

COSTA RICAN ORCHIDACEAE TYPES (CROTYPES) DIGITAL IMAGING DOCUMENTATION AT AMES, HARVARD UNIVERSITY

FRANCO PUPULIN¹ & GUSTAVO A. ROMERO-GONZÁLEZ²

¹ Jardín Botánico Lankester, Universidad de Costa Rica
Research Associate, Marie Selby Botanical Gardens

P.O. Box 1031-7050 Cartago, Costa Rica, AC. fpupulin@cariari.ucr.ac.cr

²Orchid Herbarium of Akes Ames, Harvard University Herbaria, Harvard University, U.S.A.

Botanical collections in developed countries are not always restricted to their native plants. Many herbaria in those countries also host large collections from tropical and subtropical floras as the result of floristic projects carried out by leading European and North American botanical institutions in the past three centuries. Access to these research collections and data resources has been historically a significant impediment for scientists working in tropical countries, where, paradoxically, a better documentation system is needed for the identification, comparison, and management of the much more diverse floras and faunas. Recent conventions on sustainable use of biodiversity (see <http://www.biodiv.org>) stress the importance of research and training contributing to biodiversity conservation, as well as the value of the interchange of relevant information aimed to maintain valuable plant resources and to make them widely available (Barthlott 2001). An effective electronic information system has been acknowledged as an important tool to provide dissemination of the information sources represented by biological collections kept in developed countries, including botanical collections. Images of herbarium specimens, in the form of photographs, slides, xerox copies, etc., with a special emphasis on nomenclatural types, have long been used as complementary materials for taxonomic studies, or as an alternative to the loan of important material. Early examples of extensive image collections are the photographs of European type specimens taken by J. Francis Macbride in the 1930's, now partially available from the web site of the Field Museum in Chicago (2003), the digitizing of Linnean types by the Swedish Museum of Natural History (2003a), and the data capture of types of all vascular plants held in

Dutch herbaria, carried out by the Leiden National Herbarium (2003). More recent type databases include the large Swartz herbarium (within the Regnellian herbarium at the Swedish Museum of Natural History) (Swedish Museum of Natural History 2003b), a collection comprising approximately 6000 specimens of phanerogams and ferns, mainly from the West Indies, loans from which are not allowed (Leiden Nationaal Herbarium 2003); the collections of specimens of *Erythroxylum* borrowed by the late Timothy Plowman at the Field Museum; the University of Florida Herbarium collections catalog and type specimens web sites, including plant species of Florida, including those potentially poisonous, and the UF Herbarium type specimens (Florida Museum of Natural History 2003); the collection of types of Costa Rican Instituto Nacional de Biodiversidad (2003); the Compositae types digital imaging project to be completed by the Munich public herbarium; and the Missouri Botanical Garden (2003) project aimed to create a database of plant images linked to associated database records as a repository for scientifically identified plant images. For a more complete survey of type database Internet addresses, see Davies *et al.* (2002).

Orchidaceae form one of the largest families of flowering plants, with an estimated 25,000 species (Dressler 1993). They are found in a great variety of habitats in all continents except Antarctica, but their diversity is greater in the tropical regions of the world. In the Neotropics, species of Orchidaceae constitute a significant part of most ecosystems and often constitute the most diverse component of the forest canopy. Costa Rica possesses 1360 orchid species, of which 267 are regarded as endemics (Pupulin 2002). This figure accounts for the highest diversity in

Mesoamerica and, in comparison with the reduced size of the country, for one of the richest orchid floras over the planet. The overall relevance of the family from both ecological and economical perspectives, makes any knowledge about the Orchidaceae of paramount importance for analysis of biodiversity, as well as for environmental evaluation and research. In these, and related fields, access to nomenclatural types is of great importance. Nomenclatural types are the specimens selected to serve as a reference point when a plant species is first described and named; they are permanently linked to the plant name and allow species to be identified without ambiguities (ICBN 2000). These specimens are extremely important to botanists when attempting to determine the correct application of a name, and provide a common basis for even the most advanced research techniques.

The origins of the Orchid Herbarium of Oakes Ames can be traced back to the establishment of the Ames Botanical Laboratory in 1899. Oakes Ames conceived his herbarium primarily as a working tool, and it became a depository of much and varied information on orchid species in addition to the storage of dried specimens. It included original descriptions, photographs, drawings, life-size copies of type-specimens, published-plates and other references useful for identification purposes. He also amassed a comprehensive library on the family. Ames donated his Orchid Herbarium and Library to Harvard in 1938, together with a sizable endowment. The Orchid Herbarium of Oakes Ames is an integral part of the Harvard University Herbaria and currently contains about 131,000 specimens and it is accompanied by a library of about 5,000 books, reprints, and journals. In addition, a collection of 3,000 flowers in glycerine, 4,000 pickled specimens, and hundreds of line drawings supplement dried specimens in the main collection. This herbarium is exceptionally rich in types, resulting from an active exchange program maintained throughout the years by the staff of the herbarium. With nearly 800 sheets, the AMES herbarium is perhaps the richest repository of Costa Rican Orchidaceae types in the world. From a preliminary survey, 23% are holotypes or holotype fragments, 11% are isotypes or isotype fragments, 52% are drawings of types (many of them to be selected as lecto-

types), 6% are types according to the literature but their category has not been established, and 3% are possible types.

The main objective of The CROTPES project is to digitize all the Costa Rican orchid types at AMES. It will be supported by two researchers, a Database/Network administrator, and two research assistants for a period of approximately one year. Specific activities will include the photographic and digital acquisition of images (including post production manipulation) and the library-based research for evaluation and collation of bibliographical documentation. Images will be acquired at AMES using an Epson 1640XL scanner and a Hasselblad 503ELX Camera equipped with 150mm f/4 Tessar Zeiss and 80mm f/2.8 Planar Zeiss lenses mounted on bellow, recorded on both Kodak E-64 120 slide film and Kodak 160 120 negative film. Photographic procedures will follow, in general, those recommended by Rochester Institute of Technology (2000) for archiving of type specimens. Slides and/or negatives will be successively scanned at Universidad de Costa Rica with a film scanner Nikon Super Coolscan 8000 ED (optical resolution of 4000 DPI [ppi], dynamic range 4.2), specifically designed for acquisition of 135 and medium format films. Computer support at AMES is currently a computer system based on a single Intel 2.4 Ghz Pentium 4 Xeon™ chip, with 120 gigabytes of storage and 1024 megabytes of RAM. At the Universidad de Costa Rica, computer support is currently a Macintosh (PowerMac G4) computer system with 17 gigabytes of storage and ~ 800 megabytes of RAM.

On average, four images will be recorded per type sheet: the entire sheets of specimens (Fig. 1, 2), macro images of taxonomically important structures (mostly the flower) (Fig. 3A), and the original label(s) (Fig. 3B, 4B). A measurement scale will be included in the images as a reference. Entire sheet specimens (11.5 x 17.5 in) will be scanned at 450 DPI (ppi), and generated file sizes will be around 39 megabytes (Fig. 1, 2). One or more close-ups will be scanned (ca. 4 x 4 in) up to 1200 DPI (ppi), with generated file sizes around 22 megabytes (Fig. 3A, 4A). Slides and negatives will be taken on medium format film (2 1/4 x 2 1/4 in) and successively scanned at



Figure 1. *Habenaria lankesteri* Ames. Holotype. Reproduced with kind permission by the Director, Harvard University Herbaria, Harvard University.

3000 DPI (ppi) or 4000 DPI (ppi), generating files of about 39 Mb and 60 Mb respectively.

Digital images will be initially recorded as TIFF files with color depth at 24/16 millions of colors. Images will be matched with a 1.8 gamma monitor

and relative colorimetrics for rendering profiles. Intermediate processing and post-production manipulation of digital herbarium images (to improve sharpening and to apply brightness/contrast filters) will be achieved with Adobe® Photoshop® 7.0.

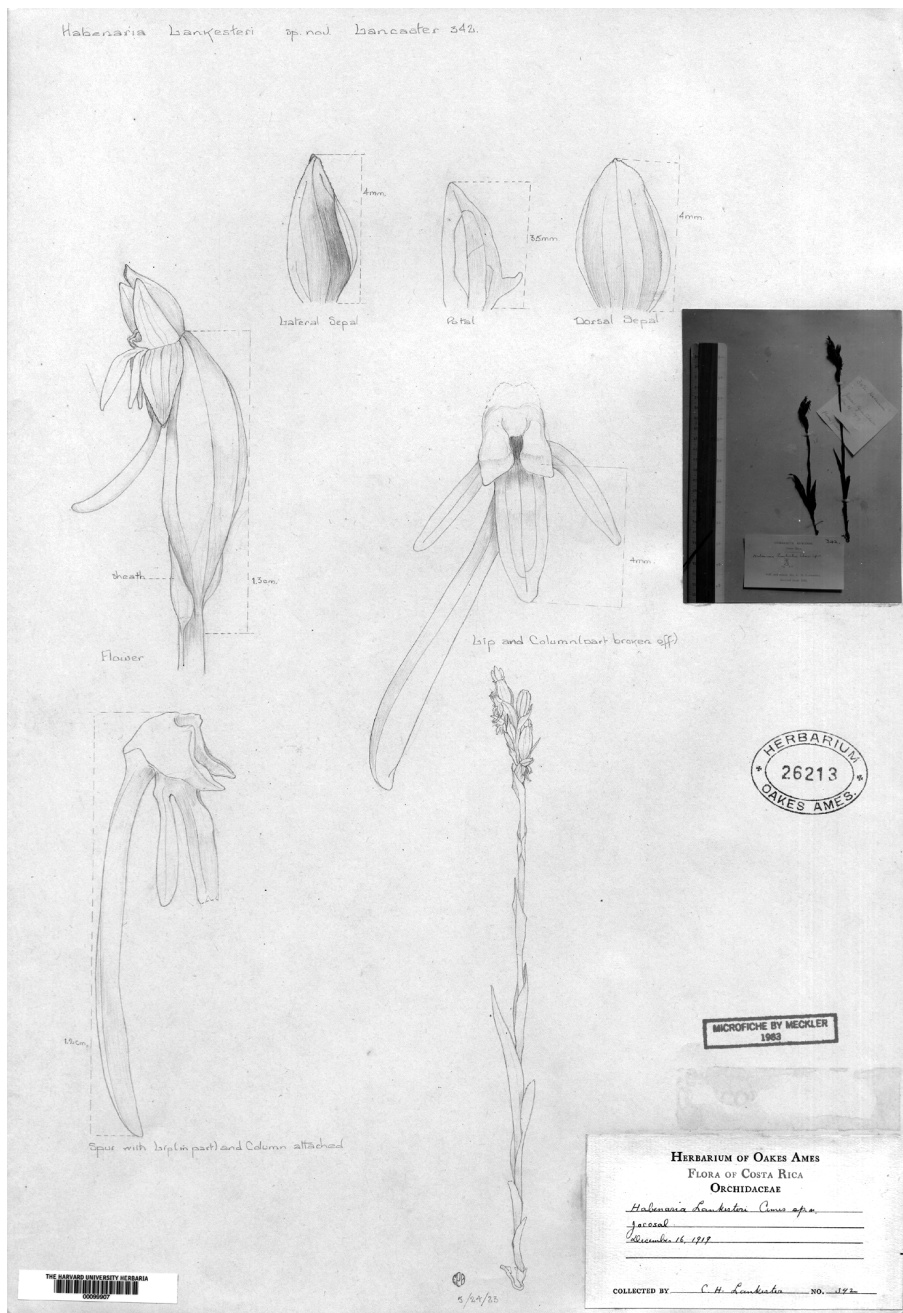


Figure 2. *Habenaria lankesteri* Ames. Drawing of holotype. Reproduced with kind permission by the Director, Harvard University Herbaria, Harvard University.

The slide and negative collections will be preserved employing accepted preservation practices. The digital images will be preserved as part of the ongoing commitment of both institutions to the maintenance and accessibility of their many collections and databases.

The status of types not yet determined will be checked in the pertinent literature and, when available, in modern revisions. Information not included on the sheet labels (i.e., author, collector, locality) will also be verified in the literature. Species names

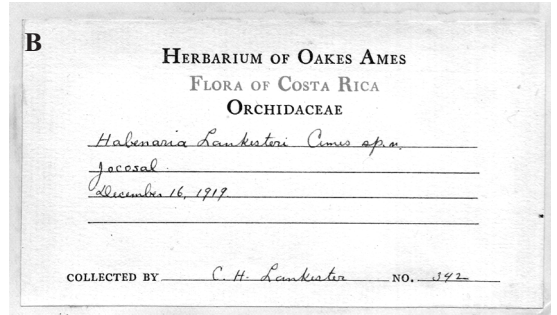
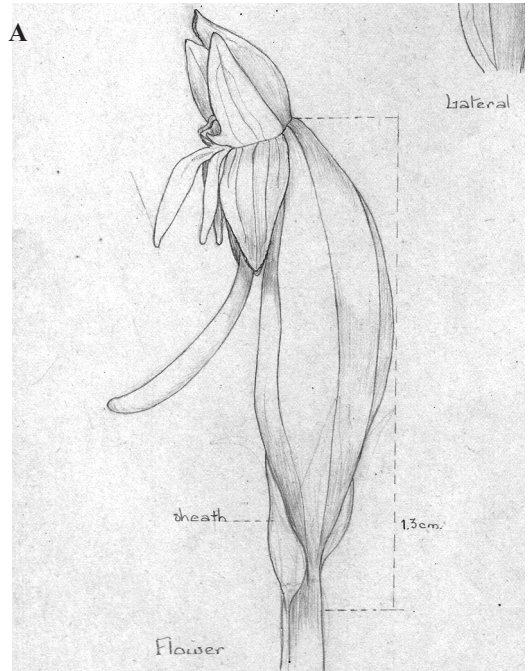
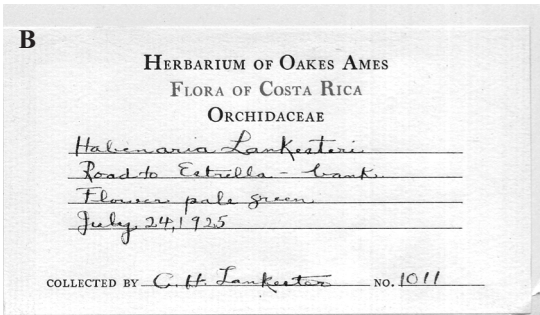


Figure 3. *Habenaria lankesteri* Ames. Holotype. A. Detail of flowers. B. Label. Reproduced with kind permission by the Director, Harvard University Herbaria, Harvard University.

Figure 4. *Habenaria lankesteri* Ames. Drawing of holotype. A. Detail of drawing. B. Label. Reproduced with kind permission by the Director, Harvard University Herbaria, Harvard University.

will be checked through the International Plant Names Index (IPNI, product of a collaboration between The Royal Botanic Gardens, Kew, The Harvard University Herbaria, and the Australian National Herbarium) and other literature sources. Author abbreviations, name of collectors, and literature citation will follow currently accepted community standards (Brummit & Powell 1992, Lawrence *et al.* 1968, Stafleu & Cowan 1976-1988, Stafleu & Mennega 1992-2000; see also <http://www.huh.harvard.edu/databases/index.html>).

men database system:http://brimsa.huh.harvard.edu/cms-wb/specimen_index.html

The following is sample of this database, using *Acer heptalobum* Diels as an example: <http://brimsa.huh.harvard.edu/cms-wb/specimens.jsp?barcode=50431>

Ultimately, images will be made available on the Internet via the Harvard University Herbaria speci-

Each type will have a unique URL (Uniform Resource Locator) maintained by the Harvard University Herbaria, and mirrored at the University of Costa Rica; other web-based databases can simply establish links to all or a partial set of the types. This approach has several advantages, the main one being that all changes made in the database need only be

made once. Partial sets of the data set, including images, will be made available using inexpensive storage media (CDs) for free to institutions not having the computer infrastructure to view the data and images on the Internet.

LITERATURE CITED

- Barthlott, W. 2001. Biodiversity and collections. BIOLOG Status Seminar 2001. Bonn, Germany.
- Brummit, R.K. and C.E. Powell (eds.). 1992. Authors of Plant Names. Royal Botanic Gardens, Kew.
- Davies, A.M.R., P. Bodensteiner, A. Pillukat and J. Grau. 2002. INFOCOMP – the Compositae Types digital imaging project in Munich. *Sendtnera* 8: 9-20.
- Dressler, R.L. 1993. Phylogeny and classification of the orchid family. Dioscorides Press.
- Field Museum of Natural History. 2003. http://www.fnmh.org/research_collections/botany (February).
- Florida Museum of Natural History, University of Florida. 2003. <http://www.flmnh.ufl.edu/natsci/herbarium/types> (February).
- Instituto Nacional de Biodiversidad. 2003. <http://www.inbio.ac.cr/tipos/herbario> (February).
- International Code of Botanical Nomenclature (St. Louis Code). 2000. Regnum Veg. 138. Königstein.
- Lawrence, G.H.M., D.F.G. Buchheim, G.S. Daniels and H. Dolezal (eds.). 1968. *Botanico-Periodico-Huntianum*. Pittsburgh.
- Leiden Nationaal Herbarium. 2003. <http://nhnml.leidenuniv.nl/#types> (february).
- Missouri Botanical Garden. 2003. <http://www.mobot.org> (February).
- Pupulin, F. 2002. Catálogo revisado y actualizado de las Orchidaceae de Costa Rica. *Lankesteriana* 4: 1-88.
- Rochester Institute of Technology. 2000. Procedures and recommendations for photographing and archiving types specimens of the New York Botanical Garden. Prepared by the Biomedical Photographic Communications Department, School of Photographic Art and Sciences.
- Stafleu, F.A. and R.S. Cowan. 1976-1988. *Taxonomic Literature*, 2nd ed. Vol. 1-7: A-Z. Utrecht.
- Stafleu, F.A. and E.A. Mennega. 1992-2000. *Taxonomic Literature*. Supplement 1-6: A-E. Königstein.
- Swedish Museum of Natural History. 2003a. <http://www.linnaeus.nrm.se/botany> (February).
- Swedish Museum of Natural History. 2003b. <http://www.nrm.se/fbo/hist/swartz/swartz.html.en> (February).

Franco Pupulin is a professor of the Universidad de Costa Rica, where he works as a researcher at Jardín Botánico Lankester. He is particularly interested in the systematics and evolution of advanced orchid groups, mainly in the subtribes Oncidiinae and Zygopetalinae. He is also working to several floristic projects in the Mesoamerican region, and is an approved AOS taxonomic authority.

Gustavo A. Romero-González is Keeper of the Orchid Herbarium of Oakes Ames and Editor of *Harvard Papers in Botany*, and he currently conducts monographic and floristic work on the Orchidaceae in northern South America as well as research on the biological basis for the long-term management of Neotropical non-timber forest products (including orchids, of course!).