

SUPPLEMENTARY MATERIAL

Exploring instream large wood accumulation at bridges: insights from bridges across the UK

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Table S1: Study Bridge Details

No.	Bridge Reference	Grid Reference [NGR (OS Ref)]	Catchment Area (km ²)	Watercourse Name	Area	River Basin District
Wood-Prone Bridges						
1	Bridge BGK_1507	TL 52500 32300	2.56	River Cam or Granta	Anglia	Anglian
2	Bridge BGK_1512	TL 52400 34100	28.07	River Cam or Granta AND Flood openings	Anglia	Anglian
3	Bridge BGK_1516	TL 51600 36200	22.34	Unnamed	Anglia	Anglian
4	Bridge CGJ6_59	SD 50300 47000	6.86	Grizedale Brook	Lancs & Cumbria	North-West
5	Bridge CGJ6_66	SD 49600 49300	88.81	River Wyre	Lancs & Cumbria	North-West
6	Bridge MVN2_96	SD 93410 21720	13.60	Calder Brook	Lancs & Cumbria	Humber
7	Bridge WCM1_3	NY 39400 56400	265.50	River Caldew	Lancs & Cumbria	Solway Tweed
8	Bridge WCM1_3A	NY 39400 56370	265.35	River Caldew	Lancs & Cumbria	Solway Tweed
9	Bridge WCM1_5	NY 38800 57100	2,276.09	River Eden	Lancs & Cumbria	Solway Tweed
10	Bridge BAC3_15	SK 45562 74095	10.78	Seymour Brook	East Midlands	Humber
11	Bridge DCL_7622	SP 48932 26161	4.18	River Cherwell	West Midlands & Chilterns	Thames
12	Bridge MBW3_55	NZ 88970 09080	2.00	River ESk	London North Eastern	Humber
13	Bridge ETN_1632	TG 20588 05197	270.97	River Yare	Anglia	Anglian
14	01563_Cowley	SX 90734 95502	269.97	River Creedy	Devon	South-West
15	01904_Ottertton	SY 07908 85261	220.68	River Otter	Devon	South-West
16	01946_South_Farm	SY 07500 83032	3.32	River Otter	Devon	South-West
17	02483_Stuckeridge	SS 93340 21625	311.46	River Exe	Devon	South-West
18	02541_Exebridge	SS 93002 24450	281.22	River Exe	Devon	South-West
19	02701_Halfpenny	SS 95244 20537	346.64	River Exe	Devon	South-West
20	02722_Oakford	SS 92011 21927	308.42	River Exe	Devon	South-West
21	03746_Old_Rothern	SS 47911 19748	694.10	River Torridge	Devon	South-West
22	03606_Taddiport	SS 48814 18735	665.68	River Torridge	Devon	South-West
23	03583_Rothern_(Rolle)	SS 47953 19707	689.23	River Torridge	Devon	South-West
24	04549_Torrington-_Viaduct	SS 48056 19539	689.15	River Torridge	Devon	South-West
25	02500_Bickleigh	SS 93733 07570	524.58	River Exe	Devon	South-West
26	01650_Pynes	SX 90624 95971	268.89	River Creedy	Devon	South-West
27	01603_Fordton	SX 83995 99019	116.99	River Yeo	Devon	South-West
28	01595_Culm	SX 94053 97997	277.20	River Culm	Devon	South-West
29	03439-_Kershams	SS 66201 13548	412.16	River Taw	Devon	South-West
30	Bridge Taw	SS 65630 01682	52.89	River Taw	Devon	South-West
31	Bridge Kingford	SS 62385 19243	812.34	River Taw	Devon	South-West
Wood-Free Bridges						
1	02576_Cove_DF	SS 94897 19746	410.95	River Exe	Devon	South-West
2	01658_Thorverton_DF	SS 93590 01637	608.13	River Exe	Devon	South-West
3	01801_Countess_Wear_DF	SX 94195 89567	1.50	River Exe	Devon	South-West
4	02616_Iron_(Stoodleigh)_DF	SS 94269 17820	420.69	River Exe	Devon	South-West
5	03615_Beafood_DF	SS 54260 14288	606.40	River Torridge	Devon	South-West
6	00024_Hele_DF	SS 54012 06322	382.56	River Torridge	Devon	South-West
7	00094_Lewer_DF	SS 53136 05248	115.96	River Lew	Devon	South-West
8	01590_Columbjohn_DF	SX 95787 99744	270.64	River Culm	Devon	South-West
9	02266_Newton_Poppleford_DF	SY 09092 89830	197.30	River Otter	Devon	South-West
10	02349_Tipton_StJohn_DF	SY 09012 91768	181.43	River Otter	Devon	South-West
11	03666_Sheepwash_DF	SS 48612 05746	251.01	River Torridge	Devon	South-West
12	03150_Dippermill_DF	SS 43804 06473	200.40	River Torridge	Devon	South-West
13	02051_LongBridge_DF	ST 25516 05481	47.72	River Yarty	Devon	South-West
14	03362_DartBridge_DF	SS 66904 13710	125.94	Little Dart River	Devon	South-West
15	01599_Eggesford_DF	SS 68279 11428	245.56	River Taw	Devon	South-West
16	00372_Dartmeet_DF	SX 67194 73181	42.32	East Dart River	Devon	South-West
17	00778_Holne_(Old)_DF	SX 73014 70586	187.27	River Dart	Devon	South-West
18	03618_Black_Torrington_DF	SS 46963 06080	230.31	River Torridge	Devon	South-West

Fig. S1 and Table S2 present the results of the riparian corridor delineation and extraction of the landuse/landcover composition for one of the study bridges (i.e. bridge BGK_1516) as described in section 3.2. of manuscript.

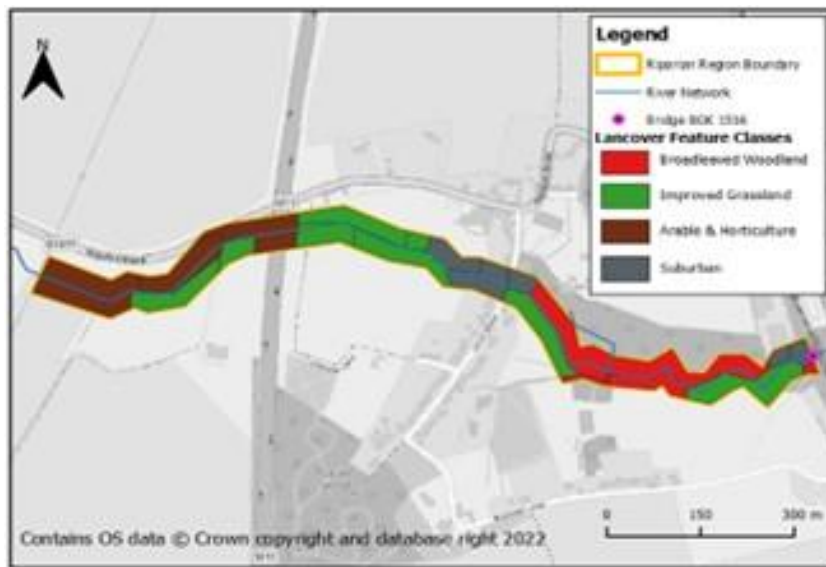


Fig. S1. Bridge BGK_1516: Riparian Corridor Landcover Map – (Source: (CEH (2019))

Table S2: Riparian Corridor Landcover Composition

LCM2015 Vector Data (CEH)		
Vegetation Class	Area (km2)	Percentage Cover (%)
Broadleaved woodland	0.012	14
Arable and horticulture	0.063	74
Improved grassland	0.010	11
Suburban	0.009	1
Total	0.085	100

Table S3. Description of Characteristics of Landcover Types

Source: CEH (2017); NFI (2017); JNCC (2018).

Landcover Type	Description of Characteristics
Broadleaved woodland	-This is a broad and heterogeneous category (includes various tree species) characterised by vegetation predominantly trees reaching heights of over 5m at maturity and canopy cover of over 20%. -Includes native and non-native stands of broadleaved tree species and yew. -Includes stands predominantly coniferous species but having a percentage cover of over 20%. -Stands may be ancient or recent, natural, semi-natural or planted.
Coniferous woodland	-This category is characterised by vegetation predominantly trees reaching heights of over 5m at maturity and canopy cover of over 20%. -Canopy is more even compared to broadleaved woodland -May includes some broadleaved species but stands predominantly coniferous tree species. -Stands may be semi-natural but mostly plantations and composed of native (e.g. Scots pine, Juniper, Yew, etc.) and non-native coniferous tree species. -This category can be considered more as a landuse (rather than landcover) as it composed mainly of new plantations and felled areas.
Arable and horticulture	- This can be considered as a landuse class characterised by agriculture including annual, perennial, and woody crops, as well as commercial agriculture (e.g. orchards, horticulture). - Intensively managed with key features including ploughed, and rotational/fallow lands.
Improved grassland	-Characterised by vegetation predominantly fast-growing grass species (e.g. <i>Lolium</i> spp., and <i>Trifolium repens</i> (or white clover) supported on fertile soils. -This category is predominantly managed and includes grazing pastures, silage production fields, as well as recreational fields.
Fen, Marsh and Swamp	-This is a quite diverse category including fens, flushes, springs, fen meadows, rush pasture and swamp. -The swampy sections are characterised by tall vegetation.
Bog	-This is a diverse and may include a good proportion of the “Fen, Marsh and Swamp” class, as well as some mosses, and herbaceous plant species. -Bog areas are predominantly wetlands that support peat-forming vegetation.
Heather	The Heather feature class is very similar to the Bog and very often, there is confusion in trying to differentiate between these two landcover categories.

Table S4. Catchment Descriptors for Study Bridges.

No.	Catchment	Drainage (Catchment) Area (km ²)	DPSBAR (m/km)	DPLBAR (km)	SAAR (mm)	PROPWET	URBEXT
Wood-Prone							
1	Catchment BGK_1507	2.56	36.10	1.75	606	0.31	0.0102
2	Catchment BGK_1512	28.07	30.90	6.19	608	0.31	0.0208
3	Catchment BGK_1516	22.34	43.30	6.56	609	0.31	0.0053
4	Catchment CGJ6_59	6.86	150.40	4.33	1235	0.6	0
5	Catchment CGJ6_66	88.81	101.60	13.77	1469	0.6	0.0005
6	Catchment MVN2_96	13.60	158.40	2.8	1434	0.57	0.021
7	Catchment WCM1_3	265.50	89.90	26.48	1187	0.62	0.0172
8	Catchment WCM1_3A	265.35	89.90	26.36	1187	0.62	0.0171
9	Catchment WCM1_5	2,276.09	103.30	62.28	1182	0.64	0.0082
10	Catchment BAC3_15	10.78	67.00	3.05	671	0.38	0.0644
11	Catchment DCL_7622	4.18	55.90	2.83	665	0.32	0.0084
12	Catchment MBW3_55	2.00	73.10	1.85	673	0.4	0.0066
13	Catchment ETN_1632	270.97	19.10	25.84	633	0.31	0.028
14	01563_Cowley_(Creedy)	269.97	112.40	17.75	908	0.46	0.0087
15	01904_Otterton	220.68	85.20	22.24	959	0.4	0.024
16	01946_South_Farm	3.32	80.50	1.57	791	0.4	0.0768
17	02483_Stuckeridge	311.46	144.40	23.61	1441	0.53	0.0015
18	02541_Exebridge	281.22	145.40	20.26	1466	0.53	0.0015
19	02701_Halfpenny	346.64	142.80	24.68	1415	0.52	0.0014
20	02722_Oakford	308.42	144.40	22.06	1415	0.53	0.0014
21	03746_Old_Rothern	694.10	82.30	43.63	1182	0.49	0.0041
22	03606_Taddipport	665.68	81.20	43.42	1184	0.49	0.0039
23	03583_Rothern_(Rolle)	689.23	82.30	43.58	1183	0.49	0.004
24	04549_Torrington_Viaduct	689.15	82.30	43.44	1183	0.49	0.004
25	02500_Bickleigh	524.58	137.50	34.37	1294	0.46	0.0065
26	01650_Pynes	268.89	112.40	17.23	908	0.46	0.0087
27	01603_Fordton	116.99	117.50	10.74	918	0.46	0.0063
28	01595_Culm	277.20	70.50	27.95	952	0.4	0.0135
29	03439_Kersham	412.16	85.30	20.03	1056	0.46	0.0042
30	Taw	52.89	100.20	9.57	1314	0.46	0.0067
31	Kingford	812.34	103.70	29.05	1156	0.48	0.0038
Wood-Free Bridges							
32	Catchment 02576_Cove_DF	410.95	141.70	24.7	1367	0.48	0.0017
33	Catchment 01658_Thorverton_DF	608.13	137.90	38.3	1249	0.46	0.0061
34	Catchment 01801_Countess_Wear_DF	1.50	6.80	2.79	812	0.46	0.6131
35	Catchment 02616_Iron_(Stoodleigh)_DF	420.69	142.30	26.85	1361	0.48	0.0017
36	Catchment 03615_Beafood_DF	606.40	77.90	29.98	1198	0.49	0.0035
37	Catchment 00024_Hele_DF	382.56	68.20	22.36	1201	0.49	0.0024
38	Catchment 00094_Lewer_DF	115.96	73.80	10.84	1146	0.5	0.0021
39	Catchment 01590_Columbjohn_DF	270.64	71.20	25.16	956	0.4	0.0137
40	Catchment 02266_Newton_Poppleford_DF	197.30	83.40	18.43	974	0.4	0.0236
41	Catchment 02349_Tipton_StJohn_DF	181.43	83.10	17.23	984	0.4	0.0226
42	Catchment 03666_Sheepwash_DF	251.01	65.20	20.14	1235	0.49	0.0026
43	Catchment 03150_Dippermill_DF	200.40	63.50	16.9	1256	0.48	0.0028
44	Catchment 02051_LongBridge_DF	47.72	95.80	7.45	1034	0.4	0.0034
45	Catchment 03362_DartBridge_DF	125.94	84.70	17.03	1073	0.46	0.0035
46	Catchment 01599_Eggesford_DF	245.56	84.50	18.33	1049	0.46	0.0051
47	Catchment 00372_Dartmeet_DF	42.32	101.20	9.17	1941	0.46	0.0014
48	Catchment 00778_Holne_(Old)_DF	187.27	114.40	18.15	1841	0.47	0.0014
49	Catchment 03618_Black_Torrington_DF	230.31	64.70	19.13	1244	0.49	0.0026

Table S5. Calculated Flow Parameters Using the ReFH Method in Flood Modeller Software for 10-Year Return Period Design Rainfall Winter Profile.

No.	Catchment	Tp(0) (hrs)	Cmax (mm)	BL	BR	Peak Discharge, Q (m ³ /s)	Stream Power, Ω (Wm ⁻¹)	Unit Stream Power, ω (Wm ⁻²)
Wood-Prone								
1	Catchment BGK_1507	2.812	323.890	33.632	0.892	2.303	117.36	19.56
2	Catchment BGK_1512	6.124	471.842	51.731	1.369	25.18	1135.11	227.02
3	Catchment BGK_1516	5.881	481.095	53.793	1.399	20.10	1181.88	393.96
4	Catchment CGJ6_59	1.614	261.622	28.430	1.063	7.957	3134.74	626.95
5	Catchment CGJ6_66	3.605	227.146	33.780	0.906	101.3	12707.1	577.60
6	Catchment MVN2_96	1.269	281.202	26.945	1.117	20.12	11515.1	2878.8
7	Catchment WCM1_3	5.076	292.877	41.494	1.234	240.3	18604.0	442.95
8	Catchment WCM1_3A	5.062	292.877	41.454	1.234	240.2	18596.3	442.77
9	Catchment WCM1_5	8.122	336.602	53.965	1.475	2060.2	40379.9	1009.5
10	Catchment BAC3_15	2.358	358.451	32.972	1.139	11.16	1028.06	257.02
11	Catchment DCL_7622	3.107	502.650	44.368	1.501	3.931	138.686	19.812
12	Catchment MBW3_55	1.718	313.546	28.814	1.011	2.320	90.944	1.1368
13	Catchment ETN_1632	15.593	441.701	64.178	1.270	263.6	3099.94	193.75
14	01563_Cowley_(Creedy)	5.414	425.692	53.888	1.563	304.4	8054.42	233.73
15	01904_Ottertorn	7.672	432.223	59.400	1.456	232.6	9345.87	584.12
16	01946_South_Farm	1.402	612.868	36.143	2.165	3.473	132.738	8.8492
17	02483_Stuckeridge	5.169	360.392	50.024	1.415	376.4	21763.4	1813.6
18	02541_Exebridge	4.705	361.076	48.473	1.418	350.6	23020.4	1046.4
19	02701_Halfpenny	5.436	357.923	50.716	1.387	401.1	22012.4	1375.8
20	02722_Oakford	4.962	360.392	49.315	1.415	374.4	22381.6	1721.7
21	03746_Old_Rothern	9.485	315.512	54.818	1.157	791.9	13969.1	698.46
22	03606_Taddiport	9.493	314.108	54.642	1.152	772.1	12106.5	526.37
23	03583_Rothern_(Rolle)	9.478	315.512	54..805	1.157	786.3	13870.3	693.52
24	04549_Torrington_Viaduct	9.460	315.512	54.768	1.157	782.5	13803.3	600.14
25	02500_Bickleigh	7.594	388.392	59.076	1.408	560.1	24700.4	988.02
26	01650_Pynes	5.318	425.692	53.553	1.563	303.1	8317.06	594.08
27	01603_Fordton	3.977	412.341	47.964	1.508	120.5	8030.12	617.70
28	01595_Culm	9.397	461.242	65.093	1.567	298.2	9936.02	1104.0
29	03439_Kershams	6.322	333.858	49.248	1.186	453.5	19554.9	1629.6
30	Taw	3.870	367.197	44.100	1.321	59.63	9057.80	503.21
31	Kingford	7.140	348.039	53.396	1.277	900.4	30883.7	1625.5
Wood-Free								
32	Catchment 02576_Cove_DF	5.944	364.866	52.891	1.348	475.5	25629.5	2135.8
33	Catchment 01658_Thorverton_DF	8.105	390.509	60.651	1.417	637.8	25626.8	1164.9
34	Catchment 01801_Countess_Wear_DF	2.050	480.976	21.677	1.796	1.699	56.6106	0.8449
35	Catchment 02616_Iron_(Stoodleigh)_DF	6.242	364.866	53.826	1.348	475.4	24226.4	1345.9
36	Catchment 03615_Beafield_DF	7.693	310.596	50.287	1.137	680.3	12667.2	904.80
37	Catchment 00024_Hele_DF	6.703	294.415	46.090	1.070	422.9	8703.28	543.96
38	Catchment 00094_Lewer_DF	4.169	288.783	39.017	1.060	131.0	9371.74	1561.9
39	Catchment 01590_Columbjohn_DF	8.795	457.620	63.404	1.553	286.8	10118.3	778.33
40	Catchment 02266_Newton_Poppleford_DF	6.879	416.947	55.977	1.397	218.2	8339.60	555.97
41	Catchment 02349_Tipton_StJohn_DF	6.616	407.475	54.584	1.361	205.5	9263.94	671.30
42	Catchment 03666_Sheepwash_DF	6.362	295.824	45.114	1.076	293.9	6336.48	528.04
43	Catchment 03150_Dippermill_DF	5.895	297.999	43.973	1.071	239.5	6571.88	525.75
44	Catchment 02051_LongBridge_DF	3.947	387.767	45.733	1.287	60.13	6069.52	606.95
45	Catchment 03362_DartBridge_DF	5.749	291.756	44.541	1.017	137.2	6857.26	571.44
46	Catchment 01599_Eggesford_DF	6.007	362.321	49.614	1.261	264.2	13722.5	1143.5
47	Catchment 00372_Dartmeet_DF	3.770	349.484	42.740	1.249	84.07	15818.6	1581.9
48	Catchment 00778_Holne_(Old)_DF	5.353	375.857	50.626	1.375	305.0	54698.7	5469.9
49	Catchment 03618_Black_Torrington_DF	6.180	294.415	44.511	1.070	270.9	6371.57	579.23

Eigenvalues												
	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5							
Variance	2.886	2.594	1.726	1.158	1.078							
% of var.	22.203	19.954	13.277	8.906	8.293							
Cumulative % of var.	22.203	42.157	55.434	64.340	72.633							
Individuals (the 10 first)												
	Dist	Dim.1	ctr	cos2	Dim.2	ctr	cos2	Dim.3	ctr	cos2		
1	4.260	-0.391	0.108	0.008	-0.276	0.060	0.004	-1.780	3.746	0.175		
2	3.717	-0.945	0.632	0.065	-1.520	1.818	0.167	-3.000	10.640	0.651		
3	5.611	0.751	0.399	0.018	-0.587	0.271	0.011	-3.903	18.012	0.484		
4	2.945	-0.618	0.270	0.044	0.648	0.331	0.048	-0.085	0.009	0.001		
5	3.310	-0.042	0.001	0.000	0.146	0.017	0.002	1.554	2.855	0.220		
6	5.247	-1.251	1.107	0.057	1.791	2.522	0.116	-1.025	1.243	0.038		
7	4.475	3.051	6.581	0.465	-1.949	2.987	0.190	1.805	3.851	0.163		
8	4.503	3.066	6.648	0.464	-1.982	3.092	0.194	1.811	3.877	0.162		
9	3.701	0.730	0.376	0.039	-1.398	1.539	0.143	1.738	3.570	0.220		
10	4.175	-1.831	2.371	0.192	0.243	0.047	0.003	-3.320	13.034	0.632		
Continuous variables												
	Dim.1	ctr	cos2	Dim.2	ctr	cos2	Dim.3	ctr	cos2			
FAH.Cover	-0.291	2.941	0.085	0.614	14.528	0.377	-0.209	2.542	0.044			
ForestCover	-0.338	3.964	0.114	0.706	19.214	0.498	0.014	0.012	0.000			
BridgeSpan	0.917	29.143	0.841	0.044	0.075	0.002	0.246	3.501	0.060			
ChannelPiers	-0.306	3.251	0.094	-0.544	11.390	0.295	0.370	7.922	0.137			
BSC.W.R	0.549	10.460	0.302	0.366	5.174	0.134	-0.480	13.350	0.230			
BSW.L.R	0.919	29.271	0.845	0.037	0.053	0.001	0.246	3.494	0.060			
SAAR	-0.004	0.001	0.000	0.701	18.959	0.492	0.613	21.792	0.376			
U.StreamPower	-0.106	0.386	0.011	0.709	19.357	0.502	0.180	1.870	0.032			
Categories												
	Dim.1	ctr	cos2	v.test	Dim.2	ctr	cos2	v.test	Dim.3	ctr	cos2	v.test
V9	2.501	10.728	0.596	4.164	1.025	2.229	0.100	1.799	-0.799	3.063	0.061	-1.721
Circular	0.712	0.994	0.074	1.283	-1.583	6.078	0.364	-3.008	0.708	2.751	0.073	1.650
flat	2.090	2.141	0.163	1.758	1.278	0.991	0.061	1.134	-0.296	0.120	0.003	-0.322
Flat	-0.762	0.854	0.057	-1.161	-0.334	0.203	0.011	-0.537	-2.764	31.399	0.743	-5.445
Oval	-0.080	0.008	0.001	-0.110	-0.693	0.728	0.051	-1.005	0.994	3.383	0.104	1.767
Pointed	-1.067	5.860	0.523	-3.769	0.400	1.020	0.074	1.491	0.578	4.802	0.153	2.639

Fig. S2. Summary of FAMD Output.

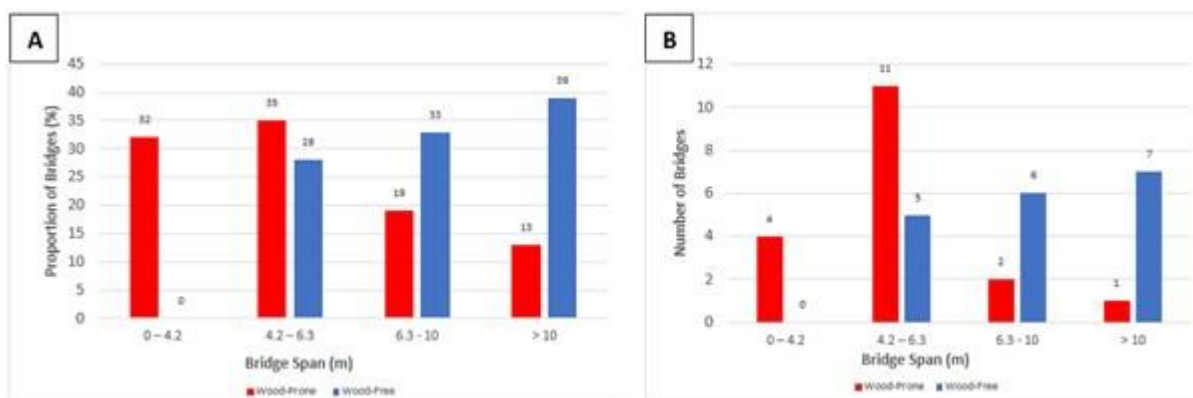


Fig. S3. Bridge Span Characterisation: (A) England-wide dataset; (B) Devon only dataset.