

Supplementary Materials:

The command syntax of drawing a trait dendrogram in R™

Step 1: load FD package

```
>library (FD)
```

Step2: set working directory

```
>setwd("F:/data folder")
```

Step 3: read the traits data

```
trait_breed<-  
read.csv("traits_breed_beta_20200915.csv",header =  
TRUE,row.names = "id",sep=",")
```

Step 4: calculate Gower distance matrix

```
> breed.dist<-gowdis(trait_breed)
```

Step 5: use hierarchical clustering by “average” method

```
> breed.dendro<-hclust(breed.dist,method = "average")
```

Step 6: plot the dendrogram

```
> plot(breed.dendro)
```

Table S1 Location, size, age and waterbody of sample parks

Park	Location	Size (ha)	Age (year)	Containing waterbody
Beihai Park	City center	71	92	Yes
Heaven Temple	Inside 2nd ring road	270	99	No
Beijing Zoo	Between 2nd and 3rd ring road	86	62	Yes
Yuyuantan Park	Between 2nd and 3rd ring road	136	57	Yes
Olympic Forest Park	Between 4th and 5th ring road	350	9	Yes
Summer Palace	Between 4th and 5th ring road	280	93	Yes
Yuanmingyuan Park	Between 4th and 5th ring road	380	29	Yes

Table S2 Independent variables for statistical analysis

Category	Indicator	Formula
Basic indicator	Park size	Unit: hectare (ha.)
	Park age	Unit: year
Accessibility	Number of bus stops	The number of bus stops in 1km buffer out of park boundary
	Number of subway stations	The number of subway stations in 1km buffer out of park boundary
	Neighbor road density (RD)	$RD = \frac{\sum_{i=1}^n l_i}{A}$ l_i = length of road i appeared in buffer. A = area of 2km buffer out of park boundary (ha).
	Distance to city center	The straight-line distance from the center of the park to Tiananmen Square
Landscape pattern	Proportion of woodland, grassland, pavements and waterbody (PLAND_woodland, PLAND_grassland, PLAND_pavements and PLAND_waterbody)	$PLAND = P_i = \frac{\sum_{j=1}^n a_{ij}}{A} (100)$ P_i = proportion of the landscape occupied by patch type (class) i. a_{ij} = area (m ²) of patch ij. A = total landscape (or class) area (m ²)
	Patch density (PD)	$PD = \frac{n_i}{A} (10,000) (100)$ n_i = number of patches in the landscape of patch type (class) i. A = total landscape area (m ²)
	Largest patch index (LPI)	$LPI = \frac{\max_{j=1}^n (a_{ij})}{A}$ a_{ij} = area (m ²) of patch ij. A = total landscape area (m ²).
	Connectedness index (CONNECT)	$CONNECT = \left[\frac{\sum_{j \neq k}^n c_{ijk}}{\frac{n_i(n_i - 1)}{2}} \right] (100)$ c_{ijk} = joining between patch j and k (0 = unjoined, 1 = joined) of the corresponding patch type

		(i), based on a user specified threshold distance. n_i = number of patches in the landscape of the corresponding patch type (class)i.
Shannon's diversity index (SHDI)		$SHDI = - \sum_{i=1}^m (P_i \ln P_i)$ P_i = proportion of the landscape occupied by patch type (class) i
Largest patch index (LPI) of woodland, grassland, pavements		$LPI = \frac{\sum_{j=1}^n \max(a_{ij})}{A}$ a_{ij} = area (m^2) of patch ij. A = total class area (m^2).
Connectedness index (CONNECT) of woodland		$CONNECT = \left[\frac{\sum_{j \neq k}^n c_{ijk}}{\frac{n_i(n_i - 1)}{2}} \right] (100)$ c_{ijk} = joining between patch j and k (0 = unjoined, 1 = joined) of the corresponding patch type (i), based on a user specified threshold distance. n_i = number of patches in the landscape of the corresponding patch type (class)i.
Edge density (ED) of woodland and waterbody		$ED = \frac{\sum_{k=1}^m e_{ik}}{A} (10,000)$ e_{ik} = total length (m) of edge in landscape involving patch type (class) i; includes landscape boundary and background segments involving patch type i. A = total class area (m^2).
Patch density (PD) of building and pavements		$PD = \frac{n_i}{A} (10,000) (100)$ n_i = number of patches in the landscape of patch type (class) i. A = total landscape area (m^2)
Landscape shape index (LSI) of woodland and waterbody		$LSI = \frac{0.25 \sum_{k=1}^m e_{ik}^*}{\sqrt{A}}$ e_{ik}^* = total length (m) of edge in landscape between patch types (classes) i and k; includes the entire landscape boundary and some or all background edge segments

		involving class i. A = total landscape area (m ²).
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Note: The indicators of Landscape composition refer to FRAGSTATS HELP (McGarigal 2014).

Table S3 Name list of breeding guilds

Guild code	Guild name	Number of present sites	Species Latin name	Species name
1	Building-low level-rock hole nest	20	<i>Alcedo atthis</i> <i>Halcyon pileata</i> <i>Saxicola maurus</i> <i>Phoenicurus aureus</i> <i>Pardaliparus venustulus</i> <i>Parus cinereus</i>	Common Kingfisher
2	Building-shrub-under level rock open nest	78	<i>Streptopelia chinesis</i>	Spotted Dove
3	Building-canopy hole nest	158	<i>Passer montanus</i> <i>Upupa epops</i> <i>Acridotheres cristatellus</i> <i>Spodiopsar cineraceus</i> <i>Spodiopsar sericeus</i>	Eurasian Tree Sparrow Eurasian Hoopoe Crested Myna White-cheeked Starling Silky Starling
4	Building-canopy open nest	136	<i>Hirundo rustica</i> <i>Cecropis daurica</i> <i>Apus apus</i> <i>Falco tinnunculus</i> <i>Pica pica</i>	Barn Swallow Red-rumped Swallow Common Swift Common Kestrel Common Magpie
5	Mid-low level hole nest	51	<i>Chloris sinica</i> <i>Poecile palustris</i>	Grey-capped Greenfinch Marsh Tit
6	Shrub-mid level open nest	81	<i>Streptopelia orientalis</i> <i>Pycnonotus sinensis</i> <i>Ardeola bacchus</i>	Oriental Turtle Dove Chinese Bulbul Chinese Pond Heron
7	Canopy nest	41	<i>Aix galericulata</i> <i>Nycticorax nycticorax</i> <i>Corvus macrorhynchos</i> <i>Corvus corone</i>	Mandarin Duck Black-crowned Night Heron Large-billed Crow Carion Crow
8	Canopy-mid level nest	131	<i>Periparus ater</i> <i>Sitta leucopsis</i> <i>Dendrocopos major</i> <i>Dendrocopos hyperythrus</i> <i>Picus canus</i> <i>Eophona migratoria</i> <i>Urocissa flavirostris</i> <i>Cyanopica cyanus</i> <i>Turdus mandarinus</i> <i>Dicrurus macrocercus</i>	Coal Tit Chinese Nuthatch Greater Spotted Woodpecker Grey-capped Woodpecker Grey-headed Woodpecker Yellow-billed Grosbeak Red-billed Blue Magpie Azure-winged Magpie Chinese Blackbird Black Drongo

			<i>Oriolus chinensis</i>	Black-naped Oriole
9	Shrub-low level open nest	25	<i>Acrocephalus orientalis</i> <i>Acrocephalus bistrigiceps</i> <i>Sinosuthora webbiana</i> <i>Phylloscopus fuscatus</i> <i>Emberiza elegans</i>	Oriental Reed Warbler Black-browed Reed Warbler Vinous-throated Parrotbill Dusky Warbler Yellow-throated Bunting
10	Nest parasitism	15	<i>Cuculus canorus</i>	Common Cuckoo
11	Water surface open nest	5	<i>Fulica atra</i> <i>Podiceps auritus</i> <i>Tachybaptus ruficollis</i> <i>Sterna hirundo</i> <i>Cuculus micropterus</i>	Common Coot Horned Grebe Little Grebe Common Tern Indian Cuckoo
12	Reed open nest	1	<i>Ixobrychus sinensis</i> <i>Ardea cinerea</i> <i>Egretta garzetta</i> <i>Anas zonorhyncha</i>	Yellow Bittern Grey Heron Little Egret Chinese Spot-billed Duck
13	Reed-mid level open nest	14	<i>Anas platyrhynchos</i>	Mallard

Table S4 Correlation matrix of landscape index

	Park size	PD	LPI	CONNECT	SHDI	PLAND_Woodland	PLAND_Building	PLAND_Pavements	PLAND_Waterbody	LPI_Woodland	LPI_Grass	LPI_Pavements	CONNECT_Woodland	ED_Waterbody	ED_Woodland	LSI_Waterbody	LSI_Woodland	PD_Woodland	PD_Building	PD_Pavements
Park size	1																			
Patch density (PD)	-0.231*	1																		
Largest patch index (LPI)	-0.382**	-0.125	1																	
Connectedness index (CONNECT)	-0.409**	0.078	0.334**	1																
Shannon’s diversity index (SHDI)	0.306**	0.201*	-0.753**	-0.291**	1															
Proportion of woodland (PLAND_Woodland)	-0.095	-0.174	0.406**	0.088	-0.600**	1														
Proportion of building (PLAND_Building)	-0.039	0.290**	-0.189	-0.109	0.426**	-0.223*	1													
Proportion of Pavements (PLAND_Pavements)	-0.111	0.164	-0.417**	0.115	0.506**	-0.221*	.330**	1												
Proportion of waterbody (PLAND_Waterbody)	0.306**	-0.114	-0.235*	-0.220*	0.098	0.023	-0.114	-0.126	1											
Largest patch index of woodland (LPI_Woodland)	-0.261**	-0.145	0.735**	0.213*	-0.614**	0.864**	-0.134	-0.255**	-0.125	1										
Largest patch index of grassland (LPI_Grass)	-0.014	-0.061	-0.004	0.179	0.12	-0.453**	-0.026	-0.106	-0.17	-.302*	1									
Largest patch index of pavements (LPI_Pavements)	-0.238*	0.179	-0.178	.374**	.298**	-0.175	0.151	0.788**	-0.161	-0.124	-0.007	1								
Connectedness index of woodland (CONNECT_Woodland)	-0.354**	0.096	0.418**	0.705**	-0.423**	0.279**	-0.126	-0.16	-0.167	.376**	0.091	0.039	1							
Edge density of waterbody (ED_Waterbody)	-0.011	0.124	-0.302*	0.278*	0.334*	-0.521**	-0.132	-0.048	0.126	-.475**	0.217	0.068	0.103	1						
Edge density of woodland (ED_Woodland)	-0.121	0.548**	-0.321**	0.026	0.335**	0.242*	0.311**	0.462**	0.016	0.122	-0.278	0.294**	0.032	0.012	1					
Landscape shape index of water body (LSI_Waterbody)	0.621**	0.031	-0.430**	-0.408**	0.301*	-0.036	0.052	-0.091	0.219	-0.26	-0.066	-0.222	-0.282*	0.287*	0.123	1				
Landscape shape index of woodland (LSI_Woodland)	0.861**	-0.048	-0.614**	-0.531**	0.584**	-0.217*	0.188	0.108	0.278**	-.411**	-0.013	-0.164	-0.488**	0.035	0.167	0.663**	1			
Patch density of woodland (PD_Woodland)	-0.164	0.494**	-0.377**	0.167	0.484**	-0.272**	.309**	0.724**	-0.103	-.277**	-0.074	0.691**	-0.125	0.093	0.536**	-0.013	0.075	1		
Patch density of building (PD_Building)	-0.201*	0.503**	-0.107	0.143	0.15	-0.137	0.522**	0.195	-0.179	-0.122	-0.045	0.233*	0.12	-0.114	0.403**	-0.141	-0.071		1	
Patch density of pavements (PD_Pavements)	-0.195*	0.976**	-0.081	0.044	0.152	-0.129	0.257**	0.093	-0.087	-0.1	-0.052	0.102	0.098	0.073	0.479**	-0.002	-0.046		0.419**	1

*: p<0.05

**.: p<0.01

Table S5 The variance inflation coefficient (VIF) of index in regression

	VIF (dependent variable=bird habitat area)	VIF (dependent variable=the number of birdwatching records)
Park size	47.999	N/A
Distance to city center	226.919	N/A
Number of bus stops	18.511	12.903
Number of subway stations	30.101	5.892
Road density	159.179	12.316
Proportion of woodland	152.769	N/A
Proportion of building	91.513	6.738
Proportion of Pavements	19.493	N/A
Proportion of waterbody	3.264	1.876
Patch density (PD)	66.38	1.87
Largest patch index (LPI)	94.669	17.715
Connectedness index (CONNECT)	23.431	7.567
Shannon's diversity index (SHDI)	18.034	N/A
Largest patch index of woodland	139.123	17.353
Largest patch index of grassland	4.294	5.879
Largest patch index of pavements	15.017	8.846
CONNECT_Woodland	25.844	N/A
Edge density of waterbody	22.158	N/A
Edge density of woodland	70.733	6.943
Patch density of building	49.325	7.896
Patch density of pavements	64.891	N/A
Landscape shape index of water body	66.388	N/A
Landscape shape index of woodland	39.683	10.441

Table S6 The area under the curve (AUC) of each guild habitat assessment in MaxEnt model

Guild code	Number of presence sites	Training AUC	Test AUC
1	20	0.87	0.71
2	78	0.86	0.81
3	158	0.89	0.82
4	136	0.89	0.8
5	51	0.87	0.81
6	81	0.84	0.79
7	41	0.92	0.85
8	131	0.9	0.82
9	25	0.92	0.85
10	15	0.88	0.78
13	14	0.82	0.75

Table S7 Parks with bird habitat of less than 1.6 ha

Park name	Habitat area (ha)	Park size (ha)
Yuting Park	1.53	7.432777
Fuhai Park	1.47	4.474344
Beijiao Park	0.45	4.250326
Fengtai Garden	0.27	7.7374
Dongdan Park	0.27	4.533728
Fengxuan Park	0.23	3.733408
Changpuhe Park	0.23	2.657924
Huaifang fishing Park	0.18	6.745931
Lidu Garden	0.09	7.674828
Fengtai Park	0.09	6.46704
Nanguan Park	0.09	2.817507