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Pollen core assemblages as indicator of Polynesian and European impact on the vegetation cover of Auckland Isthmus catchment, New Zealand

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ABSTRACT

Tamaki Estuary is an arm of the Hauraki Gulf situated on the eastern side of central Auckland. Over the last 100 years, Tamaki catchment has evolved from a nearly rural landscape to an urbanised and industrialised area. Pollen, ^{14}C and glass shards analyses, were carried out on three cores collected along the estuary with the aim to reconstruct the estuary's history over the last ~8000 years and trace natural and anthropogenic effects recorded in the sediments. Glass shard analysis was used to establish key tephra time markers such as the peralkaline eruption of Mayor Island, ~6000 years BP. During the pre-Polynesian period (since at least 8000 years BP), regional vegetation was podocarp/hardwood forest dominated by *Dacrydium cupressinun*, *Prumnopits taxifolia*, and *Metrosideros*. Major Polynesian settler impact (commencing ~700 yr BP) was associated with forest clearance as indicated by a sharp decline in forest pollen types. This coincided with an increase in bracken (*Pteridium esculentum*) spores and grass pollen. Continuing landscape disturbance during European settlement (commencing after 1840 AD) was accompanied by the distinctive appearance of exotic pollen taxa such as *Pinus*.

1. Introduction

Pollen analysis of sediments from lakes, bogs and estuaries may be used to reconstruct past vegetation patterns. It is also used in the study of human activity as an agent of vegetation change in addition to natural causes such as climate variations and natural fires. The present study focuses on three sediment cores from Tamaki Estuary which is located on the eastern side of Auckland City (Fig. 1). Previous work on the Tamaki area (McGlone, 1997; Abrahim and Parker, 2002; Abrahim et al., 2007, 2008) provides a background for the study of Holocene to present day changes in pollen counts in Auckland estuarine sediments. The cores sample sediment depths of up to 8000 yr BP. Since this time, the climatic regime has oscillated around an average similar to, but slightly warmer and wetter than, the present day (Denton and Karlen, 1973; McGlone and Topping, 1977). The New Zealand flora are well able to adjust to these and other types of disturbance such as forest fires as the flora have a range of successional mechanisms to recover from these processes.

The Auckland region has a pristine Holocene history unaffected by human activities until arrival of Polynesian settlers *c.* 700 yr BP. In this regard the present study is significant in comparison to other pollen studies elsewhere in the world. In large parts of Europe, the Middle East and Asia, human impact on catchment vegetation and the associated pollen record extends back at least over the last five to ten thousand years since the start of agricultural activities in these areas (Bellwood, 2005). The Tamaki Estuary catchment represents a substantial drainage system covering 97 km^2 and pollen sediment profiles provide a robust record of vegetation history during Holocene to modern times in a relatively large and, until relatively recently, undisturbed area within the Auckland metropolitan region.

At the time of early European settlements (*c.* 1840), the Auckland Isthmus was dominated by bracken fern and shrubs with evidence of extensive cultivation by Maori of kumara (*Impomoea batatas*) and flax (*Phormium tenax*) in earlier times (Colenso, 1844; Newnham and Lowe, 1991). Although vegetation of the pre-human era can be inferred from small forest remnants in gullies, tree-clad cliffs and scattered small swamps, the early vegetation history of the Auckland region is not all that well known (Millener, 1979; Cranwell, 1981; Newnham and Lowe, 1991).

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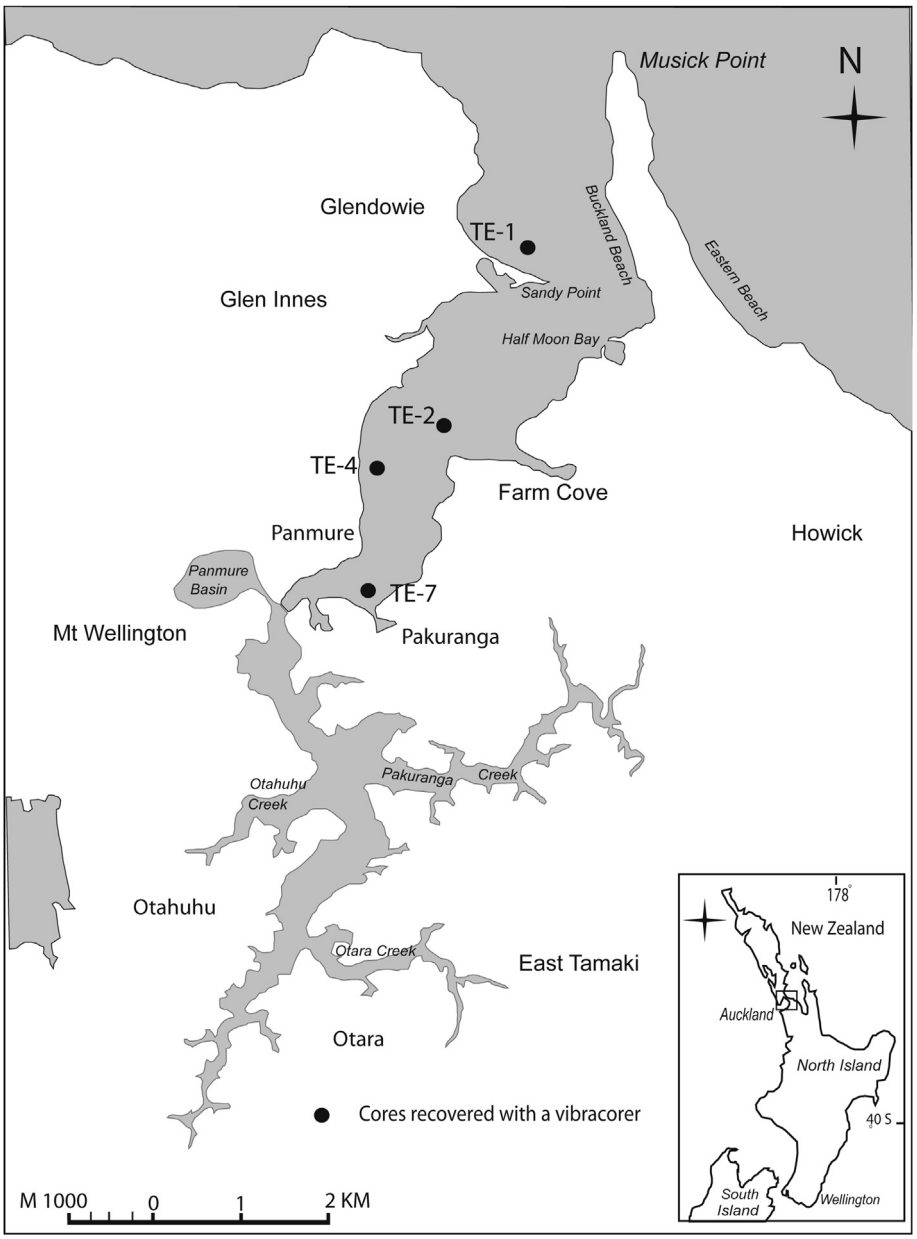

Fig. 1. Location of core sites (●), Tamaki Estuary, Auckland.

Pollen assemblages from the cored sediments of Tamaki Estuary were extracted and identified. Pollen variations in sediment layers effectively delineate significant changes in the vegetation history of Tamaki catchment. These changes are too substantial to be attributed solely to natural causes and instead point to important stages in the urbanization history of the area. They are also associated with significant changes in sedimentation rates in the estuary, which in turn are linked to accelerated urbanization and infrastructure construction in the catchment. Pollen analysis was used in conjunction with other dating methods (e.g. radiocarbon dating and glass shards) as a tool to identify meaningful time markers within the studied sediment layers. These markers allowed reconstruction of the settlement and urbanization history of Tamaki catchment. Examples of such major settlement phases include the early forest clearance following the arrival of Polynesians (*c.* 700 yr BP) and the wide scale disturbance to vegetation cover associated with the arrival of European settlers since the 1840s (Hume et al., 2001; Abrahim and Parker, 2002).

1.1. Anthropogenic disturbance of Tamaki Estuary vegetation

Although natural disturbances such as fires caused occasional large changes in the vegetation history of the region, human settlement brought significant changes associated with decreased vegetation cover, reduction in tree density and introduction of exotic tree species.

(a) Maori Settlement

The timing of first human settlement in New Zealand has been the subject of ongoing controversy and debate over the last several decades. Davidson (1984) proposes that first settlement occurred at around 1000 yr BP. However a younger date of 700 years BP has