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Xylotheque of the Federal University of Amazonas

Dr. Valmir Souza de Oliveira Collection

ECO & COMPANHIA

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UFAM
Federal University of Amazonas
Forest Sciences Department
Wood Physics Laboratory

Xylotheque of the Federal University of Amazonas

Dr. Valmir Souza de Oliveira Collection

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FORESTRY UFAM 30 YEARS

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PACE
Extension Curricular Activity Program

PROEXTI
Pró-Reitoria de Extensão e Interiorização

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Presentation

The first contact with sites that keep scientific collections is always charming. When I entered college, in the first or second period, I had the opportunity to study at the Zoology Laboratory of the Federal University of Amazonas, where we would attend classes in the midst of animal skeletons, fish swimming in aquariums, drawers lined with collections of insects and a large emerald tree boa (Corallus caninus), which lay in an outer area and which, to our good fortune, had little interest in us. Until then, I considered those classes the best moments of the course I was beginning, either by the curiosity that all this aroused, or by the wonderful bonuses about the natural world with which the prof. Paulo Buhrnheim (in memorian) gave us, in detailed explanations, after school, about everything that surrounded us. Or, to see materialized there in front of us, what we only tried to capture in photos in the zoology books: the enormous dental arch of a shark, the skeleton of a wolf, and even an electric fish that was dozing during class, in its tank.

I had the same feeling when I was able to do my first internship in wood anatomy at the Xylotheque of the National Institute for Amazonian Research. I was honored to be there, it is a respectable, organized collection, and I knew that in those wood samples there was a bit of the life of everyone who had donated their time to the composition of that collection.

These collections are important not only to arouse the scientific interest but to actually perform science. These samples work as books and, together, they become encyclopedias of the natural world, containing thousands of information that can be read, interpreted and compared, providing data that helps us better understand the dynamics of our planet and make decisions that ensure the continuity of life of these species.

Interestingly, some countries hold voluminous collections of wood, even possessing small territorial areas, which harbor modest forests and in general, with low biodiversity. In Belgium is located the Royal Museum for Central Africa, in Tervuren, where there is a collection that begun at the end of the XIX century, with more than 60 thousand samples of woods, of 14 thousand different species. The explanation for the accumulation of such diversity lies in the fact that at this time King Leopold II maintained the territory of the Congo as a kind of Belgian colony in Africa, where he extracted, among other natural riches, noble woods. The aim of the collection at first, was to convince the Belgian population and the economic sector about the advantage of having a colony in Central Africa, much later, it changed to a scientific purpose (Becherman, 2003). In Madison, in the United States, the largest collection of wood in the world is located, with more than 100 thousand samples, most of which are obviously from other countries. In Brazil, a country with huge biodiversity, the

Technological Research Institute (IPT) in São Paulo, is the institution that owns the largest collection of wood with around 20 thousand samples, it started in 1930, a century of activity. In the State of Amazonas, which among the Brazilian states, is the one that holds the largest portion of native tropical forest in Brazil, the National Institute for Amazonian Research (INPA) began its collection in 1954 and has about 11 thousand samples in over 60 years of work. If we compare these four cases, in a way, we will note the amount of investment these countries have made to maintain and expand their scientific collections, one prioritizing the training of technicians and infrastructure more adequately than others.

Unfortunately, in Brazil, wood collections (xylotheques) still suffer from the change of public policies that little or no resources offer to maintain these collections, even resulting in the risk of their permanent loss, either by the death or even retirement of their employees and by not hiring immediately new staff to replace those absents. In this context, in general, the physical facilities and technological resources in these spaces are deficient, from the absence of essential equipment such as dehumidifiers, improvised samples storage and even the absence of trained personnel to take care of the collections.

Contrary to this scenario, it is part of the routine and mission, whether the professional from research institutes or the professor from higher education institutions, to continue investing effort, time and dedication in the creation, maintenance and expansion of these collections.

Recalling what I wrote in the first paragraphs, when I became a professor at the Federal University of Amazonas, years later, I paid special attention to our collection of woods, mainly in the sense of making it more attractive for undergraduates and visitors to where they are. In 2012, I received in the Laboratory of Physics of Madeira the illustrious visit of Dr. Nair Aguiar, who was one of my teachers in the discipline of zoology, about which I commented. I showed her the collection and told her the same story I am now narrating, that I relied on the idea that just as that memorable collection of zoology inspired me to learn more if we also had a good collection of wood samples, we could arouse curiosity in students and the desire to learn more about technology. She was surprised and gratified, as we were facing a real example of successful experience being replicated, leading more people to its benefits. I believe that there is still much to be done, but I note that the result so far has aroused the students' interest, evidently perceived in the many questions they ask about the items in the collection and in the selfies they publish on their social networks. woods as background. More than this, several monographs and scientific works have already been developed, subsidized by the knowledge that has been acquired over the years with the xylotheque. And probably many others will still benefit from this collection in the years to come.

With the publication of this work, I hope that the history of the xylotheque is known and its importance is recognized. Furthermore, it awakens in the readers the feeling of zeal, both for constituting a patrimony that is public and therefore belongs to all, and for the scientific value that, over the years and addition of new samples, will certainly increase.

Francisco Tarcísio Moraes Mady
Organizer, January 31, 2017

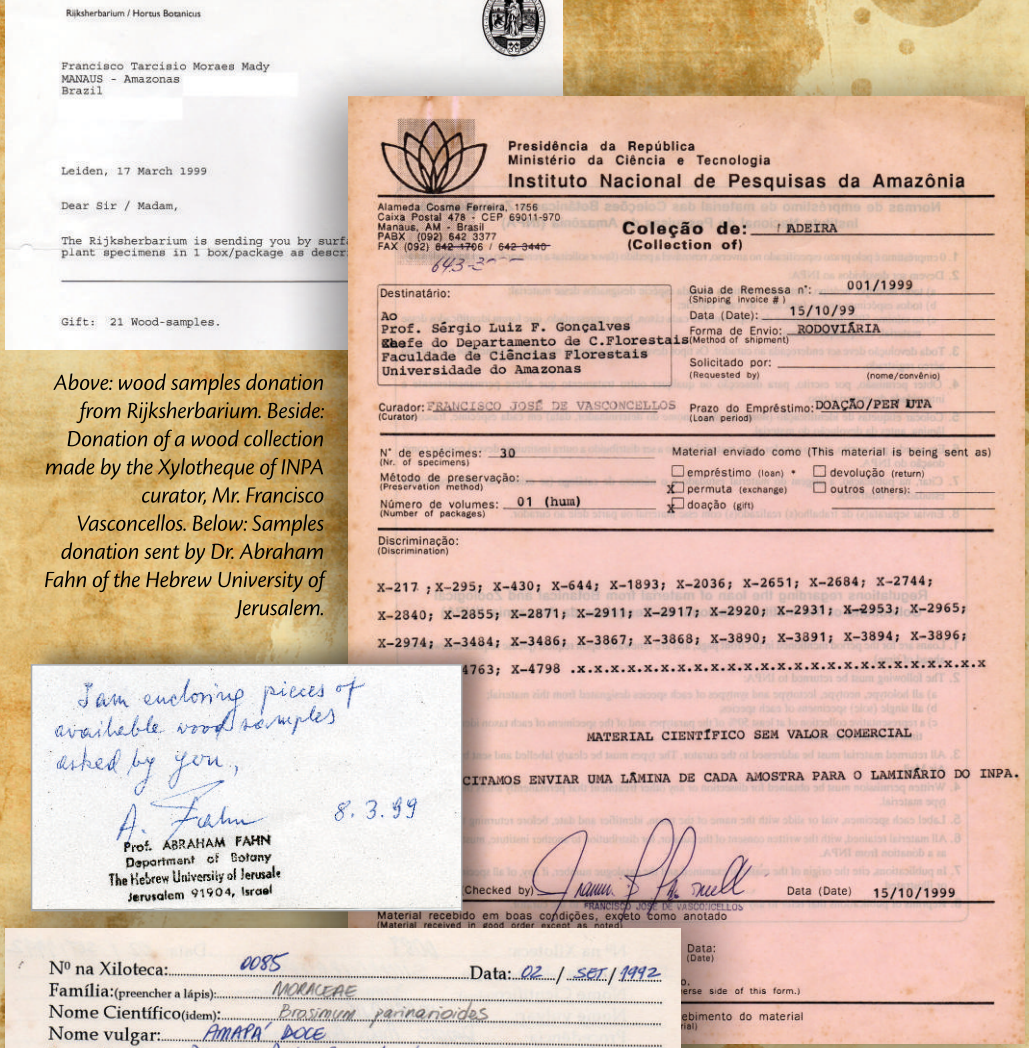
To the professors Dr. Eduardo Coutinho da Cruz, Dr. Valmir Souza de Oliveira, Dr. Lizit Alencar da Costa and to Mr. Claudinez de Lima Chaves (the Nei), we dedicate *in memorian*

A brief history

The Forest Engineering program of the Federal University of Amazonas was created in 1987 through resolution 003/87 - CONSEP / UFAM, with the first admission of students in 1988. The program is divided into 4 areas of concentration: silviculture, forest management, nature conservation and wood technology. Among the courses in wood technology, the first one to take place is Anatomy and Identification of Amazonian Woods. When recently created, the Forest Engineering program was still being organized and had only three teachers in the technology area: Valmir Souza de Oliveira, who had returned from his doctorate at the University of Wales, Wales, Nabor da Silveira Pio and Fernando Cardoso Lucas Filho, all forest engineers graduated by the agreement between the Federal University of Amazonas (UFAM) and the Federal University of Paraná (UFPR). At the end of 1991, there were positions available at the Federal University of Amazonas to hire approximately 40 laboratory technicians. One of these vacancies was a technician in Wood Anatomy, in which Francisco Tarcísio Moraes Mady was approved, at the time a new student of the Forest Engineering program. After his appointment, a training course was offered at the National Institute of Amazonian Research Institute (INPA), in order to train the server for the role it would play. The tutors were Francisco José de Vasconcellos and Jorge Alves de Freitas, both researchers and wood anatomists. INPA's xylotheque is one of the most important collections of Amazonian wood in the world, accounting for about 11 thousand samples. Among the contents covered, it prevailed the macroscopic identification and the xylotheque organization. After the internship, in March 1992, a small collection of wood samples was started for the UFAM Forest Engineering program, with samples mostly from the Amazon region and a few were conifers. At the moment, there were still no records of these samples, only the material that would compose the collection was collected. A percentage of these initial pieces were donations from teachers, some were from the forest incursions of the program courses and others were donated by INPA anatomists. Only on July 28, 1992, the collection began, with the record of the first sample of the xylotheque, a small piece of itauba wood (*Mezilaurus itauba* (Meisn.) Taub, ex Mez, Lauraceae).

Also in the same year, the Forest Engineering program acquired a microtome, an apparatus that allows the wood to be cut into slides of microscopic thickness, which would allow the study of details of the anatomy only visible under the microscope.

In 1995, there was the opportunity of a new internship, this time at Dr. Calvino



Rijksherbarium / Hortus Botanicus

Francisco Tarcisio Moraes Mady
MANAUS - Amazonas
Brazil

Leiden, 17 March 1999

Dear Sir / Madam,

The Rijksherbarium is sending you by surf
plant specimens in 1 box/package as descr

Gift: 21 Wood-samples.

Presidência da República
Ministério da Ciência e Tecnologia
Instituto Nacional de Pesquisas da Amazônia

Alameda Cosme Ferreira, 1756
Caixa Postal 478 - CEP 69011-970
Manaus, AM - Brasil
PABX (092) 642 3377
FAX (092) ~~642 1706~~ / ~~642 3440~~
643-2...

Coleção de: ...ADEIRA
(Collection of)

Destinatário:
Ao
Prof. Sérgio Luiz F. Gonçalves
&hefe do Departamento de C.Florestais
Faculdade de Ciências Florestais
Universidade do Amazonas

Guia de Remessa nº: 001/1999
(Shipping invoice #)
Data (Date): 15/10/99
Forma de Envio: RODOVIÁRIA
(Method of shipment)
Solicitado por:
(Requested by) (nome/convênio)

Curador: FRANCISCO JOSÉ DE VASCONCELLOS
(Curator)
Prazo do Empréstimo: DOAÇÃO/PER UTA
(Loan period)

Nº de espécimes: 30
(Nr. of specimens)
Método de preservação:
(Preservation method)
Número de volumes: 01 (hum)
(Number of packages)

Material enviado como (This material is being sent as)
☐ empréstimo (loan) ☐ devolução (return)
X ☐ permuta (exchange) ☐ outros (others):
X ☐ doação (gift)

Discriminação:
(Discrimination)

X-217 ; X-295; X-430; X-644; X-1893; X-2036; X-2651; X-2684; X-2744;
X-2840; X-2855; X-2871; X-2911; X-2917; X-2920; X-2931; X-2953; X-2965;
X-2974; X-3484; X-3486; X-3867; X-3868; X-3890; X-3891; X-3894; X-3896;
4763; X-4798 .x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x

MATERIAL CIENTÍFICO SEM VALOR COMERCIAL

CITAMOS ENVIAR UMA LÂMINA DE CADA AMOSTRA PARA O LAMINÁRIO DO INPA.

Checked by: FRANCISCO JOSÉ DE VASCONCELLOS Data (Date) 15/10/1999

Material recebido em boas condições, exceto como anotado
(Material received in good order except as noted) Data: (Date)

...erse side of this form.)

...ebimento do material
...rial)

I am enclosing pieces of
available wood samples
asked by you.

A. Fahn 8.3.99

Prof. ABRAHAM FAHN
Department of Botany
The Hebrew University of Jerusale
Jerusalem 91904, Israel

Nº na Xiloteca: 0085 Data: 02 / SET / 1992
Família: (preencher a lápis): MORACEAE
Nome Científico (idem): Brosimum parinarioides
Nome vulgar: AMAPÁ DOCE
Procedência: Doação Prof. Fernando Lucas
Coletor:
Determinante (preencher a lápis):
Observações: MADEIRA DE COR CREME, POROS VISÍVEIS A OLHO NU, SEM CHEIRO OU GOSTO.

A amostra possui:
☐ lâminas ☐ duplicata ☐ corpo de prova ☐ foto micro ☐ foto macro
A amostra posui material botânico do: ☐ herbário /UA ☐ herbário/INPA

Nº na Xiloteca: 0086 Data: 02 / SET / 1992
Família: (preencher a lápis): LAURACEAE
Nome Científico (idem): Ocotea cymbarum
Nome vulgar: LOURO INHAMUÍ
Procedência: Doação Prof. Fernando Lucas
Coletor:
Determinante (preencher a lápis):
Observações: Madeira castanho claro, odor característico fácil de cortar.

A amostra possui:
☐ lâminas ☐ duplicata ☐ corpo de prova ☐ foto micro ☐ foto macro
A amostra posui material botânico do: ☐ herbário /UA ☐ herbário/INPA

Above: wood samples donation from Rijksherbarium. Beside: Donation of a wood collection made by the Xylotheque of INPA curator, Mr. Francisco Vasconcellos. Below: Samples donation sent by Dr. Abraham Fahn of the Hebrew University of Jerusalem.

Beside: Sheet of the register book from the xylotheque with the entries of September 2, 1992. The sample 0086 was donated by Prof. Fernando Cardoso Lucas Filho.

UNIVERSIDADE FEDERAL DO AMAZONAS
Faculdade de Ciências Agrárias
Departamento de Ciências Florestais

Ofício 011/2009

Manaus, 12 de fevereiro de 2009

Ao Ilmo Prof.
Dr. Julio Cesar Rodriguez Tello
Chefe do Departamento de Ciências Florestais

Prezado Professor

Encaminho em anexo o projeto **CRIAÇÃO DA XILOTECA DA UNIVERSIDADE FEDERAL DO AMAZONAS** para que seja submetido aos trâmites de escolha de relator e subseqüente aprovação em reunião do departamento.

Certo de sua compreensão e atenção para com o assunto, agradeço antecipadamente.

rcísio Moraes Mady
ecnologia da madeira

orcísio Moraes Mady
Florestal CREA
FEDERAL DO AMAZONAS

Recebido em
16.02.09

UFAM

UNIVERSIDADE FEDERAL DO AMAZONAS
CONSELHO DE ADMINISTRAÇÃO

UFAM 100 anos

RESOLUÇÃO 018/2009

A REITORA DA UNIVERSIDADE FEDERAL DO AMAZONAS e PRESIDENTE do CONSELHO DE ADMINISTRAÇÃO, no uso de suas atribuições estatutárias,

CONSIDERANDO o Proc. nº. 023/2009 – CONSAD;

CONSIDERANDO o Oficio nº 145/2009 – GD/FCA, de 01.10.2009;

CONSIDERANDO a Ata do Conselho Departamental da FCA que aprovou a criação da Xiloteca vinculada à Faculdade de Ciências Agrárias/UFAM;

CONSIDERANDO o Parecer do Relator, aprovado por unanimidade, realizada nesta data,

RESOLVE:

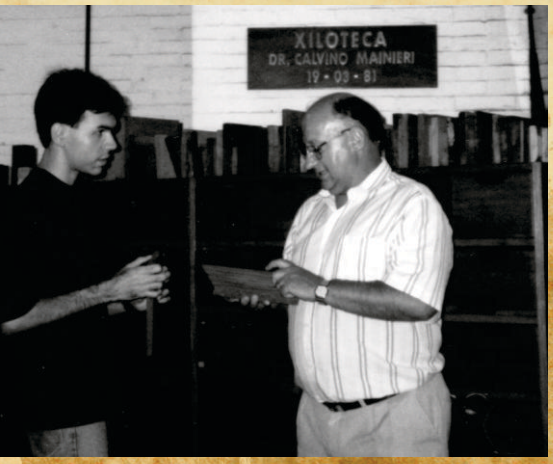
HOMOLOGAR a criação da **Xiloteca** intitulada **"Coleção Dr. Valmir Souza de Oliveira"**, vinculada à Faculdade de Ciências Agrárias / UFAM.

PLENÁRIO DOS CONSELHOS SUPERIORES da UFAM "ABRAHAM MOYSÉS COHEN", em Manaus, 11 de novembro de 2009.

Márcia Perales Mendes Silva
Presidente

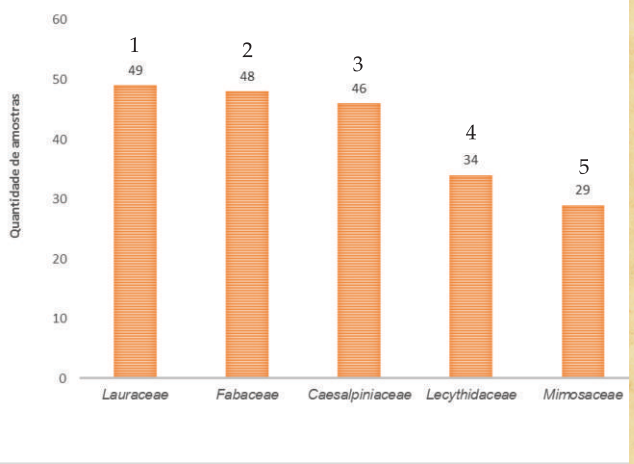
Above: Copy of the official letter that sent the project to create the xylotheque on February 17, 2009. On the left: Facsimile of resolution 018/2009 that approved the xylotheque creation of the Forest Engineering program at Federal University of Amazonas, in November 11, 2009.

Above: Francisco Vasconcellos (wearing blue) and Jorge Freitas, in the Xylotheque of National Institute for Amazonian Research (2017).



Above: January, 1995: Internship of the technician Francisco Tarcísio in the Xylotheque Dr. Calvino Mainieri, of the Technological Research Institute, in São Paulo. On the left, with Dr. João Peres Chimelo and, on the right, with the technician Antônio Carlos Franco Barbosa.

Xylotheque team that collaborated with this publication (from the left to the right): Jeandria Picanço, Pillar Pena, Lauana Costa, Miza Bentes, Igor Corrêa, Israel Silva Jr., Adriano Silva, Guilherme Modolo, João Wezen, Prof. Francisco Tarcísio and, seated, Dina Karen, Dália Oliveira and Diulio Torres.



Beside: The botanical families with the largest number of representatives in the Xylotheque of UFAM: Lauraceae (1), Leg. Faboideae (2), Leg. Caesalpinioideae (3), Lecythidaceae (4) and Leg. Mimosoideae (5). Besides these, the families Myristicaceae, Pinaceae, Fagaceae, Anacardiaceae and Meliaceae soon appear as the most well represented.

Mainieri xylotheque, from the Technological Research Institute of São Paulo (IPT), focused on the macroscopic identification and the preparation of wood slides for microscopy. The Xylotheque Dr. Calvino Mainieri is the most important in the state of São Paulo and the largest in Brazil. Started in 1930, the collection gathers about 19,500 samples of Brazilian and foreign woods, and about 15 thousand histological slides. The internship took place in January, with a duration of 30 days, and was supervised by Dr. João Peres Chimelo and by the technician Antônio Carlos Franco Barbosa. At the time, IPT donated a considerable amount of samples to the Xylotheque of UFAM.

In the meantime, several samples were added by professors form the Forest Engineering program, such as those from number 193 to 197, from Japan, donated by Prof. Eduardo Coutinho da Cruz (deceased) and those from 242 to 274, donations from the Laboratory of Forest Products (LPF) of IBAMA, in Brasilia, brought by Prof. Valmir Souza de Oliveira (deceased), who visited his premises in 1995. In addition, several samples were brought by other collaborators, among them Mr. Pedro Marinho, botanical identifier of the forestry course, who occasionally collected a piece of wood in his incursions in the woods, and brought to compose the collection. Eventually, students and visitors also donated some pieces, such as the Spanish Forest Engineer student Maria Paz Cornes, who graduated from the Anatomy Laboratory of Madeira in 1995 and, when she returned home, sent samples of native wood from her region, registered under the numbers 331 to 342.

Until then, both the microtome and the small collection, housed in a modest wooden cabinet, were provisionally allocated in a microbiology laboratory in the former "F" block of the Faculty of Agrarian Sciences. Only after the construction of the Wood Physics Laboratory in block V of the UFAM mini-campus (now known as the Southern sector) in 1995 was it possible to better accommodate what had already been gathered.

From then on, an exchange with other institutions began with a view to increasing and diversifying the collection. Requests were sent to various research institutions in wood technology, in Brazil and abroad, requesting donation or exchange of samples. The collection received donations from the Hebrew University of Jerusalem, through Prof. Abraham Fahn from the botany department. Among the samples received, there were some species with unusual anatomical characteristics, such as wood of the genus *Ephedra* and *Suaeda*. Several samples came from the Institute of Ecology in Veracruz, Mexico, mainly from the genus *Pinus* and *Quercus*. In 1999 the

Rijksherbarium of the Netherlands sent 21 wood samples, registered under numbers 375 to 395. The National Institute for Amazonian Research, located in Manaus, made two more donations in 1997 and 1999, totaling more than 50 samples.

The wood collection of the Forestry Engineering program at UFAM, from its beginning, had as objective to attend the discipline of Wood Anatomy. There was never an expectation about the quantitative, but about the diversification, trying to include species with characteristics previously known only in the literature and, from the entry into the collection, increased the possibility of learning. In this context, Prof. Valmir was undoubtedly the great incentive for the creation of a collection of wood that would adequately attend to the program and students' formation, since anatomy is the key to understanding phenomena related to wood. With his demise, in January 2008, there was a position available, this time for professor in Wood Technology. After the exams, Francisco Tarcísio, after 16 years in the position of technician, graduated as a forest engineer and with a master's degree, was approved for the position of professor, assuming the Wood Anatomy and Identification course and continuing the collection. In 2009, following the policy of donation and exchanges with other institutions, the xylotheque received from the Forestry and Forest Products Research Institute of Japan a donation of 146 Asian wood.

Still in 2009, Prof. Francisco Tarcisio wrote the creation project of the Federal University of Amazonas Xylotheque and sent it on February 12 to Prof. Julio César Rodríguez Tello, head of the Forestry Sciences Department, for arrangements. On November 11 of that same year, resolution 018 was published, approving the xylotheque creation, signed by the rector Márcia Perales Mendes Silva.

In 2016, there was a reorganization of the xylotheque, with a purchase of cabinets, production of drawers, and a collection inventory. 800 wood samples were received, from Coari municipality, in the Amazonas, donated by the herbarium of the Federal University of Amazonas, which are being incorporated into the collection. In addition, a public database was created on the Internet at xiloteca.ufam.edu.br, where you can check the existing samples online.

Collection Status

The Valmir Souza de Oliveira collection is divided into 4 sub-collections:

1. Xylotheque samples collection, which counts up to the date of this publication, 1,000 wood samples registered and about 800 samples received in 2016 in the process

of registration. Among the registered ones, they represent 106 wood producers botanical families, which appear with greater number of representatives: Lauraceae, Leguminosae Faboideae, Leg. Caesalpinioideae, Lecythidaceae and Leg. Mimosoideae, followed by Myristicaceae, Pinaceae, Fagaceae, Anacardiaceae and Meliaceae.

2. Wooden objects and non-wood products collection, in permanent exhibition, which is currently composed of about 240 items, such as: solid wood cubes, tree stalks, woody fruits, xylophagous fungi, oils, resins and larger pieces which are used in exhibitions and as a permanent showcase for students from courses of Wood Anatomy and Identification, Wood Chemistry, Wood Physics, Wood Preservation, among others.

3. Xylem slides collection, with approximately 300 units of several species from Brazil and abroad.

4. Wood collection for practical classes, consisting of more than 2,000 samples, comprising almost 100 commercial species, which are used in classes, training and courses for Amazonian wood identification. In this collection, handling in general is allowed, including cut of fragments for odor and/or flavor perception.
The xylotheque also has a collection of duplicate samples woods for donation and exchange.

Dr. Valmir Souza de Oliveira

Professor PhD Valmir Souza de Oliveira was part of the staff of the Federal University of Amazonas since 1979, when he started his position, due to the agreement between Federal University of Amazonas (UFAM) and Federal University of Paraná (UFPR). He took a great responsibility with his fellow professors, Dr. Eduardo Coutinho da Cruz and Luiz Joaquim Bacelar de Souza, in the creation and implementation of the Forest Engineering program at UFAM in 1987 (Resolution No. 003/87 of the Teaching, Research and Extension Council - CONSEPE).

Graduated in Forest Engineering from the Federal University of Paraná in 1978, he completed his master's degree at the same institution in 1982, and in 1990 he completed his PhD in Wood Sciences from University of Wales.

Always acting in the undergraduate level, he was deputy director of the Agricultural Sciences Faculty, head of the Forestry Sciences Department and academic coordinator of the Forest Engineering program at UFAM. Besides being tutor of the Tutorial Education Program (PET) in the Forest Engineering program, for a period of 11 years, to which he dedicated himself in a selfless way.

With extensive experience in the field of Forest Resources, Technology and Forest Resources Usage, he provided relevant services to society as a member of the Regional Council of Engineering and Agronomy of the Amazonas State (CREA), acting as coordinator of the Specialized Agronomy Assembly and Regional Council, in the period from 2005 to 2007.

He died in a traffic accident, on the AM-010 road, on January 16, 2008, on the way to a lumberyard in Itacoatiara, a municipality in the state of Amazonas, where he would participate in a technical visit with his class of Forest Engineering students from UFAM.

Adapted from the text kindly provided by professors Dr. Luiz Bacelar and Marciléia Lopes, Msc., from the Department of Forest Sciences - UFAM.

Above: A technical visit in 1998, to a forest managed area of a forestry company in the Manicoré municipality, State of Amazonas. Prof. Valmir accompanying the process of cutting and felling (left). Francisco Tarcísio (at that time wood anatomy technician) and Prof. Valmir (right).

Above: I Forest Engineering Week at the Federal University of Amazonas in 2001. Prof. Valmir next to Senator Jefferson Peres (left) and among students, in the exhibition of scientific work during such event (left).

Pinus elliottii Elgelm *disk. The collection at UFAM has the aim of attending to the classes of the wood technology area in the Forest Engineering degree, always seeking the greatest possible diversity in the collection, which contains samples of conifers and hardwoods.*

Items from the Dr. Valmir Souza de Oliveira Collection: collection of xylophagous fungi (above) and part of the wood showcase in permanent exhibition at the Wood Physics Laboratory of UFAM (below).

Above: Student volunteers work in the xylotheque: Antônio Linhares and Dina Karen register new samples for the collection (2016). Below: samples from the Dr. Valmir Souza de Oliveira collection with a registration number in the xylotheque.

What a xylotheque is

Xylotheque is a word of Greek origin, where *xylon* means wood and *theka* means box, collection. Thus, xylotheque means a collection of woods. The value of these collections, organized with the objective of increasing the scientific and economic knowledge of wood, is invaluable, since it allows the identification of species by comparison with the existing collection, as well as gather in one place a considerable amount of information, which helps supporting new research.

The xylotheque should be a properly designed and built place to hold a collection of wood samples, arranged to easily find each unit that makes up the collection.

A xylotheque may contain samples of wood from one or more geographical regions, which serve as a reference for the identification of other woods, as well as being a tool for information consultation. In addition, it is a source of important material to assist professionals from different areas, both national and foreign, in the solution of taxonomic, anatomical, phylogenetic, ecological, technological, silvicultural, management and forest inventories problems (Fonseca *et al*. 2005).

According to Hernández (2009), the purpose of the xylotheque is to have a collection of wood samples, which serve as the basis for scientific studies of different applications, and also aims to serve as reference material for comparisons. Researches in the wood technology and related areas can be subsidized by the existing collections in the xylotheques, as these can contribute to the accomplishment of thesis, dissertations, monographs, research projects, practical classes and to the aid of the correct identification of species, including those whose cutting is prohibited, thus helping to comply with current legislation and principles of forest management.

These researches, according to Hernández (2009), have covered several fields that relate wood anatomy with taxonomy, wood technology, ecoanatomy, art work restoration and, more recently, dendrochronology.

According to Barros and Coradin (2015), to check the quality of a xylotheque, two points are fundamental: number of specimens and diversity. Considering the number, stand out the collections Dr. Calvino Mainieri Xylotheque, in the Technological Research Institute of São Paulo State S.A. - IPT (BCT) and the National Institute for Amazonian Research (INPA) Xylotheque.

A xylotheque serves several research segments related to dendrochronology, climatology, chemistry and microbiology, which seek to better understand the exchange activity, formation of growth rings, climatic variations of the past, coloration due to deposition of tannin, resins, carbohydrates and other substances,

and enzymatic degradation of certain structures caused by xylophages. Besides these, several studies, in several areas of human knowledge, can be carried out using the collection of a wood shop as a basis for comparison: technological studies of the wood aiming at its best use; determination of the tree flora of a geological era in paleontological studies; better understanding of phylogenetic relationships between plants; changes in the environment that directly influence the formation of wood cells, caused by rising or falling temperatures, acid rain, pollutant gases and several other factors; species identification in floristic inventories which no fertile material was obtained; wood identification used by ancient societies in archeological studies, among many other possibilities.

What wood is

Conceptually, wood is an organic tissue, plant origin, result of special cells division, called meristematic cells, present in the stem of the trees, in a region called vascular cambium. The wood is composed from xylem cells, and is present in the trunk, in the roots and in the branches of the trees. Palm trees, for instance, lack cambium therefore, they neither have secondary growth nor form wood.

The wood consists basically of a permeable system, formed by microscopic channels arranged vertically and horizontally, where the water and minerals from the roots are directed to the crown. It is a material that presents considerable rigidity with respect to its maximum density of 1.53 g / cm^3. As far as the aesthetic aspect, it is incredibly diverse, presenting numerous variations of color, texture, figure formation and brightness. It is relatively easy to work with and can be cut and processed with simple tools.

The wood is also heterogeneous, anisotropic and hygroscopic, properties that make it a unique material and object of varied studies in order to understand its behavior and optimize its use. Heterogeneity, anisotropy and hygroscopicity are factors that cause a series of problems in the industry, when the use of methodologies that minimize these undesired effects are not considered.

The wood is obtained from 2 large vegetable groups: conifers (which are popularly known as pines) and hardwoods. Conifers are important species of wood and resin producers. From the structural point of view, conifers wood is much less complex than hardwoods, composed by tracheids and parenchyma cells combination that form the rays. Tracheids are elongated and generally vertically oriented cells responsible for the support and conduction of water and minerals from the root to the leaves. The radial parenchyma comprises a set of cells arranged horizontally from the bark to the pith.

The hardwoods appeared about 125 million years ago, with great morphological and physiological alterations, especially in the conductive tissue, allowing the appearance of new cells types specialized only in sustentation and others only in conduction (fibers and vase elements, respectively), resulting in a more complex and more efficient sap transport.

The wood presents a three-dimensional structure and can be visualized in three planes oriented with respect to the vertical axis of the tree:

Transverse plane - corresponds to the extremities, in other words, the top and bottom of a wood segment. In this plane, it is possible to see the pores, which are the openings

or lumen of the raw sap conducting cells, known as vessel elements. It is possible to see the axial parenchyma and the lines formed by the ray cells. The macroscopic identification of wood is mainly based on observation of the transverse plane.

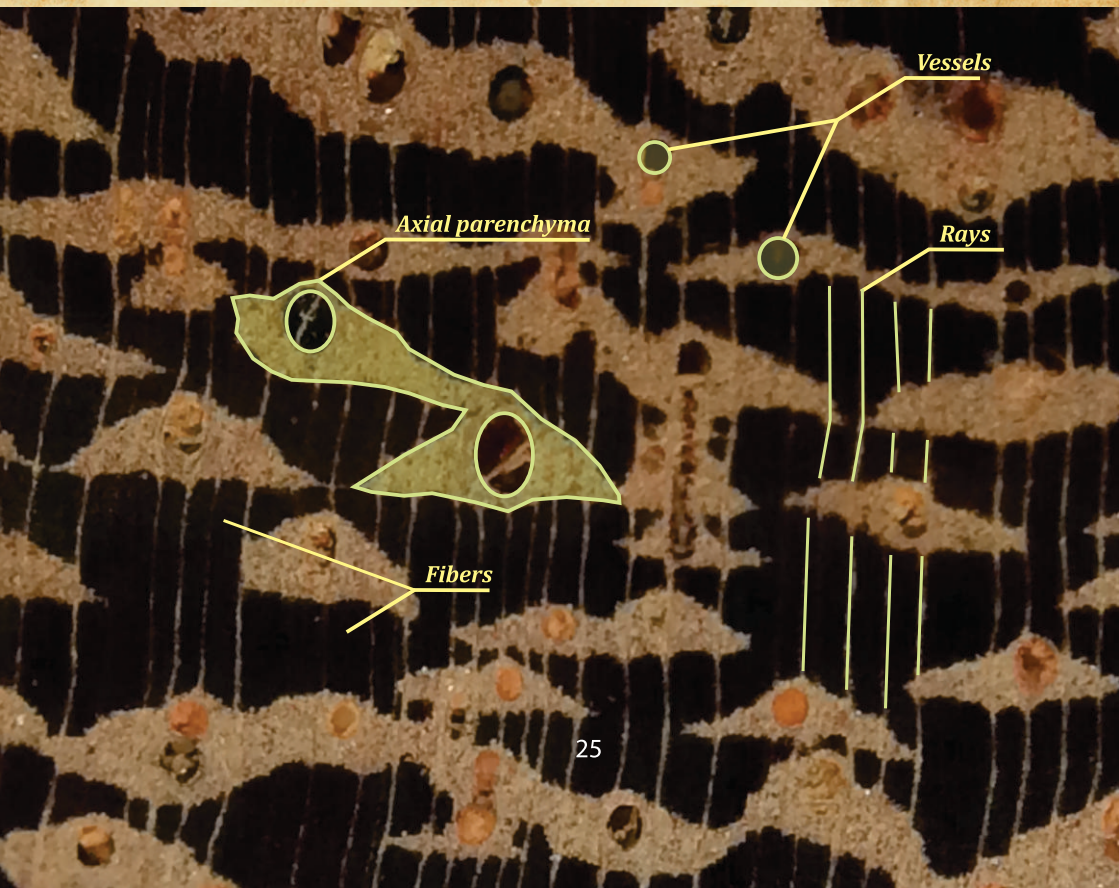
Radial plane - is the plane parallel to the ray lines. In the radial plane it is possible to see the set of ray cells and vascular lines.

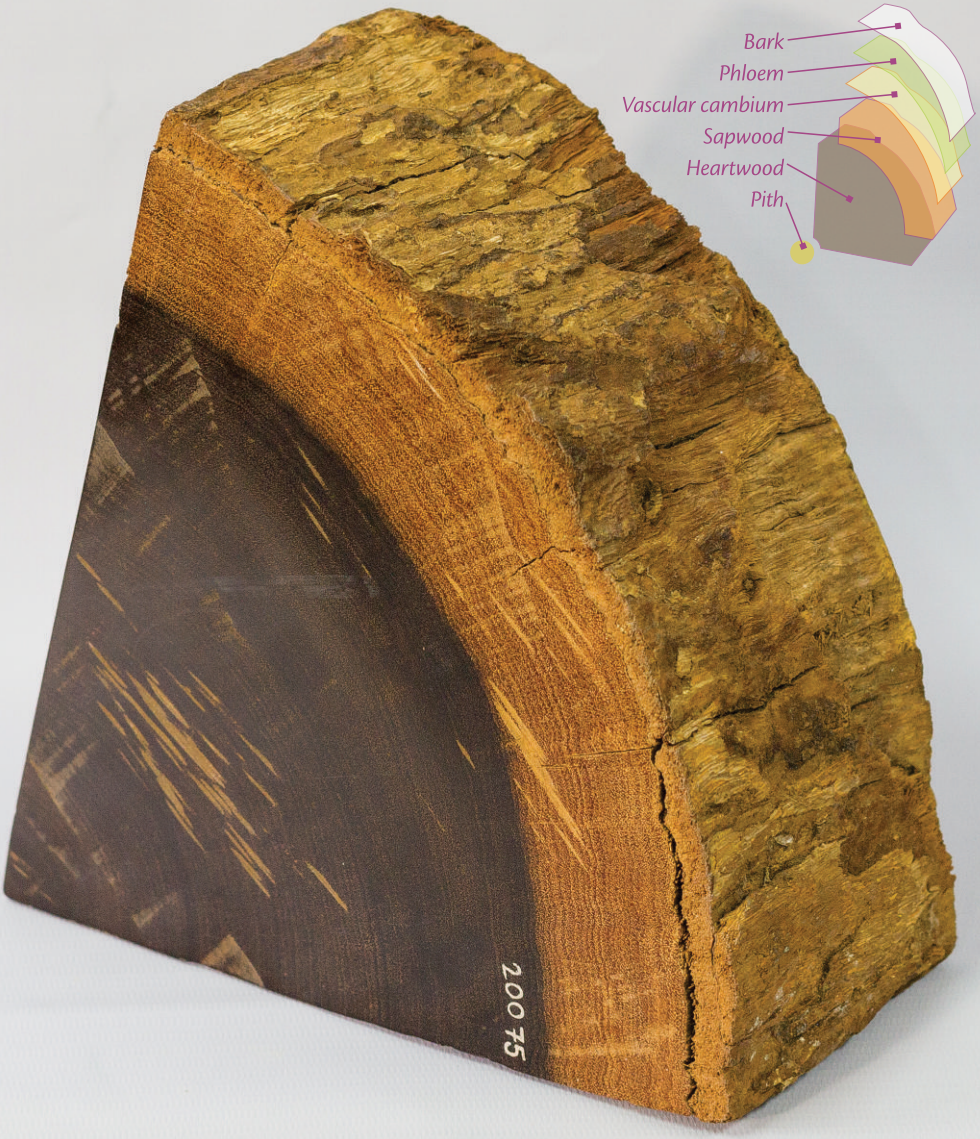
Tangential Plane - It is the plane that tangents the growth layers, being possible to notice the rays opening, if they are low or high, if they are arranged in stratified layers or not. You can also see the vascular lines.

From the chemical point of view, the wood is basically composed of cellulose, hemicellulose and lignin. These three substances are of great importance to the planet and the man, serving as a structural component, source of food for other species and even in the global economy, when marketed in the form of wood. Other chemical substances that participate in the composition of the wood are the extractives, such as pigments, tannins, terpenes, greases, waxes, phenolic compounds, among others.
The stem of a tree has six distinct layers from outside to inside: the bark, the phloem, the vascular cambium, the sapwood, heartwood and pith. From these, the sapwood and heartwood make up the wood we use. The sapwood is the most peripheral region of the stem, younger and lighter in color. The heartwood is the most central, oldest, durable, and usually darker region. Both are differentiated, among other characteristics, by the color, permeability and level of physiological activity. In general, the more intense the color of the core, the less permeable it will be, as the color intensification derives from the oxidation of substances stored in the wood, aging and obstructions caused by the accumulation of organic compounds inside the cells. Some species do not present this differentiation of tonality between heartwood and sapwood, possessing what is called a physiological or physiologically active heartwood.

Beside: strobile, the cone-shaped structure that gives the conifers a name. Part of the sub collection that is permanently exhibited in the Wood Physics Laboratory/FUA

Below: Transversal section of red sucupira (Andira parviflora Ducke*). It is possible to visualize the parallel vertical lines formed by ray cells, the pores (some obstructed by organic content), the paratracheal axial parenchyma surrounding the pores and fibers (the entire area blackened in the photo). Sample registered under number 561 in the xylotheque of FUA. Large Image 40x.*

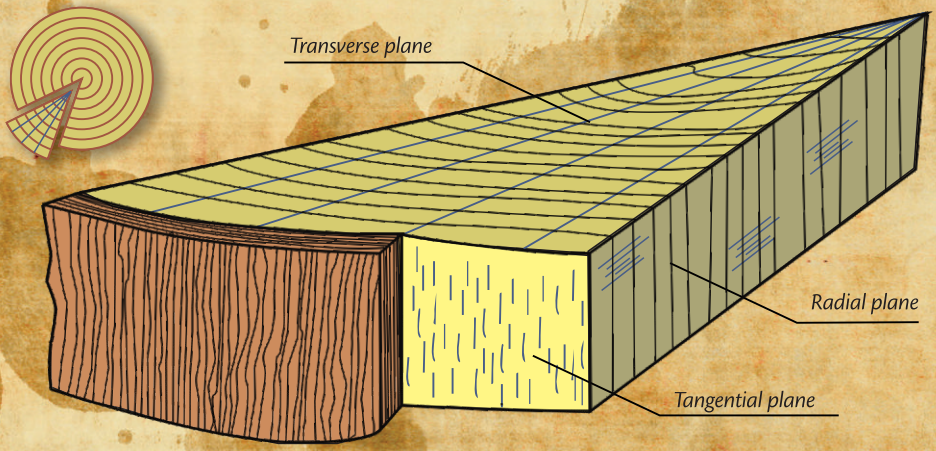




Above: Rosewood (Aniba canellila (Kunth) Mez). The stem of a tree has 6 layers: the bark, the phloem (where the elaborated sap circulates), the vascular cambium, the sapwood (the most yellowish wood layer in this species), the heartwood (blackened portion) of the stem, the medulla, which is a remnant of the tree's primary growth. Part of the sub collection that is permanently exhibited in the Wood Physics Laboratory / UFAM.

Above: perforations caused by the presence of xylophages in assacu, Hura crepitans L. Infestations such as these should be quickly combated, separating the sample and assigning it to the necessary care, in order to eliminate the causing agents, avoiding that the sample is lost and that other parts of the collection are also contaminated.

Below: cutting planes for the anatomical study, using as an example, a wedge removed from a wooden disc. The blue lines represent the radial parenchyma.



Reasons to study wood

The man, to survive, has since immemorial time needed to understand the natural world around him. Understanding included identifying and recognizing the plants that were edible, the vegetables that could be poisonous, the fibers that would be used in the making of utensils, the woods to produce houses, boats, and weapons. In this way, the study of plants has become useful and fundamental to man. Theophrastus, a Greek who lived between 369-202 BC, is considered the father of botany and the study of wood. Among the various treatises he has left, there is a list where he classifies more than 500 species of cultivated plants.

Forests, in particular, have always played an essential role in the economic, ecological and social spheres. Tropical forests have a role in maintaining the balance of ecosystems, in addition to possessing rich biodiversity, presenting high relevance as a source of natural resources, timber, medicinal, food, energy resources, ecotourism and research.
According to Lisboa *et al*. (1991), the Amazon rainforest covers 6.5 million km² in the north of South America, with Brazil having the largest share (58%), covering an area of 4,990,520 km² of forest.

The wood was one of the first natural raw materials used by man. Its abundance and multiple utilities, added to the empirical knowledge of its physical and mechanical properties, contributed to the popularization of its use by the primitive civilizations. Throughout the centuries, notable and historical examples of its use have been known, such as those referred to in Genesis and New Testament: Noah's Ark, the Ark of the Covenant, and the Cross used in the martyrdom and crucifixion of Jesus Christ (Brotero, 1941; Cavalcante, 1983, Mattar *et al*., 1996, Paula and Alves, 1997).
Information on physical, chemical, biological and mechanical properties, coupled with the commercial need, can be met by anatomical studies and wood characteristics and may be contained in a woods collection, the xylotheque. In addition, historical temples such as the Todai-ji, in the city of Nara, Japan, built in wood in the year 728 AD (until now receiving visitors) and the Transfiguration Church in Russia, built in 1714 are examples of the influence of wood in civilization.
Wood is the unacknowledged hero of the technological revolution, which has propelled us from stone and bone culture to our present time (Perlin, 1992).
Wood was the main source of fire and allowed man to dwell and survive in cold

regions. Inedible foods have been modified with the heat of the wood fire and have become important source of nutrients. The clay could be converted into pottery, useful for storing food and even for funeral urns. Cooked, the clay originated the bricks used in the constructions. Man was able to shape the metals and thereby produce tools for agriculture, boats and armaments. Coal and wood were used to heat sea water and extract salt from it. The wood heated the beach sand and gave rise to the glass. Transportation would be unthinkable without the wood (until the nineteenth century, all ships were constructed of wood - the reed boats had no resistance to loads). Carriages and carts were also made of wood. Bridges were (and in many cities still are) wooden. The train sleepers were made exclusively of wood. Water wheels, mills, tool handles, etc. wood has always been present in everything that man has done. Only wood serves the finest musical instruments, such as violins, cellos and pianos.

Studying wood is an important step towards the preservation of natural resources, understanding the evolution of plant life and adopting technologies that allow the use of this wonderful resource of nature without exhausting it.

Gathering Woods for a Collection

There are several ways to gather samples for a research institution xylotheque. The simplest is to obtain wood by donation or exchange with other institutions. However, when it is necessary to send or receive wood from other countries or even from other cities in Brazil, it is necessary to require prior authorization from the environmental agencies, explaining the reasons and objectives of such procedure. If it is possible to obtain wood samples for the xylotheque, directly in forest areas, the extraction should strictly follow the legislation and regulations in force, regarding the cutting of individuals from natural regeneration or from forest plantations. In addition to scientific expeditions to collect botanical material, including wood samples, in general, can yield a good amount of specimens to accompany a forest operation, which is duly authorized by the competent bodies. When this is not possible, it is recommended to request authorization from the environmental agencies to remove a sample with the aid of an increment borer (Pressler borer), which allows the extraction of a small cylindrical sample from the inside of the stem, called a core, containing the wood growth rings, without sacrificing the tree.

The most important thing is to be sure about the identification of the species being collected. When collecting in the wild, it is possible to remove a branch sample, to obtain a botanical sample, containing leaves, flowers and / or fruits and, in the uncertainty of the identification, to send to an herbarium. In this way, a referenced collection is formed, that is, wood samples are also associated with an herbarium sample, which increases the degree of knowledge about these species. This is related to the two ways of assessing collection wealth: the first is the number of specimens deposited and the second is the diversity of species, in which the small collections with regional representation often stand out (Barros and Coradin, 2015).

There are other ways to get samples, such as soliciting donations from environmental agencies that seize illegal logs. But these do not come with botanical material and, in this case, they will have to be identified with exactness comparing with similar samples already existing in the own collection or in other xylotheque.

When collection is legally allowed in forest areas, it is recommended to remove samples from the trunk of mature trees, preferably at 1.30m from the ground, or Diameter at Breast Height (DBH). It is important to note that, depending on the purpose of the collection, this height may vary, as in the case of samples for dendrochronology studies, since the closer to the soil, the more growth rings will contain and, consequently, allowing more precise definition of tree age. In individuals

whose branches occur close to the ground, extract the sample just below the first fork. Avoid collecting samples close to tabular roots and / or branch samples, because in such regions the anatomy differs from the stem.
Concerning the sample size, it is recommended to remove a segment of the trunk, where it should include, if possible, bark, sapwood and heartwood. In areas of natural regeneration, especially in tropical forests, it is not at all easy to walk carrying many large pieces of wood (some trees are more than 1 meter in diameter, making it almost impossible to remove a disk from a tree and walk with it through the woods). In this case, it is better to use common sense and collect a sample possible to be transported. It is interesting to always get a piece free of defects, such as: nodes, perforations by insect larvae, areas attacked by fungi and cracks, which allows to obtain more than one sample in the laboratory, since it is always good to have at least one duplicate of the species which will join the xylotheque. This duplicate may serve for future exchanges, for test specimens and even to replace the main sample in case of loss.
In order to register a sample in the xylotheque, it is important to gather the greatest amount of information about the collected wood, such as:
PLACE OF COLLECTION: inform the place from which the wood proceeds, preferably georeferenced. E.g.: AM-010 highway, Km 28, Itacoatiara Municipality, State of Amazonas, Brazil.

COLLECTOR AND IDENTIFIER: usually the name of the person who took the sample and proceeded with the tree botanical identification. COLLECTION DATE: day, month and year.

NUMERIC RECORD: Write on the piece of wood that matches the record sheet to avoid any further confusion. If the sample accompanies botanical sample or fruits, they should also receive the same registration number.

TREE AND SITE INFORMATION: botanical and dendrological aspects such as height, leaf size, whether these are composed or simple, resin exudation, resin color, presence of buttresses, color and morphology of the flowers, characteristics of the bark. In addition, it is interesting to include the classification of the soil and the type of vegetation that exists on the site.

When arriving in the xylotheque, the wood must then be cut into a standardized

format, such as 12 x 6 x 2 cm boards, one of which will compose the xylotheque and others that will serve as duplicates for future exchanges and donations. Samples should be dried in an oven at 103º C until constant weight, then they must be registered and, finally, packed in a cabinet with drawers.
Each sample of different species will receive a record in ascending numerical order, which should be repeated in the duplicates. The numbering can be engraved on the wood with the use of a punch and hammer set. In the logbook or in the computer file, where the information on each sample will be stored, the following fields should be included:

Nº in the xylotheque
Entry date
Family
Scientific name
Common name
From
Collector
Identifier
Comments

In the case of completing a book record, the Family, Scientific Name and Identifier should be filled in pencil, as there are frequent changes in the systematic organization of the species, which would cause the record to be crossed out.
At the Xylotheque of UFAM, for many years, only books were used to register the woods that entered the collection. In 2016, with the implementation of a computerized system, where the information is filled in an online form, a new methodology was adopted: the sample is registered in the database and then is printed this register that will integrate a binder, along with all the other pieces of samples in the xylotheque.

It is important to make a copy of this database whenever it is updated, to avoid that the saved information in it can be, for any reason, lost.
Photograph the samples is necessary, both their general appearance and a macro lens image of their transverse plane and, if necessary, additional characteristics that facilitate their identification, such as stratification of the rays, figures formation in

longitudinal planes, among others.

Caring for the collection

Eventually, collection of wood samples can be attacked by xylophagous organisms, mainly by insects, which can cause irreparable damages to the material, forcing them to be replaced. When it comes to rare or distant species, the damage is infinitely greater. Termites and beetles top the list of unwanted visitors who can most endanger a collection. The best way to combat these invaders is to take preventive measures.

Fungi may appear in the collection, but are rarer considering that the samples were oven dried before being stored. In any case, the low humidity in the air, achieved with the aid of dehumidifiers, already greatly restricts the appearance of xylophagous fungi.

Coleoptera can be avoided by periodically cleaning the drawers, using a brush to remove possible debris, remaining bark and dust that accumulate over time. The use of naphthalene in the drawers between the samples inhibits insect attack. An alternative and less aggressive solution is to buy cloves and spread them inside the drawers, this helps to keep the insects apart.

If there are already beetles present (identifiable by holes in the wood and deposition of dust under the samples), it is sufficient to separate the affected samples and immerse them in a container with kerosene for 24 hours. The kerosene effect remains active for more than six months. The drawer should be properly cleaned and all adjacent samples inspected to prevent contamination. The drawback is that the sample treated with kerosene will lose its original odor and possibly will have its coloration changed.

Ideally, the xylotheque should adopt preventive, periodic cleaning and safety measures to prevent pests from accommodating in the enclosure.

The Xylotheque of UFAM

Location:

Wood Physics Laboratory, V Block
Faculty of Agrarian Sciences - Southern Sector
Federal University of Amazonas
6200, Gal. Rodrigo Octávio Avenue - Coroado I
Zip code 69080-900 - Manaus, Amazonas Brasil

Coordinator: Francisco Tarcísio Moraes Mady, Msc.
Email: madyftm@gmail.com

Laboratory technician: Nerci Nina Lima, Dr.

Monitoring vacancies/year: 2
Volunteer internship vacancies/year: 4

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