SMALL FRUIT GERMPLASM RESOURCES IN THE ANDEAN REGION OF ECUADOR

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INTRODUCTION

The Andes of Ecuador is a region which contains tremendous diversity in genera of small fruit taxa, particularly Vacciniaceous taxa. Twenty-one genera and approximately 200 species of Vacciniaceous plants have been described in Ecuador (Luteyn, 1989). They are of general occurrence throughout the region, primarily on cool moist slopes at intermediate to high elevations. No horticultural or cytological information is available for the vast majority of these taxa, however at least six genera include species worthy of consideration as potential new crops (Martin, et al., 1987).

One species in Vaccinium L., V. floribundum H.B.K., the Andean blueberry or "Mortino," produces fruit highly esteemed by people in various parts of the Andean region (Popenoe, 1924; Macbride, 1959; Galletta, 1975). Although not cultivated, it is widely harvested from wild populations and sold in village markets. This species is abundant on the cold bleak paramos or rolling plains at 3000-3700 m. elevation throughout Ecuador (Popenoe, 1924). It is also the most common Vaccinium species in Peru (Macbride, 1959), the only species in Argentina and Bolivia, and also occurs in Colombia and Venezuela. On some of the higher elevation sites where it grows, frost can occur any night of the year, and it could prove to be a valuable source of genes for frost resistance during bloom.

Most other taxa of Vacciniaceous species in Ecuador produce more-or-less edible fruit. In addition, they are often highly ornamental with leathery evergreen leaves and large, brightly-colored flowers. The genus Cavendishia also has large, colorful bracts subtending the flowers. Based on the limited information available at the present time, genera such as Cavendishia, Ceratostema, and Psammisia appear to have particular potential as new floricultural crops.

In Ecuador, the genus Rubus includes species in subgenus Rubus (the blackberries) which also is found in North America and Eurasia, and the strictly Latin American subgenus Orobatus (Jennings, 1978). In addition, there is a unique species, R. glaucus Benth., which appears to combine the characteristics of the black raspberry and blackberries in a fertile amphidiploid (Jennings et al. 1988).

In the Andean region, R. glaucus, often referred to as the Andean blackberry, and R. macrocarpus Benth. (subgenus Orobatus), the giant Colombian blackberry, are both especially interesting species producing large to very large fruit of good to superior quality, together with small to moderate seed size (Darrow, 1955; Jennings, 1978; 1988; Popenoe, 1920; 1921; 1924). In addition, R. adenotrichos Schlecht. (syn. R. adenothallus Focke.) (subgenus Rubus) and R. roseus Poir. (subgenus Orobatus) also produce large to very large fruit of good quality and appear worthy of consideration (Martin, et al., 1987; Popenoe, 1924). Of these species only R. glaucus is presently grown in cultivation. It is cultivated widely in Central America and tropical South America, and both wild and cultivated forms occur in Ecuador in cool humid regions at altitudes between 2000 - 4000 m. The other three species are of widespread occurrence on the paramos along with Vaccinaceous taxa. All four of these species appear

promising as parents for incorporating improved fruit size and quality into temperate zone Rubus genotypes. In addition, R. glaucus may transmit small seed size. Occasional collections of R. glaucus and R. macrocarpus have been made for and/or by plant breeders. However, essentially none of these Rubus species have been systematically collected for preservation and/or evaluation outside their native range.

A grant proposal for funding to collect small fruit germplasm in Andean Ecuador was submitted to the Plant Introduction Service of the United States Department of Agriculture in January, 1989, and funding approved for 1990. The objectives of this proposal were to collect seed, clonal and herbarium specimens of Vacciniaceous genera and Rubus species which are potential sources of genes for frost tolerance during bloom and/or large fruit-size, improved fruit-quality and small seed-size, or have potential as new ornamental and/or floricultural crops; for maintenance at the National Clonal Germplasm Repository (NCGR) in Corvallis, OR, USA, and the Department of Plant Genetic Resources, INIAP, Quito, Ecuador, and for potential utility in plant breeding, genetics, and phylogenetic studies.

MATERIALS AND METHODS

The collection expedition was conducted between October 29, 1990 and November 26, 1990. James L. Luteyn conducted one additional day trip on November 29, but no additional Vacciniaceous or Rubus accessions were collected. All collection sites were accessible by road, mainly packed gravel, or sometimes paved. Locations were mainly along side roads leading from the Pan American Highway, and involved travel from Tulcan, near the Colombia border in the north to Loja in southern Ecuador.

Local specialists accompanied us on most excursions, and provided invaluable assistance with collecting and identification, and serving as additional interpreters. These primarily included Raul Castillo (RC), Head, National Department of Plant Genetic Resources, INIAP, Quito, and Katya Romoleroux (KR) and Peter Jorgensen (PJ) of the Catholic University of Ecuador in Quito. In addition, the following individuals from the Catholic University also assisted: Patricio Yanez (PY), Mauricio Gavilnez (MG), Carmen Ulloa U., C.C. Berg, Jaime Jaramillo and Elena Grijalva. The initials (in parentheses) of all individuals involved in each excursion will be listed with the other passport data.

Population collections of seeds and herbarium vouchers were most strongly emphasized, however, representative or elite clonal accessions and/or pollen samples were included in certain instances, and particularly where it was not possible to collect seeds. Species designations for Vacciniaceous species were made by Luteyn, and Rubus as circumscribed by Macbride (1959) and Popenoe (1920, 1924). In the interest of time, considering the area to be covered in 4 weeks, descriptions are very brief. With Rubus, species designations were often tentative, indicative of the uncertain status of many of the taxa in montane Latin America. Five digit field numbers were assigned to each accession. These numbers came from the ongoing field collections of Luteyn in Latin America. Since he

from the ongoing field collections of Luteyn in Latin America. Since he spends a considerable amount of time each year collecting in this region, this seemed to be a logical approach. In addition, each accession for which seed, pollen or clonal collections were made was also assigned a Plant Introduction (PI) number. Associated species, for which herbarium vouchers were collected, were also assigned five digit field numbers and are listed by location.

Seeds were extracted with a battery-powered blender, and then packaged and stored using established procedures. In addition, in the Vacciniaceous genera Ceratostema, Macleania, and Psammisia, where each seed is surrounded by a gelatinous sheath at maturity, a small sample of seeds was also held moist until return to the U.S. to determine if this characteristic affected germination. Herbarium specimens were generally pressed at the end of each day of collecting. Cuttings and plants were stored in plastic bags at 4°C until they could be placed under intermittent mist in a greenhouse either at INIAP or upon receipt in the U.S. Pollen was collected in petri dishes, placed in a small desiccator overnight, and then the dish was sealed with Parafilm and stored at 4°C.

Half of the germplasm from each seed and clonal accession collected was given to the National Department of Plant Genetic Resources, INIAP, prior to leaving Quito. The majority of the remaining seeds were forwarded to Dr. Kim Hummer, Research Leader/Curator, NCGR/Corvallis. Small samples of a number of seed accessions were forwarded to North Carolina State University. Clonal material forwarded to the U.S. was sent to North Carolina for rooting and/or reestablishment. Following repropagation, representative clones will be sent to Corvallis and the New York Botanical Garden. All appropriate export and import permits were secured prior to shipping seeds and clonal materials.

Herbarium vouchers were collected for all accessions except market samples of fruit (seeds). Complete sets of vouchers were collected for the New York Botanical Garden, NCGR/Corvallis and the Catholic University of Ecuador (for Ecuador). Representative vouchers of each species of small fruits were also collected for North Carolina State University, the National Herbarium, and INIAP.

ITINERARY AND DESCRIPTION OF LOCATIONS AND ACCESSIONS

October 29, 1990 - arrived in Quito

October 30 - November 1 - Acclimated to the high altitude, purchased supplies, rented a 4-wheel drive vehicle, and became familiar with the Ericaceous and Rubus collection in the herbarium at the Catholic University.

November 2-4 - North from Quito on the Pan American Highway to Carchi and Imbabura provinces. Participants; JLL, JRB, MT, KR and RC.

Location 1 - Carchi province. Maldonado road, 3-10 km. west of Tulcan; 2954 - 3077 m. elevation; Ca. 0°50'N, 77°50'W. Inter-Andean secondary vegetation along roadsides with Phytolacca, Atriplex, Monina, Brugmansia, Eucalyptus, Bomarea, and Rubus.

14017 - Rubus adenothallus Focke. Upright with arching stems. Angular hispid primocanes to 3 m. Hairs reddish. Inflorescence to 30 cm. long. Prickles sparse. Five leaflets. Linear stipules. Petals pale pink in bud, pure white at anthesis. Fruit immature, to about half-size. Scattered along the roadside with R. glaucus. Herbarium only.

14018 - Rubus glaucus Benth. Glaucous, upright but arching primocanes to 3 m. or more long. Petals white. Typically in flower but some approximately half-size fruit. Locally abundant. Herbarium only.

Location 2 - Carchi province. Maldonada road, 1.4 km. west of Tufino; 3292 m. elevation; Ca. 0°48'N, 77°52'W. Highly disturbed subparamo vegetation along the roadside. One V. floribundum seedling found on the roadbank.

14019 (PI548912) - Rubus robustus Presl. Upright but arching stems to 2 m. Stems tomentose, with sparse prickles. 3-5 leaflets. Large compound inflorescence. Petals pinkish-white. Fruit small, a few starting to ripen. Occasional plants. Herbarium and seed.

14020 (PI548908) - Rubus macrocarpus Benth. Trailing or climbing shrub. Primocanes to at least 2 m. long, hispid. Three leaflets, leaves coriaceous. Flower petals and filaments magenta. Fruit large, to 2.5 x 2.5 cm. Partially mature fruits dark reddish purple, mature fruits dull black. Rust fungus common on underside of leaves and also on calyces of fruits. Scattered along the roadside. Herbarium and seed.

14021 - Rubus roseus Poir. Trailing or climbing shrub. Primocanes basically glabrous, to at least 2 m. long. Three leaflets. Petals magenta. No fruit. Only a single plant on this location. Herbarium only.

14022 (PI548889) - Rubus adenothallus Focke. Plant very similar to 14017. Fruit starting to ripen, nice size, black. Occasional. Seed from a single plant. Herbarium and seed.

14024 - Rubus robustus Presl. Arching canes to about 3. long, tomentose. Five leaflets. Fruit starting to ripen, but plant appears to be only partially fertile. Single individual. Herbarium only.

Collected associates
14023 - Viburnum sp. Shrub to 2.5 m. tall. Corolla white. Fruit immature, green. Herbarium only.

Location 3 - Carchi province. Maldonado road, 3.0 km. west of Tufino; 3400 m. elevation; Ca. 0°48'N, 77°52'W. Disturbed shrub subparamo.

14025 (PI548937) - Vaccinium floribundum H.B.K. Shrub to 1.5 m. tall. Flowers white to rose-red. Most plants still mainly in flower. Fruit turning dark blue-black. Plant abundant on the site. Visited by several types of bumble bees. Herbarium and seed.

14026 (PI548901) - Rubus glabratus H.B.K. Trailing shrublet. Primocanes to about 1.5 m., glabrous. Three leaflets. Flowers, single, terminal. Petals pink-rose. Immature to partially mature fruits, reddish-orange. Occasional. Herbarium and a small sample of seed.

Location 4 - Carchi province. Maldonado road, 13.7 km. west of Tufino; 3938 m. elevation; Ca. 0°50'N, 77°55'W. Espeletia paramo with rock outcrops at las Lagunas.

14027 (PI548896) - Rubus coriaceus Poir. Trailing, herbaceous subshrub. Stoloniferous. Stem glabrous. Simple leaves, bullate. Broad stipules. Petals dark magenta. 1-2 flowers per cluster. Fruit translucent, bright red at maturity. Calyx caudate, clasping on the fruit. Rare, among Polylepis and rock outcrops. Herbarium and a small seed sample.

14028 - Ribes andicola Jancz. Shrub to 1 m. tall. Inflorescence pendent. Corollas red. No fruit. Locally common. Herbarium only.

Collected associates
14029 - Apiaceae - herb, ± succulent, with short taproot. Corolla white, fruits brown.

Location 5 - Carchi province. Tulcan- El Angel road, approx. 9 km. southwest of the Pan American Highway; 3385 m. elevation; Ca. 0°48'N, 77°48'W. Disturbed slopes through the subparamo.

14030 - Rubus glabratus H.B.K. Trailing subshrub. Glabrous stems. Trifoliate leaves. Magenta flowers. Fruit orangish-red. Rare. Herbarium only.

14031 (PI548938) Vaccinium floribundum H.B.K. Shrub, 1.0-1.5 m. tall. Leaves glaucous, young growth reddish, very attractive. Corollas white to rose-red, most plants mainly flowering. Mature fruit glaucous blue-black. Locally common. Herbarium and seed.

14032 (PI548909) Rubus macrocarpus Benth. Morphologically very similar to 14020. Calyx silky above, caudate, reflexed on the fruit. Rust evident again, especially on calyces of fruit. Scattered on the site. Herbarium and a small sample of seed.

14033 - Rubus glaucus Benth. typical for the species. No ripe fruit. Herbarium only.

14034 - Gaultheria glomerata (Cav.) Terrestrial shrub to 2 dm. tall. Corolla white to rose. Mature calyx blue-black. Common. Herbarium only.

Location 6 - Imbabura province. Approximately 4 km. east of Ibarra along the road towards Laguna San Marcas. Elevation, approximately 2492 m.; Ca. 0°23'N, 78°4'W. Weedy vegetation along the roadside and a hedge row.

14035 (PI548900) - Rubus ellipticus Smith. Arching shrub. Primocanes to 3 m. plus tall, 2.5 cm. dia., covered with red-brown bristles. Petals white. Mature fruit small, golden-yellow. Escape, scattered through the area. Herbarium and seed.

November 5 - Quito - Preparation of herbarium specimens; planning remainder of trip. Dr. Thompson purchased three cultivated fruit (seed) samples of R. glaucus Benth. (sample Nos. 1, 2 and 3) and one sample of V. floribundum H.B.K., all from the Ambato region.

November 6 & 7 - North from Quito on the Pan American Highway to Sucumbios, Napo, and Pichincha provinces. Participants, JLL, JRB, MT, PY, and MG.

Location 7 - Sucumbios province. Road to Laguna San Marcos, approximately 13 km. east of Olmedo. 3570 m. elevation; Ca. 0°07'N, 77°52'W. Shrub paramo, burned within the last 18 months.

14036 (PI548939) - Vaccinium floribundum H.B.K. Shrub to 1.5 m. tall. Corolla white to rose-red. Berry blue-black, glaucous, to 9.5 mm. dia., abundant ripe fruit. Plants locally abundant. Herbarium and seed.

14037 - Rubus macrocarpus Benth. Typical morphologically. Fruit only partially mature. Occasional on the site. Herbarium only.

14039 (PI548897) - Rubus coriaceus Poir. Trailing or climbing subshrub, to ca 30 cm long, in dense brush. Glabrous stems, simple leaves, with much red pigment in the leaf veins. Petals deep magenta. Mature fruit red, borne singly. Plants scattered on the site. Herbarium and a small seed sample.

14040 - Certostema alatum (Hoer.) Sleumer. Terrestrial shrub. Corolla deep scarlet, very attractive. No fruit at this time. Scattered plants. Herbarium only.

Collected associates

14038 - Brachyotum sp. (Melastomataceae) - Shrub to 2 m. tall. Calyx red. Petals dark blue-black. Common. Herbarium.

Location 8 - Sucumbios province. Outwash area just east of Laguma San Marcos and north slope along the lake. 3477 m. elevation; Ca. 0°07'N, 77°52'W. Paramo vegetation in outwash area and cloud forest along the lake.

14041 (PI548940) - Vaccinium floribundum H.B.K. Shrub to 2 m tall. Leaves quite glaucous. Corolla rose-red. Berry blue-black, glaucous. Plants highly ornamental. Mostly flowering at this time, with only occasional ripe fruits. Common in the outwash area. Herbarium, seed and pollen.

14042 - Rubus roseus Poir. Single clone, trailing, rooting at the nodes. In dense shade, under shrubs. Stem to approximately 2 m. No flowers or fruits. Herbarium only.

14045 - Rubus macrocarpus Benth. Typical. Occasional. Growing among dense shrubs. Flowers only. Herbarium only.

14046 (PI548867) - Gaultheria amoena A.C. Smith. Trailing subshrub to 2 dm. tall. Corolla rose-red. Mature calyx white. Locally common by the roadside near the lake margin. Potential evergreen groundcover. Herbarium and seed.

14047 - Ribes cf. hirtum H.B.K. Shrub to 2 m. tall. Corolla greenish with a pinkish-red tint. No fruit. Scattered. Herbarium only.

14048 (PI548863) Disterigma sp. (poss. SP. NOV.). Terrestrial shrub. Calyx and corolla pale green. Corolla campanulate. Berry translucent white. Herbarium and seed.

14053 (PI548879) Macleania rupestris (H.B.K.) A.C. Smith. Terrestrial or epiphytic shrub. Corollas whitish with a pink tint. Berry violet, to 1.2 cm. dia. Scattered, in cloud forest. Herbarium and seed.

Collected associates

14043 - Diplostephium sp. (Asteraceae) - Shrub to 1.5 m. tall. Phyllaries green with a maroon tip. Florets white. Common on open, rocky outwash. Herbarium.

14044 - Diplostephium sp. (Asteraceae) - Shrub 1.5 m. tall. Phyllaries green. Florets white. Common on rocky outwash. Herbarium.

14049 - Pernettya prostrata (Cav.) DC. Shrub to 0.5 m. tall. Berry purplish-violet. Common. Herbarium.

14050 - Passiflora sp. - Vine. Calyx pale green. Tube greenish with a maroon tint. Petals rose within. Occasional along lake margin. Herbarium.

14051 - Conyza sp. (Asteraceae). Suffrutescent herb with a purple cast. Florets purplish-white. Herbarium.

14052 - Lupinus sp. Shrub to 1.5 m. tall. Petals dark blue. Legume brownish-black. Abundant. Herbarium.

Location 9 - Napo province. Margins of Laguna Papallacta. 3385 m. elevation; Ca. 0°25'S, 78°10'W. Heavily disturbed forest edges.

14054 (PI548864) - Disterigma sp. (poss. SP. NOV.). Epiphytic shrub. Corolla deep red. Berry white. Scattered. Herbarium and seed.

14057 - Ribes andicola Jancz. Weak shrub to 1.5 m. tall. Flowers dull red with a green tint. No fruit. Occasional. Herbarium only.

14058 - Vaccinium floribundum H.B.K. Shrub to 1 m. tall, from an old 1 m. long stem. Corolla pinkish-white. No fruit. Rare on this site. Herbarium only.

14059 (PI548916) - Rubus roseus Poir. Scandent shrub. Growing at the edge of trees and shrubs. Stems glabrous, to over 4 m. long, when climbing through trees. Leaves typical. Petals magenta. Generally 3-6 flowers/cluster. Fruit bright red, mostly only partially mature, to 3.2 x 2.5 cm. Plant abundant. Herbarium and seed.

14060 (PI548910) - Rubus macrocarpus Benth. Scandent in trees, canes to over 4 m. long. Typical stem and leaf morphology. Petals magenta. Fruit black to 3.7 cm. long x 2.5 cm. diam. Most fruit still immature. Plant abundant. Herbarium and seed.

14061 (PI548898) - Rubus coriaceus Poir. Typical for the species. Only one fruit, bright red. Herbarium and a small seed sample.

14063 - apparent Rubus macrocarpus x roseus hybrid. Intermediate between the species in all aspects of stem and foliar morphology. No flowers or fruits. Herbarium only.

Collected associates

14055 - Salpichroa diffusa Miers. (Solanaceae). Vine. Corolla yellow-green with a purple tint. Berry black. Herbarium.

14056 - Solanum brevifolium Dunal. Vine. Corolla deep purple. Berry bright orange. Common. Herbarium.

14064 - Asteraceae. Vine. Phyllaries green. Outer florets white to purple, inner yellow. Common. Herbarium.

14065 - Asteraceae. Prostrate, spreading herb. Inner florets yellow, outer white. Phyllaries purple-tipped. Herbarium.

14066 - Solanum sp. Non-tuberous herb. Corolla blue. Anthers yellow. Fruit green now, but turning dark.

14071 - Buddleja sp. Tree to 4 m. tall. Corolla dark dull orange. Scattered. Herbarium.

14072 - Eupatorium sp. Tree to 4 m. tall. Florets white. Abundant. Herbarium.

Location 10 - Pichincha province. Quito - Papallacta road, about 26.4 km. east of Tumbaco. 3692 m. elevations; Ca. 0°13'S, 78°15'W. Polylepis forest.

14067 - Ribes andicola Jancz. Shrub to 1.2 m. tall. Corolla dark red. No fruit. Herbarium.

Collected associates

14068 - Berberis sp. Shrub to 1.5 m. tall. Perianth bright orange. Berry blue-black. Herbarium.

14069 - Polylepis incana H.B.K. Tree to 6 m. tall. Perianth green. Bark red, flaking-off. Dominant. Herbarium.

14070 - Senecio sp. Shrub to 1.2 m. tall. Florets bright yellow-green. Common. Herbarium.

November 8 - Day trip to Imbabura province. Participants JLL, JRB, MT and KR.

Location 11 - Imbabura province. IETEL towers side road, about 10 km. from the Otavalo - Selva Alegre road. 3446 m. elevation; Ca. 0°16'N, 78°19'W. Disturbed montane forest and subparamo ecotonal vegetation.

14073 (PI548891) - Rubus bogotensis H.B.K. Arching tomentose canes to 6 m. long. Uniformly three leaflets. Fruits black, about 5% ripe (2 cm wide x 1.6 cm high). Herbarium and seed.

14074 (PI548917) - Rubus roseus Poir. Scandant habit. Extremely vigorous canes to 6 m. long, glabrous. Flower petals magenta. Fruit dark red when ripe, very large, up to 38 mm. long by 32 mm. dia. Outstanding population. Plants scattered, but relatively abundant. Herbarium and seed.

14077 (PI548922) - Rubus sp. (subg. Orobatus). Canes to 0.5 long, with upright floricanes 25-50 cm tall. Canes and leaves glabrous. Sharp, recurved thorns, Three leaflets. Petals magenta, calyx acute. 15-25 flowers/stem. Young fruit very tomentose. Fruits small, black. Herbarium and a small seed sample.

14082 - Ribes andicola Jancz. Scandent, climbing shrub. Perianth dull, dark red. Common. Herbarium only.

14083 - Rubus adenothallus Focke. Arching canes to 6 m. long. Five leaflets. Petals white. Fruits immature. Scattered. Herbarium only.

14084 (PI548852) - Cavendishia bracteata (R. & P. ex J.St.-Hil.) Hoer. Shrub to 3 m. tall. Bracts red. Corolla red with greenish tips. Common. Herbarium and seed.

14085 (PI548941) - Vaccinium floribundum H.B.K. Shrub to 1 m. tall. Flowers rose-red. Berry blue-black and glaucous. Mostly still flowering. Occasional. Herbarium and seed.

Collected associates

14075 - Centropogon calycinus Zahlbr. Succulent herb. Corolla magenta. Scattered. Herbarium.

14076 - Centropogon sp. Herb. Corolla orange with yellow within. Herbarium.

14078 - Bomarea sp. (Alstroemeriaceae). Vine. Tepals bright yellowish-orange, the outer with green tips, the inner red-speckled. Scattered. Herbarium.

14079 (PI548851) - Bomarea sp. (Alstroemeriaceae). Vine. Perianth red without, orangish within. Herbarium and seed.

14080 - Cestrum sp. (Solanaceae). Shrub to 2 m. Corolla purple without and green within. Herbarium.

14081 - Tournefortia cf. scabrida H.B.K. Shrub to 1.5 m. tall. Perianth green. Berry white. Herbarium.

14086 - Weinmannia glabrta L.F. Tree to 6 m. tall. Perianth white. Common. Herbarium and wood sample.

14087 - Freziera sp. (Theaceae). Tree to 5 m. tall. Leaves tan-pubescent beneath. Fruit black. Common. Herbarium and wood sample.

14088 - Viburnum sp. Tree to 7 m. tall. Flower buds white. Common. Herbarium and wood sample.

14089 - Myrsine dependens (R. & P.) Spreng. f. Shrub 3 m. tall. Common. Herbarium and wood sample.

November 9 - Day trip to Cotopaxi National Park. Participants JLL, JRB, MT and PJ.

Location 12 - Cotopaxi province. Cotopaxi National Park. 3440 - 3820 m elevation; Ca. 0°40'S, 78°25'W. Cultivated Pinus radiata forest (3440 m.) and paramo (3820 m.) on the slopes of vulcan Cotopaxi.

14090 (PI548902) - Rubus glabratus H.B.K. Trailing shrublet, canes to 1 m growing among grasses and shrubs. Petals rose to magenta, mostly flowers with a few immature and ripe fruit. Ripe fruit bright red. Typical for the species. Occasional in P. radiata forest. Herbarium and a small seed sample.

14091 (PI548942) - Vaccinium floribundum H.B.K. Terrestrial shrub to 1.5 m. tall. Corolla white to dark rose-red. Fruits green. Plants mostly flowering. Quite abundant, both as an understory under P. radiata and at the upper slope paramo location. Plants especially impressive for adaptation and survival on the paramo. Pollen and herbarium.

14092 - Rubus glabratus H.B.K. Typical for the species. Growing in sheltered ravines under trees and shrubs on the paramo. Only flowers and young fruits. Occasional. Herbarium only.

14094 - Ribes andicola Jancz. Shrub to 2 m. tall. Corolla dark, dull-red. No fruit. Occasional in sheltered ravines on the paramo. Herbarium only.

Collected associates

14093 - Buddleja incana R. & P. Tree to 4 m. tall. Leaves white canescent beneath. Corolla bright orange. Scattered, mainly in ravines on the paramo. Herbarium.

14095 - Botrychium schaffueri Underw. Succulent herb. Rare. Herbarium.

November 10 - Quito. Extracted seeds and pressed herbarium vouchers. Visited Inaquito Market, where samples of V. floribundum H.B.K. from the Corazon region and R. glaucus Benth. (sample #4) from cultivated plantings in the Ambato region were purchased.

November 11-18 - South along the Pan American Highway toward Loja, via Cuenca, Azuay, Loja and Zamora/Chinchipe provinces. Participants JLL, JRB, MT, KR, and PJ.

November 11 - South toward Cuenca. Overnight in Gualaceo.

November 12 & 13 - Azuay province.

Location 13 - Azuay province. Gualaceo-Limon road, approximately 3.4 km. east of Gualaceo. 2462 m. elevation; 2°5'S, 78°43'W. Roadsides and slopes along the edge of cultivated fields.

14120 - Rubus sp. (subg. Orbatus). Scandent, primocanes dark red, to 3 m. long, long internodes. Canes and leaves glabrous. Leaves simple, lanceolate. Petals violet, long caudate sepals. No fruit. Rare. Herbarium only.

14121 (PI548888) - Rubus acanthophyllus Focke. Suffrutescent, scrambling subshrub. Canes to 1 m. long, hispid. Leaves simple. Petals magenta. Fruit black. Common. Herbarium and seed.

14122 - Rubus sp. (subg. Orobatus). Trailing canes to 2 m., pubescent. Leaves trifoliate, pubescent. Magenta flowers in clusters of four to five. Broad stipules, pubescent, becoming caudate with age. Fruit immature. Herbarium only.

14123 (PI548924) - Rubus sp. (subg. Rubus). Arching primocanes to 2 m. long. Very small flowers, petals pink, much shorter than the calyx. Large narrow fruit clusters. Fruit black 26-29 mm. dia., roundish. Large drupelets which shatter apart on picking. Drupelets 7-8 mm. wide x 9-10 mm. long, irregular shape. Plant and fruit diseased, dead leaves and canes and white mold on fruits. Herbarium and seed.

14124 (PI548860) - Disterigma empetrifolium (H.B.K.) Drude. Attractive subshrub 2 dm. tall. Small linear leaves. Corolla variable in color but mostly rose. Fairly large, translucent white berry. Abundant on roadbanks and roadsides. Herbarium and seed.

14125 (PI548868) - Gaultheria erecta Vent. Shrub to 1 m. tall. Corollas dark-red. Mature calyx blue-black. Common. Herbarium and seed.

14126 (PI548874) - Gaultheria strigosa Benth. Shrub to 2.5 m. tall. Corolla dark red. Mature calyx whitish-red, open, exposing the capsule. Herbarium and seed.

14127 - Ribes sp. Shrub to 1 m. tall. Corolla green. No fruit. Herbarium only.

14128 - Ceratostema alatum (Hoer.) Sleumer. Terrestrial shrub 1.0 - 1.5 m. tall. Corolla bright scarlet, waxy. One partially mature fruit collected, approx. 2 cm. dia. Seed did not germinate. Scattered. Herbarium only.

14129 - Gaultheria sp. (poss. SP. NOV.). Subshrub to 2 dm. tall. Flowers nodding. Calyx red. Corolla greenish-white. Rare. Herbarium only.

Location 17 - Azuay province. Paramo de Tinajillas, approximately 64.7 km. south of Cuenca, along the road to Loja. 3323 m. elevation; 3°17'S, 79°10'W. Shrub paramo with Befaria, Gaultheria, Macleania, Rubus, Vaccinium, Proteaceae and bracken fern.

14103 - Myrica parvifolia Benth. Shrub to 1 m. tall. Inflorescence greenish. Abundant. Herbarium.

14106 - Baccharis sp. Shrub to 1.2 m. tall. Flowers cream-green. Herbarium.

14107 - Eupatorium sp. Shrub to 2 m. tall. Florets white, tips of phyllaries maroon. Common. Herbarium.

Location 15 - Azuay province. Gualaceo-Limon road, approximately 21 km. east of Gualaceo in Paramos de Culebrillas. 3230 m. elevation; Ca. 3°1'S, 78°40' W.

14112 - Rubus coriaceus Poir. Suffrutescent, scrambling subshrub. Canes 75-100 cm long. Flowers magenta. No fruit. Scattered. Herbarium only.

14113 (PI548918) - Rubus roseus Poir. Canes trailing or climbing through roadside shrubs, to 3 m. long. Scattered glandular hairs, but overall very similar to 14074. Petals magenta. Fruit dark-red, large. Occasional. Herbarium and seed. (also cuttings for Raul Castillo). Plant appears to be very productive.

14114 - Rubus robustus Presl. Canes arching, 1.5 - 2.0 m. long. Leaves 3 or 5-foliate. Petals white to greenish-white. Fruit green. Large infloresence with up to 10 laterals. Buds, flowers and green fruit smaller than usual. Occasional. Herbarium only.

14116 (PI548887) - Ribes lehmannii Jancz. Shrub to 1.6 m. tall. Corolla clear green. Berry orange, somewhat translucent. Occasional. Herbarium and small seed sample.

14118 - Macleania rupestris (H.B.K.) A.C. Smith. Shrub to 3 m. tall. Corollas red with white tips. Berry blackish-purple. Abundant. Fruit collected but all seeds floated (apparently inviable). Herbarium only.

Collected associates

14111 - Lamiaceae. Herb. Corolla dark purplish-violet. Herbarium.

14115 - Geranium sp. Somewhat scandent herb. Petals magenta. Fruit green, immature. Herbarium.

Location 16 - Azuay province. Gualaceo-Limon road, approximately 23 km. east of Gualaceo in Paramos de Culebrillas. 3477 m. elevation; Ca. 3°01'S, 78°41'W.

14119 - Rubus coriaceus Poir. Typical for the species. No fruit. Herbarium only.

14096 (PI548913) - Rubus robustus Presl. Seeds collected from two types of plants: One with small fruits on plants of low vigor and small infloresences; The second from vigorous plants with large infloresences and large fruits (up to 22 mm long x 18 mm wide). Leaf and cane morphology typical for the species. Petals white. Fruit black. Scattered plants. Herbarium and seed.

14097 - Rubus niveus Wall. Canes less than 2 m. long. Fruit green. Weak plant beside the road near a farm. Occasional escape. Herbarium only.

14098 - Fragaria vesca L. Stoloniferous herb. Petals white. Fruit red. Scattered probable escape. Herbarium only.

Collected associates

14099 - Julgans neotropica Diels. Tree to 8 m. Variable development stage from flowering to green fruit. Staminate flowers diseased. Common. Herbarium.

14100 - Scrophulariaceae - Weak shrub to 1.5 m. Corolla tube orange, the inner lobes reddish-orange. Common. Herbarium.

Location 14 - Azuay province. Gualaceo-Limon road, approximately 12.1 km. east of Gualaceo. 2954 m. elevation; 2°53'S, 78°40'W. Heavily disturbed montane forest.

14104 (PI548923) - Rubus sp. (subg. Rubus). Arching shrub, canes to 1.5 m long. Glandular hairs on floricanes along with sharp recurved spines. Primocanes glabrous. Leaves small, glossy. Flower petals pale greenish-white. Infloresence medium to small. Berry small, black, seedy. Occasional. Herbarium and seed.

14105 - Vaccinium floribundum H.B.K. Shrub to 1 m. tall. Corolla white to rose-pink. Flowering only. Common. Herbarium only.

14108 - Rubus adenothallus Focke. Arching canes to 4 m. long. Petals white. Fruit green. Typical. Scattered along roadside. Herbarium only.

14109 - Rubus roseus Poir. Trailing glabrous canes to 2 m. long, but browsed by cattle. Up to six flowers/cane Petals magenta. No fruit. Occasional. Herbarium only.

14110 (PI548866) - Fragaria vesca L. Stoloniferous herb. Petals white. Fruits red with white flesh. Little aroma. Common. Herbarium and seed.

Collected associates

14101 - Miconia sp. (Melastomataceae). Shrub to 1.2 m. tall. Petals white. Stamens yellow. Very common. Herbarium.

14102 - Berberis sp. Shrub to 1.6 m. tall. Fruit blue-green. Rare. Herbarium.

14131 (PI548892) - Rubus bogotensis H.B.K. Very vigorous arching canes to 4 m. long. Stipitate, glandular red hairs on stems, infloresences and both sides of the leaves. Scattered recurved thorns. Strictly trifoliate leaves. Infloresence narrow, 20-25 cm. long. Flowers small, petals pinkish. Fruits fairly large (17-18 mm. dia.), round, starting to ripen (black). Large seeds. Only one clone fruiting. Scattered plants. Very similar overall to 14073. Herbarium and seed.

14132 (PI548903) - Rubus glabratus H.B.K. Vigorous canes to over 3 m. long, clambering through shrubs and small trees. Stems and leaves glabrous. Leaves trifoliate, glossy, with 8-9 main veins. Infloresence terminal with about 9 flowers. Flowers magenta. Fruits mostly immature, bright red at maturity and 15 mm. x 15 mm. Seeds fairly large. Red pigment in stems, petioles, young leaves and sepals. Occasional on the site. Herbarium and a small seed sample.

14134 (PI548935) - Vaccinium crenatum (Don) Sleumer. Prostrate shrublet. Corolla red. Berry dark blue-black. Locally common. Herbarium and seed.

14135 (PI548943) - Vaccinium floribundum H.B.K. Terrestrial shrub, variable in habit, up to 1 m. tall, but often low and spreading. Corolla pink to white. Scattered ripe fruit, blue-black and glaucous. Abundant. An extremely interesting population. Herbarium and seed.

14136 (PI548872) - Gaultheria reticulata H.B.K. Shrub to 2 m. tall. Corolla white. Mature calyx reddish-white. Common. Resembles Pieris in flower. Herbarium and seed.

14137 (PI548880) - Macleania rupestris (H.B.K.) A.C. Smith. Terrestrial shrub to 2 m. tall. Corolla red with a pale yellow-green tip. Berry purple, to 1.3 cm. dia. Common. Herbarium and a small sample of seed.

14138 - Gaultheria lanigera Hooker var. lanigera. Terrestrial shrublet to 1 m. tall. (usually 2-3 dm.). Corolla cream. Locally abundant. Herbarium only.

Collected associates

14133 (PI548850) - Befaria resinosa Mutis ex L.f. Terrestrial shrub to 3 m. tall. Inflorescence viscid. Corolla essentially tubular, deep pink to dark rose. Capsule brown. Abundant. Excellent ornamental. Herbarium and seed.

November 14-16 - Loja and Zamora/Chinchipe provinces.

Location 18 - Loja province. Road to Cerro Toledo, 4.5 km. east of and above Yangana. 2307 m. elevation, 4°20'S, 79°10'W. Heavily disturbed and burned slopes. Fragaria vesca and Rubus niveus scattered along the road, neither with fruit.

14139 (PI548914) - Rubus robustus Presl. Arching primocanes 2-4 m. long. Plants with quite variable vigor, depending on microenvironment. Abundant flowers, petals white to pinkish. Few fruits, generally high abortion rate (or poor set) of drupelets. Fruit black, small, 13 mm. wide x 15 mm. long. One exceptional clone was very vigorous with up to 266 flowers/infloresence. Common by roadside. Herbarium and seed.

Collected associates

14140 - Monina sp. (Polygalaceae). Shrub to 3 m. tall. Petals dark blue. Fruit green. Herbarium.

14141 - Bidens sp. Shrub to 2 m. Florets yellow-orange. Herbarium.

14142 - Asteraceae - Shrub, 2 m. tall. Phyllaries green. Florets orangish-yellow. Herbarium.

14143 - Duranta sp. (Verbenaceae). Shrub, 2 m. tall. Corolla white to pale lilac. Herbarium.

Location 19 - Loja province. Road to Cerro Toledo, 8-10 km. east of and above Yangana. 2460-3323 m. elevation; Ca. 4°20'S, 79°8'W. Cloud forest.

14144 (PI548881) -Macleania salapa (Benth.) Benth. & Hook. Terrestrial shrub from a lignotuber. Calyx green. Corolla red. Abundant, fire seems to stimulate regrowth. Herbarium and lignotubers.

14145 (PI548862) - Disterigma popenoi Blake. Terrestrial shrublet to 1 m. tall. Corolla and fruit white. Common. Herbarium and seed.

14146 - Psammisia fissilis A.C. Smith. Terrestrial shrub to 2 m. tall. Corolla bright red with a white tip. Fruit green. Occasional. Herbarium only.

14148 - Macleania sp. Terrestrial shrub to 2.5 m. tall. Fruits green. Herbarium only.

14149 - Macleania poortmanii Drake. Terrestrial shrub to 4 m. tall. Corolla orangish-red. No fruit. Infrequent. Herbarium only.

14150 (PI548919) - Rubus roseus Poir. Decumbent. Canes to 1.5 m. long. Canes and trifoliate leaves hispid. Corolla magenta. Fruit red, small, 17 mm. wide x 15 mm. long. Rare. Herbarium and a small seed sample.

14151 - Rubus robustus Presl. Arching canes, over 2 m. long. Petals white, flushed pink. Dimunitive buds, flowers and fruits. Herbarium only

14152 - Gaultheria tomentosa H.B.K. Shrub to 1.5 m. tall. Corolla red, densely ferruginous tomentose. Scattered. Herbarium only.

14153 - Macleania farinosa Hoer. Terrestrial shrub to 3 m. tall. Flower buds white, farinose. Infrequent. Herbarium only.

14154 - Thibaudia benjaminii Luteyn. Terrestrial shrub, 1.5 m. tall. Hypanthium blue-black, calyx lobes spreading, red. Rare. Herbarium only.

14158 - Disterigma sp. Scandent shrub. Corolla pale green, urceolate-campanulate. Herbarium only.

14159 (PI548858) - Ceratostema reginaldii (Sleum.) A.C. Smith. Past bloom, only calyces remaining. Seedlings with lignotubers collected. A later collection by Luteyn (14258) revealed flowers up to 10 cm. long and deep crimson with white or pinkish tipped petals.

Collected associates

14147 - Clethra sp. Shrublet to 0.5 m. tall. Corolla white. Herbarium.

14155 - Siphocampylus sp. (Campanulaceae). Scandent. Leaves coriaceous. Corolla reddish-rose. Herbarium.

14156 - Weinmannia macrophylla H.B.K. Tree, 3 m. tall. Flowers white. Fruits brown. Herbarium.

14157 - Weinmannia sp. (Cunnoniaceae). Tree, 3 m. tall. Flowers white. Herbarium.

14160 - Asteraceae - Shrub 2.5 m. tall. Florets yellow. Pappas white. Herbarium.

14161 (PI548848) - Befaria austuans Mutis ex. L.f. Shrub to 1 m. tall in burned-over areas, to tree 10 m. tall x 20 cm. dbh. in undisturbed cloud forest. Petals pink. Flowers fragrant. Abundant. Herbarium and pollen.

Location 20 - Zamora/Chinchipe province. Old road from Loja to Zamora, 15 km. from Loja. 2800 m. elevation; Ca. 3°57'S, 79°7'W. Disturbed montane forest.

14162 (PI548869) - Gaultheria erecta Vent. Terrestrial shrub to 1 m. tall. Corolla dark red. Mature calyx blue-black. Common. Herbarium and seed.

14163 (PI548915) - Rubus robustus Presl. Extremely variable vigor and fruit set, apparently partly dependent on environment; ranging from weak plants with generally very poor fruit set and small fruits, 9 mm. x 8 mm., growing on a dry exposed roadside, to very vigorous plants with large fruit (20 mm. x 16 mm.) and excellent fruit set, growing in a moist cove. Flower petals white, fruit black. Herbarium and seed.

14164 (PI548920) - Rubus roseus Poir. Trailing canes to 2.5 m. long. Canes and leaves glabrous. Petals magenta. One partially-ripe fruit, red. Rare. Herbarium and a small seed sample.

14165 (PI548859) - Disterigma alternoides (H.B.K.) Nied. Subshrub to about 0.8 m. tall. Fruit white. Seed only.

Location 21 - Zamora/Chinchipe province. Old road from Loja to Zamora, 23.6 km. east of Loja. 2400 m. elevation; Ca. 3°57'S, 79°6'W. Disturbed montane forest.

14167 (PI548890) - Rubus adenothallus Focke. Arching canes with dark red glandular hairs, to over 5 m. long. Leaves 5- foliate. Petals white to pink. Mostly flowers and green fruit (a few black fruit - viability ?). High potential productivity. Typical for the species. Occasional by the roadside. Herbarium and a small seed sample.

Collected associates

14166 - Tournefortia cf. scabrida H.B.K. Small tree, 3 m. tall. Corolla green. Fruits greenish-white.

Location 22 - Zamora/Chinchipe province. Old road from Loja to Zamora, 27-42 km. east of Loja. 1754-2338 m. elevation range; Ca. 4°5'S, 78°58'W. Heavily disturbed roadside forest. Note: small plants of V. floribundum on roadbank, down to 2200 m. elevation.

14168 (PI548931) - Rubus urticaeifolius Poir. Canes covered with light brown bristles, arching, 1.5 - 3.0 m. long. Leaves mostly 3-foliate. Flowers pale pink to white. Fruit small (13 mm. x 12 mm.), black, soft when fully-ripe and subject to postharvest rots. Fruit picks very easily (shatters). Herbarium and seed.

14170 - Thibaudia harlingii Luteyn. Terrestrial shrub to 3 m. tall. Leaves hard, coriaceous, often reflexed on the branch. Calyx green. Corolla red. No fruit. Herbarium only.

Collected associates

14169 - Alchornea sp. (Euphorbiaceae). Shrub to small tree. Inflorescence green, pendent. Herbarium.

Location 23 - Loja province. Loma de Oro area, approximately 12 km. north of San Lucas. 2954 - 3140 m. elevation; Ca. 3°40'S, 79°15'W.

14171 (PI548936) - Vaccinium crenatum (Don) Sleumer. Prostrate subshrub. Corolla dark red. Berry dark blue-black. Scattered along exposed roadbanks. Herbarium and seed.

14173 (PI548944) - Vaccinium floribundum H.B.K. Shrub to 1 m. tall. Corolla white to pink, mostly flowering now. Berry blue-black, glaucous. Common. Herbarium and seed.

14174 (PI548873) - Gaultheria tomentosa H.B.K. Shrub to 1 m. tall. Corolla red. Mature calyx brownish. Scattered plants. Herbarium and seed.

14179 (PI548893) - Rubus bogotensis H.B.K. Arching shrub, stems to 3 m. long. Leaves 3- foliate. Terminal, interrupted inflorescence with 35-40 flowers. Flowers white. Stipitate glandular hairs on all parts including the lower leaf surface. Fruits 16-17 mm. wide x 13-14 mm. long. Large drupelets and large seeds. Very similar to 14073, but only partially fertile (or poor fruit set) and crumbly at maturity. Common. Herbarium and seed.

Collected associates

14172 - Weinmannia sp. (Cunnoniaceae). Small tree to 5 m. tall. Flowers white. Herbarium.

14175 (PI548849) - Befaria aestuans Mutis ex L.f. Shrub (on this burned-over site) 1.0 - 1.5 m. tall. Flower petals light pink to dark rose-red. Capsules tan. Common. Herbarium and seed. NOTE: B. resinosa also occurs on the site.

14176 - Gynoxis sp. (Asteraceae). Shrub, 2.5 m. tall. Florets golden yellow. Herbarium.

14177 - Eupatorium sp. Shrub, 2 m. tall. Florets cream-colored. Herbarium.

14178 - Asteraceae - Shrub to 2 m. tall. Florets bright yellow. Herbarium.

Location 24 - Loja province. Subparamo vegetation along the Pan American Highway, approximately 22.6 km. north of Saraguro. 3100 m. elevation; Ca. 3°33'S, 79°13'W. Pinus plantation with scattered natural vegetation.

14180 (PI548925) - Rubus sp. Arching canes to 2 m. long. Small green flowers. Fruit black, small (but with fairly large seeds). Same as 14104. Rare on the site. Herbarium and seed.

14187 (PI548894) - Rubus bogotensis H.B.K. Extensive colonies to about 20 m. across, scattered along the highway, with upright arching canes. All plants with poor fruit set and very large drupelets which usually fall apart on picking. Also very large seeds. Mixed fruit from 2 types of plants, based on flower color and morphology. Flowers were either small and pink or large and white. Within each flower type, the plants were so uniform they could easily be apomicts. Herbarium and seed.

Collected associates

14181 - Befaria resinosa Mutis. ex L.f. Small tree to 4 m. tall. Petals dark rose-red. Herbarium and wood sample.

14182 - Weinmannia sp. Tree, 4 m. tall. Flowers white. Capsules red. Herbarium.

14183 - Gynoxis sp. Tree to 5 m. tall. Leaves light brown tomentose beneath. Florets bright yellow. Herbarium and wood sample.

14184 - Monina sp. Shrub to 3 m. tall. Petals blue. Berry magenta. Herbarium.

14185 - Loranthaceae. Parasitic on Weinmannia. Berry black. Herbarium.

14186 - Loranthaceae. Parasitic on Weinmannia. Leaves fleshy, orangish. Berry white. Herbarium.

November 17 - Azuay province.

Location 25 - Azuay province. Cuenca-Las Cajas Recreational Area road, 14 - 16 km. west of Cuenca. 3169 -3230 m. elevation; Ca. 2°50'S, 79°5'W. Disturbed subparamo vegetation along the road.

14188 (PI548870) - Gaultheria erecta Vent. Shrub to 1.7 m. tall. Mature calyx dark blue-black. Common. Herbarium and seed.

14189 (PI548921) - Rubus roseus Poir. Trailing or climbing stems to over 4 m. long, with a few scattered stipitate glands. Basically typical for the species and similar to 14074, except a greater number of fertile nodes in the inflorescence (up to 33 flowers). Flowers magenta. Most fruit only partially-ripe, very large size. Herbarium and seed. (Also cuttings for Raul Castillo).

14190 (PI548871) - Gaultheria glomerata (Cav.) Sleumer. Prostrate subshrub. Corolla rose. Calyx black. Herbarium and seed.

14193 - Rubus coriaceus (Poir). Canes to over 1 m. long. Petals magenta. No fruit. Typical for the species. Herbarium only.

14194 (PI548929) - Rubus sp. (subg. Rubus). Arching canes to 2 m. long. Leaves shiny-green. Flowers small. Petals greenish. Fruit small, black. Herbarium and seed.

14195 (PI548895) - Rubus bogotensis H.B.K. Arching canes, over 4 m. long. Stems only slightly angled. Leaves essentially 3 - foliate. Very large infloresence with up to 100 flowers. Flowers small and pink. Stems, young foliage and infloresence covered with red, gland-tipped hairs. Generally poor fruit set and large drupelets which crumble readily. Most fruit and many flower clusters appear to be infected by Botrytis. Herbarium and seed.

14196 (PI548927) - Rubus sp. (subg. Rubus). Arching, tomentose, non-glandular stems, over 3 m. long. Leaves with 3 or mostly 5 leaflets. Inflorescence narrow, no open flowers. Poor fruit set and large drupelets, which crumble easily. Most fruit has dried-up, apparently following Botrytis infection. Herbarium and seed.

Collected associates

14191 - Elaphoglossum sp. Terrestrial fern. Herbarium.

14192 - Elaphoglossom sp. Terrestrial fern. Herbarium.

Location 26 - Azuay province. Cuenca-Las Cajas Recreational Area road, 28 km. west of Cuenca. Paromo at 3662 m. elevation; Ca. 2°49'S, 79°6'W.

No small fruit genera found, only the following collected for herbarium vouchers.

14197 - Hesperomeles obtusifolia var. microphylla. Shrub, 0.5 m. tall. Petals generally white, but sometimes pinkish.

14198 - Galium sp. (Rubiaceae). Herb in gravelly soil. Corolla light magenta.

14199 - Perezia sp. (Asteraceae). Growing in gravelly soil. Florets white.

14200 - fern. Rhizomatous, along stream edge.

14201 - fern. Along stream edge. Reddish-brown pubescence.

14202 - Valeriana microphylla H.B.K. Shrublet, wiry, to 1 m. tall. Flowers white.

14203 - Pernettya sp. Prostrate subshrub. Corolla white. Immature fruits green. Rare form.

14204 - rhizomatous herb.

14205 - Llerasia assuensis (H.B.K.) Cuatrec.(Asteraceae). Shrub 1.75 m. tall. Florets golden-yellow. Further up the road approaching the pass. Rare.

Location 27 - Azuay province. Las Cajas Recreational Area, 43.5 km. west of Cuenca. 3690 m. elevation; Ca. 2°49'S, 79°7'W. Damp stream valley in Polylepis forest.

14210 - Ribes cf. hirtum H.B.K. Thin shrub to 1 m. tall. Corolla pale yellow-green with distal part orangish. No fruit. Infrequent. Herbarium only.

14211 (PI548899) - Rubus coriaceus Poir. Scandent subshrub. Petals magenta. Fruit red. Typical for the species. Herbarium and a small seed sample.

Collected associates

14206 - Polypodium sp. Scandent, rhizomatous, epiphyte. Herbarium.

14207 - Hymenophyllum sp. (Hymenophyllaceae) Pendent growing in the shade of a boulder. Herbarium.

14208 - Adiantum sp. Terrestrial. Herbarium.

14209 - Ranunculus praemorsus H.B.K. ex DC. Terrestrial herb in moist soil. Petals yellow. Infrequent. Herbarium.

14212 - Poaceae - Herb. Herbarium.

14213 - Poaceae - Herb. Herbarium.

November 18 - Traveled back to Quito.

November 19 - Extracted seeds, pressed herbarium vouchers. Calvin Sperling purchased a fruit (seed) sample of V. floribundum from the Ibarra area, which he presented to the collecting team.

November 20 & 21 - Pastaza and Tungurahua provinces. Participants JLL, JRB, MT.

Location 28 - Pastaza province. Road between Puyo and Mera. 1077 - 1230 m. elevations; Ca. 1°30'S, 78°5'W. Heavily disturbed forest with Cecropia, Saurauria, Vismia, and leguminous tree species.

14214 - Rubus urticaefolius Poir. Arching canes, 3 - 5 m. long. Leaves mostly 3 - foliate (a few 5). Flowers small, white. Fruit green. Typical. Scattered. Herbarium only.

14215 (PI548934) - Themistoclesia cutucuensis A.C. Smith. Epiphyte. Corolla green with a red tint. Herbarium and cuttings.

14216 (PI548857) - Ceratostema lanigera (Sleumer) Luteyn. Epiphyte from a lignotuber. Corolla dark scarlet with blue-black lobes. Scattered. Herbarium, lignotuber and cuttings.

14217 (PI548856) - Cavendishia sp. Terrestrial shrub to 3 m. tall. No flowers or fruits. Herbarium and cuttings.

14218 (PI548884) - Psammisia ferruginea A.C. Smith. Terrestrial shrub, arching to 2 m. Calyx red-orange. Corolla past anthesis. No fruit. Herbarium and cuttings.

14219 (PI548882) - Psammisia coarctata (Ruiz. & Pav.) A.C. Smith. No flowers or fruit. Herbarium and cuttings.

14220 (PI548855) - Cavendishia tarapotana (Meissn.) Benth. & Hook. Terrestrial shrub to 3 m. tall. Bracts pink. Corolla white with a red band distally. Berry dark purple, to 1.7 cm. dia. Herbarium, seed, and cuttings.

Location 29 - Tungurahua province. Road between Rio Negro and Rio Verde. 1290 - 1850 m. elevation; Ca. 1°23'S, 78°13'W. Heavily disturbed forest by the roadside.

14221 - Rubus sp. (subg. Rubus). Stems to over 9 m. long climbing up through the trees, tomentose, also a few glandular-tipped hairs and scattered prickles. Leaves 5 - foliate. Large infloresence. Flowers white, small. No fruit. Appears similar to R. robustus. Rare. Herbarium only.

14222 (PI548932) - Rubus urticaefolius Poir. Arching canes to over 4 m. long. Canes bristly, red-brown hairs, no glandular hairs. Inflorescence many-flowered, flowers white. Fruit black, very small. Herbarium and seed.

14223 (PI548853) - Cavendishia bracteata (R. & P. ex J. St.-Hil.) Hoer. Terrestrial shrub to 2 m. tall, growing on roadbanks. Corolla red with a greenish tip. No fruit. Herbarium and cuttings.

Location 30 - Tungurahua province. Puyo to Ambato road, 5.2 km. west of Banos. 2060 m. elevation; Ca. 1°21'S, 78°24'W. Open-disturbed area on the right resulting from land clearing-filling operations.

14224 (PI548928) - Rubus sp. (subg. Rubus). Arching canes to about 2 m. long. Reddish hairs on canes. Underside of leaves green. Petals pink, small. Loose flower clusters. Very poor fruit set, large individual drupelets. Herbarium and seeds.

14225 (PI548929) - Rubus sp. (subg. Rubus). Arching canes to 2 m. long. Golden hairs on stems. Undersurface of leaves whitish. Petals white. Inflorescence very compact. Good fruit set. Fruits black, very small. Herbarium and seed.

14226 (PI548930) - Rubus sp. (subg. Rubus). Arching canes over 2 m. long. Red hairs on canes, especially primocanes. Petals pink, large. Good fruit set. Fruit large, black. Herbarium and fruit.

November 22 - Day trip to Pichincha province. Participants JLL, JRB, MT.

Location 31 - Pichincha province. Quito-Tendayapa road, between Nono and Tandayapa. 1780 - 2430 m. elevation; Ca. 0°1-5'S, 78°41-43'W. Disturbed montane forest.

14227 (PI548854) - Cavendishia bracteata (R. & P. ex J.St-Hil) Hoer. Terrestrial shrub to 3 m. tall. Corolla red with tips greenish. Berry blue-black. Herbarium, seed, and cuttings.

14228 (PI548875) - Macleania coccoloboides A.C. Smith. Terrestrial, from a lignotuber. Herbarium and cuttings.

14229 (PI548885) - Psammisia sodiroi Hoer. Terrestrial shrub to 2 m. tall. Calyx reddish-orange. Lower corolla purplish-red, upper tip dark green. No fruit. Herbarium and cuttings.

14230 (PI548886) - Psammisia ulbrichiana (Britton) A.C. Smith. Terrestrial shrub to over 3 m. tall. Pedicel, calyx, and basal 2/3 of the corolla bright red. Upper 1/3 of the corolla white (above the constriction). Fruit green, but seeds essentially mature. Fruit to 1.8 cm. dia. Scattered. Herbarium, seed, and cuttings.

14231 (PI548883) - Psammisia ecuadorensis Hoer. Terrestrial or epiphytic shrub. Calyx and pedicel orange. Corolla yellow at the base, greenish distally (above the constriction). No fruit. Occasional. Herbarium and cuttings.

14232 (PI548876) - Macleania bullata Yeo. Terrestrial shrub to 1.5 m. tall. Corolla bright orange, tubular. Very floriferous along lateral branches. No fruit. Scattered. Herbarium, lignotuber, and cuttings.

14233 (PI548877) - Macleania ecuadorensis Hoer. Terrestrial shrub to 2 m. tall, from lignotubers. Flower bud reddish at base, green distally. Scattered. Herbarium, lignotubers, and cuttings.

14234 (PI548861) - Disterigma pentandrum Blake. Corolla red. Rare. Cuttings only.

Location 32 - Pichincha province. Quito-Nono road, 4 km. northwest of Nono. 2738 m. elevation; Ca. 0°5'S, 78°37'W. Steep roadside cliff, heavily disturbed.

14235 (PI548878) - Macleania loeseneriana Hoer. Terrestrial shrub to 3 m. tall. Corolla red with whitish tips. No fruit. Scattered. Herbarium and cuttings.

Location 33 - Pichincha province. Quito-Tanadayapa-Mindo road, approximately 2 km. northwest of Tandayapa. 1785 m. elevations; Ca. 0°2'N, 78°40'W.

14236 (PI548933) - Rubus urticaefolius Poir. Arching canes to over 3 m. long. Primocanes 5 - foliate, floricanes 3 - foliate. White tomentum on underside of leaves. Large, open inflorescences. Flowers white. Fruit black, very small (12 mm. x 11 mm.), soft, picks very easily (shatters). Herbarium and seed.

November 23 - 25. In Quito. Seed extraction and pressing herbarium vouchers.

November 26 - Drs. Ballington and Thompson returned to the U.S. Dr. Luteyn remained through most of December working on other research projects.

PRELIMINARY RESULTS AND OBSERVATIONS ON ACCESSIONS FORWARDED TO NORTH CAROLINA

The seed samples of Gaultheria species and also species in the Vaccinieae which were sent to North Carolina were germinated in winter 1990/91 using standard procedures for Vaccinium on an intermittent mist bench in a greenhouse. Germination was generally good. However, as was noted earlier, during seed extraction, in three of the genera of Vaccinieae, Ceratostema, Macleania, and Psammisia, each seed is surrounded by a gelatinous sheath. In a preliminary effort to ascertain a possible role of this membrane upon viability and germination, duplicate samples of a species with the gelatinous sheath, Psammisia ulbrichiana, and a species where it does not occur (or is not evident), Cavendishia tarapotana, were germinated. In each case, one seed sample was held moist from extraction until sowing, and the other sample dried after extraction. Both samples were maintained in a folded filter paper in a polyethylene bag at 4°C from the time of extraction until shipment to the United States, and then again after arrival in the U.S. until time of sowing. With Psammisia ulbrichiana the sample held moist began germinating in 7 days, while the dried seed sample did not germinate. With Cavendishia tarapotana, both samples germinated equally well with germination beginning 13 days after sowing. With Macleania rupestris (the only Macleania species where seeds were collected), only modest or small numbers of seeds were available, so all returned to the United States were held moist, and both samples germinated. Unfortunately, no viable seeds of Ceratostema species were collected. At this time it cannot be ascertained whether drying seeds of these genera results in onset of dormancy or loss of viability.

With regard to associates collected as seeds, both Befaria aestuans and B. resinosa germinated under the same conditions as the other Ericaceous species.

All lignotuber plants forwarded to North Carolina are surviving and most have initiated new growth. These were all established in composted pine bark in hanging baskets and are being maintained in the greenhouse at Raleigh, N.C. For each species shipped to North Carolina as cuttings, at least one cutting has rooted. Cuttings were wounded at the base on both sides of the stem and dipped in 1000 ppm of IBA dispersed in talc prior to sticking. They were than placed in 10 cm. deep flats filled with composted pine bark and placed on an intermittent mist bench in the greenhouse for rooting.

The pollen samples of Rubus roseus and Vaccinium floribundum were used in controlled pollinations with North American genotypes of Rubus and Vaccinium, respectively, during winter/spring 1991. The pollen sample of Befaria aestuans will be utilized in crossing attempts with B. racemosa from the southeastern United States as soon as the B. racemosa flowers. At the time of this writing the potential successes are: NC 3088 (V. ovatum x V. crassifolium subsp. sempervirens) x V. floribundum (14041); NC 121 ('Tayberry' x 'McLeod') x R. roseus (14074); and 'Lincoln Logan' x R. roseus (14074). Also a cross involving a V. floribundum seedling (Vacc 669) from an earlier collection has set fruit when pollinated by NC 80-2-14 (V. myrsinites). Fruits (and seeds) resulting from these crosses are either just at maturity (with Rubus crosses) or still maturing (Vaccinium), so it remains to be seen whether viable hybrids will result.

DISCUSSION AND SUMMARY

The total number of accessions of small fruit genera collected is summarized in Table 1. This table also summarizes the number of locations where each species was noted, which in a few cases exceeds the number collected. This should be helpful to future collectors who might be visiting these same sites. For those interested in a summary of accessions

Table 1. Summary of Small Fruit Genera Collected in Andean Ecuador, 1990.

Genus & Species	Type of Collection			Total No. Accessions[1]	Total No. of Locations[2]
	Seed	Clonal	Herbarium		
Andromadeae					
Gaultheria amoena	1		1	1	1
Gaultheria erecta	3		3	3	3
Gaultheria glomerata	1		2	1	2
Gaultheria lanigera			1		1
Gaultheria reticulata	1		1	1	1
Gaultheria strigosa	1		1	1	1
Gaultheria tomentosa	1		2	1	2
Gaultheria sp.			1		1
Vaccinieae					
Cavendishia bracteata	2	2	3	3	3
Cavendishia tarapotana	1	1	1	1	1
Cavendishia sp.		1	1	1	1
Ceratostema alatum			2		2
Ceratostema lanigera		1	1	1	1
Ceratostema reginaldii		1	1	1	1
Disterigma alaternoides	1			1	1
Disterigma empetrifolium	1		1	1	1
Disterigma pentendrum		1		1	1
Disterigma popenoi	1		1	1	1
Disterigma sp.	2		3	2	3
Macleania bullata		1	1	1	1
Macleania coccoloboides		1	1	1	1
Macleania ecuadorensis		1	1	1	1
Macleania farinosa			1		1
Macleania loesnoriana		1	1	1	1
Macleania poortmanii			1		1
Macleania rupestris	2		3	2	3
Macleania salapa		1	1	1	1
Macleania sp.			1		1
Psammisia coartata		1	1	1	1
Psammisia ecuadorensis		1	1	1	1
Psammisia ferruginea		1	1	1	1
Psammisia fissilis			1		1
Psammisia sodiroi		1	1	1	1
Psammisia ulbrichiana	1	1	1	1	1

Table 1. Summary, etc. (contd.)

Genus & Species	Type of Collection			Total No. Accessions[1]	Total No. of Locations[2]
	Seed	Clonal	Herbarium		
Vaccinieae (contd.)					
Themistoclesia cutucuensis		1	1	1	1
Thibaudia benjamii			1		1
Thibaudia harlingii	1		1		
Vaccinium crenatum	2		2	2	2
Vaccinium floribundum[3]	10		10	10	12
Fragaria vesca	1		2	1	3
Ribes andicola			5		5
Ribes hirtum			2		2
Ribes lehmanii	1		1	1	1
Ribes sp.			1		1
Rubus subg. Rubus					
Rubus adenothallus	2		5	2	5
Rubus bogotensis	5		5	5	5
Rubus robustus	4		7	4	7
Rubus urticaefolius	3		4	3	4
Rubus sp. (greenish flws.)	3		3	3	3
Rubus spp.	5		6	6	6
Rubus subg. Orobatus					
Rubus acanthophyllus	1		1	1	1
Rubus coriaceus	4		7	4	7
Rubus glabratus	3		4	3	4
Rubus macrocarpus	3		5	3	5
Rubus roseus[4]	6	2	9	6	9
Rubus spp.	1		3	1	3
Rubus glaucus	4		2	4	6
Rubus subg. Idaeobatus					
Rubus ellipticus	1		1	1	1
Rubus niveus	1		2	1	3

[1]Total number of accessions collected as seeds, cuttings, or lignotubers (if accession was collected as more than one of these, all types of propagules have the same accession number).

[2]Total number of locations where a species was noted as occurring.

[3]Two pollen samples also collected for use as parents.

[4]One pollen sample also collected for use as a parent.

listed by PI and field number, type of material collected, and maintenance and preservation site(s), this is given in Appendix Table 1.

Associated species listings were neither extensive nor complete in most cases, because it was not possible to include much of this type of information and do the necessary collecting of target species within the allowed time frame. Associated species and plant community types were basically the same as published elsewhere (Luteyn, 1983, 1989; Popenoe, 1920; Simpson and Todzia, 1990; Van der Hammen and Cleef, 1986).

The horticultural potential for a number of the species collected on this expedition was quite evident, and is summarized in Table 2.

Generally, the Gaultheria species were quite showy in flower and/or fruit. Gaultheria reticulata, in particular, was reminiscent of Pieris. Gaultheria erecta was also a very attractive plant which resembles G. shallon Pursh. of the Pacific Northwest of North America. The golden brown indumentum on young leaves of G. lanigera was very attractive, and the low-growing stoloniferous G. amoena should make an excellent evergreen groundcover for cool-mild climate regions.

Cavendishia species are much more diverse in Colombia than in Ecuador (Luteyn, 1983). However, the accessions collected in Ecuador on this expedition clearly indicated the potential of this genus as florist crops. In addition C. bracteata, in particular, is a vigorous and adaptable shrub of good ornamental form. Both C. bracteata and C. tarapotana produce fruit with good size potential. Cavendishia tarapotana may also be a source of genes for heat tolerance within this genus.

The large and brightly colored pendent flowers of species of Ceratostema were one of the highlights of the trip. This genus includes a number of species with excellent potential as florist crops, as well as ornamental shrubs (in cool-mild climatic zones). Ceratostema alatum and C. reginaldii were particularly noteworthy in these regards. They are also a potential source of genes for very large fruit size in the Vaccinieae. In addition, C. lanigera should be a potential source of genes for heat tolerance.

Disterigma species were quite distinct and generally more diminutive than most other genera. Overall, the most attractive species was D. empetrifolium, a dwarf shrub to subshrub, with pink-rose flowers and translucent white fruits, which resembles a heather in overall aspect. It is a very fine ornamental which would probably make an excellent specimen in the rock garden in cool-mild climate regions.

A number of species of Macleania also appear to have potential as florist crops and ornamentals. The very floriferous M. bullata with its bright orange tubular corollas, in inflorescences, often at every node on lateral branches was quite specular, and the most attractive species observed in this genus. However, M. rupestris was also quite floriferous, and the very large leathery evergreen leaves of M. coccoloboides were also quite attractive, as were the deep orange-red flowers of M.

Table 2. Horticultural Potential of Noteworthy Small Fruit Species Collected in Ecuador, 1990

Species	Potential Utility	
	Direct	Parental Value[1]
Andromadeae		
Gaultheria spp.	ornamental plants	
Vaccinieae		
Cavendishia spp.	florist crops, ornamentals	large fruit size
Ceratostema spp.	florist crops, ornamentals	very large fruit size
Disterigma spp.	ornamental plants	
Macleania spp.	florist crops, ornamentals	large fruit size
Psammisia spp.	florist crops, ornamentals	very large fruit size
Vaccinium crenatum	groundcover	
V. floribundum	new fruit crop, ornamental	frost resist. in bloom
Rubus subgenus Rubus		
R. adenothallus	new fruit crop	imp. productivity
R. robustus	new fruit crop	imp. productivity
R. urticaefolius		imp. productivity, mech. harvesting
Rubus subgenus Orobatus		
R. macrocarpus	new fruit crop	very large fruit size
R. roseus	new fruit crop	very large fruit size
Rubus glaucus	major fruit crop	large size, ex. quality

[1]Potential parental value for improving cultivars of current cultivated crops of these species.

poortmanii. Fruit size (where present) was in the same range as cultivated blueberries in North America.

The species of Psammisia were also quite variable. All had corollas with a distinct constriction about one-third of the distance down from the apex. Included in this genus were several apparent species pairs with large and strikingly attractive flowers, which should also have potential as florist crops. These include the P. ecuadorensis - P. ferruginea pair with corollas that are yellow below the constriction and bright green above, and the especially attractive P. fissilis - P. ulbrichiana pair with bright red pedicels, calyces, and corollas below the constriction, and pure white above. Species such as P. ulbrichiana also make large vigorous attractive evergreen shrubs and produce very large fruit.

Vaccinium crenatum was an attractive decumbent evergreen shrub, attractive in foliage, flower, and fruit, with apparent potential as a groundcover in cool-mild climates.

As noted by a number of authors (Macbride, 1959; Popenoe, 1924), V. floribundum was an extremely variable plant, ranging from decumdent to narrowly erect. Plant form was very ornamental, as were the generally glaucous, small, closely-spaced leathery evergreen leaves and the white to rose flowers. Fruit was mostly glaucous blue to blue-black and variable in size. Size ranged up to 9.5 mm. diameter even in the limited collections made during this expedition. It seems reasonable to assume that genotypes with fruit in excess of 12.7 mm. diameter probably occur in this species. Therefore, it would appear that there is, in fact, approximately the same variation for fruit size in V. floribundum in the Andes, as occurs in V. corymbosum (highbush blueberry) in eastern North America. Macbride (1959) noted that he found genotypes of V. floribundum in Peru with good flavor. This was not the case with these collections, but this does not mean that such genotypes do not occur in Ecuador. Vaccinium floribundum occurred across a fairly broad elevational gradient in Ecuador, from approximately 2200 m. to over 3800 m., and at the highest elevation visited (Access. 14091), frost could literally occur any night of the year. It was quite evident that it is a tough adaptable plant, with tremendous potential for domestication as a fruit crop in the Andes or similar regions, and as a parent for incorporation of traits such as frost resistance during bloom into blueberry cultivars grown in frost-prone temperate zone regions.

Of the Rubus subgenus Rubus (blackberry) species collected, R. adenothallus and R. robustus appeared to have the most promise. Both these species have large inflorescences along with reasonably large aggregate fruits and small-to-modest seed size. Flavor of fruits was good, but not equal to R. glaucus. These two species (and possibly their hybrids, if fertile) are probably worthy candidates for domestication, and probably would be more productive than R. glaucus. Rubus urticaefolius also had large inflorescences and the fruit separated easily from the pedicel (in some cases too readily, and shattered) and therefore is a potential source of genes for improved productivity and ease of separation (important for adaptation to mechanical harvest). However, fruit size was very small and soft, and fruits prone to preharvest rots. In addition, Rubus bogotensis and a number of unidentified accessions belonging to this subgenus were collected. Rubus bogotensis had extremely large seeds (Nutlets or "stones") and this along with often observed poor fruit set (or poor fertility) would appear to be serious limitations to utility of this species in breeding. This is evidently not the same R. bogotensis mentioned by Jennings et al. (1978) as a possible parent of R. glaucus. None of the unidentified accessions of subgenus Rubus appeared particularly promising.

Accessions of Rubus subgenus Orobatus included both simple (R. acanthophyllus and R. coriaceus) and compound-leaved (trifoliate) species and several unidentified forms. They were only uniform in sepal and flower petal form and color (magenta). Of the species collected only R. macrocarpus (Giant Colombian blackberry) and R. roseus appeared especially promising. Both species have extremely large fruits, with some compensation in inflorescence size. Individual fruit of R. roseus were actually larger than R. macrocarpus with these collections, but the number of flowers in the inflorescence (often three) was typically correspondingly

RECOMMENDATIONS

The potential of a number of the small fruit species collected on this expedition is quite evident. However, where this potential appears to lie with development of new cultivated crops, all the problems associated with domestication of any new species will have to be solved. Realistically, most, if not all of these same problems may also have to be solved to be able to carry out large scale attempts to incorporate genes from these species into related cultivated crops.

The cloud forest, subparamo and paramo plant communities where most of these species occur are unique environments and difficulties might be expected in attempting to grow them outside the areas where they occur naturally. In Ecuador there is little or no variation in daylength throughout the year, and most species would be expected to be short day plants. These climatic zones are also cool throughout the year and frost and freezing temperatures only occur at the higher elevations on the paramos. In addition, both diurnal and year-round temperature ranges are typically quite narrow, although these can vary significantly with aspect.

In this regard, Darrow (1955) reported almost 100% loss of Giant Colombian blackberry seedlings established outdoors at Beltsville, Maryland, during their first summer in the field. Jennings (1978) also noted that when plants of R. macrocarpus can be kept alive in temperate zones, no one has yet been able to induce flowering or fruiting to occur. Williams et al. (1949) were only successful in inducing flowering of R. glaucus in North Carolina after establishing it in a controlled environment chamber. However, in the very mild temperate climate of New Zealand, certain forms of this species flower and fruit with temperate zone Rubus species (Hall, personal communication). Likewise, as noted in the Introduction, Luteyn has had reasonable success growing and producing flowers on a number of genera of neotropical Vaccinieae in a greenhouse and office at the New York Botanical Garden. Therefore, limited experience with a small number of these species indicates varying degrees of success with attempts to grow them outside their natural environment. Based on similarity of climate, the most likely region for outdoor success with many of these species in temperate North America would be along the Pacific Coast from San Francisco to Washington State. There, the only major difference, or obstacle, should be daylength.

The most desirable scenario for development of new crops from these species would be to establish research and development programs for this purpose in the Equatorial highlands of the Andes, or perhaps expand or redirect ongoing programs in this region. This may also be the most viable approach to incorporating genes from certain of these species into current cultivated crops and vice-versa. For example, the American blackberry cultivars Cherokee, Commanche, Shawnee, and Black Satin were observed to successfully cycle through vegetative, flowering and fruiting cycles throughout the year at the Experiment Station of the Technical University of Ambato. These cultivars would be readily available for hybridization with native subgenus Rubus species and also with R.

glaucus. This does not imply that all species or cultivars of other cultivated temperate zone small fruits, or even all other blackberry cultivars, can be grown this successfully in the equatorial highlands of the Andes. Only cultivar trials will determine success or failure of these other crops and cultivars in equatorial regions.

It is realized that most countries in this region have limited resources. Therefore, such programs in the Andean region could probably only be justified with species or species groups with high likelihood for success in a relatively short period of time, and then when these are potentially high value crops intended largely for export. A number of species in the Vaccineae with potential as florist crops should meet all these criteria. Rubus macrocarpus and R. roseus should also fit into such a program. In addition, improving characteristics such as fruit firmness and productivity in R. glaucus through selection and/or hybridization with other Rubus species should also easily fall within these criteria, and potentially make the Andean blackberry an even more viable commercial fruit for domestic and export production. Of course one constraint, inherent in domestication and/or improving any crop in the same region where it is native, is that pest pressures will probably be greater.

A number of developed countries in the temperate zone have the technical expertise and greenhouse and controlled environment facilities for achieving these goals. In most instances this would involve maintaining these species in such facilities throughout the year. It is also quite possible that long-term breeding efforts will be required to develop even the first temperate-zone adapted cultivars or hybrids involving these species. This may even apply to florists' crop which are intended for greenhouse growing in the temperate zone. All these requirements could make such research and development programs very expensive, so the same justification criteria outlined for the equatorial highland neotropics would probably apply, at least to some degree, if undertaken in temperate zone regions.

Finally, it is hoped that if improvement and/or hybridization programs with any of these Andean small fruit species come to fruition, that determined efforts will be made to involve scientists and graduate students from the region throughout the life of such programs as integral research team leaders and/or members. Particular efforts also need to be made to assure that production technologies developed in the course of such programs be made available to agricultural and horticultural research, extension and industry personnel in the region.

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Appendix Table 1. Field and Plant Introduction (P.I.) Numbers of Seed, Clonal, or Pollen Accessions of Small Fruit Species Collected in Ecuador in 1990.

P.I. No.	Field No.	Species	Type Collection
A. Accessions to National Clonal Repository/Corvallis and INIAP, Quito, Ecuador[1]			
548852	14084	Cavendishia bracteata (R.&P. ex J. St.-Hil)	seed
548855	14220	Cavendishia tarapotana (Meissn.) Benth. & Hook.	
548867	14046	Gaultheria amoena A.C. Smith	
548868	14125	Gaultheria erecta Vent.	
548869	14162	Gaultheria erecta Vent.	
548870	14188	Gaultheria erecta Vent.	
548871	14190	Gaultheria glomerata (Cav.)	
548872	14136	Gaultheria reticulata H.B.K.	
548874	14126	Gaultheria strigosa Benth.	
548873	14174	Gaultheria tomentosa H.B.K.	
548886	14230	Psammisia ulbrichiana (Britton) A.C. Smith	
548935	14134	Vaccinium crenatum (Don) Sleumer	
548936	14171	Vaccinium crenatum (Don) Sleumer	
548937	14025	Vaccinium floribundum H.B.K.	
548938	14031	Vaccinium floribundum H.B.K.	
548939	14036	Vaccinium floribundum H.B.K.	
548940	14041	Vaccinium floribundum H.B.K.	seed & pollen
548941	14085	Vaccinium floribundum H.B.K.	seed
548943	14135	Vaccinium floribundum H.B.K.	
548944	14173	Vaccinium floribundum H.B.K.	
548945	V. floribundum HBK Corazon region		
548946	V. floribundum HBK Ambato area		
548947	V. floribundum HBK Ibarra area		
548888	14121	Rubus acanthophyllus Focke	
548889	14022	Rubus adenothallus Focke	
548890	14167	Rubus adenothallus Focke	
548891	14073	Rubus bogotensis H.B.K.	
548892	14131	Rubus bogotensis H.B.K.	
548893	14179	Rubus bogotensis H.B.K.	
548894	14187	Rubus bogotensis H.B.K.	
548895	14195	Rubus bogotensis H.B.K.	
548896	14027	Rubus coriaceus Poir	
548897	14039	Rubus coriaceus Poir	
548898	14061	Rubus coriaceus Poir	
548899	14211	Rubus coriaceus Poir	
548900	14035	Rubus ellipticus Smith	
548901	14026	Rubus glabratus H.B.K.	
548902	14090	Rubus glabratus H.B.K.	
548903	14132	Rubus glabratus H.B.K.	
548904	Rubus glaucus Benth. (sample #1) Ambato-cult. plants		
548905	Rubus glaucus Benth. (sample #2) Ambato-cult. plants		
548906	Rubus glaucus Benth. (sample #3) Ambato-cult. plants		
548907	Rubus glaucus Benth. (sample #4) Ambato-cult. plants		
548908	14020	Rubus macrocarpus Benth.	
548909	14032	Rubus macrocarpus Benth.	
548910	14060	Rubus macrocarpus Benth.	
548911	Rubus niveus Wall. from city market Gualaceo		

P.I. No.	Field No.	Species	Type Collection
548912	14019	Rubus robustus Presl.	seed
548913	14096	Rubus robustus Presl.	
548914	14139	Rubus robustus Presl.	
548915	14163	Rubus robustus Presl.	
548916	14059	Rubus roseus Poir.	
548917	14074	Rubus roseus Poir.	seed & pollen
548918	14113	Rubus roseus Poir.	seed & cuttings
548919	14150	Rubus roseus Poir.	seed
548920	14164	Rubus roseus Poir.	seed
548921	14189	Rubus roseus Poir.	seed & cuttings
548931	14168	Rubus urticaefolius Poir.	seed
548932	14222	Rubus urticaefolius Poir.	
548933	14236	Rubus urticaefolius Poir.	
548922	14077	Rubus sp.	
548923	14104	Rubus sp. (greenish flws.)	
548924	14123	Rubus sp.	
548925	14180	Rubus sp. (greenish flws.)	
548926	14194	Rubus sp. (greenish flws.)	
548927	14196	Rubus sp.	
548928	14224	Rubus sp.	
548929	14225	Rubus sp.	
548930	14226	Rubus sp.	
548866	14110	Fragaria vesca L.	
548887	14116	Ribes lehmannii Jancz.	

B. Additional Accessions to INIAP, Quito, Ecuador and North Carolina State University only.

548853	14223	Cavendishia bracteata (R&P.ex J.St.-Hil)	clonal
548854	14227	Cavendishia bracteata (R&P.ex J.St.-Hil)	clonal & seed
548855	14220[2]	Cavendishia tarapotena(Meissn.) Benth.& Hook.	clonal
548856	14217	Cavendishia sp.	clonal
548857	14216	Ceratostema lanigera (Sleum.) Luteyn	clonal
548858	14159	Ceratostema reginaldii (Sleum.) A.C. Smith	clonal
548859	14165	Disterigma alaternoides (HBK) Nied.	seed
548860	14124	Disterigma empetrifolium (HBK) Drude	seed
548861	14234	Disterigma pentadrum Blake	clonal
548862	14145	Disterigma popenoi Blake	seed
548863	14048	Disterigma sp. (poss. SP. NOV.)	seed
548864	14054	Disterigma sp. (poss. SP. NOV.)	seed
548876	14228	Macleania bullata Yeo.	clonal
548875	14232	Macleania coccoloboides A.C. Smith	clonal
548877	14233	Macleania ecuadorensis Hoer.	clonal
548878	14235	Macleania loeseneriana Hoer.	clonal
548879	14053	Macleania rupestris (HBK) A.C. Smith	seed
548880	14137	Macleania rupestris (HBK) A.C. Smith	seed
548881	14144	Macleania salapa (Benth.) Benth. & Hook.	clonal
548883	14231	Psammisia ecuadorensis Hoer.	clonal
548884	14218	Psammisia ferruginea A.C. Smith	clonal

P.I. No.	Field No.	Species	Type Collection
548885	14229	Psammisia sodiroi Hoer.	clonal
548882	14219	Psammisia coarctata (Ruiz. & Pav.) A.C. Smith	clonal
548886	14230[2]	Psammisia ulbrichiana (Britton) A.C. Smith	clonal
548934	14215	Themistoclesia cutucuensis A.C. Smith	clonal
5488942	14091	Vaccinium floribundum H.B.K.	pollen

C. Miscellaneous Species, to INIAP, Quito, Ecuador and North Carolina State University.

548850	14133	Befaria resinosa Mutis ex. L.f.	seed
548848	14161	Befaria aestuans Mutis ex. L.f.	pollen
548849	14175	Befaria aestuans Mutis ex. L. f.	seed
548851	14079	Bomarea sp.	seed

[1]Small samples of a number of these accessions also sent to North Carolina State University.

[2]Same source as seed accessions listed in Part A.