Quaternary International xxx (2016) 1–13

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Holocene diatom records of wetland development near Weipa, Cape York, Australia

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
Dry tropics
Diatom
Holocene
Weipa, Cape York
Australia

ABSTRACT

To better understand the response of tropical wetlands to Holocene environmental changes, two lacustrine diatom records from Weipa, Cape York, have been investigated. The record from Big Willum (BW01) commenced approx. 7.9 calibrated thousand years before present (k cal a BP) and details stages of initial swamp development, a phase of ephemeral conditions between approximately 5.7 and 2.2 k cal a BP and relative wetland stability after 2.2 k cal a BP. Lithological and to a lesser extent diatom assemblage changes in BW01 appear to be linked to broad-scale changes in effective precipitation. The record from Little Willum (LW01) commenced around 0.9 k cal a BP and documents initial phases of swamp development until approximately 0.8 k cal a BP with subsequent relative wetland stability. The uppermost 10 cm of this record, approximately spanning the last 40 years, coincide with mining activity in the region. Only minor changes in the diatom assemblage are recorded for this period implying that the overall character of the swamp probably remained unchanged.

Both sites offer new insights into wetland dynamics in Australia's dry tropics and demonstrate that changes in these lacustrine systems were probably driven by shifts in effective precipitation, in particular during the late Holocene.

1. Introduction

Wetlands are among the world's most biologically productive environments and have been recognised for providing a range of ecosystem services such as regulating water flow and improving water quality (TEEB, 2012). Knowing the response of wetlands to changes in climate is crucial to understand the future availability of these services (Ramsar, 1971; TEEB, 2012). However, projections of wetland response to future climate variability remain vague due to an inadequate understanding of how changes in climate impact on, for example, wetland stability and character. Palaeoenvironmental records have shown to enhance our understanding of the wetland–climate relationship (Ryu et al., 2008; Smol and Stoermer, 2010; Pearson et al., 2015; Wang et al., 2014) and thus are a powerful tool in detailing wetland responses to past climate change.

The Australian dry tropics extend across the northern part of the continent (Fig. 1) and host a large number of regionally and globally significant freshwater wetlands such as Kakadu National Park and the Ord River Floodplain (Ramsar, 2009). This region is influenced by intersecting climate systems such as the Australian-Indonesian monsoon and the El Niño Southern Oscillation. Due to the spatial and temporal variability of these systems and the non-uniform impact of recent climate change across the region, local precipitation throughout the Holocene has been highly variable (Dunlop and Brown, 2008; Reeves et al., 2013). A recent synthesis of past climate changes for the Australian tropics showed that the early Holocene increase in effective precipitation is primarily linked to the post-glacial transgression (Reeves et al., 2013). For the middle Holocene, records of climate variability diverge considerably. Although the majority of records suggest a peak in effective monsoon precipitation (Reeves et al., 2013), a few records imply reduced summer monsoon activity (Nott and Price, 1994; Lough et al., 2014). During the last ca. five thousand years, climate records show greater intra- and inter-site variability and it is speculated that ENSO becomes a key driver of these fluctuations (Reeves et al., 2013). Numerous sites in the far north of Australia and in Indonesia record a renewed

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http://dx.doi.org/10.1016/j.quaint.2016.09.014
1040-6182/

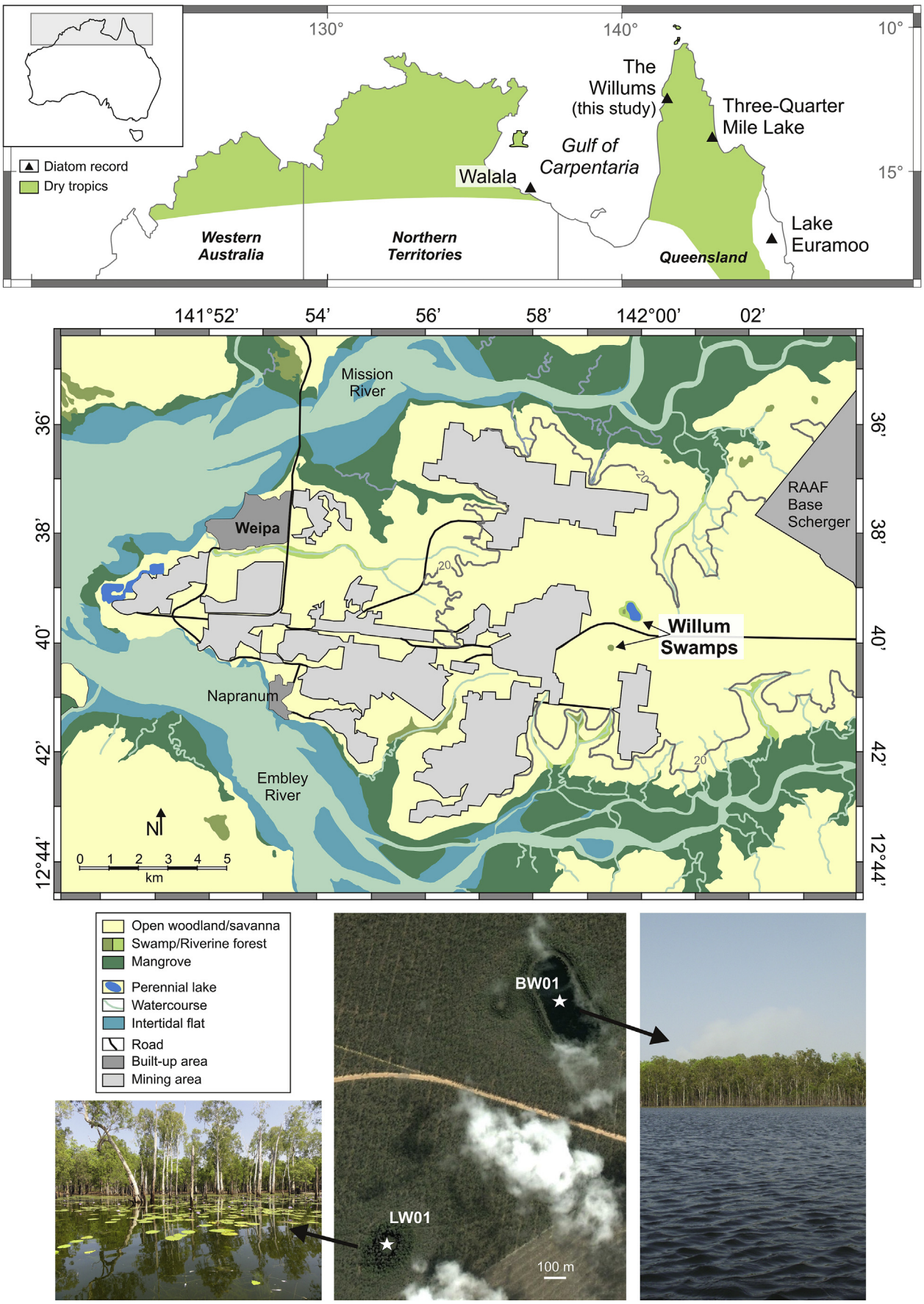

Fig. 1. Overview map of the study region. The top panel shows the study area within the north Australian context and sites discussed in the text. The central and lower panels show a GoogleEarth image and photographs of both Big Willum (BW) and Little Willum (LW) taken during coring at the end of the dry season in 2011.

Please cite this article in press as: Proske, U., et al., Holocene diatom records of wetland development near Weipa, Cape York, Australia, Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.09.014