

**UNDERSTANDING THE NATURE: INTERPRETIVE TRAIL ABOUT
PLANTS IN A REMNANT OF THE ATLANTIC RAINFOREST
COMPREENDENDO A NATUREZA: TRILHA INTERPRETATIVA SOBRE
PLANTAS EM UM REMANESCENTE DA FLORESTA ATLÂNTICA**

Melo, P. H. A.¹; Peixoto, T. R.¹; Kamimura, V. de A.¹; Marcusso, G. M.¹

¹Departamento de Botânica, Instituto de Biociências de Rio Claro, Universidade Estadual Paulista -
UNESP, Rio Claro, Brasil.

Melo, P. H. A.: pablopains@yahoo.com.br

ABSTRACT

We proposed an interpretive trail, a significant pedagogical tool to stimulate the perception of nature, through the floristic and ecological characterization of tree species in the “Centro Integrado de Estudos Multidisciplinares” (CIEM), Apiaí, SP, Brazil. We sampled twenty-one tree individuals, which were identified to the species level when possible, and selected attributes to be applied in four approaches: evolutionary, morphological, ecological, and conservation. The planning of this trail intends to allow the perceptive exploration through these different themes, which can be used according to the profile and interests of the visitors. Subsequently the trail’s implementation, we suggest an evaluation via questionnaires, in order to assess the levels of perception this proposal may provide.

Keywords: environmental education. Interpretation of nature. CIEM. CPRM.

RESUMO

Nesse trabalho foi proposta uma trilha interpretativa, importante ferramenta pedagógica para estimular a percepção da natureza, por meio da caracterização florística e ecológica de espécies arbóreas na área do Centro Integrado de Estudos Multidisciplinares (CIEM) de Apiaí, SP, Brasil. Foram marcados 21 indivíduos, identificados até espécie quando possível, e alguns atributos foram escolhidos para serem explorados em quatro temáticas: evolutiva, morfológica, ecológica e conservacionista. O planejamento da trilha proposto pretende permitir a exploração perceptiva através de quatro abordagens, que podem ser feitas acordo o perfil e interesse da turma de visitantes. Após implantação, a trilha deve ser avaliada por meio de formulários preenchidos para os visitantes, para que se possa avaliar o grau de percepção que a proposta pode proporcionar.

Palavras-chaves: educação ambiental. Interpretação da natureza. CIEM. CPRM.

The Atlantic Rainforest was a continuous formation in Brazil, covering nearly the entire coast of the country and an area of about 1.3 million km² (MORELLATO; HADDAD, 2000). However, studies revealed that its vegetation cover has already been reduced to about 11% of the original area, and its preservation is restricted mainly to conservational areas of integral protection (RIBEIRO et al., 2009).

Conservation units perform an important role in preservation of natural ecosystems, by allowing scientific research and the development of environmental education activities (BRASIL, 2000). In this context, the enhancement of species knowledge is an approach to stimulate environmental interpretation and to develop the conversion of the environmental aspects in the common language (VACONCELLOS, 1997).

Tilden and Craig (2008) argued the environmental interpretation has as basic objective to reveal the meanings, relations and natural phenomena through practical experiences and interpretive tools, improving the pure communication of data. The practical approach on the perception of nature is applied in the interpretative trails, which include substantial aspects of the environmental education, by considering different social groups, such as scientific, professional, and academic ones (SOUZA, 2000).

The route planning can be developed as an interpretive trail when their resources are explained to the visitor by specialized guides, information leaflets, panels or even through audio and video resources (FEINSINGER et al., 1997). Thus, we used the floristic and ecological characterization along an Atlantic Rainforest remnant, to develop an interpretative trail in the “Centro Integrado de Estudos Multidisciplinares” (CIEM), Apiaí, São Paulo state, Brazil.

CIEM of Apiaí is a component of the “Companhia de Pesquisa de Recursos Minerais” (CPRM). The city of Apiaí is located in the south of São Paulo state, in the region of the Ribeira Watershed, and is part of the largest preserved extension of the Atlantic Rainforest in the aforementioned state (CPRM, 2017). Apiaí, as well as Iporanga - SP and Guapiara - SP, includes in its domains the “Parque Estadual Turístico do Alto Ribeira” (IVANAUSKAS et al., 2012).

Twenty-one trees were chosen for the trail (Figure 1; Table 1), by following morphological, ecological, evolutionary, and conservation criteria (Table 2) and according to the ease of visualization by the visitors as well. These plants were numbered using aluminum plates, georeferenced with GPS, photographed in the field and samples of each of them were pressed and herborized. The identification of the species was performed through consultation to the taxonomic literature and by comparison with specimens in the “Herbário Rioclarense” (HRCB). Different systems were utilized to classify these species in families: for the tree fern the proposal of Smith et al. (2008), for the gymnosperm the work of Souza and Lorenzi (2012) and for angiosperms the APG IV (APG, 2016). The names of the species were updated regarding the synonymy according to the

Plantminer (2017).



Figure 1. Map of the trees numbered in the trail of the “Centro Integrado de Estudos Multidisciplinares” (CIEM), Apiaí, São Paulo state, Brazil.

The evolution aspects considered plants that belong to distinct taxonomic groups, basal (tree ferns) and derived ones, represented by the flowering plants (Gymnosperms and Angiosperms). *Alsophila setosa* (Cyatheaceae), *Araucaria angustifolia* (Araucariaceae) and *Nectandra oppositifolia* (Lauraceae) were the chosen species to represent this approach (Figure 2). Some species could not be identified, because they were not fertile. This aspect may also be explored with visitors, demonstrating the importance of reproductive structures to the taxonomic identification, as well as the underlying role of the reproduction and the dynamic of forest assemblage. The morphological attributes used to feature the species were phyllotaxis, and leaf type. These characters were used according to the ease of observation in the field and to highlight this structure as a source of taxonomic information (for example, to identify some families). In regard to the ecological aspects, we explored information about pollination and diaspore dispersal for the marked trees along the trail. The last theme contemplated was the conservation status of the tree species. For this purpose, the “Livro Vermelho da Flora do Brasil” was consulted, and the species whose wood is exploited were also considered (MARTINELLI; MORAES, 2013).

Araucaria angustifolia (Bertol.) Kuntze



Information	
Popular name	Araucária
Group	Gymnosperm
Family	Araucariaceae
Genus	<i>Araucaria</i>
Phyllotaxis	Alternate
Leaf type	Simple
Life form	Tree
Pollination	Anemophily
Diaspore dispersal	Zoochory
Conservation status	Endangered
Curiosity	Dioecious plant

Figure 2. An example of tree species used in the trail with some information about it.

The trail projected, as opposed to those that are conventional (CARVALHO; BÓÇON, 2004; MENDES et al., 2007), does not investigate only aesthetic features, such as size, but also biological ones. Even though the proposed trail needs a guide, the implementation of plates will probably allow achieving objectives similar to those of traditional trails (MENDES et al., 2007). The planning according to the visitors' profile intends to offer various approaches of the flora and vegetation of an Atlantic Rainforest remnant (Figure 3). After implantation, this interpretive trail needs to be tested through questionnaires, in order to assess the levels of perception this proposal may provide.

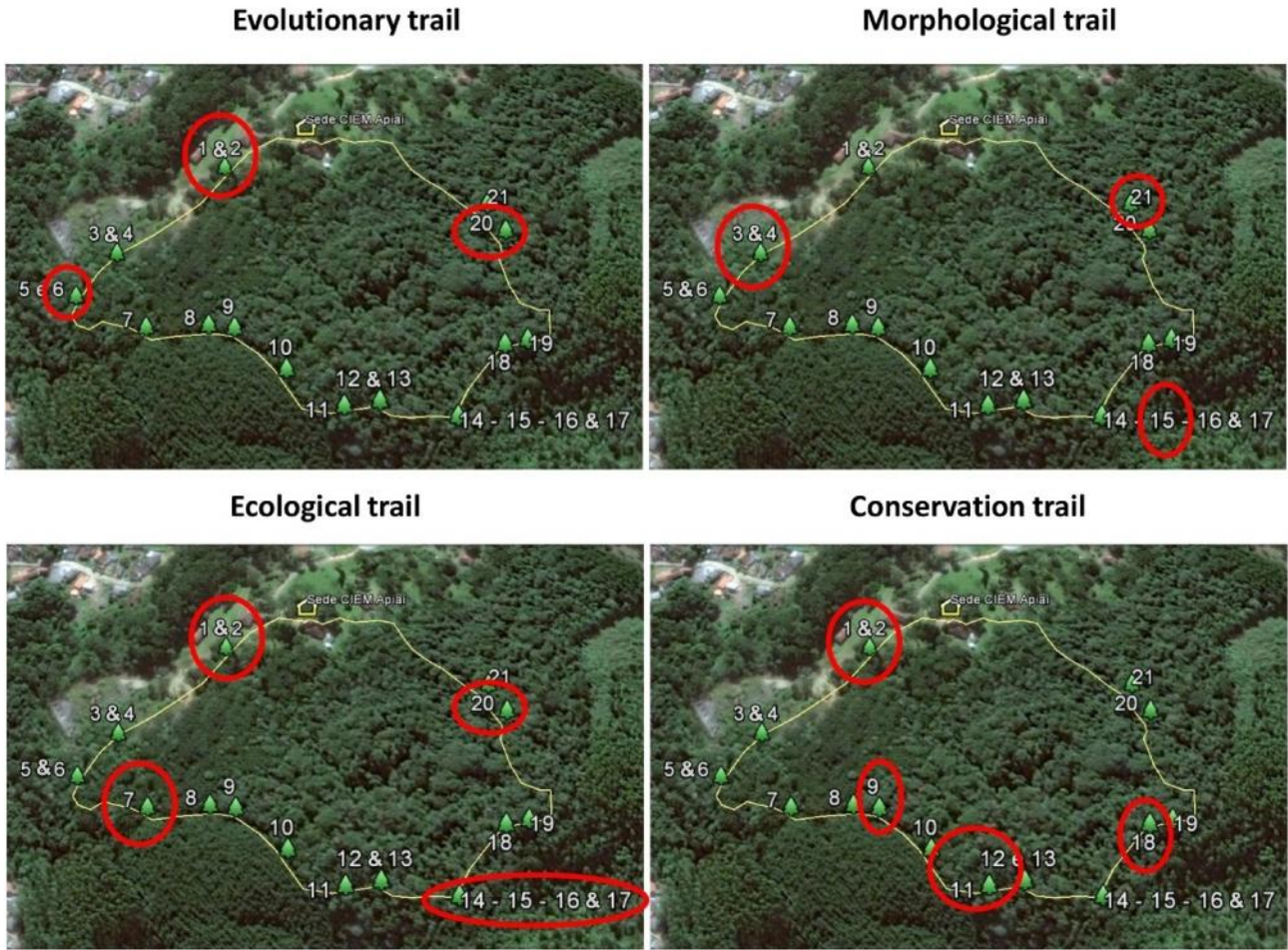


Figure 3. The four approaches utilized in the trail, and the trees selected for each one of them (circled in red).

Table 1. Twenty-one trees selected for the trail by following morphological, ecological, evolutionary, and conservation criteria, CIEM, Apiaí, SP, Brazil.**Bold text** – Selected species to approach each one of the trails.

Number	Family	Scientific name	Trails						Curiosities
			Evolutionary	Morphological		Ecological		Conservation	
			Taxonomic group	Phyllotaxis	Leaf type	Pollination	Dispersal	Status	
1	Araucariaceae	<i>Araucaria angustifolia</i>	Gymnosperm	Alternate	Simple	Anemophily	Zoochory	Endangered	Female individual, and epiphytic bromeliads.
2	Araucariaceae	<i>Araucaria angustifolia</i>	Gymnosperm	Alternate	Simple	Anemophily	Zoochory	Endangered	Male individual, and epiphytic bromeliads.
3	Rosaceae	<i>Eriobotrya japonica</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	Exotic fruit tree of Asia.
4	Myrtaceae	<i>Psidium cattleianum</i>	Angiosperm	Opposite	Simple	Zoophily	Zoochory	Not evaluated	Native fruit tree.
5	Flacourtiaceae	<i>Casearia sylvestris</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	
6	Lauraceae	<i>Nectandra oppositifolia</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	Family of avocado.
7	Melastomataceae	<i>Tibouchina pulchra</i>	Angiosperm	Alternate	Simple	Zoophily	Anemochory	Not evaluated	
8	Rubiaceae	<i>Psychotria vellosiana</i>	Angiosperm	Opposite	Simple	Zoophily	Zoochory	Not evaluated	
9	Lecythidaceae	<i>Cariniana estrellensis</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	Exploited wood.
10	Araliaceae	<i>Schefflera angustissima</i>	Angiosperm	Alternate	Compound	Zoophily	Zoochory	Not evaluated	
11	Unidentified species		Angiosperm	Alternate	Simple				Importance of identification for conservation.
12	Lauraceae	<i>Ocotea porosa</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Endangered	
13	Urticaceae	<i>Cecropia pachystachya</i>	Angiosperm	Alternate	Simple	Anemophily	Zoochory	Not evaluated	
14	Euphorbiaceae	<i>Alchornea triplinervia</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	
15	Meliaceae	<i>Cabralea canjerana</i>	Angiosperm	Alternate	Compound	Zoophily	Zoochory	Not evaluated	Exploited wood.
16	Sapindaceae	<i>Cupania vernalis</i>	Angiosperm	Alternate	Compound	Zoophily	Zoochory	Not evaluated	
17			Angiosperm						Dead individual, nutrient cycling, and use by wildlife.
18	Myrtaceae		Angiosperm	Opposite	Simple	Zoophily	Zoochory		Importance of identification for conservation.
19	Moraceae	<i>Ficus pertusa</i>	Angiosperm	Alternate	Simple	Zoophily	Zoochory	Not evaluated	
20	Cyatheaceae	<i>Alsophila setosa</i>	Monilophyte		Bipinnate	Ausent	Anemochory	Not evaluated	
21	Rubiaceae	<i>Bathysa australis</i>	Angiosperm	Opposite	Simple	Zoophily	Zoochory	Least concern	The largest simple leaf of the Atlantic Rainforest.

Table 2. Terms and concepts related to the interpretive trail.

Terms	Concepts
Evolution	Genetic changes in generations throughout time (JUDD et al., 2009).
- Species	A type of organism, whose scientific name is formed by two terms written in italics (RAVEN; EICHHORN; EVERT, 2014).
- Genus	A hierarchical level between family and species (RAVEN; EICHHORN; EVERT, 2014).
- Family	A hierarchical level between order and gender (ending <i>-aceae</i> for plants; RAVEN; EICHHORN; EVERT, 2014).
- Monilophyte	Group of seedless vascular plants usually with compound or lobed leaves and underground stem (JUDD et al., 2009).
- Gymnosperm	Group of vascular plants whose seeds are not involved by an ovary (RAVEN; EICHHORN; EVERT, 2014).
- Angiosperm	Group of vascular plants whose seeds originate inside a developed ovary (fruit; RAVEN; EICHHORN; EVERT, 2014).
Morphology	The study of the structure and form of organisms (JUDD et al., 2009).
- Life form	Characteristic aspect of a plant (JUDD et al., 2009).
* Tree	Large plant, whose stem (trunk) usually does not branch in the lower part, but in the upper part (crown; VIDAL, VIDAL, 2000).
* Tree fern	Fern of arboreal aspect.
- Phyllotaxis	Arrangement of the leaves in the caulinar axis (VIDAL, VIDAL, 2000).
* Alternate	When in each node there is only one leaf (VIDAL; VIDAL, 2000).
* Opposite	When in each node there are two leaves (VIDAL; VIDAL, 2000).
- Simple leaf	The blade is not segmented into leaflets (VIDAL; VIDAL, 2000).
- Compound leaf	The blade is segmented in leaflets (VIDAL, VIDAL, 2000).
- Bipinnate leaf	Composite leaf whose leaflets are also compound (VIDAL; VIDAL, 2000).
Ecology	The study of the interactions of organisms with one another and with the environment (RAVEN; EICHHORN; EVERT, 2014).
- Pollination	Pollen conduction from male parts to female ones of a flower (VIDAL, VIDAL, 2000).
* Zoophily	When the responsible for the pollination is an animal (VIDAL, VIDAL, 2000).
* Anemophily	When the agent of the pollination is the wind (VIDAL, VIDAL, 2000).
- Diaspore dispersal	Process in which spores, seeds or fruits are disseminated (VIDAL; VIDAL, 2000).
* Zoochory	When it is performed by animals (VIDAL, VIDAL, 2000).
* Anemochory	When it is performed by the wind (VIDAL, VIDAL, 2000).
Conservation	Preservation of the environment.

Acknowledgments

CPRM, Alexandre Oliveira, São Paulo Research Foundation (FAPESP), grant #2015/13112-7 to Pablo Hendrigo Alves de Melo and grant #2016/09444-7 to Tharso Rodrigues Peixoto, and National Council for Scientific and Technological Development (CNPq), grant #141781/2016-5 to Vitor de Andrade Kamimura.

References

- APG. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. **Botanical Journal of the Linnean Society**, v. 181, n. 1, p. 1-20, 2016.
- BRASIL. **Lei nº 9.985, de 18 de julho de 2000**. Brasília, DF: MMA/SBF, 2000. 32 p.
- CARVALHO, J.; BÓÇON, R. Planejamento do traçado de uma trilha interpretativa através da caracterização florística. **Revista Floresta**, v. 34, n. 1, p. 23-32, 2004.
- CPRM. **CIEM Apiaí (SUREG/SP)**. Available at: www.cprm.gov.br/publicue/Sobre-a-CPRM/Equipe-e-Enderecos/CIEM-Apai-i-%28SUREG%7CSP%29-155.html (accessed 26 March 2017).
- FEINSINGER, P.; MARGUTTI, L.; OVIEDO, R. D. School yards and nature trails: ecology education outside the university. **Trends in Ecology & Evolution**, v. 12, n. 3, p. 115-120, 1997.
- IVANAUSKAS, N. M.; MIASHIKE, R. L.; GODOY, J. R. L.; SOUZA, F. M.; KANASHIRO, M. M.; MATTOS, I. F. A.; TONIATO, M. T. Z.; FRANCO, G. A. D. C. A vegetação do Parque Estadual Turístico do Alto Ribeira (PETAR), São Paulo, Brasil. **Biota Neotropica**, v. 12, n. 1, p. 147-177, 2012.
- JUDD, W.S.; CAMPBELL, C. S.; KELLOG, E. A.; STEVENS, P. F.; DONOGHUE, M. J. **Sistemática Vegetal: Um Enfoque Filogenético**. 3. ed. Porto Alegre: Editora Artmed, 2009. 612 p.
- MARTINELLI, G.; MORAES, M. **Livro Vermelho da Flora do Brasil**. Rio de Janeiro: Andrea Jakobson Estúdio, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, 2013. 1100 p.
- MENDES, A. F.; SOUZA, S. A.; TABANEZ, M. F. A trilha interpretativa das árvores gigantes do parque estadual de porto ferreira na modalidade autoguiada. **Revista do Instituto Florestal**, v. 19, n. 2, p. 173-188, 2007.
- MORELLATO, L. P. C.; HADDAD, C. F. 2000. Introduction: The Brazilian Atlantic Forest. **Biotropica**, v. 32, n. 4, p. 786-792.
- PLANTMINER. **Brazilian Flora 2020**. Available at: www.plantminer.com (accessed 17 March 2017).
- RAVEN, P. H.; EVERT R. F.; EICHHORN, S. E. **Biologia Vegetal**. 8. ed. Rio de Janeiro: Guanabara Koogan, 2014. 856 p.

- RIBEIRO, M. C.; METZGER, J. P.; MARTENSEN, A. C.; PONZONI, F. J.; HIROTA, M. M. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. **Biological Conservation**, v. 142, n. 6, p. 1141-1153, 2009.
- SMITH, A. R.; PRYER, K. M.; SCHUETTPELZ, E.; KORALL, P.; SCHNEIDER, H.; WOLF, P. G. Fern classification. In: RANKER, T. A.; HAUFLER, C. H. (Eds.), **Biology and Evolution of Ferns and Lycophytes**. Cambridge: Cambridge University Press, p. 417-467, 2008.
- SOUZA, N. M. **Educação ambiental**: dilemas da prática contemporânea. Rio de Janeiro: Thex, 2000. 282 p.
- SOUZA, V. C.; LORENZI, H. **Botânica Sistemática**: Guia Ilustrado para Identificação das famílias de Fanerógamas nativas e exóticas no Brasil, baseado em APG III. 3. ed., Nova Odessa: Instituto Plantarum, 2012. 768 p.
- TILDEN, F.; CRAIG, R. B. **Interpreting our heritage**. 4. ed. Chapel Hill: University of North Carolina Press, 2008. 224 p.
- VASCONCELLOS, H. S. R. A pesquisa-ação em projetos de educação ambiental. In: PEDRINI, A. G. (Org). **Educação ambiental**: reflexões e práticas contemporâneas. 3. ed. Petrópolis: Vozes, 1997. p. 26-35.
- VIDAL, W. N.; VIDAL, M. R. R. **Botânica Organografia**: quadros sinóticos ilustrados de fanerógamos. 4. ed. Viçosa: Editora UFV, 2000. 124 p.