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Distribution and plant community associations of the understory bamboo *Fargesia qinlingensis* in the Foping National Nature Reserve, China

Xi-Chun Du · Yi Ren · Gao-Di Dang · Jeremy Lundholm

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Abstract

• **Introduction** *Fargesia qinlingensis* is the primary food source for the endangered giant panda during the summer months in the Qinling Mountains, but little is known about its spatial distribution and plant community associations.
• **Methods and materials** We examined the composition and structure of the forest canopy and topographic patterns as correlates of *F. qinlingensis* population structure in Foping National Nature Reserve (FNNR), Qinling Mountains, China.
• **Discussion** *F. qinlingensis* is the dominant understory vegetation from 1,800–2,600 m in FNNR. Populations of *F. qinlingensis* were associated with several different tree communities, mainly with broad-leafed dominants at intermediate elevations and conifers at higher elevations. *F. qinlingensis* was associated with herb communities of

intermediate species richness. *F. qinlingensis* densities were lowest at the highest elevations in herb-rich alpine meadows and at low elevations where the most species-rich tree communities had high cover.

• **Conclusion** The most species-rich tree and herb communities were not associated with *F. qinlingensis* populations, thus efforts to conserve both bamboo as a food resource for pandas and species diversity of other plants must prioritize the entire elevation range in these mountains.

Keywords Qinling mountain range · Vegetation · Topography · Giant panda

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1 Introduction

The forest canopy often influences the distribution and dominance of understory species, and plays a decisive role in the process of community development (Fredericksen et al. 1999; Gillet et al. 1999; McKenzie et al. 2000; Taylor et al. 2004). The distribution and dominance of understory plants may, in turn, affect long-term canopy structure and composition by influencing the establishment and growth of tree species seedling populations (George and Bazzaz 1999), especially in bamboo forests (Narukawa and Yamamoto 2002; Taylor et al. 2004; Wang et al. 2006).

Bamboo species form the dominant understory vegetation of the giant panda (*Ailuropoda melanoleuca*) habitat in China (Hu et al. 1985; Taylor et al. 2004). While the distribution and abundance of these understory bamboo species are influenced by the forest canopy (Taylor et al. 2004), in turn, they also affect canopy structure and composition (Wang et al. 2006). At the same time, understory bamboo species influence the distributions of other understory plant species (Linderman et al. 2004) and

wild animal species (Wei et al. 1999), including the giant panda, and knowledge of bamboo distribution can help map the spatial distribution of animal species. Understory bamboo makes up 99% diet of the wild giant panda is bamboo (Hu et al. 1985) and its distribution and ecological relationships to other plant species are essential for giant panda conservation (Taylor et al. 2004; Wang et al. 2006).

Most research on giant panda and its habitat was originally conducted in Sichuan province of China (Hu et al. 1985; Schaller et al. 1985; Taylor et al. 1991; Liu et al. 1999; Taylor and Qin 1988). More attention has been paid recently to panda populations in the Qinling Mountains (Yang et al. 1998; Wang et al. 2006). According to the latest survey, the giant panda reaches its highest density in Foping National Nature Reserve (FNNR) in the Qinling Mountains (State Forestry Administration 2006), where a bamboo species, *Fargesia qinlingensis*, which dominates the understory of subalpine forests, makes up the pandas only food resource during summer (Yang et al. 1998; Wang et al. 2006). Therefore, research on habitat preferences and plant community associations of *F. qinlingensis* has special significance for panda conservation at Qinling Mountains (Yang et al. 1998; Ren 1998; Wang et al. 2006). *F. qinlingensis* is the dominant understory bamboo species in subalpine forests at FNNR (Ren 1998), but the distribution of this understory bamboos is patchy, thus habitat models including distribution and abundance of *F. qinlingensis* show much smaller estimates than expected of suitable panda habitat area in nature reserves (Linderman et al. 2005). Predicting the spatial distribution of bamboo species at a fine scale has not been possible due to the lack of any significant relationship between overstory and abiotic variables and the presence or absence of bamboo (Linderman et al. 2004).

The goal of this study was to better understand the implications of the bamboo species *F. qinlingensis* for the giant panda's habitat. To achieve this aim, we surveyed the distribution and abundance of *F. qinlingensis*, the plant species composition and structure of the forest, and topographic characteristics in FNNR.

2 Methods and materials

2.1 Study site

The study was conducted in the FNNR, which is located on the south slope of the Qinling Mountains, Shaanxi Province, China (107° 40'–107° 55' E, 33° 33'–33° 46' N). The reserve spans the north subtropical and temperate zones, with a warm, humid climate. With elevations ranging from 980–2,900 m, there are several climatic zones in the reserve, and consequently it has high habitat diversity. From the lowest elevation to approximately 2,000 m, the canopy consists mainly of

deciduous broad-leaved *Quercus* species. From 2,000 to 2,500 m, there is mixed coniferous and deciduous broadleaf forest with *Betula* and *Abies* as dominant species. The canopy is dominated by coniferous forest consisting of *Abies fargesii* from 2,500–2,800 m (Ren 1998). Throughout the reserve, forest canopies average 56% closure and rarely exceed 90%, maintaining significant gap areas that allow light penetration. According to the third-level survey on panda population and habitat, the highest giant panda density in China occurs in this reserve (State Forestry Administration 2006). The vegetation is diverse due to the coexistence of both northern and southern Chinese taxa (Pan et al. 1988; Ren 1998). At present, there are 1,377 species of seed plants, belonging to 561 genera and 132 families, respectively (Ren 1998).

2.2 Field methods

The reserve was divided into three sections, each including a mountain peak (to facilitate placement of vertical transects): Lubanzhai (2,904 m), Guangtoushan (2,800 m), and Sangebao (2,500 m; Ren 1998). A vertical transect was set from the highest point to the lowest point in each of the sections, more or less heading south. Along the transect from the Lubanzhai peak (which contained the greatest elevation gradient), every 150 m, a study stand with two 20×20-m plots was established, and every 300 m along the other two transects. The distance between the two plots within a stand was 30 m. Because of a localized hailstorm which destroyed foliage in one area, only one plot was established at the 2,300 m in elevation on the first transect, so 15 plots were sampled along the first transect from 1820 m to 2,900 m. There were eight plots along the second transect from 1,900 to 2,800 m, and 10 plots along the third transect from 1,760 to 2,615 m, for 33 plots total in the survey from July to September 2002. Altitude, aspect and slope were recorded for each plot.

The southwestern corner of each 20×20-m tree plot were used as a starting point from which the position and diameter at breast height (DBH) of each individual tree >5 cm was quantified (*x* axis=eastern direction; *y* axis=northern direction). After estimating the height, projection diameter, and the height of the lowest branch of each individual tree >5 cm from about 3 m away, we plotted every individual tree on the graph paper according to their position and projection diameter, so we could calculate the cover area of each individual tree, and summed for the plot as total projection area; overlap was the total projection area divided by percent cover.

Tree architecture is an important determinant of the height extension and light capture (David 1998; Lourens et al. 2006); it allows species to exploit the vertical height gradient in the forest canopy and horizontal light gradients at the forest floor. Lowest branch height is used here as an index of light availability at the forest floor: higher lowest

branch heights are associated with thinner tree canopies (Wei et al. 1999) that allow greater light penetration, plots with no trees were given values of 15 m and 10 m for lowest and average lowest branch height, respectively (to reflect relatively high light penetrations), so that these plots could be included in the analyses. Stem area at breast height of each individual tree was calculated from its DBH, and summed to calculate stem area at breast height for each plot. These stand variables represent various indicators of forest biomass or light penetration that may be related to bamboo population characteristics.

Five 1×1-m plots (four at the corner, one at the center) in every 20×20-m plot were set to investigate the abundance and distribution of *F. qinlingensis* and herbaceous species. In each of the 1×1-m herb species plot, each individual herb was identified and counted, so herb density (stems/5 m²) and diversity can be calculated. The abundance and distribution of *F. qinlingensis* in every 1×1-m plot was also surveyed. Culms of *F. qinlingensis* were divided into new shoots (dark green, sheaths still attached to the nodes), culms more than 1 year old (light green, sheaths fallen out from the nodes; Wang et al. 2006), and dead culms. We counted all the culms, and measured their heights. Then the distribution of *F. qinlingensis* in the plot was plotted on graph paper, and the percent cover of bamboo plots calculated.

2.3 Data analysis

In order to determine the relationships between potential univariate predictors and response variables, redundancy in both predictor (forest structure, species diversity, topographic variables) and response variables (bamboo) was reduced using principal components analysis (PCA). This reduced the number of potential predictors from 20 to five. In order for aspect to be used in linear methods, it was first transformed to northness and eastness using the cosine and sine, respectively, of the radian angle. The response variables related to bamboo density and bamboo cover were also subjected to PCA; this resulted in a single principal component with eigenvalue > 1, but the loadings were below 0.3 for all variables, thus we ended up using univariate correlation analyses (Pearson's) to explore the relationships among bamboo variables (only plots containing bamboo were used for the correlation analyses). We ended up selecting total number of stems, average height, and total number of new stems as the key bamboo response variables for subsequent analyses, since total number of stems (total density) was positively correlated with all other density variables, height was related to none of the other variables and is likely correlated with overall bamboo productivity (Qin et al. 1993), and new shoot density is likely most important to giant pandas as a food resource. To explore the relationships between bamboo variables and

predictors, multiple linear regression with backward and forward stepwise selection using stepAIC in R (v. 2.8.1) were carried out between each of the three bamboo variables and the set of five principal components.

To examine the relationships between community composition and bamboo characteristics, we used detrended correspondence analysis (DCA) for tree and herb communities separately since these were sampled at different scales. Both non-metric multidimensional scaling and DCA were attempted, and results were similar. We present only DCA results here because the DCA produces a unique solution and is easier to interpret in terms of environmental gradients. The abundance measure for both was density (for trees: total number of stems of each species in each 20×20-m plot; for herbs: total number of stems summed over all five sub-plots within each 20×20-m plot). Two plots that contained only *Larix chinensis* in the tree layer were omitted from the tree ordination as they were extreme outliers on the ordination plots. For the herb plots, bamboo density was included with the other species in the ordination. We used an indirect gradient analysis to examine the relationships between aspect (transformed as described above), slope, elevation, and community structure (ENVFIT function in vegan, R-package v. 2.8.1). We opted for an indirect approach, as without prior knowledge of appropriate constraints, direct gradient analysis is not advisable (Oksanen 2008). To determine the relationships between community composition and other structural variables, for both herb and tree ordinations, we used tree species richness, total DBH, and tree cover, as well as herb species richness as environmental variables in the indirect gradient analysis. To determine the forest community composition most closely associated with bamboo population abundance, bamboo total density, new culm density and average height were also used as “environmental variables” in the indirect gradient analysis of the tree communities. Since giant pandas prefer areas with intermediate densities of bamboo culms, we indicated plots with between 25 and 50 culms/m² (Wang et al. 2007) with separate symbols on the ordination diagrams.

3 Results

3.1 *F. qinlingensis* distribution and abundance

Understorey bamboo (*F. qinlingensis*) occurred from 1,760–2,800 m, and had >85% cover between 1,800 and 2,600 m. Cover dropped to below 10% above 2,800 m in the subalpine shrub and meadow areas. Below 1,800 m, in the deciduous broad-leaved forest areas, *F. qinlingensis* was uncommon, with cover below 1% in some plots (Table 1). The average density was 28.9 culms/m², with density reaching a maximum of 49.7 culms/m² at 2450 m in

Table 1 *F. qinlingensis* and topographical factors in the 20 study plots

Plot	Aspect	Slope	Elevation	Area of bamboo	New culms/5 m ²	Dead culms/5 m ²	Living culms/5 m ²	Total culms/5 m ²	Average height
F1-1-1	E	10	2,900	0	0	0	0	0	
F1-1-2	E	10	2,890	0	0	0	0	0	
F1-2-1	SW	20	2,746	0	0	0	0	0	
F1-2-2	SW	20	2,720	0	0	0	0	0	
F1-3-1	SE	25	2,600	379.5	27	29	217	273	1.24
F1-3-2	SW	25	2,600	363.5	36	35	203	274	1.13
F1-4-1	S	30	2,420	392.5	29	33	158	220	1.76
F1-4-2	SE	35	2,450	369.5	39	45	261	345	1.36
F1-5-1	NE	35	2,300	377.4	19	14	122	155	1.51
F1-6-1	SE	30	2,150	395.8	12	24	153	189	1.8
F1-6-2	SE	30	2,160	397.4	15	24	148	187	1.88
F1-7-1	W	30	2,000	0	0	0	0	0	
F1-7-2	N	35	1,970	0	0	0	0	0	
F1-8-1	W	35	1,850	0	0	0	0	0	
F1-8-2	Sw	35	1,820	0	0	0	0	0	
F2-1-1	S	15	2,800	0	0	0	0	0	
F2-1-2	SW	25	2,827	0	0	0	0	0	
F2-2-1	SW	20	2,500	375	36	20	126	182	2.3
F2-2-2	SW	25	2,500	113.2	13	32	69	114	1.99
F2-3-1	SE	20	2,200	368	23	33	114	170	2.45
F2-3-2	NW	30	2,200	372.8	16	26	45	87	1.74
F2-4-1	SW	30	1,900	0	0	0	0	0	
F2-4-2	NW	30	1,890	0	0	0	0	0	
F3-1-1	SW	5	2,630	357.7	13	57	182	252	1.59
F3-1-2	SE	30	2,630	0	0	0	0	0	
F3-2-1	SW	20	2,350	385.5	8	23	100	131	1.35
F3-2-2	S	40	2,350	388	22	28	102	152	1.57
F3-3-1	S	5	1,900	355.8	6	4	70	80	1.32
F3-3-2	S	5	1,920	326.4	11	14	140	165	1.05
F3-3a-1	W	35	2,040	273.6	10	0	91	101	1.05
F3-3a-2	W	35	2,050	300.7	10	4	155	169	1.32
F3-5-1	S	5	1,760	21.6	4	14	25	43	2.45
F3-5-2	S	5	1,760	0	0	0	0	0	0

elevation. At 2,800 m elevation, the density of *F. qinlingensis* was 13.2 culms/m², less than half of the average level; at the altitude of 1,760 m, density was only 3.9 culm/m², only one-eighth of the average density (Table 1).

With declining elevation, the number of new culms and dead culms decreased, thus the turnover rate of *F. qinlingensis* slowed down. The highest average density of new bamboo shoots was 6.4 culms/m², between 2,200 and 2,600 m. With declining elevation, the average height of adult *F. qinlingensis* culms increased slightly (Table 1). Average height of bamboo was 1.6±0.43 m. Although the density of *F. qinlingensis* was the lowest at the 1,760 m in elevation, the height was 2.5 m, which was the highest in

all the plots. Average height was less than 1 m at the highest elevation of 2,800 (Table 1).

There were significant positive correlations between bamboo cover and new shoot density and total culm density (Table 2). So areas with greater bamboo cover had greater overall density and new shoots. New shoot density was positively correlated with dead, living, and total culm density. Average height of bamboo culms was not correlated with the other variables (Table 2).

Principal components analysis returned five PCs with eigenvalues >1 for the environmental and forest structure variables, accounting for 84% percent of the total variance (Table 3). The first PC was negatively related to variables

Table 2 Pairwise correlation coefficients comparing *F. qinlingensis* population structure

	Bamboo cover	New shoot density	Dead culm density	Living culm density	Total culm density	Average height
Bamboo cover	1	0.542*	0.386	0.589**	0.508*	0.19
New shoot density	0.542*	1	0.568**	0.672**	0.747**	0.253
Dead culm density	0.386	0.568**	1	0.550*	0.659**	0.361
Living culm density	0.589**	0.672**	0.550*	1	0.976**	0.003
Total culm density	0.508*	0.747**	0.659**	0.976**	1	-0.282
Average height	0.19	0.253	0.361	0.003	-0.282	1

* $P < 0.05$; ** $P < 0.01$

associated with forest cover and tree species richness and positively related to elevation, herb richness and variables associated with higher light levels (lowest branch height). The second PC was negatively related to total and herb richness and positively related to slope and northness. PC3 was positively related to eastness and dead/living tree ratio, and negatively related to northness and tree richness. PC 4 was positively related to maximum DBH, stem area, lowest, and average branch heights and negatively related to northness and dead tree density. PC 5 was negatively related to eastness, northness, and slope and positively related to dead/living tree ratio. Multiple regression of the five PCs on the three bamboo variables (average height, new, and total culm densities) were significant for all three (Table 4). Total density was positively related to PC3 and PC5, indicating that greater total densities were found in areas characterized

by low slopes, southern aspect, low tree richness, high ratio of dead to living trees, and taller trees with lower branch heights. The results for eastness are contradictory, i.e., density is positively related to PCs variously negatively and positively related to the eastern aspect; univariate correlations between eastness and total density were not significant. New shoot density was positively related to PC3, thus more new shoots were found in areas characterized by most of the same features as total density. Average height was positively related to PC3 and PC5, similar to total density.

3.2 Composition and structure of the forest canopy

The average number of species (trees and herbs combined) was 31.15 ± 8.37 (SD) in the 33 plots; highest at 2,900 m in elevation (61 species); lowest at 2,150 m in elevation (13

Table 3 Principal components summarizing environmental and forest structural variables

	PC1	PC2	PC3	PC4	PC5
Standard deviation	3.08	1.53	1.45	1.21	1.11
Proportion of total	0.48	0.12	0.11	0.07	0.06
Variance explained					
Eastness ^a	-0.02	-0.09	0.34	0.11	-0.57
Northness	-0.07	0.20	-0.28	-0.38	-0.38
Slope	-0.01	0.45	0.00	-0.11	-0.48
Elevation	0.29	-0.11	0.20	-0.09	-0.02
Total richness	0.10	-0.53	0.09	-0.03	-0.24
Tree richness	-0.26	-0.11	-0.28	-0.04	0.05
Herb richness	0.21	-0.39	0.19	-0.01	-0.19
Tree density	-0.26	-0.24	-0.17	-0.16	-0.17
Dead tree density	-0.19	-0.09	0.17	-0.43	-0.00
Dead/living tree density	-0.04	0.18	0.49	-0.24	0.26
Tree average height	-0.22	0.24	0.29	0.14	-0.02
Tree maximum height	-0.28	0.17	0.16	0.08	-0.13
Lowest branch height	0.26	0.12	-0.18	0.25	-0.07
Average lowest branch height	0.19	0.13	-0.29	0.32	-0.14
Maximum DBH	-0.24	0.06	0.20	0.36	0.01
Stem area	-0.23	-0.10	0.13	0.45	-0.14
Maximum projection diameter	-0.29	-0.00	-0.02	-0.04	0.05
Tree cover	-0.30	-0.11	-0.12	-0.05	-0.14
Projected area	-0.28	-0.18	-0.20	0.12	0.04
Overlap	-0.29	-0.13	-0.03	0.07	0.14

^a See methods for details of environmental variables

important for the growth and development of *F. qinlingensis*. This likely explains the vertical limit of *F. qinlingensis* in FNNR: due to the long dry northern wind, high elevations contain only *A. fargesii*, *S. squamata*, and *L. chinensis* in terms of woody plants (Ren 1998). At lower elevations, bamboo may be facilitated by conifers that have relatively low canopy cover due to low leaf area indices such as *A. fargesii*, providing partial shade in the summer. Disturbance due to conifer logging negatively influenced the survivorship of dwarf bamboo (Li and Denich 2001), possibly because of the sheltering effect of conifers. This condition was similar in Sichuan province where pandas prefer forests with higher canopy coverage, for young pandas climb trees to avoid enemies, and mostly give birth in tree cavities. Light conditions under the canopy in the leafless season can have a great effect on bamboo biomass (Toko et al. 2005). At the lower elevations where tree canopy cover is higher, light availability likely limits the density of *F. qinlingensis*.

In areas where bamboo is dominant, it has been suggested that tree species richness can be low because bamboos reduce tree regeneration (Taylor and Qin 1988). In conclusion, conditions of low temperature and desiccation may limit the upper part of its elevation range while light may be limiting at the lower end of its range. High species richness tree communities at low elevations and high richness herb communities at high elevations were not associated with *F. qinlingensis* populations in FNNR, thus efforts to conserve both bamboo as a food resource for pandas and species diversity of other plants must prioritize the entire elevation range in these mountains.

4.3 Implications for giant panda habitat

As the dominant species of the understory subalpine forests and the panda's only food resource during summer in FNNR at the Qinling Mountains, *F. qinlingensis* has a wide tolerance of environmental conditions and is found in a variety of plant communities. Intermediate density level of *F. qinlingensis* were found over a broad range of communities along the elevation gradient, in areas with intermediate to low tree cover, especially in coniferous forests dominated by *A. fargesii* and mid-elevation broad-leaved forests. This may partly account for the fact that the giant panda reaches its highest density in FNNR at the Qinling Mountains (State Forestry Administration 2006). The spatial distribution and abundance of *F. qinlingensis* within different plant communities quantified here provides important baseline ecological information regarding panda habitat in the Qinling Mountains, and sets up future studies of habitat use by pandas in the region.

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Appendix

Table 5 Composition and structure of the forest canopy in the quadrats

Plot	Total species richness	Tree species richness	Herb species richness	Tree density	Dead tree density	Dead/living tree density	Tree average height (m)	Tree maximum height (m)	Lowest branch height (m)	Average lowest branch height (m)	Maximum DBH (cm)	Maximum stem area at breast height	Maximum projection diameter	Cover	Total projection area	Overlap	
F1-1-1	62	1	61	22	5	0.2	4.5	9	0.1	1.8	30	0.9	5.5	210.5	274.9	1.3	
F1-1-2	36	1	35	18	0	0.0	2.5	6	0.2	1.6	30	0.5	3.9	201.2	110.9	0.6	
F1-2-1	42	1	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F1-2-2	35	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F1-3-1	24	1	23	10	6	0.6	25.1	28	4	5.2	60	1.2	7	181.7	284.6	1.6	
F1-3-2	33	1	32	4	8	2.0	20.3	23	2	5.5	43	0.4	7	76.1	98.9	1.3	
F1-4-1	29	3	26	5	1	0.2	10.7	12	2	3.1	43	1.5	8	59.3	530.7	9.0	
F1-4-2	41	2	39	7	0	0.0	12.1	16	2	4.4	40	2.0	8	69.3	1,103.9	15.9	
F1-5-1	28	3	18	16	5	0.3	13	29	2.8	4.5	60	1.0	14	259.2	455.5	1.8	
F1-6-1	13	3	10	6	3	0.5	6.9	14	2	3	25	0.1	6	69.8	124.0	1.8	
F1-6-2	25	3	22	3	4	1.3	20.7	30	3	7.3	150	2.0	7	93.9	96.6	1.0	

Table 5 (continued)

Plot	Total species richness	Tree species richness	Herb species richness	Tree density	Dead tree density	Dead/living tree density	Tree average height (m)	Tree maximum height (m)	Lowest branch height (m)	Average lowest branch height (m)	Maximum DBH (cm)	Stem area at breast height	Maximum projection diameter	Cover	Total projection area	Overlap
F1-7-1	23	6	17	14	5	0.4	13.8	28	0.3	6.5	70	0.9	12	313.5	576.2	1.8
F1-7-2	30	8	22	27	9	0.3	15.4	28	2.5	7.2	70	2.3	16	379	1,149.2	3.0
F1-8-1	31	12	19	32	5	0.2	12.5	30	0.5	5.5	55	0.5	8	343.5	3,074.4	9.0
F1-8-2	29	12	17	29	4	0.1	11.4	21	0.2	5.7	33	0.3	8	321	2,971.2	9.3
F2-1-1	34	0	34	0	0		0	0	0	0	0	0	0	0	0	
F2-1-2	26	0	26	0	0		0	0	0	0	0	0	0	0	0	
F2-2-1	30	3	27	12	0	0.0	10.3	15	2	3.7	30	0.4	10	168.4	243.4	1.5
F2-2-2	39	2	37	7	5	0.7	6.4	9	1.5	2.8	18	0.1	5	40.2	52.0	1.3
F2-3-1	34	6	26	19	1	0.1	14.6	25	1	5.9	65	1	8	246.5	438.8	1.8
F2-3-2	20	2	18	6	1	0.2	16.8	25	2	7.2	60	0.8	12	192.9	311.7	1.6
F2-4-1	22	4	18	20	0	0.0	25	23	0.2	5.0	85	1.8	14	385.9	974.2	2.5
F2-4-2	31	9	22	20	0	0.0	12.6	25	0.5	6.0	55	1	13	344.7	724.0	2.1
F3-1-1	33	3	30	9	0	0.0	3.3	4	1	2	10	0.0	5	69	86.4	1.3
F3-1-2	37	0	37	0	0		0	0	0	0	0	0	0	0	0	
F3-2-1	29	3	26	19	2	0.1	11.3	20	1.5	4.1	50	0.8	12	218.7	646.8	3.0
F3-2-2	25	6	19	12	4	0.3	6.7	12	1.5	2.9	30	0.1	15	136.5	343.8	2.5
F3-3-1	36	14	22	25	12	0.5	11.3	21	0.3	4.9	55	1.0	17	339.9	1,034.6	3.0
F3-3-2	24	11	13	20	8	0.4	10.1	24	0.2	2.2	55	0.8	20	368.3	1,181.0	3.2
F3-3a-1	26	11	15	25	7	0.3	10.0	18	0.5	4.2	80	0.9	15	305.8	777.9	2.5
F3-3a-2	34	11	23	39	11	0.3	10.2	20	1	5.2	35	0.9	11	337	785.8	2.3
F3-5-1	36	15	21	28	4	0.1	13.5	24	0.2	5.0	165	3.5	16	383.7	1,528.6	4.0
F3-5-2	31	11	20	32	2	0.1	14.2	26	0.2	6.3	60	1.8	14	389.9	1,731.9	4.4

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