Human Impact from the Paleoenvironmental Record on New Caledonia

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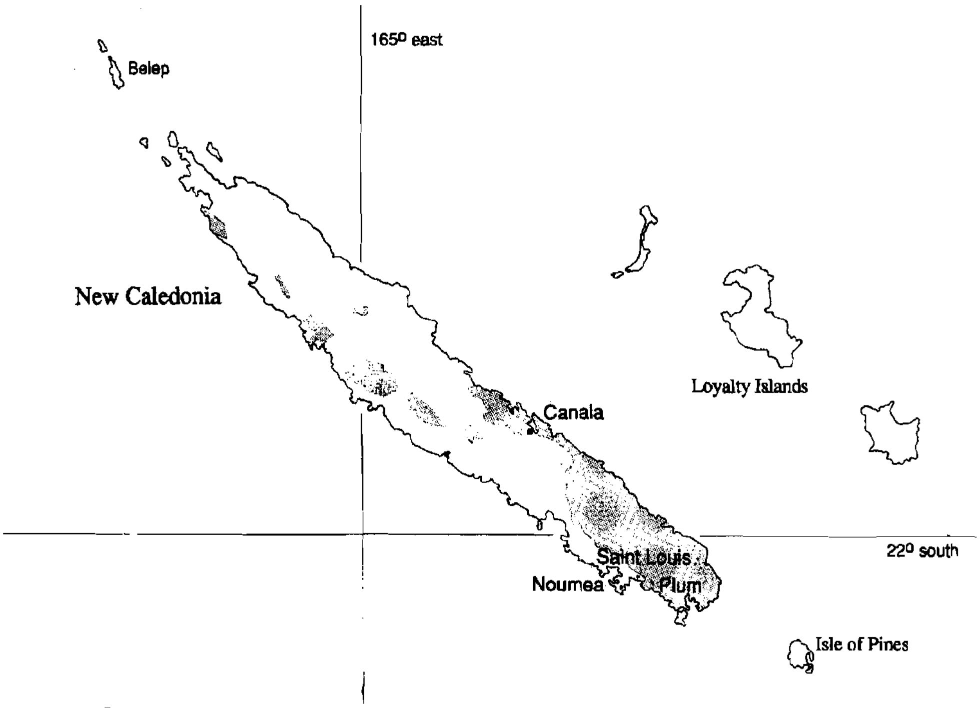
Introduction

The paleoenvironmental records for three sites on New Caledonia are currently being investigated. An interesting aspect of these records is the period that overlaps with New Caledonia's known human occupation. Pleistocene occupation sites in the Bismark Archipelago and on Buka Island at the northern end of the Solomon Islands chain record the early movement of people into northwest Island Melanesia (Allen et al., 1988; Wickler and Spriggs, 1988). There is consensus that for the islands east of the Solomons colonisation took place from 3,200 BP onwards and in conjunction with the introduction of Lapita pottery. However, the question of whether people moved beyond the Solomons prior to this time will be a matter of speculation as long as a human origin for the so-called tumuli of New Caledonia is entertained (see Sand, 1995 p. 44). Sand (1996) also points to the lack of rock shelter excavations for New Caledonia making it difficult to definitively rule out pre-ceramic populations. The paleoenvironmental records from the island are one line of evidence, independent of the archaeological record, that may throw light on the question of human colonisation in the southwest Pacific.

Pollen and Charcoal Analyses

Analyses of fossil pollen and charcoal from two sites, Saint Louis and Plum (Fig. 1), are presented here. Identification of lowland tropical pollen is inherently difficult and it



I Figure 1
Location map of Lac Saint Louis and Plum Swamp.
Shading denotes ultrabasic terrain.

is not unusual for sites in New Guinea, for example, to have 20-40 % of the pollen classed as unknowns, despite a relatively large reference collection and body of work. New Caledonia is renowned for its rich and diverse flora, and as this is one of the first palynological studies to be carried out for the territory, the reference collection is still meagre. As a consequence the unknown category in the summary diagrams includes a large number of grains which at present can only be identified by number (eg Type 4). Ferns and Cyperaceae (sedges) are counted outside the terrestrial pollen sum but have been included in the summary diagram for each site due to their importance in the present day landscape. In badly degraded environments of New Caledonia, especially on soils high in heavy minerals, Cyperaceae and *Pteridium* (bracken) often dominate. While neither of the pollen diagrams presented here include all the taxa counted, they are a good summary of the major changes that have occurred since the last glacial maximum for New Caledonia.

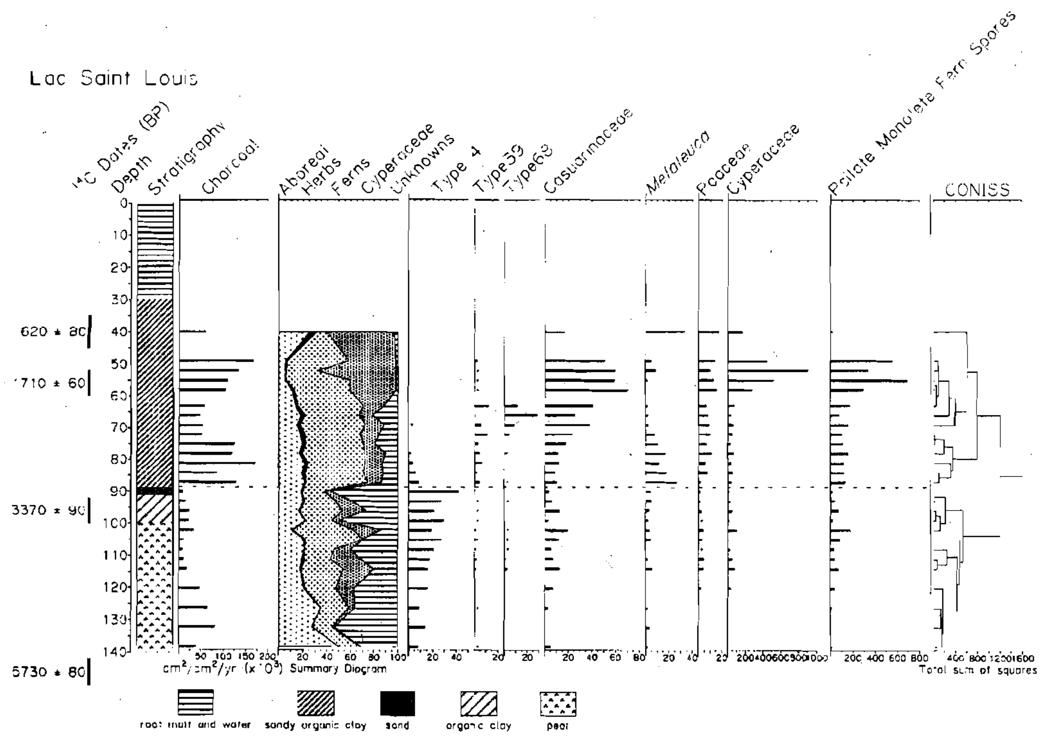
Lac Saint Louis

Lac Saint Louis is a small coastal swamp semi enclosed by ridges on its northeastern and northwestern sides. The inner slopes of these ridges are terraced for yam (*Dioscorea esculenta, D. alata*) cultivation, but these are no longer in use. Fires in 1993 exposed the surface of the ridges, revealing scattered pottery sherds. The present-day vegetation is composed predominantly of *Melaleuca* and grass. This type of savanna is known locally as *niaoulis* and has been greatly extended by European people through the use of fire associated with grazing. Essentially, Lac Saint Louis is a small basin with a small local catchment. Preliminary work focusing on the record of human impact is presented by Stevenson and Dodson (1995).

The substantive archaeological record for New Caledonia starts at around 3,200 BP with the Koné period, which includes Lapita as well as other pottery styles (Galipaud 1988, 1992). Radiocarbon dating (Fig. 2) reveals that the collected sediments span this date, with the dashed line at around 3,000 BP representing the start of human impact. This has been established objectively through stratigraphically constrained cluster analysis on the dryland pollen composition.

The summary diagram (Fig. 2) is a percentage diagram calculated on a pollen sum comprising arboreal and herb pollen, fern spores, Cyperaceae and the unknown category. Ferns and Cyperaceae are found throughout the record, but really dominate after 3,000 BP, indicating significant changes at the site. Herb pollen is low throughout and the percentage of unknown taxa drops dramatically after 3,000 BP. While the percentage of arboreal taxa across the 3,000 BP boundary does not appear to change, the diversity of the taxa does. Of note is a significant decrease in diversity at around 1,700 BP, which possibly marks the onset of the present-day environment.

Specific changes across the 3,000 BP boundary (Fig. 2) include the abrupt increase in charcoal and the abrupt decrease in Type 4 (an important unknown). Types 39 and 68 are also shown as they illustrate the importance of the unknown category, with both types increasing after 3,000 BP. Casuarinaceae, *Melaleuca* and Poaceae (grass) are elements indicative of a more open landscape, their presence being enhanced by fire. These pollen types increase after 3,000 BP. As with other wind-pollinated genera (*Nothofagus*, for example), results must be treated with caution when interpreting the record for Casuarinaceae, as the pollen can be found in surface samples from forested situations without the local presence of the trees or shrubs. There is no evidence in the data from Lac Saint Louis for a pre-Lapita presence.



I Figure 2
Lac Saint Louis. Summary diagram based on total pollen sum (see text).

Plum Swamp

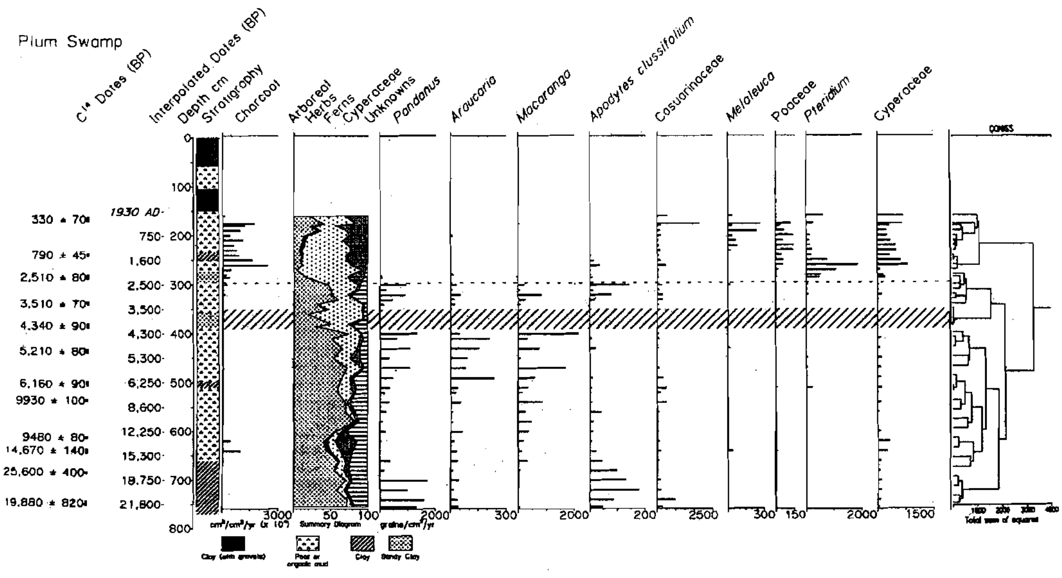
Plum Swamp is an inland backswamp on the Plum River, a small incised stream, with a larger catchment than Saint Louis. It is just within the ultrabasic terrain, a geology that dominates the southern half of the main island of New Caledonia (see Fig. 1). The southern edge of the swamp is dominated by *Melaleuca*, while the surrounding vegetation is a fairly depauperate heath *(maquis)* dominated by *Casuarina, Pteridium* and Cyperaceae.

In general, the stratigraphy alternates between clay and peat or organic mud (Fig. 3). There are two sand layers, the one from 350 to 390 cm associated with poor pollen preservation. The top 150 cm has been deposited since 1936 as a consequence of mining that commenced on Mont Dore at this time (Atlas, 1981). The orange clay and gravels were deposited across the floodplain by a tributary channel that drains the mined area and joins the main channel just above Plum Swamp.

The basal date of the Plum Swamp core is around 20,000 BP and the dashed line at around 2,500 BP denotes the commencement of human impact. Once again cluster analysis was used to define this point in the record.

Charcoal is found throughout the record prior to 2,500 BP, but values are very low, except for the significant peak between 16,000 and 12,000 BP. This late Pleistocene peak in charcoal is associated with a complex arboreal pollen assemblage rather than taxa indicative of an open landscape. After 2,500 BP charcoal increases dramatically and then remains constant, and is associated with a pollen record dominated by ferns and Cyperaceae. This, in general, reflects the present-day environment.

In the summary diagram we can see that the pre-2,500 BP record is dominated by arboreal taxa and the unknown category (if we ignore the zone of poor pollen preservation which is shown as hatching across the figure). By the morphology of the grains, the unknown category is itself, also largely arboreal, both at Plum and Saint Louis. Herb pollen is low throughout, with the highest values associated with the two periods of significant charcoal accumulation.



I Figure 3
Plum Swamp. Summary diagram based on total pollen sum (see text). Interpolated dates are derived from a straight line of best fit through the radiocarbon ages.

Once again the fire-tolerant species increase with the increase in charcoal: Casuarinaceae, *Melaleuca*, grass and *Pteridium*. *Pteridium* is rarely found prior to 2,500 BP, then comes into the record dramatically and dominates, along with Cyperaceae, the post-2,500 BP record. These two elements form the major cover on the slopes of the catchment today.

Curves of individual taxa in Fig. 3 are shown as absolute values, and therefore each is independent of the other; that is, the curve for any particular species is not affected by the rise and fall of any other. *Pandanus*, or the Screw Palm, is a common low-altitude rainforest element, which is also found in littoral vegetation and along creek lines. It is plentiful in the lower part of the record, then decreases abruptly at 2,500 BP. Other forest types have a similar record. *Araucaria* is found in rainforest, but can also form an open tree stratum on ultrabasic terrain. *Macaranga* is often shown in pollen diagrams as a secondary or disturbance element, and on New Caledonia it is found as a shrub in rainforest and in *maquis* on a wide range of substrates. It enters the record at around 16,000 BP and disappears at 2,500 BP. *Apodytes clussifolium* is a tree found exclusively in rainforest, with its greatest representation recorded during the last glacial maximum. The disturbance associated with the charcoal between 16,000 and 12,000 BP greatly reduces the presence of this species, its subsequent re-establishment being quite slow. The dramatic shift seen at 2,500 BP in most of the taxa and the charcoal is also seen in the *Apodytes* curve. By around 1,000 BP it disappears from the record completely. The palaeoecological data from Plum, like Lac Saint Louis, has no evidence of a pre-Lapita presence.

Discussion

Both sites were surrounded by forest prior to the commencement of the substantive archaeological record for New Caledonia. This conclusion is based on the representation of rainforest types, such as *Apodytes clussifolium*, the high floristic diversity of taxa prior to 3,000 BP and the low values or absence of pollen indicative of open vegetation. Fire was present in this environment prior to the start of the archaeological record, although after 3,000 BP at Saint Louis and 2,500 BP at Plum charcoal accumulation increased significantly and was associated with an open landscape. Each site records a continued loss in diversity from 3,000 BP and 2,500 BP, and at each site the modern landscape has taken form in the recent past. Similar work from other islands of this region is still scarce. On Aneityum, in Vanuatu, Hope and Spriggs (1982) in a preliminary study detected an abrupt change from closed forest to open fern/grassland coincident with a significant increase in charcoal at around 2,900 BP. These changes postdate the commencement of the archaeological record. For Viti Levu, Fiji, major vegetation disturbance began around 3,000 BP (Southern, 1986) overlapping with the archaeological record.

Nunn (1994) believes that human impact on island environments of the southwest Pacific has been over emphasised and that ongoing natural processes have played a significant role in environmental change since initial colonisation. If we are to evoke climate change for the post 3,000 BP changes on New Caledonia then we have to accept that the climate since that time has in some way been more extreme than at the Last Glacial Maximum. One possible mechanism that is often cited as leading to profound climate change during the late Holocene is the greater interannual variability associated with El Nimate since that time has in some way been more extreme than at the Last Glacial Maximum. One possible mechanism that is often cited as leading to profound climate chactive sometime after 5,000 BP (see Markgraf *et al.*, 1992; Shulmeister and Lees, 1995; Sandweiss *et al.*, 1996). Shulmeister and Lees (1995) conclude that for Tropical Northern Australia this was around 4,200 BP. Haberle (1996) suggests that for Guadalcanal in the Solomon Islands, greater climatic variability in the late Holocene probably enhanced the impact people had on the landscape rather than directly leading to vegetation change. A similar scenario seems likely for New Caledonia, given the abrupt nature of the changes recorded in the palaeoecological data.

No doubt the question will arise as to why the charcoal peak and vegetation shift between 16,000 and 12,000 BP at Plum is not considered to be human in origin. Firstly, the vegetation remains complex and although the values for arboreal pollen fall, they are still the largest component. Secondly, the charcoal values post-2,500 BP are much larger and are maintained, with the vegetation opening up and becoming more degraded over time as burning continues. This is unlike the earlier period where there is minor disturbance and then a gradual recovery. Fire on the island today is widespread and often indiscriminate, with the majority of fires being ignited by people. In recognition of the devastating effect these fires are having on the island's ecosystems, the Province Sud and Province Nord authorities mounted a poster campaign (*Halte aux Feux*) in 1993 and 1994 to deter people from lighting them.

While palynological studies have been criticised when they propose a scenario that is not in keeping with the archaeological record (see discussion of issue in Spriggs and Anderson, 1993; Anderson, 1994; Ellison 1994; Kirch and Ellison 1994), Anderson (1995, p. 125) concedes that palynology does have an "important role to play" with regard to questions of East Polynesian colonisation. Palynological research does not presume to replace archaeology; indeed that is an absurd notion. However, it is one source of data, independent of the archaeological record, that can record evidence of human activity, and herein lies its value. Though the paleoecological data presented here have had nothing to say on the question of a possible pre-Lapita occupation on New Caledonia, what they do show is that from the time of Lapita onwards people have had a significant impact on the environment, an imprint that is likely to be found across the region and further to the east.

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