

CHAPTER 9

Curating xylaria

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WOOD AS A BIOCULTURAL MATERIAL

Wood is perhaps the quintessential material used in most human cultures. In prehistoric times, it was employed, either directly or indirectly, to provide most human needs: warmth, shelter, and nearly all manner of tools suitable for procuring food, water and security (Beeckman, 2003). In modern times it continues to play important roles in human cultures (Radkau, 2012). Despite its ubiquity as a technological material, it is often a surprise to the general public, and even to other biologists, that xylaria, or collections of wood specimens, exist.

XYLARIA

Throughout this chapter, the word xylarium is used in place of wood collection. This use indicates a conceptual separation between informal wood collections (e.g. a woodworker's personal set of favourite or reference specimens) and more formally organised xylaria of scientific wood specimens, which are most frequently associated with research or academic institutions and often have affiliated microscope slide collections and herbaria (Lamb & Curtis, 2005).

Unlike more traditional botanical collections (such as herbaria) or more modern collections (such as DNA libraries), wood is comparatively commonly collected by the non-botanical public, with collections ranging from a few choice pieces of favourite woods to hundreds or thousands of rigorously collected specimens. Some collections compiled by wood enthusiasts rival or surpass the scientific quality, and even quantity, of some of the more modest institutional xylaria around the world. There are wood collectors, most associated with the International Wood Collectors Society who have demonstrated botanical and organisational commitment in collecting and depositing herbarium-quality vouchers for their wood specimens. Their work in that regard justifies acknowledgement, and it is hoped that this entry into the research literature will make scientists aware of the resources available outside of institutional xylaria. This is particularly important for wood, because private, hobbyist collectors probably outnumber the professional botanists with the necessary field skills, patience and perseverance to collect wood specimens of high scientific value and quality (for Belgium and the Netherlands, see van der Dussen & Miedema, 2008).

Institutional xylaria are listed in the Index Xylariorum, first published in 1967; the fourth and most current edition is maintained online (Lynch & Gasson, 2010 (online)). It lists 158 xylaria, 81 with current information.

XYLARIUM CURATION

The simplicity of xylarium curation can be attributed to the ease of physical and botanical curation of wood specimens, and to the comparatively simple modes of loaning specimens and providing access to collections.

Specimen format

The concept of distinct wood collections first appeared in central Europe in the late 18th century, with the preparation and sale of *Holzbibliotheken*, comprising boxes made from the wood of the species concerned, and containing other parts of the tree such as dried flowers and leaves (Feuchter-Schawelka et al., 2001). The concept of a more utilitarian wood collection, destined to be sampled for wood anatomical purposes, probably dates to the mid-19th century. The Royal Botanic Gardens, Kew was collecting wood specimens of this kind from 1847 (Cornish et al., in press); many xylaria were established subsequently with a peak in the 1940s and 1950s. The typical specimen format was a piece of timber, usually lacking bark, shaped like a book and of varying size (often about 12 cm high, 8 cm deep and 4 cm wide). Although well adapted to the study of commercial timbers that predominated in the period 1850–1950, such samples are less well-suited to current research as they lack bark and only represent a small part of a tree's diameter.

Modern specimens are often from small woody plants, in which case it may be possible to cut whole pieces of stem and branch. In the case of larger trees, the specimen format will depend on whether a fallen or felled trunk is available. If it is, then an entire stem disc (cross-section) may be cut; if this will be too large, then a wedge-shaped piece (in both cases about 5 cm thick) can be cut that stretches from the centre of the trunk to the bark. Such samples enable ecological studies that rely on tree-ring width, anatomical studies looking at different parts of the xylem, and studies of the tree bark. Such specimens are far more 'future-proof' than the traditional format. If a fallen tree is not available, then a similar disc can usually be cut off from a branch without damaging the tree. Juvenile wood often differs anatomically from mature wood, however, especially with regard to quantitative features such as vessel diameter and frequency.

Physical curation

The physical curation of a xylarium is perhaps the simplest of any biological collection. Although wood exhibits dimensional change with changes in relative humidity in the environment, if wood specimens are 'dry' (i.e. a moisture content below about 20%) when they are accessioned into a xylarium, they are not particularly susceptible to biological attack, will experience few chemical changes over the course of tens to hundreds of years, and will change dimension only slightly. Provided that they are not stored in direct sunlight, wood specimens should last indefinitely under such conditions. Even when exposed to direct sunlight, only the surface millimetre of tissue is likely to be altered. In this regard, the specimens comprising the heart of a xylarium are extremely stable and forgiving materials for physical curation. Nonetheless, to avoid the risk of attack by mould or insects, or of distortion of specimens under highly variable relative humidity or temperature, wood specimens must be kept in reasonably stable environments of the kind described in Chapter 2.

Botanical curation

The botanical curation of a xylarium is quite similar to that of a herbarium, except that far fewer researchers are interested in wood specimens, so the traffic through a xylarium is proportionally less. Taxonomic inertia tends to be significant, resulting in longer retention times for entrenched taxonomic schemes and a resultant use of archaic names. A practical factor that works in synergy with the paucity of scientific visitors to xylaria is the general trend across much of the world to reduce institutional support for xylaria. With fewer professional curators, updating the taxonomic system used in a xylarium becomes an impossible task. Researchers interested in exploring the contents of



Figure 1. Specimens in drawers of (left) the Madison xylarium (MADw) and (right) the Samuel J. Record Memorial xylarium (SJRw), both in the Center for Wood Anatomy Research at the Forest Products Laboratory (FPL) in Madison. MADw was founded at the FPL by Eloise Gerry, the first female scientist in the US Forest Service. It is the active xylarium to which specimens are accessioned when new collections arrive. SJRw was formerly at Yale University and is curated as a static, memorial collection that is available for research. © ALEX WIEDENHOEFT.

a xylarium to study any particular taxon would be well-advised to approach the xylarium catalogue with a robust understanding of the synonymy in the group of interest.

The proportion of wood specimens vouchered as herbarium specimens varies greatly between xylaria. Vouchering has only become standard practice since the 1980s. Nevertheless, older specimens often derive from sources such as forestry departments or arboreta that were generally able to accurately identify trees, and a surprisingly high proportion may be vouchered by herbarium specimens (Chapter 22).

Specimen exchanges, loans and public access

Specimen exchanges and loans generally take one of two forms, either a wholesale transfer of a xylarium-sized (i.e. full-size) duplicate specimen cut from the same tree as the specimen in the donor's xylarium, or the sharing of a small sectioning block of about 1 cm³ suitable for making microscope slides. In as much as the primary function of xylaria in the past has been as repositories for specimens for wood anatomical research, the transfer of a well-prepared sectioning block is more than sufficient to provide representative material. The recipient typically provides the donor with a permanent microscope slide prepared from the block. In the USA, a number of xylaria not only failed to provide specimens, but did not respond to formal requests for sectioning blocks as recently as 2006 (personal observation). It is reasonable to assume that the xylaria that are failing to respond

are probably in legitimate danger of being discarded by the host institution, as they tend to be space-intensive. General public access to most xylaria is restricted or prohibited in line with practice for herbaria, although the robust nature of wood specimens means that they are well-suited for use in public engagement.

Digitisation of xylaria

Some biological collections such as herbaria have moved toward digitising their contents. For most scientific uses, a macroscopic scan of wood is virtually useless; the beauty of wood structure is at varying microscopic scales. The most comprehensive database of wood anatomy, *Inside Wood* (2004, online), features 7,800 descriptions and 41,437 images, made up of modern woods (6,070 descriptions, 39,112 images) and fossil woods (1,730 descriptions, 2,325 images). Other wood collections, for example at the Forestry and Forest Products Research Institute in Japan (Database of Japanese Woods, 2002, online), have placed both macroscopic and microscopic images online. Macroscopic images in books are often life-size and show the colour or grain of wood (Lincoln, 1986; Hoadley, 2000; Flynn & Holder, 2001). Digital images can be less true to colour and size, but nonetheless show the characteristic figuring of wood surfaces which can be valuable to designers and furniture historians. The labels on wood specimens can be of historic or scientific interest, and form an important resource for historians (Bowett, 2012).

Non-traditional uses of xylarium specimens

Wood anatomical studies are not the only scientific endeavours to which xylaria can contribute. Xylaria are potential storehouses of both plastid and nuclear plant DNA. The successful visualisation and extraction of DNA from long-stored specimens (Abe et al., 2011) demonstrates that xylarium specimens can serve as a source of plant DNA. Two main limitations of xylarium specimens as a source for DNA are the low DNA content of wood as a tissue, and the difficulties associated with extracting and purifying high-quality DNA from wood. The former limitation is a biological one, and must be considered on a taxon-by-taxon basis. The latter limitation is technological, solvable



Figure 2. Cabinets housing the prepared slide collection associated with MADw and SJRw, in the Center for Wood Anatomy Research at the Forest Products Laboratory in Madison, WI. Both stained and unstained slides are included in the collection. Note specimens from the Jesup wood collection atop the cabinets. © ALEX WIEDENHOEFT.

and a topic of ongoing research at a number of laboratories around the world (Asif & Cannon, 2005; Ogden et al., 2008; Lowe & Cross, 2011; Rachmayanti et al., 2009).

Wood is also a reliable source of stable isotopes for a variety of types of research, including determining the provenience of museum artefacts, understanding palaeoclimate (van Bergen & Poole, 2002; Ward et al., 2005), exploring environmental effects on physiological processes, and even tracing the origin of illegally felled trees (Kagawa & Leavitt, 2009). Xylaria, especially those with vouchered specimens with detailed collection information, are well-suited to provide a rich source of material for isotopic studies if the requisite sample sizes are small.

The value of wood as a material for making beautiful and functional objects, such as furniture, is largely taken for granted. Ebony, rosewood, mahogany, walnut and zebrawood all derive their beauty from their chemistries. In general terms, the basic chemical constituents of wood are cellulose, hemicellulose and lignin. When these constituents are the only chemicals in a wood, the wood is a whitish colour, and such whitish woods are not typically valued as highly as richly coloured woods. The non-white colours in wood are imparted by a host of secondary plant compounds, collectively known as extractives. Extractive chemistry is a rich source of information for applications similar to those in isotopic research, such as provenancing and physiology, and can only be obtained from wood; unlike DNA, no other tissue will suffice to provide specimens. Thus, xylaria are potential sources of numerous chemical compounds that would otherwise require collection from a tree *in situ*. The use of infrared spectroscopy to separate similar woods is based on variation in their extractive chemistries (Brunner et al., 1996; Tsuchikawa et al., 2003a, 2003b; Kite et al., 2010; Braga et al., 2011; Pastore et al., 2011) and such methods must be calibrated by first obtaining reference spectra, some or all of which can be collected from xylarium specimens.

Depending on the nature of the specimens in a xylarium, tree-ring data can also be available. Some xylaria have only one small specimen per accession, but in some cases, a pith-to-bark transect or even an entire stem disk is stored. In these latter cases, tree-ring data are available across the entire age of the tree. With bark present and a known collection date, such tree-ring chronologies can be accurately calibrated. Generally, xylarium specimens do not represent ancient wood, so such chronologies will not date back the thousands of years desirable for some types of tree-ring research, such as studies of the incidence of cyclical disturbances such as fires over long time frames for a region. Instead, they typically provide a range of specimens from a variety of species and sites spanning the past few decades or centuries.

THE FUTURE OF XYLARIA

General trends in xylarium longevity

The future of xylaria is an open question. As early as 1973, William L. Stern lamented the ongoing decline of institutional wood collections (Stern, 1973). Historically, most xylaria have been active only so long as they were championed by one or more researchers at an institution. With the loss of a champion, there is generally the loss of xylarium activity and sometimes loss of the xylarium itself. Many older collections have seen closure or consolidation. For example, in the past 55 years, the Forest Products Laboratory (FPL) in Madison, WI, has acquired the Yale University xylarium (the Samuel J. Record collection, last championed by William L. Stern), the Chicago Field Museum xylarium, the Jessup wood collection, and the Houghton, Michigan xylarium (Miller, 1999). It is important to note, however, that in some parts of the world, particularly in Brazil, new xylaria are being formed. It may be that rather than seeing a decline in xylaria, we are instead seeing a shift in the loci of active xylaria.

Societal benefits of xylaria and conclusions

The value of biocultural collections can be difficult to articulate to the general public, and demonstrating the tangible benefits of the expense and effort spent establishing, curating and growing such collections is an ongoing challenge for most scientists who champion them. Historically, this has been the situation at the FPL wood collection in Madison, but recent societal events have changed the dynamic for the better. With increased interest in combating illegal logging, the FPL xylarium has been approached numerous times by Federal law enforcement and Department of Justice personnel in search of scientific expertise to perform forensic identifications of wood. All such identifications depend on the strength of the reference collection supporting them; collections are central to robust, scientifically sound forensic identification and prosecution (for current perspectives, see Wiedenhoef & Baas, 2011). By means of such forensic work, it has been possible to increase awareness and acknowledgment of the scientific and social benefits of a xylarium. Demonstrating that a xylarium, with its silent, low-tech blocks of wood, has a tangible value might help to raise societal awareness of all biocultural collections so that they are curated, grown and preserved for the future.

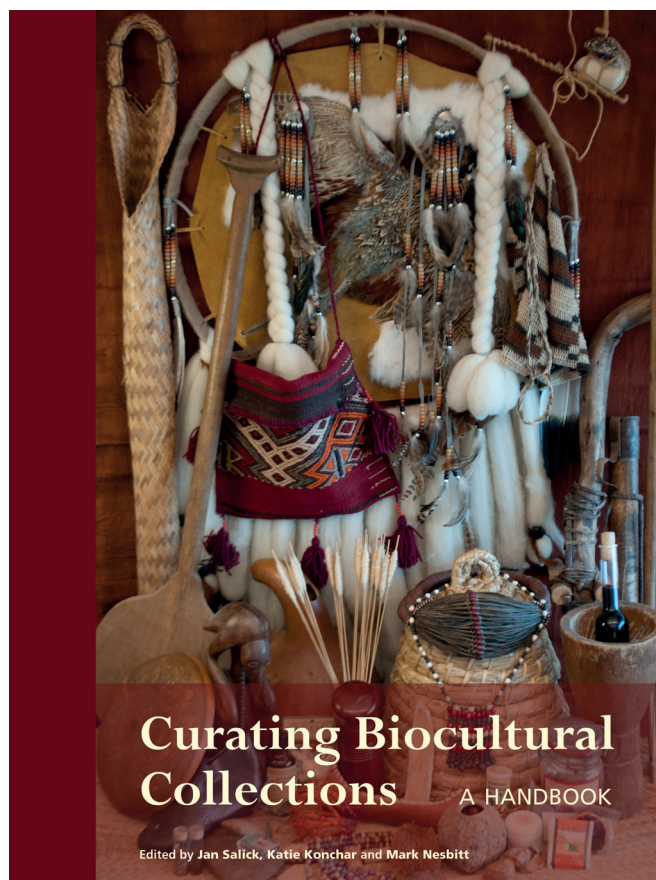
Websites

- Database of Japanese Woods. <http://f030091.ffpri.affrc.go.jp/index-E1.html>
- International Wood Collectors Society. www.iwcs.org
- InsideWood. <http://insidewood.lib.ncsu.edu/search>
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Awards and reviews

Winner Postgraduate Textbook Prize,
Royal Society of Biology book awards, 2015

Finalist Mary W. Klinger Book Award,
Society for Economic Botany, 2016

"This volume illuminates a world of work, tradition, insight and foresight. It is a "go-to" book both for young professionals...and for experienced colleagues."

Collections, Winter 2016

"...the volume should be regarded as an essential work of reference for anyone with responsibility for ethnographic collections of whatever nature."

Journal of Museum Ethnography, March 2016

"... offers a fresh way of thinking about potential implications and uses for such collections, in a more holistic way than is often achieved in multidisciplinary museums."

Journal of Historical Geography, 2015

CURATING BIOCULTURAL COLLECTIONS - A HANDBOOK

Biocultural collections document the remarkable richness and diversity of human engagements with nature. This handbook, written and edited by experts from around the world, is the first practical resource for those involved in the use and curation of such collections.

All aspects of the field are covered, from the curation of specimens, artefacts and documents to their associated reference materials and metadata. Throughout there is a strong emphasis on the needs of collection users, ethical considerations and engagement with source communities.

This book will be of interest to readers in a wide range of fields including ethnobiology, anthropology, archaeology, agriculture, botany, geography, history, zoology and museum curation. View the table of contents overleaf.

The editors

Dr Jan Salick, Senior Curator at the Missouri Botanical Garden, has helped ethnobotany become a quantitative science, international in scope and active in global policy. She is a Fellow of the American Association for the Advancement of Science and was President of the Society for Economic Botany.

Katie Konchar is a biologist and botanist with a MS degree from the University of Wisconsin-Madison. She conducts research and publishes in the areas of phytochemistry, conservation, climate change and ethnobiology. Katie was one of the lead organisers of the 2011 workshop on Biocultural Collections from which this book originates.

Dr Mark Nesbitt is curator of the Economic Botany Collection at the Royal Botanic Gardens, Kew. His research interests centre on botany and empire in the nineteenth century, and on the history and current day management of botanical collections.

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