Seed plant diversity of different forest types in Liangshui National Natural Reserve

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Abstract

Background

Thirty years ago, there was a monograph of vegetation and plant diversity in the region prepared by the Department of Forestry at the Northeast Forestry University (unpublished), but the variety of plants in the region has changed significantly over the past 30 years. In future years, the authors hope to publish a new monograph and this research is to prepare for this work. This study aimed at reporting the characteristics of plant diversity in five different forest types in Liangshui National Natural Reserve, China, each with three 25 × 25 m tree quadrats, twelve 5 × 5 m wide shrub quadrats and twelve 1 × 1 m wide herbaceous quadrats. Censuses of each forest type were conducted in 2016.

New information

The five main forest types presented differences in structure, diversity and species richness.
Keywords

China, diversity, quadrat, Liangshui Natural Reserve, conservation, species inventory

Introduction

The Korean pine forest of Liangshui National Natural Reserve is the most important primitive broad-leaved Korean pine forest in China and it is also one of the modern Korean pine distribution centres (Liu 2015, Zhang et al. 2000). The primitive broad-leaved Korean pine forest area is less than 40000 hm² in China (Liu et al. 2014), while there are 4100 hm² in Liangshui National Natural Reserve, accounting for 11% of the country (Liu et al. 2014). Liangshui National Natural Reserve is rich in biodiversity, preserves several species of the Tertiary plant communities and has an irreplaceable role in maintaining global diversity (Chen et al. 2012, Liu et al. 1993, Ma et al. 2007, Wang 1981, Rong et al. 2009). Korean pine forest has existed on earth for at least 30 million years, but the existing broad-leaved Korean pine forests of the Reserve formed about 3000 years ago. The Korean pine forest in this area is young, the age of the oldest individual is no more than 500 years, with a 1.5 m breast diameter. The tree height here is 15-40 m and seeds produced per plant are about 30 kg (Liu 2015). Although the Liangshui National Nature Reserve is very important, research for the different forests is not comprehensive and the data of plant diversity are still insufficient. In this research, the plant diversity of five different forest types in this area were studied, which provided the basic data for the study of biodiversity in this area.

Project description

Title: Construction of Plant checklist Database in Heilongjiang Province

Personnel: Wang Hongfeng

Study area description: Liangshui National Natural Reserve is located in the southeastern of the Xiaoxing'anling Mountains in Heilongjiang Province, China (47°7'39"-47°14'22" N, 128°48'30"-128°55'50" E). It is made up of hills, the terrain is high in south and low in north. The average elevation is about 400 m, the highest elevation is 707.3 m, the lowest is 280 m, mountain slope is generally 10-15 degrees (The Compilation Group Physical Geography of China 1986). This area belongs to the temperate continental monsoon climate. The extreme minimum temperature is -43.9 °C and the extreme maximum temperature is 38.7 °C. The annual average temperature is about -0.3 °C, positive temperature accumulated is 2200-2600°C. The average annual precipitation is 676 mm, June-August precipitation accounted for more than 60% of annual precipitation. The relative humidity in Liangshui is about 78%. The average annual evaporation is 805 mm, the total sunshine hours are 1848h, frost-free period is 100-120 days, the annual snow period is 130-150 days, frozen soil depth is about 2 m (Liu et al. 2014, Su et al. 2006). The forest types in this region mainly include five types of forest, namely Ulmus davidiana var.
japonica—Pinus koraiensis forest (UPF), Betula costata—Pinus koraiensis forest (BPF), Quercus mongolica—Pinus koraiensis forest (QPF), Fraxinus mandshurica—Pinus koraiensis forest (FPF), Tilia—Pinus koraiensis forest (TPF).

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**Sampling methods**

**Study extent:** The dataset was collected between August 2016 and August 2017.

**Sampling description:** A square plot approach was chosen to sample forest diversity. A total of five major forest types were selected, namely Ulmus davidiana var. japonica—Pinus koraiensis forest, Betula costata—Pinus koraiensis forest, Quercus mongolica—Pinus koraiensis forest, Fraxinus mandshurica—Pinus koraiensis forest, Tilia—Pinus koraiensis forest. Each forest type was set with 3 tree quadrats, 12 shrub quadrats with sampling from all the four corners and 12 herbaceous quadrats. The size of the tree quadrates was 625 m² (25 × 25 m) which had four shrub plots (5 × 5 m) distributed on the four corners. Shrub plots 25 m² which also had four herbaceous plots (1 × 1 m) distributed on the four corners. The plant species name were identified according to *The researches of liangshui natural* (Ma 1993), *Arbor flora of Heilongjiang Province* (Zhou 1986), *Flora plantarum herbacearum chiae boreali–orientalis* (Liu 1959), *Silva of Heilongjiang* (Zhou 1985), *Flora of China* (Fu et al. 2013), *Key of Plants of Northeastern China* (Fu 1995), *Flora Republicae Popularis Sinicae* (Editorial Committee of Flora of China of Chinese Academy Sciense 2004) and a plant checklist was obtained by survey. The number and height of each species were recorded for all plots, the crown of the trees was recorded, the coverage and total coverage of shrubs and herbs were also recorded.

**Quality control:** The present dataset was updated to match the APGIV classification of angiosperm families (The Angiosperm Phylogeny Group 2016) and all species names were checked for validity (spelling and authorship) against online databases ([http://tnrs.iplantcollaborative.org/index.html](http://tnrs.iplantcollaborative.org/index.html), [http://ipni.org](http://ipni.org), [http://plants.jstor.org](http://plants.jstor.org), [http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php](http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php)).

**Step description:** The dataset presented here was collected over a period of one year.

**Geographic coverage**

**Description:** Data was collected in five different forest types (*Ulmus davidiana var. japonica—Pinus koraiensis forest*, *Betula costata—Pinus koraiensis forest*, *Quercus mongolica—Pinus koraiensis forest*, *Fraxinus mandshurica—Pinus koraiensis forest*, *Tilia—* *Pinus koraiensis forest*) across the reserve as illustrated inTable 1 Table 2, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11 and Table 12.
Table 1.
Basic description of five forest types in Liangshui National Natural Reserve, where: UPF = *Ulmus davidiana* var. *japonica*—*Pinus koraiensis* forest; BPF = *Betula costata*—*Pinus koraiensis* forest; QPF = *Quercus mongolica*—*Pinus koraiensis* forest; FPF = *Fraxinus mandshurica*—*Pinus koraiensis* forest; TPF = *Tilia*—*Pinus koraiensis* forest.

| Forest types | Habitat                     | Coverage of shrub layer | Coverage of herb layer | Soil                                              |
|--------------|-----------------------------|-------------------------|------------------------|--------------------------------------------------|
| UPF          | River bank or valley        | 40-50%                  | About 60%              | Gravel soil, thick and humid, about 50-60 cm     |
| BPF          | Medium or gentle slope      | 50-60%                  | 40-50%                 | Dark brown soil, fertility, about 25-30 cm       |
| QPF          | Sunny and steep slope       | About 30%               | 30-40%                 | Gravel soil, barren and dry, 25-30 cm            |
| FPF          | River bank or valley        | 40-50%                  | About 60%              | Gravel soil, thick and humid, about 50-60 cm     |
| TPF          | Medium or gentle slope      | 50-60%                  | 40-50%                 | Dark brown soil, fertility, about 25-30 cm       |

Table 2.
Geographical coordinates of quadrats of five forest types in Liangshui National Natural Reserve.

| Forest type | Plot number | North latitude | East longitude |
|-------------|-------------|----------------|----------------|
| UPF         | 04-T        | 47°11′33.52″N | 128°52′55.85″E |
|             | 11-T        | 47°11′2.41″N  | 128°53′59.93″E |
|             | 13-T        | 47°10′57.16″N | 128°53′44.97″E |
| BPF         | 01-T        | 47°11′5.39″N  | 128°53′15.30″E |
|             | 12-T        | 47°11′0.43″N  | 128°53′45.52″E |
|             | 03-T        | 47°11′43.98″N | 128°52′59.89″E |
| QPF         | 02-T        | 47°11′57.73″N | 128°53′29.72″E |
|             | 14-T        | 47°8′32.22″N  | 128°54′3.04″E     |
|             | 15-T        | 47°8′41.58″N  | 128°53′50.70″E    |
| FPF         | 06-T        | 47°11′43.84″N | 128°53′16.33″E    |
|             | 07-T        | 47°10′56.62″N | 128°53′32.46″E    |
|             | 08-T        | 47°10′44.92″N | 128°53′36.05″E    |
| TPF         | 05-T        | 47°11′44.71″N | 128°53′20.16″E    |
| Family            | Species richness |
|-------------------|------------------|
| Rosaceae          | 11               |
| Betulaceae        | 6                |
| Umbelliferae      | 6                |
| Pinaceae          | 5                |
| Sapindaceae       | 5                |
| Adoxaceae         | 3                |
| Compositae        | 3                |
| Cyperaceae        | 3                |
| Fabaceae          | 3                |
| Araliaceae        | 2                |
| Asparagaceae      | 2                |
| Dryopteridaceae   | 2                |
| Gramineae         | 2                |
| Oleaceae          | 2                |
| Ranunculaceae     | 2                |
| Rhamnaceae        | 2                |
| Ruscaceae         | 2                |
| Saxifragaceae     | 2                |
| Tiliaceae         | 2                |
| Ulmaceae          | 2                |
| Urticaceae        | 2                |
| Family               | Count |
|---------------------|-------|
| Actinidiaceae       | 1     |
| Amaranthaceae       | 1     |
| Athyriaceae         | 1     |
| Berberidaceae       | 1     |
| Campanulaceae       | 1     |
| Cannabaceae         | 1     |
| Caprifoliaceae      | 1     |
| Caryophyllaceae     | 1     |
| Celastraceae        | 1     |
| Cruciferae          | 1     |
| Equisetaceae        | 1     |
| Hydrangeaceae       | 1     |
| Labiatae            | 1     |
| Liliaceae           | 1     |
| Malvaceae           | 1     |
| Melanthiaceae       | 1     |
| Oxalidaceae         | 1     |
| Papaveraceae        | 1     |
| Phrymaceae          | 1     |
| Polemoniaceae       | 1     |
| Primulaceae         | 1     |
| Pteridaceae         | 1     |
| Rubiaceae           | 1     |
| Rutaceae            | 1     |
| Salicaceae          | 1     |
| Scrophulariaceae    | 1     |
| Violaceae           | 1     |
Table 4.
The number of individuals in each family of tree in Liangshui National Natural Reserve.

| Family       | Number of individuals |
|--------------|-----------------------|
| Pinaceae     | 535                   |
| Sapindaceae  | 462                   |
| Betulaceae   | 226                   |
| Tiliaceae    | 119                   |
| Ulmaceae     | 96                    |
| Fabaceae     | 43                    |
| Oleaceae     | 22                    |
| Salicaceae   | 20                    |
| Rosaceae     | 10                    |
| Rhamnaceae   | 6                     |
| Rutaceae     | 1                     |

Table 5.
The number of individuals in each family of shrub in Liangshui National Natural Reserve.

| Family         | Number of individuals |
|----------------|-----------------------|
| Araliaceae     | 177                   |
| Betulaceae     | 136                   |
| Adoxaceae      | 124                   |
| Caprifoliaceae | 107                   |
| Rosaceae       | 77                    |
| Oleaceae       | 30                    |
| Berberidaceae  | 10                    |
| Sapindaceae    | 9                     |
| Hydrangeaceae  | 4                     |
| Family             | Number of individuals |
|-------------------|-----------------------|
| Celastraceae      | 3                     |
| Rhamnaceae        | 2                     |
| Actinidiaceae     | 1                     |
| Oxalidaceae       | 445                   |
| Umbelliferae      | 332                   |
| Cyperaceae        | 305                   |
| Saxifragaceae     | 237                   |
| Rosaceae          | 231                   |
| Papaveraceae      | 194                   |
| Athyraceae        | 171                   |
| Ruscaceae         | 114                   |
| Urticaceae        | 113                   |
| Adoxaceae         | 101                   |
| Gramineae         | 98                    |
| Compositae        | 55                    |
| Ranunculaceae     | 54                    |
| Amaranthaceae     | 53                    |
| Pteridaceae       | 40                    |
| Dryopteridaceae   | 38                    |
| Rubiaceae         | 37                    |
| Melanthiaceae     | 35                    |
| Violaceae         | 32                    |
| Labiatae          | 29                    |

Table 6. The number of individuals in each family of herb in Liangshui National Natural Reserve.
Table 7.
The number of individuals in each species of tree in Liangshui National Natural Reserve. (Species names are checked by TPL)

| Species                                         | Number of individuals |
|------------------------------------------------|-----------------------|
| Acer pictum subsp. mono Thunb.                  | 270                   |
| Picea koraiensis Nakai                         | 234                   |
| Pinus koraiensis Siebold & Zucc.               | 189                   |
| Betula lenta L.                                 | 162                   |
| Acer ukurunduense (Trautv. & C.A.Mey.) E.Murray| 116                   |
| Tilia amurensis Rupr.                          | 103                   |
| Ulmus davidiana var. japonica (Rehder) Nakai    | 80                    |
| Acer tegmentosum Maxim.                        | 76                    |
| Picea jezoensis var. microsperma (Siebold & Zucc.) Carrière | 72 |
| Betula platyphylla Sukaczew                    | 51                    |
| Species                                      | Number of individuals |
|----------------------------------------------|-----------------------|
| *Quercus mongolica* Fisch. ex Ledeb.         | 39                    |
| *Pinus sylvestris* var. *mongolica* Litv.    | 34                    |
| *Fraxinus mandshurica* Rupr.                 | 22                    |
| *Populus davidiana* (Dode) C.K.Schneid.     | 20                    |
| *Tilia mandshurica* Rupr. & Maxim.          | 16                    |
| *Ulmus laciniata* (Trautv.) Mayr            | 16                    |
| *Betula dahurica* Pall.                     | 9                     |
| *Larix gmelinii* (Rupr.) Kuzen.             | 6                     |
| *Rhamnus davurica* Pall.                    | 6                     |
| *Amygdalus davidiana* (Carr.) Franch.       | 6                     |
| *Maackia amurensis* Rupr. et Maxim.         | 4                     |
| *Alnus hirsuta* (Spach) Rupr.               | 3                     |
| *Padus avium* L.                            | 2                     |
| *Sorbus daccica* Borbás                     | 2                     |
| *Alnus cremastogyne* Burkill                | 1                     |
| *Phellodendron amurense* Rupr.              | 1                     |

Table 8.
The number of individuals in each species of shrub in Liangshui National Natural Reserve.
| Species                                      | Number of individuals |
|---------------------------------------------|-----------------------|
| *Aralia elata var. glabrescens* (Miq.) Seem. | 12                    |
| *Berberis ferdinandi-coburgii* C.K.Schneid. | 10                    |
| *Acer tataricum* subsp. *ginnala* (Maxim.) Wesm. | 6                     |
| *Acer pictum* subsp. *mono* Thunb.           | 4                     |
| *Deutzia glabrata* Kom.                     | 4                     |
| *Spiraea thunbergii* Siebold ex Blume        | 4                     |
| *Euonymus alatus* (Thunb.) Siebold          | 3                     |
| *Rhamnus davurica* Pall.                    | 2                     |
| *Rosa davurica* Pall.                       | 1                     |

**Table 9.**

The number of individuals in each species of herb in Liangshui National Natural Reserve.
| Scientific Name                        | Frequency |
|---------------------------------------|-----------|
| Adiantum pedatum L.                   | 40        |
| Saussurea alatipes Hemsl.              | 38        |
| Galium spurium L.                     | 37        |
| Paris verticillata M.Bieb.            | 35        |
| Viola chaerophylloides (Regel) W. Becker | 32        |
| Meehania urticifolia (Miq.) Makino    | 29        |
| Sambucus javanica Blume               | 28        |
| Polystichum tripteron (Kunze) C. Presl | 27        |
| Carex breviculmis R.Br.               | 23        |
| Parasenecio hastatus (Linn.) H. Koyama | 16        |
| Geum aleppicum Jacq.                  | 12        |
| Dryopteris crassirhizoma Nakai        | 11        |
| Lathyrus davidi Hance                 | 10        |
| Polygonatum odoratum (Mill.) Druce    | 10        |
| Urtica laetevirens Maxim.             | 9         |
| Adenophora tetraphylla (Thunb.) A.DC. | 7         |
| Cardamine leucantha (Tausch) O.E.Schulz | 7         |
| Stellaria radians L.                  | 7         |
| Asparagus oligoclonos Maxim.          | 6         |
| Lilium distichum Nakai ex Kamib.      | 6         |
| Abutilon theophrasti Medik.           | 5         |
| Agrimonia pilosa Ledeb.               | 5         |
| Convallaria majalis L.                | 5         |
| Humulus scandens (Lour.) Merr.         | 4         |
| Carex siderosticta Hance              | 3         |
| Heracleum hemsleyanum Diels           | 3         |
| Families/Species                          | UPF | BPF | QPF | FPF | TPF |
|------------------------------------------|-----|-----|-----|-----|-----|
|                                          | N   | DBH (cm) | N   | DBH (cm) | N   | DBH (cm) | N   | DBH (cm) |
| **Betulaceae**                           |     |       |     |     |     |
| Alnus cremastogyne Burkill               | -   | -    | -   | -   | 1   | 10.5     | -   | -        |
| Alnus hirsuta (Spach) Rupr.              | -   | -    | -   | -   | 3   | 16.87    | -   | -        |
| Betula dahurica Pall.                    | -   | -    | -   | 9   | 22.55 | -      | -   | -        |
| Betula lenta Ehrh.                      | -   | -    | 112 | 18.56 | 28 | 22.96    | 4   | 13.8     | 18 | 10.14    |
| Betula platyphylla Sukaczev             | -   | 44   | 19.69 | 2   | 28  | 3   | 18.33    | 2   | 19.75    |

Table 10.

The characteristics of tree community of five forest types in Liangshui National Natural Reserve, where: UPF = Ulmus davidiana var. japonica—Pinus koraiensis forest; BPF = Betula costata—Pinus koraiensis forest; QPF = Quercus mongolica—Pinus koraiensis forest; FPF = Fraxinus mandshurica—Pinus koraiensis forest; TPF = Tilia—Pinus koraiensis forest; DBH = diameter at breast height; N = number.
| Family            | Species Name                                         | Genus     | Species                        | Taxon | Count | Size | Percent | Count | Size | Percent | Count | Size | Percent | Count | Size | Percent |
|-------------------|------------------------------------------------------|-----------|-------------------------------|-------|-------|------|---------|-------|------|---------|-------|------|---------|-------|------|---------|
| Fabaceae          | Maackia amurensis                                   | Rupr. et Maxim. | - | - | - | 4 | 14.6 | - | - | - | - | - | - | - | - |
|                   | Quercus mongolica                                   | Fisch. ex Ledeb. | - | - | - | 39 | 17.86 | - | - | - | - | - | - | - | - |
| Oleaceae          | Fraxinus mandshurica                                | Rupr. | - | - | - | 1 | 33 | - | - | - | - | - | - | - | - |
| Pinaceae          | Larix gmelinii                                       | (Rupr.) Kuzen. | - | - | 6 | 11.87 | - | - | - | - | - | - | - | - | - |
|                   | Picea jezoensis var. microsperma                    | (Siebold & Zucc.) Carrière | 3 | 25.17 | 38 | 11.36 | 18 | 7.07 | 8 | 15.99 | 5 | 37.3 | - | - | - | - |
|                   | Picea koraiensis                                    | Nakai | 32 | 14.46 | 112 | 9.86 | 55 | 7.47 | 17 | 15.76 | 18 | 8.58 | - | - | - | - |
|                   | Pinus koraiensis                                    | Siebold & Zucc. | 21 | 51.45 | 64 | 23.19 | 60 | 12.79 | 13 | 49.59 | 31 | 46.92 | - | - | - | - |
|                   | Pinus sylvestris var. mongolica                     | Litv. | - | - | 12 | 5.75 | 22 | 1.77 | - | - | - | - | - | - | - | - |
| Rhamnaceae        | Rhamnus davurica                                    | Pall. | - | - | 6 | 5.2 | - | - | - | - | - | - | - | - | - |
| Rosaceae          | Amygdalus davidiana (Carr.) Franch.                 | - | - | 4 | 4 | - | - | - | - | 2 | 21 | - | - | - | - |
|                   | Padus avium                                          | L. | - | - | - | 1 | 8 | 1 | 4.5 | - | - | - | - | - | - |
|                   | Sorbus dacica                                       | Borbás | - | - | - | - | - | - | - | 2 | 5.5 | - | - | - | - |
| Rutaceae          | Phellodendron amurense                               | Rupr. | - | - | - | 1 | 20 | - | - | - | - | - | - | - | - | - |
| Salicaceae        | Populus davidiana                                   | (Dode) C.K.Schneid. | 2 | 7.1 | - | - | 18 | 16.5 | - | - | - | - | - | - | - | - | - |
| Sapindaceae       | Acer pictum subsp. mono                              | Thunb. | 29 | 7 | 47 | 5.75 | 60 | 8.16 | 57 | 6.03 | 77 | 5.42 | - | - | - | - |
|                   | Acer tegmentosum                                     | Maxim. | 24 | 3.88 | 3 | 4.67 | 2 | 4.4 | 12 | 5.6 | 35 | 6.55 | - | - | - | - |
|                   | Acer ukurunduense                                    | (Trautv. & C.A.Mey.) E.Murray | 19 | 6.27 | 18 | 4.74 | 53 | 12.39 | 17 | 3.09 | 9 | 3.53 | - | - | - | - |
| Tiliaceae         |                                                        |           |     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Families/Species                        | UPF | BPF | QPF | FPF | TPF |
|----------------------------------------|-----|-----|-----|-----|-----|
|                                        | N   | H   | N   | H   | N   | H   |
|                                        | (m) |     | (m) |     | (m) |     |
| *Actinidiaceae*                        |     |     |     |     |     |     |
| *Actinidia kolomikta* (Rupr. & Maxim., Maxim.) | -   | -   | -   | 1   | 1.5 | -   | -   | -   | -   |
| *Adoxaceae*                            |     |     |     |     |     |     |
| *Sambucus williamsii* Hance            | 24  | 0.99| 12  | 1.33| 6   | 1.23| 36  | 1.19| 46  | 0.91|
| *Araliaceae*                           |     |     |     |     |     |     |
| *Aralia elata var. glabrescens* (Miq., Seem.) | -   | -   | -   | 10  | 0.93| -   | -   | 2   | 2   |
| *Eleutherococcus senticosus* (Rupr. & Maxim., Maxim.) | 51  | 1.1 | 14  | 0.65| 15  | 0.41| 60  | 0.82| 25  | 0.75|
| *Berberidaceae*                        |     |     |     |     |     |     |
| *Berberis ferdinandi-coburgii* C.K.Schneid. | -   | -   | -   | -   | 10  | 0.47| -   | -   |     |
| *Betulaceae*                           |     |     |     |     |     |     |
| *Corylus mandshurica* (Maxim.; C.K.Schneid.) | 23  | 1.87| 23  | 1.8 | 45  | 1.47| 16  | 0.95| 29  | 2.04|
| *Caprifoliaceae*                       |     |     |     |     |     |     |
| *Lonicera japonica* Thunb.             | 24  | 0.9 | 18  | 0.83| 40  | 1.38| 20  | 0.93| 5   | 1   |
| *Celastraceae*                         |     |     |     |     |     |     |
| *Euonymus alatus* (Thunb.) Siebold     | -   | -   | 2   | 1.5 | -   | -   | -   | 1   | 3.5 |

**Table 11.**

The characteristics of shrub community of five forest types in Liangshui National Natural Reserve, where: UPF = *Ulmus davidiana* var. japonica—*Pinus koraiensis* forest; BPF = *Betula costata*—*Pinus koraiensis* forest; QPF = *Quercus mongolica*—*Pinus koraiensis* forest; FPF = *Fraxinus mandshurica*—*Pinus koraiensis* forest; TPF = *Tilia*—*Pinus koraiensis* forest; N = number; H = high.
### Hydrangeaceae

*Deutzia glabrata* Kom.  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
|     |     | 4   | 0.4 |     |     |

### Oleaceae

*Syringa reticulata* subsp. *amurensis* (Rupr.) P.S.Green & M.C.Chang  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
| 4   | 5   | 15  | 2.54| 11  | 1    |

### Rhamnaceae

*Rhamnus davurica* Pall.  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
| 2   | 1.8 |     |     |     |     |

### Rosaceae

*Cerasus verecunda* Koehne  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
| 9   | 0.7 |     |     | 12  | 0.55|

*Rosa davurica* Pall.  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
|     |     | 1   | 0.8 |     |     |

*Sorbaria sorbifolia* (L.) A.Braun  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
| 7   | 1.45| 37  | 1.15| 7   | 1.2 |

*Spiraea thunbergii* Siebold ex Blume  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
|     |     |     |     | 4   | 0.8 |

### Sapindaceae

*Acer pictum* subsp. *mono* Thunb.  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
|     |     | 4   | 1.75|     |     |

*Acer tataricum* subsp. *ginnala* (Maxim.) Wesm.  

| UPF | BPF | QPF | FPF | TPF |
|-----|-----|-----|-----|-----|
| N   | H(m)| N   | H(m)| N   | H(m) |
|     |     | 5   | 1.2 |     |     |

### Table 12.
The characteristics of herb community of five forest types in Liangshui National Natural Reserve, where: UPF = *Ulmus davidiana* var. *japonica*—*Pinus koraiensis* forest; BPF = *Betula costata*—*Pinus koraiensis* forest; QPF = *Quercus mongolica*—*Pinus koraiensis* forest; FPF = *Fraxinus mandshurica*—*Pinus koraiensis* forest; TPF = *Tilia*—*Pinus koraiensis* forest; N = number=N; H = high.

| Families/Species          | UPF | BPF | QPF | FPF | TPF |
|---------------------------|-----|-----|-----|-----|-----|
| **Adoxaceae**             |     |     |     |     |     |
| *Adoxa moschatellina* L.  | 13  | 0.06| 9   | 0.03| 38  | 0.07|
| *Sambucus javanica* Blume | 25  | 0.3 | 1   | 0.3 | -   | 2   |
| **Amaranthaceae**         |     |     |     |     |     |
| *Chenopodium album* L.    | 18  | 0.28| -   | -   | -   | 24  | 0.22|

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| Family                  | Species                                                                 | Seed Count | Seed Mass (%) | Seed Number (%) | Height (%) | Spacing (%) | Length (%) | Width (%) | Santorin (%) |
|------------------------|-------------------------------------------------------------------------|------------|---------------|-----------------|------------|-------------|------------|-----------|--------------|
| Asparagaceae           | *Polygonatum odoratum* (Mill.) Druce                                    | -          | 10            | 0.33            | -          | -           | -          | -         | -            |
|                        | *Asparagus oligoclonos* Maxim.                                          | -          | -             | -               | -          | -           | -          | -         | -            |
| Athyriaceae            | *Athyrium brevifrons* Nakai ex Kitag.                                    | 10         | 0.46          | 82              | 0.23       | 14          | 0.25       | 51        | 0.34         | 14          | 0.32         |
| Campanulaceae          | *Adenophora tetraphylla* (Thunb.) A.DC.                                 | -          | -             | -               | -          | -           | -          | -         | -            |
| Cannabaceae            | *Humulus scandens* (Lour.) Merr.                                        | 3          | 1.2           | -               | 1          | 0.2         | -          | -         | -            |
| Caryophyllaceae        | *Stellaria radians* L.                                                  | 7          | 0.03          | -               | -          | -           | -          | -         | -            |
| Compositae             | *Artemisia stolonifera* Maxim.                                          | 1          | 0.3           | -               | -          | -           | -          | -         | -            |
|                        | *Parasenecio hastatus* (Linn.) H. Koyama                                | 9          | 0.45          | 7               | 0.23       | -           | -          | -         | -            |
|                        | *Saussurea alatipes* Hemsl.                                             | 30         | 0.45          | 5               | 0.3        | -           | -          | -         | 3            | 0.6         |
| Cruciferae             | *Cardamine leucantha* (Tausch) O.E.Schulz                              | 3          | 0.3           | -               | -          | -           | 4          | 0.2       | -            |
| Cyperaceae             | *Carex breviculmis* R.Br.                                               | 7          | 0.3           | 11              | 0.6        | -           | -          | -         | 5            | 0.15        |
|                        | *Carex leiorhyncha* C.A.Mey.                                           | 10         | 0.35          | 28              | 0.3        | 140         | 0.29       | 74        | 0.38         | 27          | 0.2         |
|                        | *Carex siderosticta* Hance                                             | -          | -             | -               | -          | 3           | 0.1        | -         | -            |
| Dryopteridaceae        | *Dryopteris crassirhizoma* Nakai                                       | 4          | 0.5           | 1               | 0.3        | 1           | 0.6        | 3         | 0.7          | 2           | 0.5         |
|                        | *Polystichum tripterum* (Kunze) C. Presl                               | -          | -             | 18              | 0.25       | -           | -          | 1         | 0.15         | 8           | 0.1         |
| Equisetaceae           | *Equisetum hyemale* L.                                                  | -          | -             | -               | -          | -           | -          | -         | 2            | 0.6         |
| Family         | Species                                                                 | Length | Width | Height | Width | Width | Width | Width |
|---------------|--------------------------------------------------------------------------|--------|-------|--------|-------|-------|-------|-------|
| Fabaceae      | *Lathyrus davidii* Hance                                                | 10     | 0.16  |        |       |       |       |       |
| Gramineae     | *Agrostis clavata* Trin.                                                 | 53     | 0.28  | 44     | 0.28  |       |       |       |
|               | *Miscanthus sacchariflorus* (Maxim.) Hack.                              | -      | -     | -      | -     | 1     | 0.3   |       |
| Labiatae      | *Meehania urticifolia* (Miq.) Makino                                    | -      | -     | -      | -     | 29    | 0.05  |       |
| Liliaceae     | *Lilium distichum* Nakai ex Kamib.                                      | -      | -     | -      | -     | 3     | 0.28  | 3     | 0.2   |
| Malvaceae     | *Abutilon theophrasti* Medik.                                           | 5      | 0.05  | -      | -     | -     | -     | -     |       |
| Melanthiaceae | *Paris verticillata* M.Bieb.                                             | -      | -     | 2      | 0.15  | 33    | 0.1   | -     | -     |
| Oxalidaceae   | *Oxalis griffithii* Edgew. & Hook. f.                                   | 62     | 0.06  | 51     | 0.04  | 46    | 0.06  | 176   | 0.08  | 110   | 0.04 |
| Papaveraceae  | *Hylomecon japonica* (Thunb.) Prantl & Kündig                           | 38     | 0.4   | -      | -     | 23    | 0.22  | 77    | 0.06  | 56    | 0.06 |
| Phrymaceae    | *Phryma leptostachya* subsp. *asiatica* (Koidz.) Honda                  | 2      | 0.6   | -      | -     | -     | -     | -     | -     |       |
| Polemoniaceae | *Polemonium caeruleum* L.                                               | -      | -     | -      | -     | -     | -     | -     | -     | 3     | 0.2  |
| Primulaceae   | *Trientalis europaea* (L.) U.Manns & Anderb.                            | -      | -     | -      | -     | -     | -     | -     | -     | 3     | 0.03 |
| Pteridaceae   | *Adiantum pedatum* L.                                                   | -      | -     | -      | -     | -     | -     | 40    | 0.25  | -     | -    |
| Ranunculaceae |                                                                       |        |       |        |       |       |       |       |       |       |       |
| Species                                      | Family       | Abundance | Diameter | Height | Width | Density | Biomass | Coverage |
|----------------------------------------------|--------------|-----------|----------|--------|-------|---------|---------|----------|
| Aconitum volubile                             | -            | -         | -        | -      | -     | -       | -       | -        |
| Enemion raddeanum                             | -            | -         | -        | -      | -     | -       | -       | -        |
| Rosaceae                                      | -            | -         | -        | -      | -     | -       | -       | -        |
| Agrimonia pilosa                              | -            | -         | -        | -      | -     | -       | -       | -        |
| Filipendula palmata (Pall.) Maxim.            | -            | -         | -        | -      | -     | -       | -       | -        |
| Fragaria orientalis Losinsk.                  | -            | -         | -        | -      | -     | -       | -       | -        |
| Geum alleppicum Jacq.                         | -            | -         | -        | -      | -     | -       | -       | -        |
| Rubiaceae                                     | -            | -         | -        | -      | -     | -       | -       | -        |
| Galium spurium L.                             | -            | -         | -        | -      | -     | -       | -       | -        |
| Ruscaceae                                     | -            | -         | -        | -      | -     | -       | -       | -        |
| Maianthemum bifolium (L.) F.W.Schmidt         | -            | -         | -        | -      | -     | -       | -       | -        |
| Convallaria majalis L.                        | -            | -         | -        | -      | -     | -       | -       | -        |
| Saxifragaceae                                 | -            | -         | -        | -      | -     | -       | -       | -        |
| Chrysosplenium lectus-cochleae Kitag.         | -            | -         | -        | -      | -     | -       | -       | -        |
| Chrysosplenium sinicum Maxim.                 | -            | -         | -        | -      | -     | -       | -       | -        |
| Scrophulariaceae                              | -            | -         | -        | -      | -     | -       | -       | -        |
| Pseudolysimachion spurium L.                  | -            | -         | -        | -      | -     | -       | -       | -        |
| Umbelliferae                                  | -            | -         | -        | -      | -     | -       | -       | -        |
| Carum buriaticum Turcz.                       | -            | -         | -        | -      | -     | -       | -       | -        |
| Heracleum hemsleyanum Diels                   | -            | -         | -        | -      | -     | -       | -       | -        |
| Ostericum grosseserratum Maxim.               | -            | -         | -        | -      | -     | -       | -       | -        |
| Ostericum sieboldii (Miq.) Nakai              | -            | -         | -        | -      | -     | -       | -       | -        |
| Peucedanum praenuptorum Dunn                  | -            | -         | -        | -      | -     | -       | -       | -        |
| Sanicula rubriflora F. Schmidt ex Maxim.      | -            | -         | -        | -      | -     | -       | -       | -        |
| Urticaceae                                    | -            | -         | -        | -      | -     | -       | -       | -        |
| Urtica angustifolia Fisch. ex Hornem.          | -            | -         | -        | -      | -     | -       | -       | -        |
**Coordinates:** and Latitude; and Longitude.

**Taxonomic coverage**

**Description:** The dataset contains a total of 5007 tagged individuals representing 95 total taxa identified to species level belonging to 48 families and 78 genera (see Suppl. material 1).

**Temporal coverage**

**Notes:** Data range: 1 August 2016 - 1 August 2017.

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**Data resources**

**Data package title:** List of all individuals established in all 5 forest types in Liangshui National Natural Reserve.

**Number of data sets:** 1

**Data set name:** raw_data_Lsnrr.xls - Download file

| Column label                  | Column description                                           |
|------------------------------|--------------------------------------------------------------|
| Forest type                  | Forest community types                                       |
| Family_name                  | Plant family for the species following APG IV                |
| Genus_name                   | Full scientific name of the genera in which the taxon is classified |
| Species_name                 | Name of the identified species                               |
| Plot number                  | Transect number                                              |
| Quadrat size                 | Quadrat size in metres                                       |
| Diameter at breast height (cm)| Diameter at breast height in centimetres                    |
|               | Description                                      |
|---------------|--------------------------------------------------|
| High (m)      | Height of vegetations in metres                 |
| Canopy diameter (m) | Canopy diameter in metres                  |
| Number        | The number of the plant                        |
| Total coverage| Coverage of all species in each quadrat        |
| Coverage      | Coverage of each species                       |

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**Supplementary material**

**Suppl. material 1: List of all plants recorded in all 5 forest types in Liangshui National Natural Reserve.**

**Authors:** Wang Hongfeng & Dong Xueyun  
**Data type:** Excel file of List of all plants recorded in all 5 forest types in Liangshui National Natural Reserve  
**Brief description:** This is the raw dataset of each plant individual recorded with their diameter at breast height, high, canopy diameter, as well as all shrubs and herbs recorded with their coverage, total coverage, number, height.  
**Filename:** Suppl. material.xls - Download file (297.50 kb)