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Evaluating methods and results for the application of anthracology to high diversity and high endemism environments: Case study in the Tiwaka Valley, north-eastern Grande Terre of New Caledonia

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Summary: *Although anthracology is nowadays extensively involved in archaeological projects conducted in temperate or dry areas, applications in tropical environments remain rare. Indeed, in such places, anthracologists are facing highly peculiar and diverse flora, as well as poor or inexistent wood anatomy resources which they often have to create themselves. This paper aims at discussing a recent PhD research that applied anthracology to New Caledonia for the first time, as an integrated approach with archaeological analysis of precolonial Kanak landscapes. The strategies and methods used, from sampling to taxonomical identification, will be evaluated. The levels of identification, ratio of unidentified/identified and ecological representation/diversity of the assemblages will be discussed.*

Key words: *Anthracology, tropical environment, archaeology, reference collection, methods.*

INTRODUCTION

Although the methodological developments of anthracology have triggered a diffusion of the discipline in various parts of the world, applications in tropical environments have remained few. The main area where such a work has been realised is Brazil, where R. Scheel-Ybert has been conducting several anthracological research projects (Scheel-Ybert, 2002). In the Pacific, apart from the work of C. Orliac on Rapa Nui, palaeoenvironmental or archaeobotanical studies are mainly produced through palynological research, and they remain a domain to be promoted in the regional archaeology. This is especially true for New Caledonia (South-West Pacific), where our PhD research program was hence set.

DATA AND RESULTS

The first phase of the program was the construction of a wood reference collection on New Caledonia (Dotte-Sarout, 2010; Dotte *et al.,* 2010). Each wood sample was accompanied by a herbarium voucher, and three collections were created to be kept in the three laboratories involved in the project (Paris I-Sorbonne University, now UMR 7209; Australian National University; Institute of Archaeology of New Caledonia and the Pacific). Each wood specimen of the 142 taxa sampled was then charred under controlled conditions and observed under a reflective light microscope, as well as with an SEM when needed, in order to describe the anatomical features of the wood. This information was systematically compiled within a searchable database (under file maker-pro) that also contains pictures of each of the three anatomical sections for each taxon (Dotte-Sarout, 2010).

Given the high diversity an endemism level of the New Caledonia Flora (more than 3.200 indigenous species of vascular plants with 77% endemic), we followed a specific strategy to determine priority taxa that should be included in a first, partial, but most pertinent possible reference collection. Botanical inventories were associated either with botanical sampling or archaeological surveys that aimed at characterizing vegetation types around pre-colonial kanak sites. Systematic lists of species present were made on and around six archaeological sites located in our region, and their analysis integrates general observations made during archaeological surveys and excavations throughout Northeastern Grande Terre. This fieldwork was coupled with a study of botanical references about trees and forest species as well as ethno-botanical and archaebotanical records (Dotte-Sarout, 2010). This enabled us to list 220 taxa to look for in priority during our samplings for the reference collection, defined as: the most widespread species or genus in our region of research; the "leading" species most representative of the main vegetation types; the most important "social" species within the kanak socio-cultural system; and the principal Pan-Pacific species, either "indigenous" or "introduced".

The ecological representation of the collection and database was then evaluated. It appears to be in accordance with the main ecological conditions found in alluvial valleys of Northeastern Grande Terre: containing 65% of rainforest associated species and the remaining 35% equally divided between species related to wetlands and coastal formations, ruderal or anthropogenic vegetation types, and dry forests (Dotte-Sarout, 2010). Within this general frame, the collection presents a strong emphasis on anthropogenically related plants, regardless of their ecological affiliation. As a result, and in relation to its archaeological and socio-cultural focus, the collection offers an over-representation of non-endemic species: almost half of the taxa have a pan-Pacific distribution.

Archaeological excavations and systematic anthracological sampling on pre-colonial kanak settlement sites constituted the second phase of the research. Test pits were dug on three settlement mounds, from three different kanak precolonial sites, and all sediment excavated was collected. The sediment was then wet-sieved directly in a nearby river and charcoals fragments were hand-picked (>2 mm and >4 mm samples), while flotation revealed to be inefficient due to the clayous nature of the sediment. Referring to previous works in the tropics or in pedo-anthracology (Scheel-Ybert, 2002; Delhon, 2006), our aim was to gather at least 400 fragments to be analysed for each archaeological level, and 100 for non-archaeological levels. This method, together with the use of two other techniques to control ecological diversity, guaranteed that our anthracological assemblages were ecologically representative and our results coherent; especially in the case of a new, inevitably incomplete, reference collection. First, the species-area curves (or taxa-fragments curves) were constructed for each assemblage. Even though they showed a regular and continuous increase in taxonomic diversity (1 new taxon every 3 fragments observed in average), there is a recurrent slackening plateau between 100 and 120 fragments. Second, Pareto Indexes calculated for each assemblage are comprised between 25/75 and 29/71, which can be considered good in relation to the reference of 25/75 calculated for tropical environment by R. Scheel-Ybert (2002). Only two low indexes exist (32/68, 36/64) and are associated with non-archaeological levels from a very diverse environment gathering forests, mangroves and riverine as well as coastal floras. Nearly 2400 fragments were analysed and 2/3 of them identified, (more than 50% down to the genus level at least), which represented 136 different taxa. Unidentified taxa gather 70 different types, most of them being rare taxa only represented in one assemblage and by one or two fragments only. These results showed that the anatomical database and strategic choices made for the constitution of the reference collection were efficient and coherent with our archaeological focus. Moreover, the most frequent taxa of each assemblage were always identified except in the case of one unidentified type, present in 3 of the 8 assemblages in proportions of 0.3% to 9.4% of the identified taxa. 9 taxa were found in more than half of the assemblages, most of the time showing the highest occurrence in proportions of fragments, ranging from 2 to 13% by assemblage in average. All unidentifiable fragments encountered in our samples were either too reflective (vitrification process during burning) or coming from distorted wood parts (knots, etc). The main problems faced for the identification of the charcoal fragments, all due to the very incomplete state of our reference collection in regard to the high diversity of the local flora, were:

- The absence of many rare, endemic species, genus or even families, from our database,
- The question of unknown inter-specific anatomical similarity, requesting more species to be collected and described,
- The problem of intra-specific and individual anatomical variability, requesting several reference samples of the same species from different environment/plant parts to be compared
- The archaic or irregular aspect of the wood anatomy of many tropical/island species, requesting large archaeological charcoal fragments to be observed for variable characteristics to be determined.

DISCUSSION AND CONCLUSION

It is clear from the general coherence of our results that anthracology is a pertinent and promising approach for New Caledonian archaeology. This research also constitutes one more example of the relevant applicability of anthracology in tropical contexts, resulting directly in the creation of a new regional wood atlas. However, several problems arise, all linked to the difficulty of creating rapidly – within a typical research program timeframe of 3-4 years – a reference collection and a database gathering the anatomical description of each taxon collected. Here, we showed how we tried to overcome these difficulties, by defining strategic taxa to be sampled and described, and then by controlling the representativity of our collection as well as of our anthracological assemblages. Still, the main way to secure identifications and interpretations of anthracological samples remains the continuous extension of the reference collection and attached wood atlas. It also implies the acknowledgement that some identification, tentative (cf., family levels) or apparently sure, may be questioned by future descriptions of anatomical variability discovered with the improvement of the reference collection. We believe that such risks can be managed by paying attention to the ethnobotanical, ecological and archaeological context of the anthracological results, in order to control as much as possible the interpretations proposed.

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