

Ecography

**ECOG-02534**

Hu, W., Gao, J., Yan, D., Liu, L., Wu, F. and Yang, X.  
2016. Influences of interpolation of species ranges on  
elevational species richness gradients. – Ecography doi:  
10.1111/ecog.02534

**Supplementary material**

1 Appendix 1

2 Table A1. Number of sampling points, individuals and observed, interpolated, rarefied and Chao1 species richness in each elevation band on the  
 3 eastern slopes of the Ailao Mountains. Rarefied 1 refers to individual-based rarefaction, and the rarefied number of individuals was 578.  
 4 Rarefied 2 refers to sample-based rarefaction, and the rarefied number of samples was 28. Obs/Cha donates the ratio of observed richness to  
 5 Chao1 richness. Correlations between observed and interpolated, Rarefied 1, Rarefied 2, Chao1 richness are 0.86, 0.94, 0.94 and 0.97,  
 6 respectively.

Elevation bands (m)	Number of sampling points	Individuals	Observed	Interpolated	Rarefied 1	Rarefied 2	Chao1	Obs/Cha
500–600	59	1075	73	73	62.17	59.88	83.66	87%
600–700	33	578	48	78	48.00	46.82	52.89	91%
700–800	64	893	71	98	63.28	56.60	88.98	80%
800–900	56	1053	73	110	64.13	62.60	78.14	93%
900–1000	42	770	62	110	59.14	57.70	64.46	96%
1000–1100	80	837	83	123	75.59	60.77	96.87	86%
1100–1200	76	1189	86	123	71.99	66.47	98.45	87%
1200–1300	136	1410	98	137	82.52	67.18	102.50	96%
1300–1400	86	1151	102	144	84.36	73.24	122.82	83%
1400–1500	96	1448	103	157	84.73	77.91	112.03	92%
1500–1600	87	2038	116	161	83.40	86.66	126.99	91%
1600–1700	117	1993	110	161	82.62	77.83	123.88	89%
1700–1800	90	1581	92	149	74.39	71.07	94.38	97%
1800–1900	80	1212	94	152	81.84	75.69	100.03	94%
1900–2000	147	2502	111	152	78.83	74.50	118.60	94%
2000–2100	218	3131	125	154	83.57	74.84	142.99	87%
2100–2200	68	978	89	142	78.13	70.97	119.22	75%

2200–2300	68	877	74	137	67.36	59.58	84.22	88%
2300–2400	95	1701	101	138	78.94	75.90	112.56	90%
2400–2500	142	2287	111	134	80.41	74.73	120.00	93%
2500–2600	124	2157	105	116	79.30	75.71	113.53	92%
2600–2700	48	649	59	71	57.84	52.40	61.89	95%
Above 2700	28	242	43	43	43.00	43.00	47.03	91%

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7 Table A2. The declining rate of temperature on the eastern slopes of the Ailao Mountains from *Comprehensive Survey of Ailaoshan Nature*  
 8 *Reserve* (Wang et al. 1988)

Elevation (m)	Declining rate (c/hm)
700–1300	0.15
1300–1900	0.59
1900–2300	0.75

9 \* This comprehensive survey of Ailaoshan Nature Reserve was carried out in 1984 and the field work lasted for 7 months. It was organized by  
 0 Forestry Department of Yunnan Province, China, implemented by 50 people from the Ecology Group in the branch of Chinese Academy of  
 1 Sciences, the Yunnan Normal University, the Southwest Forestry College, the Yunnan Academy of Forestry, Kunming Institute of Zoology, etc.  
 2 Geology, climate, soil, vegetation, fungus, mammals, birds, amphibious, reptiles and insects in the Ailao Mountains were surveyed and  
 3 analyzed.

5 Table A3. The correlation between precipitation and elevation on the eastern slopes of the Ailao Mountains from *Comprehensive Survey of*  
 6 *Ailaoshan Nature Reserve* (Wang et al. 1988).

The correlation between precipitation (R) and elevation (h)	Elevation (m)	a	b
$R=ah^2+b$	400–700	$10^{-3}$	539.6
	700–1300	$2*10^{-5}$	998.9
	1300–2000	$3*10^{-4}$	563.1
	2000–3000	$3*10^{-5}$	1658.0

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 0 Geology, climate, soil, vegetation, fungus, mammals, birds, amphibious, reptiles and insects in the Ailao Mountains were surveyed and  
 1 analyzed.

3 Table A4. Correlation matrix among the independent variables. TEMP, mean annual temperature; PREC, annual precipitation; AET, annual  
 4 actual evapotranspiration; POCL, the proportion of cultivated land; POFR, the proportion of forest; POGL, the proportion of grassland; POSL,  
 5 the proportion of shrubland; POWB, the proportion of water bodies; POAS, the proportion of artificial surfaces; SDI, Shannon-Weiner diversity  
 6 index of land cover; MDE, the Mid-domain effect.

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	Area	TEMP	PREC	AET	POCL	POFR	POGL	POSL	POWB	POAS	SDI	MDE
Area	1.00											
TEMP	-0.74	1.00										
PREC	0.74	-1.00	1.00									
AET	-0.42	0.33	-0.33	1.00								
POCL	-0.67	0.84	-0.84	0.51	1.00							
POFR	0.64	-0.91	0.91	-0.41	-0.97	1.00						
POGL	-0.43	0.84	-0.84	0.36	0.75	-0.84	1.00					
POSL	-0.47	0.83	-0.83	0.42	0.75	-0.83	0.81	1.00				
POWB	-0.54	0.45	-0.45	-0.31	0.21	-0.27	0.12	0.26	1.00			
POAS	-0.70	0.92	-0.92	0.36	0.85	-0.90	0.78	0.76	0.50	1.00		
SDI	-0.65	0.95	-0.95	0.38	0.93	-0.97	0.86	0.86	0.32	0.92	1.00	
MDE	-0.02	0.01	-0.01	0.86	0.20	-0.12	0.24	0.18	-0.62	0.02	0.08	1.00

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7 Table A5. Multiple regression and hierarchical partitioning analyses explaining rarefied and Chao1 richness of all bird species along the  
8 elevational gradients on the eastern slopes of the Ailao Mountains. Model selection for multiple regressions was based on minimizing AICc  
9 values, with consideration of all possible models. Group A: the best-fit models were selected from combinations of all variables except MDE.  
0 Group B: the best-fit models were selected from combinations of all variables except AET. Beta donates the standardized regression coefficient  
1 of each factor in the best-fit models. Effects donates the independent effects of each factor estimated using hierarchical partitioning. \*\*\*p <  
2 0.001; \*\*p < 0.01.

	All species			
	Rarefied		Chao1	
	Beta	Effects	Beta	Effects
<b>Group A</b>				
AET	1.15***	0.43	1.08***	0.37
Area	1.32***	0.20	1.25***	0.16
POWB	0.94**	0.11	0.94**	0.09
R <sup>2</sup>	0.74***		0.62***	
AICc	46.96		55.57	
<b>Group B</b>				
MDE	1.20***	0.67	1.12***	0.55
Area	0.68***	0.09	0.67**	0.08
POWB	0.94***	0.12	0.96***	0.11
R <sup>2</sup>	0.88***		0.74***	
AICc	29.92		46.80	

3 Table A6. Relative importance of each variable from multi-model inferences calculated by summing the weights of all models that included the  
4 variable. Variables noted in bold indicate the variables selected in the best-fit models. Group A included all variables except MDE, while group  
5 B included all variables except AET.

	All species		Large-ranged species		Medium-ranged species		Small-ranged species	
	Observed	Interpolated	Observed	Interpolated	Observed	Interpolated	Observed	Interpolated
<b>Group A</b>								
Area	<b>1.00</b>	<b>1.00</b>	<b>0.99</b>	<b>0.97</b>	<b>0.91</b>	<b>1.00</b>	<b>0.74</b>	<b>0.42</b>
TEMP	0.99	1.00	0.94	0.95	0.43	0.94	0.18	0.20
PREC	0.99	1.00	0.94	0.95	0.84	0.98	0.17	0.22
AET	<b>0.07</b>	<b>0.14</b>	<b>0.19</b>	<b>0.21</b>	<b>0.20</b>	<b>0.14</b>	0.17	0.30
POCL	0.72	0.14	0.39	0.18	0.24	0.15	0.29	0.20
POFR	0.76	0.14	0.43	0.18	0.45	0.15	0.28	0.19
POGL	0.11	0.14	0.17	0.16	<b>0.25</b>	<b>0.15</b>	0.26	0.17
POSL	0.07	0.11	0.11	0.11	0.14	0.16	0.27	0.22
POWB	<b>0.39</b>	<b>0.98</b>	<b>0.75</b>	<b>0.94</b>	<b>0.37</b>	<b>0.86</b>	0.30	0.21
POAS	0.06	0.09	0.08	0.10	0.18	0.09	<b>0.63</b>	<b>0.47</b>
SDI	0.79	0.22	0.56	0.32	0.36	0.22	0.23	0.30
<b>Group B</b>								
Area	<b>0.86</b>	<b>1.00</b>	<b>0.33</b>	0.95	<b>0.87</b>	<b>0.70</b>	<b>0.87</b>	<b>0.42</b>
TEMP	0.55	0.18	0.36	0.35	0.41	0.52	0.11	0.21
PREC	0.57	0.13	0.40	0.55	<b>0.78</b>	<b>0.59</b>	0.11	0.25
POCL	0.52	0.51	0.56	0.62	0.22	0.31	0.22	0.22
POFR	0.55	0.59	0.61	0.46	0.41	0.24	0.21	0.19
POGL	0.17	<b>0.97</b>	0.18	<b>0.89</b>	0.23	0.11	0.20	0.18

POSL	0.05	0.15	0.08	0.13	0.10	0.12	0.19	0.20
POWB	<b>0.57</b>	<b>0.75</b>	<b>0.61</b>	<b>1.00</b>	<b>0.40</b>	<b>0.67</b>	0.26	0.21
POAS	0.08	0.10	0.06	0.09	0.19	0.22	<b>0.77</b>	<b>0.58</b>
SDI	0.48	0.20	0.58	0.09	0.29	0.57	0.18	0.37
MDE	<b>0.67</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>0.28</b>	<b>1.00</b>	0.10	0.14

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6 Table A7. Moran's *I* and p values for residuals of the best-fit models to examine spatial autocorrelation. P values noted in bold indicate  
 7 significant spatial autocorrelation.

	All species		Large-ranged species		Medium-ranged species		Small-ranged species	
	Observed	Interpolated	Observed	Interpolated	Observed	Interpolated	Observed	Interpolated
<b>Group A</b>								
Moran's <i>I</i>	0.22	0.39	0.07	0.26	0.25	0.52	-0.41	-0.10
p	0.10	<b>0.01</b>	0.27	<b>0.04</b>	<b>0.07</b>	<b>0.00</b>	0.96	0.60
<b>Group B</b>								
Moran's <i>I</i>	0.17	-0.02	0.13	0.14	0.15	0.14	-0.41	-0.10
p	0.14	0.44	0.18	0.18	0.18	0.18	0.96	0.60

8 Table A8. Summary of standardized regression coefficients from multiple linear regression (MLR) and simultaneous autoregressive model (SAR) for models with significant spatial autocorrelation in residuals.

9 \*\*\*p < 0.001; \*\*p < 0.01; \*p < 0.05; ' P < 0.1.

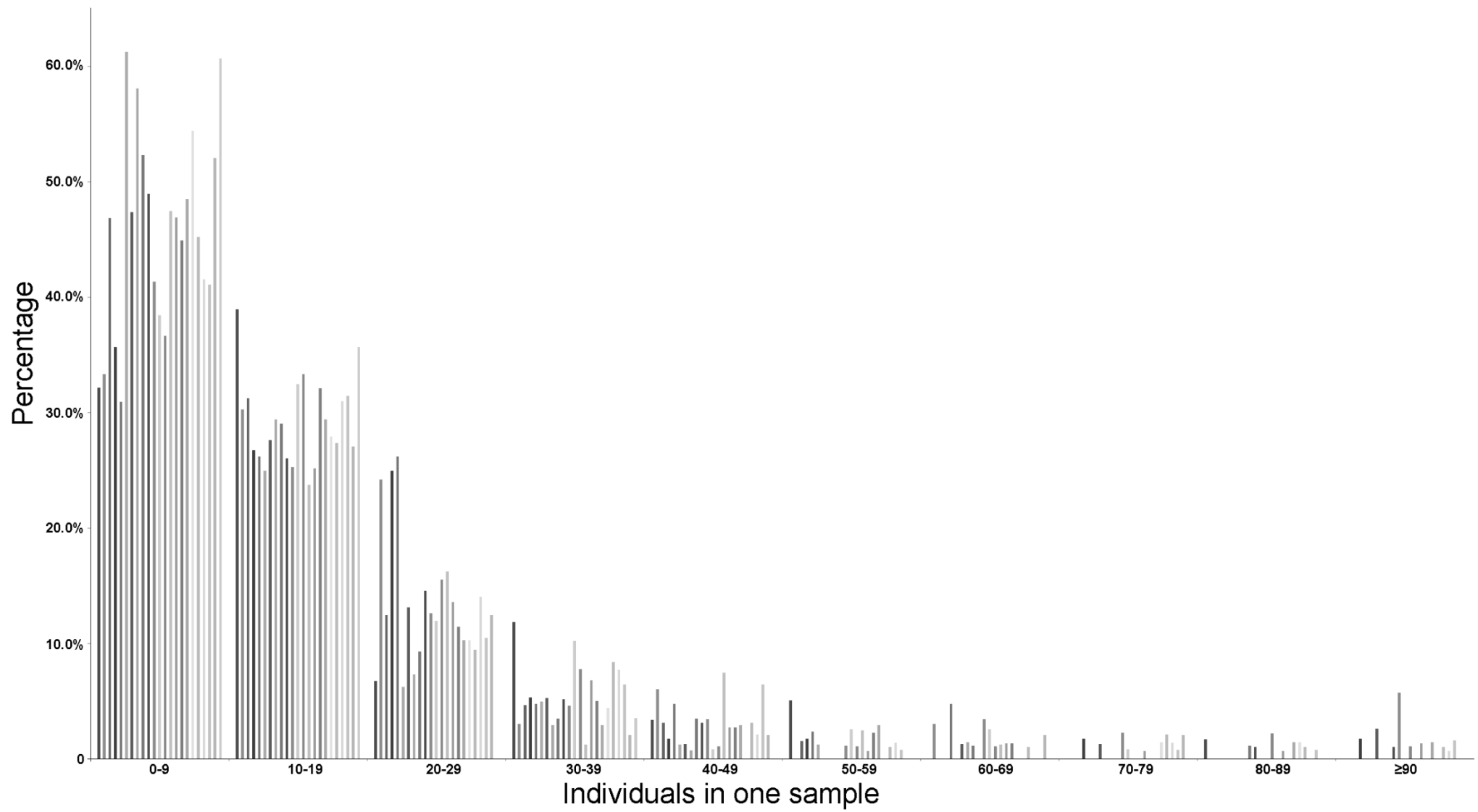
	Interpolated richness of all species		Interpolated richness of large-ranged species		Observed richness of medium-ranged species		Interpolated richness of medium-ranged species	
	MLR	SAR	MLR	SAR	MLR	SAR	MLR	SAR
<b>Group A</b>								
AET	1.12***	1.11**	1.13***	1.17**	0.86***	1.23'	1.15***	0.67'
Area	0.88***	1.33***	0.65**	0.94*	1.43***	0.51	1.07***	0.51'
POWB	0.50*	1.04***	0.46*	0.81*	1.07**	0.47	0.63**	0.31
POGL	–	–	–	–	-0.36'	-0.20	-0.39**	-0.24

0 Table A9. Number and rate of change in richness in each elevation band on the eastern slopes of the Ailao Mountains through interpolation  
 1 among all categories. Large, medium and small-ranged species were divided according to their elevational ranges, and this division was  
 2 relative.

Elevation bands (m)	All species	Large-ranged species	Medium-ranged species	Small-ranged species
500–600	0 (0%)	0 (0%)	0 (0%)	0 (0%)
600–700	30 (63%)	20 (56%)	6 (55%)	4 (400%)
700–800	27 (38%)	18 (38%)	7 (50%)	2 (22%)
800–900	37 (51%)	20 (36%)	14 (140%)	3 (38%)
900–1000	48 (77%)	30 (65%)	15 (107%)	3 (150%)
1000–1100	40 (48%)	24 (42%)	15 (94%)	1 (10%)
1100–1200	37 (43%)	21 (33%)	15 (79%)	1 (25%)
1200–1300	39 (40%)	23 (33%)	14 (67%)	2 (29%)
1300–1400	42 (41%)	27 (38%)	12 (46%)	3 (75%)
1400–1500	54 (52%)	34 (49%)	20 (83%)	0 (0%)
1500–1600	45 (39%)	25 (31%)	19 (61%)	1 (25%)
1600–1700	51 (46%)	32 (43%)	18 (64%)	1 (13%)
1700–1800	57 (62%)	33 (45%)	23 (135%)	1 (50%)
1800–1900	58 (62%)	32 (44%)	25 (147%)	1 (20%)
1900–2000	41 (37%)	24 (32%)	17 (57%)	0 (0%)
2000–2100	29 (23%)	12 (14%)	15 (41%)	2 (40%)
2100–2200	53 (60%)	30 (48%)	21 (88%)	2 (67%)
2200–2300	63 (85%)	35 (70%)	27 (135%)	1 (25%)
2300–2400	37 (37%)	21 (33%)	16 (50%)	0 (0%)
2400–2500	23 (21%)	18 (31%)	3 (8%)	2 (13%)

2500–2600	11 (10%)	5 (8%)	4 (13%)	2 (14%)
2600–2700	12 (20%)	5 (14%)	5 (29%)	2 (29%)
Above 2700	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average	36 (42%)	21 (35%)	14 (67%)	1 (45%)

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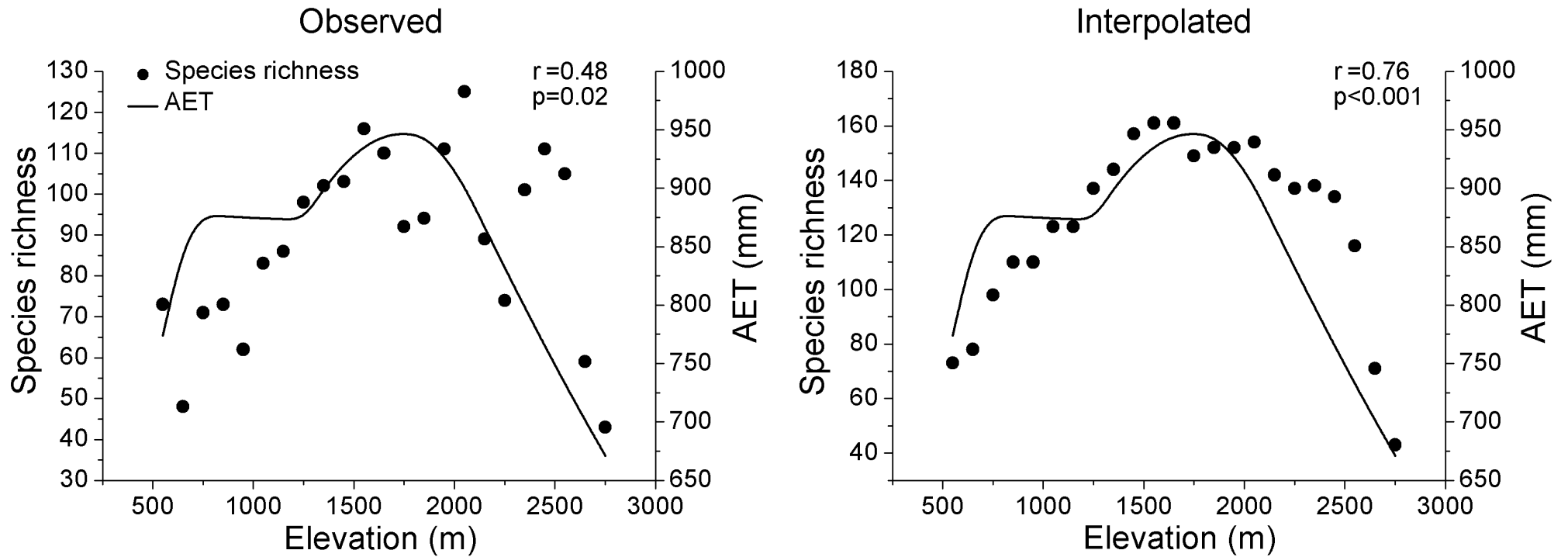
4

Figure A1. The percentage of samples with different levels of individuals in each band. Different bars donate different elevational bands. In all bands, samples with 0-20 individuals made up the largest

5

portion.





9 Figure A2. The relationship between observed (left column) and interpolated (right column) richness and actual evapotranspiration (AET) of all species along the elevational gradients on the eastern slopes of the

0 Ailao Mountains. The  $r$  and  $p$  values indicate the correlation between species richness and AET.











<i>Eudynamys scolopacea</i>	1				1	1	3	3		1		1										
<i>Falco tinnunculus</i>							2	1				2										
<i>Ficedula hodgsonii</i>										1			2	1			5	2				
<i>Ficedula hyperythra</i>													4						1			
<i>Ficedula parva</i>	2						2	3		1	1	5		1	2	1	4	2	2			
<i>Ficedula strophciata</i>							1		1	1			2		4	4	1	3	9	1	2	
<i>Ficedula tricolor</i>															1			2	2			
<i>Ficedula westermanni</i>								2		1	3	4	10	13	3		2	3				
<i>Fringilla montifringilla</i>												3	1									
<i>Gallus gallus</i>	5	2	1					8	2													
<i>Garrulax erythrocephalus</i>																	2	2	4	14	5	
<i>Garrulax affinis</i>																			4	23	12	16
<i>Garrulax canorus</i>				7					4													
<i>Garrulax cineraceus</i>											3		4		1	1						
<i>Garrulax leucolophus</i>																			2			
<i>Garrulax milnei</i>																	6	2	2	33	32	
<i>Garrulax monileger</i>								23	29	43	18	10										
<i>Garrulax pectoralis</i>								4	36	96	73	36	6									
<i>Garrulax sannio</i>	37	15	24	63		4	6	16	33	7	13	41	10	19		14						
<i>Garrulax</i>															5				6		2	

















