

# Home ranges and habitat vegetation characters in breeding season of Narcissus Flycatcher and Yellow-rumped Flycatcher

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**Abstract** The home ranges of the Narcissus Flycatcher (*Ficedula narcissina elisae*) and the Yellow-rumped Flycatcher (*F. zanthopygia*) are measured by radio telemetry in a subalpine forest near Beijing, China. The home range is calculated by 100% Minimum Convex Polygon (MCP), and the area varies from 2,000 to 5,000 m<sup>2</sup>. The majority of flycatchers can be found in the bottom of valleys and the under-side of mountains. It is fairly rare for both Flycatcher species to leave their nests more than 70 m. Individuals of the species in pair-banding and nest-detecting periods have larger home ranges than those in incubation and rearing periods. The levels of canopy coverage in the home ranges of Narcissus Flycatchers are significantly higher than that of Yellow-rumped Flycatchers. There are also more tall trees and stumps in the home ranges of Narcissus Flycatchers than in that of Yellow-rumped Flycatchers. The dominant tree species in the home ranges of Narcissus Flycatchers is Dahurian Birch (*Betula dahurica*), whereas Manchurian Walnut (*Juglans mandshurica*) is the dominant tree species in the home ranges of Yellow-rumped Flycatchers.

**Keywords** Narcissus Flycatcher, Yellow-rumped Flycatcher, radiotelemetry, home range, habitat

## 1 Introduction

Narcissus Flycatcher (*Ficedula narcissina*) belongs to Muscipidae, Passeriformes. It is divided into three subspecies: *F. narcissina*, *F. owstoni*, and *F. elisae*. The *F. elisae* breeds only in the mountainous regions of north China, while it winters in the Indo-China Peninsula and the Malay Peninsula (Cheng, 1987; Dickinson, 2003; Zheng, 2005). The ecology of this

subspecies is not reported yet. The Yellow-rumped Flycatcher (*Ficedula zanthopygia*) is a sibling species of *F. narcissina*, and is a monotypic species. It breeds in the northeast, north, east and middle China and Far East Russia. It winters in southeast Asia. Some researchers (Fan, 1981; Liu and Wang, 1981; Zhang and Zhang, 1983) have reported the breeding ecology of Yellow-rumped Flycatchers. Both the Narcissus Flycatcher and Yellow-rumped Flycatcher breed in the Xiao Longmen Forest, Beijing and they are sympatric species. By radio-tracking, we measured the home ranges of the two species during breeding season. The vegetation characters are also analyzed.

## 2 Method and study area

### 2.1 Study area

Our study area was in the subalpine Xiao Longmen Forest (N 40° 00'–40° 02', E 115° 26'–115° 30'), 114 km west of downtown Beijing. Situated north of the Taihang Mountains, this Forest is 705.4 ha in size at an altitude of 1,000–1,763 m. Mean annual temperature of the study area is about 2–7°C and annual precipitation is 600–700 mm. The vegetation is dominated by secondary temperate deciduous broad-leaf forest with patches of coniferous plantation. The broad-leaf forest is dominated by *Populus davidiana*, *P. cathayana*, *Salix viminalis*, *S. caprea*, *Juglans mandshurica*, *Betula platyphylla*, *B. dahurica*, *Quercus mongolica*, *Acer truncatum*, *Fraxinus rhynchophylla* and *Syringa pekinensis*. The coniferous plantation is dominated by *Larix principis-rupprechtii*, *L. kaempferi* and *Pinus tabulaeformis*. The terrain in this forested area is rugged with steep sides (30°–60° incline), and there are several paths that extend from the bottom to the top of the valley. Few permanent springs exist in the valley and only some temporary puddles emerge after heavy summer rains (between June and August).

## 2.2 Method

### 2.2.1 Density and altitude distribution

We designed nine line transects (Bibby et al., 1998) to make surveys from the end of May to the beginning of June, 2005. The total length of the line transects was 16.9 km (Table 1). Taking 50 m to each side as our detecting range and by a speed of 1 km per hour, we record species, sex of the flycatchers and the altitude when we saw the birds. Encountering rate (individuals per hour) was used to show the relative density of the flycatchers.

### 2.2.2 Capture and tag the birds

To capture birds, we set a mist net (3 m height, 7–10 m length) near the singing-male birds and replayed the song that came from the same species. We also set a mist net near the nest to capture the adults that feed nestlings. Radio transmitters (Micro-Pip II, Biotrack, UK, weight 0.37–0.39 g, about 3% of body mass, frequency 173.200–173.500 MHz, lifetime approximately 3–10 days, available distance 80–150 m) were glued on the feathers of the back by super glue (cyanoacrylate adhesive). Emitter antenna is parallel with tail quills and point backwards. All captured birds were released right away after tagging (Pan and Zheng, 2003). Signal was received by an M-57 receiver (Biotrack, UK) and a Flexible Yagi antenna.

### 2.2.3 Birds' location and home range

The locations of the birds were defined by trigonometric method (Kenward, 1987; Pan and Zheng, 2003). Tracking line was near the positions where we released the birds and there were several signal-received points every other 20–50 m along the line. We chose one as the origin among all points and measured the distance ( $D$ ) and aspect ( $\theta$ ) between origin and other points. The coordinate ( $x_i, y_i$ ) of every single point ( $i$ ) in the reference frame can be figured out. Here is the expression

$$x_i = D_i \sin \theta_i; y_i = D_i \cos \theta_i$$

We defined the aspect (the angle to east pass north,  $\alpha_i$ ) on point  $i$  ( $x_i, y_i$ ) when the strongest signal was received. Then we defined another aspect (angle  $\alpha_{i+1}$ ) on the next point  $i+1$  ( $x_{i+1}, y_{i+1}$ ) immediately (less than 1 min). The tracking work had been done once if the angle between two aspects was close to 90°. The point of intersection in the reference frame was the bird-point ( $X_i, Y_i$ ).

$$X_i = x_i - y_i \tan \alpha_i + Y_i \tan \alpha_i$$

$$Y_i = \frac{x_{i+1} - x_i + y_i \tan \alpha_i - y_{i+1} \tan \alpha_{i+1}}{\tan \alpha_i - \tan \alpha_{i+1}}$$

Every tagged bird was tracked every other 30 min or more. We tracked all the birds as many times as possible until the

emitter battery power was used up. The coordinates ( $X_i, Y_i$ ) of the tagged birds were input to Ranges 6 for Windows and home range were calculated by 100% Minimum Convex Polygon (MCP). The distance between bird activity points to the valley or its nest is measured by Global Position System (GPS), compass and the relief map of the area (1:50,000). The distance of the valley to the ridge of the hill around the birds' active area was also measured.

### 2.2.4 Home range vegetation characters sampling measurements

Vegetation characters around the roosts or nests of flycatchers were described in sample circles by radius of 6 m. Data measured were as follows: canopy cover, the species, height and diameter at breast height (1.3 m high from ground) of the arborous layer. The important value (Zhang, 1995) of arborous species and basal coverage of arbor were accounted as the summation of relative abundance (the number ratio of one species' and all species' in the sample circle), relative height (the height ratio of one species' and sum of all species' in the sample circle) and relative basal coverage (the sum of the square of the diameter at breast height ratio of one species' and all species' in the sample circle) in the sample circles. (The basal coverage of the arborous area is the ratio of the sum of the square of all species' diameter at breast height and the square of the diameter of the sample circle).

The greater the important value is, the larger the dominance. To compare the dominance of arbor species in different sample circles, we accounted for the relative important values of every species in every sample circle (the important value ratio of every species and the species that has the greatest important value). The ratio is ranged 0–1. The arbor species in sample circles that has a greater relative important value will have greater dominance. The relative important value is equal to 1 in the sample circle that has the greatest dominance, and is equal to 0 in sample circles that have no such species in them.

The stump height and diameter at breast (1.3 m height from the ground or the section diameter of stump top in case the stump height was no more than 1.3 m) of dead standing trees were measured. The volume of stump and dead standing trees in the sample circles were accounted for approximately in cylinder.

### 2.2.5 Data statistical Analyses

We analyzed our data using SPSS for Windows 11.0. After examining the normality of data with one sample Kolmogorov-Smirnov test, we compared the means of two independent samples with  $t$ -test for data with normal distribution. For data that did not show normal distribution, we used the Mann-Whitney  $U$ -test. For correlative samples, we used the Friedman test. All data followed standard error, maximum and minimum values [ $x \pm se(x_{\min} - x_{\max}, n)$ ].

### 3 Results

#### 3.1 Quantity and distribution

During breeding season, the encountering rate of the Narcissus Flycatcher is  $3.1 \pm 1.6$  birds per hour, while the Yellow-rumped Flycatcher is  $1.8 \pm 1.2$  (Table 1). There was a close difference between the two species (Mann-Whitney *U*-test,  $Z = -1.770$ ,  $P = 0.077$ ). The altitude distribution of the Narcissus Flycatcher is  $1,348 \pm 122$  m (1,103–1,577 m,  $n = 50$ ), while the Yellow-rumped Flycatcher is  $1,256 \pm 128$  m (1,005–1,508 m,  $n = 28$ ). There was a significant difference between the two species (independent samples *t*-test,  $t = 3.173$ ,  $P < 0.001$ ).

**Table 1** Encountering rate of Narcissus Flycatcher and Yellow-rumped Flycatcher in breeding season

Line Transects	Line length /km	Encountering rate/individuals per hour	
		Narcissus Flycatcher	Yellow-rumped Flycatcher
South valley	2.8	3.6	2.2
Mayashi valley	1.8	6.7	1.7
Yinggou valley	1.8	3.9	2.2
Goucaozi right valley	1.5	2.0	0.7
Goucaozi left valley	2.2	1.4	0
East songshu valley	1.8	2.8	1.7
West songshu valley	1.5	2.7	3.3
Meiyao valley	2.1	1.9	0.5
Niulang valley	1.4	2.8	3.6

#### 3.2 Home range and position

Most tracked Narcissus Flycatchers (3♂) and Yellow-rumped Flycatchers (1♂ and 2♀) had home ranges of 2,000–5,000 m<sup>2</sup>. Only one female Narcissus Flycatcher had a home range of 22,000 m<sup>2</sup> and it was obviously bigger than others (Table 2, Fig. 1).

The male Narcissus Flycatchers are located in a radius of up to 40 m away from nest, except for only one location, which is 88 m away from the nest. The Yellow-rumped Flycatchers are located in a radius of up to 70 m from nest

(Table 3, Fig. 1). The male Narcissus Flycatchers are located in a radius of up to 70 m from the bottom of valleys and the females have two locations which are more than 60 m (99 and 120 m, respectively) away from the bottom of the valleys. The Yellow-rumped Flycatchers are located in a radius up to 60 m from the bottom of the valleys (Table 3). In the study area, the distance from the bottom to the ridge of the mountains is 200–300 m. This suggests that the major positions of flycatchers lie at the bottom of valleys and at the underside of mountains.

#### 3.3 Vegetation characterize in home range

Forty one circular sample-plots were measured in the home ranges of Narcissus Flycatchers and twenty were done in those of the Yellow-rumped Flycatchers. The home ranges of Narcissus Flycatchers were in areas with higher canopy cover, higher canopy height, more trees with > 9 cm diameter, more trees with > 6 m height and more stake volume than those of Yellow-rumped Flycatchers (Table 4). The ground cover in Narcissus Flycatchers' home range is higher than that of Yellow-rumped Flycatchers ( $t = 1.970$ ,  $P = 0.054$ ).

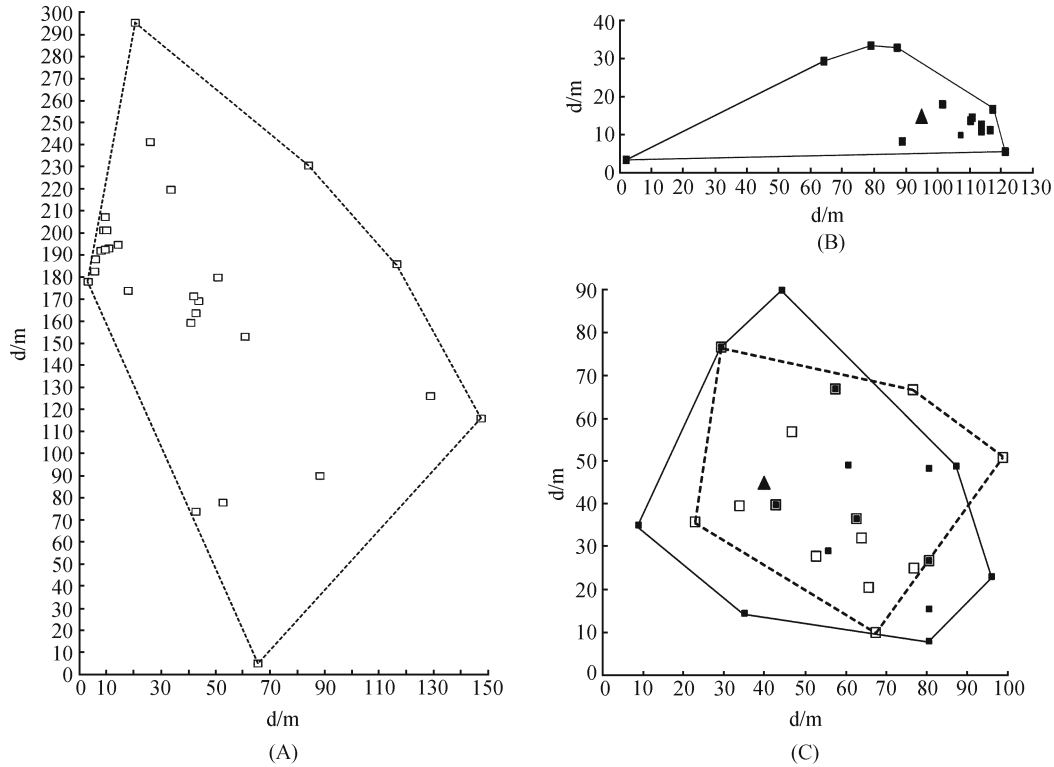
Twenty two tree species were recorded in Narcissus Flycatchers' home ranges and eighteen were recorded in Yellow-rumped Flycatchers'. There are seventeen tree species in both flycatchers' home ranges (Fig. 2). The different trees' relative important values have a significant difference in the home ranges of Narcissus Flycatchers (Frideman test:  $\chi^2 = 286.401$ ,  $P = 0.000$ ) and Yellow-rumped Flycatchers (Frideman test:  $\chi^2 = 122.945$ ,  $P = 0.000$ ). The dominant tree species in the home ranges of Narcissus Flycatchers is the Dahurian Birch (*Betula dahurica*), whereas the Manchurian Walnut (*Juglans mandshurica*) is the dominant tree species in the home ranges of Yellow-rumped Flycatchers. The relative important values of *Betula platyphylla* and *B. dahurica* in Narcissus Flycatchers' home ranges are greater than those of the Yellow-rumped Flycatchers (Mann-Whitney *U*-test,  $P < 0.05$ ). On the other hand, the relative important values of *Juglans mandshurica*, *Fraxinus rhynchophylla* and *Syringa pekinensis* in Yellow-rumped Flycatchers' home ranges are higher than those of the Narcissus Flycatchers (Mann-Whitney *U*-test,  $P < 0.05$ ).

**Table 2** Home ranges of Narcissus Flycatcher and Yellow-rumped Flycatcher in breeding season

Species	No.	Sex	Breeding phase	Mass (birds) /g	Mass (emitter) /Mass (birds)	Date (start tracking)	Tracking time/days	Active spots	Home range S/m <sup>2</sup>
Narcissus Flycatcher	503	m	paired	12.0	0.031	May 22	7	20	3,200
	505	m	paired	13.0	0.028	May 31	3	13	3,500
	509	m	Fed nestlings	12.0	0.032	July 5	4	14	2,200
	507	f	Brood patch found	14.0	0.026	June 3	8	28	22,000
Yellow-rumped Flycatcher	502 <sup>a)</sup>	m	Passed in and out nest box	12.5	0.030	May 21	7	21	4,500
	501 <sup>a)</sup>	f	Passed in and out nest box and hatching	12.5	0.030	May 19	8	17	3,200
	508	f	Got married	14.6	0.025	June 10	6	31	4,900

<sup>a)</sup>501 and 502 were couples;

<sup>b)</sup>Activity with mate were seen while nest-building, egg-laying, hatching and nestling-feeding were not seen.



**Fig. 1** Parts of tagged flycatchers' home range in breeding season

A: Female Narcissus Flycatcher (No.507); B: Male Narcissus Flycatcher (No.509); C: Paired Yellow-rumped Flycatchers (No.502, Male; No.501, Female); ■: Location of male bird; □: location of female bird; the real line shows the boundary of male birds; the broken line shows the boundary of female birds; ▲: Nest site; the coordinate shows the distance from the origin (d/m)

**Table 3** Distance from two flycatchers' locations to the nest and valley

		Distance from locations to nest (d/m)		Distance from locations to valley (d/m)	
		<i>n</i>	$\bar{x} \pm s$ ( $x_{min}-x_{max}$ )	<i>n</i>	$\bar{x} \pm s$ ( $x_{min}-x_{max}$ )
Narcissus Flycatcher	Male	14	37.9 ± 13.4 (14-61)	47	18.6 ± 11.9 (1-51)
	Female	-	-	28	24.5 ± 26.5 (0-120)
	Mean distance	-	-	75	20.8 ± 18.7 (0-120)
Yellow-rumped Flycatcher	Male	21	37.0 ± 22.8 (9-91)	21	24.4 ± 14.6 (0-46)
	Female	17	37.8 ± 19.3 (9-63)	48	19.6 ± 11.8 (0-52)
	Mean distance	38	37.4 ± 21.0 (9-91)	69	21.1 ± 12.8 (0-52)

### 4 Discussion

The Collared Flycatcher (*Ficedula albicollis*) and Pied Flycatcher (*F. hypoleuca*) often hunt in the direct vicinity of

their nests (30–50 m), and in a radius of up to 150 m from their nests (Dement'ev and Gladkov, 1968). From radio-tracking, we found Narcissus Flycatcher and Yellow-rumped Flycatchers always appear at a radius of 40–70 m, from their nests. And most individuals' home ranges are between 2, 000 and 5,000 m<sup>2</sup>. This agreement suggests that *Ficedula* spp. have similar abilities in movement.

The female Narcissus Flycatcher No. 507 had a larger home range than other tagged birds. Her nest was unable to be found in their home range. We inferred that the main reason for this was that the female bird did not nest yet or was in search for a new nest site because its first nest had been destroyed. Individuals of the species in pair-banding and nest-detecting periods have larger home ranges than those in incubation and rearing periods mainly because the flycatcher always searches for many suitable breeding grounds in early breeding season (Dement'ev and Gladkov, 1968) but seldom leaves the nest during incubation periods and hunts near the nest in rearing periods.

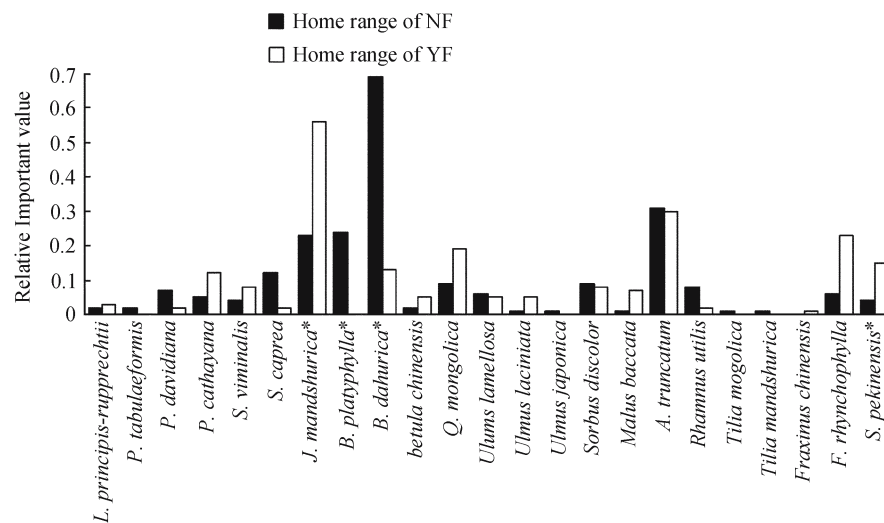
That the majority of flycatchers lie in the bottom of valleys and the underside of mountains may be due to their dependence on water. The temporary puddles, which form in the underside of the mountain during heavy rain seasons, were often the only water source in the flycatcher's home ranges.

**Table 4** Vegetation characteristics of Narcissus Flycatcher (NF) and Yellow-rumped Flycatcher's (YF) home range in breeding season

Vegetation characteristic	NF		YF		Interspecific Contrast	
	<i>n</i>	$\bar{x} \pm s (x_{\min} - x_{\max})$	<i>n</i>	$\bar{x} \pm s (x_{\min} - x_{\max})$		
Canopy cover/%	41	64.9 ± 6.7 (55–80)	20	57.3 ± 7.5 (40–65)	<i>t</i> = 4.025 <sup>a)</sup>	<i>P</i> = 0.000**
Canopy height/m	724	5.8 ± 2.6 (2.5–18.0)	308	5.3 ± 2.4 (2.5–15.0)	<i>Z</i> = -3.187 <sup>b)</sup>	<i>P</i> = 0.001**
Tree diameter/cm	724	10.2 ± 7.3 (3–40)	308	9.6 ± 7.0 (3–40)	<i>Z</i> = -1.423	<i>P</i> = 0.155
Ground cover/%	41	0.20 ± 0.08 (0.07–0.38)	20	0.15 ± 0.09 (0.02–0.35)	<i>t</i> = 1.970	<i>P</i> = 0.054*
Number of trees in one circular sample-plot	41	17.8 ± 9.1 (4–51)	20	15.4 ± 7.5 (3–28)	<i>t</i> = 0.016	<i>P</i> = 0.314
Number of trees with >9 cm diameter	41	8.7 ± 3.9 (3–24)	20	6.7 ± 2.7 (1–11)	<i>t</i> = 2.028	<i>P</i> = 0.047**
Number of trees with >6 m height	41	7.9 ± 3.9 (2–20)	20	5.4 ± 2.4 (0–9)	<i>t</i> = 3.008	<i>P</i> = 0.004**
Volume of dead tree stake /m <sup>3</sup>	41	0.12 ± 0.15 (0–0.61)	20	0.04 ± 0.05 (0–0.02)	<i>Z</i> = -2.541	<i>P</i> = 0.011**

<sup>a)</sup> Independent sample *T*-test; <sup>b)</sup> Mann-Whitney *U*-test

\*\* *P* < 0.05; \* 0.05 < *P* < 0.1

**Fig. 2** Tree's relative important value in Narcissus Flycatcher's (NF) and Yellow-rumped Flycatcher's (YF) home range in breeding season

\*Species with significant different Relative important value between the two flycatcher's home ranges (Mann-Whitney *U*-test, *P* < 0.05).

They were often observed to drink and bathe in these puddles, especially in hot days. The water source in the valley also supplied the other conditions that keep the flycatchers alive: (1) Because of the lack of permanent water source, the upper side of the mountain is drier than the downside. Therefore the taller trees, which are the necessary for the flycatchers to inhabit, mainly distribute in the bottom of valleys and the underside of mountains. (2) The temporary puddles and the tall trees keep the valley moist enough to provide suitable conditions for many insects' life cycles and reproduction. Therefore, the flycatchers have a stable food source. (3) The flycatchers mainly nest in the cavities or hollows of the stems and stakes. The woodpeckers could be attracted by the tall trees in the valley to make cavities and the moist environment in the valley accelerate the moldering in trees so that hollows were formed on the stake. Consequently, the conditions for the flycatchers' hunting, drinking, inhabitation and nesting are mostly focused on the valley and the underside of the mountain.

The breeding density of Collared Flycatcher and Pied Flycatcher, which are sympatric species in Europe, was higher in broad-leaf forests (dominated by oak *Quercus robur* and ash *Fraxinus excelsior*) than in mixture forests (dominated by pine *Pinus sylvestris* and birch *Betula pubescens*) (Alatalo et al., 1984). In our surveys, the Narcissus Flycatcher and Yellow-rumped Flycatcher also distributed mostly in broad-leaf forests but seldom appeared in the mixture forests and never appeared in the pure coniferous plantation (dominated by *Larix principis-rupprechtii*, *L. kaempferi* and *Pinus tabulaeformis*). In the broad-leaf forest, the vegetation characterized by the Narcissus Flycatcher's home ranges differs from that of the Yellow-rumped Flycatchers': there are more tall trees and dead tree stakes in the Narcissus' home ranges than those in Yellow-rumped Flycatchers'; the *Betula platyphylla* and *B. dahurica* are dominant in the Narcissus' home ranges whereas the *Juglans mandshurica* and *Fraxinus rhynchophylla* are dominant in the Yellow-rumped Flycatchers'. The birch grows faster, lives shorter and has

softer timber than the *Juglans mandshurica* and *Fraxinus Rhynchophylla* (Zheng, 1985, 2004). For these reasons, the Narcissus Flycatcher chose habitats wherein more stakes and hollows appeared, which may have induced the nest-site separation of the two flycatchers.

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