Table S1 Distribution of plots across county, elevation band, and risk class.

County	Elevation band	None	Low	Moderate	High	Total
Fengjie	High	3	3	0	3	9
Fengjie	Middle	3	3	0	3	9
Wushan	High	0	0	2	0	2
Wushan	Middle	1	0	3	0	4
Zhongxian	Low	3	0	0	0	3
Zhongxian	High	0	3	0	3	6
Zhongxian	Middle	3	3	0	3	9
Fuling	High	3	0	3	3	9
Fuling	Middle	3	0	3	3	9
Total		16	12	11	18	57

Note: Counts refer to the 57 plots used in the core analyses. Three additional low-elevation plots from Zhongxian were excluded (see Section 2.3). Risk classes follow the original assessment and were recoded as none, low, moderate, and high.

Table S2 Summary of the 11 independent slope units.

Slope unit ID	Number of plots	Elevation bands	County
A7	6	Low, Middle	Zhongxian
B1	6	High, Middle	Fuling
B14	6	High, Middle	Fuling
B16	1	Middle	Wushan
B2	6	High, Middle	Fengjie
B22	6	High, Middle	Fengjie
B4	5	High, Middle	Wushan
B5	6	High, Middle	Fengjie
B6	6	High, Middle	Zhongxian
B7	6	High, Middle	Fuling
B8	6	High, Middle	Zhongxian

Note: Ten of the 11 slope units spanned two elevation bands; B16 was confined to the middle-elevation band and contained a single plot. Slope units were treated as the clustering unit for cluster-robust standard errors and as the permutation block in PERMANOVA.

Table S3 Correspondence between plots and slope units.

Plot ID	Slope unit ID	Replicate plot ID	County	Elevation band	Risk class
A7-ZX2-B1	A7	1	Zhongxian	middle	none
A7-ZX2-B2	A7	2	Zhongxian	middle	none
A7-ZX2-B3	A7	3	Zhongxian	middle	none
B14-FL1-B1	B14	1	Fuling	middle	none
B14-FL1-B2	B14	2	Fuling	middle	none
B14-FL1-B3	B14	3	Fuling	middle	none
B16-WS2-B1	B16	1	Wushan	middle	none
B22-FJ5-B1	B22	1	Fengjie	middle	none
B22-FJ5-B2	B22	2	Fengjie	middle	none
B22-FJ5-B3	B22	3	Fengjie	middle	none
A7-ZX2-C1	A7	1	Zhongxian	low	none
A7-ZX2-C2	A7	2	Zhongxian	low	none
A7-ZX2-C3	A7	3	Zhongxian	low	none
B2-FJ4-B1	B2	1	Fengjie	middle	low
B2-FJ4-B2	B2	2	Fengjie	middle	low
B2-FJ4-B3	B2	3	Fengjie	middle	low
B8-ZX3-B1	B8	1	Zhongxian	middle	low
B8-ZX3-B2	B8	2	Zhongxian	middle	low
B8-ZX3-B3	B8	3	Zhongxian	middle	low
B1-FL3-B1	B1	1	Fuling	middle	moderate
B1-FL3-B2	B1	2	Fuling	middle	moderate
B1-FL3-B3	B1	3	Fuling	middle	moderate
B4-WS11-B1	B4	1	Wushan	middle	moderate
B4-WS11-B2	B4	2	Wushan	middle	moderate
B4-WS11-B3	B4	3	Wushan	middle	moderate
B5-FJ3-B1	B5	1	Fengjie	middle	high
B5-FJ3-B2	B5	2	Fengjie	middle	high
B5-FJ3-B3	B5	3	Fengjie	middle	high
B6-2X1-B1	B6	1	Zhongxian	middle	high
B6-2X1-B2	B6	2	Zhongxian	middle	high
B6-2X1-B3	B6	3	Zhongxian	middle	high
B7-FL2-B1	B7	1	Fuling	middle	high
B7-FL2-B2	B7	2	Fuling	middle	high
B7-FL2-B3	B7	3	Fuling	middle	high
B14-FL1-A1	B14	1	Fuling	high	none
B14-FL1-A2	B14	2	Fuling	high	none
B14-FL1-A3	B14	3	Fuling	high	none
B22-FJ5-A1	B22	1	Fengjie	high	none
B22-FJ5-A3	B22	2	Fengjie	high	none
B22-FJ5-A4	B22	3	Fengjie	high	none
B2-FJ4-A2	B2	1	Fengjie	high	low

B2-FJ4-A4	B2	2	Fengjie	high	low
B2-FJ4-A5	B2	3	Fengjie	high	low
B8-ZX3-A1	B8	1	Zhongxian	high	low
B8-ZX3-A2	B8	2	Zhongxian	high	low
B8-ZX3-A3	B8	3	Zhongxian	high	low
B1-FL3-A1	B1	1	Fuling	high	moderate
B1-FL3-A2	B1	2	Fuling	high	moderate
B1-FL3-A3	B1	3	Fuling	high	moderate
B4-WS11-A1	B4	1	Wushan	high	moderate
B4-WS11-A2	B4	2	Wushan	high	moderate
B5-FJ3-A1	B5	1	Fengjie	high	high
B5-FJ3-A2	B5	2	Fengjie	high	high
B5-FJ3-A3	B5	3	Fengjie	high	high
B6-2X1-A1	B6	1	Zhongxian	high	high
B6-2X1-A2	B6	2	Zhongxian	high	high
B6-2X1-A3	B6	3	Zhongxian	high	high
B7-FL2-A1	B7	1	Fuling	high	high
B7-FL2-A2	B7	2	Fuling	high	high
B7-FL2-A3	B7	3	Fuling	high	high

Table S4 Fixed effects of geological hazard risk class, elevation band, and their interaction on community structural metrics.

Panel A. Pooled model (cluster-robust standard errors clustered by slope unit)		
Metric	Risk main effect	Risk × elevation-band interaction
Species richness	$F = 17.28$, df = 3, 49, $p < 0.001$	$F = 5.62$, df = 3, 49, $p = 0.002$
Community cover	$F = 17.65$, df = 3, 49, $p < 0.001$	$F = 1.09$, df = 3, 49, $p = 0.364$
Shannon diversity	$F = 11.25$, df = 3, 49, $p < 0.001$	$F = 0.46$, df = 3, 49, $p = 0.711$
Aboveground biomass	$F = 1.86$, df = 3, 37, $p = 0.154$	$F = 1.97$, df = 3, 37, $p = 0.135$
Panel B. Middle-elevation band (155–165 m)		
Metric	Risk main effect	
Species richness	$F = 17.77$, df = 3, 27, $p < 0.001$	
Community cover	$F = 18.15$, df = 3, 27, $p < 0.001$	
Shannon diversity	$F = 11.57$, df = 3, 27, $p < 0.001$	
Aboveground biomass	$F = 1.93$, df = 3, 21, $p = 0.156$	
Panel C. High-elevation band (165–175 m)		
Metric	Risk main effect	
Species richness	$F = 0.75$, df = 3, 22, $p = 0.533$	
Community cover	$F = 0.12$, df = 3, 22, $p = 0.950$	
Shannon diversity	$F = 0.25$, df = 3, 22, $p = 0.863$	
Aboveground biomass	$F = 0.17$, df = 3, 16, $p = 0.917$	
Panel D. Slope-unit-level aggregation, middle band (n = 11)		
Metric	Risk main effect	
Species richness	$F = 3.76$, df = 3, 7, $p = 0.068$	
Community cover	$F = 2.93$, df = 3, 7, $p = 0.109$	
Shannon diversity	$F = 0.66$, df = 3, 7, $p = 0.602$	
Panel E. Slope-unit-level aggregation, high band (n = 9)		
Metric	Risk main effect	
Species richness	$F = 0.32$, df = 3, 5, $p = 0.809$	
Community cover	$F = 0.28$, df = 3, 5, $p = 0.836$	
Shannon diversity	$F = 0.07$, df = 3, 5, $p = 0.976$	

Note: Pooled and band-specific models used linear models with cluster-robust standard errors clustered by slope unit; F statistics are from joint Wald tests. Slope-unit-level aggregation (mean per slope unit × elevation band) was a sensitivity check. Biomass was not analyzed at the slope-unit level because too few slope units had complete biomass records.

Table S5 Multivariate analyses of community composition in relation to geological hazard risk classes and elevation bands.

Panel A. PERMANOVA						
Model	Term	Df	Sum of squares	R^2	F	p
Overall model (restricted permutation within slope units)	Elevation band	1	3.476	0.169	11.21	< 0.001
	Risk class × elevation band	3	1.222	0.06	1.37	0.133
	Residual	49	-	-	-	-
Middle-elevation band	Risk class	3	1.743	0.217	2.49	0.003
High-elevation band	Risk class	3	0.718	0.08	0.63	0.908
Slope-unit level (n = 11)	Risk class	3	0.596	0.293	0.96	0.534

Panel B. Multivariate dispersion (betadisper with permutest)					
Factor	Df	Sum of squares	Mean square	F	p
Risk class	3	0.078	0.026	0.999	0.399
Elevation band	1	0.157	0.157	3.561	0.066
Residuals	53	-	-	-	-

Panel C. RDA marginal tests and variance partitioning					
Component	Df	Variance	F	p	Adjusted R^2 (independent)
Elevation band (marginal)	1	0.109	9.83	0.001	0.141
Risk class (marginal)	3	0.046	1.4	0.077	0.018
Shared variance	-	-	-	-	< 0.001
Full model	4	-	-	0.001	0.154 (total adjusted R^2)

Note: Panel A-The plot-level risk main effect could not be tested because risk class is constant within slope units; the slope-unit-level PERMANOVA is reported as the corresponding test. Df ranges (49–55) reflect residual degrees of freedom across models. Panel B- Marginal heterogeneity across elevation bands (p = 0.066) should be considered when interpreting the elevation-band effect in Panel A. Panel C- RDA axis percentages are ordination summaries and are not interpreted as the independent contribution of any single predictor. RDA does not account for slope-unit nesting; marginal p-values should be interpreted alongside the restricted-permutation PERMANOVA results in Panel A.

Table S6 Indicator species analysis at the middle-elevation band (n = 31).

Species	Risk combination	IndVal	raw p	BH p	Occupied plots (none/low/moderate/high)
C. dactylon	none+low+high	0.913	0.004	0.185	8/10, 5/6, 2/6, 9/9
P. virgatus	moderate	0.707	0.007	0.185	0/10, 0/6, 3/6, 0/9
P. lapathifolia	none+moderate	0.732	0.023	0.276	5/10, 0/6, 4/6, 2/9
A. theophrasti	none+low	0.746	0.026	0.276	7/10, 2/6, 0/6, 1/9
A. australis	high	0.577	0.028	0.276	0/10, 0/6, 0/6, 3/9
C. odoratus	moderate	0.568	0.049	0.404	1/10, 0/6, 2/6, 0/9

Note: Only species with raw $p < 0.05$ are shown. BH = Benjamini–Hochberg adjusted p. Occupied plots are the number of plots in which a species was recorded, by risk class.