectopores.

Remarks: Large size. Nexine thickness. Ornamentation pattern is echinate and punctate. Acicular echinae, slightly larger than in *Boerhavia*. Pantoporate (about 20 pores). Costate endopores.

ONAGRACEAE Juss.

Species: *Epilobium fragile* Sam. (Plate 17; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Tetrahedral tetrad of large size (90-110 μm). Pollen grains with radial symmetry, triangular amb, elliptical acuminate outline in equatorial view, oblate shape tetrahedral. Large size pollen grain (60-67 μm). Eutectate exine of 3 μm . Visible thick nexine (1.3 μm). Tectum of 1 to 1.2 μm . Slightly conspicuous columellae of 0.5 to 0.7 μm high. Sexine increases in thickness towards the apertures (5 to 6 μm). Psilate to slightly scabrate. Triporate. Annulate circular projected ectopores of 7 to 10 μm in diameter. Annulus is 2 to 3 μm wide. Costate circular endopores, almost double in size than ectopores (16 to 20 μm). Exine separates towards the apertures vestibula, about 1 μm high. It also can be noticed a string-like structure emerging from the apertures (viscin thread).

Remarks: Dispersal unit. Large size tetrad and pollen grain. Projected annulate ectopores. Vestibulate. Presence of a viscin thread. Individual grains are psilate to slightly scabrate. Triporate. Presence of a string-like structure emerging from the apertures (viscin thread).

Species: *Ludwigia octovalvis* (Jacq.) P.H.Raven (Plate 18; 1-5)

Description: Coaperturate tetrahedral tetrad of large size (90-100 μm). Pollen grains with radial symmetry, isopolar, subtriangular amb, elliptical acuminate outline in equatorial view, oblate shape. Large size pollen grain (70-75 μm). Eutectate exine of 3 μm thick. Visible nexine (1 μm). Tectum of 0.5 to 0.7 μm thick. Indistinct columellae. Sexine increases in thickness towards the apertures (about 5 μm). Rugulate. Irregular rugulae of 4 to 4.5 μm wide, irregularly distributed across the surface, increasing in width towards the apertures. Triporate. Annulate circular projected ectopores of 7 to 10 μm in diameter. Well-defined annulus about 5 to 7 μm wide. Costate circular endopores, almost double in size than the ectopores (18 to 20 μm). Exine separates towards the apertures forming vestibula of 1.5 μm wide. Presence of a viscin thread coming out the apertures.

Remarks: Coaperturate tetrad. Large size tetrad and pollen grain. Rugulate. Projected annulate ectopores. In contrast to *Epilobium*, the annulus is wider. Presence of a viscin thread.

Species: *Oenothera arequipensis* Munz & I.M.Johnst. (Plate 18; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical acuminate outline in equatorial view, oblate shape. Large size (78-90 μm). Tectate perforate exine of 3.5 μm thick. Visible nexine (1 μm). Tectum of 0.8 to 1 μm thick. Indistinct columellae. Psilate, punctate to slightly scabrate. Circular puncta of less than 0.5 μm in diameter, distributed across the

surface, but getting conspicuously denser towards the apertures. Scabrae are usually present at the mesocolpium zone, with no pattern. Triporate. Annulate lalongate and very projected ectopores, about 18 to 22 μm in diameter. Projected ectopores give the appearance of a crater. Annulus about 3 to 4 μm wide. Costate lalongate endopores, slightly wider than the ectopores (25 to 27 μm). Exine separates towards the apertures forming vestibula (about 0.8 to 1 μm). Difficult to observe in equatorial view.

Remarks: Large size. Psilate, punctate to slightly scabrate. Triporate. Annulate lalongate and very projected ectopores, Differing with *Epilobium* and *Ludwigia* in dispersal unit. Large size. Psilate, punctate to slightly scabrate. Projected annulate ectopores.

OROBANCHACEAE Vent.

Species: *Castilleja arvensis* Schltdl. & Cham. (Plate 18; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, circular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (22-25 μm). Tectate perforate exine of 1 to 1.2 μm thick. Slightly visible thin nexine. Tectum of 0.5 μm thick. Inconspicuous columellae. Exine decrease in thickness towards the apertures. Microreticulate. Circular lumina of less than 0.5 μm in diameter, dispersed heterogeneously across the surface. Tricolpate to syncolpate at only one pole. Slightly marginate irregular colpi of 20 to 22 μm long and 2 to 4 μm wide. The syncolpate pole resembles a fissure-like pattern. Reduced apocolpium zone.

Remarks: Small size. Inconspicuous columellae yet microreticulate pattern. Syncolporate at only one pole. Small apocolpium zone.

PAPAVERACEAE Juss.

Species: *Argemone subfusiformis* Ownbey (Plate 18; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, heteropolar, circular amb, circular outline in equatorial view, shape spheroidal. Medium size (50-56 μm). Semitectate exine of 2 to 2.2 μm thick. Visible nexine, almost disappearing at the apertures zone. Tectum of 0.5 μm thick. Conspicuous columellae of 1 to 1.2 μm high. Sexine decreases in thickness towards the apertures. Fossureticulate. Heterobrochate. Irregular lumina of 0.5 to 0.7 μm wide and 1 to 2 μm long, heterogeneously dispersed across the surface, but getting smaller towards the center of the apocolpium zone. Fossulate at the apocolpium zone. Tricolpate. Marginate colpi with acute endings, about 48 to 54 μm long and 7 to 15 μm wide. Colpi with irregular borders. Margo is defined by a sexine thinning. Presence of an ornamented opercula. Very small apocolpium zone only at one pole. Difficult to observe in equatorial view.

Remarks: Medium size. Fossureticulate. Heterobrochate. Tricolpate. Reduced apocolpium zone only at one pole. Colpi with irregular borders. Presence of an ornamented opercula.

Species: *Fumaria capreolata* L. (Plate 18; 21-25)

Description: Monad, radial symmetry, apolar, circular amb. Medium size (45-50 μm).

Eutectate exine of 1.5 μm thick. Visible nexine. Tectum of 0.5 to 0.7 μm thick.

Inconspicuous columellae. Verrucate. Irregular shaped verrucae of 1.5 to 2 μm high and 3 to 5 μm wide, slightly decreasing in size towards the apertures. Pantoporate (7 to 9 pores).

Aspidate circular to irregular ectopores of 7 to 9 μm wide. Wide open pores. Well-defined aspis of 3 wide. Simple circular to irregular endopores of 10 to 15 μm wide. Presence of an aperture membrane.

Remarks: Medium size. Verrucate. Pantoporate (7 to 9 pores). Wide open aspidate ectopores. Presence of an aperture membrane.

PASSIFLORACEAE Juss. ex Roussel

Species: *Malesherbia scarlatiflora* Gilg (Plate 18; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Large size (60-67 μm). Semitectate exine of 2 μm thick.

Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 1 μm high, decreasing towards the apertures. Reticulate. Heterobrochate. Irregular luminae of 1 to 1.8 μm wide, decreasing in width towards the apocolpium zone and the apertures, but slightly increasing at the equator. Luminae with free-standing columellae. Simplicolumellate muri of 0.5 μm wide. Tricolpate. Marginate ectocolpi with acute endings, about 58 to 65 μm long and 15 to 20 μm wide in polar view, but 7 to 8 μm wide in equatorial view (slightly constricted colpi).

Reduced apocolpium zone.

Remarks: Large size. Reticulate pattern. Heterobrochate. Simplicolumellate. Free-standing columellae. Tricolpate.

Species: *Passiflora foetida* L. (Plate 18; 31-35)

Description: Monad, radial symmetry, isopolar, triangular amb, prolate shape. Large size (60-75 μm). Semitectate exine, about 5 μm thick. Visible nexine. Tectum of 1 μm thick.

Conspicuous columellae of 3 μm high. Reticulate. Heterobrochate. Irregular lumina about 4 to 8 μm wide, getting slightly smaller at the mesocolpium. Lumina with free-standing columellae at the center. Larger luminae are located at the opercula's surface.

Simplicolumellate muri of 1 to 1.5 μm thick. Secondly, inside the lumina there are about 3 to 4 free-standing columellae. Tricolpate. Simple and wide open colpi with rounded endings, about 65 to 70 μm long and 45 to 50 μm wide. Ornamented opercula of 60 to 67 μm long. Opercula is less wide than the aperture. The ornamentation is the same as the pollen grain. Opercula attached to the apertures is difficult to observe. Difficult to observe in equatorial view.

Remarks: Large size. String-like shape pollen grain. Large size. Reticulate. Heterobrochate. Luminae with free-standing columellae. Tricolpate. Ornamented opercula.

PHYTOLACCACEAE R.Br.

Species: *Phytolacca bogotensis* Kunth (Plate 18; 36-40)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (26-30 μm). Tectate perforate exine of 1 to 1.5 μm thick. Visible nexine. Tectum of 0.3 to 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm high. Sexine slightly decreases in thickness towards the apertures. Microreticulate. Circular luminae of 0.3 to 0.5 μm in diameter, homogeneously dispersed across the surface. Tricolpate. Marginate long colpi with acute endings, about 23 to 27 μm long and 5 to 7 μm wide in polar view. Colpi is constricted in equatorial view. Medium size apocolpium zone.

Remarks: Medium size. Microreticulate. Tricolpate. Marginate long colpi.

PIPERACEAE Giseke

Species: *Peperomia galioides* Kunth (Plate 19; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Very small to small size (7-10 μm). Eutectate exine of 0.8 to 1 μm thick. Visible nexine. Thin tectum of less than 0.5 μm thick. Inconspicuous columellae. Verrucate. Irregular verrucae of variable shapes and size, about 1 to 4 μm wide and less than 1 μm high. Inaperturate.

Remarks: Small size. Verrucate. Irregular verrucae. Inaperturate.

PLANTAGINACEAE Juss.

Species: *Plantago limensis* Pers. (Plate 19; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, apolar, circular amb. Medium size (22-30 μm). Eutectate exine of 1 to 1.2 μm thick. Visible nexine. Thin tectum of less than 0.5 μm thick.

Inconspicuous columellae. Verrucate. Irregular to verrucae of 1 to 2 μm wide, densely dispersed across the surface. Pantoporate (5 to 7 pores). Simple circular to slightly irregular ectopores of 3 to 5 μm in diameter. Costate circular endopores, similar in width to the ectopores. Apertures are widely separated. Sometimes, the aperture has a membrane.

Remarks: Medium size. Verrucate. Pantoporate (5 to 7 pores). Apertures widely separated. Presence of an aperture membrane.

Species: *Veronica persica* Poir. (Plate 19; 11-15)

Description: Monad, symmetry radial, isopolar, amb circular to subtriangular, shape spheroidal to oblate. Medium size (25-33 μm). Tectate perforate exine of 1.5 μm thick. Visible nexine. Tectum is 0.5 μm thick. Slightly conspicuous columellae of 0.7 μm high. Sexine slightly decreases in thickness towards the apertures. Microreticulate to punctate. Heterobrochate. Circular lumina of 0.5 μm in diameter or less, dispersed across the surface. Luminae's width decrease towards the apertures, turning into very small puncta. Tricolpate. Marginate ectocolpi with acute endings, about 23 to 30 μm long and 8 to 12 μm wide in polar view. Colpi are constricted in equatorial view (2 μm wide). Presence of a granulate aperture membrane, irregularly dispersed. Granulae increases in size towards the equator. Medium size apocolpium.

Remarks: Medium size. Ornamentation pattern is microreticulate to punctate. Tricolpate. Presence of a granulate aperture membrane.

PLUMBAGINACEAE Juss.

Species: *Plumbago caerulea* Kunth (Plate 19; 16-20)

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, spheroidal to oblate spheroidal. Large size (55-62 μm). Intectate exine of 4.5 to 5 μm thick. Visible thick nexine (2 μm), getting thicker towards the apertures. Large conspicuous columellae of 2.5 to 3 μm high, decreasing in size towards the apertures. Clavate. Large clavae (capitate columellae) of 2.5 to 3 μm high. Clavae's capita is 1 μm wide. Clavae clustered in groups of 2 to 5, about 3 μm wide. Clavae accommodation form a particular negative reticulum pattern. Tricolpate. Simple colpi with acute endings, about 50 to 60 μm long and 8 to 12 μm wide in polar view. Colpi seem to be slightly conspicuous in equatorial view (4 to 5 μm wide). Small apocolpium zone.

Remarks: Large size. Nexine increasing pattern. Intectate. Clavate. Clavae clustered in groups of 2 to 5. Tricolpate. Small apocolpium zone.

POACEAE Barnhart

Species: *Aristida adscencionis* L. (Plate 19; 21-25)

Description: Monad, bilateral symmetry, heteropolar, circular amb, circular outline in equatorial view, spheroidal shape. Medium size (30-35 μm). Tectate perforate exine of 2 μm thick. Visible nexine. Tectum of 0.5 μm thick. Slightly onspicuous columellae of 0.5 μm high, decreasing in size towards the aperture. Punctate. Circular puncta of 0.5 to 0.7 μm in diameter, disperses homogeneously across the surface. Monoporate (ulcerate). Annulate circulae ectopore about 4 to 6 μm in diameter. Annulus is 2 μm wide. Costate circular endopore, slightly wider than the ectopore, about 5 to 7 μm .

Remarks: Medium size. Punctate. Monoaperturate. Annulate.

POLYGALACEAE Hoffmanns. & Link

Species: *Monnina pseudopilosa* Ferreyra (Plate 19; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, prolate spheroidal shape. Large size (57-63 μm). Eutectate to tectate perforate exine of 1.5 μm thick. Visible nexine. Tectum of 0.5 μm Inconspicuous columellae. Psilate and foveolate. Irregular foveolae of 0.7 to 1 μm wide, only located at the apocolpium zone. Stephanocolporate (13 colpori). Endocingulate. Marginate ectocolpi with rounded endings, about 54 to 60 μm long and 3 to 9 μm wide. Well-defined endocingulum about 5 to 7 μm high, with a length about the circumference of the grain itself (70 to 80 μm). Medium size apocolpium zone.

Remarks: Large size. Psilate to foveolate. Foveolae are only located at the apocolpium zone. Stephanocolporate (13 colpori). Endocingulate.

Species: *Monnina macrostachya* Ruiz & Pav. (ex-*Pteromonnina macrostachya* (Ruiz & Pav.) B.Eriksen) (Plate 19; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular amb, elliptical acuminate outline in equatorial view, oblate spheroidal shape. Medium size (35-40 μm). Eutectate to tectate perforate exine of 1 μm . Visible nexine. Tectum of less than 0.5 μm thick. Inconspicuous columellae. Psilate and foveolate. Irregular foveolae of 1 μm wide, densely located at the apocolpium zone and extending to the apical part of the mesocolpium. Stephanocolporate (13 to 15 colpi). Endocingulate. Marginate ectocolpi with rounded endings, about 30 to 38 μm long and 4 to 7 μm wide. Well-defined endocingulum, about 3 to 5 μm high with a length about the circumference of the grain itself (70 to 80 μm). Medium size apocolpium zone.

Remarks: Medium size. Psilate to foveolate. Foveolae are only located at the apocolpium zone. Stephanocolporate (13 to 15 colpi). Endocingulate.

POLYGONACEAE Juss.

Species: *Polygonum aviculare* L. (Plate 19; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, circular to elliptical truncate outline in equatorial view, spheroidal to prolate shape. Medium size (30-37 μm). Tectate perforate exine of 2.5 μm . Visible thick nexine (1 μm). Tectum of 0.5 μm thick. Conspicuous columellae of 1 μm high. Exine slightly decreases in thickness towards the apertures. Microreticulate. Circular to irregular luminae of 0.3 to 0.7 μm wide. Luminae decrease in width towards the apertures. Tricolporate. Marginate ectocolpi with acute endings, about 27 to 35 μm long and 2 to 5 μm wide. Very long colpi. Lalongate endopores with acute extremes, about 2 to 3 μm high and 12 to 16 μm wide with acute endings, resembling an endocingulate condition. Endopore's width forms a triangular shadow inside the grain. Reduced apocolpium zone.

Remarks: Medium size. Visible nexine. Microreticulate. Tricolporate. Wide endopores. Endopore's width forms a triangular shadow inside the grain.

Species: *Rumex conglomeratus* Murray (Plate 20; 1-5)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species. The genus, however, has been widely documented.

Description: Monad, radial symmetry, isopolar, circular to rectangular amb, circular to elliptical outline in equatorial view, spheroidal to oblate shape. Medium size (27-30 μm). Tectate perforate exine of 2 μm thick. Visible thin nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 0.8 to 1 μm high. Microreticulate to reticulate. Homobrochate. Circular lumina of up to 0.5 μm in diameter, homogeneously dispersed across the surface, turning into a fossulate-like pattern at the mesocolpium. Tricolporate to stephanocolporate (4 colpi), predominantly tricolporate. Marginate ectocolpi with acute endings, about 22 to 28 μm long and 1.5 to 2 μm wide. Costate lalongate endopores of 5 to 7 μm high and 3 μm wide. Exine separates towards the apertures forming fastigia of 0.5 μm high. Medium size apocolpium zone. When the grain is stephanocolporate, it is difficult to observe in equatorial view.

Remarks: Medium size. Exine thickening towards the apertures. Microreticulate to reticulate. Homobrochate. Tricolporate to stephanocolporate (4 colpi), predominantly tricolporate. Well-defined marginate ectocolpi. Costate lalongate endopores.

PORTULACACEAE Juss.

Species: *Portulaca nivea* Poelln. (Plate 20; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, apolar, amb circular. Large size (87-100 μm). Eutectate exine of 2 μm thick. Visible thin nexine. Tectum of 0.5 μm thick. Slightly conspicuous columellae of 1 μm high. Echinate. Conical echinae of variable size, about 2 to 3 μm high, slightly wider at the base (1 μm). Echinae are distributed all over the grain but locally appear clustered in small groups. Pantocolpate (12 colpi). Simple indistinct brevicolpi of 15 to 20 μm long and 2 to 5 μm wide. Colpi are arranged in groups of five, forming an H-like pattern. Apertures are difficult to observe.

Remarks: Large size. Apolar. Echinate with small spines. Colpi forming an H-like pattern. Pantocolpate (12 colpi). Apertures are difficult to observe.

PRIMULACEAE Batsch ex Borkh.

Species: *Lysimachia arvensis* (L.) U.Manns & Anderb. (ex-*Anagallis arvensis*) (Plate 20; 11-15)

Description: Monad, radial symmetry, isopolar, subtriangular amb, circular to elliptical outline in equatorial view, oblate spheroidal shape. Small size (20-25 μm). Tectate perforate exine of 1.5 to 1.7 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high, decreasing in size towards the apertures. Nexine generates an internal circular shadow. Microreticulate to reticulate. Heterobrochate. Circular lumina of less than 1 μm in diameter. Luminae decrease in width towards the apertures. Thin but well-defined muri. Tricolporate. Slightly marginate ectocolpi with acute endings, about 20 to 22 μm long and 4 to 5 μm wide, getting narrow towards the apocolpium zone. Costate alongate endopores about 4 μm high and 7 to 10 wide. Sexine separates towards the apertures forming fastigia of 1 μm high. Reduced apocolpium zone. Difficult to observe in equatorial view.

Remarks: Small size. Triangular amb. Internal circular shadow. Microreticulate to reticulate. Heterobrochate. Tricolporate. Fastigiate. Reduced apocolpium zone.

ROSACEAE Juss.

Species: *Hesperomeles ferruginea* (Juss. ex Pers.) Benth. (ex-*Hesperomeles lanuginosa*) (Plate 20; 16-20)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, rectangular obtuse convex outline in equatorial view, prolate spheroidal shape. Small size (20-25 μm). Eutectate exine of 1 to 1.2 μm thick. Visible nexine. Tectum of less than 0.5 μm thick. Inconspicuous columellae. Psilate. Tricolporate. Marginate ectocolpi with acute endings of 18 to 22 μm long and 4 to 5 μm wide. Geniculate. Costate circular endopores of 2 to 5 μm in diameter. Small apocolpium zone. Difficult to observe in a perfect polar view.

Remarks: Small size. Rectangular obtuse convex outline in equatorial view . Inconspicuous columellae. Psilate. Tricolporate. Geniculate. Difficult to observe in a perfect polar view.

Species: *Rubus urticifolius* Poir. (Plate 20; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular to circular amb, circular to elliptical truncate outline in equatorial view, spheroidal to prolate shape. Medium size (25-32 μm). Tectate perforate exine of 2 to 2.2 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 0.8 to 1 μm high, decreasing in size towards the apertures but increasing towards the apocolpium zone. Striate at the equator and microreticulate at the apocolpium. Long striae of 1 μm wide, dispersed across the mesocolpium zone with a fingerprint-like pattern. Irregular lumina of 0.5 μm wide, densely located at the mesocolpium zone and between some striae. Tricolporate. Pontoperculate marginate ectocolpi with rounded endings, length is about 22 to 30 μm long and 7 to 10 μm wide in polar view. Colpi is constricted in equatorial view. Thin ornamented pontopercula. Costate circular endopores about 4 to 5 μm in diameter. Exine separates towards the apertures forming fastigia, about 0.7 μm high. Medium size apocolpium.

Remarks: Medium size. Spheroidal to prolate shape. Striate at the equator and microreticulate at the apocolpium. Striae with fingerprint-like pattern. Tricolporate. Pontoperculate.

RUBIACEAE Juss.

Species: *Arcytophyllum thymifolium* (Ruiz & Pav.) Standl. (Plate 20; 26-30)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, oblate spheroidal shape. Small size (20-25 μm). Semitectate exine of 2.5 μm thick. Visible thick nexine (1 μm), getting thicker towards the apertures. Tectum of 0.5 μm thick. Conspicuous columellae, about 1 μm high, decreasing in size towards the apocolpium zone. Reticulate. Heterobrochate. Pentagonal luminae of 0.5 to 2 μm wide, heterogeneously dispersed across the surface. Luminae decrease in width towards the apertures. Simplicolumellate muri of 0.7 to 1 μm wide. Tricolporate. Marginate ectocolpi with rounded

endings, about 17 to 23 μm long and 3 to 5 μm wide, getting narrow towards the apocolpium. Costate alongate endopores of 3 to 4 μm high and 7 to 8 μm wide, acute at the lateral axes. Medium size apocolpium. Difficult to observe in a perfect polar view.

Remarks: Small size. Reticulate. Heterobrochate. Pentagonal luminae. Tricolporate. Towards the apertures, columellae decrease in size, while the nexine increases. Colpi with rounded endings.

Ornamentation pattern. Aperture features.

Species: *Randia armata* (Sw.) DC. (Plate 20; 31-35)

Description: Decussate to tetrahedral tetrad of medium size (35-42 μm), predominantly decussate. Pollen grains with radial symmetry, isopolar, circular to quadrangular amb, elliptical acuminate outline in equatorial view, oblate shape. Medium size pollen grains (25-30 μm). Eutectate exine, about 1 to 1.3 μm thick. Visible thin nexine (about 0.3 μm thick). Tectum of 0.5 μm thick. Inconspicuous columellae. Psilate. Triporate. Coaperturate (Fischer's law). Annulate circular pores of 3 to 5 μm in diameter. Well-defined annulus, about 1 to 1.3 μm wide. Large apoparium zone.

Remarks: Decussate to tetrahedral tetrad. Psilate. Triporate. Coaperturate. Annulate pores. Large apoparium zone.

SAPINDACEAE Juss.

Species: *Cardiospermum grandiflorum* Sw. (Plate 20; 36-40)

Description: Monad, radial symmetry, heteropolar, triangular amb, oblate shape. Medium to large size (40-55 μm). Semitectate exine of 1 μm thick. Visible nexine. Thin tectum about 0.2 μm thick. Slightly conspicuous small columellae, about 0.5 μm high. Exine decreases in thickness towards the apertures. Reticulate. Heterobrochate. Circular to pentagonal lumina about 1 to 3 μm wide. Luminae's width decrease towards the apertures and the apocolpium zone. Simplicolumellate muri of 0.7 to 1 μm wide. Tricolporate and syncolporate at only one pole. Anguloaperturate. Simple straight circular ectocolpi about 25 to 30 μm long and 1 to 2 μm wide. Simple to costate projected endopores, about 7 to 10 μm in diameter. Not observed in equatorial view.

Remarks: Large size. Triangular amb. Reticulate. Heterobrochate. Syncolporate at only one pole. Anguloaperturate. Projected endopores.

Species: *Sapindus saponaria* L. (Plate 21; 1-5)

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical outline in equatorial view, oblate shape. Small size (12-20 μm). Tectate perforate exine of 1 to 1.2 μm thick. Visible thin nexine. Tectum of 0.5 μm thick. Inconspicuous columellae. Sexine decreases in thickness towards the apertures, while the nexine disappears. Punctate to microreticulate.

Circular lumina of less than 0.5 μm in diameter, dispersed across the surface. Largest lumina (0.5 μm long) located at the apocolpium zone, resembling a fossula-like shape. Tricolporate. Anguloaperturate. Simple ectocolpi with rounded endings, about 12 to 17 μm long and 2 to 3 μm wide. Costate lalongate endopores of 3 to 4 μm high and 5 to 7 μm wide. Very reduced apocolpium zone. Exine separates towards the apertures, forming fastigia (0.5 μm high).

Remarks: Small size. Triangular amb. Small size. Sexine decreases in thickness towards the apertures, while the nexine disappears. Ornamentation pattern (microreticulate). Fossula-like luminae at the apocolpium zone. Tricolporate. Anguloaperturate. Fastigiate.

SCHOEPIACEAE Blume

Species: *Quinchamalium chilense* Molina (Plate 21; 6-10)

Description: Monad, radial symmetry, heteropolar, circular to subtriangular amb. Small size (14-22 μm). Eutectate exine of 1 μm thick. Very thin nexine. Tectum of 0.5 μm thick. Inconspicuous columellae. Exine decrease in thickness towards the apertures. Microreticulate and scabrate. Irregular lumina of less than 0.5 μm , dispersed equatorially across the grain and close the aperture (proximal face). The distal face of the grain lacks microreticulate ornamentation, being more scabrate. The distal face has a tetrad mark characterized by three prominent globular structures of about 5 to 6 μm in diameter, enclosed by a weakening zone of the exine. Trichotomocolpate. Marginate colpi with rounded endings. Colpi ratio is about 10 to 12 μm long and 2 to 3 μm wide. Colpi arms reach the border. Margo's surface is scabrate, about 1 μm wide.

Remarks: Small size. Heteropolar. Circular to subtriangular amb. Microreticulate (proximal face) and scabrate (distal face). Trichotomocolpate. Presence of a tetrad mark.

SCROPHULARIACEAE Juss.

Species: *Alonsoa meridionalis* (L.f.) Kuntze (Plate 21; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subcircular to triangular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (30-38 μm). Tectate perforate exine of 1.5 μm thick. Visible thick nexine (0.7 μm). Tectum is less than 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Sexine sharply decreases in thickness towards the apertures. Microreticulate to reticulate. Irregular luminae of 0.3 to 0.5 μm wide densely dispersed across the whole surface, but elongating towards the mesocolpium zone, resembling a fossulate-like pattern. Tricolpate. Simple irregular colpi with rounded endings, about 26 to 35 μm long and 8 to 15 μm wide in polar view but being constricted (about 1 μm wide) in equatorial view. Presence of a granulate aperture membrane. Medium size apocolpium zone.

Remarks: Medium size. Subcircular to triangular amb, Microreticulate to reticulate. Tricolpate. Simple colpi. Presence of a granulate aperture membrane. Medium size apocolpium zone.

SOLANACEAE Juss.

Species: *Iochroma arborescens* (L.) J.M.H.Shaw (ex-*Acnistus arborescens*) (Plate 21; 16-20)

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical truncate to elliptical acuminate outline in equatorial view, oblate shape. Small size (18-23 μm). Tectate perforate exine of 1 to 1.2 μm thick. Visible nexine, increasing in thickness towards the aperture and forming an internal circular shadow. Tectum of less than 0.5 μm thick. Inconspicuous columellae. Foveoreticulate. Irregular lumina of 0.5 μm wide, dispersed homogeneously across the surface. Thin and well-defined muri (less than 0.5 μm wide). Tricolporate. Anguloaperturate. Marginate long ectocolpi with rounded endings, about 16 to 20 μm long and 2 to 3 μm wide. Costate lalongate endopores of 2 to 3 μm high and 10 to 12 μm wide. Geniculate. Endopores are laterally acute. The exine separates towards the apertures forming fastigia (1 μm wide). Reduced apocolpium zone.

Remarks: Small size. Triangular amb. Small size. Nexine increases in thickness towards the apertures and forms an internal circular shadow. Tricolporate. Anguloaperturate. Long colpi. Wide endopores with acute lateral endings. Fastigiate.

Species: *Cestrum auriculatum* L'Hér. (Plate 21; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical outline in equatorial view, prolate shape. Medium size (26-35 μm). Eutectate exine of 2 to 2.3 μm thick. Visible thick nexine (1 to 1.3 μm). Tectum of 0.5 to 0.7 μm thick. Inconspicuous columellae. Exine decreases in thickness towards the apocolpium zone. Psilate. Tricolporate. Marginate ectocolpi with rounded endings, about 23 to 30 μm long and 2 to 3 μm wide. Costate lalongate endopores of 5 to 7 μm high and 12 to 15 μm wide. Endopores with rounded extremes. Wide open endopores. The exine separates towards the apertures forming fastigia (0.7 to 1 μm wide). Medium size apocolpium zone.

Remarks: Medium size. Subtriangular amb. Inconspicuous columellae. Psilate. Tricolporate. Wide open endopores with rounded extremes. Fastigiate

Species: *Datura stramonium* L. (Plate 21; 26-30)

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical outline in equatorial view, prolate spheroidal shape. Medium size (40-48 μm). Semitectate exine of 1 μm thick. Visible nexine. Tectum of 0.5 μm thick. Slightly conspicuous columella of less

than 0.5 μm high. Fossureticulate. Heterobrochate. Irregular lumina of 0.7 to 1.2 μm wide, dispersed across the surface. Luminae are elongated at the mesocolpium. Simplicolumellate muri are less than 0.5 μm wide. Muri and luminae are latitudinally aligned, giving the impression of striae. Tricolporate. Brevicolpate. Simple ectocolpi with irregular endings, about 33 to 42 μm long and 3 to 5 μm wide. Costate small lalongate endopores of 2 to 3 μm high and 5 to 6 μm wide. Endopores are inconspicuous. Exine separates towards the aperture forming fastigia (1 μm wide). Large size apocolpium zone. Difficult to find in equatorial view.

Remarks: Medium size. Subtriangular amb. Fossureticulate. Heterobrochate. Muri and luminae are latitudinally aligned, giving the impression of striae. Tricolporate. Brevicolpate. Small lalongate and inconspicuous endopores. Fastigate.

Species: *Exodeconus prostratus* (Dombey ex L'Hér.) Raf. (Plate 21; 31-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical outline in equatorial view, oblate shape. Small to medium size (18-27 μm). Eutectate exine of 1 to 1.5 μm thick. Visible nexine, getting thicker towards the apertures and forming an internal subtriangular shadow. Slightly conspicuous columellae of less than 0.5 μm high. Verrucate. Circular to irregular verrucae of 1 μm wide. Verrucae are homogeneously dispersed across the surface. Verrucae form a negative reticulate pattern at the apocolpium zone. Tricolporate. Marginate ectocolpi with rounded endings, about 16 to 25 μm long and 6 to 7 μm wide. Costate lalongate wide open endopores of 6 to 8 μm high and 10 to 13 wide. Medium size apocolpium zone. Exine separates towards the apertures, forming fastigia (0.7 to 1 μm wide).

Remarks: Small to medium size. Subtriangular amb. Verrucate. Negative reticulate pattern at the apocolpium zone. Tricolporate. Fastigate.

Species: *Jaltomata umbellata* (Ruiz & Pav.) Mione & M.Nee (Plate 21; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (29-35 μm). Tectate perforate exine of 1 to 1.2 μm thick. Visible thin nexine. Tectum of 0.5 μm thick. Conspicuous columellae about 0.5 μm high. Microreticulate. Circular lumina of 0.3 to 0.5 μm in diameter, homogeneously dispersed across the surface. Lumina increases in width towards the apocolpium zone and gets smaller towards the apertures. Muri is less than 0.5 μm wide. Tricolporate. Simple

ectocolpi with rounded endings, about 27 to 35 μm long and 3 to 7 μm wide. Costate lalongate endopores of 3 to 5 μm high and 8 to 15 μm wide. Endopores are difficult to observe in equatorial view. Exine separates towards the apertures, forming fastigia (1.2 μm wide). Reduced apocolpium zone.

Remarks: Medium size. Subtriangular amb. Microreticulate. Tricolporate. Reduced apocolpium zone. Irregular simple colpi with rounded endings. Fastigate.

Species: *Leptoglossis lomana* (Diels) Hunz. (Plate 22; 1-5)

-Endemic species for the Peruvian lomas-

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical truncate outline in equatorial view, prolate shape. Medium size (25-30 μm). Semitectate exine of 2.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Conspicuous columellae of 1.5 μm high, decreasing towards the apertures. Sexine thicker than nexine. Reticulate. Heterobrochate. Irregular luminae of 1 to 3 μm wide. Larger lumina (2 to 3 μm) located at the mesocolpium zone, getting smaller towards the apocolpium zone. Simplicolumellate muri of 1 μm wide. Tricolporate. Marginate ectocolpi with acute endings, about 20 to 28 μm long and 2 to 3 μm wide. Colpi are constricted. Small simple lalongate endopores of 2 to 3 μm high and 4 to 5 μm wide. Endopores are difficult to observe. Reduced apocolpium zone.

Remarks: Medium size. Subtriangular amb. Reticulate. Heterobrochate. Long columellae. Tricolporate. Constricted ectocolpi. Inconspicuous endopores.

Species: *Lycium americanum* Jacq. (Plate 22; 6-10)

Description: Monad, radial symmetry, isopolar, circular amb, elliptical acuminate in equatorial view, prolate shape. Small size (16-22 μm). Eutectate exine of 1 μm thick. Slightly visible nexine. Tectum of 0.5 μm thick. Inconspicuous columellae. Striate. Striae are as long as the grain (15 to 20 μm) and 0.5 μm wide. Inconspicuous striae. Tricolporate. Marginate ectocolpi with rounded endings, about 15 to 20 μm long and 3 μm wide. Costate circular endopores of 3 to 5 μm in diameter. Conspicuous costae. Reduced apocolpium zone.

Remarks: Small size. Striate. Inconspicuous striae. Tricolporate. Conspicuous costae.

Species: *Nicotiana glauca* Graham (Plate 22; 11-15)

Description: Monad, radial symmetry, isopolar, circular to subtriangular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (20-25 μm). Tectate perforate exine of 1 μm thick. Slightly visible nexine, not reaching the apertures. Tectum of less than 0.5 μm thick. Slightly conspicuous columellae of 0.5 μm high, decreasing towards the apertures. Microreticulate. Striate. Small circular lumina of 0.5 μm in diameter, located exclusively at the apocolpium zone. Thin striae of 1 to 3 μm long and 0.5 μm wide, overlapping. Striae are located at the mesocolpium zone, running from pole to pole.

Tricolporate. Marginate ectocolpi with rounded endings, about 18 to 25 μm long and 8 to 10 μm wide in polar view. Colpi are constricted in equatorial view (3 μm wide). Costate circular endopores of 6 to 8 μm in diameter. Slightly projected endopores. Presence of prominent aperture membranes. Reduced apocolpium zone

Remarks: Small size. Microreticulate at the apocolpium zone, striate at the mesocolpium zone. Tricolporate. Slightly projected endopores. Prominent aperture membranes.

Species: *Nolana humifusa* (Gouan) I.M.Johnst. (Plate 22; 16-20)

-Endemic species for Peru-

Description: Monad, radial symmetry, isopolar, circular to subtriangular amb, elliptical acuminate outline in equatorial view, oblate spheroidal shape. Medium size (26-35 μm). Eutectate exine of 1.5 to 2 μm thick. Visible nexine. Tectum of 0.3 to 0.7 μm thick. Conspicuous columellae of 0.5 to 0.7 μm high. Striate to striato-reticulate. Thin striae of 0.5 μm wide and 3 to 8 μm long. Larger striae are located at the mesocolpium zone. Striae reduce in length towards the apocolpium zone, forming a striato-reticulate pattern, with irregular luminae of less than 0.5 μm wide. Striae running from pole to pole. Tricolporate. Marginate ectocolpi with rounded endings, about 23 to 34 μm long and 2 to 5 μm wide. Colpi are slightly constricted. Margo's surface is psilate. Costate lalongate endopores of 5 to 6 μm high and 8 to 12 μm wide. Well-defined costae. Endopores are difficult to observe in equatorial view. Reduced apocolpium zone.

Remarks: Medium size. Striate to striato-reticulate. Striate at the mesocolpium zone to striato-reticulate at the apocolpium zone. Tricolporate. Psilate margo. Well-defined endocostae. Endopores are difficult to observe in equatorial view.

Species: *Salpichroa ramosissima* Miers (Plate 22; 21-25)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, spheroidal shape. Medium size (28-30 μm). Tecate-perforate exine of 1.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Slightly conspicuous columellae of 0.5 to 0.7 μm high. Sexine decreases towards the apertures. Microreticulate. Circular luminae of 0.3 to 0.5 μm in diameter, homogeneously dispersed across the surface. Tricolporate. Marginate ectocolpi with rounded endings, about 25 to 28 μm long and 3 to 4 μm wide. Costate lalongate endopores with acute lateral axes, about 3 to 4 μm high and 6 to 8 μm wide. Well-defined costae. Medium size apocolpium zone.

Remarks: Medium size. Microreticulate. Tricolporate. Wide costate endopores. Medium size apocolpium zone.

Species: *Solanum peruvianum* L. (Plate 22; 26-30)

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical truncate outline in equatorial view, prolate shape. Small size (15-20 μm). Eutectate exine of 1.5 μm thick. Visible nexine, forming an internal circular shadow. Tectum of 0.5 to 0.7 μm thick. Inconspicuous columellae. Psilate. Tricolporate. Anguloaperturate. Marginate ectocolpi with rounded endings, about 14 to 18 μm long and 2 to 3 μm wide. Costate lalongate endopores with rounded lateral axes, about 2 to 3 μm high and 4 to 8 μm wide. Well-defined costae. Exine separates towards the apertures forming fastigia (0.5 to 0.7 μm wide). Reduced apocolpium zone.

Remarks: Small size. Triangular amb. Psilate. Tricolporate. Anguloaperturate. Fastigiate.

TROPAEOLACEAE Juss ex DC.

Species: *Tropaeolum majus* L. (Plate 22; 31-35)

Description: Monad, radial symmetry, isopolar, triangular amb, elliptical acuminate outline in equatorial view, oblate shape. Small to medium size (18-28 μm). Semitectate exine of 1 to 1.5 μm of thickness. Visible thick nexine (0.5 μm). Tectum of 0.2 to 0.5 μm thick. Slightly conspicuous columellae of 0.3 to 0.5 μm high. Sexine decreases in thickness towards the apertures. Reticulate. Heterobrochate. Irregular lumina of 0.5 to 3 μm wide. Larger luminae (1 to 3 μm) are located at the mesocolpium zone, decreasing in width towards the apocolpium zone. Simplicolumellate muri of 0.5 μm wide. Tricolporate (short colpi to brevicolpate). Anguloaperturate. Marginate ectocolpi with acute endings, about 13 to 15 μm long and 3 to 6 μm wide. Costate circular endopores of 3 to 5 μm in diameter. Large size apocolpium zone.

Remarks: Small to medium size. Triangular amb. Reticulate. Heterobrochate. Tricolporate. Short colpi to brevicolpate. Large size apocolpium zone.

URTICACEAE Juss.

Species: *Pilea microphylla* (L.) Liebm. (Plate 22; 36-40)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, circular amb, elliptical outline in equatorial view, peroblate shape. Small size (11-15 μm). Eutectate exine of 1 μm thick. Not visible nexine. Tectum of 0.3 to 0.5 μm thick. Slightly conspicuous small columellae of less than 0.5 μm high. Exine slightly decreases in thickness towards the apertures. Microechinate. Conical microechinae of less than 0.5 μm high, wider at the base (0.5 to 0.7 μm), scarcely dispersed across the surface. Space between microechinae is psilate. Diporate. Annulate circular ectopores of 2 to 3 μm in diameter. Costate circular endopores of 3 to 4 μm in diameter. Exine separates towards the apertures, forming vestibula (0.5 μm wide). Difficult to observe in polar view.

Remarks: Small size. Microechinate. Diporate. Annulate ectopores. Costate endopores. Vestibulate.

Species: *Urtica urens* L. (Plate 23; 1-5)

Description: Monad, radial symmetry, isopolar, circular amb, circular outline in equatorial view, oblate spheroidal shape. Small size (14-17 μm). Eutectate exine of 1 μm thick. Very thin nexine. Tectum of 0.5 μm thick. Inconspicuous columellae. Psilate. Triporate. Simple circular ectopores of 2 to 3 μm in diameter. Costate circular endopores, slightly smaller than the ectopores, about 1 to 1.5 μm in diameter. Large apopodium zone.

Remarks: Small size. Inconspicuous columellae Psilate. Simple ectopores. Costate endopores. Large apopodium zone.

VERBENACEAE J.St.-Hil.

Species: *Lantana scabiosiflora* Kunth (Plate 23; 6-10)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical outline in equatorial view, prolate shape. Medium size (25-35 μm). Eutectate exine of 1 to 1.5 μm thick. Slightly visible nexine. Tectum of 0.5 to 0.7 μm thick. Inconspicuous columellae. Psilate. Tricolporate. Slightly marginate ectocolpi with rounded endings, about 22 to 30 μm long and 4 to 5 μm wide. Costate elongate endopores of 6 to 8 μm high and 11 to 13 μm wide. Very wide endopores. Exine separates towards the apertures forming small fastigia (0.5 μm wide). Large apocolpium zone.

Remarks: Small to medium size. Subtriangular amb. Inconspicuous columellae. Psilate. Tricolporate. Very wide endopores. Fastigate.

Species: *Phyla nodiflora* (L.) Greene (Plate 23; 11-15)

Description: Monad, radial symmetry, isopolar, subtriangular amb, elliptical outline in equatorial view, prolate shape. Small to medium size (22-30 μm). Eutectate exine of 1.2 to 1.5 μm thick. Visible nexine. Tectum of 0.5 μm thick. Inconspicuous to slightly conspicuous columella of 0.5 μm high. Psilate and punctate at the apocolpium zone. Tricolporate. Brevicolpate. Simple ectocolpi with rounded endings, about 20 to 27 μm of long and 2 to 5 μm wide. Endocingulate. Costate endocingulum of 3 to 5 μm high and about 25 to 30 μm of circumference. Exine separates towards the apertures, forming small fastigia (0.5 μm wide). Large apocolpium zone. Difficult to observe in polar view.

Remarks: Small to medium size. Subtriangular amb. Psilate and punctate at the apocolpium zone. Tricolporate. Costate endocingulum. Fastigate.

ZYGOPHYLLACEAE R.Br.

Species: *Kallstroemia pubescens* (G.Don) Dandy (Plate 23; 16-20)

Description: Monad, radial symmetry, apolar, circular amb. Large size (51-60 μm). Semitectate exine of 7 to 8 μm thick. Visible thick nexine (3 to 4 μm). Tectum of 1.5 μm thick. Conspicuous capitate columellae of 2.5 μm high. Rectangular capita. Reticulate. Homobrochate. Irregular lumina of 8 to 10 μm wide, homogeneously dispersed across the surface. Simplicolumellate muri of 1.5 μm wide. Pantoporate (about 45 to 50 pores). Metareticulate. Simple circular ectopores of 3 μm in diameter. Costate circular endopores, wider than ectopores, about 4 to 5 μm in diameter.

Remarks: Large size. Thick nexine. Rectangular capita. Reticulate. Homobrochate. Metareticulate. Pantoporate (about 45 to 50 pores). Costate endopores, wider than ectopores.

Species: *Tribulus terrestris* L. (Plate 23; 21-25)

Description: Monad, radial symmetry, apolar, circular amb. Medium size (35-45 μm). Semitectate exine of 5 to 5.5 μm thick. Visible thick nexine (2 μm). Tectum of 1 μm thick. Conspicuous capitate columellae of 2 to 2.5 μm high. Circular capita. Reticulate. Homobrochate. Irregular luminae of 5 to 6 μm wide, homogeneously dispersed across the surface. Simplicolumellate muri of 1 μm wide. Pantoporate (about 80 to 90 pores). Metareticulate. Simple circular ectopores of 1.5 to 2 μm in diameter. Costate circular endopores, slightly wider than ectopores, about 3 μm in diameter.

Remarks: Medium size. Circular capita. Reticulate. Homobrochate. Metareticulate. Pantoporate (about 80 to 90 pores). Costate endopores, slightly wider than ectopores.

PTERIDOPHYTES

ASPLENIACEAE Newman

Species: *Asplenium monanthes* L. (Plate 23; 26-30)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (30-45 μm). Wing-like cavate perispore of 0.5 to 0.8 μm thick. Cavea of 4 to 5 μm high. Perispore with scarce microechinae with acute tips. Granulate perispore surface with irregular granula of 1 μm wide. 1-layered exospore of 1.2 to 2 μm , decreasing in thickness towards the laesura. Laevigate in distal and proximal face. Monolete. Labrate laesura of 14 to 22 μm long and 1 to 2 μm wide. Laesura is 1/3 to 2/3 of the spore length. Well-defined labrum (2 μm wide).

Remarks: Medium to large size spore. Wing-like cavate perispore. Perispore microechinate and granulate. Monolete. Laevigate exospore in distal and proximal face. Well-defined labrum.

BLECHNACEAE Newman

Species: *Blechnum occidentale* L. (Plate 23; 31-35)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (30-37 μm). Cavate perispore of 1 μm thick. Cavea of 4 to 5 μm high. Scabrate perispore. 1-layered exospore of 3 to 3.5 μm thick, slightly decreasing in thickness towards the laesura. Laevigate in distal and proximal view. Monolete. Labrate laesura of 12 to 15 μm long and 1 to 2 μm wide. Laesura is 1/3 of the spore length. Well-defined labrum (2 to 3 μm wide). Slightly projected labrum. Retusoid.

Remarks: Medium size spore. Cavate perispore with scabrate ornamentation. Thick exospore. Monolete. Exospore decreases in thickness towards the laesura. Laevigate exospore in distal and proximal view.

CYSTOPTERIDACEAE Schmakov

Species: *Cystopteris fragilis* (L.) Bernh. (Plate 23; 36-40)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (25-35 μm). Echinate thin perispore of 0.5 μm thick. Straight homogeneous echinae of 1 to 1.5 μm long disperses across the surface. Acavate. 1-layered exospore of 1 μm thick, slightly decreasing in thickness towards the laesura. Laevigate in distal and proximal view. Monolete. Labrate laesura of 17 to 22 μm long and 1 to 2 μm wide. Laesura is 2/3 of the spore length. Well-defined labrum (2 μm wide). Slightly projected labrum. Curvaturae imperfectae. Retusoid.

Remarks: Medium size spore. Echinate thin perispore. Monolete. Acavate. Exospore decreases in thickness towards the laesura. Laevigate exospore in distal and proximal view. Curvaturae imperfectae. Retusoid.

DENNSTAEDTIACEAE Pic.Serm.

Species: *Pteridium arachnoideum* (Kaulf.) Maxon (ex-*Pteridium aquilinum*) (Plate 24; 1-5)

Description: Spore free, radial symmetry, heteropolar, triangular amb, subtriangular shape. Medium size spore (25-32 μm). Granulate, acavate, thin perispore of 0.5 to 1 μm thick. Irregular granula about 0.3 to 0.5 μm wide, dispersed across the surface but being predominantly dense at the distal face. 1-layered exospore of 1 to 1.3 μm thick. Laevigate in distal face and proximal face. Trilete. Labrate laesura of 20 to 22 μm long and 1 μm wide per arm. Laesura is 3/3 the length of the spore. Labrum of variable width, about 0.7 to 2 μm . Concave at the proximal face. Slightly retusoid.

Remarks: Medium size spore. Granulate perispore. Trilete. Laevigate exospore at the distal face and proximal face. Laesura 3/3 the length of the spore. Variable width of the labrum. Slightly retusoid.

DRYOPTERIDACEAE Herter

Species: *Dryopteris saffordii* C.Chr. (Plate 24; 6-10)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal to subcircular amb, reniform shape. Medium size spore (30-40 μm). Cavate laevigate perispore of 1.5 to 2 μm thick. High cavea with rounded tips, about 12 to 17 μm high. Perispore resembles a “candy envelope”. 1-layered exospore of 1.5 μm thick. Homogeneously thick. Laevigate. Monolete. Simple laesura of 30 to 37 μm long and 1 μm wide. Laesura is 3/3 the length of the spore. Absent labrum.

Remarks: Medium size spore. Laevigate and cavate perispore. Monolete. Laevigate exospore at distal and proximal face. Long laesura. Absent labrum.

Species: *Elaphoglossum minutum* (Pohl ex Fée) T.Moore (Plate 24; 11-15)

To the best of our knowledge, this represents the first morphological description of spore morphology for this species.

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal to sub-circular amb, reniform shape. Small to medium size spore (22-28 μm). Cavate granulate perispore of 1.5 to 1.7 μm thick. High cavea of 5 to 10 μm high, with well-defined ridges. Irregular granula of less than 1 μm dispersed across the perispore surface. Perispore contour has a fin-like appearance. Rarely observed without perispore. 1-layered exospore of 1.5 μm thick, getting slightly thinner towards the laesura. Laevigate in distal and proximal face. Monolete. Labrate laesura of 7 to 10 μm long and 3 μm wide. Thin labrum of 0.5 μm wide. Laesure is 1/3 of the spore length.

Remarks: Small to medium size spore. Granulate perispore having a fin-like appearance. Monolete. Laevigate exospore in distal and proximal face. Short laesura. Labrate. Perispore is always present.

EQUISETACEAE Rich. ex DC.

Species: *Equisetum bogotense* Kunth (Plate 24; 16-20)

Description: Spore free, radial symmetry, apolar to heteropolar, circular amb. Large size spore (50-65 μm). Cavate laevigate perispore of 0.5 μm thick. Cavea of 5 to 8 μm high, reducing towards the basal point of the spore. 1-layered exospore of 1.2 to 1.5 μm thick. Laevigate to scabrate. Attached to the spore, there are four elaters that could be found surrounding the spore body or free (like tentacles) getting wider at the endings. Alete.

Remark: Large size spore. Laevigate to scabrate perispore. Elaters. Alete.

OPHIOGLOSSACEAE Martinov

Species: *Ophioglossum crotalophoroides* Walter (Plate 24; 21-25)

Description: Spore free, radial symmetry, heteropolar, circular to subtriangular amb, obtuse convex shape. Medium size (43-50 μm). 1-layered exospore of 2 to 3 μm . Foveoreticulate in distal and proximal face. Heterobrochate. Irregular luminae about 3 μm in the center of the distal face, getting bigger (5 to 6 μm), towards the equator. Luminae drastically reduce in width towards the proximal face, turning into small foveolae. Muri of 0.5 to 0.7 μm wide. Trilete. Labrate laesura of 15 to 20 μm long and 1 to 1.5 μm wide per arm. Laesura is 2/3 to 3/3 of the spore length. Well defined labrum of 1 μm wide. Some spores had a thickening at the interradian area of the laesura, forming a torus with scabrate ornamentation. Torus is 5 μm wide. Slightly Retusoid.

Remarks: Medium to large size spore. Foveoreticulate in distal and proximal face. Trilete. Labrate. Occasionally presence of a torus. Slightly Retusoid.

POLYPODIACEAE J.Presl & C.Presl

Species: *Pleopeltis macrocarpa* (Willd.) Kaulf. (Plate 24; 26-30)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (48-55 μm). 1-layered exospore of 3.5 to 4 μm thick. Verrucate in distal and proximal face. Irregular verrucae of 1 to 1.5 μm high and 2 to 4 μm wide. Larger verrucae are predominantly located at the distal face, decreasing in size towards the proximal face. Monolete. Labrate laesura of 45 to 52 μm long and 1 to 2 μm wide. Laesura is 3/3 the length of the spore. Labrum of 1.5 to 3 μm wide, decreasing towards the edges of the laesura.

Remarks: Medium to large size spore. Monolete. Verrucate in distal and proximal face. Labrate.

Species: *Serpocaulon lasiopus* (Klotzsch) A.R.Sm. (ex-*Polypodium lasiopus*) (Plate 24; 30-35)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Large size (63-75 μm). 1-layered exospore of 3 to 3.2 μm thick, getting thinner towards the proximal face. Verrucate in distal and proximal face. Irregular verrucae of 2 μm high and 4 to 7 μm wide, heterogeneously dispersed across the surface. Verrucae decrease in width (2 to 3 μm) towards the proximal face, near the laesura. Monolete. Labrate laesura of 30 to 35 μm long and 10 μm wide. Laesura is 2/3 the length of the spore. Labrum is verrucate, about 3 to 5 μm wide. Slightly Retusoid.

Remarks: Large size spore. Monolete. Verrucate in distal and proximal face. Larger and wider verrucae than in *Pleopeltis*. Labrate. Slightly Retusoid.

PTERIDACEAE E.D.M.Kirchn.

Species: *Adiantum digitatum* Hook. (Plate 24; 36-40)

Description: Spore free, radial symmetry, heteropolar, triangular amb. Medium size (30-40 μm). Acavate gemmate perispore of 0.7 to 1 μm thick. Gemmae of 2 to 3 μm high and 2 μm wide, rounded at the tip. Gemmae have a circular hollow space at its center. 1-layered exospore of 1.5 μm thick. Laevigate in distal and proximal face. Trilete. Labrate laesura of 13 to 20 μm long and 1 μm wide per arm. Laesura is 2/3 to 3/3 of the spore length. Labrum is 1.5 to 3 μm wide, getting slightly thinner towards the edge of the laesura. Not found in equatorial view.

Remarks: Medium size spore. Acavate and gemmate perispore. Laevigate exospore in distal and proximal face. Trilete. Labrate.

Species: *Anogramma leptophylla* (L.) Link (Plate 25; 1-5)

Description: Spore free, radial symmetry, heteropolar, triangular amb. Medium size (42-55 μm). 1-layered exospore of 3 to 3.5 μm . Fossulate. Irregular to worm-like shaped fossulae of 5 to 10 μm long and 0.5 to 1 μm wide, mainly located at the distal face but crossing to the edge of the proximal face. The space between fossulae and the surface at the proximal face is laevigate. Trilete. Labrate laesura is 20 to 25 μm long and 1.5 to 3 μm wide per arm. The laesura is 3/3 the length of the spore. Labrum of 3 to 4 μm wide, with slightly verrucate ornamentation. At the interradian space, there is a torus with quadrangular verrucae (3 μm wide) in its surface, forming a negative reticulate pattern. Laesura is internally placed in the spore body, opening as valvae. Not found in equatorial view.

Remarks: Medium size spore. Trilete. Fossulate in the distal face, laevigate to fossulate in proximal face. Verrucate labrum. Verrucate torus with negative reticulate pattern.

Species: *Hemionitis nivea* (Poir.) Christenh. (ex-*Argyroschisma nivea* (Poir.) Windham) (Plate 25; 6-10)

Description: Spore free, radial symmetry, heteropolar, triangular amb. Large size (85-90 μm). Rugulate perispore of 0.5 to 0.7 μm thick. High irregular rugulae of 4 to 5 μm high and 2.5 to 3 μm wide. Rugulae are delimited by well-defined ridges. Rugulae are heterogeneously accommodated, giving a reticula-like appearance. Non-resistant perispore (not observed in its entirety). 1-layered exospore of 1 μm thick, slightly decreasing in thickness towards the axes. Laevigate. Trilete. Labrate laesura with two different arm's lengths. The larger one is 48 to 50 μm long and 7 to 10 μm wide, while the smaller ones are 37 to 40 μm long and 7 to 9 μm wide. Laesura is 3/3 the length of the spore. Labrum of 1.5 to 2 μm thick. Not found in equatorial view.

Remarks: Large size spore. Rugulate perispore. Laevigate exospore in distal and proximal face. Trilete. Asymmetrical laesura ratio. Laevigate labrum.

Species: *Hemionitis sinuata* (Lag.) Christenh. (ex-*Astrolepis sinuata* (Lag. ex Sw.) D.M.Benham & Windham) (Plate 25; 11-15)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Spore free, radial symmetry, heteropolar, triangular amb, obtuse convex outline in equatorial view, subtriangular shape. Medium size (42-50 μm). Rugulate perispore of 0.3 to 0.5 μm thick. Irregular rugulae of 3 to 4 μm high and 5 to 6 μm wide. Non-resistant perispore (not observed in its entirety). 1-layered exospore of 1.2 to 1.5 μm thick. Laevigate. Trilete. Labrate laesura with two slightly different arm's lengths. The larger one is 22 to 27 μm long and 4 μm wide, while the smaller ones are 16 to 18 μm long and 2 to 3 μm wide. Laesura is 2/3 the length of the spore. Laevigate labrum of 1 to 1.2 μm wide. Difficult to find in equatorial view.

Remarks: Medium size spore. Rugulate perispore less developed than in *Argyrochosma*. Laevigate exospore in distal and proximal face. Trilete. Slightly asymmetrical laesura ratio. Laevigate labrum.

Species: *Hemionitis peruviana* (Desv.) Christenh. (ex-*Cheilanthes peruviana* T.Moore) (Plate 25; 16-20)

-Endemic species for Peru-

Description: Spore free, radial symmetry, heteropolar, triangular amb, obtuse concave outline in equatorial view, reniform shape. Medium size (40-50 μm). 2-layered exospore of 3.5 to 4 μm thick, slightly decreasing in thickness towards the axes. Gemmate to verrucate. Globular verruca of 5 to 8 μm wide and 3 μm high, densely spread across the surface, almost blocking the laesura. Trilete. Labrate laesura of 22 to 25 μm long and 2 to 3 μm wide per arm. Laesura is 3/3 the length of the spore, reaching the axes of the spore body. Gemmate labrum of 3.5 to 5 μm . Difficult to observe in equatorial view.

Remarks: Medium size spore. Perispore absent. Trilete. Densely gemmate-verrucate in proximal and distal face. Globular verruca. Labrate.

Species: *Hemionitis ternifolia* (Cav.) Christenh. (ex-*Pellaea ternifolia* (Cav.) Link) (Plate 25; 21-25)

Description: Spore free, radial symmetry, heteropolar, triangular amb, obtuse concave outline in equatorial view, subtriangular shape. Medium to large size (40-52 μm). Rugulate perispore of 0.7 to 1 μm thick. Slightly homogeneous rugula about 3 to 6 μm high and 3 to 5 μm wide. Some rugulae form a cavate-like space. 1-layered exospore of 1.7 to 2 μm thick. Laevigate.

Trilete. Labrate laesura with two slightly different arm's lengths. The larger one is 25 to 30 μm long and 3 to 4 μm wide, while the smaller ones are 13 to 16 μm long and 2 to 3 μm wide. Laesura is 3/3 the length of the spore, reaching the axes. Laevigate labrum of 1 to 1.5 μm thick.

Remarks: Medium to large size spore. Rugulate perispore forming cavate-like spaces. Perispore less-developed than in *Argyrochosma* and *Astrolepis*. Trilete. Laevigate exospore in distal and proximal face. Slightly asymmetrical laesura. Laevigate labrum.

SALVINIACEAE Martinov

Species: *Azolla filiculoides* Lam. (Plate 25; 26-30)

Description: Asymmetrical massulae of very large size (150-170 μm ; Note that photo is at 20X). Massulae surface is laevigate. Massulae have tubular tentacle-like outgrowths (glochidia) with anchor-like endings. Very resistant massulae. After five rounds of KOH, the massulae remained intact. Single microspores of radial symmetry, heteropolar, circular amb, elliptical shape. Small size microspore (12-23 μm). 1-layered exospore is about 1 to 1.2 μm thick, getting thinner towards the proximal face (see arrow in Plate 25, photo 30). Laevigate in distal and proximal face. Trilete. Labrate laesura of 5 to 8 μm and 1 μm wide per arm. Laesura is 2/3 to 3/3 the length of the spore, reaching the axes. Laevigate labrum of 0.5 μm thick.

Remarks: Microspores enclosed in massulae. Small size microspore. Laevigate exospore in distal and proximal face. Trilete. Laevigate labrum.

THELYPTERIDACEAE Pic.Serm.

Species: *Thelypteris glandulosolanosa* (C.Chr.) R.M.Tryon (Plate 25; 30-35)

To the best of our knowledge, this represents the first morphological description of pollen morphology for this species.

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (28-35 μm). Cavate and cristate perispore of 0.5 to 0.7 μm thick. Cavea of 5 to 6 μm high, decreasing in size towards the proximal face. Cristae of 3 to 5 μm high and 6 to 7 μm wide, with small echinae of 1 μm high at the borders. Space between cristae is laevigate. 1-layered exospore of 1.5 to 2 μm thick, getting slightly thinner towards the proximal face. Laevigate at the proximal face, and laevigate to slightly microreticulate at the distal face. Slightly inconspicuous irregular luminae of less than 0.5 μm wide with well-defined thin muri, homogeneously dispersed across the surface. Monolete. Labrate laesura of 23 to 25 μm long and 4 to 5 μm wide. Laesura is 3/3 the length of the spore. Labrum 2.5 to 3 μm thick. Slightly retusoid.

Remarks: Medium size spore. Cavate and cristate perispore. Monolete. Laevigate at the proximal face, and laevigate to slightly microreticulate at the distal face. Well-defined laevigate labrum. Slightly retusoid.

WOODSIACEAE Herter

Species: *Woodsia montevidensis* Hieron. (Plate 25; 36-40)

Description: Spore free, bilateral symmetry, heteropolar, ellipsoidal amb, reniform shape. Medium size (34-40 μm). Fin-like cavate, granulate and regulate perispore of 0.5 μm thick. Cavea of 3 to 7 μm high. Small rugulae of 1 μm long, scarcely dispersed across the surface. Granula of 0.5 μm in the lower surface. 1-layered exospore of 1 to 1.3 μm thick, decreasing in thickness towards the proximal face. Laevigate at distal and proximal face. Monolete. Labrate laesura of 20 to 25 μm long and 2 to 5 μm wide. Laesura is 2/3 the length of the spore. Laevigate labrum of 1 μm thick.

Remarks: Medium size spore. Cavate, granulate and regulate perispore. Monolete. Laevigate exospore at distal and proximal face. Laevigate labrum.

4. Discussion

4.1. Morphological diversity

Among the 200 recovered species for the *Lomas* formations, ferns constitute 9.5% (n=19), gymnosperms correspond to 0.5%, being represented by a single specimen (*Ephedra americana*; Ephedraceae), and angiosperms dominate at 90% (n=180). The palynological forms of 114 species from the *Lomas* ecosystem are described for the first time (see Appendix 1), although other species within the same genus may have been described elsewhere.

The most common aperture condition observed in pollen grains (n=183) is the tricolporate type (Fig. 2), accounting for 40% of the occurrences (n=74). It is followed by the tricolpate condition at 17 % (n=32) and the pantoporate condition at 13% (n=23). In contrast, less common aperture types include diporate, found only in *Pilea microphylla* (Urticaceae), trichotomosulcate observed in *Pasithea caerulea* (Asparagaceae) and the trichotomocolpate, only observed in *Quinchamalium chilense* (Schoepfiaceae). The predominant type of exine ornamentation is the reticulate type (Fig. 2), with 30% of occurrences (n=55). This pattern is especially dominant in monocotyledonous families such as Alstromeriaceae, Amaryllidaceae, and Bromeliaceae, or eudicotyledonous groups such as Amaranthaceae, Caryophyllaceae,

Cactaceae, Fabaceae, Lamiaceae, Malvaceae, Passifloraceae, Solanaceae, Tropaeolaceae, and Zygophyllaceae. However, echinate (17.1%; n=31), foveolate (9.9%; n=18), fossulate (7.7%; n=14), striate (3.9%; n=7), clavate (2.8%; n=5), lophate (2.2%; n=4) and striato-reticulate ornamentations (1.7%; n=3) are also present (Fig. 2). The prevalence of these well-developed types of ornamentation on pollen grains highlights the importance of pollination processes driven by insects or other animal vectors (*e.g.*, birds, bats, etc.) within the *Lomas* vegetation. Other ornamentation types, such as punctate (20.4%; n=37), microreticulate (14.4%; n=26), psilate (11.6%; n=21), microechinate (17.1%; n=31), scabrate (4.4%; n=8), verrucate (2.8%; n=5), gemmate (2.2%; n=4), rugulate (0.6%; n=1), and plicate (0.6%; n=1), also suggest an important contribution of anemophilous interactions (*e.g.* Hu et al. 2008; Winship and Hu 2010; Lu et al. 2022).

In the case of fern spores, out of the 19 genera described, 9 (47.5%) are identified as trilete, another 9 (47.5%) as monolete, and only one genus, *Equisetum* (Equisetaceae), is described as alete. The morphological features of the spores from *Elaphoglossum minutum* (Dryopteridaceae), *Astrolepis sinuata* (Pteridaceae), and *Thelypteris glandulosolanosa* (Thelypteridaceae) are described for the first time for the *Lomas*. As for sclerine stratification, we considered the ornamentation of both the perispore and exospore layers. The former is absent in 26% of the cases (n=5). We would argue that it was either not resistant to the reaction of the KOH solution or was not preserved. The cavate condition of the perispore is also present in 5 species (26%). Among the more frequent ornamentation types for the perispore (Fig. 3), we found the rugulate (21%; n=4), granulate (21%; n=4), laevigate (16%; n=3), and cristate (11%; n=2) conditions. Less common perispore ornamentation includes the echinate (n=1) and gemmate (n=1) types, each present in *Cystopteris fragilis* (Cystopteridaceae) and *Adiantum digitatum* (Pteridaceae), respectively. Conversely, the exospore shows less diversity in structure (Fig. 3), with more than 69% of fern spores exhibiting laevigate ornamentation (n=13), followed by the verrucate ornamentation (16%; n=3) that is present in *Cheilanthes peruviana* (Pteridaceae) and in the Polypodiaceae family. Other types of exospore ornamentation are found one per species (Fig. 3), such as fossulate (*Anogramma leptophylla*; Pteridaceae), foveoreticulate (*Ophioglossum crotalophoroides*; Ophioglossaceae) and microreticulate (*Thelypteris glandulosolanosa*; Thelypteridaceae).

Spore dispersal for ferns is assumed to be anemophilous, however, there are reports of fern spores dispersed by the feces of animal vectors, such as insects, birds, and mammals (Hendrix 1980; Tryon 1985, 1990; Arosa et al. 2010; Sugita et al. 2013; Hervías-Parejo et al.

2019; Brock and Collier 2020). Although perispore or exospore ornamentations can exhibit well-developed patterns, there remains a gap in understanding the relationship between these morphological characteristics and potential animal affinities for dispersal. This presents an intriguing avenue for exploration, particularly considering the forced seasonality of any plant-animal interaction within the *Lomas* ecosystem, as well as the limited knowledge on animal-driven pollination of this flora, which have primarily focused on angiosperm-based animal diets (e.g., Maguiña and Amanzo, 2016; Cairampoma et al., 2020), leaving pteridophyte species with minor attention in this regard.

4.2. Insights on palynological traits in selected plant groups

Within the *Lomas* palynoflora, we found that families such as Amaranthaceae, Amaryllidaceae, Apiaceae, Bromeliaceae, Caryophyllaceae, Lamiaceae, Malvaceae, Nyctaginaceae, Polygalaceae and Zygophyllaceae are conservative in exine ornamentation and aperture types, likely being stenopalynous. Whereas families such as like Cactaceae, Convolvulaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Papaveraceae, Passifloraceae, Sapindaceae and Solanaceae show variations in exine ornamentation, with some genera even varying in aperture type or condition, thus being eurypalynous.

As expected, the within-family morphological diversity of the monocotyledonous families is considerably low, with the majority of pollen grains being monosulcate monads with reticulate ornamentation (e.g. *Bomarea ovata* within Alstroemeriaceae, Amaryllidaceae, Asparagaceae, Bromeliaceae). However, there are a few exceptions, such as *Furcraea andina* (Asparagaceae), dispersed as a tetrad, *Pasithea caerulea* (Asparagaceae), which exhibits a trichotomosulcate aperture, and *Alstroemeria paupercula* (Alstroemeriaceae), characterized by striate ornamentation. In contrast, certain eudicotyledonous plants show higher within-family morphological diversities. For instance, the Asteraceae family exhibit stenopalynous and eurypalynous patterns at subfamily or tribe level (e.g. Asteroideae, Chicorioideae, Mutisioideae; Plates 4-6). The three observed genera within the Cucurbitaceae family differ from each other in ornamentation, as well as type and number of apertures (Plate 12). The Convolvulaceae family presents variable morphological features in ornamentation, as well as aperture type and number (Plate 11-12). Similarly, the Solanaceae family exhibits a wide range of ornamentation types, such as psilate, striate, (micro)reticulate, and verrucate

patterns, sometimes even combining these traits, as seen in species like *Iochroma arborescens*, *Datura stramonium*, and *Nolana humifusa*.

Finally, two genera, *Melochia* and *Waltheria* (Malvaceae, subfamily: Byttnerioideae; Plates 16-17), were found to exhibit pollen dimorphism, potentially related with the presence of heterostylous flowers. Heterostyly involves genetically controlled heteromorphism, comprising two or three types differing in style length (Ganders 1979; Saba and dos Santos 2015; Silveira et al. 2015). These genera feature one type of pollen for longistylous flowers (reticulate) and another for brevistylous ones (microechinate and punctate). In *Melochia pyramidata*, both morphotypes are tricolporate (Plate 16), whereas in *Waltheria ovata* (Plate 17), they are stephanocolporate, but differ in aperture number; the reticulate type has four colpi, while the microechinate type has five.

4.3. New and contrasting observations on spore and pollen morphology

We observed some differences compared to previous morphological descriptions obtained through light-microscopy techniques. In terms of spore morphology, the species *Anogramma leptophylla* (Pteridaceae) has been described as verrucate or tuberculate (Tryon and Lugardon 1991; Vaganov et al. 2017); however, our findings indicate that it can also have a fossulate pattern (1-5 in Plate 25).

In the case of pollen grains, we list below the most contrasting observations, arranged alphabetically by family. *Gomphrena meyeniana* (Amaranthaceae) was reported by Heusser (1971; ex-*G. acaulis*) as having circa 48 pores per grain. However, our findings reveal an approximate range of 20 to 25 pores (16-20 in Plate 2). *Proustia cuneifolia* (Asteraceae) was described as microechinate by Tellería et al. (2003). However, our observations indicate a fossulate ornamentation (1-5 in Plate 6). *Tourrettia lappacea* (Bignoniaceae), described as psilate-foveolate or perforate (Gentry and Tomb 1979; Gentry 1980), is also found to have a fossulate ornamentation (10-15 in Plate 7). *Tournefortia schomburgkii* (Boraginaceae), formerly described as psilate to finely rugose (Nowicke and Skvarla 1974), is found to be verrucate as well (16-20 in Plate 7). *Cleome chilensis* (Cleomaceae), described as microechinate (Heusser 1971), also can exhibit a microreticulate ornamentation (16-20 in Plate 11). In the Convolvulaceae family, *Cuscuta grandiflora* has been described as stephanocolpate (Welsh et al. 2010), however, it can also occur as tricolpate (26-30 in Plate 11). On the other hand, *Dichondra microcalyx* described by Telleria and Daners (2003) as

finely microechinate, is found to vary from foveoreticulate to reticulate with an heterobrochate pattern (31-35 in Plate 11). Heusser (1971) described *Frankenia chilensis* (Frankeniaceae) as foveolate, while we also observed a gemmate to slightly clavate ornamentation (16-20 in Plate 14). For the Onagraceae family, the species *Ludwigia octovalvis* has been previously described as tricolporate (Garg et al. 2021), however, according to our observations we determined this species as triporate. *Aristida adscencionis* (Poaceae), described as having scabrate ornamentation (Perveen 2006), is found to have a punctate ornamentation (21-25 in Plate 19). *Lysimachia arvensis* (Primulaceae), described as tricolpate (Shiha, 2020), is also found to be tricolporate (11-15 in Plate 20). Within the Solanaceae, *Datura stramonium* has been described as striate at the mesocolpium and coarsely reticulate-rugulate at the apocolpium zone (Perveen and Qaiser 2007a); however, we observed a fossureticulate ornamentation with an heterobrochate pattern (26-30 in Plate 21). In the case of *Iochroma arborescens*, the exine has been described as tectate and its ornamentation as reticulate (Murry and Eshbaugh 1971); however, our observations show a tectate perforate tectum with a foveoreticulate ornamentation (16-20 in Plate 21). *Lycium americanum* has been described as striate at the mesocolpium and rugulate at the apocolpium (Bernardello and Luján 1997); nonetheless, our specimens exclusively have an striate ornamentation (6-10 in Plate 22). *Nicotiana glauca*, described by Heusser (1971) as striate, includes grains with a microreticulate ornamentation at the apocolpium and a striate pattern only at the mesocolpium (11-15 in Plate 22). Within the Urticaceae family, *Urtica urens* has been described as microechinate (Sorsa and Huttunen 1975); however, pollen grains observed herein lack supratectal elements, having a psilate ornamentation (1-5 in Plate 23). Finally, *Phyla nodiflora* (Verbenaceae), described as having psilate to punctate ornamentation and a tricolporate aperture (Heusser 1971; Perveen and Qaiser 2007b), show a punctate ornamentation at the apocolpium and a psilate pattern at the mesocolpium, with apertures exhibiting an endocingulate condition.

These observations and morphological intricacies should be further investigated at greater detail using high-resolution techniques such as confocal microscopy and scanning electron microscopy to obtain a comprehensive understanding of the observed variations in ornamentation and aperture characteristics.

4.4. Foreword on samples yielding negative results

The actual number of species collected for palynological analysis from the MHN-UNMSM Herbarium was 251. However, after the KOH procedure, 51 species, ascribed to 17 families, did not yield any (or enough) palynomorph traces (Appendix 1). Nine of these sterile samples correspond to endemic species of the *Lomas* ecosystem. The negative result could be attributed to either the condition of the herbarium specimen or the plants having already released their pollen prior to collection. Additionally, the flowers of some xeric species are too small to extract anthers or to determine the presence of pollen (e.g., *Crassula connata* and *Nama dichotoma*). Another factor to consider as potentially inducing negative results could be the pollen size. For instance, genera such as *Galium* (Rubiaceae) and *Crassula* (Crassulaceae) possess small pollen grains (<15 µm) according to the palynological literature (Abdel Khalik et al. 2007; Shehata et al. 2023), and thus pollen grains may have been accidentally discarded during the sample preparation. Nonetheless, these 51 species will undergo reprocessing with the aim of completing the palynological spectrum at the genus level for the Peruvian *Lomas*.

5. Conclusions

In the western Peruvian lowlands of the Andean region, the seasonal greening of the landscape promotes the development of a diverse and highly endemic flora, which locally can interrupt the extended hyperarid landscape. These vegetation patches, known as *Lomas* formations, provide key ecosystem services for numerous species, including humans. We present the palynological features, obtained through light-microscopy, of 200 genera out of the 353 currently described, including 37 endemic species. Specifically, we provide information for one gymnosperm species (0.5%), 180 angiosperms (90%), and 19 pteridophytes (9.5%). The palynological forms of 114 species from the *Lomas* ecosystem are described for the first time (see Appendix 1), although other species within the same genus may have been described elsewhere. We discuss some key morphological observations remarks and differences noted when comparing our material with existing descriptions. Furthermore, given the morphological diversity of the palynoflora presented here, a summary table outlining key morphological features and serving as morphology-based search index is also provided (Appendix 3).

Georeferenced and voucher-related palynological reference materials from xeric vegetation, such as those presented herein, are essential for morphological comparisons,

enabling the testing of diverse evolutionary, biogeographic, and ecological hypotheses. Therefore, this work serves as a reference for upcoming (paleo) palynological studies addressing the evolution of dry floras, plant-animal interactions, landscape changes, as well as human-plant interactions from prehistoric to historic settlements.

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7. Declaration of interest statement: We declare no competing interests

8. Author contributions:

Conceptualization: DO

Methodology: ATF, JFM, BO, MLT, DO

Investigation: ATF, JFM, DO

Visualization: ATF, DO

Supervision: DO

Writing—original draft: ATF, DO

Writing—review & editing: ATF, JFM, BO, MLT, DO

9. Data and material availability: All data are available as supplementary materials.

LIST OF APPENDICES

Appendix 1. Inventory list of sampled species, including herbarium metadata.

Appendix 2. Morphometric information of reviewed palynomorphs.

Appendix 3. Summary table detailing key palynological features per species.

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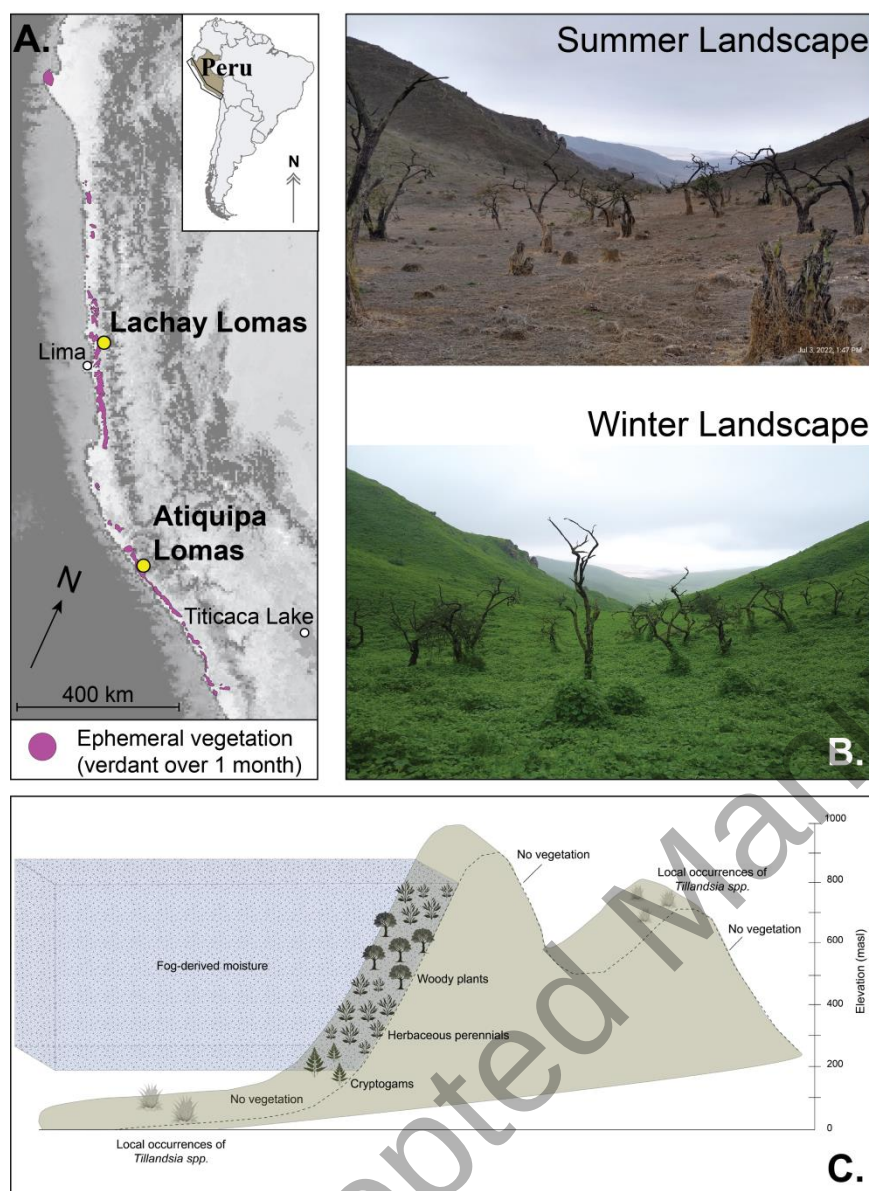


Figure 1. **A.** Distribution of *Lomas* vegetation along the Peruvian Pacific coast. The two most diverse *Lomas* are indicated by filled circles. **B.** Seasonal landscape changes observed in the Lachay Lomas over the summer (above) and winter (below) austral months, depicting the fog-driven greening of the vegetation. Photographs © taken by the corresponding author (DO). **C.** Schematic view of vegetation zones in a fog-derived Peruvian coastal *Lomas* (modified from Rundel et al. 1991).

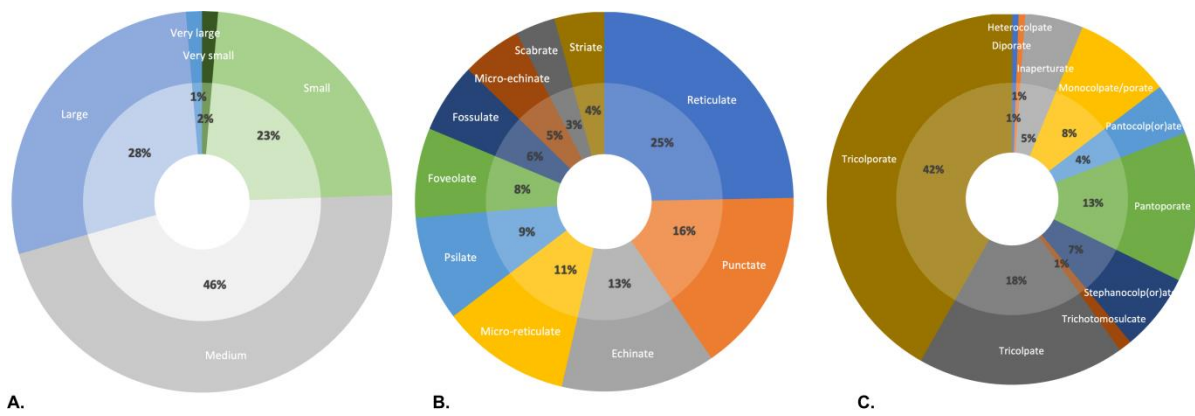


Figure 2. Morphological palynological diversity: Relative abundance of pollen types categorized by size (A.), ornamentation (B.), and aperture (C.).

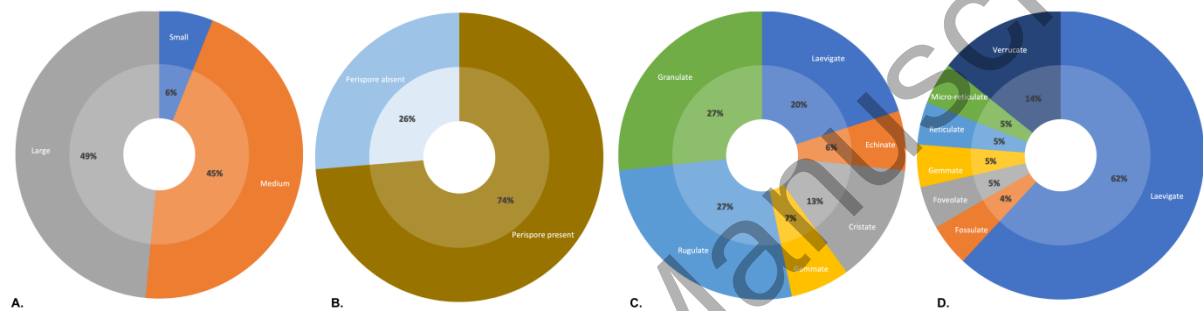


Figure 3. Morphological palynological diversity: Relative abundance of spore types categorized by size (A.), perispore presence (B.), perispore ornamentation (C.), and exospore ornamentation (D.).

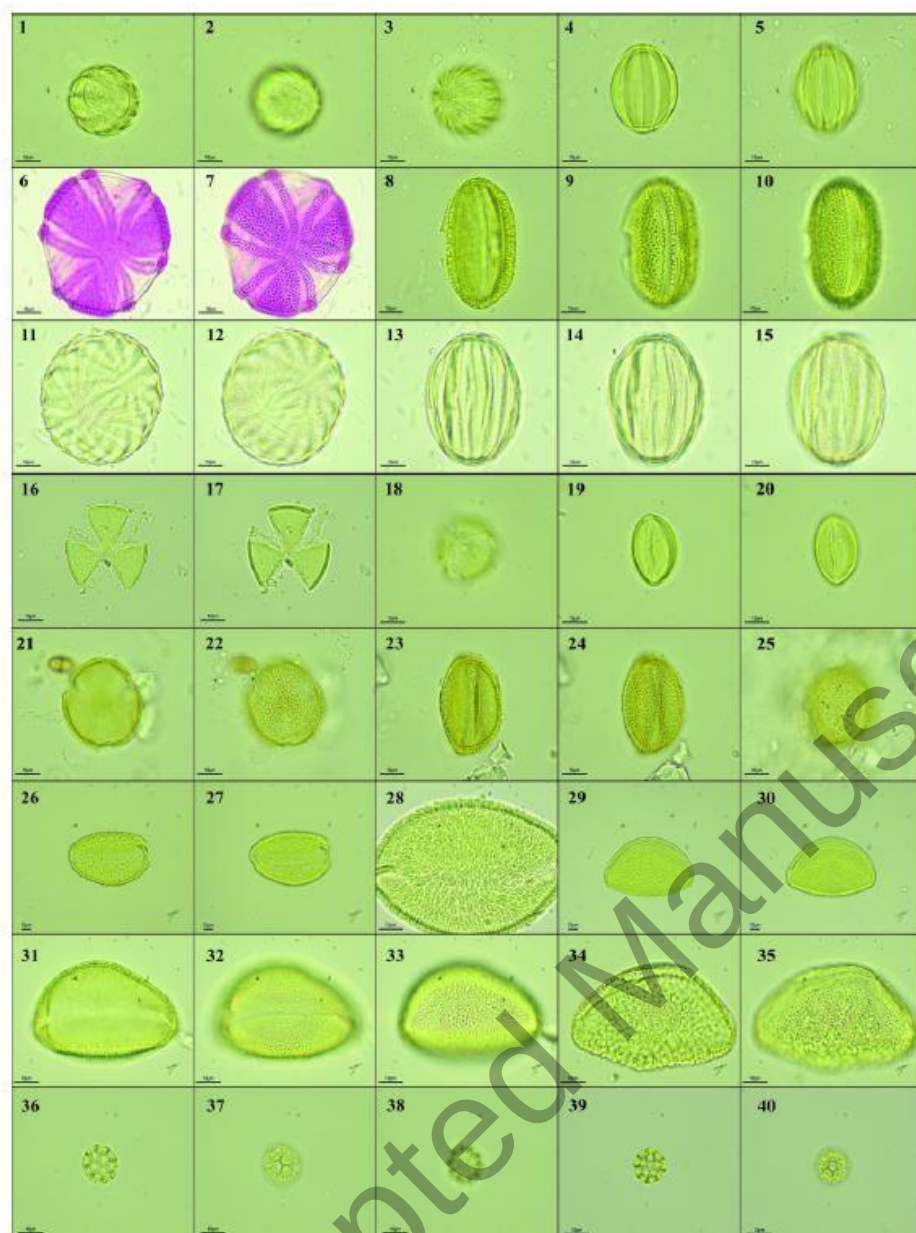


Plate 1. Gymnosperms. Ephedraceae: *Ephedra americana* (Pv: 1-3; Ev: 4-5).

Angiosperms. Acanthaceae: *Dicliptera tomentosa* (Pv: 6-7; Ev: 8-10); *Dyschoriste repens* (Pv: 11-12; Ev: 13-15). **Aizoaceae:** *Sesuvium portulacastrum* (Pv: 16-18; Ev: 19-20); *Tetragonia crystallina* (Pv: 21-22; Ev: 23-25). **Alstroemeriaceae:** *Alstroemeria paupercula* (Ev: 26-30); *Bomarea ovata* (Ev: 31-35). **Amaranthaceae:** *Alternanthera halimifolia* (Gv: 36-40). Ev = Equatorial view; Pv = Polar view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 26-27, 29, and 30 (at 40X magnification).

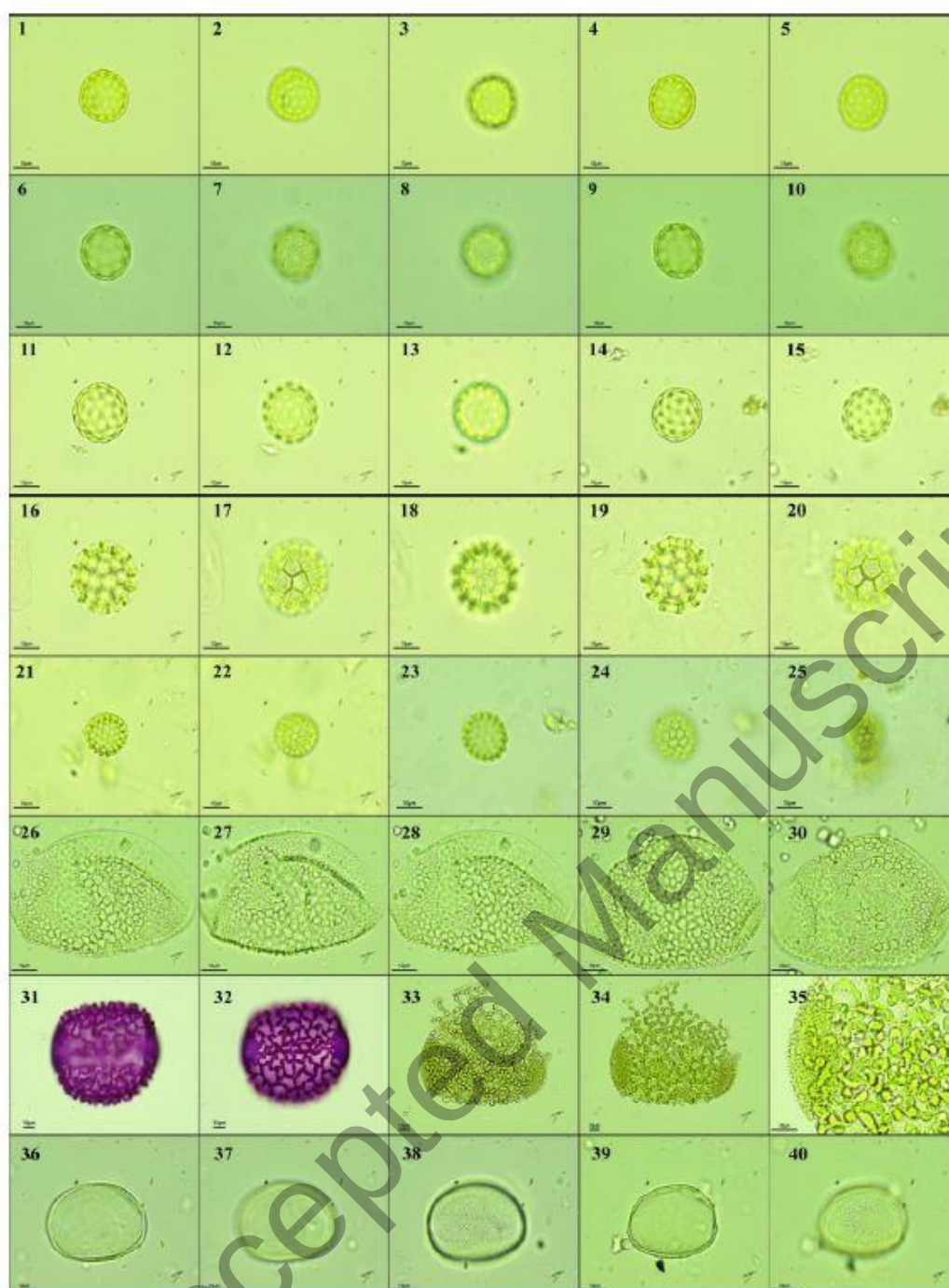


Plate 2. Angiosperms. Amaranthaceae: *Amaranthus spinosus* (Gv: 1-5); *Atriplex imbricata* (Gv: 6-10); *Chenopodium petiolare* (Gv: 11-15); *Gomphrena meyeniana* (Gv: 16-20); *Guilleminea densa* (Gv: 21-25). **Amaryllidaceae:** *Clinanthus incarum* (Ev: 26-30); *Ismene amancaes* (Pv: 31-32; Ev: 33-34; Dt: 35); *Allium napolitanum* (Pv: 36-38; Ev: 39-40). Ev = Equatorial view; Pv = Polar view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 31-34 (at 40X magnification).



Plate 3. Angiosperms. Amaryllidaceae: *Pyrolirion tubiflorum* (Ev: 1-5); *Stenomesson miniatum* (Ev: 6-10). **Anacardiaceae:** *Schinus molle* (Pv: 11-13; Ev: 14-15). **Apiaceae:** *Daucus montanus* (Ev: 16-20); *Domeykoa amplexicaulis* (Ev: 21-25); *Eremocharis ferreyrae* (Ev: 26-30); *Eryngium foetidum* (Ev: 31-35). **Apocynaceae:** *Asclepias curassavica* (Gv: 36-38; Dt: 39-40). Ev = Equatorial view; Pv = Polar view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of figures: 1-2, 40 (at 40X magnification); 36 (at 2X magnification); 37 (at 4X magnification); 38 (at 10X magnification); 39 (at 20X magnification).

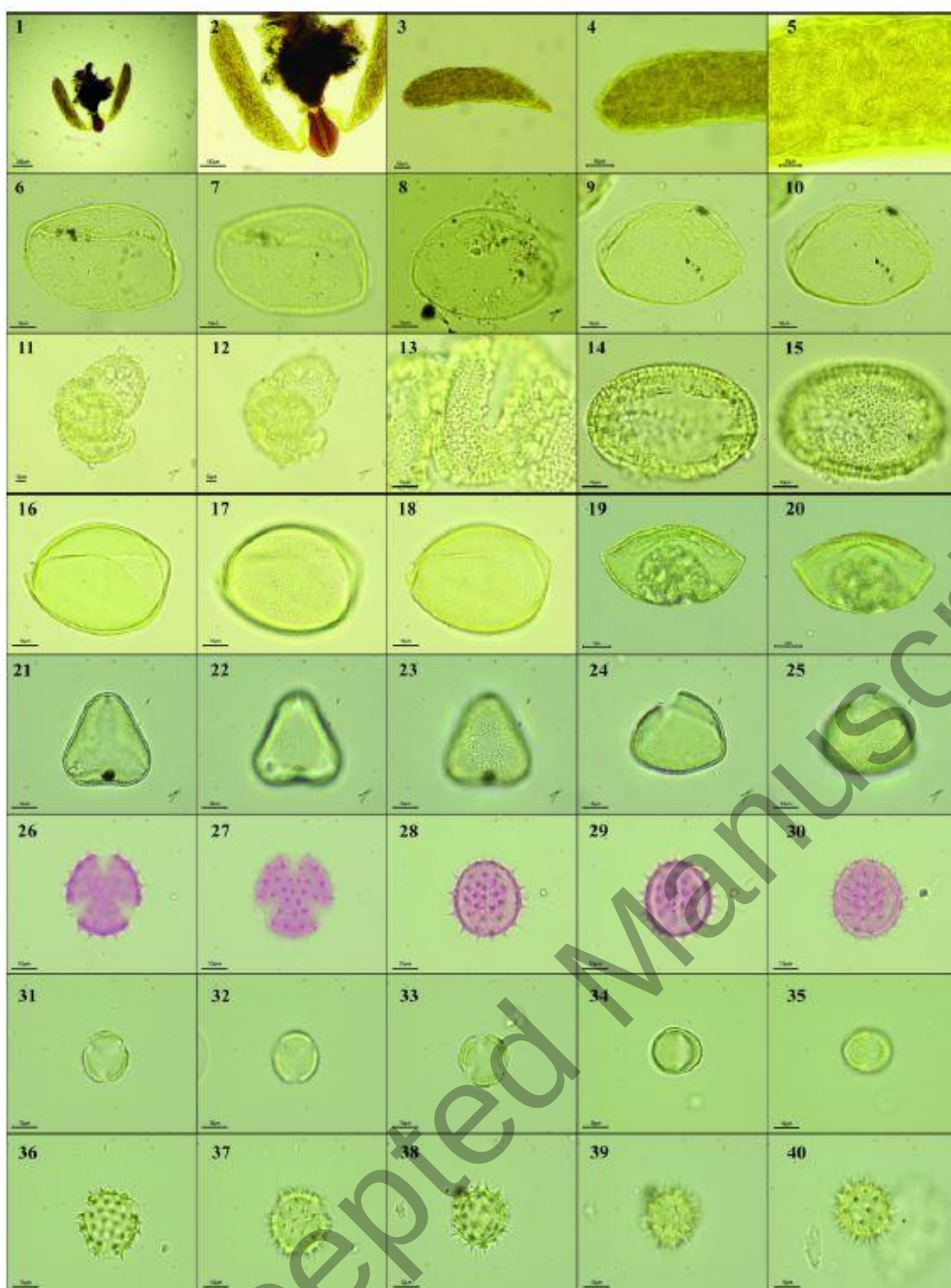


Plate 4. Angiosperms. Apocynaceae: *Philibertia solanoides* (Gv: 1-4; Dt: 5).

Asparagaceae: *Echeandia eccremorrhiza* (Pv: 6-7; Ev: 8-10); *Furcraea andina* (Gv: 11-12; Dt: 13; Pv isolated grain: 14-15); *Oziroë biflora* (Pv: 16-18; Ev: 19-20); *Pasithea caerulea* (Pv: 21-23; Ev: 24-25). **Asteraceae:** *Acnella ciliata* (Pv: 26-27; Ev: 28-30); *Artemisia absinthium* (Pv: 31-33; Ev: 34-35); *Bidens pilosa* (Pv: 36-37; Ev: 38-40). Ev = Equatorial view; Pv = Polar view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 1 (at 4X magnification); 2-3 (at 10X magnification); 4 (at 20X magnification) and 10, 11-12 (at 40X magnification).

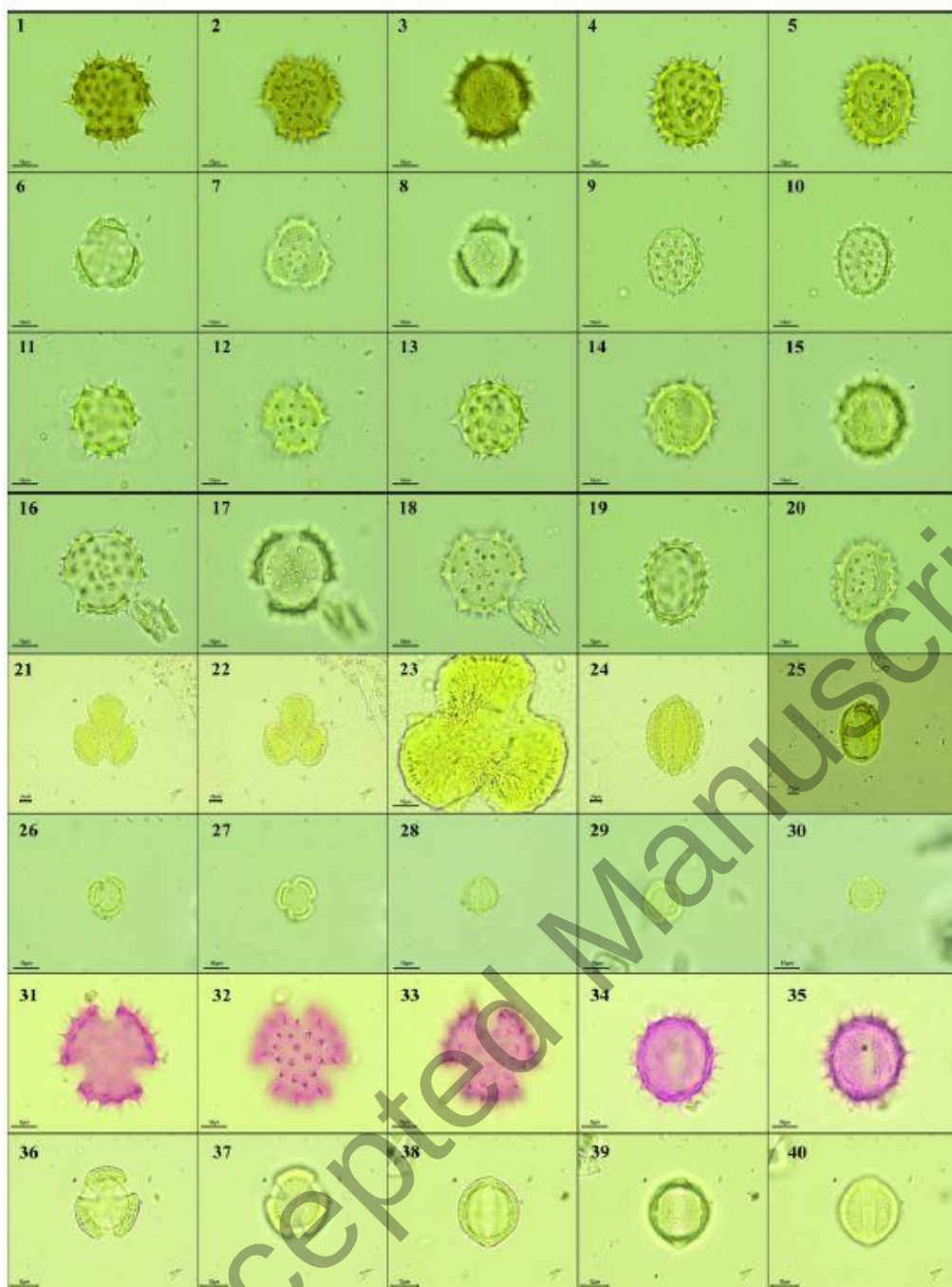


Plate 5. Angiosperms. Asteraceae: *Burnellia fasciculata* (Pv: 1-3; Ev: 4-5); *Cotula australis* (Pv: 6-8; Ev: 9-10); *Flaveria bidentis* (Pv: 11-12; Ev: 13-15); *Grindelia glutinosa* (Pv: 16-18; Ev: 19-20); *Onoseris odorata* (Pv: 21-23; Ev: 24-25); *Ophryosporus peruvianus* (Pv: 26-27; Ev: 28-30); *Philoglossa peruviana* (Pv: 31-33; Ev: 34-35); *Polyachyrus annus* (Pv: 36-37; Ev: 38-40). Ev = Equatorial view; Pv = Polar view. Photographs were taken at 100X magnification, with the exception of figures: 21-22, 24-25 (at 40X magnification).

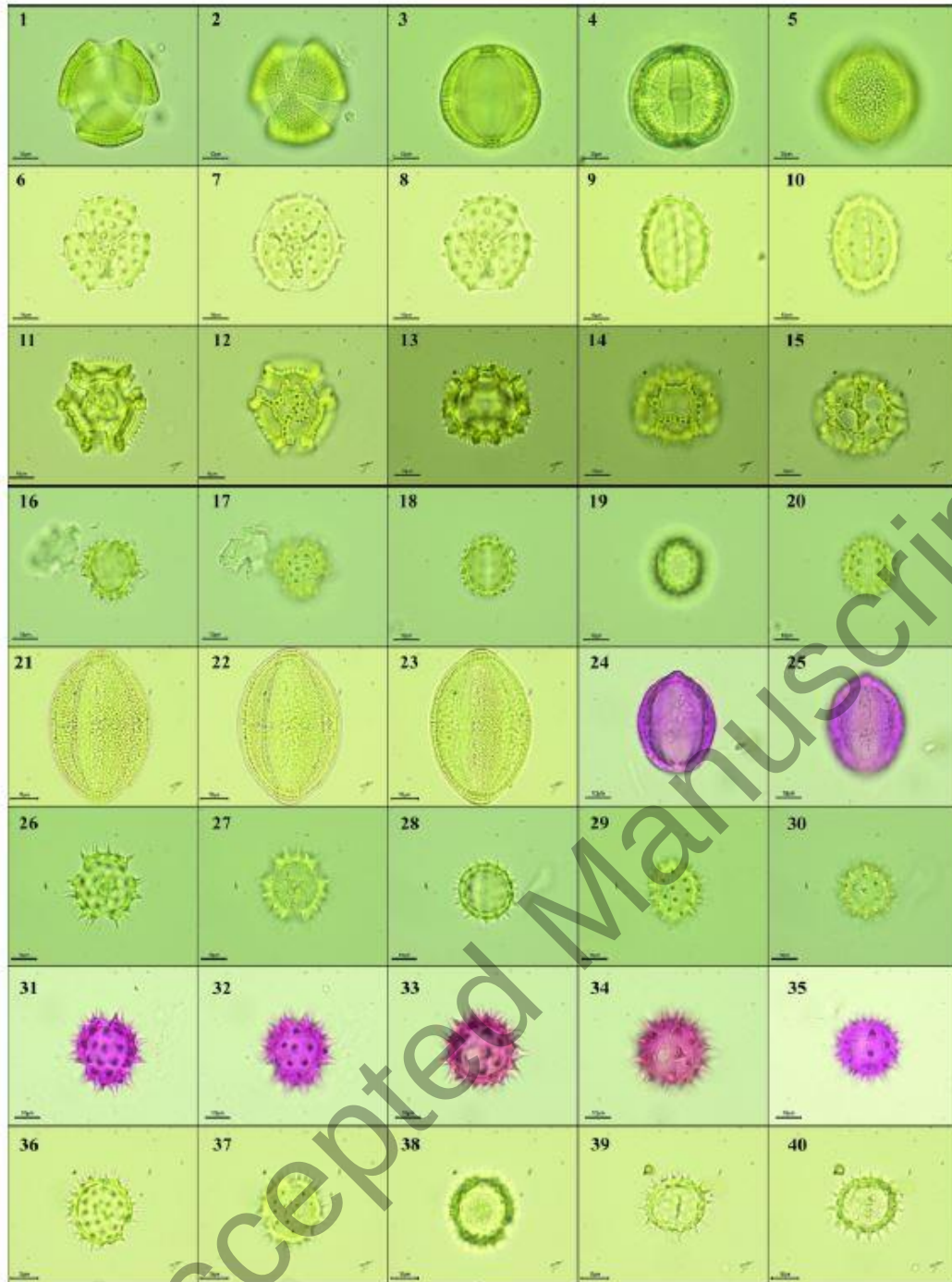


Plate 6. Angiosperms. Asteraceae: *Proustia cuneifolia* (Pv: 1-2; Ev: 3-5); *Lomanthus mollendoensis* (Pv: 6-8; Ev: 9-10); *Sonchus oleraceus* (Pv: 11-12; Ev: 13-15); *Stevia ovata* (Pv: 16-17; Ev: 18-20); *Trixis cacalioides* (Ev: 21-25); *Aldama lanceolata* (Pv: 26-27; Ev: 28-30); *Villanova oppositifolia* (Pv: 31-32; Ev: 33-35); *Wedelia hoffmanniana* (Pv: 36-38; Ev: 39-40). Ev = Equatorial view; Pv = Polar view. Photographs were taken at 100X magnification.



Plate 7. Angiosperms. Begoniaceae: *Begonia octapetala* (Pv: 1-3; Ev: 4-5). **Bignoniaceae:** *Argyria radiata* (Pv: 6-7; Dt: 8; Ev: 9-10); *Tourrettia lappacea* (Pv: 11-13; Ev: 14-15). **Boraginaceae:** *Tournefortia schomburgkii* (Pv: 16-18; Ev: 19-20). **Brassicaceae:** *Brassica rapa* (Pv: 21-22; Ev: 23-25); *Capsella bursa-pastoris* (Pv: 26-28; Ev: 29-30); *Lepidium chichicara* (Pv: 31-32; Ev: 33-35); *Lobularia maritima* (Pv: 36-37; Ev: 38-40). Ev = Equatorial view; Pv = Polar view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 6-7, 9-10 (at 40X magnification).



Plate 8. Angiosperms. Brassicaceae: *Mathewsia peruviana* (Gv: 1-5); *Mostacillastrum gracile* (Pv: 6-8; Ev: 9-10). **Bromeliaceae:** *Puya ferruginea* (Ev: 11-15); *Tillandsia latifolia* (Ev: 16-20); **Cactaceae:** *Armatocereus matucanensis* (Pv: 21-22; Dt: 23; Ev: 24-25); *Borzicactus fieldianus* (Pv: 26-27; Ev: 28-29; Dt: 30); *Carryocactus brachypetalus* (Pv: 31-32; Ev: 33-35); *Cumulopuntia sphaerica* (Gv: 36-39; Dt: 40). Pv = Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 21-22, 24, 26-29, 36-39 (at 40X magnification).



Plate 9. Angiosperms. Cactaceae: *Trichocereus macrogonus* (Pv: 1-3; Ev: 4-5); *Haageocereus acranthus* (Pv: 6-7; Dt: 8; Ev: 9-10); *Loxanthocereus sextonianus* (Pv: 11-12; Dt: 13; Ev: 14-15); *Neoraimondia arequipensis* (Pv: 16-18; Ev: 19-20); *Opuntia stricta* (Gv: 21-24; Dt: 25); *Haageocereus* (ex-*Pygmaeocereus*) *bylesianus* (Pv: 27-29; Dt: 30); *Weberbauerocereus rauhii* (Pv: 31-32; Ev: 33-35). **Calceolariaceae:** *Calceolaria tripartita* (Pv: 36-38; Ev: 39-40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 1-7, 9-12, 14-17, 19, 21-24, 26-29, 33-34 (at 40X magnification).

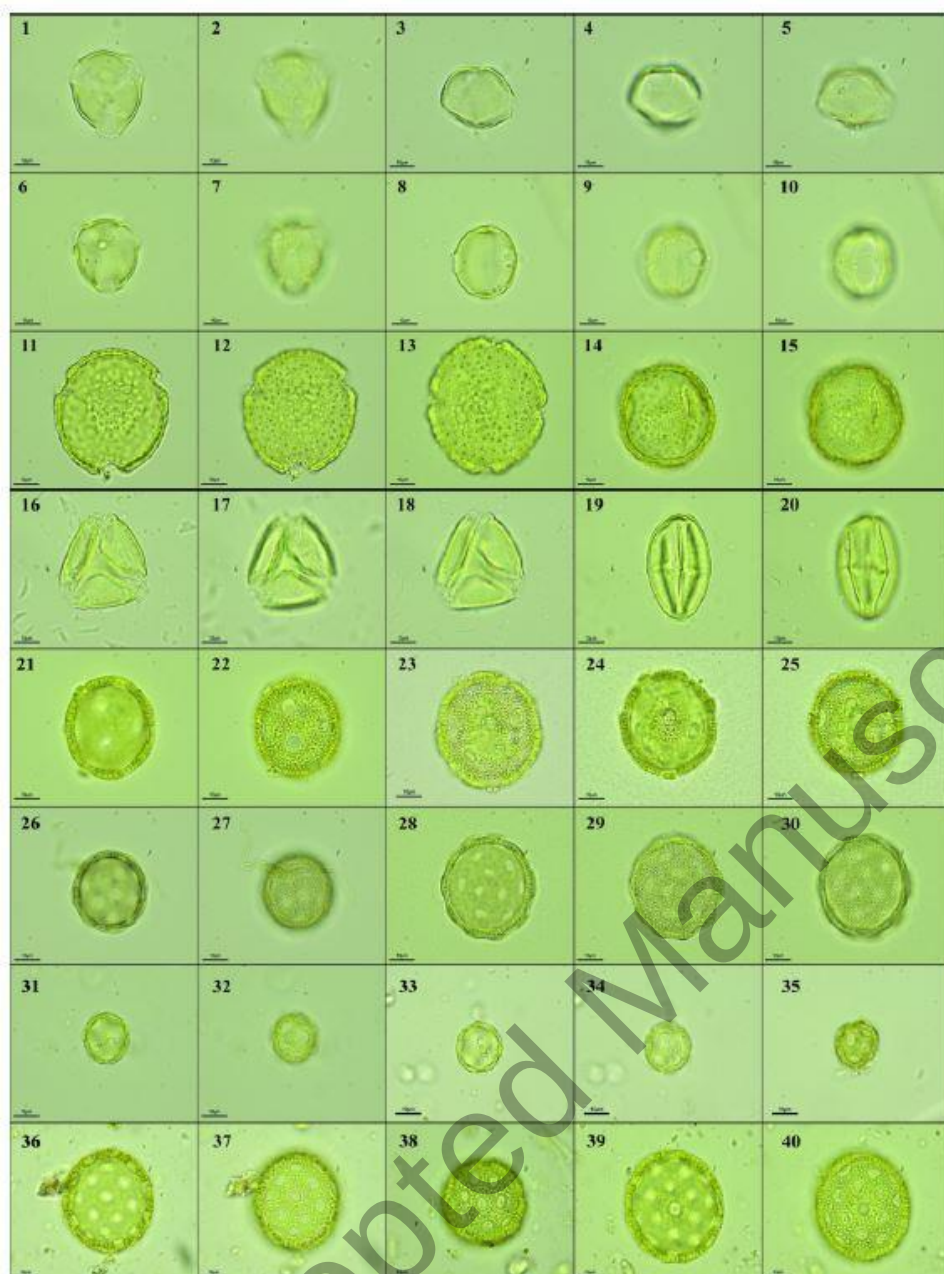


Plate 10. Angiosperms. Campanulaceae: *Lobelia decurrens* (Pv: 1-2; Ev: 3-5).

Capparaceae: *Morisonia petiolaris* (Pv: 6-7; Ev: 8-10). **Caprifoliaceae:** *Valeriana chaerophylloides* (Pv: 11-13; Ev: 14-15). **Caricaceae:** *Vasconcellea candicans* (Pv: 16-18; Ev: 19-20). **Caryophyllaceae:** *Cerastium glomeratum* (Gv: 21-25); *Drymaria divaricata* (Gv: 26-30); *Paronychia setigera* (Gv: 31-35); *Silene gallica* (Gv: 36-40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification.

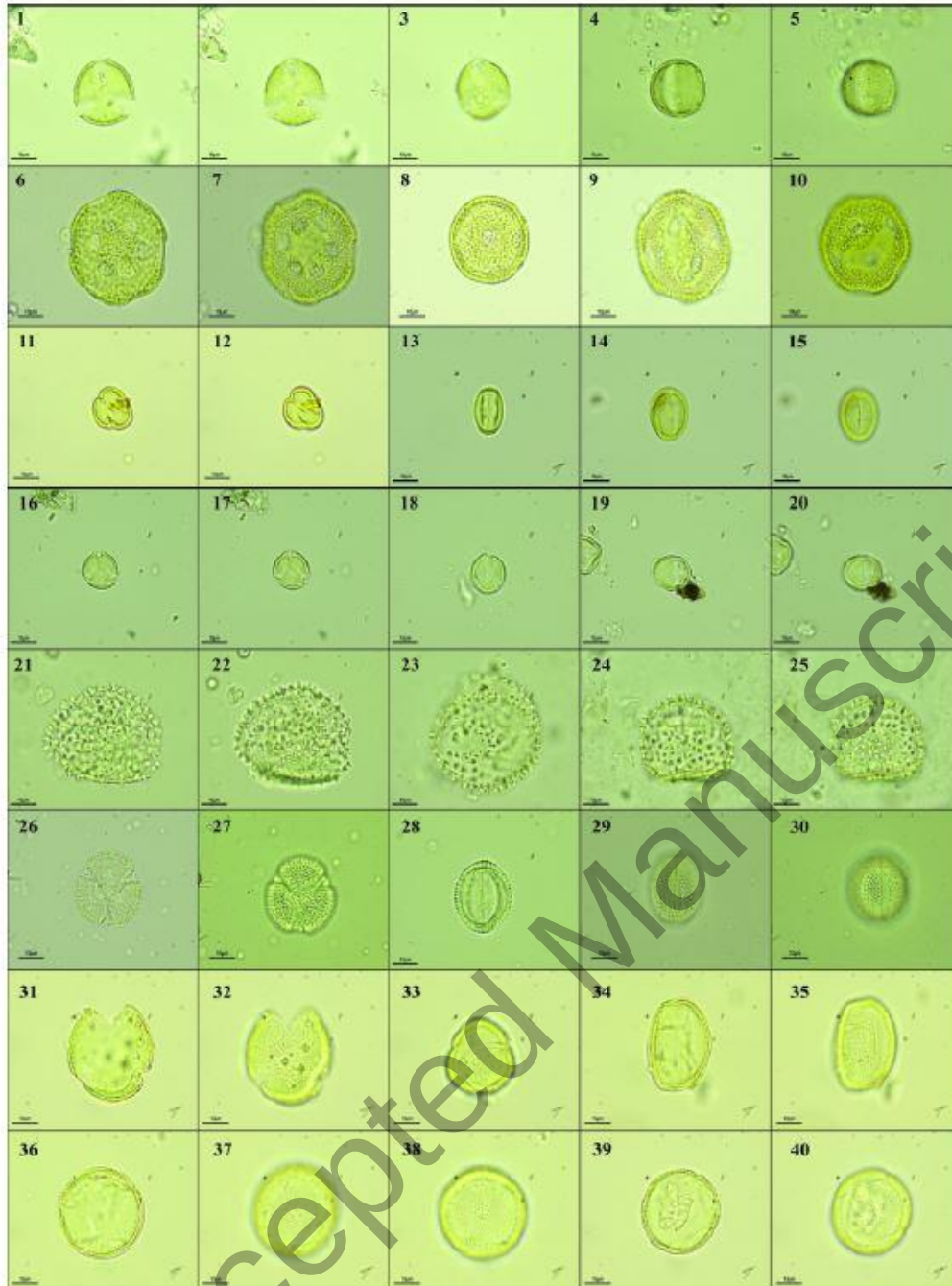


Plate 11. Angiosperms. Caryophyllaceae: *Spergularia congestifolia* (Pv: 1-3; Ev: 4-5); *Stellaria ovata* (Gv: 6-10). **Celastraceae:** *Maytenus orbicularis* (Pv: 11-12; Ev: 13-15). **Cleomaceae:** *Cleome chilensis* (Pv: 16-18; Ev: 19-20). **Commelinaceae:** *Commelina tuberosa* (Ev: 21-22; Dt: 23; Pv: 24-25). **Convolvulaceae:** *Cuscuta grandiflora* (Pv: 26-27; Ev: 28-30); *Dichondra microcalyx* (Pv: 31-33; Ev: 34-35); *Evolvulus villosus* (Gv: 36-40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification.

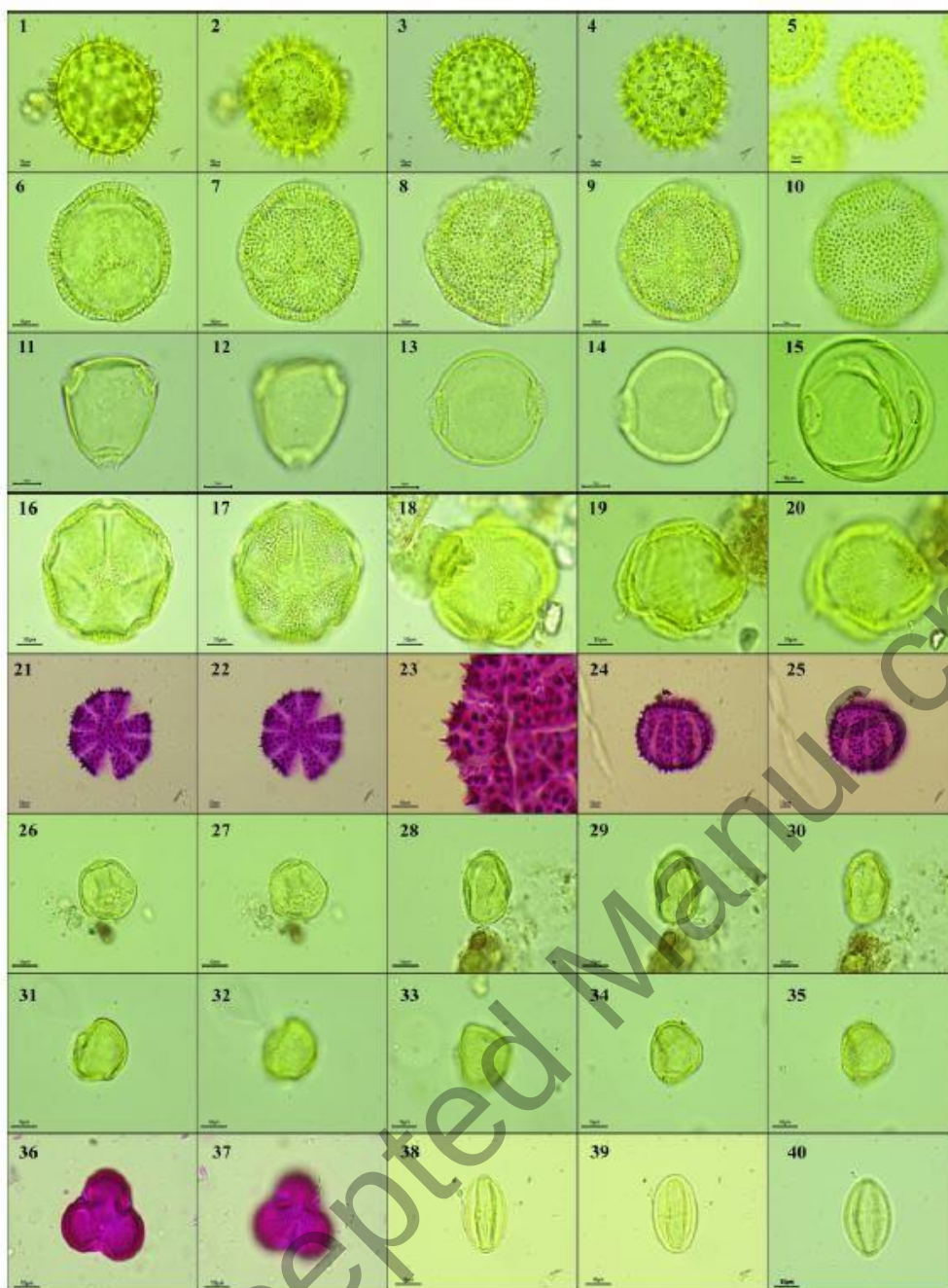


Plate 12. Angiosperms. Convolvulaceae: *Ipomoea dumetorum* (Gv: 1-5); *Jacquemontia unilateralis* (Gv: 6-10). **Cucurbitaceae:** *Cucumis sativus* (Pv: 11-12; Ev: 13-15); *Cyclanthera mathewsii* (Pv: 16-18; Ev: 19-20); *Sicyos baderoa* (Pv: 21-22; Dt: 23; Ev: 24-25). **Cyperaceae:** *Cyperus laxus* (Gv: 26-30); *Cyperus odoratum* (ex-*Torulinium odoratum*) (Gv: 31-35). **Euphorbiaceae:** *Euphorbia* (ex-*Chamaesyce*) *serpens* (Pv: 36-37; Ev: 38-40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 1-5, 21-22, 24-25 (at 40X magnification).

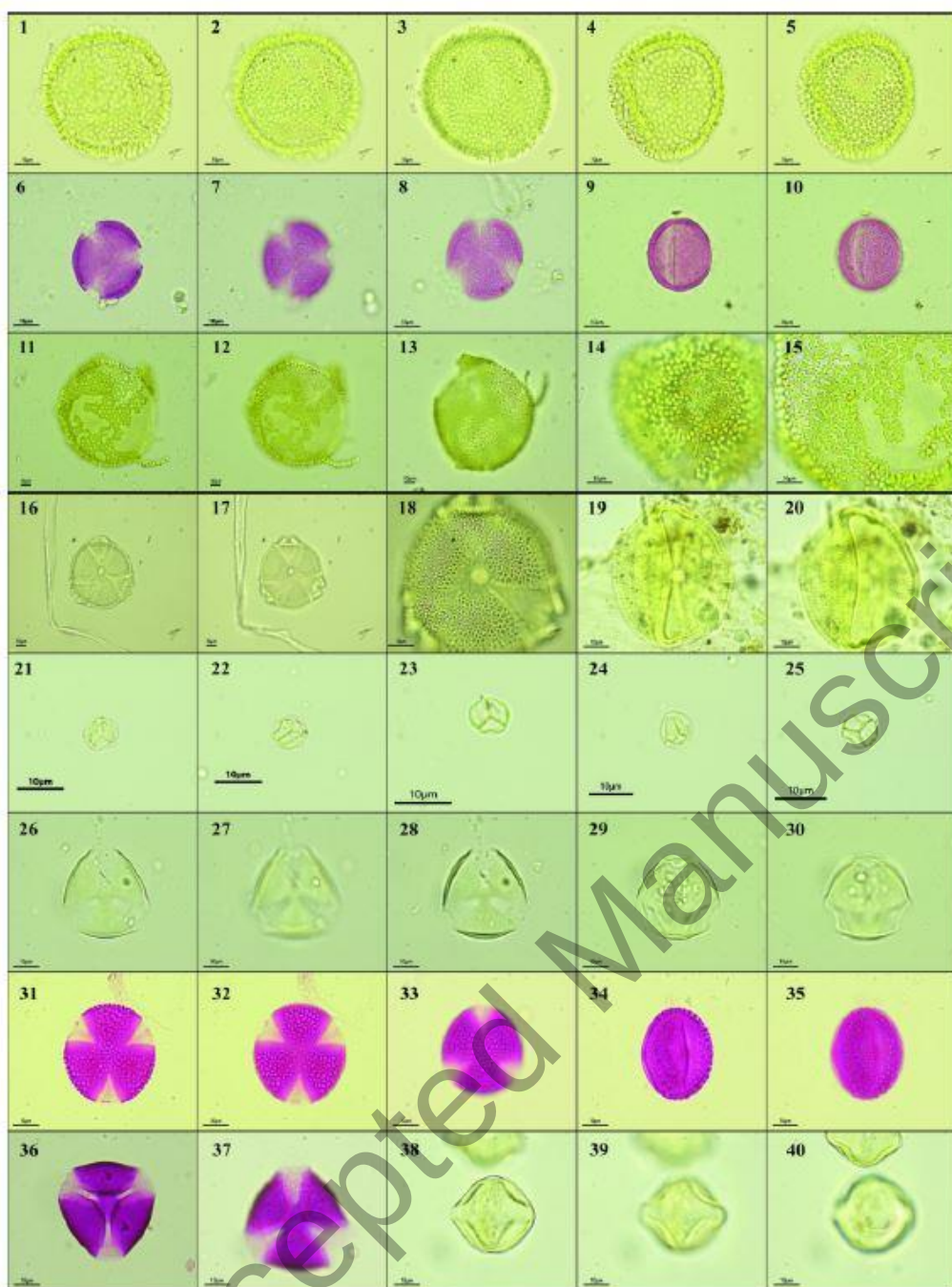


Plate 13. Angiosperms. Euphorbiaceae: *Croton alnifolius* (Gv: 1-5); *Euphorbia peplus* (Pv: 6-7; Ev: 8-10); *Jatropha macrantha* (Gv: 11-13; Dt: 14-15). **Fabaceae:** *Hoffmannssegia miranda* (Pv: 16-18; Ev: 19-20); *Mimosa albida* (Gv: 21-25); *Neltuma juliflora* (Pv: 26-28; Ev: 29-30); *Parkinsonia aculeata* (Pv: 31-33; Ev: 34-35); *Senna birostris* (Pv: 36-37; Ev: 38-40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 11-13, 16-17 (at 40X magnification).

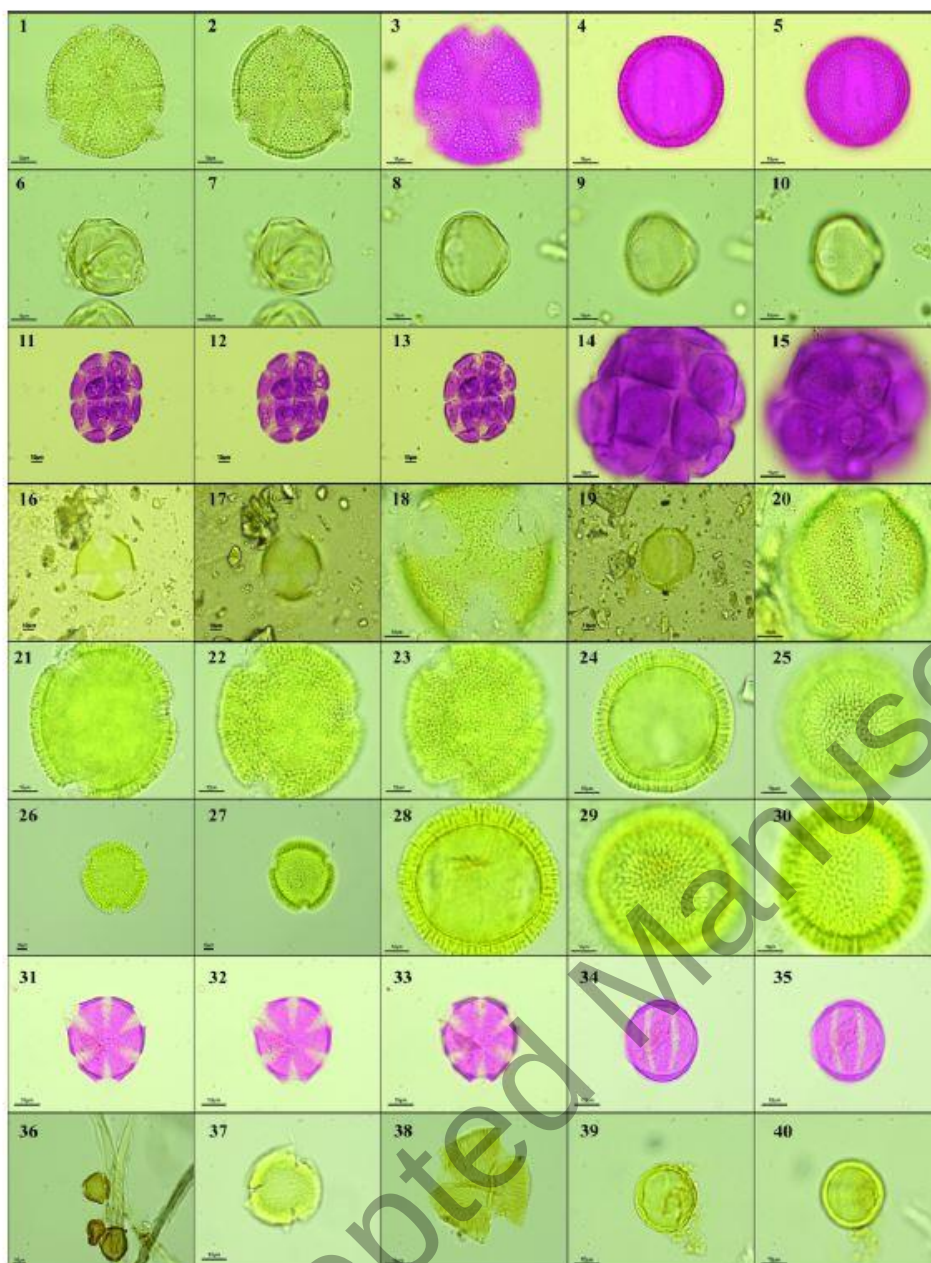


Plate 14. Angiosperms. Fabaceae: *Tara spinosa* (Pv: 1-3; Ev: 4-5); *Trifolium repens* (Pv: 6-7; Ev: 8-10); *Vachellia macracantha* (Gv: 11-15). **Frankeniaceae:** *Frankenia chilensis* (Pv: 16-18; Ev: 19-20). **Geraniaceae:** *Erodium cicutarium* (Pv: 21-23; Ev: 24-25); *Geranium limae* (Pv: 26-27; Ev: 28-30). **Heliotropiaceae:** *Heliotropium arborescens* (Pv: 31-33; Ev: 34-35). **Krameriaceae:** *Krameria lappacea* (Pv: 36-38; Ev: 39-40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 11-13, 16-17, 19, 26-27, 36 (at 40X magnification).

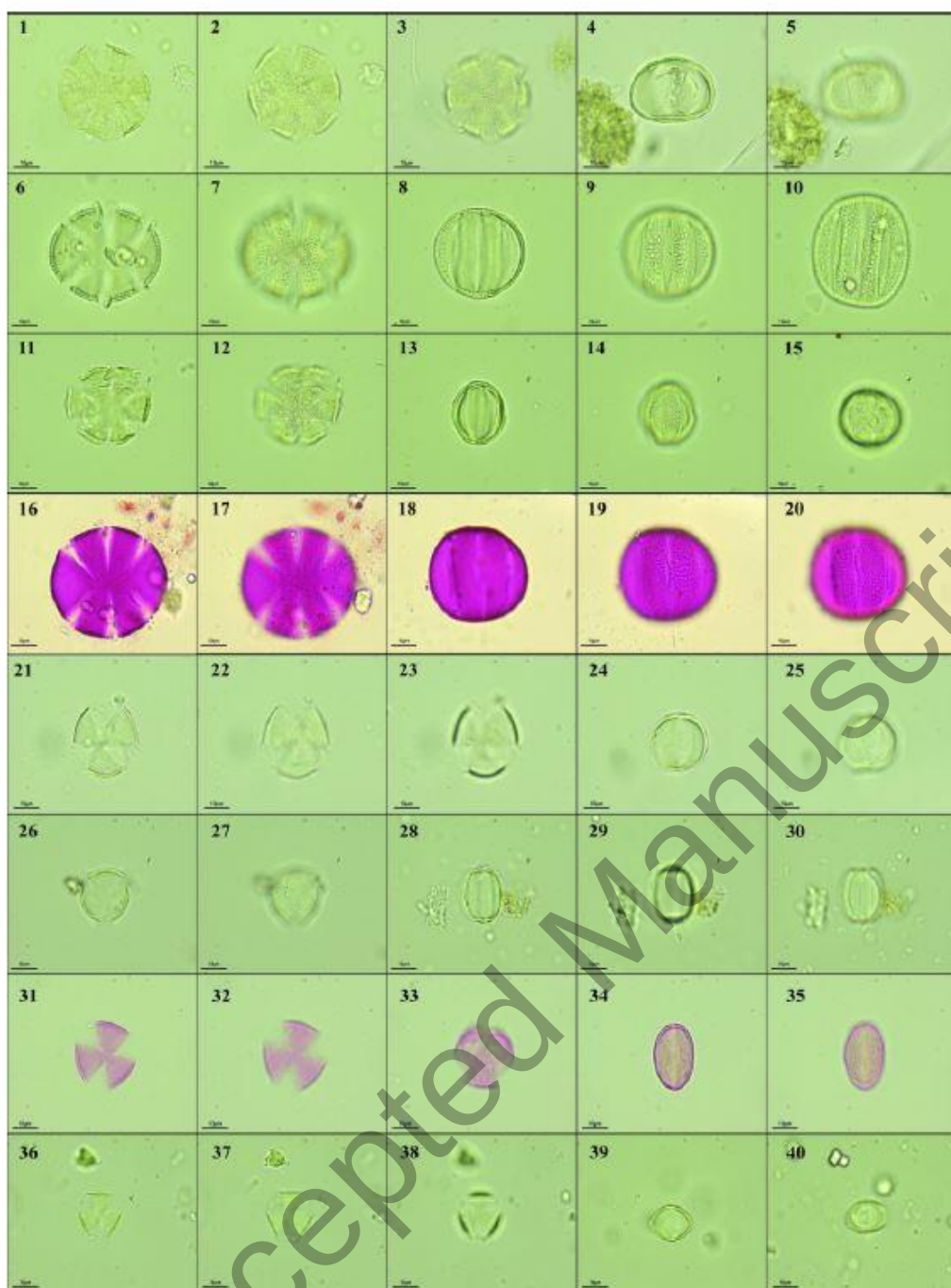


Plate 15. Angiosperms. Lamiaceae: *Hyptis uncinata* (Pv: 1-3; Ev: 4-5); *Lepechinia lamiifolia* (Pv: 6-7; Ev: 8-10); *Minthostachys mollis* (Pv: 11-12; Ev: 13-15); *Salvia rhombifolia* (Pv: 16-17; Ev: 18-20); *Stachys peruviana* (Pv: 21-23; Ev: 24-25). **Loasaceae:** *Loasa nitida* (Pv: 26-27; Ev: 28-30); *Nasa urens* (Pv: 31-33; Ev: 34-35); *Presliophytum arequipense* (Pv: 36-38; Ev: 39-40). Polar view; Ev = Equatorial view. Photographs were taken at 100X magnification.

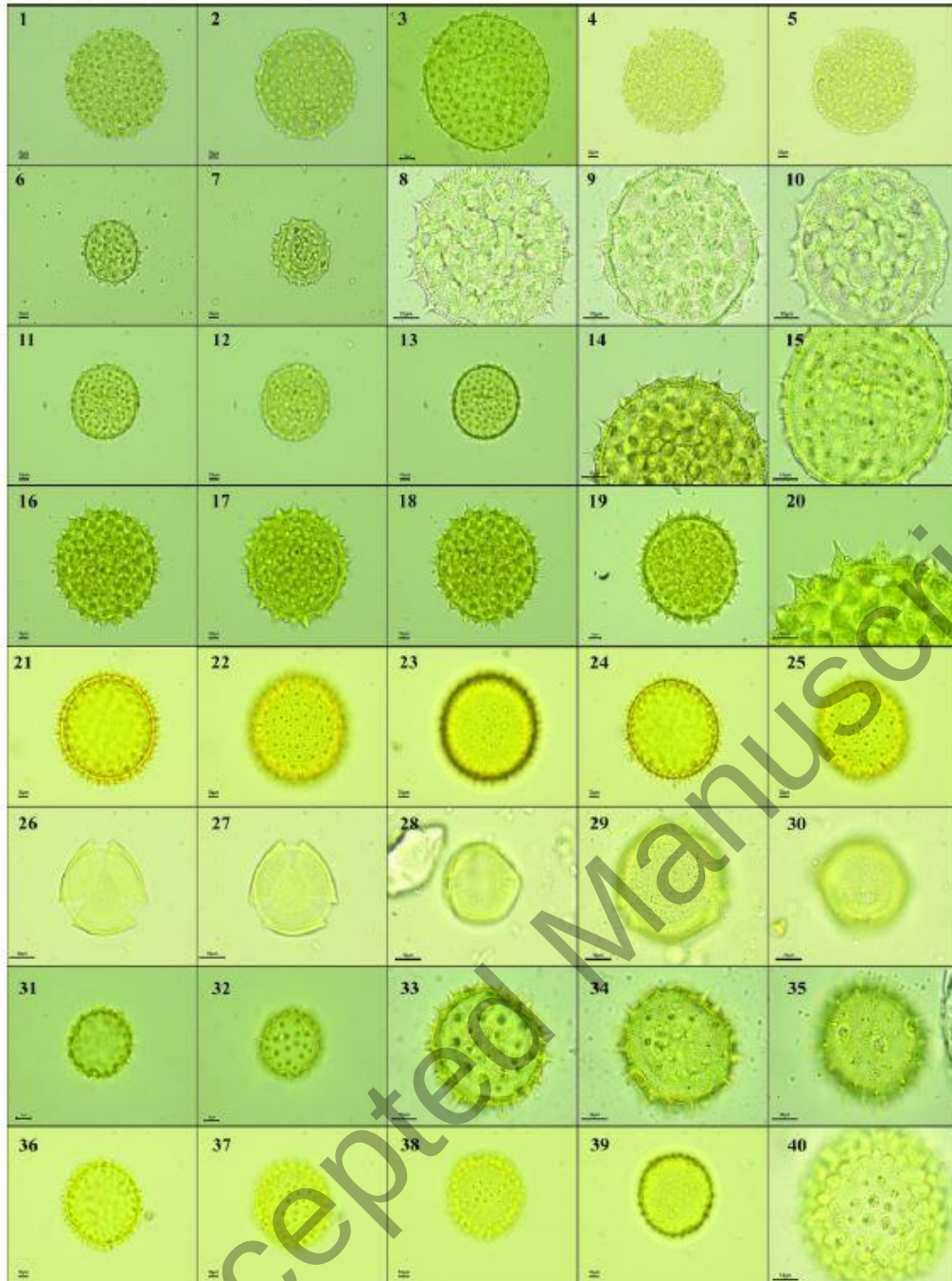


Plate 16. Angiosperms. Malvaceae: *Abutilo bivalve* (Pv: 1-2; Ev: 3-5); *Cristaria multifida* (Pv: 6-10); *Fuertesimalva chilensis* (Gv: 11-13; Dt: 14-15); *Gaya atquipana* (Gv: 16-19; Dt: 20); *Malva parviflora* (Gv: 21-25); *Melochia pyramidata*: Type 1 (Pv: 26-27; Ev: 28), *M. pyramidata* Type 2 (Pv: 29; Ev: 30); *Palaua rhombifolia* (Gv: 31-35); *Sida acuta* (Gv: 36-39; Dt: 40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 1-5, 6-7 11-13 16-19 21-25 31-32, 36-39 (at 40X magnification).

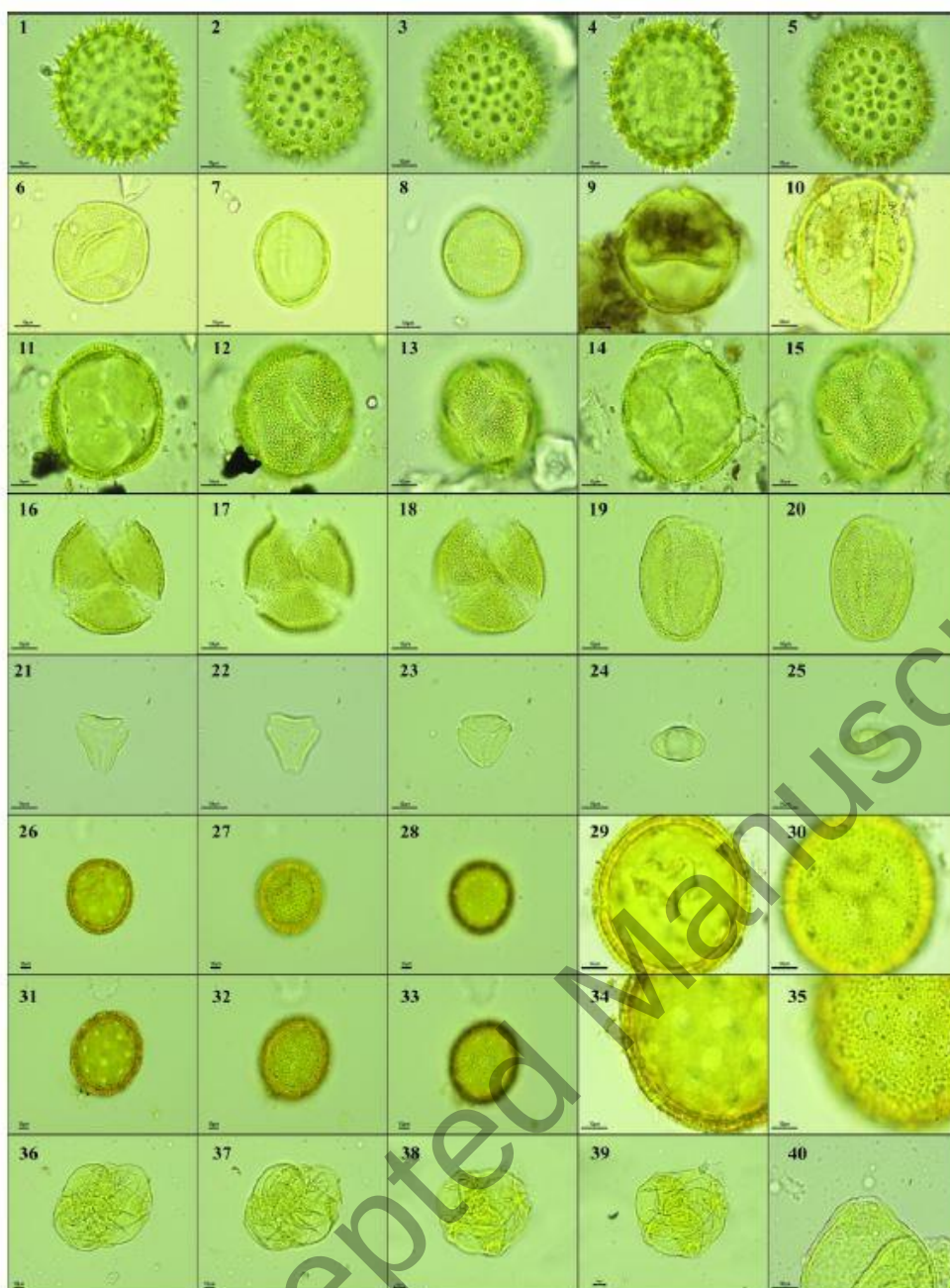


Plate 17. Angiosperms. Malvaceae: *Fuertesimalva* (ex-*Urocarpidium*) *peruviana* (Gv: 1-5); *Waltheria ovata* Type 1 (Pv: 6; Ev: 7-8), *W. ovata* Type 2 (Pv: 9; Ev: 10). **Montiaceae:** *Calandrinia alba* (Gv: 11-15); *Cistanthe calycina* (Pv: 16-18; Ev: 19-20). **Myrtaceae:** *Myrcianthes ferreyrae* (Pv: 21-23; Ev: 24-25). **Nyctaginaceae:** *Boerhavia coccinea* (Gv: 26-30); *Mirabilis prostrata* (Gv: 31-35). **Onagraceae:** *Epilobium fragile* (Gv: 36-39; Dt: 40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 26-28, 31-33, 36-39 (at 40X magnification).

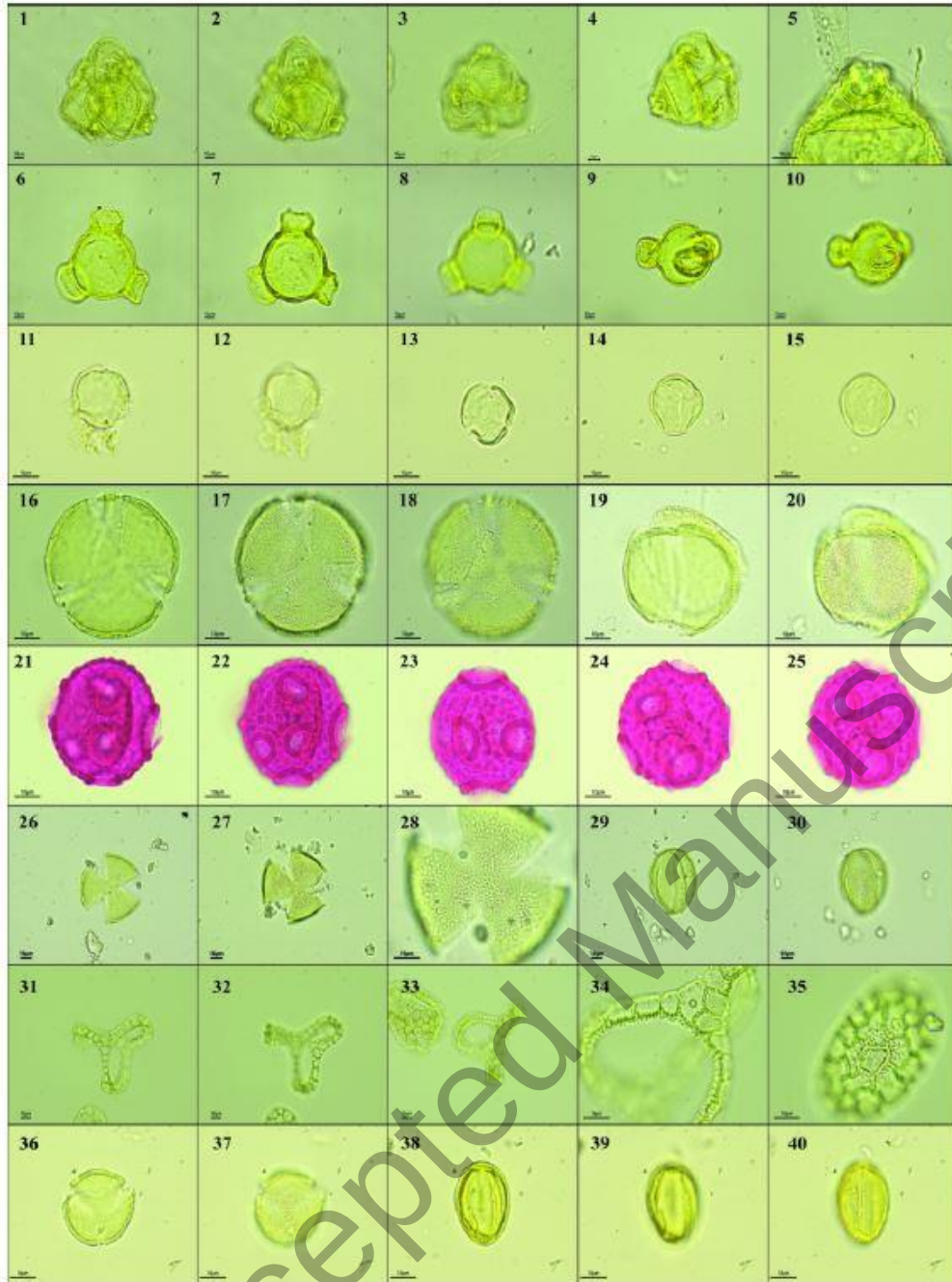


Plate 18. Angiosperms. Onagraceae: *Ludwigia octovalvis* (Gv: 1-4; Dt: 5); *Oenothera arequipensis* (Pv: 6-8; Ev: 9-10). **Orobanchaceae:** *Castilleja arvensis* (Pv: 11-13; Ev: 14-15). **Papaveraceae:** *Argemone subfusiformis* (Pv: 16-18; Ev: 19-20); *Fumaria capreolata* (Gv: 21-25). **Passifloraceae:** *Malesherbia scarlatiflora* (Pv: 26-28; Ev: 29-30); *Passiflora foetida* (Pv: 31-34; Dt: 35). **Phytolaccaceae:** *Phytolacca bogotensis* (Pv: 36-37; Ev: 38-40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 1-4, 6-10, 26-27, 29-30, 31-34 (at 40X magnification).

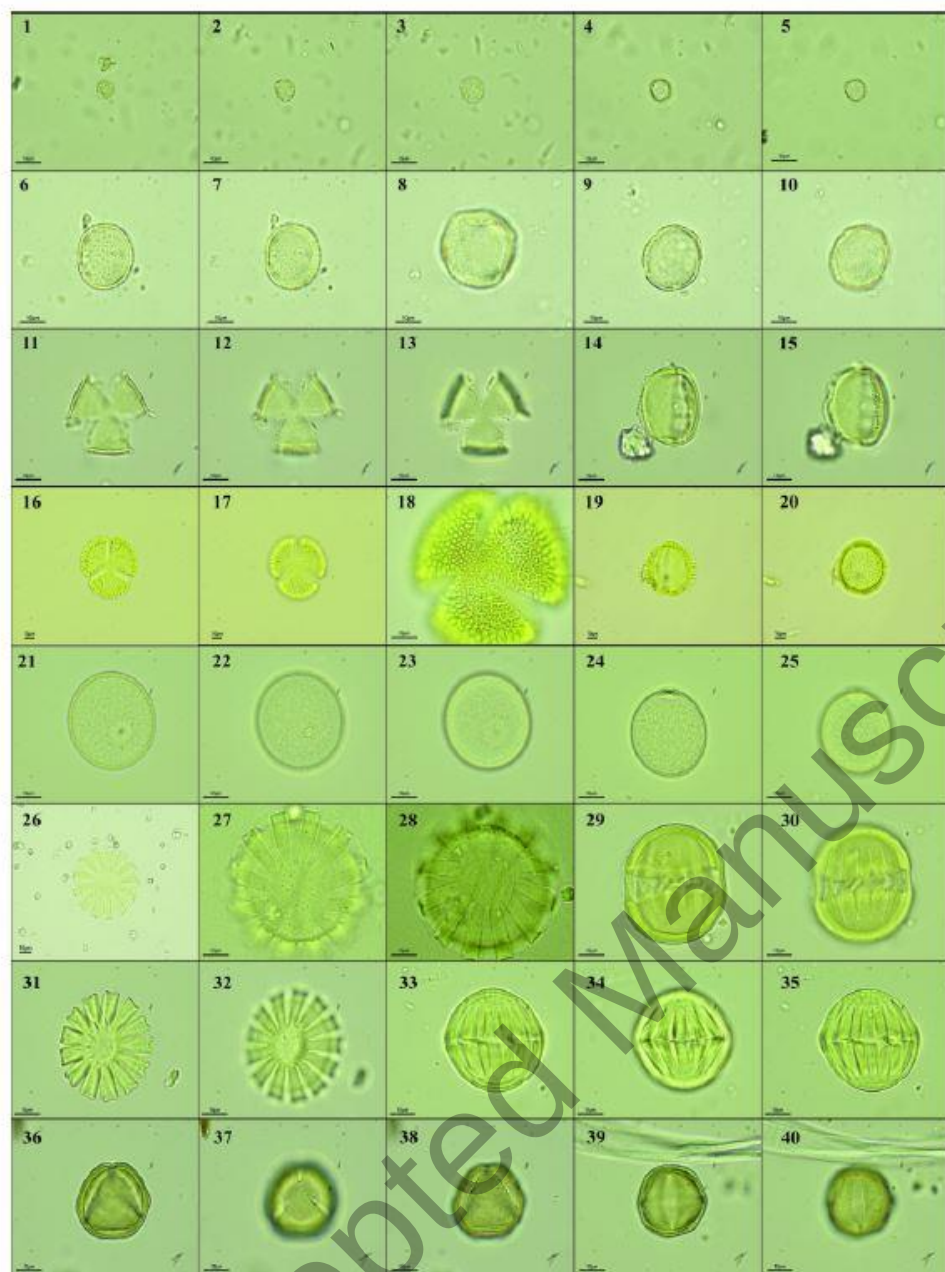


Plate 19. Angiosperms. Piperaceae: *Peperomia galioides* (Gv: 1-5). **Plantaginaceae:** *Plantago limensis* (Gv: 6-10); *Veronica persica* (Pv: 11-13; Ev: 14-15). **Plumbaginaceae:** *Plumbago caerulea* (Pv: 16-18; Ev: 19-20). **Poaceae:** *Aristida adscencionis* (Pv: 21-23; Ev: 24-25). **Polygalaceae:** *Monnina pseudopilosa* (Pv: 26-28; Ev: 29-30); *Monnina macrhostachya* (Pv: 31-32; Ev: 33-35). **Polygonaceae:** *Polygonum aviculare* (Pv: 36-38; Ev: 39-40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 16-17, 19-20, 26 (at 40X magnification).

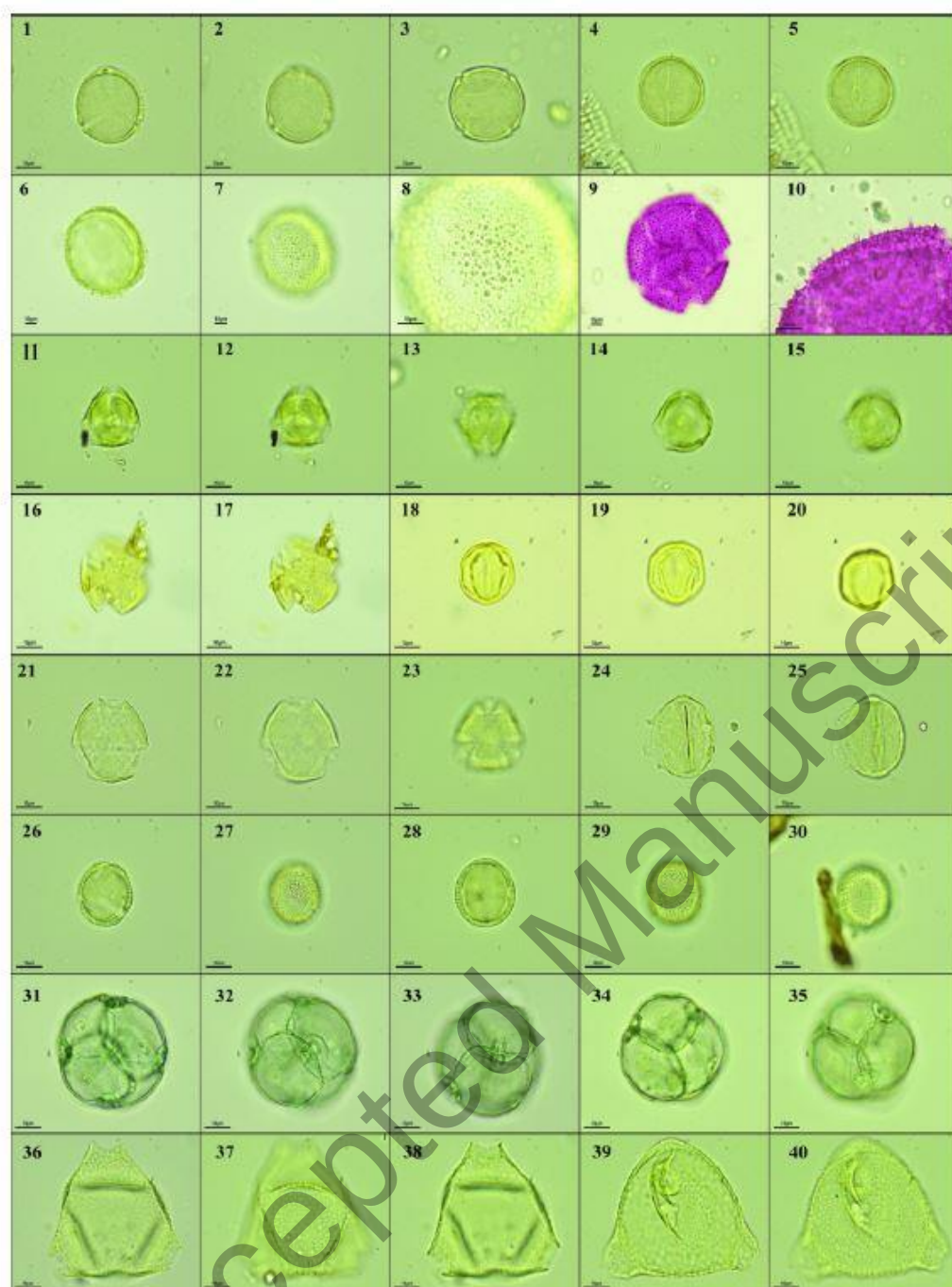


Plate 20. Angiosperms. Polygonaceae: *Rumex conglomeratus* (Pv: 1-3; Ev: 4-5).

Portulacaceae: *Portulaca nivea* (Gv: 6-7,9; Dt: 8,10). **Primulaceae:** *Lysimachia arvensis* (Pv: 11-13; Ev: 14-15). **Rosaceae:** *Hesperomeles ferruginea* (Pv: 16-17; Ev: 18-20); *Rubus urticifolius* (Pv: 21-23; Ev: 24-25). **Rubiaceae:** *Arcytophyllum thymifolium* (Pv: 26-27; Ev: 28-30); *Randia armata* (Gv: 31-35); **Sapindaceae:** *Cardiospermum grandiflorum* (Pv: 36-40). Polar view; Ev = Equatorial view; Gv = General view; Dt = Detail. Photographs were taken at 100X magnification, with the exception of 6-7, 9 (at 40X magnification).

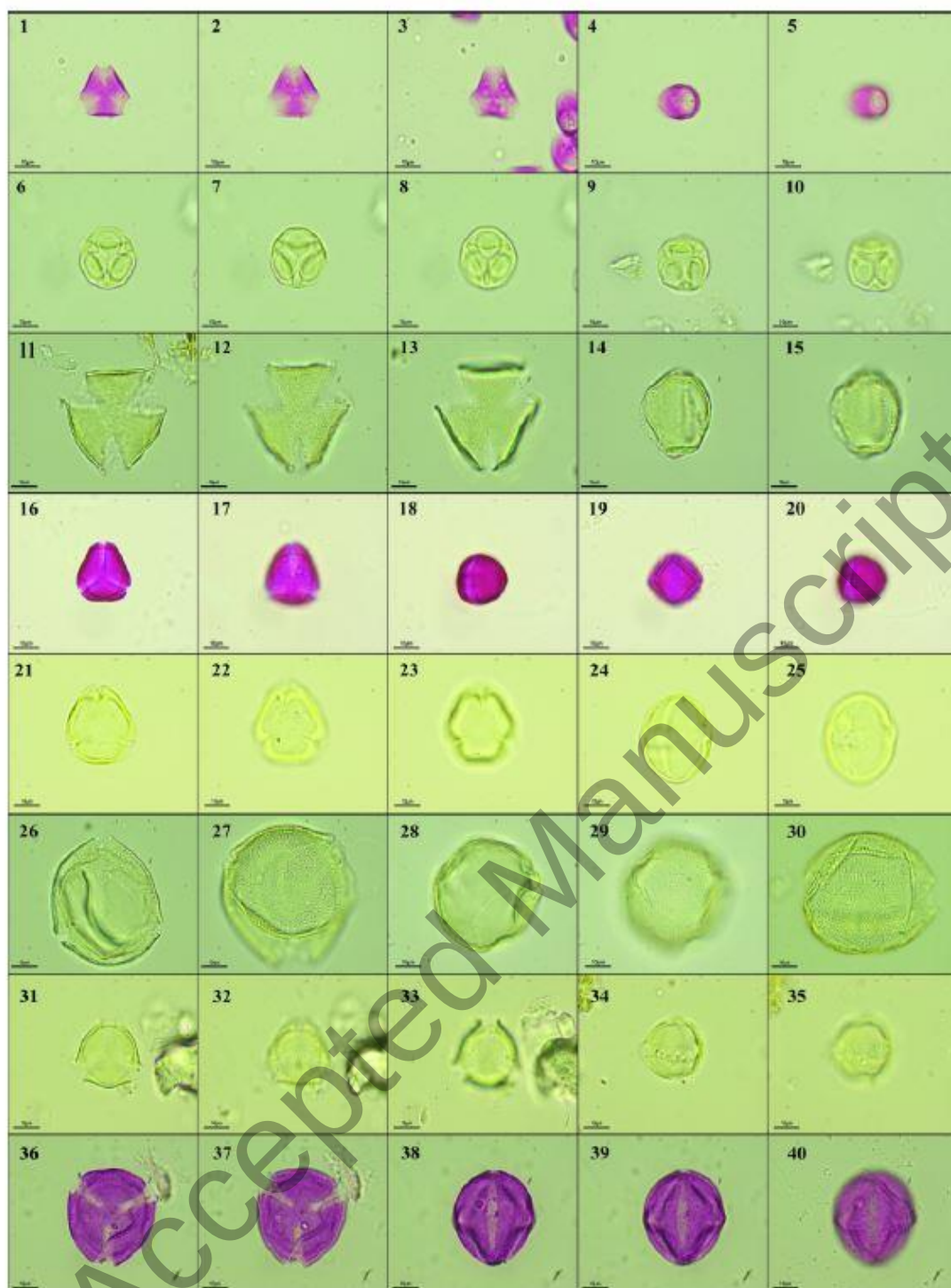


Plate 21. Angiosperms. Sapindaceae: *Sapindus saponaria* (Pv: 1-3; Ev: 4-5).

Schoepfiaceae: *Quinchamalium chilense* (Pv: 6-8; Ev: 9-10). **Scrophulariaceae:** *Alonsoa meridionalis* (Pv: 11-13; Ev: 14-15). **Solanaceae:** *Iochroma arborescens* (Pv: 16-17; Ev: 18-20); *Cestrum auriculatum* (Pv: 21-23; Ev: 24-25); *Datura stramonium* (Pv: 26-27; Ev: 28-30); *Exodeconus prostratus* (Pv: 31-33; Ev: 34-35); *Jaltomata umbellata* (Pv: 36-37; Ev: 38-40). Polar view; Ev = Equatorial view. Photographs were taken at 100X magnification.

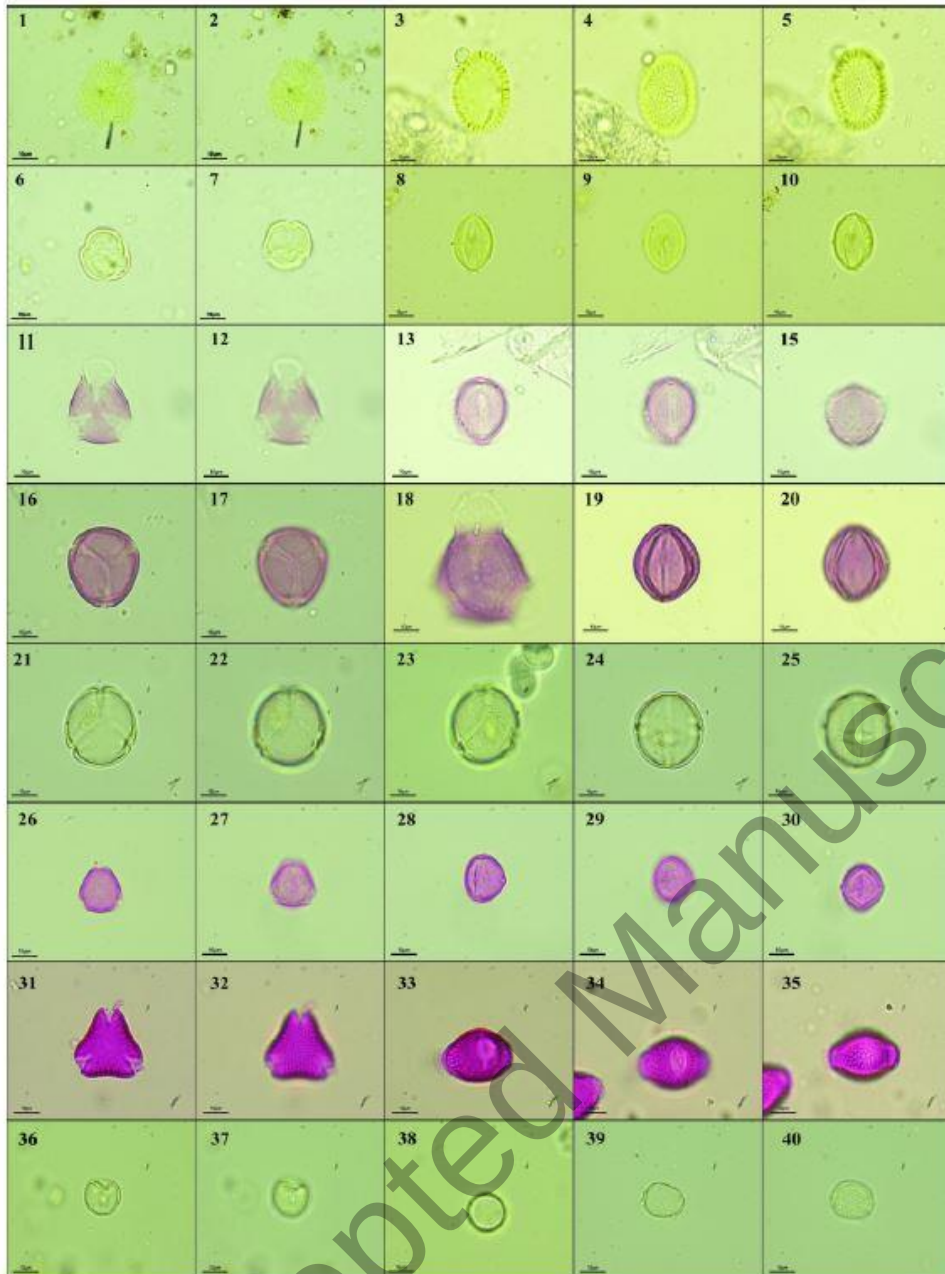


Plate 22. Angiosperms. Solanaceae: *Leptoglossis lomana* (Pv: 1-2; Ev: 3-5; *Lycium americanum* (Pv: 6-7; Ev: 8-10); *Nicotiana glauca* (Pv: 11-12; Ev: 13-15); *Nolana humifusa* (Pv: 16-18; Ev: 19-20); *Salpichroa ramosissima* (Pv: 21-23; Ev: 24-25); *Solanum peruvianum* (Pv: 26-27; Ev: 28-30). **Tropaeolaceae:** *Tropaeolum majus* (Pv: 31-32; Ev: 33-35). **Urticaceae:** *Pilea microphylla* (Pv: 36-38; Ev: 39-40). Polar view; Ev = Equatorial view. Photographs were taken at 100X magnification.

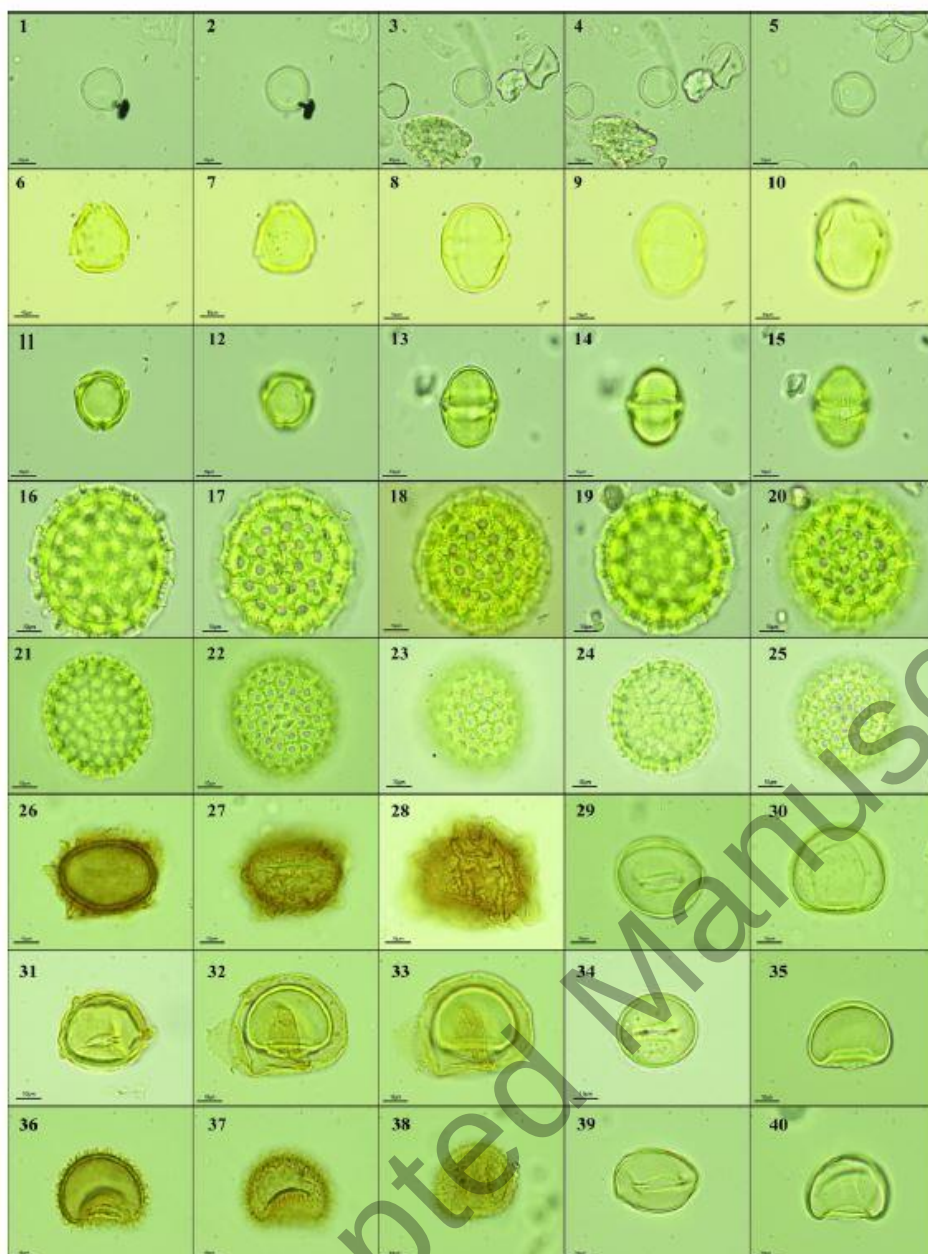


Plate 23. Angiosperms. Urticaceae: *Urtica urens* (Pv: 1-2; Ev: 3-5). **Verbenaceae:** *Lantana scabiosiflora* (Pv: 6-7; Ev: 8-10); *Phylla nodiflora* (Pv: 11-12; Ev: 13-15). **Zygophyllaceae:** *Kallstroemia pubescens* (Gv: 16-20); *Tribulus terrestris* (Gv: 21-25). **Pteridophytes. Aspleniaceae:** *Asplenium monanthes* (Pv: 26-27, 29; Ev: 28, 30). **Blechnaceae:** *Blechnum occidentale* (Pv: 31, 34; Ev: 32-33; 35). **Cystopteridaceae:** *Cystopteris fragilis* (Pv: 39; Ev: 36-38, 40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification.

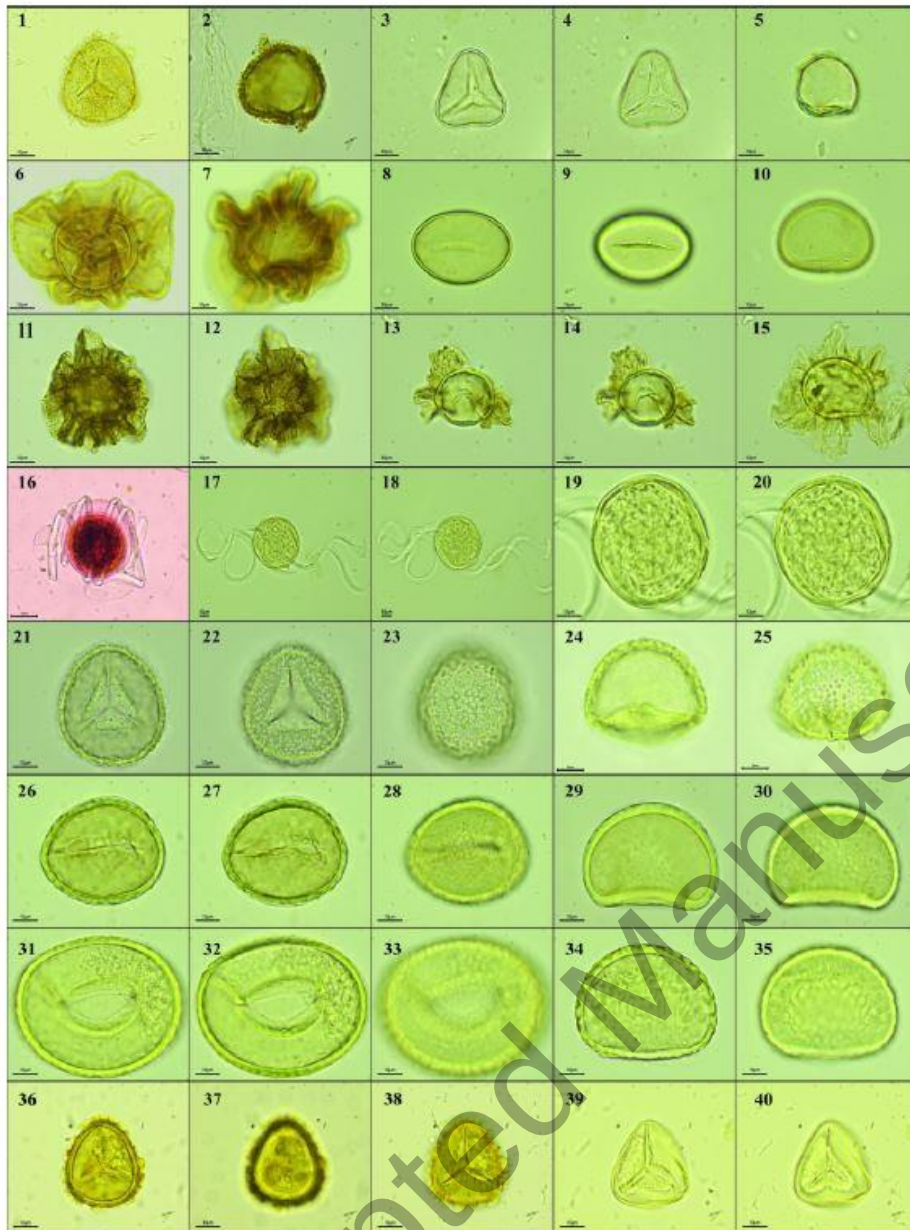


Plate 24. Pteridophytes. Dennstaedtiaceae: *Pteridium arachnoideum* (Pv: 1, 3-4; Ev: 2, 5).

Dryopteridaceae: *Dryopteris saffordii* (Pv: 6, 8-9; Ev: 7, 10); *Elaphoglossum minutum* (Pv: 13, 14; Ev: 11-12, 15).

Equisetaceae: *Equisetum bogotense* (Gv: 16-20).

Ophioglossaceae: *Ophioglossum crotalophoroides* (Pv: 21-23; Ev: 24-25).

Polypodiaceae: *Pleopeltis macrocarpa* (Pv: 26-28; Ev: 29-30); *Serpocaulon lasiopus* (Pv: 31-33; Ev: 34-35).

Pteridaceae: *Adiantum digitatum* (Pv: 36-40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 17-18 (at 40X magnification).

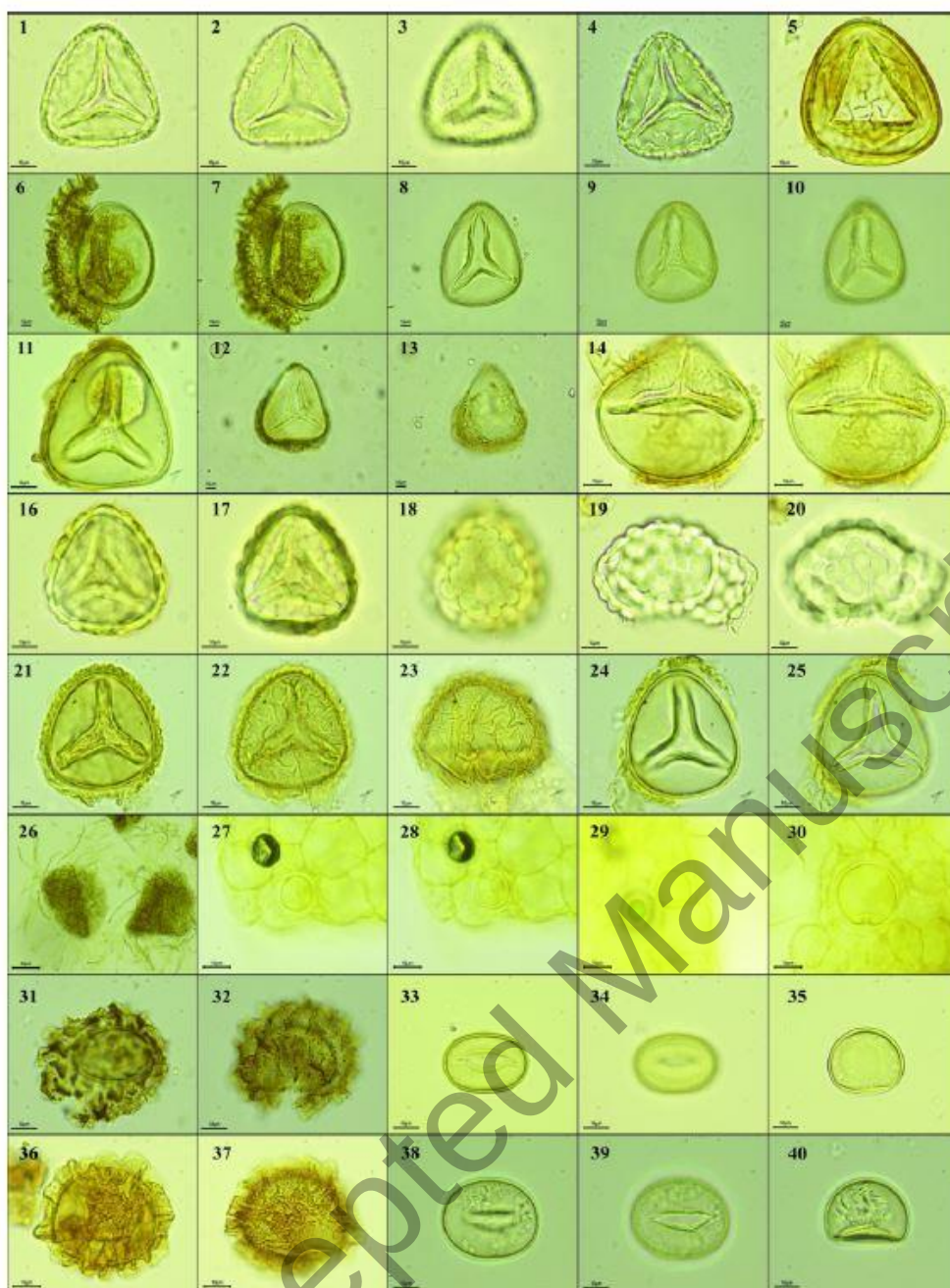


Plate 25. Pteridophytes. Pteridaceae: *Anogramma leptophylla* (Pv: 1-5); *Hemionitis nivea* (Pv: 6-10); *Hemionitis sinuata* (Pv: 11-13; Gv: 14-15); *Hemionitis peruvianum* (Pv: 16-18; Ev: 19-20); *Hemionitis ternifolia* (Pv: 21-22, 24-25; Ev: 23). **Salviniaceae:** *Azolla filiculoides* (Gv: 26; Pv: 27-28; Ev: 29-30). **Thelypteridaceae:** *Thelypteris glandulosolanosa* (Pv: 31, 33-34; Ev: 32, 35). **Woodsiaceae:** *Woodsia montevidensis* (Pv: 38-39; Ev: 36-37, 40). Polar view; Ev = Equatorial view; Gv = General view. Photographs were taken at 100X magnification, with the exception of 6-10, 12-13 (at 40X magnification), 26 (at 20X magnification).

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