Supplementary materials

Table S1 Characteristics of disturbances and stresses in disturbed and stressful environments used in this study

Items	Time scale	Frequency	Intensity	Disadvantages to plants	Advantages to plants	Example
Disturbance in disturbed environments	Minutes, hours, days, months, quarters	High	Strong	Habitat degradation, fragmentation, loss, and change in distribution range	Creating bare patches and increasing resource utilization for colonization of plant species	Earthquakes, volcanic eruptions, wildfires, and windstorms, heavy rain, land reclamation, deforestation, grazing, and mowing
Stresses in stressful environments	Years, decades, centuries, millenniums	Low	Weak	Suppression of plants in terms of obtaining water, sunshine, and nutrition	Providing stable conditions for plants to grow	Deep valley, cliff, treetop, mountain slopes, and forest understory

Table S2 Definition of six invasive ranks and their perspective percentage of alien plant species in China (adapted from Zhou et al., 2020).

Rank	**Description**	**Category**	**Distribution spatial extent**	**Distribution characteristics**	**Loss**	**Number of species**	**Percentage (%)**
I	Malignant invaders	Transformer	National scale	More than one physical geographical region	Enormous economic and ecological loss	37	6.4
II	Serious invaders	Invasive	National scale	At least one physical geographical region	Enormous economic and ecological loss and a bad influence on society	50	9.0
III	Local invaders	Invasive	Regional scale	At least one physical geographical region	Big economic and ecological loss	73	13.3

IV	Mild invaders	Invasive	Local or national scale	Unable to invade into new geographical regions	Low economic and ecological loss	79	14.2
V	Requiring further observation	Naturalized non-invasive	Unknown	Undetermined	In a naturalized state	225	39.8
VI	Cultivated aliens	Cultivated	National scale	Under cultivation	No loss	98	17.3
Total						562	100

Table S3 Categories of Chinese rare species (1898) based on International Union for Conservation of Nature (IUCN) Red List

Extinction risk status	Description	Number of species	Percentage (%)
EW	Extinct in the Wild	5	0.26
CR	Critically Endangered	137	7.22
EN	Endangered	298	15.70
VU	Vulnerable	340	17.92
NT	Near Threatened	217	11.43
LC	Least Concern	421	22.18
DD	Data Deficient	25	1.32
NE	Not Evaluated	453	23.97
Total		1898	100

Table S4 Five dispersal strategies and 21 dispersal modes of diaspores based on previous literature (Adapted from Zhou Q, 2020).

Dispersal strategies	Dispersal modes		Description
Autochory (diaspores dispersed without the help of an external agent)	1	Barochory	Diaspores falling from the plant
	2	Ballistichory /ballochory	Diaspores ejected by explosion
	3	Blastochory	Diaspores deposited by the stem of the plant growing or crawling on the ground as far as possible from the mother plant
Anemochory (diaspores dispersed by wind)	4	Chamaechory /chamae-anemochory	Diaspores (more or less the whole plant) rolling on the ground pushed by wind.
	5	Cystometeorochory	Balloon-like diaspores gliding or rolling by wind
	6	Trichometeorochory	Diaspores with hairy structure (e.g. pappus) dispersed by wind
	7	Pterometeorochory	Diaspore with wings dispersed by wind
	8	Semachory/ boleochory	Diaspore with no special morphology for dispersal by wind
Hydrochory (diaspores dispersed by water)	9	Bythisochory	Semi-floating and non-floating diaspores dispersed by water currents or heavy rains on the bottom of a channel.
	10	Zoohydrochory	Diaspores despersed by animals, humans and their vessels, moving in the water
	11	Nautohydrochory	Diaspores despersed by floating and moving on rivers, lakes or ponds
Zoochory (diaspores dispersed by animals, either internally or externally or by caching)	12	Endozoochory	Diaspores eaten by animals and undamaged through their gut
	13	Epizoochory/ synzoochory	Diaspores transported by animals in fur
	14	Frugivory	Diaspores dispersed by frugivore as a food resource
	15	Herbivory	Diaspores dispersed by herbivore
	16	Granivory	Diaspores dispersed by granivore
	17	Myrmecochory	Diaspores dispersed by ants.
	18	Dyszoochory/ dysochory	Diaspores destroyed (eaten and digested) by an animal, but some of the seeds are dropped by accident.
Anthropochory (diaspores dispersed by humans)	19	Agochory	Diaspores travelling hidden in goods, cars, soil under soles, with hay, etc.
	20	Ethelochory	Plants or diaspores being sold for agriculture and gardening

21	Speirochory	Diaspores being involuntarily mixed with the previous ones

Analytic hierarchy process (AHP) method for evaluation of adaptive capacity of alien and rare plants to environment

Using AHP method to evaluate adaptive capacity of alien and rare plants to environment in eight steps (Figure S1)

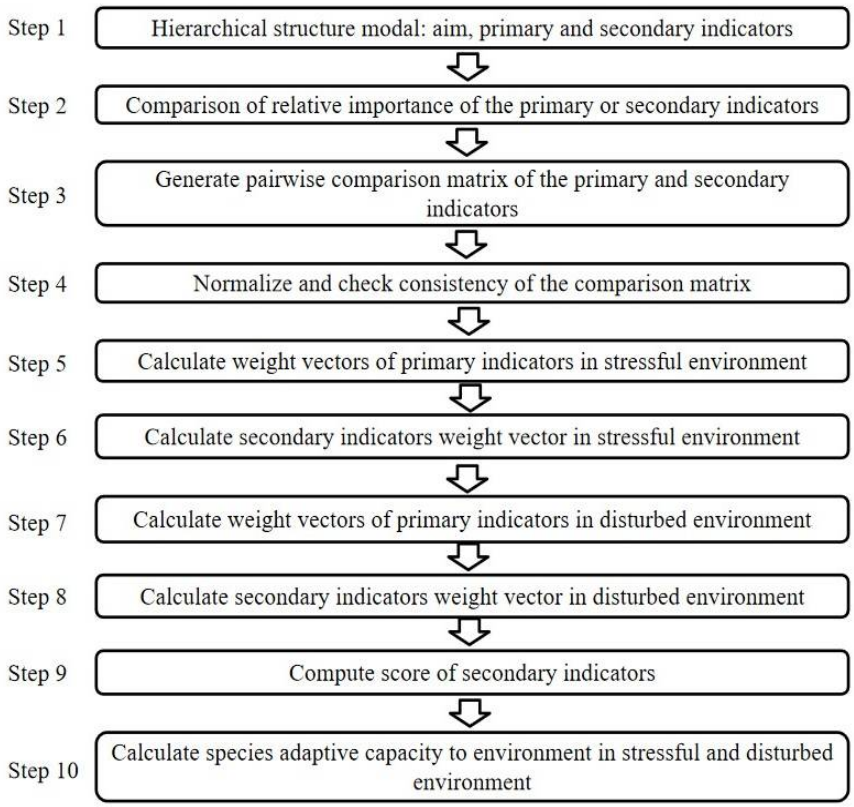

Figure S1 Steps of analytic hierarchy process (AHP) method for evaluation of adaptive capacity of alien and rare plants to environment

Step 1. Determine hierarchical structure model

Establish assessment indices system of adaptive capacity to environments (Figure S2), determine the aim, primary and secondary indicators.

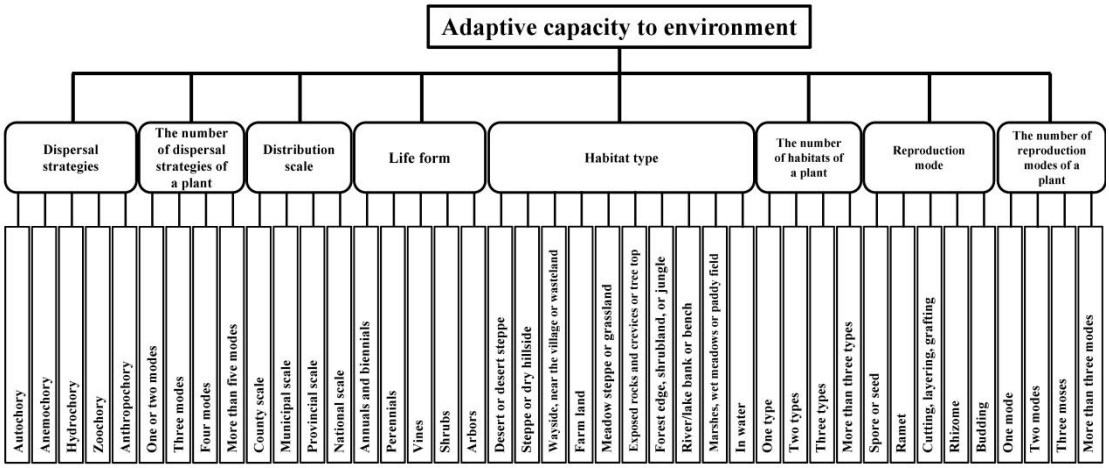

Figure S2 Assessment indices system of adaptive capacity to environment

Step 2. Comparison of relative importance of the two primary indicators or their secondary indicators

Calculate the relative importance of two primary indicators and secondary indicators using a numerical scale from 1 to 5 (Table S5). When first criterion (element_i in a matrix) is the relative important compared to second criterion (element_j in the matrix), the element_ij is assigned with a number between 1 and 5, this second criterion compared to first criterion becomes its reciprocal.

Table S5 Numerical scale for pairwise comparison

Fuzzy linguistic variable	Numeric value
Extremely important	5
Very Strongly more important	4
Strongly more important	3
Moderately more important	2
Equally important	1

We invited 5 experts in plant ecology to compare relative importance of the

primary indicators and their secondary indicators and grade the indicators. Orders of the primary and secondary indicators are listed by statistical average of the grading results.

Step 3. Generate pairwise comparison matrix of the primary indicators and secondary indicators

Comparison matrix of the primary indicators (dispersal strategy, the number of dispersal strategies of a plant, distribution scale, life form, habitat type, the number of habitats of a plant, reproductive mode, and the number of reproductive modes of a plant) in stressful environment is shown in Eq. (1).

$$\text{Primary indicators} = \begin{pmatrix} 1 & 2 & 2 & \frac{1}{2} & 2 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & 2 & 1 & \frac{1}{2} & 2 & 2 & \frac{1}{2} & 2 \\ 2 & 2 & 2 & 1 & 2 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} & 1 & 2 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ 2 & 2 & 2 & 2 & 2 & 2 & 1 & 2 \\ \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} & 2 & 2 & \frac{1}{2} & 1 \end{pmatrix} \quad (1)$$

Comparison matrix of the dispersal strategy (autochory, anemochory, hydrochory, zoochory, and anthropochory) in stressful environment is shown in Eq. (2).

$$\text{Dispersal strategy} = \begin{pmatrix} 1 & 2 & 2 & 2 & 2 \\ \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & 1 & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & 2 & 1 & 2 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix} \quad 2$$

Comparison matrix of the number of dispersal strategies of a plant (one or two modes, three modes, four modes, more than four modes) in stressful environment is shown in Eq. (3).

$$\text{The number of dispersal strategy of a plant} = \begin{pmatrix} 1 & 2 & 2 & 3 \\ \frac{1}{2} & 1 & 2 & 1 \\ \frac{1}{2} & \frac{1}{2} & 1 & 1 \\ \frac{1}{3} & 1 & 1 & 1 \end{pmatrix} \quad 3$$

Comparison matrix of the distribution scale (county scale, municipal scale, provincial scale, regional scale) in stressful environment is shown in Eq. (4).

$$\text{Distribution scale} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ 2 & 1 & \frac{1}{2} & \frac{1}{3} \\ 3 & 2 & 1 & \frac{1}{2} \\ 4 & 3 & 2 & 1 \end{pmatrix} \quad 4$$

Comparison matrix of the life form (annuals and biennials, perennials, vines, shrubs, arbors) in stressful environment is shown in Eq. (5).

$$\text{Life form} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} & \frac{1}{4} \\ 2 & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{3} \\ 3 & 2 & 1 & 2 & \frac{1}{2} \\ 3 & 2 & \frac{1}{2} & 1 & \frac{1}{2} \\ 4 & 3 & 2 & 2 & 1 \end{pmatrix} \quad 5$$

Comparison matrix of the habitat type (Desert or desert steppe, Steppe or dry hillside, Wayside, near the village or wasteland, Farm land, Meadow steppe or grassland, Exposed rocks and crevices or tree top, Forest edge, shrubland, or jungle,

River/lake bank or bench, Marshes, wet meadows or paddy field, and In water) in stressful environment is shown in Eq. (6).

$$\text{Habitat type} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ 2 & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & 2 \\ 2 & 2 & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & 2 & 2 \\ 2 & 2 & 2 & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & 2 \\ 2 & 2 & 2 & 2 & 1 & 2 & \frac{1}{2} & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 \\ 2 & 2 & 2 & 2 & 2 & 2 & 1 & 2 & 2 & 2 \\ 2 & 2 & \frac{1}{2} & 2 & \frac{1}{2} & 2 & \frac{1}{2} & 1 & 2 & 2 \\ 2 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} & 1 & 2 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix} \quad 6$$

Comparison matrix of the number of habitats of a plant (one type, two types, three types, more than three types) in stressful environment is shown in Eq. (7).

$$\text{The number of habitats of a plant} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} \\ 2 & 1 & \frac{1}{2} & \frac{1}{2} \\ 3 & 2 & 1 & \frac{1}{2} \\ 3 & 2 & 2 & 1 \end{pmatrix} \quad 7$$

Comparison matrix of the reproductive modes (spore or seed, ramet, cutting or layering or grafting, rhizome, budding) in stressful environment is shown in Eq. (8).

$$\text{Reproductive mode} = \begin{pmatrix} 1 & \frac{1}{3} & 1 & \frac{1}{2} & 1 \\ 3 & 1 & 2 & 1 & 2 \\ 1 & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ 2 & 1 & 2 & 1 & 2 \\ 1 & \frac{1}{2} & 2 & \frac{1}{2} & 1 \end{pmatrix} \quad 8$$

Comparison matrix of the number of reproductive mode (one mode, two modes, three modes, more than three modes) in stressful environment is shown in Eq. (9).

$$\text{The number of reproductive modes of a plant} = \begin{pmatrix} 1 & 2 & 2 & 2 \\ \frac{1}{2} & 1 & 2 & 2 \\ \frac{1}{2} & \frac{1}{2} & 1 & 1 \\ \frac{1}{2} & \frac{1}{2} & 1 & 1 \end{pmatrix} \quad (9)$$

Comparison matrix of the primary indicators (dispersal strategy, the number of dispersal strategies of a plant, distribution scale, life form, habitat type, the number of habitats of a plant, reproductive mode, and the number of reproductive modes of a plant) in disturbed environment is shown in Eq. (10).

$$\text{Primary indicators} = \begin{pmatrix} 1 & 2 & 2 & 2 & 2 & 2 & 2 & 2 \\ \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & 1 & \frac{1}{2} & 2 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & 2 & 1 & 2 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} & 1 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & 2 & 2 & 2 & 2 & 2 & 1 & 2 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & 1 \end{pmatrix} \quad (10)$$

Comparison matrix of the dispersal strategy (autochory, anemochory, hydrochory, zoochory, and anthropochory) in disturbed environment is shown in Eq. (11).

$$\text{Dispersal strategy} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{3} \\ 2 & 1 & 2 & \frac{1}{2} & \frac{1}{2} \\ 2 & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ 2 & 2 & 2 & 1 & 1 \\ 3 & 2 & 2 & 1 & 1 \end{pmatrix} \quad (11)$$

Comparison matrix of the number of dispersal strategy (one or two modes, three modes, four modes, more than four modes) in disturbed environment is shown in Eq. (12).

$$\text{The number of dispersal strategies of a plant} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} \\ 2 & 1 & \frac{1}{2} & \frac{1}{2} \\ 3 & 2 & 1 & \frac{1}{2} \\ 3 & 2 & 2 & 1 \end{pmatrix} \quad (12)$$

Comparison matrix of the distribution scale (county scale, municipal scale, provincial scale, regional scale) in disturbed environment is shown in Eq. (13).

$$\text{Distribution scale} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ 2 & 1 & \frac{1}{2} & \frac{1}{3} \\ 3 & 2 & 1 & \frac{1}{2} \\ 4 & 3 & 2 & 1 \end{pmatrix} \quad (13)$$

Comparison matrix of the life form (annuals and biennials, perennials, vines, shrubs, arbors) in disturbed environment is shown in Eq. (14).

$$\text{Life form} = \begin{pmatrix} 1 & 2 & 2 & 3 & 4 \\ \frac{1}{2} & 1 & 2 & 2 & 3 \\ \frac{1}{2} & \frac{1}{2} & 1 & 1 & 2 \\ \frac{1}{3} & \frac{1}{2} & 1 & 1 & 2 \\ \frac{1}{4} & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix} \quad (14)$$

Comparison matrix of the habitat type (Desert or desert steppe, Steppe or dry hillside, Wayside, near the village or wasteland, Farm land, Meadow steppe or grassland, Exposed rocks and crevices or tree top, Forest edge, shrubland, or jungle, River/lake bank or bench, Marshes, wet meadows or paddy field, and In water) in disturbed environment is shown in Eq. (15).

$$\text{Habitat type} = \begin{pmatrix} 1 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 1 \\ \frac{1}{2} & 1 & 2 & 2 & 2 & 2 & 2 & 2 & 1 & 1 \\ \frac{1}{2} & 2 & 1 & 2 & 2 & 2 & 2 & 2 & 1 & 1 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & 1 & 2 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & 1 & \frac{1}{2} & 2 & 1 & 1 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & 2 & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & 1 & 1 & 2 & 2 & 1 & \frac{1}{2} & 2 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & \frac{1}{2} & 2 & 1 & 1 \end{pmatrix} \quad 15$$

Comparison matrix of the number of habitats of a plant (one type, two types, three types, more than three types) in disturbed environment is shown in Eq. (16).

$$\text{The number of habitats of a plant} = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} \\ 2 & 1 & \frac{1}{2} & \frac{1}{3} \\ 3 & 2 & 1 & \frac{1}{2} \\ 3 & 3 & 2 & 1 \end{pmatrix} \quad 16$$

Comparison matrix of the reproductive mode (spore or seed, ramet, cutting or layering or grafting, rhizome, budding) in disturbed environment is shown in Eq. (17).

$$\text{Reproductive mode} = \begin{pmatrix} 1 & 2 & 2 & 2 & 2 \\ \frac{1}{2} & 1 & 2 & 2 & 1 \\ \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & 1 \\ \frac{1}{2} & \frac{1}{2} & 2 & 1 & 2 \\ \frac{1}{2} & 1 & 1 & \frac{1}{2} & 1 \end{pmatrix} \quad 17$$

Comparison matrix of the number of reproductive modes of a plant (one mode, two modes, three modes, more than three modes) in disturbed environment is shown in Eq. (18).

$$\text{The number of reproductive modes of a plant} = \begin{pmatrix} 1 & 2 & 2 & 3 \\ \frac{1}{2} & 1 & 2 & 2 \\ \frac{1}{2} & \frac{1}{2} & 1 & 2 \\ \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix} \quad 18$$

Step 4. Normalize and check consistency of the comparison matrix

We use software package of R to normalize the comparison matrix and to get the maximum eigenvalues of the matrix λ_{max}. Consistency of a comparison matrix is tested by the following equation:

$$CR = \frac{CI}{RI} = \frac{\frac{\lambda_{max}-n}{n-1}}{RI} \quad 19$$

Where CI is the coincidence index; RI is the random coincidence index value (Table S6); n is the matrix order; and CR is the random coincidence coefficient, indicating the matrix satisfy the requirement of consistency check when the value of CR is smaller than 0.1 (Table s6). We use R to normalize and check consistency of the comparison matrix (Eq. 1-18).

Table S6 Random coincidence index value (RI)

Content	**Value**								
n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.96	1.12	1.26	1.32	1.41	1.45

Step 5. Calculate weight vectors of primary indicators in stressful environment

We use R software package to calculate the weight vector of primary indicators (dispersal strategy, the number of dispersal strategies of a plant, distribution scale, life form, habitat type, the number of habitats of a plant, reproductive mode, and the number of reproductive modes of a plant) in stressful environment.

$$\mathrm{WS_{PI}} = \begin{pmatrix} 0.150 \\ 0.075 \\ 0.126 \\ 0.178 \\ 0.089 \\ 0.063 \\ 0.212 \\ 0.106 \end{pmatrix} \quad 20$$

Where WS_{PC} is the weight vector of primary indicators.

Step 6. Calculate secondary indicators weight vector in stressful environment

The weight vector of dispersal strategy (WS_{DSt}), the number of dispersal strategies of a plant (WS_{NDS}), distribution scale (WS_{DSc}), life form (WS_{LF}), habitat type (WS_{HT}), the number of habitats of a plant (WS_{NH}), reproductive mode (WS_{RM}) and the number of reproductive modes of a plant (WS_{NRM}) are calculated as follows:

$$\mathrm{WS_{DSt}} = \begin{pmatrix} 0.323 \\ 0.107 \\ 0.141 \\ 0.185 \\ 0.245 \end{pmatrix} \quad 21$$

$$\mathrm{WS_{NDS}} = \begin{pmatrix} 0.430 \\ 0.231 \\ 0.163 \\ 0.176 \end{pmatrix} \quad 22$$

$$\mathrm{WS_{DSc}} = \begin{pmatrix} 0.095 \\ 0.160 \\ 0.278 \\ 0.467 \end{pmatrix} \quad (23)$$

$$\mathrm{WS_{LF}} = \begin{pmatrix} 0.073 \\ 0.120 \\ 0.246 \\ 0.187 \\ 0.373 \end{pmatrix} \quad (24)$$

$$\mathrm{WS_{HT}} = \begin{pmatrix} 0.057 \\ 0.076 \\ 0.100 \\ 0.100 \\ 0.152 \\ 0.100 \\ 0.174 \\ 0.115 \\ 0.076 \\ 0.050 \end{pmatrix} \quad (25)$$

$$\mathrm{WS_{NH}} = \begin{pmatrix} 0.108 \\ 0.187 \\ 0.292 \\ 0.413 \end{pmatrix} \quad (26)$$

$$\mathrm{WS_{RM}} = \begin{pmatrix} 0.130 \\ 0.305 \\ 0.122 \\ 0.281 \\ 0.162 \end{pmatrix} \quad (27)$$

$$\mathrm{WS_{NRM}} = \begin{pmatrix} 0.392 \\ 0.278 \\ 0.165 \\ 0.165 \end{pmatrix} \quad (28)$$

Step 7. Calculate weight vectors of primary indicators in disturbed environment

We use R software package to calculate the weight vector of primary indicators (dispersal strategies, number of dispersal strategy, distribution scale, life form, number of habitat, reproductive mode, and number of Reproductive mode) in disturbed environment.

$$\mathrm{WD_{PC}} = \begin{pmatrix} 0.260 \\ 0.099 \\ 0.128 \\ 0.156 \\ 0.063 \\ 0.213 \\ 0.081 \end{pmatrix} \quad 29$$

Where WD_{PC} is the weight vector of primary indicators.

Step 8. Calculate secondary indicators weight vector in disturbed environment

The weight vector of dispersal strategy (WD_{DSt}), the number of dispersal strategies of a plant (WD_{NDS}), distribution scale (WD_{DSc}), life form (WD_{LF}), habitat type (WD_{HT}), the number of habitats of a plant (WD_{NH}), reproductive mode (WD_{RM}) and the number of reproductive modes of a plant (WD_{NRM}) are calculated as follows:

$$\mathrm{WD_{DSt}} = \begin{pmatrix} 0.097 \\ 0.184 \\ 0.139 \\ 0.278 \\ 0.302 \end{pmatrix} \quad 30$$

$$\mathrm{WD_{NDS}} = \begin{pmatrix} 0.108 \\ 0.187 \\ 0.292 \\ 0.413 \end{pmatrix} \quad 31$$

$$\mathrm{WD_{DSc}} = \begin{pmatrix} 0.095 \\ 0.160 \\ 0.278 \\ 0.467 \end{pmatrix} \quad 32$$

$$\mathrm{WD_{LF}} = \begin{pmatrix} 0.397 \\ 0.305 \\ 0.122 \\ 0.281 \\ 0.162 \end{pmatrix} \quad 33$$

$$\mathrm{WD_{HT}} = \begin{pmatrix} 0.162 \\ 0.131 \\ 0.131 \\ 0.053 \\ 0.081 \\ 0.087 \\ 0.057 \\ 0.076 \\ 0.114 \\ 0.107 \end{pmatrix} \quad 34$$

$$\mathrm{WD_{NH}} = \begin{pmatrix} 0.105 \\ 0.164 \\ 0.285 \\ 0.446 \end{pmatrix} \quad 35$$

$$\mathrm{WD_{RM}} = \begin{pmatrix} 0.328 \\ 0.216 \\ 0.124 \\ 0.188 \\ 0.143 \end{pmatrix} \quad 36$$

$$\mathrm{WD_{NRM}} = \begin{pmatrix} 0.420 \\ 0.269 \\ 0.190 \\ 0.121 \end{pmatrix} \quad 37$$

Step 9. Compute score of secondary indicators

Using weight vector of primary and secondary of indicators (Weight vector of primary indicators × Weight vector of secondary indicators) to calculate score of all secondary indicators (Table S7).

Table S7 Assessment indices system of adaptive capacity of alien and rare plants in stressful and disturbed environment and weight vector of primary and secondary indicators as well as score of the secondary indicators

Environment condition	Primary indicator	Weight of primary indicator	Secondary indicator	Weight of secondary indicator	Score
Stressful	Dispersal strategy	0.150	Autochory	0.323	0.048

environment			Anemochory	0.107	0.016
			Hydrochory	0.141	0.021
			Zoochory	0.185	0.028
			Anthropochory	0.245	0.037
	The number of dispersal strategies of a plant	0.075	One or two modes	0.430	0.032
			Three modes	0.231	0.017
			Four modes	0.163	0.012
			More than four modes	0.176	0.013
	Reproductive mode	0.212	Spore or seed	0.130	0.028
			Ramet	0.305	0.065
			Cutting or layering or grafting	0.122	0.026
			Rhizome	0.281	0.060
			Budding	0.162	0.034
	The number of reproductive modes of a plant	0.106	One mode	0.392	0.042
			Two modes	0.278	0.029
			Three modes	0.165	0.017
			More than three modes	0.165	0.017
	Life form	0.178	Annuals and biennials	0.073	0.013
			Perennials	0.120	0.021
			Vines	0.246	0.044
			Shrubs	0.187	0.033
			Arbors	0.373	0.066
	Habitat type	0.089	Desert or desert steppe	0.057	0.005
			Steppe or dry hillside	0.076	0.007
			Wayside, near the village or wasteland	0.100	0.009
			Farm land	0.100	0.009
			Meadow steppe or grassland	0.152	0.014
			Exposed rocks and crevices or tree top	0.100	0.009
			Forest edge, shrubland, or jungle	0.174	0.015
			River, lake bank or bench	0.115	0.010
			Marshes, wet meadows or paddy field	0.076	0.007
			In water	0.050	0.004
	The number of habitats of a plant	0.063	One type	0.108	0.007
			Two types	0.187	0.012
			Three types	0.292	0.018
			More than three types	0.413	0.026
	Distribution scale	0.126	County scale	0.095	0.012
			Municipal scale	0.160	0.020
			Provincial scale	0.278	0.035
			National scale	0.467	0.059
Disturbed environment	Dispersal strategies	0.212	Autochory	0.097	0.021
			Anemochory	0.184	0.039
			Hydrochory	0.139	0.029
			Zoochory	0.278	0.059

		Anthropochory	0.302	0.064
The number of dispersal strategy	0.089	One or two modes	0.108	0.010
		Three modes	0.187	0.017
		Four modes	0.292	0.026
		More than four modes	0.413	0.037
Reproductive mode	0.178	Spore or seed	0.328	0.058
		Ramet	0.216	0.038
		Cutting or layering or grafting	0.124	0.022
		Rhizome	0.188	0.033
		Budding	0.143	0.025
The number of reproductive modes of a plant	0.075	One mode	0.420	0.032
		Two modes	0.269	0.020
		Three modes	0.190	0.014
		More than three modes	0.121	0.009
Life form	0.150	Annuals and biennials	0.397	0.060
		Perennials	0.242	0.036
		Vines	0.147	0.022
		Shrubs	0.136	0.020
		Arbors	0.078	0.012
Habitat type	0.106	Desert or desert steppe	0.162	0.017
		Steppe or dry hillside	0.131	0.014
		Wayside, near the village or wasteland	0.131	0.014
		Farm land	0.053	0.006
		Meadow steppe or grassland	0.081	0.009
		Exposed rocks and crevices or tree top	0.087	0.009
		Forest edge, shrubland, or jungle	0.057	0.006
		River/lake bank or bench	0.076	0.008
		Marshes, wet meadows or paddy field	0.114	0.012
		In water	0.107	0.011
The number of habitats of a plant	0.063	One type	0.105	0.007
		Two types	0.164	0.010
		Three types	0.285	0.018
		More than three types	0.446	0.028
Distribution scale	0.126	County scale	0.095	0.012
		Municipal scale	0.160	0.020
		Provincial scale	0.278	0.035
		National scale	0.467	0.059

Step 10. Calculate species adaptive capacity to environment

According to secondary indicators of primary indicators of each plant, the

adaptive capacity (AC) of each species can be calculated as follows:

$$AC = S_1 + S_2 + S_3 + \cdots + S_i \quad 38$$

Where DA is dispersal ability of each species; S is score of each secondary indicators of primary indicators ; i is the ith secondary indicators.

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