

Herbaria – archives of biodiversity

Professor Eberhard Fischer from the University of Koblenz-Landau highlights the importance of the evaluation of herbaria for assessing land-use change and climate change in tropical Africa

The evaluation of the National Herbarium of Rwanda enables an assessment of land-use change and climate change. Rwanda, at c. 26,000km², is one of the smallest countries in Africa but also one of the hotspots of biodiversity, harbouring c. 3,500 species of vascular plants, among them around 400 endemic species. It is situated along the Albertine Rift where refugial rainforests persisted during the Pleistocene with its huge climate changes between humid, dry and cold conditions. Species' ancestors were thus isolated and developed into endemics by allopatric speciation.

On the other hand, Rwanda has a population density of more than 450 inhabitants/km², but still more than 10% of its surface is covered by natural vegetation, most of it protected within the four national parks (Volcano, Akagera, Nyungwe and Gishwati-Mukura).

An intended project will deal with the evaluation of the National Herbarium of Rwanda (NHR) (Fig. 1) housed in Butare. It comprises c. 17,000 specimens of ferns and flowering plants, collected between the 1930s and 2000. The herbarium was founded during the Belgian colonial period as part of the Institut de Recherche Scientifique en Afrique Centrale (IRSAC) which, after independence, was renamed Institut National de Recherche Scientifique (INRS). It was mainly in the 1970s when the botanist George Troupin collected the majority of the 17,000 specimens during the preparation of the *Flora of Rwanda* (vol. 1, 1978, vol. 2 1983, vol. 3 1985, vol. 4 1988). In 1987, the INRS was renamed Institut de Recherche Scientifique et Technologique (IRST). The focus was then mainly research on plants used in traditional medicine.

Herbaria potential

Unfortunately, herbaria are nowadays often considered as old-fashioned collections of useless hay. However, they play an enormous role as archives, e.g. for the verification of names used in phylogenetic molecular studies. The herbarium of Rwanda constitutes a cultural heritage and an invaluable archive of biodiversity. Each specimen represents a documented locality comprising information on ecology and historical distribution.

The aim of the project is to scan every specimen and to enter the locality data after having been geo-referenced into an access database. Thus it will be possible to locate every collected



Fig. 1 Cupboards of the National Herbarium of Rwanda containing herbarium sheets

specimen and to link it with a GPS reference. The data will be made available via 'museum-digital' (<http://www.museum-digital.de>) and the world's largest biodiversity portal, the Global Biodiversity Information Facility (GBIF, <http://www.gbif.org>). Also, the identification of the plants can be revised if necessary as the specimens are available in a digital format. By comparing the data from the herbarium specimens with actual distribution data obtained from field work during the project, conclusions can be made whether the plant still exists or whether it has disappeared due to habitat destruction through land-use change or possibly climate change. Thus, a change of biodiversity during the last 85 years can be detected, using some selected model plant groups.

Three examples highlight the importance of the herbarium sheets. A specimen of *Impatiens niarniamensis* Gilg, collected



Fig. 2 Herbarium sheet of *Impatiens niarniamensis* collected in Nyungwe National Park in 1980

Fig. 3 *Impatiens niarniamensis* photographed at the same locality 35 years later

in Nyungwe National Park, was found and photographed at the same locality almost 35 years later (Figs. 2, 3). Another specimen from the Berlin Herbarium is one of the first specimens ever collected in Rwanda by the German botanist Johannes Mildbraed in 1907. It is a type specimen of *Impatiens purpureo-violacea* Gilg, an Albertine Rift endemic only known from eastern Democratic Republic of Congo, western Rwanda and western Burundi.

As the type specimen, which is the reference for the definition and circumscription of a species, is not in good shape, it was important to relocate it at the type locality, the source of the Nile in Nyungwe. The locality is now protected as a national park and, with fresh material, it was possible to redefine the identity of this



Fig. 4 Type specimen of *Impatiens purpureo-violacea* at the source of the Nile, Nyungwe National Park, collected in 1907

Fig. 5 *Impatiens purpureo-violacea* photographed at the same locality 108 years later



Fig. 6 The orchid *Brachycorythis friesii* disappeared in 1958 as a result of land-use change

species by also using molecular methods (Figs. 4, 5). A last example is the orchid *Brachycorythis friesii* (Schltr.) Summerh., which was once widespread in montane savanna in southwest Rwanda (Fig. 6). The last plant was collected in the 1950s and the montane savanna habitat was mostly converted into agricultural landscape during the 1990s. This probably led to the extinction of the species in Rwanda.

By evaluating all 17,000 specimens a differentiated image of historical and actual distribution will emerge that allows an analysis of the reasons of biodiversity change.



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