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Coconut Shells Recovered from the Goodwin Sands in the Vicinity of the Wreck of the *Rooswijk*

Radiocarbon Dating

Alex Bayliss, Serena Cant, Sanne Palstra, and Ruth Pelling

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Front Cover: Three coconut shells associated with the wreck of the *Rooswijk. Photograph source Ruth Pelling.*

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SUMMARY
Five coconuts were recovered during excavation at the wreck site of the *Rooswijk,* an eighteenth-century ship of the Dutch East India Company (*Verenigde Oostindische Compagnie*, 'VOC'), wrecked on the Goodwin Sands off the coast of Kent, South East England, in January AD 1740. The highly mobile sea-bed environment has resulted in scattered ship debris across the area of the site. Dating of the coconuts was required to establish if they were part of the cargo of the *Rooswijk*, in which case they will date from shortly before AD 1740 and potentially hail from Indonesia. If they are not associated with the *Rooswijk* they must be related to a different, more recent historic wreck or cargo loss, more likely to have been returning from the Caribbean. Alternatively, the coconuts could be modern.

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CONTENTS

INTRODUCTION

The *Rooswijk* was an eighteenth-century ship of the Dutch East India Company (*Verenigde Oostindische Compagnie*, 'VOC'), wrecked on the Goodwin Sands in January AD 1740 (Fig 1) and designated under the Protection of Wrecks Act, 1973 (LEN 1000085). The ship was outward-bound for Batavia (modern-day Jakarta) for the second time when it sunk in treacherous conditions (Dunkley 2009; van Popta 2014). Excavation of the wreck site was conducted by MSDS Marine Ltd on behalf of The Cultural Heritage Agency of the Netherlands, RCE, (on behalf of the Ministry of Education, Science and Culture) and Historic England (on behalf of the Department of Digital, Culture, Media and Sport) in 2017 and 2018. The highly mobile sea-bed environment has resulted in scattered ship debris across the area of the site, from which five coconuts were recovered during two seasons of excavation. These were not, however, directly associated with any particular context relating to the vessel.

Dating is required to establish if the coconuts were part of the cargo of the *Rooswijk*, in which case they will date from shortly before AD 1740 and potentially hail from Indonesia. If they are not associated with the *Rooswijk* they could be related to a different, more recent historic wreck or cargo loss, more likely to have been returning from the Caribbean. Alternatively, the coconuts could be modern.

RADIOCARBON DATING

Radiocarbon dating was undertaken on samples of seed testa from two waterlogged coconut shells by the Centre for Isotope Research, University of Groningen, the Netherlands in 2020. Each sample was pretreated using an acid-base-acid protocol (Dee *et al* 2020) and combusted in an elemental analyser (IsotopeCube NCS), coupled to an Isotope Ratio Mass Spectrometer (Isoprime 100). The resultant CO_2 was graphitised by hydrogen reduction in the presence of an iron catalyst (Aerts-Bijma *et al* 1997). The graphite was then pressed into aluminium cathodes and dated by AMS (MICADAS; Synal *et al* 2007; Salehpour *et al* 2016).

Data reduction was undertaken as described by Wacker *et al* (2010). The facility maintains a continual programme of quality assurance procedures (Aerts-Bijma *et al* 2021), in addition to participation in international inter-comparison exercises (Scott *et al* 2017). These tests demonstrate the reproducibility and accuracy of these measurements.

The results are conventional radiocarbon ages, corrected for fractionation using $\delta^{13}C$ values measured by Accelerator Mass Spectrometry (Stuiver and Polach 1977; Table 1). The quoted $\delta^{13}C$ values were measured by Isotope Ratio Mass Spectrometry, and more accurately reflect the natural isotopic composition of the sampled plant macrofossils.

CALIBRATION

Calibration of these results to accurate calendar ages is complex, since it depends on the location where the coconut palms that produced these nuts grew. Cultivated coconuts are globally distributed within the tropics (Gunn *et al* 2011) and were historically imported to northern Europe from India via Portugal or the Mediterranean (Kennedy 2017; Fritz 1983) and increasingly from the sixteenth century onwards, the Caribbean (Laurance 2019). Eighteenth-century Dutch trading vessels could presumably also bring back coconuts from Indonesia.

The Inter-Tropical Convergence Zone (ITCZ) is an asymmetric area of low pressure around the thermal equator where the northeast and southeast trade winds converge. The ITCZ migrates on seasonal and longer timescales (Haug *et al* 2001; Schneider *et al* 2014), and plants growing within the ITCZ are potentially subjected to air masses from different hemispheres at certain times of the year (Marsh *et al* 2018; Hogg *et al* 2020). The present extent of the ITCZ, after the reconstruction of the present zonal boundaries based on wind data discussed by Hogg *et al* (2020), is shown in Reimer *et al* (2020, fig 1).

The Caribbean is clearly north of the ITCZ throughout the year, and Indonesia is clearly within the ITCZ throughout the year. If the sampled coconuts come from the Caribbean, it is appropriate to calibrate these measurements using the atmospheric calibration curve for the northern hemisphere, IntCal20 (Reimer *et al* 2020). Samples that grew within the ITCZ need to be calibrated with a mixture of the northern and southern hemispheric calibration curves, IntCal20 (Reimer *et al* 2020) and SHCal20 (Hogg *et al* 2020). Hogg *et al* (2020, 773–4) suggest a 50%:50% mixture for vegetation, like coconut palms, which grow throughout the year as they should receive northern air masses in December–February and southern air masses in June–August. In contrast, Marsh *et al* (2018, 932–3) suggest a more conservative mixture which allows for the full possible range of ^{14}C input from 100% northern hemisphere to 100% southern hemisphere based upon geographical variations in the mixture of air masses.

The radiocarbon measurements on the two coconut shells have been calibrated using the probability method (Stuiver and Reimer 1993; Bronk Ramsey 2009), and the three different calibration datasets described above (Fig 2; Table 2). Clearly, all the probability distributions of the calibrated dates are multi-modal, allowing the possibility that the sampled coconuts grew at the very end of the seventeenth century or in the early decades of the eighteenth century, or in all but the earliest part of the nineteenth century or the first decades of the twentieth century (Fig 2).

DISCUSSION

Cultivated coconuts originate from the Old-World tropics. Genetic, geographic, and phenotypic diversity of coconuts are consistent with two centres of origin, one in the Indian Ocean, and one in the Pacific Ocean (Gunn *et al* 2011). A population was established around the Indian Ocean by 1000–500 BC, which spread westward via human agency reaching the Caribbean during the sixteenth century (Gunn *et al*

2011; Sauer 1971). A second population, based in the south-west Pacific islands, spread by natural sea born processes across the Pacific Ocean and may have reached the west coast of central America significantly prior to the arrival of Europeans (Baudouin *et al* 2009).

Coconuts were first brought to northern Europe as early as the thirteenth or fourteenth century (Kennedy 2017; Laurance 2019), where they were used for medicines and food, and the empty shells were used as, sometimes elaborate, cups. Examples of carved beakers, mounted cups and fragments of shell, are known from the Netherlands from the sixteenth to the eighteenth centuries (Rijkelijkhuizen and van Wijngaarden-Bakker 2006; Manders and Kuiper 2015; https://www.rijksmuseum.nl/), and from Britain from as early as the thirteenth or fourteenth century (Campbell, 2002, 127–8, n. 4; Kennedy 2017), and more commonly in the fifteenth to nineteenth centuries (Kennedy 2017; Laurance 2019; https://collections.vam.ac.uk/). By the time the *Rooswijk* was in operation, coconuts would have been available from the Caribbean, the Indian Ocean, and the south-west Pacific Ocean islands. Twelve shipwrecks in the Historic England Research Records database from AD 1763 onwards reference coconuts (or cocoanuts) as cargo, all being homeward bound, mostly returning from the Caribbean, with two dating from 1939 returning from the Far East (Historic England Research Records accessed 2020 and 2022; Larn and Larn 1995). In AD 1889, the Norwegian barque, *Ala*, returning from Jamaica and carrying a cargo of coconuts amongst other goods, was burnt off the North Sand Head, some 4km to the north-northwest of the site of the *Rooswijk* wreck; rigging and coconuts were found floating in the sea (Historic England Research Records 881477).

The *Rooswijk* was outward bound, on its second voyage to Indonesia when it sunk on the Goodwin Sands (MSDS Marine Ltd 2017; van Popta 2014). It would, therefore, be hard to explain how the coconuts would be part of its cargo, but if they had, it would be reasonable to assume they derived from Indonesia. The Dutch East Indies company were trading regularly and directly to Indonesia along the Brouwer route, a southerly route that by-passed Madagascar and any Indian or Sri Lankan ports (Parthesius 2010). If the coconuts were part of the cargo of the *Rooswijk*, and derived from Indonesia, then the radiocarbon dating suggests that they would have had to have been a decade or two old when the vessel sank. As there is no evidence that these shells had been mounted as objects, this seems unlikely. In contrast, if the coconuts come from the Caribbean, the source of most imported coconuts recorded from wreck sites in British waters, then the calibrated radiocarbon dates are clearly compatible with them coming from the cargo spillage off the Goodwin Sands in AD 1889. We suggest that the latter interpretation is the more plausible.

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TABLES

Table 1: Radiocarbon measurements and associated stable isotope values from the two coconut shells recovered in the vicinity of the wreck of the Rooswijk

Laboratory Number	Sample and context details	Radiocarbon Age (BP)	$\delta^{13}C_{IRMS}$ (‰)
GrM-22140	*Cocos nucifera* seed testa from one of five coconut shells recovered from the mobile sea-bed within the wreck debris of the Rooswijk vessel on the Goodwin Sands in 2017–18	108±24	−27.84±0.15
GrM-22141	*Cocos nucifera* seed testa from one of five coconut shells recovered from the mobile sea-bed within the wreck debris of the Rooswijk vessel on the Goodwin Sands in 2017–18 (different coconut from GrM-22141)	119±24	−25.91±0.15

Table 2: Calibrated radiocarbon dates of the radiocarbon measurements from the two coconut shells recovered in the vicinity of the wreck of the Rooswijk, if derived from Jamaica (IntCal20) or Indonesia (50%:50% (Hogg et al *2020) or 0–100% (Marsh* et al *2018) mixture of IntCal20 and SHCal20)*

	GrM-22140	GrM-22141
	95% probability	95% probability
Jamaica (IntCal20)	1685–1733 cal AD (25%) or 1805–1928 cal AD (70%)	1683–1738 cal AD (25%) or 1755–1761 cal AD (1%) or 1801–1939 cal AD (69%)
Indonesia Marsh *et al* (2018)	1692–1728 cal AD (20%) or 1809–1927 cal AD (75%)	1689–1730 cal AD (21%) or 1808–1931 cal AD (73%) or 1934–1941 cal AD (1%)
Indonesia Hogg *et al* (2020)	1694–1727 cal AD (20%) or 1810–1926 cal AD (75%)	1690–1729 cal AD (22%) or 1808–1930 cal AD (73%)

FIGURES

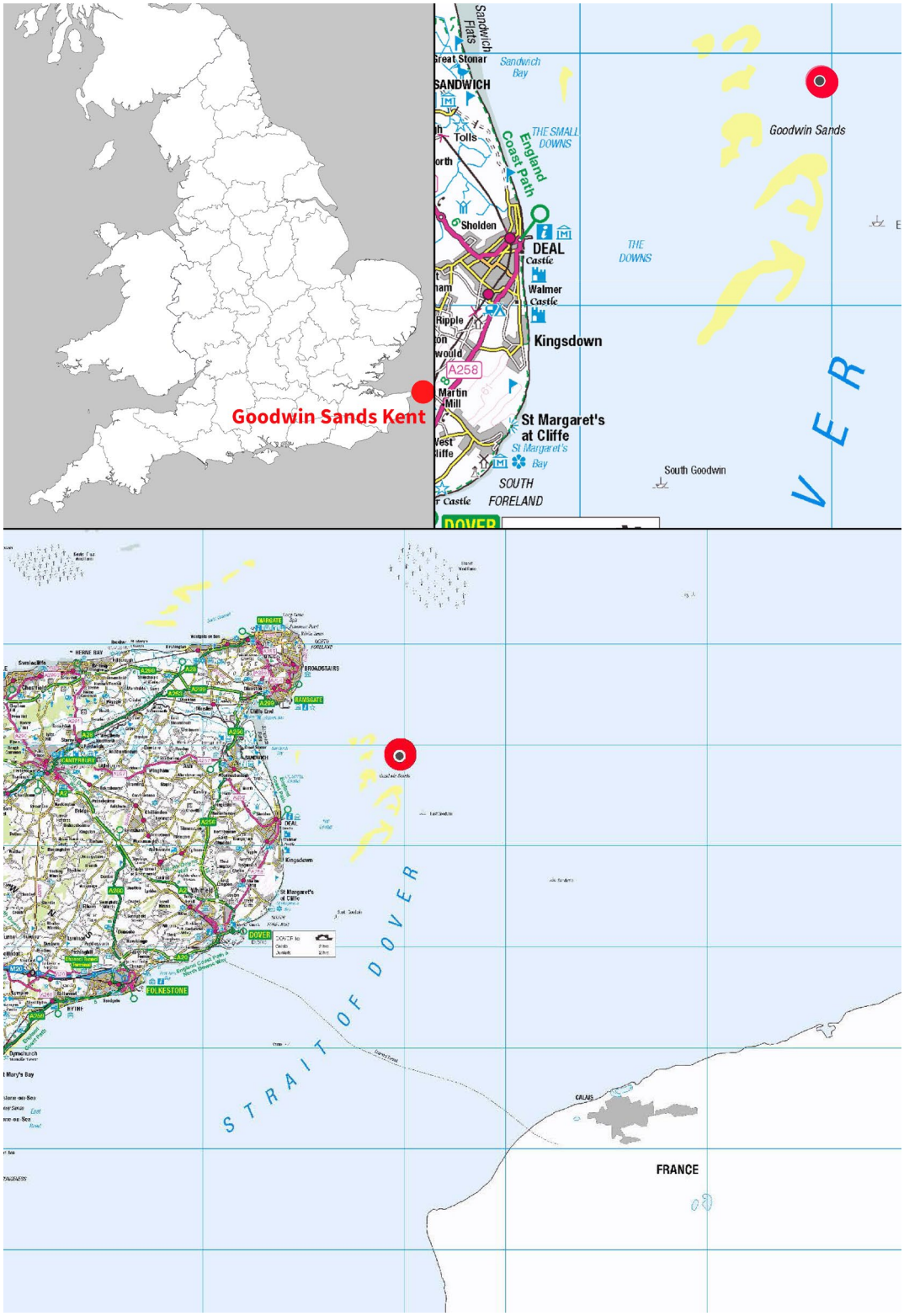

Figure 1: Maps to show the location of Rooswijk on the Goodwin Sands off the coast of Kent, South East England, marked in red. Scale: top right 1:200,000, bottom 1:5000,000 © Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900

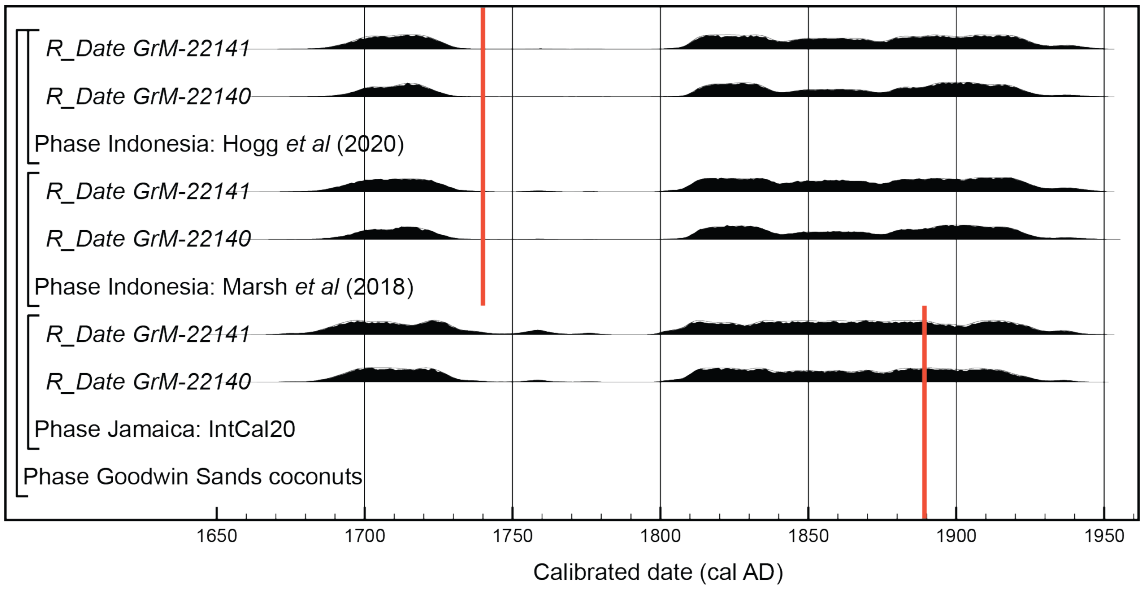

Figure 2: Probability distributions of dates from the two coconut shells recovered on the Goodwin Sands in the vicinity of the wreck of the Rooswijk, if derived from Jamaica (IntCal20) or Indonesia (50%:50% (Hogg et al *2020) or 0-100% (Marsh* et al *2018) mixture of IntCal20 and SHCal20). The red lines indicate the sinking of the Rooswijk in AD 1740 and the spillage from the Norwegian vessel in AD 1889.*

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