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Point Clear, River Colne, Essex

Radiocarbon dating of waterlogged timbers

Peter Marshall, Oliver Hutchinson, Danielle Newman, Gill Campbell, Sanne Palstra and Lukas Wacker

Scientific Dating

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Summary

Four groups of worked wood exposed at –1.61mOD by aggressive tidal scour on the open foreshore at Point Clear on the River Colne, Essex were surveyed and sampled by CITiZAN and local volunteers. Radiocarbon dating and chronological modelling estimates that the three dated features groups (1–3) were constructed in the second half of the sixth century cal AD. The function of the structures is unclear, although possibly linked to the extensive fishing industry operational at the time in the Blackwater estuary.

Contributors

Peter Marshall, Oliver Hutchinson, Danielle Newman, Gill Campbell, Sanne Palstra and Lukas Wacker

Acknowledgements

The survey of Point Clear was made possible by the dedicated Mersea Island Discovery Programme volunteer team. Their diligent and dedicated observation and monitoring of sites across the Blackwater foreshore have proved invaluable in recording Point Clear and many more sites of significance in the area. Huge thanks go to Mark and Jane Dixon, James Pullen, John Pullen-Appleby, Carol Wyatt, Alan Williams and Geoff Lunn.

Valuable comments and insightful feedback on a draft of this report was provided by Marcus Jecock (Historic England) whose expertise and support were invaluable in shaping CITiZAN.

Front cover photo

The front cover photo shows the view north-east across the site with CITiZAN archaeologist Oliver Hutchinson supported by volunteer James Pullen on 12th February 2020 (photograph taken by Jane Dixon).

Archive location

Historic England, The Engine House, Fire Fly Avenue, Swindon, SN2 2EH

Historic environment record

Essex HER, Historic Environment Specialist Team, Place Services, County Hall, Chelmsford, Essex, CM1 1QH

Date of survey & research

Point Clear was visited several times by CITiZAN between 2020 and 2022. The samples dated in this report were obtained in January 2020 whilst a more complete site survey was conducted on the 12th February 2020.

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Introduction

Point Clear is located on estuarine mudflats 15km south of Colchester on the eastern bank of the Colne estuary by the mouth of Brightlingsea Creek at TM 08299 15344 (Fig.1). The site is *c.* 20m from the Mean Low Water line (MLW) and occupies an area of soft to stable mud and is bounded to the south and east by a dense natural oyster reef. Over 300 upright and horizontal timbers that form four distinct feature groups were observed within an area roughly 100m^2:

- a circular feature diameter 17m; Feature group 1 (Figs 2–3);
- two intersecting single rows of posts *c*.18m long; Feature group 2 (Figs 2–3);
- a scattered group of structural timbers; Feature group 3 (Figs 2–3);
- a wattle trackway Feature group 4 (Figs 2–3).

First observed by a volunteer, Alan Williams, in October 2019, the site was subsequently brought to the attention of CITiZAN (Coastal and Intertidal Zone Archaeological Network) and a rapid two-day survey undertaken at the next sufficiently low tide in February 2020. The site is only accessible with low tides of 0.4mOD and below, and then only for a couple of hours unless a favourable offshore wind extends the workable tidal window. The site survey was made possible by the dedicated work of a group of six local CITiZAN volunteers over two days with three-hour tidal windows. A high precision GPS survey, a high-resolution aerial survey, three small archaeological interventions and detailed recordings of several larger timbers were undertaken by the team under the supervision of CITIAN archaeologists Oliver Hutchinson and Danielle Newman.

Four feature groups were identified during the survey and are described below (see also Hutchinson and Newman 2023, §3)

Feature group 1

A circular structure 17m in diameter comprising 172 vertically set roundwood piles which were on average 90mm in diameter, was exposed to a height of *c.* 300mm and spaced relatively uniformly *c.* 400 mm apart (Fig. 4). An arc of 15 piles were observed set 0.6m outward of the main circle with particular concentrations in the northern and western quadrants. Four uprights were observed set 2m inside the circle and mirroring its curvature. Wattle-work was observed laying on the exposed foreshore surface in several locations around the structure (Fig. 4). In other areas it was still *in situ*, woven between

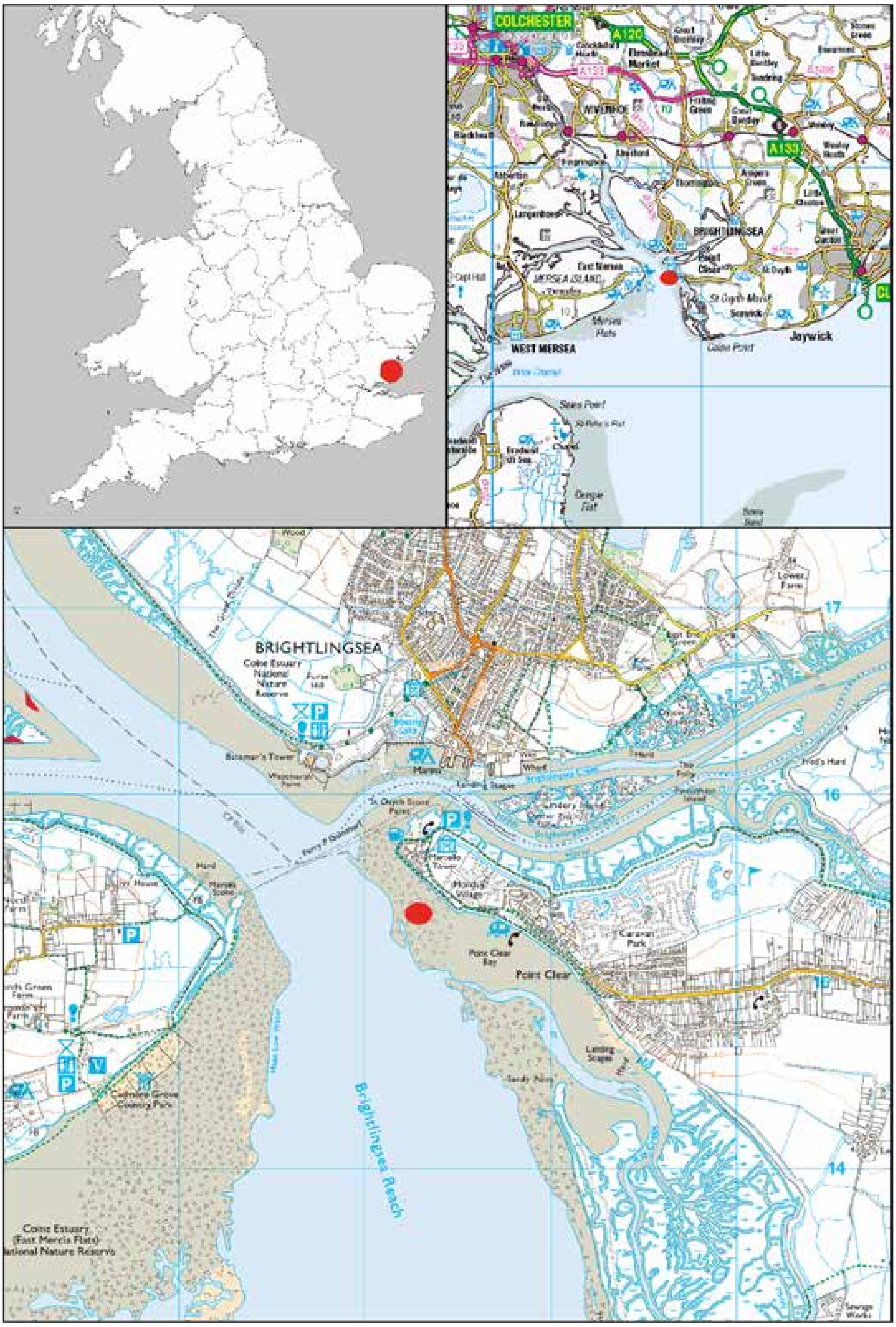

Figure 1: Maps to show the location of Point Clear, River Colne, Essex England, marked in red. Scale: top right 1:211,654, bottom 1:26,457 © Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900.

Figure 2: Point Clear site plan (© O Hutchinson).

Figure 3: Feature groups 1–4 (© O Hutchinson).

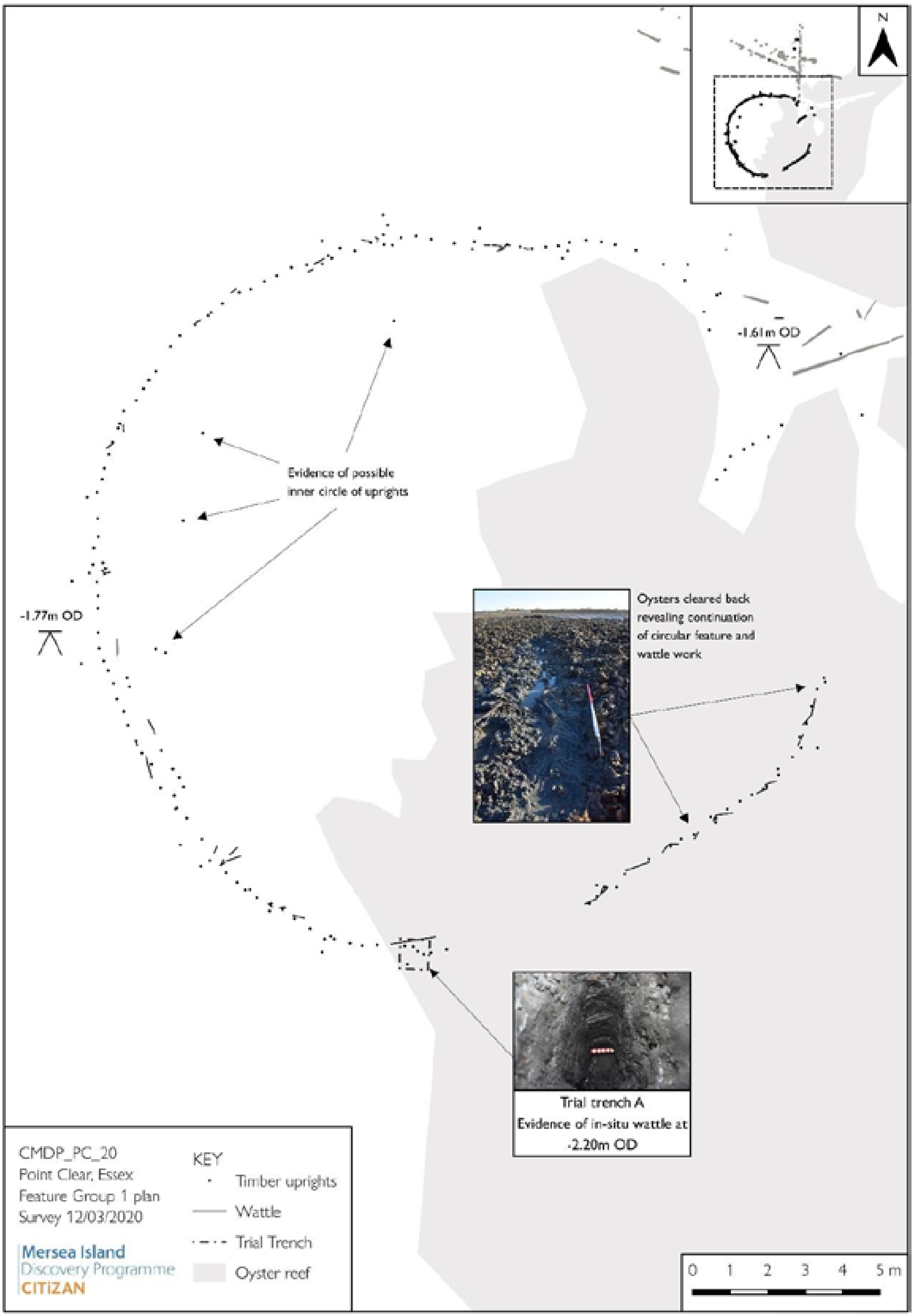

Figure 4: Feature group 1 (© O Hutchinson).

some of the upright piles. A row of seven posts on a roughly southwest–northeast alignment measuring 2.3m long was recorded, probably intersecting with the circular feature beneath the oyster reef. The posts are of similar character to those comprising the circular feature and thus may be contemporary, representing another element of the structure. Oysters were cleaned back in the south-east quadrant, which revealed a continuation of the feature with particularly well-preserved wattles woven between the uprights (Fig. 4). A 300mm x 300mm x 500mm archaeological intervention (Trial trench A; Fig. 4) revealed wattles *in situ*, woven directly into the upright frame of the superstructure to a depth of 500mm (trench bottom) at −2.20m OD. These wattles averaged 30mm diameter and were neatly and tightly woven, and incorporated the outer bracing timbers, presumably providing stability for the structure. The wattle-work continued below the bottom of the trench to an unknown depth and comprised coppiced hazel in an excellent state of preservation. Since wattle-work was exposed above the surface of the foreshore at many points around the circumference of the circular feature, it is likely that more wattle-work is present and *in situ* below the foreshore, suggesting the basal elements of the structure remain largely intact and well protected.

Feature group 2

Some of the structural elements of Feature group 2 show parallels with intertidal fish traps found around the English coastline, notably those in the Blackwater estuary (Hall and Clark 2000; Heppell 2011; Heppell and Brown 2008; Ingle and Saunders 2011; Strachan 1998). The intersecting rows (Fig. 5) could be interpreted as forming the typical V-shape of a kiddle trap, funnelling the fish to the end at the apex, in this case the south-eastern intersection. However, the uprights average diameter 65mm, are likely too slight to withstand the forces placed on such structures during the ebb tide.

The brushwood found at the base of Trench C (Figs 5–6) is difficult to interpret given the limited size of the trench. The sands, gravels and shells underlying it suggest it may have been laid as a platform to access the tidal Colne or to provide the base for a larger structure. The size, character, and arrangement of the brushwood at the base of trench C is markedly different from that found in the first 200mm of the trench and it seems reasonable to suggest, albeit given limited evidence, that this is an earlier feature in a sealed context (Fig. 7).

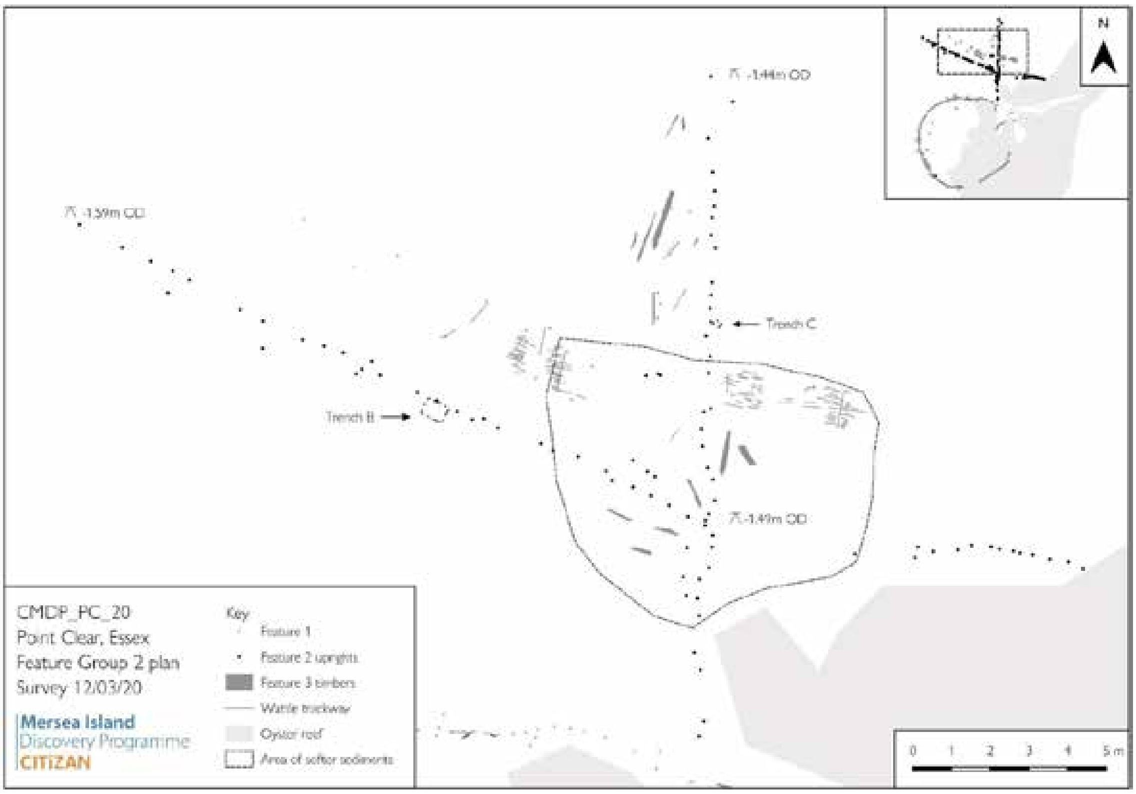

Figure 5: Feature group 2 (© O Hutchinson).

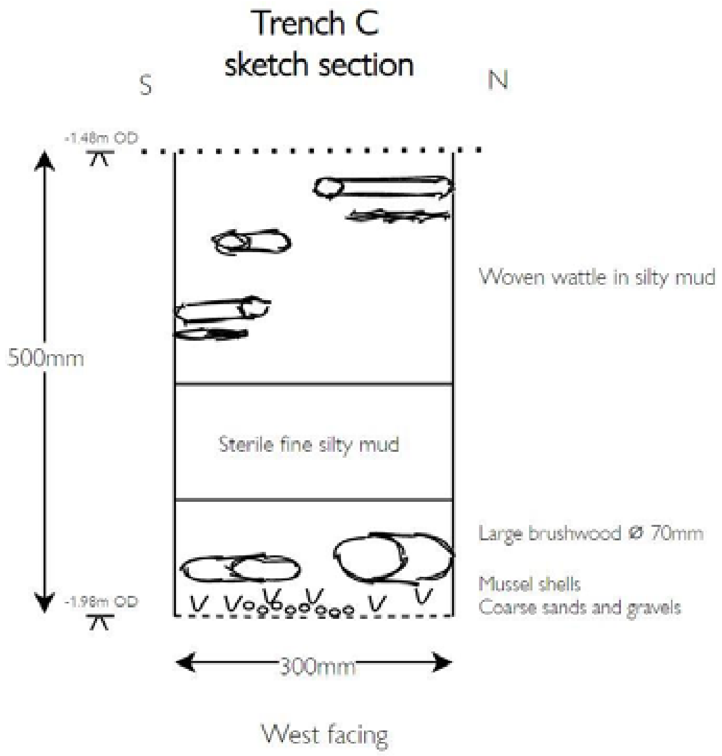

Figure 6: Trench C sketch section (© O Hutchinson).

Figure 7: Trial Trench C in oblique section showing sealing band of sterile mud (left) and trial Trench C in section showing larger diameter brushwood resting on horizon of coarse sand, gravel, and shells (right) (© O Hutchinson).

Feature group 3

Two groups of scattered, larger timbers that appear structural in nature form Feature group 3 (Fig. 8). One group is clustered around the north–south post alignment of Feature group 2 and contains roughly worked large timbers. The second group is directly to the east of circular feature 1 and consists of timbers, in the round, with tool marks where the ends are worked (Fig. 8). These appear to be part of a fence or possibly rafters for the roof of a larger structure.

Figure 8: Feature group 3 (© O Hutchinson).

Feature group 4

Feature group 4 is formed of two sections of wattle hurdle trackway made of coppiced hazel rods (Fig. 9). The panels are of single rod-and-sail design, and tool marks are evident on both rods and sails, with the tips of some rods worked to a point. The tool marks may be too small to be diagnostic. Small roundwood uprights, likely pegs that pinned the walkway to the ground, mark out the original position and alignment of the trackway where the wattles have since eroded away to the west.

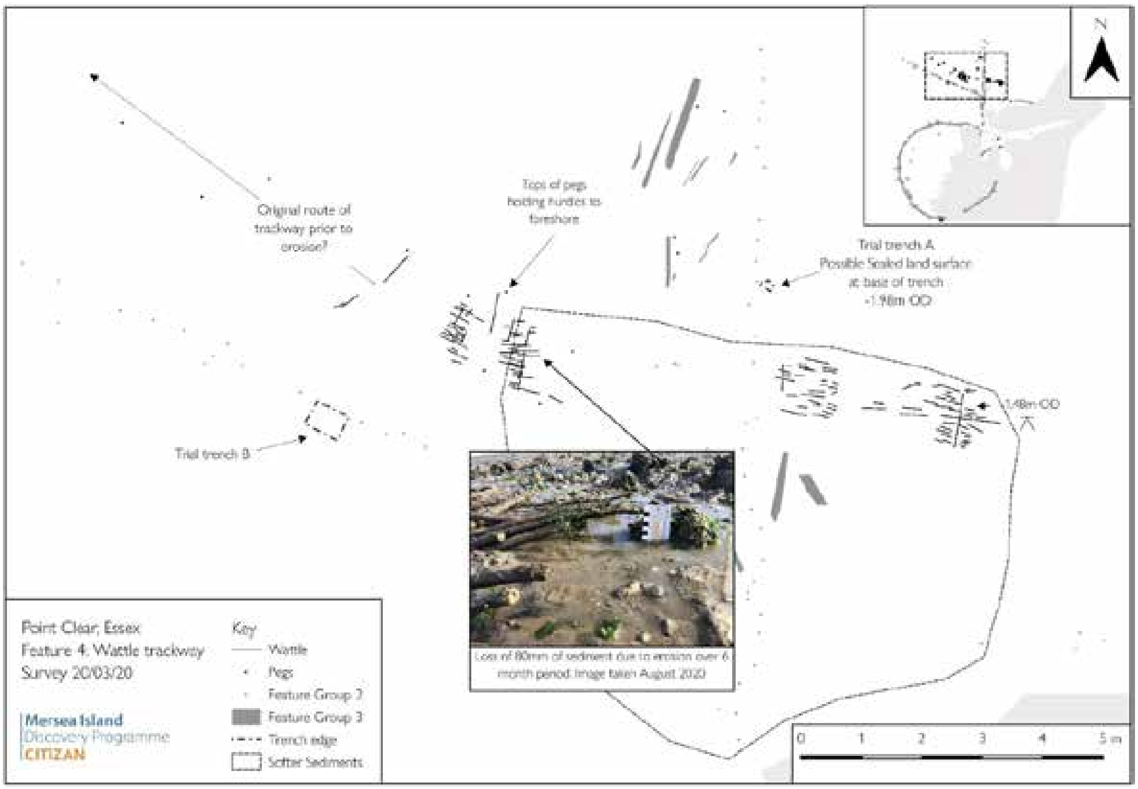

Figure 9: Feature group 4 (© O Hutchinson).

Sampling

Given “intertidal archaeology is essentially a guerrilla technique” (Wilkinson and Murphy 1986, 179), three small archaeological interventions and detailed recording of several larger timbers at Point Clear was undertaken in tandem with the high precision GPS survey and high-resolution aerial survey in order to obtain samples for scientific dating and palaeoecological analysis (Tables 1–4).

Table 1: Feature group 1 (circular timber feature comprising uprights and wattles) samples (see Figs 4 and 10)

Sample Number	Description
1	Upright timber 1
2	Upright timber 2
3	Upright timber 3
4	Upright timber 4
5	Upright timber 5
6	Upright timber 6
7	Wattle 1
8	Wattle 2
9	Wattle 3
39	Trench A/Sample 1, sampled February 2020, 200mm subsurface, wattle
40	Trench A/Sample 2, sampled February 2020, 300mm subsurface, wattle
41	Trench A/Sample 1, sampled February 2020, 500mm subsurface, wattle

Table 2: Feature group 2 (linear timber features) samples (see Figs 5–7 and 10)

Sample number	Description
10	Upright timber 1
11	Upright timber 2
12	Upright timber 3
13	Upright timber 4
14	Upright timber 5
15	Upright timber 6
16	Wattle 1
17	Wattle 2
18	Wattle 3
19	Wattle 4
20	Wattle 5
21	Wattle 6
34	V shaped timber
35	Trench C/ Sample 5, environmental sample, 400mm subsurface above sample 36
36	Trench C/ Sample 6, brushwood taken at base of trench 450mm subsurface
37	Trench C/ Sample 7, environmental sample, contains shells, taken at base of trench below sample 36
38	Trench C/ Sample 4, brushwood taken from 200mm subsurface (sample taken in February 2020)

Table 3: Feature group 3 (scattered larger timbers) samples (see Figs 8 and 10)

Sample number	Description
22	Horizontal timber 1
23	Horizontal timber 2
24	Horizontal timber 3
25	Horizontal timber 4, roundwood, worked tip
26	Horizontal timber 5, possible worked point
27	Horizontal timber 6

Table 4: Feature group 4 (wattle hurdle trackway) samples (see Figs 9–10)

Description	Sample number
28	Wattle 1
29	Wattle 2
30	Wattle 3
31	Wattle 4
32	Wattle 5
33	Wattle 6

Radiocarbon dating sampling

Samples for radiocarbon dating were selected from three Feature groups (1–3) with the aim of understanding their date, their chronological relationships with each other and to situate them within the contemporary timescape of intertidal activity on the coast of this part of Essex.

Feature group 1

Five samples were selected for scientific dating from Feature group 1 (Table 1); a circular structure 17m in diameter comprising 172 vertically set roundwood piles, with wattle-work clearly woven between at least some of the upright piles.

- Upright (sample 2; Fig. 10);
- Wattle samples 8 (Fig. 10), 39 (Fig. 10), 40 (Fig. 10) and 41 (Fig. 10).

Feature group 2

Two samples were selected for scientific dating from Feature group 2 (Table 2); two single rows of upright posts *c*. 18m long on N–S and NW–SE alignments, with coppiced hazel wattles exposed on the surface and woven between the uprights.

- Horizontal brushwood from the base of Trench C, 450mm below surface (sample 36; Fig. 10);
- Wattle sample 38 (Fig. 10).

Feature group 3

Fives samples were selected for scientific dating from Feature group 3 (Table 3); two groups of scattered, larger timbers that appear structural in nature.

- Upright (sample 23; Fig. 10);

- Upright (sample 25; Fig. 10);
- Upright (sample 34; Fig. 10);
- Wattle (sample 28; Fig. 10);
- Wattle (sample 30; Fig. 10).

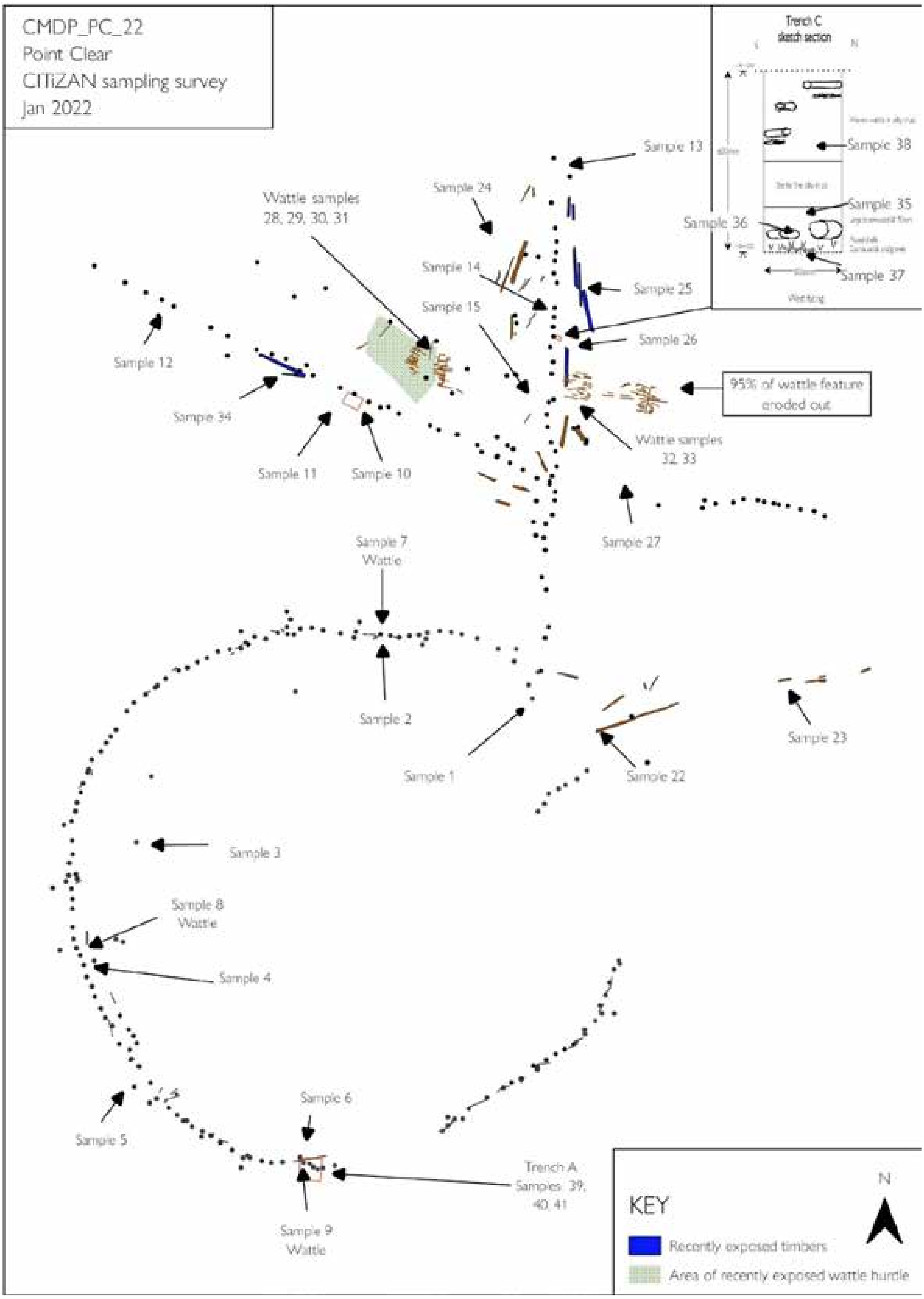

Figure 10: Location of samples taken at Point Clear (see Tables 1–4) (© O Hutchinson).

Wood identification

Wood identifications were carried out by Gill Campbell on the seven wattle samples prior to their submission for radiocarbon dating (Table 5). Thin sections were taken by hand using a double-edged razor blade, from the three planes of wood required for secure identifications: the transverse section (TS), radial longitudinal section (RLS) and the transverse longitudinal section (TLS). These were then examined under high power magnification (×100–400) using a Leica DM2500. Identifications were made using a combination of the texts and keys by Schweingruber (1982) and Gale and Cutler (2000) and the reference material from Historic England's Wood and Charcoal Reference Collection.

Table 5: Point Clear wood identifications

Feature Group	Sample	Identification	No of growth rings	Bark & pith present	Diameter minimum (mm)	Diameter maximum (mm)
1	8	Pomoideae	15	Yes	35.77	38.40
3	28	*Betula* sp.	7	Yes	15.12	16.07
3	30	*Corylus* sp.	5	Yes	16.36	21.89
2	38	Pomoideae	6	Yes	21.44	27.77
2	39	? *Rosa* sp.	11	Yes	18.91	16.37
2	40	Pomoideae	8	Yes	14.94	13.68
2	41	Pomoideae	10	Yes	15.12	16.07

Three wood types were identified (Table 5), all of which are hardwoods: *Betula* sp. (birch) *Corylus* sp. (hazel) and Pomoideae (hawthorn, crab apple, pear, *Sorbus* species etc.). One sample was tentatively identified as ?*Rosa* sp. In Britain, there are three native *Betula* tree species: *Betula pubescens*, *Betula pendula* and *Betula nana*. *Betula pubescens* (downy birch) and Betula pendula (silver birch) are common, widespread and often sympatric or parapatric, with the former adapted to wetter and colder habitats than the latter (Atkinson 1992; Wang et al. 2014). *Corylus* has only one native species (Stace 1977, 127); the native hazel *Corylus avellana* (hazel). Pomoideae is a subfamily of flowering plants in the family Rosaceae and includes several fruit-bearing trees such as apples, pears, and quinces, as well as hawthorn and *Sorbus* species, such a whitebeam, The five timbers sub-sampled for radiocarbon wiggle-matching (see Wiggle matching – below) were all identified as *Quercus* (oak). In the British Isles, the only native oaks are *Q. petraea* (sessile oak) and *Q. robur* (pedunculate oak) (Gale and Cutler 2000, 204).

Radiocarbon dating

Radiocarbon dating is based on the radioactive decay of ^{14}C, which trees absorb from the atmosphere during photosynthesis and store in their growth-rings. The radiocarbon from each year is stored in a separate annual ring. Once a ring has formed, no more ^{14}C is added to it, and so the proportion of ^{14}C versus other carbon isotopes reduces in the ring through time as the radiocarbon decays. Radiocarbon ages, like those in Table 6, measure the proportion of ^{14}C in a sample and are expressed in radiocarbon years BP (before present, 'present' being a constant, conventional date of AD 1950).

Radiocarbon measurements have been obtained on the outer rings and bark from wattle samples identified by Gill Campbell and from single annual tree-rings of known distances from the outside of the parent tree from timbers, with dissection undertaken by Robert Howard at the Nottingham Tree-Ring Dating Laboratory. Annual growth rings were split from the rest of the tree-ring sample using a chisel or scalpel blade. Each radiocarbon sample consisted of a complete annual growth ring, including both earlywood and latewood.

Radiocarbon dating was undertaken at the Centre for Isotope Research, University of Groningen, the Netherlands and the Laboratory of Ion Beam Physics, ETH Zürich, Switzerland in 2022. At ETH Zürich cellulose was extracted from each ring using the base-acid-base-acid-bleaching (BABAB) method described by Němec et al. (2010), combusted and graphitised as outlined in Wacker et al. (2010a), and dated by Accelerator Mass Spectrometry (Synal et al. 2007; Wacker et al. 2010b).

At the Centre for Isotope Research the samples were pretreated using an acid-base-acid protocol (4% HCl, 1% NaOH, <1% HCl) followed by bleaching (Dee et al. 2020, 67–8) 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. The graphite was then pressed into aluminium cathodes and dated by AMS (Synal et al. 2007; Salehpour et al. 2016).

Data reduction was undertaken at both laboratories as described by Wacker et al. (2010c). Both facilities maintain continual programmes of quality assurance procedures, in addition to participation in international inter-comparison exercises (Scott et al. 2017). Details of quality assurance data and error calculation at Groningen are provided by Aerts-Bijma et al. (2021), and similar details for ETH are provided in Sookdeo et al. (2020).

Details of the radiocarbon ages and associated stable isotopic measurements are provided in Table 6. The radiocarbon results are conventional radiocarbon ages (Stuiver and Polach 1977), corrected for fractionation using $\delta^{13}C$ values measured by AMS. At the University of Groningen $\delta^{13}C$ values were also measured by Isotope Ratio Mass Spectrometry. These values more accurately reflect the natural isotopic composition of the sampled wood.

Table 6: Point Clear radiocarbon and associated stable isotope measurements

Laboratory Number	**Sample**	**Radiocarbon Age (BP)**	**$\delta^{13}C_{IRMS}$ (‰)**	**$\delta^{13}C_{AMS}$ (‰)**
Feature group 1				
GrM-29639	8.1. Waterlogged wood, Pomoideae, 15 annual rings, bark and outermost ring dated (G Campbell) from wattle hurdle	1485±18	−27.1±0.15	
GrM-29638	40.1. Waterlogged wood, Pomoideae, 8 annual rings, bark and outermost ring dated (G Campbell) from wattle hurdle	1506±18	−28.3±0.15	
ETH-123024	2R1. Waterlogged wood, *Quercus* sp., 10 annual rings, ring 1 dated (R Howard) from vertical post (sample 2; Fig. 10)	1513±19	-	−25.5
GrM-29788	2R10. Waterlogged wood, *Quercus* sp., 10 annual rings, ring 10 dated (R Howard) from vertical post (sample 2; Fig. 10)	1465±21	−29.1±0.15	
ETH-122535	39.1. Waterlogged wood, ? *Rosa* sp. 11 annual rings, bark and outermost ring dated (G Campbell) from wattle hurdle sample 39; Fig. 10)	1531±16	-	−28.4
ETH-122536	41.1. Waterlogged wood, Pomoideae, 10 annual rings, bark and outermost ring dated (G Campbell) from wattle hurdle sample 39; Fig. 10)	1502±15	-	−28.5
Feature group 2				
GrM-29637	38.1. Waterlogged wood, Pomoideae, 6 annual rings, bark and outermost ring dated (G Campbell) from woven wattle (sample 38; Fig. 10)	1490±18	−25.8±0.15	
GrM-29794	36R1. Waterlogged wood, *Quercus* sp., 7 annual rings, ring 1 dated (R Howard) from horizontal post (sample 36; Fig. 10)	1491±21	−25.8±0.15	

Laboratory Number	**Sample**	**Radiocarbon Age (BP)**	**$\delta^{13}C_{IRMS}$ (‰)**	**$\delta^{13}C_{AMS}$ (‰)**
ETH-123028	36R7. Waterlogged wood, *Quercus* sp., 7 annual rings, ring 7 dated (R Howard) from horizontal post (sample 36; Fig. 10)	1506±19	-	−24.0
Feature group 3				
GrM-29789	23R1. Waterlogged wood, *Quercus* sp., 10 annual rings, ring 1 dated (R Howard) from vertical post (sample 23; Fig. 10)	1518±21	−28.5±0.15	
ETH-123025	23R10. Waterlogged wood, *Quercus* sp., 10 annual rings, ring 10 dated (R Howard) from vertical post (sample 23; Fig. 10)	1488±19	-	−26.6
GrM-29792	25R1. Waterlogged wood, *Quercus* sp., 13 annual rings, ring 1 dated (R Howard) from vertical post (sample 25; Fig. 10)	1501±21	−27.5±0.15	
ETH-123026	25R13. Waterlogged wood, *Quercus* sp., 13 annual rings, ring 13 dated (R Howard) from vertical post (sample 25; Fig. 10)	1485±20	-	−23.1
GrM-29793	34R1. Waterlogged wood, *Quercus* sp., 15 annual rings, ring 1 dated (R Howard) from vertical post (sample 34; Fig. 10)	1472±21	−26.2±0.15	
ETH-123027	34R15. Waterlogged wood, *Quercus* sp., 15 annual rings, ring 15 dated (R Howard) from vertical post (sample 34; Fig. 10)	1510±19	-	−24.2
ETH-122533	28.1. Waterlogged wood, *Betula* sp. 7 annual rings, outer 2 rings dated (G Campbell) from wattle hurdle (sample 28; Fig. 10)	1494±16	-	−31.5
ETH-122534	30.1. Waterlogged wood, *Betula* sp., 7 annual rings, outer ring 2 dated (G Campbell) from wattle hurdle sample 30; Fig. 10)	1451±15	-	−29.9

Wiggle-matching

Radiocarbon ages are not the same as calendar dates because the concentration of ^{14}C in the atmosphere has fluctuated over time. A radiocarbon measurement has thus to be calibrated against an independent scale to arrive at the corresponding calendar date. That independent scale is the IntCal20 calibration curve (Reimer et al. 2020). For the period covered by this study, this is constructed from radiocarbon measurements on tree-ring samples dated absolutely by dendrochronology. The probability distributions of the calibrated radiocarbon dates are derived from the probability method (Stuiver and Reimer 1993) and are shown in outline on the relevant figures.

Wiggle-matching is the process of matching a series of calibrated radiocarbon dates, which are separated by a known number of years, to the shape of the radiocarbon calibration curve. At its simplest, this can be done visually, although statistical methods are usually employed. Floating tree-ring sequences are particularly suited to this approach as the calendar age separation of tree-rings submitted for dating is known precisely by counting the rings in the timber. A review of the method is presented by Galimberti et al. (2004).

The approach to wiggle-matching adopted here employs Bayesian chronological modelling to combine the relative dating information provided by the tree-ring analysis with the calibrated radiocarbon dates (Christen and Litton 1995). It has been implemented using the program OxCal v4.4 (http://c14.arch.ox.ac.uk/oxcal.html; Bronk Ramsey et al. 2001; Bronk Ramsey 2009). The modelled dates are shown in black on the relevant figures and quoted in italics in the text. The Acomb statistic shows how closely the assemblage of calibrated radiocarbon dates as a whole agree with the relative dating provided by the tree-ring analysis that has been incorporated in the model; an acceptable threshold is reached when it is equal to or greater than An (a value based on the number of dates in the model). The A statistic shows how closely an individual calibrated radiocarbon date agrees its position in the sequence (most values in a model should be equal to or greater than 60).

Radiocarbon wiggle-matching results

Figure 11 illustrates the chronological models for the “mini” wiggle-matches undertaken on timber samples 2, 23, 25, 34 and 36. These models incorporate the gaps between each dated annual ring known from tree-ring counting (e.g. for sample 2 that the carbon in ring one of the tree-ring series (ETH-123024) was laid down nine years before the carbon in ring ten of the series (GrM-29788); Fig. 11), with the radiocarbon measurements (Table 6) calibrated using the internationally agreed radiocarbon calibration data for the northern hemisphere, IntCal20 (Reimer et al. 2020). The full OxCal CQL2 code for the models is given in Appendix 1.

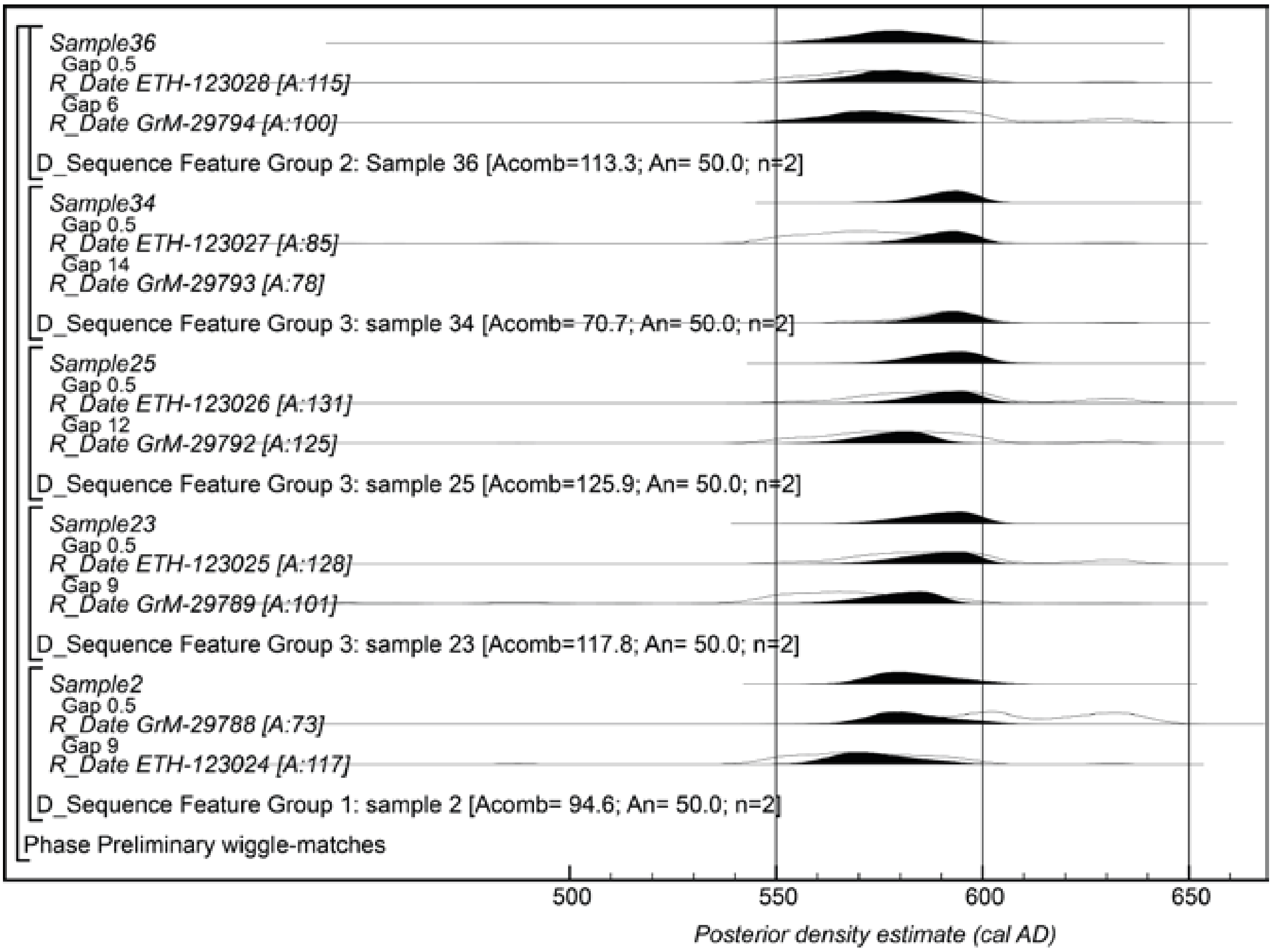

Figure 11: Probability distributions of dates from Point Clear: wiggle-matches.
Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one, based on the chronological model used. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly (© Historic England).

Sample 2

The model for sample 2 has good overall agreement (Acomb: 94.6, An: 50.0, n: 2; Fig. 11), with both radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of sample 2 formed in *cal AD 565–615* (*95% probability*; *Sample2*; Fig. 11), probably in *cal AD 575–605* (*68% probability*).

Sample 23

The model for sample 23 has good overall agreement (Acomb: 117.8, An: 50.0, n: 2; Fig. 11), with both radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of sample 23 formed in *cal AD 555–605* (*95% probability*; *Sample23*; Fig. 11), probably in *cal AD 570–600* (*68% probability*).

Sample 25

The model for sample 25 has good overall agreement (Acomb: 125.9, An: 50.0, n: 2; Fig. 11), with both radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of sample 25 formed in *cal AD 560–610* (*95% probability*; *Sample25*; Fig. 11), probably in *cal AD 575–605* (*68% probability*).

Sample 34

The model for sample 34 has good overall agreement (Acomb: 70.7, An: 50.0, n: 2; Fig. 11), with both radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of sample 34 formed in *cal AD 560–610* (*95% probability*; *Sample34*; Fig. 11), probably in *cal AD 580–605* (*68% probability*).

Sample 36

The model for sample 36 has good overall agreement (Acomb: 113.3, An: 50.0, n: 2; Fig. 11), with both radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of sample 36 formed in *cal AD 555–605* (*95% probability*; *Sample36*; Fig. 11), probably in *cal AD 570–600* (*68% probability*).

Chronological modelling

Estimates for the date of formation of the final rings from the “mini” wiggle-matches undertaken on timber samples 2, 23, 25, 34 and 36 were then incorporated with the radiocarbon dates for the wattle samples in a single model for activity at Point Clear. The chronological modelling has been undertaken using OxCal 4.4 (Bronk Ramsey 1995; 2009), and the internationally agreed calibration curve for terrestrial samples from the northern hemisphere (IntCal20; Reimer et al. 2020). The model is defined by the OxCal CQL2 keywords and by the brackets on the left-hand side of Figure 12. In the diagram, calibrated radiocarbon dates are shown in outline and the posterior density estimates produced by the chronological modelling are shown in solid black. The Highest Posterior Density intervals which describe the posterior distributions are given in italics.

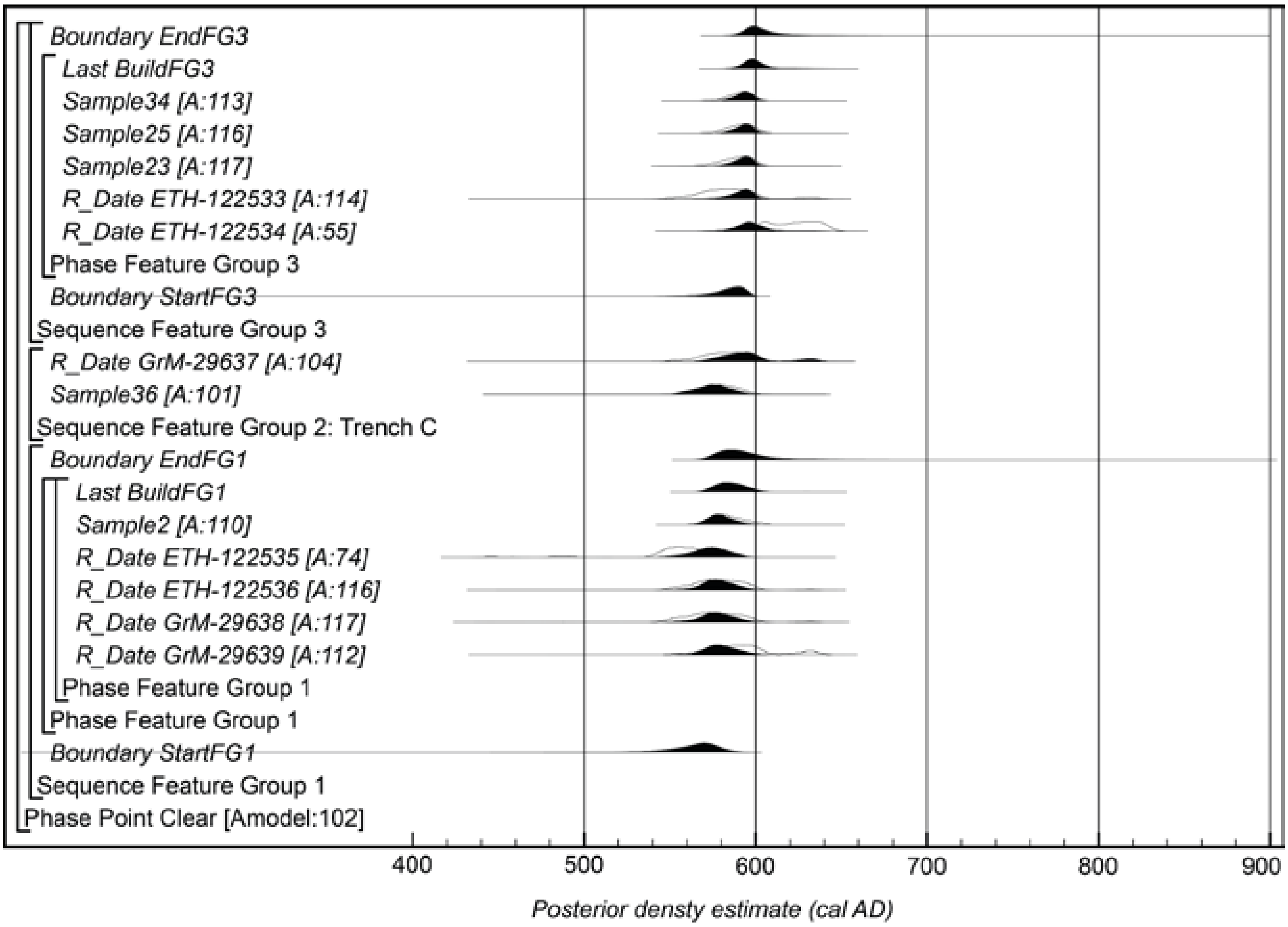

Figure 12: Probability distributions of dates from Point Clear.
Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one, based on the chronological model used. The distributions for Samples 2, 23, 24, 34 and 36 are derived from the model shown in Figure 11. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly (© Historic England).

The model shown in Figure 12 has good overall agreement (Amodel: 102) with all the individual dates having good individual agreement (A: > 60.0) apart from one (ETH-122534; A:55). The A statistic shows how closely an individual calibrated radiocarbon date agrees its position in the model (most values should be equal to or greater than 60). The Amodel statistic is calculated for the model from the individual indices of agreement and provides a measure of the consistency between the prior information and radiocarbon dates (Bronk Ramsey 2009, 357). The model index of agreement has a threshold value 60 and models with lower values need to be critically re-examined.

Assuming a unitary construction for Feature group 1 the model suggests that it was constructed in *cal AD 565–605* (*95% probability*; *BuildFG1*; Fig. 12) probably in *cal AD 575–595* (*68% probability).* The single dated timber, *Sample36*, from the base of Trench

C, part of Feature group 2 was felled in *cal AD 555–595* (*95% probability*; *Sample36*; Fig. 12), probably in cal AD 560–590 (*68% probability).* and the woven wattle from the stratigraphically later feature dates to *cal AD 565–610* (*83% probability*; *GrM-29637; Fig. 11) or cal AD 620–640 (12% probability), probably to cal AD 575–605* (*68% probability).* Assuming a unitary construction for Feature group 3 the model suggests that it was constructed in *cal AD 580–620* (*95% probability*; *BuildFG3*; Fig. 12) probably in *cal AD 590–605* (*68% probability).*

The dynamic nature of change in the intertidal zone is exemplified by the submerging a potentially earlier land surface in Trench C at −1.98m OD (Fig. 6) by the deposition of *c.* 150mm extremely fine, dark sterile silts above the coarse sands, shells and brushwood. The model estimates that these sands accumulated over an interval of *1–60 years* (*95% probability*; *Silt*; Fig. 13) probably *1–25 years* (*68% probability*) before the construction of the woven wattles.

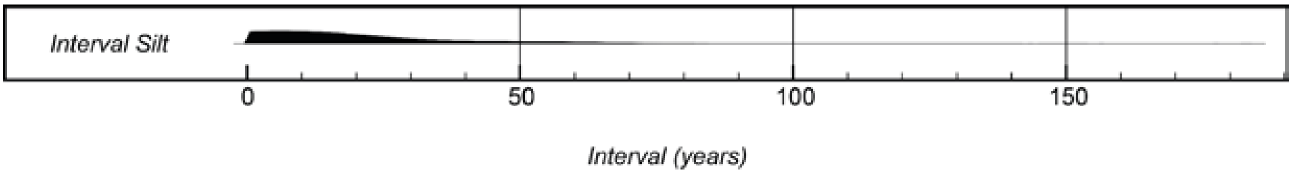

Figure 13: Probability distribution for the number of years it took the silt deposit in Trench C (Feature group 2) to accumulate, derived from the model defined in Figure 12.

Figure 14 shows a summary of the key dated constructional events at Point Clear. The brushwood at the base of Trench C (Feature group 2) is not surprisingly, given its stratigraphic position, the earliest (*67.2% probable*; Table 7) evidence for human activity in this part of the intertidal zone. Feature group 1 is probably earlier (*62.1% probable*) than Feature Group 3 and the woven wattles from the top of Trench C (Feature group 2), although the area was the focus of intense activity in the last quarter of the sixth century cal AD.

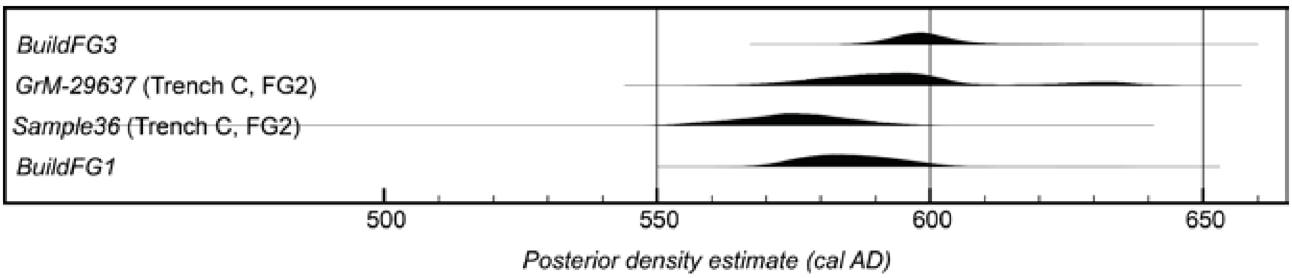

Figure 14: Probability distributions of dates for the construction of wooden structures at Point Clear, derived from the model defined in Figure 12.

Table 7: Percentage probabilities of the relative order of the construction of wooden structures at Point Clear, from the model defined in Figure 12. The cells show the probability that the distribution on the left-hand column is earlier than the distribution on the top row. For example, the probability that *BuildFG1* is earlier than *Build FG3* is *90.1%.*

	BuildFG1	***BuildFG3***	***Sample36***	***GrM-29637***
BuildFG1		90.1	21.5	68.9
BuildFG3	9.9		1.7	33.0
Sample36	78.5	98.3		87.0
GrM-29637	31.1	67.1	13.0	

Discussion

Although the function of the features at Point Clear is unclear, they may be linked to the extensive fishing industry in the Blackwater estuary (Fig. 15) that flourished in the seven–tenth centuries cal AD (Hall and Clark 2000; Strachan 1998; Fig. 16; Appendix 2). It is clear, however, that the structures at Point Clear were constructed before the main *floruit* of fishing structures in the Blackwater estuary.

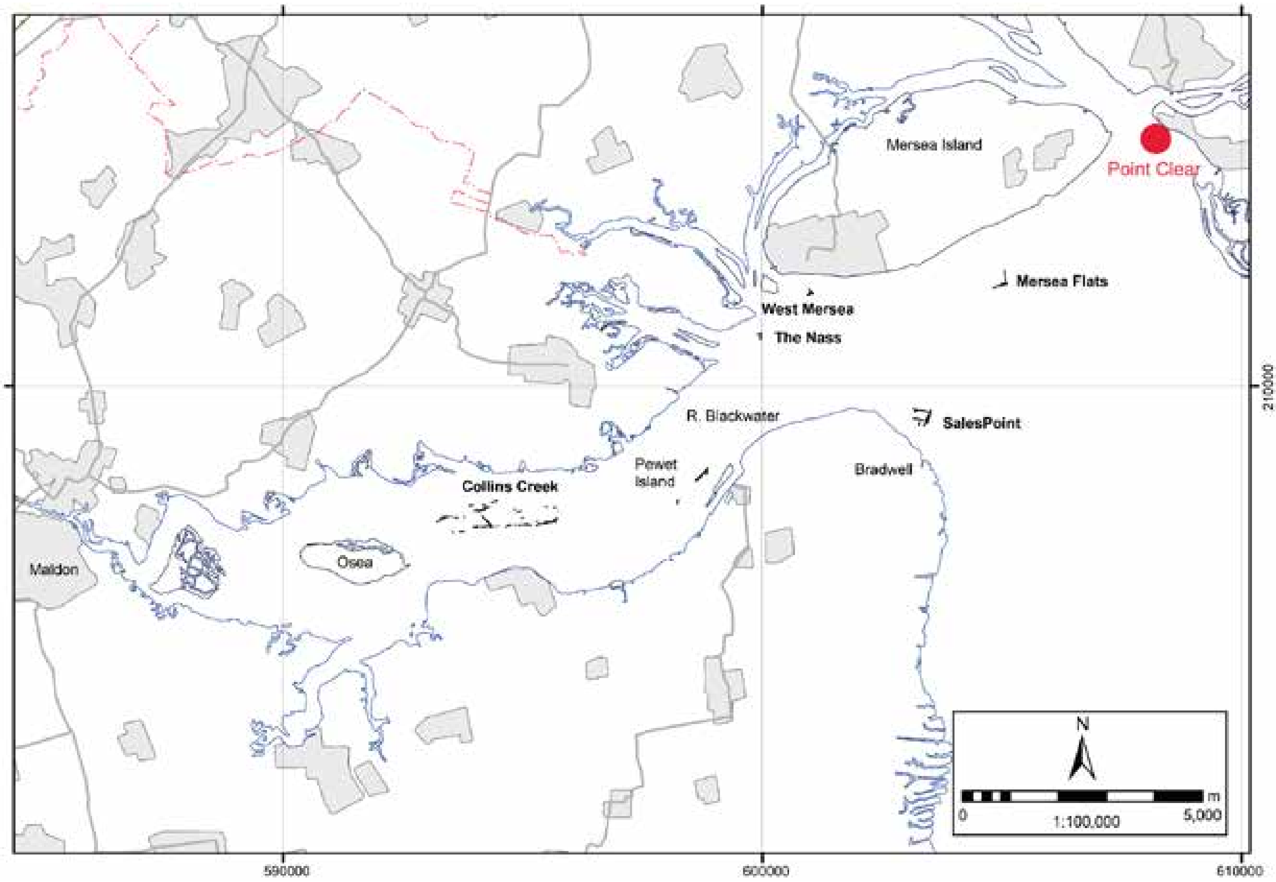

Figure 15: Location of known fish traps in the Blackwater Estuary (adapted from Heppell 2005) (© Historic England).

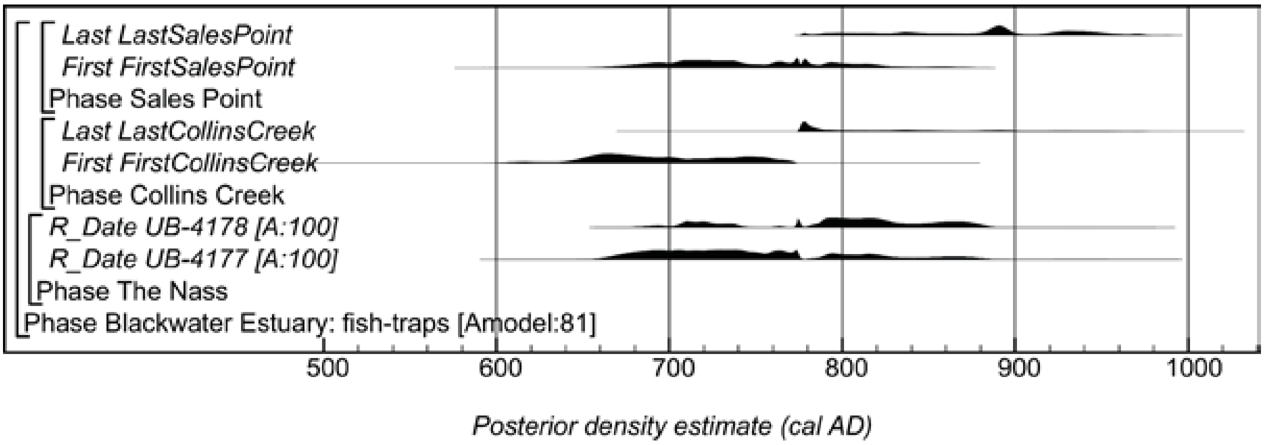

Figure 16: Probability distributions of dates for the construction of fish-traps in the Blackwater Estuary derived from the model described in Appendix 2 (Fig. 17) (© Historic England).

If constructed as fishing structures, those at Point Clear vary significantly in form from the larger fish traps identified in the Blackwater estuary to date. Given they appear to have been built on the contemporary foreshore, however, a similar function is implied. The structures may represent a much smaller, earlier enterprise, the beginnings of the large-scale industrial fishing of the estuary that would follow. The circular Feature group 1 may have been a pound (or pond) of sorts through which ebbing waters flowed, naturally trapping the fish to be easily collected when the tide had fully gone out. The north–south alignment in Feature group 2 with sub-surface wattles between the uprights suggests that it could have served a funnelling function. The existence of a second alignment to the east of Feature group 1 beneath the thick oyster reef would support this theory but would require targeted exploration in a future survey. Evidence of an internal circle of uprights is also problematic in this context, unless serving as raised platform from which to fish out the catch when waters didn't fully recede.

The structures at Point Clear may be better interpreted as having served a more terrestrial function, albeit built close to the contemporary Mean High Water line. Feature group 1 could conceivably be identified as a pen for animals grazing on nearby saltmarsh. The diameter of the uprights (*c.* 90mm) would likely not have been enough to withstand constant inundation, especially from any larger storm surges, making use as an intertidal structure a constant battle of repairs unless only very infrequently inundated. The woven nature of the entire structure would, however, doubtless have provided strength against penned animals with dreams of freedom. In this context, the observed inner circle of uprights could have supported a roof on the structure, with the scattered timbers in Feature group 3 possibly the rafters and beams. If a terrestrial building (or one with terrestrial uses), it may offer tantalising evidence of a significant marine transgression along the Essex coast since the Saxon period.

The high level of preservation of the sub-surface wattles surrounding Feature group 1 suggests that any rise in sea level was rapid and sustained enough to submerge the base of the structure and render the land almost immediately inaccessible and uninhabitable. Gradual sea-level rise could not account for such an inundation, unless the land was particularly low lying, perhaps protected by a natural defence against the Colne that was breached by a storm surge that failed to recede. It could be theorised that the structural timbers in Feature group 3 (and their distribution across the north-east quadrant of the site) are evidence of such a catastrophic event. A large storm wave or surge impacting the building, destroying it, and scattering structural elements along the vector of impact.

A combination of forces threatens the visible archaeology at Point Clear. The daily wash of the tide has had a significant impact on some of the more fragile elements exposed since the site was first visited, with the removal of sediment by wave action and subsequent undercutting of the wooden structures being particularly destructive. In addition to the daily tides, winter storms pose a direct threat to the site. Their capacity for damaging archaeological features is evident on nearby Mersea Island and it is difficult to predict how many winters will pass before the Point Clear structures are completely lost. The site therefore requires urgent attention as soon as is practicably possible, at the very least, to retrieve more of the timbers.

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Appendix 1: CQL2 code for Point Clear chronological models

Wiggle-matches (Fig. 11)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Phase("Preliminary wiggle-matches")
  {
   D_Sequence("Feature Group 1: sample 2")
   {
    R_Date("ETH-123024", 1513, 19);
    Gap(9);
    R_Date("GrM-29788", 1465, 21);
    Gap(0.5);
    Date("Sample2");
   };
   D_Sequence("Feature Group 3: sample 23")
   {
    R_Date("GrM-29789", 1518, 21);
    Gap(9);
    R_Date("ETH-123025", 1488, 19);
    Gap(0.5);
    Date("Sample23");
   };
   D_Sequence("Feature Group 3: sample 25")
   {
    R_Date("GrM-29792", 1501, 21);
    Gap(12);
    R_Date("ETH-123026", 1485, 20);
    Gap(0.5);
    Date("Sample25");
   };
   D_Sequence("Feature Group 3: sample 34")
   {
    R_Date("GrM-29793", 1472, 21);
```

```
    Gap(14);
    R_Date("ETH-123027", 1510, 19);
    Gap(0.5);
    Date("Sample34");
   };
   D_Sequence("Feature Group 2: Sample 36")
   {
    R_Date("GrM-29794", 1491, 21);
    Gap(6);
    R_Date("ETH-123028", 1506, 19);
    Gap(0.5);
    Date("Sample36");
   };
  };
 };
```

Site chronological model (Fig. 12)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Phase("Point Clear")
  {
   Sequence("Feature Group 1")
   {
    Boundary("StartFG1");
    Phase("Feature Group 1")
    {
     Phase("Feature Group 1")
     {
      R_Date("GrM-29639", 1485, 18);
      R_Date("GrM-29638", 1506, 18);
      R_Date("ETH-122536", 1502, 15);
      R_Date("ETH-122535", 1531, 16);
      Prior("Sample2");
      Last("BuildFG1");
     };
    };
```

```
   Boundary("EndFG1");
  };
  Sequence("Feature Group 2: Trench C")
  {
   Prior("Sample36");
   Interval("Silt");
   R_Date("GrM-29637", 1490, 18);
  };
  Sequence("Feature Group 3")
  {
   Boundary("StartFG3");
   Phase("Feature Group 3")
   {
    R_Date("ETH-122534", 1451, 15);
    R_Date("ETH-122533", 1494, 16);
    Prior("Sample23");
    Prior("Sample25");
    Prior("Sample34");
    Last("BuildFG3");
   };
   Boundary("EndFG3");
  };
 };
};
```

Appendix 2: Blackwater estuary fishing structures: radiocarbon dating and chronological modelling

Introduction

Eleven radiocarbon measurements are available (Table 8) on samples associated from inter-tidal fishing structures in the Blackwater estuary (Collins Creek, n=5, Sales Point, n=4; and The Nass n=2) obtained as part of survey work undertaken in the 1990s (Hall and Clark 2000; Strachan 1998).

Table 8: Blackwater estuary (The Nass, Collins Creek and Sales Point) fishing structures, radiocarbon and associated stable isotope measurements

Laboratory Number	**Sample details**	**Radiocarbon Age (BP)**	**$\delta^{13}C_{IRMS}$ (‰)**
The Nass			
UB-4177	Waterlogged wood, *Corylus* sp., from TL 99942 11015 (Strachan 1998, table 3)	1268±39	-
UB-4178	Waterlogged wood, *Quercus* sp., from TL 99892 11047 (Strachan 1998, table 3)	1227±24	-
Collins Creek			
UB-4139	Waterlogged wood, *Quercus* sp., from TL 95465 07144 (Strachan 1998, table 2), S1 (Hall and Clark 2000, fig 2)	1300±45	−22.1±0.2
UB-4140	Waterlogged wood, *Corylus* sp., from TL 95434 07107 (Strachan 1998, table 2), S2 (Hall and Clark 2000, fig 2)	1286±45	−30.3±0.2
UB-4141	Waterlogged wood, *Quercus* sp., from TL 95472 07171 (Strachan 1998, table 2), S3 (Hall and Clark 2000, fig 2)	1262±45	−26.7±0.2
UB-3485	Waterlogged wood, unidentified, from SA (Hall and Clark 2000, fig 2)	1364+48	−25.3±0.2
UB-3486	Waterlogged wood, unidentified, from SB (Hall and Clark 2000, fig 2)	1140±33	−24.9±0.2
Sales Point			
UB-4113	Waterlogged wood, *Alnus* sp., from TM 03195 09527 (Strachan 1998, table 4)	1144±16	-
UB-4114	Waterlogged wood, *Alnus* sp., from TM 03462 09460 (Strachan 1998, table 4)	1214±16	-
UB-4115	Waterlogged wood, *Alnus* sp., from TM 03536 09458 (Strachan 1998, table 4)	1251±21	-

UB-4116	Waterlogged wood, *Alnus* sp., from TM 03354 09375 (Strachan 1998, table 4)	1277±43	-

The samples

The waterlogged wood samples all derive from what appear to be “individual” structures (Hall and Clark 2000; Strachan 1998) and given the requirements for obtaining a radiocarbon date in the 1990s (>200g wet wood) probably comprise complete cross-sections of timbers of *c.* 15–15 rings (see Groves 2000, table 1), thus any age-at-death offset (Bayliss and Marshall 2022, §3.2.3) will be minimal.

Radiocarbon dating

The 11 waterlogged wood samples were processed and dated by liquid scintillation spectrometry at the Queen’s University, Belfast as outlined in Bayliss et al. (2013; 2015)

Chronological modelling

The chronological modelling presented below has been undertaken using OxCal 4.4 (Bronk Ramsey 2009), and the internationally agreed calibration curve for the northern hemisphere (IntCal20; Reimer et al. 2020).

The model is defined by the OxCal CQL2 keywords and by the brackets on the left-hand side of Figure 17 (the full code is given in Appendix 3). On the figure, calibrated radiocarbon dates are shown in outline, and the posterior density estimates produced by the chronological modelling are shown in solid black. The other distributions correspond to aspects of the model. For example, the distribution *LastCollinsCreek* (Fig. 17) is the posterior density estimate for the date of the last dated event from fishing structures at Collins Creek. In the text highest posterior density intervals, which describe the posterior distributions, are given in italics.

The model shown in Figure 17 has good overall agreement (Amodel: 81) and estimates derived from it for the dates of fishing structures at Collins Creek, Sales Point and The Nass are given in Table 9.

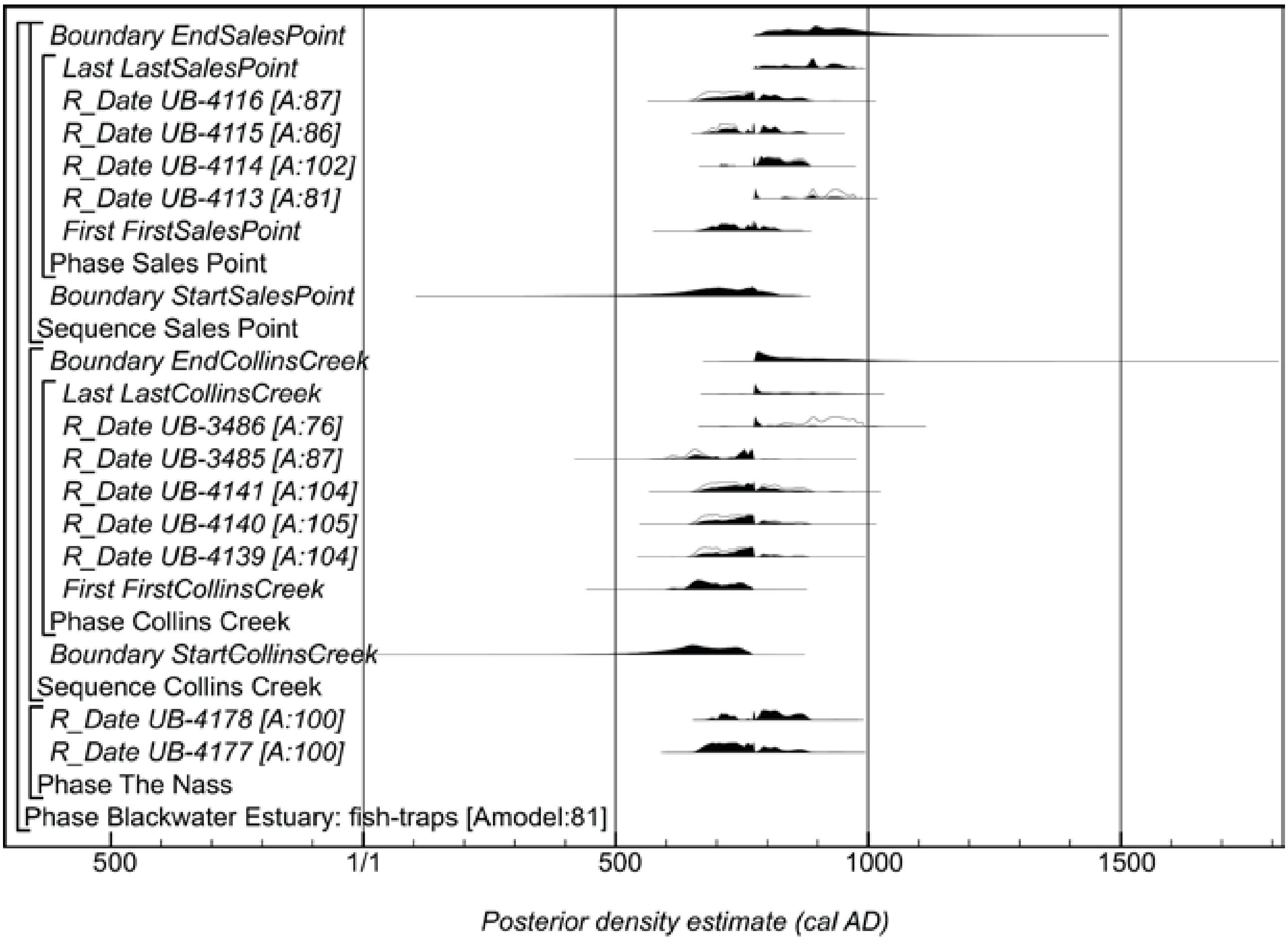

Figure 17: Probability distributions of dates from Blackwater Estuary fish-traps: The Nass, Collins Creek and Sales Point. The format is identical to Figure 12 (© Historic England).

Table 9: Highest Posterior Density intervals from key parameters for Blackwater estuary fishing structures derived from the model describe in Figure 17.

Parameter name	**Parameter description**	***Posterior Density Estimate (95% probability unless otherwise stated) cal AD***
The Nass		
UB-4177	`R_Date` estimating the date of construction of the fishing structure at TL 99942 11015	*660–835 (90%) or 845–880 (5%)*
UB-4178	`R_Date` estimating the date of construction of the fishing structure at TL 99892 11047	*685–745 (20%) or 770–885 (75%)*
Collins Creek		
FirstCollinsCreek	`First` parameter estimating the first dated event in the Collins Creek fishing structures	*635–775*

Parameter name	**Parameter description**	***Posterior Density Estimate (95% probability unless otherwise stated) cal AD***
UB-4139	`R_Date` estimating the date of construction of the fishing structure S1 at TL 95465 07144	*655–825*
UB-4140	`R_Date` estimating the date of construction of the fishing structure S2 at TL 95434 07107	*655–835*
UB-4141	`R_Date` estimating the date of construction of the fishing structure S3 at TL 95472 07171	*665–840 (92%) or 850–875 (3%)*
UB-3485	`R_Date` estimating the date of construction of the fishing structure SA	*605–625 (2%) or 635–775 (93%)*
UB-3486	`R_Date` estimating the date of construction of the fishing structure SB	*770–975*
LastCollinsCreek	`Last` parameter estimating the last dated event in the Collins Creek fishing structures	*770–975*
Sales Point		
FirstSalesPoint	`First` parameter estimating the first dated event in the Sales Point fishing structures	*665–830*
UB-4113	`R_Date` estimating the date of construction of the fishing structure at TM 03195 09527	*775–790 (24%) or 825–860 (13%) or 875–975 (53%)*
UB-4114	`R_Date` estimating the date of construction of the fishing structure at TM 03462 09460	*770–885*
UB-4115	`R_Date` estimating the date of construction of the fishing structure at TM 03536 09458	*680–840 (88%) or 850–880 (7%)*
UB-4116	`R_Date` estimating the date of construction of the fishing structure at TM 03354 09375	*670–880*
LastSalesPoint	`Last` parameter estimating the last dated event in the Sales Point fishing structures	*775–975*

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Appendix 3: CQL2 code for the Blackwater estuary chronological model (Fig. 17)

```
Options()
 {
  Resolution=1;
  kIterations=20000;
 };
 Plot()
 {
  Phase("Blackwater Estuary: fish-traps")
  {
   Phase("The Nass")
   {
    R_Date("UB-4177", 1268, 39);
    R_Date("UB-4178", 1227, 24);
   };
   Sequence("Collins Creek")
   {
    Boundary("StartCollinsCreek");
    Phase("Collins Creek")
    {
     First("FirstCollinsCreek");
     R_Date("UB-4139", 1300, 45);
     R_Date("UB-4140", 1286, 45);
     R_Date("UB-4141", 1262, 45);
     R_Date("UB-3485", 1364, 48);
     R_Date("UB-3486", 1140, 33);
     Last("LastCollinsCreek");
    };
    Boundary("EndCollinsCreek");
   };
   Sequence("Sales Point")
   {
    Boundary("StartSalesPoint");
    Phase("Sales Point")
    {
     First("FirstSalesPoint");
     R_Date("UB-4113", 1144, 16);
     R_Date("UB-4114", 1214, 16);
     R_Date("UB-4115", 1251, 21);
```

```
    R_Date("UB-4116", 1277, 43);
    Last("LastSalesPoint");
   };
   Boundary("EndSalesPoint");
  };
 };
};
```

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