[Supplementary materials]

Subsistence and persistence: agriculture in the Central Plains of China through the Neolithic to Bronze Age transition

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Zooarchaeological data

Table S1. Mammalian remains from Xipo (Ma 2007), Wadian (from Lü *et al*. 2007), Wangchenggang (from Lü *et al*. 2007), Xinzhai (Huang 2008) and Erlitou (Li *et al*. 2014). In the table are reported both the number of identified specimens (NISP) and minimum number of individuals (MNI), in form of absolute counts and percentages. The assemblages were all hand-recovered, undoubtedly exacerbating taphonomic bias against smaller taxa and less robust elements. As the original sources reported differing levels of taxanomic detail, we have standardized to common level of generalisation. "Large deer" included *Elaphurus davidianus*, "medium deer" included *Cervus nippon*, and "small deer" included *Hydropotes inermis*.

		Pigs (*Sus scrofa*)	Dogs (*Canis familiaris*)	Sheep/Goat (*Ovis*/*Capra*)	Cattle (*Bos taurus*)	Deer - undifferentiated	Large deer	Medium deer	Small deer	Rabbits	Rodents	Other wild taxa	Total
Xipo	NISP	2380	38	—	—	—	—	194	12	46	100	62	2832
	NISP %	84	1	—	—	—	—	7	0	2	4	2	100
	MNI	244	6	—	—	—	—	68	10	16	32	38	414
	MNI %	59	1	—	—	—	—	16	2	4	8	9	100
Wadian	NISP	927	69	59	53	—	—	132	38	15	21	9	1323
	NISP %	70	5	5	4	—	—	10	3	1	2	< 1	100
	MNI	58	9	6	5	—	—	10	5	3	8	7	111
	MNI %	52	8	5	5	—	—	9	5	3	7	6	100
Wangchenggang	NISP	71	7	7	7	2	—	—	—	—	17	3	114
(Late Longshan)	NISP %	62	6	6	6	2	—	—	—	—	15	3	100
	MNI	6	2	1	1	1	—	—	—	—	2	3	16
	MNI %	38	13	6	6	6	—	—	—	—	13	19	100
Xinzhai	NISP	261	47	8	65	—	1	49	2	—	—	2	435
(Phase I, 4200-3850 BP)	NISP %	60	11	2	15	—	<1	11	<1	—	—	<1	100
	MNI	44	4	2	3	—	1	4	1	—	—	1	60
	MNI %	73	7	3	5	—	2	7	2	—	—	2	100
Xinzhai	NISP	1465	74	311	325	—	34	586	69	—	—	10	2874
(Phase II, 3850-3750 BP)	NISP %	51	3	11	11	—	1	20	2	—	—	<1	100
	MNI	90	7	18	12	—	6	23	6	—	—	5	167
	MNI %	54	4	11	7	—	4	14	4	—	—	3	100
Xinzhai	NISP	231	9	92	71	—	3	113	9	—	—	3	531
(Phase III, 3750-3550 BP)	NISP %	44	2	17	13	—	1	21	2	—	—	1	100
	MNI	12	3	8	3	—	1	8	3	—	—	3	41
	MNI %	29	7	20	7	—	2	20	7	—	—	7	100
Erlitou	NISP	1443	78	474	245	—	—	320	132	39	—	35	2766
(Phase I-II)	NISP %	52	3	17	9	—	—	12	5	1	—	1	100
	MNI	76	4	22	6	—	—	17	8	5	—	6	144
	MNI %	53	3	15	4	—	—	12	6	4	—	3	100
Erlitou	NISP	681	30	312	165	—	—	239	95	20	—	9	1551
(Phase III)	NISP %	44	2	20	11	—	—	15	6	1	—	<1	100
	MNI	34	3	17	5	—	—	13	9	4	—	3	88
	MNI %	39	3	19	6	—	—	15	10	4	—	3	100
Erlitou	NISP	1828	129	777	1162	—	—	457	165	37	—	18	4573
(Phase IV)	NISP %	40	3	17	25	—	—	10	4	1	—	<1	100
	MNI	209	9	49	22	—	—	18	9	6	—	10	332
	MNI %	63	3	15	7	—	—	5	3	2	—	3	100

NISP = number of identified specimens; MNI = minimum number of individuals

Carpological data

Notes for archaeobotanical table: data were taken from publications (Peking University School of Archaeology and Museology & Henan Institute of Cultural Relics and Archaeology 2007; Liu & Fang 2010; Nongye 2011; Zhao 2014; Zhong *et al*. 2016) following heterogeneous standards. We have attempted to standardize the data for comparison taking the following steps: flora was divided into economic and non-economic species. Carpological data required taxonomic harmonization and simplification. For economic taxa, Fabaceae, and Poaceae identifications were reported as precisely as published (even keeping the species if present). For non-economic taxa identifications were lowered (if necessary) to the family level. The table reports: absolute counts, relative abundance (%), densities (seeds/liter), ubiquity. Soil volumes were not always reported for each phase, and in such cases the volume has been reconstructed on the basis of the provided average volume of samples and reported followed by "!". Ubiquity values were not always available for all species and all sites. Unknowns and indeterminable are included in the sums used to calculate the relative abundance.

Table S2. **Carpological data from Xipo (Nongye yanjiu keti zu 2011), Wadian (Liu & Fang 2010), Wangchenggang (Peking University School of Archaeology and Museology & Henan Institute of Cultural Relics and Archaeology 2007), Xinzhai (Zhong *et al*. 2016) and Erlitou (Zhao 2014). Anr= absolute abundance (number of seeds); A%nr= relative abundance (percentage); CONCseeds/litre= densities, calculated as number of seeds for litre; UB%= ubiquity percentage (percentage of samples in which the taxon is found).**

Taxon (English name)	**Xipo** - Miaodigous Phase				**Wadian** - Wangwan Culture			
	A_{nr}	$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)	A_{nr}	$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)
Economic plants								
Setaria italica (foxtail millet)	1345	41.89	5.63	90.9	2253	19.53	0.65!	66.2
Panicum miliaceum (broomcorn millet)	131	4.08	0.55	81.8	385	3.34	0.11!	49.6
Oryza sativa (rice)	9	0.28	0.04	nr	1144	9.92	0.33!	61.9
Triticum aestivum (bread wheat)	—	—	—	—	8	0.07	0.00!	4.3
Glycine max (soybean)	—	—	—	—	573	4.97	0.16!	45.3
Perilla frutescens (perilla)	2	0.06	0.01	nr	557	4.83	0.16!	nr
Trapa sp. (water caltrop)	—	—	—	—	—	—	—	—
Dioscorea sp. (yam genus)	—	—	—	—	—	—	—	—
Crataegus sp. (hawthorn)	—	—	—	—	1	0.01	0.00!	nr
Prunus sp. (plums genus)	1	0.03	0.00	nr	—	—	—	—
Prunus persica (peach)	—	—	—	—	16	0.14	0.00!	nr
Quercus mongolica (Mongolian oak)	—	—	—	—	—	—	—	—
Vitis sp. (grapevine genus)	1	0.03	0.00	nr	8	0.07	0.00!	nr
Zanthoxylum simulans (Chinese-pepper)	—	—	—	—	—	—	—	—
Ziziphus spinosa (sour jujube)	—	—	—	—	2	0.02	0.00!	nr
Wild and Weeds								
Poaceae s.l.	4	0.12	0.02	nr	29	0.25	0.01!	nr
Panicoideae s.l.	819	25.51	3.43	nr	970	8.41	0.28!	nr
Echinochloa sp.	—	—	—	—	77	0.67	0.02!	nr
Panicum sp.	—	—	—	—	326	2.83	0.09!	nr
Setaria sp.	228	7.10	0.95	nr	2817	24.42	0.81!	nr
Setaria viridis	—	—	—	—	—	—	—	—
Digitaria sp.	117	3.64	0.49	nr	509	4.41	0.15!	nr
Paspalum thunbergii	—	—	—	—	—	—	—	—
Fabaceae s.l.	470	14.64	1.97	nr	265	2.30	0.08!	nr
Glycine sp	—	—	—	—	26	0.23	0.01!	nr
Glycine soja	1	0.03	0.00	nr	14	0.12	0.00!	nr
Astragalus scaberrimus	—	—	—	—	—	—	—	—
Kummerowia striata	—	—	—	—	—	—	—	—
Lespedeza sp	—	—	—	—	—	—	—	—
Lespedeza bicolor	—	—	—	—	—	—	—	—
Melilotus suaveolens	—	—	—	—	—	—	—	—
Amaranthaceae s.l.	—	—	—	—	1	0.01	0.00!	nr
Asteraceae s.l.	32	1.00	0.13	nr	1	0.01	0.00!	nr
Caryophyllaceae s.l.	—	—	—	—	2	0.01	0.00!	nr
Chenopodiaceae s.l.	10	0.31	0.04	nr	337	2.92	0.10!	nr
Cyperaceae s.l.	—	—	—	—	32	0.28	0.01!	nr
Cucurbitaceae s.l.	—	—	—	—	11	0.10	0.00!	nr
Euphorbiaceae s.l.	—	—	—	—	23	0.20	0.01!	nr
Geraniaceae s.l.	—	—	—	—	—	—	—	—
Lamiaceae s.l.	—	—	—	—	19	0.16	0.01!	nr
Malvaceae s.l.	—	—	—	—	—	—	—	—
Nymphaeaceae s.l.	—	—	—	—	1	0.01	0.00!	nr
Polygonaceae s.l.	—	—	—	—	7	0.06	0.00!	nr
Portulacaceae s.l.	—	—	—	—	5	0.04	0.00!	nr
Potamogetonaceae s.l.	—	—	—	—	—	—	—	—
Rosaceae s.l.	2	0.06	0.01	nr	1	0.01	0.00!	nr
Solanaceae s.l.	2	0.06	0.01	nr	3	0.03	0.00!	nr
Valerianaceae s.l.	—	—	—	—	—	—	—	—
Violaceae s.l.	—	—	—	—	—	—	—	—
Indeterminable/unknown								
unknown	37	1.15	0.15	nr	1114	9.66	0.32!	nr
Other nuts (unspecified)	—	—	—	—	—	—	—	—
Other fruit (unspecified)	—	—	—	—	—	—	—	—
Other tubers fragments (unspecified)	—	—	—	—	—	—	—	—
Summary stats								
Samples nr	48				139			
Soil (liters)	239				3475**!**			
Total seeds	3211				11537			
Total seeds CONC (seeds/liter)	13.41				3.32			
Economic plants CONC (seeds/liter)	6.23				1.42			
Charcoal CONC (g/l)	nr				0.03			

Taxon (English name)	**Xinzhai** (all periods)				**Wangchenggang -** Late Longshan Period			
	A_{nr}	$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)	A_{nr}	$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)
Economic plants								
Setaria italica (foxtail millet)	5887	67.38	4.92	99.1	1442	55.44	1.22!	72.20
Panicum miliaceum (broomcorn millet)	1035	11.85	0.86	83.5	124	4.77	0.10!	44.4
Oryza sativa (rice)	381	4.36	0.32	51.4	17	0.65	0.01!	16.7
Triticum aestivum (bread wheat)	1	0.01	0.00	0.9	—	—	—	—
Glycine max (soybean)	150	1.72	0.13	37.3	153	5.88	0.13!	38.9
Perilla frutescens (perilla)	49	0.56	0.04	nr	3	0.12	0.00!	nr
Trapa sp. (water caltrop)	—	—	—	—	—	—	—	—
Dioscorea sp. (yam genus)	—	—	—	—	—	—	—	—
Crataegus sp. (hawthorn)	—	—	—	—	—	—	—	—
Prunus sp. (plums genus)	—	—	—	—	—	—	—	—
Prunus persica (peach)	—	—	—	—	—	—	—	—
Quercus mongolica (Mongolian oak)	—	—	—	—	—	—	—	—
Vitis sp. (grapevine genus)	1	0.01	0.00	nr	—	—	—	—
Zanthoxylum simulans (Chinese-pepper)	—	—	—	—	—	—	—	—
Ziziphus spinosa (sour jujube)	—	—	—	—	—	—	—	—
Wild and Weeds								
Poaceae s.l.	—	—	—	—	—	—	—	—
Panicoideae s.l.	—	—	—	—	747	28.72	0.63!	nr
Echinochloa sp.	1	0.01	0.00	nr	—	—	—	—
Panicum sp.	—	—	—	—	—	—	—	—
Setaria sp.	—	—	—	—	—	—	—	—
Setaria viridis	292	3.34	0.24	nr	—	—	—	—
Digitaria sp.	94	1.08	0.08	nr	—	—	—	—
Paspalum thunbergii	1	0.01	0.00	nr	—	—	—	—
Fabaceae s.l.	—	—	—	—	86	3.31	0.07!	nr
Glycine sp	—	—	—	—	—	—	—	—
Glycine soja	—	—	—	—	—	—	—	—
Astragalus scaberrimus	12	0.14	0.01	nr	—	—	—	—
Kummerowia striata	1	0.01	0.00	nr	—	—	—	—
Lespedeza sp	—	—	—	—	—	—	—	—
Lespedeza bicolor	286	3.27	0.24	nr	—	—	—	—
Melilotus suaveolens	35	0.40	0.03	nr	—	—	—	—
Amaranthaceae s.l.	—	—	—	—	—	—	—	—
Asteraceae s.l.	85	0.97	0.07	nr	1	0.04	0.00!	nr
Caryophyllaceae s.l.	—	—	—	—	—	—	—	—
Chenopodiaceae s.l.	314	3.59	0.26	nr	10	0.38	0.01!	nr
Cyperaceae s.l.	48	0.55	0.04	nr	—	—	—	—
Cucurbitaceae s.l.	5	0.06	0.00	nr	—	—	—	—
Euphorbiaceae s.l.	8	0.09	0.01	nr	—	—	—	—
Geraniaceae s.l.	1	0.01	0.00		—	—	—	—
Lamiaceae s.l.	18	0.21	0.02	nr	15	0.58	0.01!	nr
Malvaceae s.l.	2	0.02	0.00	nr	—	—	—	—
Nymphaeaceae s.l.	—	—	—	—	—	—	—	—
Polygonaceae s.l.	2	0.02	0.00	nr	—	—	—	—
Portulacaceae s.l.	—	—	—	—	—	—	—	—
Potamogetonaceae s.l.	1	0.01	0.00	nr	—	—	—	—
Rosaceae s.l.	—	—	—	—	—	—	—	—
Solanaceae s.l.	—	—	—	—	—	—	—	—
Valerianaceae s.l.	1	0.01	0.00	nr	—	—	—	—
Violaceae s.l.	1	0.01	0.00	nr	—	—	—	—
Indeterminable/unknown								
unknown	25	0.29	0.02	nr	3	0.12	0.00!	nr
Other nuts (unspecified)	—	—	—	—	—	—	—	—
Other fruit (unspecified)	—	—	—	—	—	—	—	—
Other tubers fragments (unspecified)	—	—	—	—	—	—	—	—
Summary stats								
Samples nr	109				59			
Soil (liters)	1197				1180!			
Total seeds	8737				2601			
Total seeds CONC (seeds/liter)	7.30				2.20!			
Economic plants CONC (seeds/liter)	6.27				1.47!			
Charcoal CONC (g/l)	0.03				nr			

Taxon (English name)	**Erlitou** - phase I-II				**Erlitou** - phase III-IV			
	A_{nr}	*$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)	A_{nr}	$A\%_{nr}$	$CONC_{seeds/l}$	UB(%)
Economic plants								
Setaria italica (foxtail millet)	5766	46.80	6.54!	nr	4258	43.15	4.11!	nr
Panicum miliaceum (broomcorn millet)	1008	8.18	1.15!	nr	366	3.71	0.35!	nr
Oryza sativa (rice)	658 (2591)*	5.34 (21.03)*	0.75! (2.94!)*	nr	1291 (1125)*	13.08 (11.40)*	1.25! (1.09!)'	nr
Triticum aestivum (bread wheat)	—	—	—	—	3	0.03	0.00!	nr
Glycine max (soybean)	9	0.07	0.02!	nr	17	0.17	0.02!	nr
Perilla frutescens (perilla)	—	—	—	—	1	0.01	0.00!	nr
Trapa sp. (water caltrop)	1	0.01	0.01!	nr	2	0.02	0.00!	nr
Dioscorea sp. (yam genus)	3	0.02	0.01!	nr	—	—	—	—
Crataegus sp. (hawthorn)	—	—	—	—	—	—	—	—
Prunus sp. (plums genus)	—	—	—	—	—	—	—	—
Prunus persica (peach)	3	0.02	0.01!	nr	10	0.10	0.01!	nr
Quercus mongolica (Mongolian oak)	1	0.01	0.01!	nr	1	0.01	0.00!	nr
Vitis sp. (grapevine genus)	—	—	—	—	1	0.01	0.00!	nr
Zanthoxylum simulans (Chinese-pepper)	1	0.01	0.01!	nr	—	—	—	—
Ziziphus spinosa (sour jujube)	1	0.01	0.01!	nr	15	0.15	0.01!	nr
Wild and Weeds								
Poaceae s.l.	1	0.01	0.01!	nr	18	0.18	0.02!	nr
Panicoideae s.l.	—	—	—	—	—	—	—	—
Echinochloa sp.	—	—	—	—	—	—	—	—
Panicum sp.	25	0.20	0.03!	nr	11	0.11	0.01!	nr
Setaria sp.	—	—	—	—	—	—	—	—
Setaria viridis	2140	17.37	2.43!	nr	1249	12.66	1.21!	nr
Digitaria sp.	17	0.14	0.02!	nr	261	2.64	0.25!	nr
Paspalum thunbergii	—	—	—	—	—	—	—	—
Fabaceae s.l.	2	0.02	0.01!	nr	24	0.24	0.02!	nr
Glycine sp	—	—	—	—	—	—	—	—
Glycine soja	—	—	—	—	—	—	—	—
Astragalus scaberrimus	—	—	—	—	—	—	—	—
Kummerowia striata	—	—	—	—	—	—	—	—
Lespedeza sp	23	0.19	0.03!	nr	46	0.47	0.04!	nr
Lespedeza bicolor	—	—	—	—	—	—	—	—
Melilotus suaveolens	—	—	—	—	—	—	—	—
Amaranthaceae s.l.	—	—	—	—	—	—	—	—
Asteraceae s.l.	—	—	—	—	—	—	—	—
Caryophyllaceae s.l.	—	—	—	—	—	—	—	—
Chenopodiaceae s.l.	37	0.30	0.05!	nr	167	1.69	0.16!	nr
Cyperaceae s.l.	1	0.01	0.01!	nr	1	0.01	0.00!	nr
Cucurbitaceae s.l.	—	—	—	—	—	—	—	—
Euphorbiaceae s.l.	—	—	—	—	—	—	—	—
Geraniaceae s.l.	—	—	—	—	—	—	—	—
Lamiaceae s.l.	1	0.01	0.01!	nr	25	0.25	0.02!	nr
Malvaceae s.l.	—	—	—	—	—	—	—	—
Nymphaeaceae s.l.	—	—	—	—	—	—	—	—
Polygonaceae s.l.	2	0.02	0.01!	nr	—	—	—	—
Portulacaceae s.l.	—	—	—	—	—	—	—	—
Potamogetonaceae s.l.	—	—	—	—	—	—	—	—
Rosaceae s.l.	—	—	—	—	5	0.05	0.00!	nr
Solanaceae s.l.	—	—	—	—	2	0.02	0.00!	nr
Valerianaceae s.l.	—	—	—	—	—	—	—	—
Violaceae s.l.	—	—	—	—	—	—	—	—
Indeterminable/unknown								
unknown	21	0.17	0.03!	nr	17	0.17	0.02!	nr
Other nuts (unspecified)	—	—	—	nr	1	0.01	0.00!	nr
Other fruit (unspecified)	2	0.02	0.01!	nr	3	0.03	0.00!	nr
Other tubers fragments (unspecified)	6	0.05	0.01!	nr	7	0.07	0.01!	nr
Summary stats								
Samples nr	63				74			
Soil (liters)	882!				1036!			
Total seeds	12320				9869			
Total seeds CONC (seeds/liter)	13.97!				9.53!			
Economic plants CONC (seeds/liter)	11.39!				6.84!			
Charcoal CONC (g/l)	nr				nr			

* in parenthesis are indicated rice grain fragments

Carbon and nitrogen isotopes data

Table S3. Carbon and Nitrogen isotopes data from Xipo (Zhang *et al.* 2010), Wadian (from Chen *et al.* 2016), Xinzhai (Dai *et al.* 2016) and Erlitou (Si *et al*. 2014); mean values and standard deviation are reported. N = number of samples analysed.

		Human	N	Pigs	N	Dogs	N	Cattle	N	Sheep	N	Deer	N
Xipo	Mean δ13C± SD (‰)	-9.65±1.14	31	-7.53±0.18	2	-8.18	1	—	0	—	0	—	0
	Mean δ15N± SD (‰)	9.43±1.06	31	—	0	—	0	—	0	—	0	—	0
Wadian	Mean δ13C± SD (‰)	-11.01±2.09	12	-11.4±2.4	10	-10.13±0.95	7	-12.83±2.03	10	-16.65±0.92	2	-20.8±0.90	10
	Mean δ15N± SD (‰)	8.2±1.3	12	6.9±1.0	10	7.2±1.1	7	7.6±0.7	10	7.6±0.1	2	5.0±1.2	10
Xinzhai	Mean δ13C± SD (‰)	-9.6±1.5	8	-8.5±1.0[1]	11	-9.6±1.6	3	-9.8±1.7	11	-14.4±1.6	8	-16.2±3.3	4
	Mean δ15N± SD (‰)	9±1.0	8	6.2±0.9	11	6.3±0.8	3	6.3±0.9	11	5.6±0.5	8	5.9±0.8	2
Erlitou	Mean δ13C± SD (‰)	-8.6±0.9	20	-9.6±1.7	19	-9.8±1.9	5	-9.2±1.4	15	-15.5±1.4	17	-19.2±1.0	13
	Mean δ15N± SD (‰)	10.2±1.8	4	7.3±1.5	19	7.3±1.2	5	6.7±1.0	15	6.4±1.0	17	4.0±0.6	13

(1) Two outlier pigs were removed from sample, one of which was suspected to have been a wild boar, the standard deviation would have been much higher had they been included.

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