

A New Website for Araceae Taxonomy on www.cate-araceae.org

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ABSTRACT

The development and current progress of the Cate-Araceae website is described and its relation to the aroid community discussed in the context of rapidly developing initiatives to migrate traditional descriptive taxonomy onto the internet (E-Taxonomy).

INTRODUCTION

The website of the International Aroid Society and its associated mailing list Aroid-l is a key achievement of the Society and its supporting community. It is a dynamic and attractive social space in which people who are interested in aroids feel comfortable to tell other people about their interests and find out more, especially by just asking for help. The success of the site is very obvious in this respect and it is moreover a lasting success. Everyone knows that there is just one place on the internet — <http://www.aroid.org/> — where you can find out all about aroids. It is easy to see that it isn't just the site but also the community that it links together which is of great significance in the context of the revolution that the internet is bringing about for biodiversity studies, including taxonomy.

Getting taxonomy onto the internet is a rapidly growing activity which is now being taken seriously by major biodiversity institutes around the world. The biggest initiative to appear so far is the global-scale *Encyclopedia of Life (EoL)* (<http://www.eol.org/>) project inspired by Prof. E.O. Wilson of Harvard University and now an international consortium. All such projects argue that the prime task for taxonomists today is to make taxonomy visible on the internet and transform classification into a “rolling” continual-update facility in which information for species is available at a mouse-click, in the most up-to-date form, to everyone, all the time. Going even further are those projects which aim to make it possible for anyone to contribute to biodiversity websites and thus enrich them, in much the same way as Wikipedia (<http://www.wikipedia.org/>). It is clear from these

visions that there is great potential to make traditional taxonomy a much more exciting, collective and dynamic activity than ever before. But one common discovery that most E-Taxonomy websites make early on is that without an interested community, ready to focus on the web-delivered information, it is difficult to create the desired inter-activity. Scientists who are engaged in this area all agree that the hardest job is not the technology, but engaging the human community, i.e. making it attractive for taxonomists, natural historians, plantspeople, ecologists, horticulturists and anybody else who is interested, to actually engage regularly with the website and turn it into a living breathing community space.

The project described here — Cate-Araceae — is thus a direct response to the existence of the aroid community that finds its expression through the IAS. If it succeeds, it will be because of the community that the IAS has created and sustained. The idea for an additional website for aroids focussing on formal species taxonomy initially arose from discussions between Tom Croat (Missouri Botanical Garden) and Simon Mayo (Royal Botanic Gardens Kew) in 2003. They were primarily seeking a mechanism which would bring about a more effective integration of effort between aroid taxonomists dispersed around the world — a means for collaboration, badly needed for the big genera which are beyond the reach of any one person to revise effectively. They reasoned that greater aggregation of the aroid taxonomic experts was the key to providing high quality information to support global facilities like Global Biodiversity Information Facility (<http://www.gbif.org/>), International Plant Names Index (<http://www.ipni.org/>), and many other such global information projects, of which EoL is a more recent example. The first step in making this idea concrete was a project to make an internet-accessible key to the species of *Philodendron*, something never previously attempted. Marcela Mora (Bogotá, now at the University of Alabama), led this project from 2005 with funding

mainly from the Kew Latin America Research Fellowships Programme (KLARF), working both at Kew and Missouri Botanical Garden before starting on her PhD studies at Tuscaloosa in 2007. The logic of this key-writing project was not only the need to provide an identification tool of some sort, but also a means to navigate the existing tangled knowledge of a very large genus, to narrow down alternatives and establish groups of species and a geographical scope on which botanists could begin new projects of taxonomic revision; i.e. the key as a research tool as well as a service.

The chance to set up a more ambitious version of the original idea came with the CATE project (*Creating a Taxonomic e-Science*). CATE is a feasibility study for a particular view of how to deliver revisionary taxonomy through the internet, first articulated clearly by Charles Godfray (2002), a British evolutionary population biologist and entomologist. There are two key ideas in Godfray's vision. First is the notion of peer-reviewed consensus taxonomy – that is, the cooperation of taxonomists to produce, maintain and update, on a permanent basis, a single agreed version of the taxonomy of family-level taxa like the Araceae. This is a response to a widely expressed and urgent demand from many sectors, including biodiversity and conservation science, horticulture, forestry and agronomy. The second point is continual update: the websites need to focus the taxonomic experts permanently on maintaining and developing the information content so that users can be sure of access to the current best scientific estimate of the family taxonomy. In order to achieve this, of course, the taxonomic community has to organize itself in such a way that this focus is achieved and maintained, and discovering how to do this is a major challenge.

Planning for CATE began in 2004 and funds from the UK's Natural Environment Research Council (NERC) were granted in June 2005 for a three-year period. The project began later that year as a consortium led by the Natural History Museum London, with the Royal Botanic Gardens

Kew and Imperial College London, later replaced by the University of Oxford (<http://www.cate-project.org>). CATE has created websites for two model groups, the Sphingidae (hawkmoths, <http://www.cate-sphingidae.org>) to represent the Animal Kingdom and the Araceae for plants (<http://www.cate-araceae.org>). Besides bringing together comprehensive taxonomic information for each family, the project's major goal is to build the software framework needed to make it possible for the taxonomists to carry out on-going revision of the uploaded information. So the three ingredients of the project are: 1) create the initial information for each species and mount it on the web; 2) create the software tools to update and change the content; 3) attract the taxonomic community to focus part of their revisionary effort onto the website.

THE ARACEAE WEBSITE

Taxonomists have the most vital role in the CATE vision, particularly in proposing changes, such as the addition of new species or synonyms, which must be published in hard copy before they can be incorporated, because of the rules of the International Code of Botanical Nomenclature (McNeill *et al.*, 2006). However, the system will be open to anyone to make contributions, for example, a distribution record, images, previously unrecorded observations and so on. These can add significant taxonomic information to species treatments.

Maintaining the quality of the information content is important to the credibility of the site. Contributions and proposals for change can be reviewed online by anyone; however, for more complex, technical or extensive material, moderators will be asked to prepare reviews by the editorial group. The taxonomic revision on the website will also be regularly versioned. This means a time series in which the current version replaces previous ones and the old versions are dated and archived and remain available for consultation. Newly accepted changes to the revision will thus

be incorporated into the next version as part of an organized work flow. Any proposals that are not accepted by the editorial group will nevertheless be posted on the site, as alternative hypotheses and attributed clearly to their authors. In effect, any kind of contribution can therefore be viewed as a form of electronic publication.

CURRENT PROGRESS

The Araceae website is built on a framework of nomenclatural data provided by the World Checklist for Selected Plant Families, (<http://www.kew.org/wcsp/>), which is a benchmark list of currently accepted species and synonyms. During the first year of the project this data was transformed into web pages, one for each accepted genus, species and infraspecific taxon, along with the associated information on synonymy, literature references and geographical distribution. Thus we were able to create quite rapidly a complete set of "skeleton" species and genus web pages for the family.

These taxon pages are now being populated with additional descriptive data edited from the current literature, including detailed morphological descriptions, images, information on type specimens and habitat. The format is different from the typical printed monograph, however, with the information divided into different screens via tabs; so the main page for a given taxon includes photographs, a short paragraph on its distinguishing features and distribution information. By scrolling through the tabs, more detailed information is available (Fig. 1). In the future new data fields can be added to include new topics where needed. The data can be searched by taxon and by geographical region, up to level 3 (corresponding approximately to country or state) of the World Geographical Scheme for Recording Plant Distributions (<http://www.tdwg.org/standards/109/>).

Currently, full descriptive information can be found for all genus pages (including the Duckweed genera of Lemnaceae, now incorporated into Araceae), and for species

pages in the genera *Arum*, *Hapaline*, *Pothos*, *Pothoidium*, *Pedicellarum* and *Colocasia*. By the end of 2008, there will be full to reasonably full (depending on current knowledge) information for all species pages of *Anthurium*, *Philodendron* and all African species (ca. 200 spp.). The *Flora Malesiana* organization and the specialists who are co-authors of the *FM* Araceae treatment (much now completed but still unpublished) have generously allowed CATE to use some of their information already, and opened the way for further fruitful collaboration; this is very important as the *Flora Malesiana* area includes a very important part of aroid diversity.

The Cate-Araceae site team are also putting much effort into the preparation of illustrated interactive identification keys built in LUCID3 software (<http://www.lucidcentral.org/>). Web-enabled keys give botanical identification a whole new dimension to explore and the opportunity to make identification of species and genera much more image-based and less dependent on cumbersome terminology. Using the *Genera of Araceae* key as a starting point (Mayo, Bogner & Boyce, 1997), a new key matrix and rich variety of illustrations (Fig. 2) of characters have been created (by Anna Haigh), resulting in the first practical, user-friendly, comprehensive generic key to Araceae. An illustrated key to the genus *Arum* (written by Anna Haigh) based mainly on Boyce (1993) and Boyce (2006), is also online. Major developments in the coming months will be keys to the two largest genera of Araceae, *Anthurium* including 790 species, written by Laura Reynolds, Tom Croat and Anna Haigh, and *Philodendron* by Marcela Mora, Tom Croat and Simon Mayo, including over 400 species. Lucinda Lay and Anna Haigh are currently preparing a key to all the aroid taxa from Africa which is planned for release by September 2008. Geographical data is included in the keys, allowing users to narrow down their search quickly to a short list of species using just a small number of illustrated characters. Further refinements to the identification may be

Creating a Taxonomic e-Science



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CATE About CATE CATE Araceae CATE Araceae home page Taxonomy Classification Keys An interactive key to the genera of Araceae An Interactive Key to the genus Arum Help Query Syntax Geographical Regions Using the Keys Terms of Use	Main Page Nomenclature Taxonomy Synonyms Included Taxa Description Keys Discussion Other Images References	<h1>Gorgonidium Schott</h1>			Contributions <input type="button" value="Make a contribution"/> No Contributions Found				
<h3>Distinguishing Features</h3> <p>Seasonally dormant tuberous geophytes; leaf blade with reticulate fine venation; flowers unisexual, perigone absent; female flowers surrounded by a whorl of free staminodes; ovules orthotropous. Differs from <i>Synandropadix</i> in staminodes in female flowers filiform to subclavate, male flowers with stamens free or connate to different degrees into a synandrium (always entirely connate in <i>Synandropadix</i>) and leaf blades pinnatifid, pinnatisect or bipinnatifid.</p> <p style="text-align: right;">Based on: Mayo, S.J., Bogner, J. & Boyce, P.C. (1997)</p>									
<p>Back to the top</p> <table border="0"> <tr> <td> All content © CATE Araceae admin@cate-araceae.org CATE version 0.4 </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>					All content © CATE Araceae admin@cate-araceae.org CATE version 0.4				
All content © CATE Araceae admin@cate-araceae.org CATE version 0.4									

Fig. 1. An example of a taxon page on www.cate-araceae.org.

made using more specialist characters or simply by comparing with the data on the webpages.

THE ARACEAE NETWORK SITE ([HTTP://SCRATCHPAD. CATE-ARACEAE.ORG/](http://scratchpad.cate-araceae.org/))

The current phase of populating species and generic web pages and preparing keys can be viewed as essentially a first stage: the creation of a point of departure for more refined and reliable taxonomic treatments in the future. The second stage is the gradual engagement of taxonomists and others who are able to contribute, to

enrich, refine and improve the taxonomic descriptions, knowledge of geographical ranges, diagnostic character variation, etc. New taxa will be described and old ones synonymized; phylogenetic studies will result in changes to the classification at various levels. These changes and developments require a system of review and evaluation by the aroid taxonomic community and the website allows anyone with a stake in aroid taxonomy to make their views known.

The long-term goals of Cate-Araceae thus require that some kind of organizational process be undertaken within the community by means of which taxonomists can

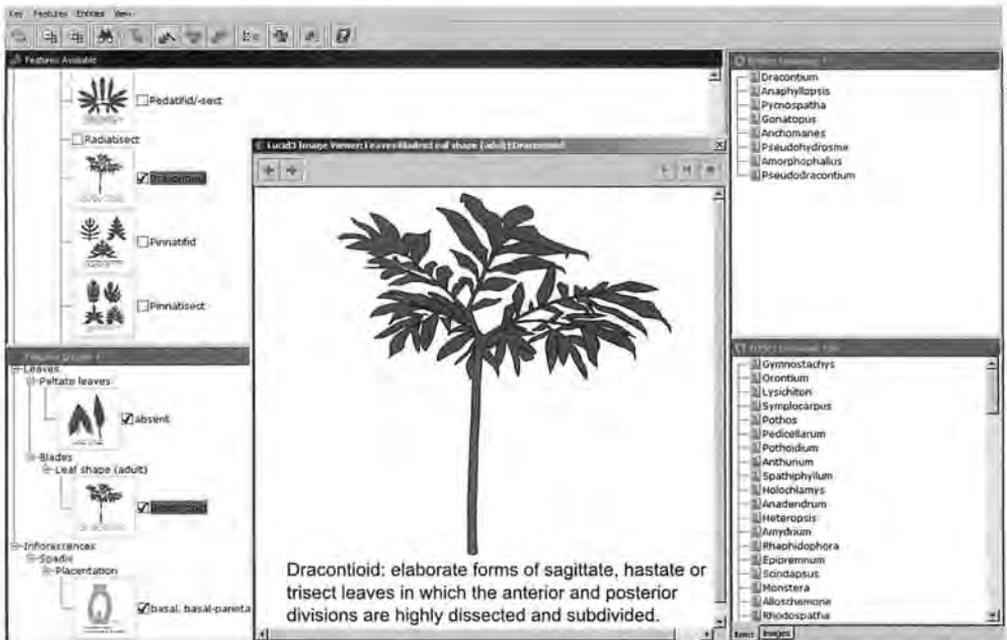


Fig. 2. A screenshot of the interactive key to the Genera of the Araceae.

participate and influence outcomes in a just and transparent manner. This process has only just begun. At the outset of the project, a group of aroid botanists lent their support by agreeing to become members of the Araceae Expert Advisory Team: Alistair Hay (Australia), Dan Nicolson (USA), David Scherberich (France), Denis Barabé (Canada), Eduardo Gonçalves (Brazil), Jin Murata (Japan), Josef Bogner (Germany), M. Sivadasan (India), Marc Gibernau (France), Peter Boyce (Sarawak, Malaysia), Simon Mayo (UK), Tom Croat (USA) and Wilbert Hetterscheid (Netherlands). In addition, the authors of this paper include other botanists who are contributing information or who have participated already in planning discussions for Cate-Araceae. Other colleagues in USA and Brazil, including Monica Carlsen, Marcus Nadruz, Cássia Sakuragui, Ivanilza Andrade and Maria de Lourdes Soares, have given their support to the project.

Recently a forum site has been established (*Araceae Network*, <http://scratchpad.cate-araceae.org/>) to foster the further involvement of aroid taxonomists and any other interested people in the Cate-Araceae

project. The objectives are to foster a supportive environment on the internet through which the taxonomic community in particular can debate and reach agreement on topics which are important for developing the consensus taxonomy of aroids. These include technical subjects like character state terminology but also organizational ones such as how the editorial and review roles needed for the CATE website can be legitimately and fairly assigned so as to promote a progressive and inclusive climate for taking the web revisions forward into the future. In addition, users can create a profile for themselves, showing for example their areas of interest and listing their publications.

The aim of the Cate-Araceae project is to complement the fine work that the International Aroid Society has been doing now for over 28 yr in improving knowledge of the fascinating family of aroids. As we envisage it, the Cate site will be able to contribute primarily two major resources. First, it will function as a mechanism to produce a "rolling" consensual taxonomy which can form the foundation for other information on aroids. It is intended that

this will be an inclusive process of fruitful collaboration across the world. We do not imagine that all disputes over taxonomic issues will disappear, nor would we wish it so. But Cate-Araceae can serve as a current benchmark, a background for scientific debate, and a useful practical tool for people who want names backed by taxonomic opinion. Second, Cate-Araceae can be a tool for self-help and for learning. The internet is the way forward for spreading taxonomic knowledge and empowering people who have a hunger to be an expert on their favourite plants.

The current funding for Cate-Araceae runs until the end of 2008 but we anticipate that it will continue to be maintained and augmented using the current structure, but without the full-time team currently available. The growth of E-Taxonomy initiatives at major institutions suggests that the site has a secure future as part of a wider taxonomic resource. It will be important to organize meetings of aroid taxonomists to discuss the site's editorial organization further, and we anticipate that this process will begin at the Araceae Symposium in Copenhagen in August 2008.

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