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2 **Supplementary Information for**

3 **The optimal species richness environments for human populations**

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7 **This PDF file includes:**

- 8 Supplementary text
- 9 Figs. S1 to S5
- 10 Tables S1 to S21
- 11 Caption for Database S1
- 12 References for SI reference citations

13 **Other supplementary materials for this manuscript include the following:**

- 14 Database S1

15 Supporting Information Text

16 This document provides additional analyses and data in support of the arguments made in the main text. All data and scripts
17 are available on Github at.... There you will find detailed scripts and data files for replicating our analysis. In this supporting
18 document, we discuss in more depth the optimal richness hypothesis and provide supplementary statistical analyses that
19 support the arguments and results made in the main body of the text.

20 1. Optimal Richness Hypothesis

21 The ORH rests on the generalization that species richness affects the stability of productivity and functioning of ecosystems.
22 Ecosystem function simply refers to the properties of an ecosystems and their efficiency. For example, variation in the production
23 of biomass over time describes a property of the ecosystem, and output of its functional relationships between biotic and
24 abiotic components. In particular, stability and functioning increase at a diminishing rate as species richness increases (1).
25 In low species richness environments, thus, we argue that there is selective pressure for individuals to disperse and use lots
26 of space. In essence, using lots of space is a way to gain access to more species richness and, thus, stabilize the supply of
27 resources that individuals can access. This is because species richness increases with the area that an individual samples (2).
28 As species richness increases, populations become more concentrated as individuals need less space to maintain a stable supply
29 of resources. Thus, individuals can increase their performance (output of resources per unit area), without sacrificing any
30 stability in their supply of resources over time.

31 However, it is important to note that living at larger population densities increases conflicts over resources and potentially
32 disease transmission. Thus, the fact that the effect of species richness on ecosystem stability displays diminishing returns is
33 very important, from the perspective of human populations. At some point, increases in species richness will only increase the
34 stability of the resources and "services" that individuals tap into at a negligible. If individuals continue to attempt to maximize
35 output per unit area, the stability of resources would not increase fast enough to compensate for the variance in resources
36 generated by competition. In other words, the costs of competition increase much faster than increases in richness stabilize
37 resources. Thus, selective pressure should favor strategies that sacrifice some output per unit area (performance) in favor of
38 strategies that maximize stability. This dynamic is illustrated in Fig. 1B & C in the main text and by the red curve on Fig. S1
39 below. At the light blue dot on the red curve in Fig. S1, selection should start to favor individual strategies that minimize the
40 costs of competition, as competition becomes a stronger limiting factor on fitness relative to the reliability of resources. In such
41 an environment, individuals should disperse and develop weak, flexible social ties to avoid direct competition.

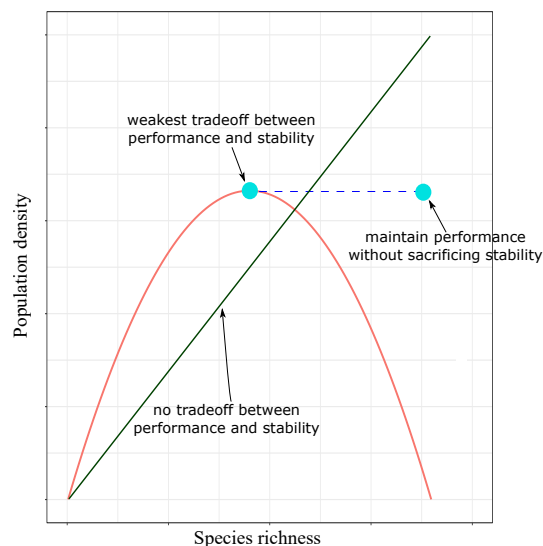


Fig. S1. Theoretical relationships between species richness and population density.

42 It is perhaps informative at this point to consider the alternatives. First, the dashed blue line in Fig S1 to the second blue
43 dot offset from the red curve illustrates a scenario in which individuals could maintain a constant level of performance without
44 sacrificing any stability (experiencing increasing variability). In this case, as above, increases in species richness would, initially,
45 allow individuals to better maximize output per unit area, leading to increases in population density up to the blue dot on the
46 red curve. However, if populations could adjust technologically and socially to maintain the "optimal" performance without
47 sacrificing as much in the way of stability, then to curve would flatten and move toward the blue-dot offset from the red curve.
48 Interestingly, this may help account for why subsistence agriculturalists have a much steeper negative slope between species
49 richness and population density in high richness environments than hunter-gatherers and modern nation states.

50 Hunter-gatherers and modern nations, in some features are similar. Hunter-gatherer often rely more on mobility and use
51 larger territories and modern nation states tap into trade flows from very different locations. Both strategies may act as

52 buffers against resource shortfalls and may allow individuals in these economic structures to better maintain stability without
53 sacrificing as much output per unit area (thus live at higher density). Ethnographically recorded agriculturalists, conversely,
54 are often more sedentary and marginal to modern economic structures (peasants). This may require individuals to sacrifice
55 more performance to maintain stability, leading to a steeper slope between species richness and population density. In any case,
56 the differences between hunter-gatherers, agriculturalists and modern nation states noted here and below are interesting and
57 open up new research questions.

58 Second, the green, linear curve illustrates a case in which no tradeoff between performance and stability exists. Quite simply,
59 as performance increases, stability increases. In this case, population density would be a positive function of species richness.
60 We simply do not observe this among human populations at a global scale. However, if one were to conduct a smaller scale
61 analysis,, especially in lower richness environments, it would appear that population density increased linearly with species
62 richness. However, this would be a matter of range and scale restriction.

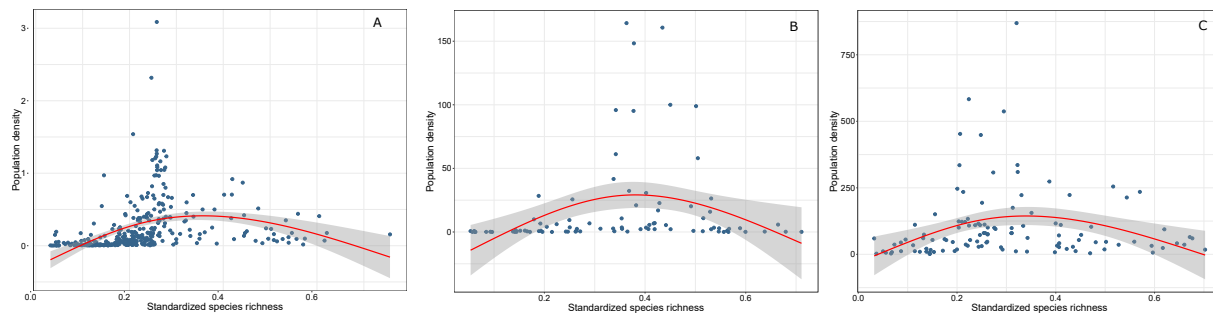


Fig. S2. Scatter plots of human population density against species richness. A-Hunter-gatherer societies, B-Agricultural societies, C-Nation states. Quadratic function fit separately to each set of societies.

63 2. Scatterplots

64 Figure S2 graphs population density (y-axis) against standardized species richness (x-axis). As discussed in the text, a quadratic
65 function that forms an inverse U fits the data. Figure S3 illustrates the log of population density (y-axis) graphed against
66 standardized species richness or net primary productivity respectively (x-axis). Again, the figure is paneled by economy
67 type. Figure S3 illustrates that the relationship between population density and net primary productivity also displays a
68 peak. However, the change in the direction of the relationship between population density and net primary productivity
69 and population density is not as strong as the shift from an increasing to decreasing relationship between species richness
70 and population density. Our path analysis of the the effects of species richness and net primary productivity in the main
71 text, in fact, suggests that while species richness either has a negative direct (agriculturalists and nation states) or indirect
72 (hunter-gatherers) effect on population density in high richness environments, net primary productivity consistently has a
73 positive direct effect. In sum, the data are consistent with the idea that competition drives populations to disperse and take
74 advantage off stable, diverse habitats in high species richness environments to avoid competition.

75 It is important to note that the breakpoint or value of species richness where population density peaks among agriculturalists
76 is significantly higher than among hunter-gahterers and modern nation states. Why this is the case is not clear at this point.
77 We suspect that subsistence agriculturalists use their environment in a more fine grained way than hunter-gatherer and modern
78 nation states economies (which may aggregate many different economic pursuits). This is to say that subsistence agriculturalists
79 can obtain their food from smaller units of land and thus, face less indirect competition for resources than hunter-gatherers.

80 3. Path Analysis and Spatial Autocorrelation

81 The goals of this section are threefold. (1) We present supplemental analyses that illustrate the relationship between social
82 complexity and distance from optimal species richness. (2) We discuss the potential consequences of spatial autocorrelation.
83 We correct for spatial dependence and find that our results do not change. (3) We present all of the coefficients, standard
84 errors and confidence intervals of coefficients for each path model run in the main text. We also present the fit statistics of
85 these models.

86 **A. Additional social complexity analysis.** Table S1 illustrates the results of a SEM analysis that replicates equations (9) and
87 (10) in the main text. However, in this case, social complexity is estimated by three ordinal categories rather than as a binary.
88 Here, as discussed in the text, social complexity is measured among hunter-gatherers as 0=no differentiation, 2=wealth and
89 social differences, 3=inherited wealth and social differences. We combined categories 2 and 3 in the main text due to the small
90 number of societies with inherited wealth and status differences among hunter-gatherers. We replicate the analysis here to
91 demonstrate that using three categories does not change our results.

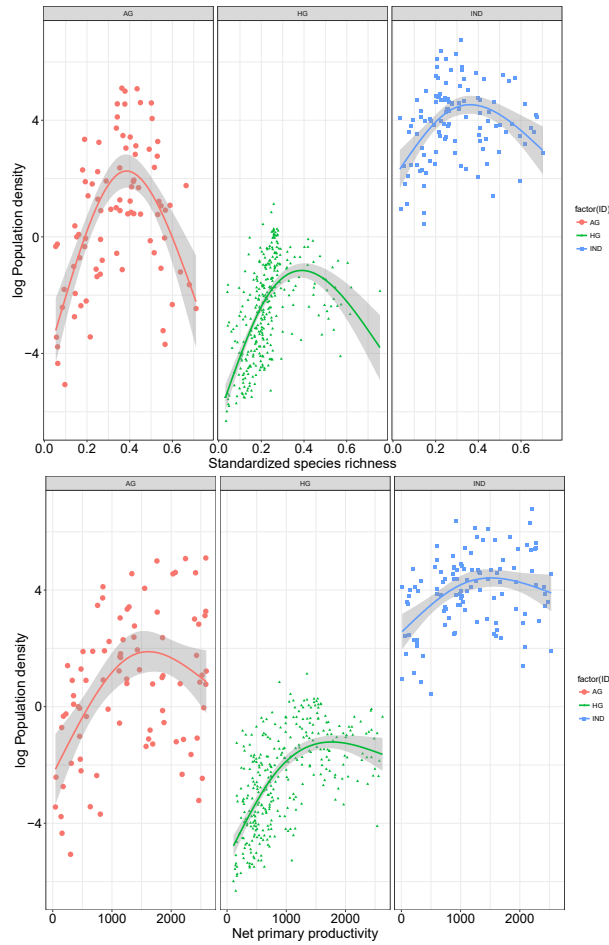


Fig. S3. Scatter plots of human population density against species richness and net primary productivity, controlling for economy type. AG=subsistence agricultural populations, HG=subsistence hunter-gatherer populations; IND=modern nation states.

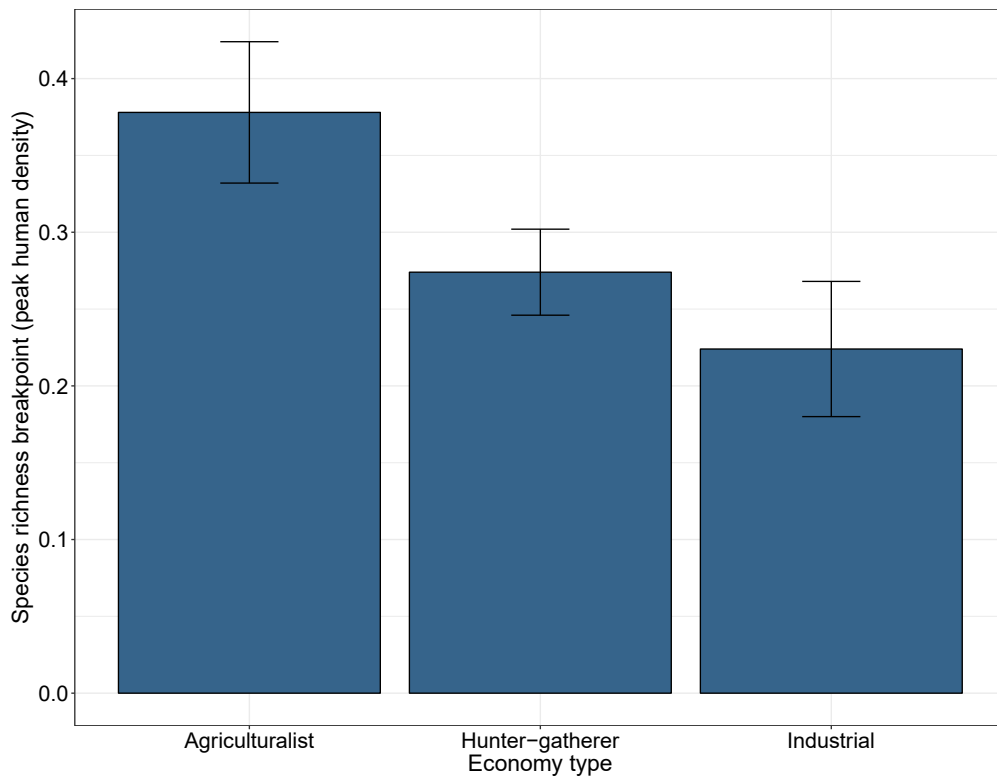


Fig. S4. Comparison of peak species richness-human population density points by economy type. Agriculturalist population density peaks at a significantly higher species richness value than hunter-gatherer and modern nation states.

Table S1. Coefficients of path model with three ordered classes as the response variable to estimate social complexity among hunter-gatherers

	lhs	op	rhs	label	coeff	se	z	pvalue	ci.lower	ci.upper
1	class	~	DivDiff	a1	-2.08	1.21	-1.72	0.09	-4.61	0.12
2	class	~	LnDENSITY	a2	0.59	0.09	6.76	0.00	0.41	0.75
3	LnDENSITY	~	DivDiff	b1	-4.02	0.63	-6.36	0.00	-5.35	-2.86
4	class		t1		-0.41	0.11	-3.61	0.00	-0.63	-0.17
5	class		t2		0.60	0.15	4.14	0.00	0.34	0.93
6	class	~	class		0.86	0.00			0.86	0.86
7	LnDENSITY	~	LnDENSITY		0.41	0.02	16.62	0.00	0.36	0.45
8	class	**	class		1.00	0.00			1.00	1.00
9	class	~1			0.00	0.00			0.00	0.00
10	LnDENSITY	~1			-0.67	0.06	-10.50	0.00	-0.79	-0.54
11	IndDiv	:=	a2*b1	IndDiv	-2.36	0.56	-4.22	0.00	-3.59	-1.35
12	TotDiv	:=	(a2*b1)+a1	TotDiv	-4.43	1.07	-4.15	0.00	-6.86	-2.63

92 Similarly, Table S2 replicates equations (9) and (10); however, instead of using the “class” variable as a measure of social
 93 complexity, here we use an alternative variable provided by Binford (3) call “Augmen2.” The Augmen2 variable is an ordinal
 94 ranking of how many weak social ties augment kinship networks. A 0 indicates that social organization is based on kinship,
 95 with no weak ties across kinship networks. A value of 1 indicates one formal set of social norms for creating weak ties across
 96 kinship networks and a value of 3 indicates two or more social mechanisms for creating such weak ties. Consistent with our
 97 analysis above, the farther a group live from the optimal species richness environment, the more that their social organization
 98 focuses on cultivating weak ties across kinship networks. This type of social organization is consistent with the fact that in low
 99 or very high richness environments, groups disperse more in space, and individuals focus on developing social ties that maximize
 100 their flexibility to move in space and change communities. Unfortunately, we only have these data for the hunter-gatherer
 101 societies compared by Binford (3).

Table S2. Coefficients of path model with kinship augmentation as the response variable

	lhs	op	rhs	label	coeff	se	z	p-value	ci.lower	ci.upper
1	augmen2	~	DivDiff	a1	4.78	1.23	3.89	0.00	2.73	7.62
2	augmen2	~	LnDENSITY	a2	-0.35	0.11	-3.17	0.00	-0.55	-0.11
3	LnDENSITY	~	DivDiff	b1	-4.11	0.67	-6.13	0.00	-5.58	-2.98
4	augmen2		t1		1.18	0.14	8.43	0.00	0.94	1.47
5	augmen2		t2		2.33	0.16	14.21	0.00	2.04	2.69
6	augmen2	~	augmen2		0.95	0.00			0.95	0.95
7	LnDENSITY	~	LnDENSITY		0.41	0.02	16.46	0.00	0.35	0.45
8	augmen2	**	augmen2		1.00	0.00			1.00	1.00
9	augmen2	~1			0.00	0.00			0.00	0.00
10	LnDENSITY	~1			-0.66	0.07	-10.01	0.00	-0.77	-0.52
11	IndDiv	:=	a2*b1	IndDiv	1.42	0.48	2.93	0.00	0.46	2.42
12	TotDiv	:=	(a2*b1)+a1	TotDiv	6.20	1.21	5.14	0.00	4.17	8.89

102 Table S3 illustrates the results of a SEM analysis that replicates equations (9) and (10) in the main text. However, in this
 103 case, social complexity is estimated by three ordinal categories rather than as a binary. Here, as discussed in the text, social
 104 complexity is measured among hunter-gatherers as 0=no differentiation, 2=wealth and social differences, 3=inherited wealth
 105 and social differences. We combined categories 2 and 3 in the main text due to the small number of societies with inherited
 106 wealth and status differences among hunter-gatherers. We replicate the analysis here to demonstrate that using three categories
 107 does not change our results.

Table S3. Coefficients of path model with a three ordination estimate of class ranking as the response variable among agricultural societies.

	lhs	op	rhs	label	Coeff	se	z	p-value	ci.lower	ci.upper
1	class	~	DivDiff	a1	-4.01	2.56	-1.57	0.12	-9.57	0.68
2	class	~	LnDENSITY	a2	0.53	0.15	3.65	0.00	0.24	0.82
3	LnDENSITY	~	DivDiff	b1	-6.54	1.18	-5.56	0.00	-8.91	-4.22
4	class		t1		-0.48	0.40	-1.22	0.22	-1.33	0.24
5	class		t2		0.96	0.33	2.94	0.00	0.37	1.67
6	class	~	class		0.81	0.00			0.81	0.81
7	LnDENSITY	~	LnDENSITY		0.67	0.10	6.91	0.00	0.47	0.85
8	class	~*	class		1.00	0.00			1.00	1.00
9	class	~1			0.00	0.00			0.00	0.00
10	LnDENSITY	~1			1.35	0.17	8.10	0.00	1.03	1.68
11	IndDiv	:=	a2*b1	IndDiv	-3.48	1.24	-2.80	0.01	-6.30	-1.40
12	TotDiv	:=	(a2*b1)+a1	TotDiv	-7.48	2.19	-3.41	0.00	-12.52	-4.07

108 **B. Spatial autocorrelation.** To account for autocorrelation we modified the spatial correct function developed by (4). Because
 109 we used piecewise regressions, we treated each regression as its own “stage.” We tested for the spatial dependence of each
 110 regressions error terms using a Moran’s I test from the APE package in R. We used a p-value of < 0.1 as sufficient evidence of
 111 spatial autocorrelation among the error terms of any given regression. In all, spatial autocorrelation was present in about 2/3
 112 of the regression analyses we ran. Controlling for spatial autocorrelation does not change our conclusions. To run all analyses
 113 see SpatialCorrect2.text below. This file can be opened in R and used to replicate our analysis. In general, we used an SAR
 114 network, global autocorrelation approach.

115 **C. Coefficients and fit statistics of path models in the main text.** we evaluate the fit of each path model using the comparative
 116 fit index (CFI), root-mean square error of approximation (RMSEA), standardized root-mean residual (SRMR), and Achaik
 117 Information Criterion (AIC). CFI, RMSEA and SRMR are less sensitive to sample size. Model fit is considered adequate for
 118 CFIs greater than 0.90. RMSEA values less than 0.02 are considered excellent fits, less than 0.05 good, and less than 0.08
 119 mediocre fits. SRMR values less than 0.08 are considered good fits. AIC is a measure of fit and complexity that allows us to
 120 compare different models; the lower the value, the better the model balances fit and complexity. No one measure is adequate to
 121 assess a path model’s fit. Thus, we observe all of these fit measures for the path models.

Table S4. Coefficients of path model (equations 2-3) in low species richness environments for hunter-gatherers

	lhs	op	rhs	label	coefficient	se	z	pvalue	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	0.00001	0.000001	6.02	0.00	0.00	0.00
2	LnDENSITY	~	biodiv	a3	5.04	0.77	6.54	0.00	3.48	6.63
3	biodiv	~	npp	b1	0.00001	0.000001	14.86	0.00	0.00	0.00
4	LnDENSITY	~	LnDENSITY		0.27	0.02	13.18	0.00	0.23	0.31
5	biodiv	~	biodiv		0.00	0.00	13.34	0.00	0.00	0.00
6	npp	~	npp		214307.45	0.00			214307.45	214307.45
7	IndNppBio	:=	a3*b1	IndNppBio	0.00	0.00	6.27	0.00	0.00	0.00
8	TotNppBio	:=	(a3*b1)+a2	TotNppBio	0.00	0.00	14.09	0.00	0.00	0.00

Table S5. Path model fits for equations 2-3 in high species richness environments for hunter-gatherers

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	3686.09

Table S6. Coefficients of path model (equations 2-3) in low species richness environments for agriculturalists

	lhs	op	rhs	label	coeff	se	z	pvalue	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	0.00001	0.000001	0.16	0.87	-0.0000001	0.000015
2	LnDENSITY	~	biodiv	a3	7.35	1.68	4.37	0.00	4.06	10.57
3	biodiv	~	npp	b1	0.00	0.00	9.17	0.00	0.00	0.00
4	LnDENSITY	~~	LnDENSITY		0.61	0.09	6.60	0.00	0.40	0.75
5	biodiv	~~	biodiv		0.00	0.00	5.66	0.00	0.00	0.01
6	npp	~~	npp		412383.11	0.00			412383.11	412383.11
7	IndNppBio	:=	a3*b1	IndNppBio	0.00	0.00	3.75	0.00	0.00	0.00
8	TotNppBio	:=	(a3*b1)+a2	TotNppBio	0.00	0.00	4.20	0.00	0.00	0.00

Table S7. Path model fits for equations 2-3 in high species richness environments for agriculturalists

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	788.12

Table S8. Coefficients of path model (equations 2-3) in low species richness environments for nation states

	lhs	op	rhs	label	est	se	z	pvalue	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	-0.00001	0.000001	-0.07	0.94	-0.0001	0.00001
2	LnDENSITY	~	biodiv	a3	6.15	2.02	3.05	0.00	1.96	9.76
3	biodiv	~	npp	b1	0.00	0.00	6.82	0.00	0.00	0.00
4	LnDENSITY	~~	LnDENSITY		0.27	0.05	5.33	0.00	0.16	0.35
5	biodiv	~~	biodiv		0.00	0.00	5.58	0.00	0.00	0.00
6	npp	~~	npp		198033.75	0.00			198033.75	198033.75
7	IndNppBio	:=	a3*b1	IndNppBio	0.00	0.00	2.97	0.00	0.00	0.00
8	TotNppBio	:=	(a3*b1)+a2	TotNppBio	0.00	0.00	3.04	0.00	0.00	0.00

Table S9. Path model fits for equations 2-3 in high species richness environments for nation states

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	582.38

Table S10. Coefficients of path model (equations 4-6) in high species richness environments for hunter-gatherers

	lhs	op	rhs	label	coeff	se	z	p-value	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	0.00	0.00	9.35	0.00	0.00	0.00
2	LnDENSITY	~	biodiv	a3	0.98	0.54	1.83	0.07	0.02	2.11
3	LnDENSITY	~	pathos	a4	-0.45	0.10	-4.29	0.00	-0.65	-0.25
4	biodiv	~	npp	b1	0.00	0.00	17.49	0.00	0.00	0.00
5	pathos	~	biodiv	c1	2.56	0.18	14.62	0.00	2.23	2.91
6	LnDENSITY	~~	LnDENSITY		0.32	0.02	14.63	0.00	0.28	0.36
7	biodiv	~~	biodiv		0.00	0.00	8.83	0.00	0.00	0.01
8	pathos	~~	pathos		0.10	0.01	11.47	0.00	0.08	0.12
9	npp	~~	npp		388779.27	0.00			388779.27	388779.27
10	IndNppBio	:=	a3*b1	IndNppBio	0.00	0.00	1.91	0.06	0.00	0.00
11	TotNppBio	:=	(a3*b1)+a2	TotNppBio	0.00	0.00	10.85	0.00	0.00	0.00
12	IndBio	:=	c1*a4	IndBio	-1.15	0.27	-4.18	0.00	-1.70	-0.62
13	TotBio	:=	(c1*a4)+a3	TotBio	-0.17	0.45	-0.37	0.71	-1.06	0.75

Table S11. Path model fits for equations 4-6 in high species richness environments for hunter-gatherers

Measure	Value
cfi	0.94
rmsea	0.29
srmr	0.06
aic	1299.79

Table S12. Coefficients of path model (equations 4-6) in high species richness environments for agricultural societies

	lhs	op	rhs	label	coeff	se	z	p-value	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	0.00	0.00	1.56	0.12	-0.00	0.00
2	LnDENSITY	~	biodiv	a3	-6.67	1.69	-3.94	0.00	-9.97	-3.50
3	LnDENSITY	~	pathos	a4	0.62	0.50	1.25	0.21	-0.37	1.54
4	biodiv	~	npp	b1	0.00	0.00	2.17	0.03	0.00	0.00
5	pathos	~	biodiv	c1	-0.68	0.46	-1.47	0.14	-1.61	0.24
6	LnDENSITY	~~	LnDENSITY		0.55	0.11	5.06	0.00	0.30	0.72
7	biodiv	~~	biodiv		0.01	0.00	5.25	0.00	0.00	0.01
8	pathos	~~	pathos		0.08	0.01	5.51	0.00	0.05	0.10
9	npp	~~	npp		358638.64	0.00			358638.64	358638.64
10	IndNppBio	:=	a3*b1	IndNppBio	-0.00	0.00	-1.96	0.05	-0.00	-0.00
11	TotNppBio	:=	(a3*b1)+a2	TotNppBio	0.00	0.00	0.23	0.82	-0.00	0.00
12	IndBio	:=	c1*a4	IndBio	-0.42	0.47	-0.90	0.37	-1.51	0.34
13	TotBio	:=	(c1*a4)+a3	TotBio	-7.09	1.64	-4.34	0.00	-10.29	-4.11

Table S13. Path model fits for equations 4-6 in high species richness environments for agriculturalists

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	587.84

Table S14. Coefficients of path model in high species richness environments (equations 4-6) for modern nation states

	lhs	op	rhs	label	coeff	se	z	p-value	ci.lower	ci.upper
1	LnDENSITY	~	npp	a2	0.00	0.00	2.28	0.02	0.00	0.00
2	LnDENSITY	~	biodiv	a3	-1.99	0.59	-3.38	0.00	-3.23	-0.91
3	LnDENSITY	~	pathos	a4	0.08	0.20	0.40	0.69	-0.33	0.49
4	biodiv	~	npp	b1	0.00	0.00	8.43	0.00	0.00	0.00
5	pathos	~	biodiv	c1	0.72	0.25	2.93	0.00	0.27	1.23
6	LnDENSITY	~~	LnDENSITY		0.18	0.03	5.23	0.00	0.10	0.25
7	biodiv	~~	biodiv		0.01	0.00	4.61	0.00	0.01	0.01
8	pathos	~~	pathos		0.09	0.02	4.68	0.00	0.05	0.13
9	npp	~~	npp		332659.37	0.00			332659.37	332659.37
10	IndNppBio	:=	a3*b1	IndNppBio	-0.00	0.00	-3.13	0.00	-0.00	-0.00
11	TotNppBio	:=	(a3*b1)+a2	TotNppBio	-0.00	0.00	-0.16	0.87	-0.00	0.00
12	IndBio	:=	c1*a4	IndBio	0.06	0.15	0.39	0.69	-0.22	0.39
13	TotBio	:=	(c1*a4)+a3	TotBio	-1.93	0.56	-3.42	0.00	-3.17	-0.95

Table S15. Path model fits for equations 4-6 in high species richness environments for agriculturalists

Measure	Value
cfi	1.00
rmsea	0.06
srmr	0.03
aic	1066.58

Table S16. Coefficients of path model of species richness and population density on social complexity (equations 7-8) for hunter-gatherers

	lhs	op	rhs	label	coeff	se	z	pvalue	ci.lower	ci.upper
1	class2	~	DivDiff	a1	-2.89	1.25	-2.32	0.02	-5.50	-0.50
2	class2	~	LnDENSITY	a2	0.55	0.10	5.54	0.00	0.35	0.75
3	LnDENSITY	~	DivDiff	b1	-4.02	0.65	-6.21	0.00	-5.45	-2.80
4	class2		t1		-0.45	0.13	-3.46	0.00	-0.70	-0.18
5	class2	~	class2		0.88	0.00			0.88	0.88
6	LnDENSITY	~	LnDENSITY		0.41	0.02	16.29	0.00	0.36	0.45
7	class2	~*	class2		1.00	0.00			1.00	1.00
8	class2	~1			0.00	0.00			0.00	0.00
9	LnDENSITY	~1			-0.67	0.06	-10.44	0.00	-0.79	-0.54
10	IndDiv	:=	a2*b1	IndDiv	-2.19	0.58	-3.75	0.00	-3.55	-1.19
11	TotDiv	:=	(a2*b1)+a1	TotDiv	-5.08	1.14	-4.43	0.00	-7.43	-3.00

Table S17. Path model fits for equations 7-8, social complexity among hunter-gatherers

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	

Table S18. Coefficients of path model of species richness and population density on social complexity (equations 7-8) for agriculturalists

	lhs	op	rhs	label	coeff	se	z	pvalue	ci.lower	ci.upper
1	class2	~	DivDiff	a1	-5.81	3.11	-1.87	0.06	-12.83	-0.65
2	class2	~	LnDENSITY	a2	0.62	0.20	3.15	0.00	0.26	1.03
3	LnDENSITY	~	DivDiff	b1	-6.54	1.26	-5.17	0.00	-8.95	-3.93
4	class2		t1		-0.68	0.50	-1.36	0.17	-1.67	0.19
5	class2	~	class2		0.74	0.00			0.74	0.74
6	LnDENSITY	~	LnDENSITY		0.67	0.10	7.03	0.00	0.47	0.85
7	class2	~*	class2		1.00	0.00			1.00	1.00
8	class2	~1			0.00	0.00			0.00	0.00
9	LnDENSITY	~1			1.35	0.17	7.89	0.00	1.00	1.68
10	IndDiv	:=	a2*b1	IndDiv	-4.07	1.65	-2.47	0.01	-7.83	-1.32
11	TotDiv	:=	(a2*b1)+a1	TotDiv	-9.89	2.76	-3.59	0.00	-16.41	-5.56

Table S19. Path model fits for equations 7-8, social complexity among agriculturalists

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	

Table S20. Coefficients of path model of species richness and population density on social complexity (equations 9-10) for nation states

	lhs	op	rhs	label	coeff	se	z	pvalue	ci.lower	ci.upper
1	ECI	~	DivDiff	a1	-3.07	0.67	-4.56	0.00	-4.53	-1.99
2	ECI	~	LnDENSITY	a2	0.42	0.15	2.91	0.00	0.16	0.71
3	LnDENSITY	~	DivDiff	b1	-1.09	0.36	-3.02	0.00	-1.85	-0.45
4	ECI	~	ECI		0.68	0.08	8.29	0.00	0.51	0.84
5	LnDENSITY	~	LnDENSITY		0.29	0.04	7.56	0.00	0.21	0.36
6	DivDiff	~	DivDiff		0.01	0.00			0.01	0.01
7	IndDiv	:=	a2*b1	IndDiv	-0.46	0.23	-2.03	0.04	-0.98	-0.12
8	TotDiv	:=	(a2*b1)+a1	TotDiv	-3.53	0.71	-4.96	0.00	-5.13	-2.38

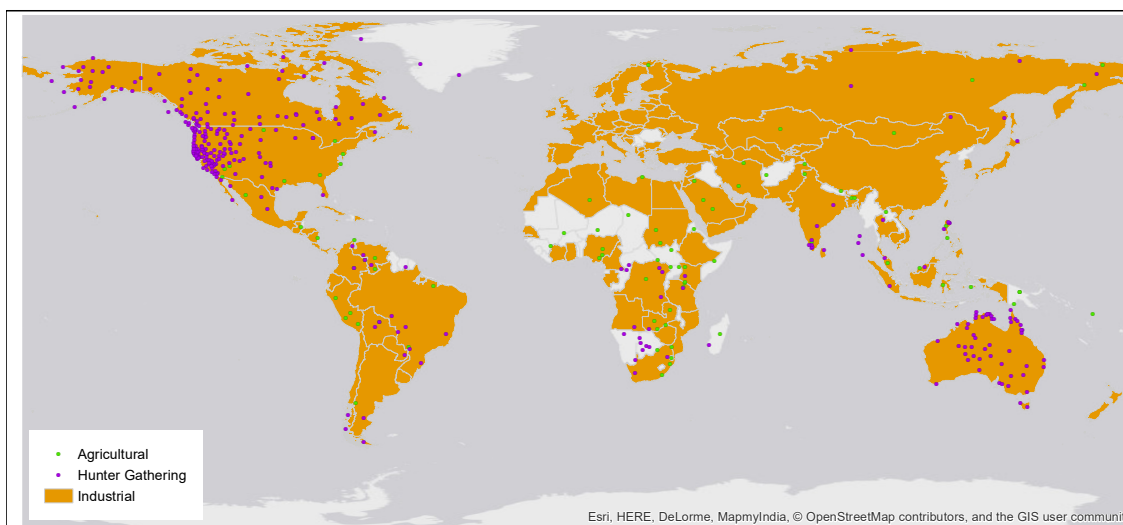


Fig. S5. Global distribution of the samples of societies analyzed in this study.

122 **Additional data table S1 (RichnessDensity.pdf)**

123 This file details an R-script and data for replicating our analysis.

124 **References**

125 1. Cardinale BJ, et al. (2012) Biodiversity loss and its impact on humanity. *Nature* 486(7401):59.

Table S21. Path model fits for equations 9-10, social complexity among nation states

Measure	Value
cfi	1.00
rmsea	0.00
srmr	0.00
aic	299.23

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- 128 *gatherer and environmental data sets*. (University of California Press, Berkeley).
- 129 4. Tallavaara M, Eronen JT, Luoto M (2017) Supporting data and script for "Productivity, biodiversity, and pathogens
- 130 influence the global hunter-gatherer population density" (Tallavaara et al.).