

Passage of Brown-chested Jungle Flycatcher *Rhinomyias brunneatus* through Singapore, with notes on wintering status in South-East Asia

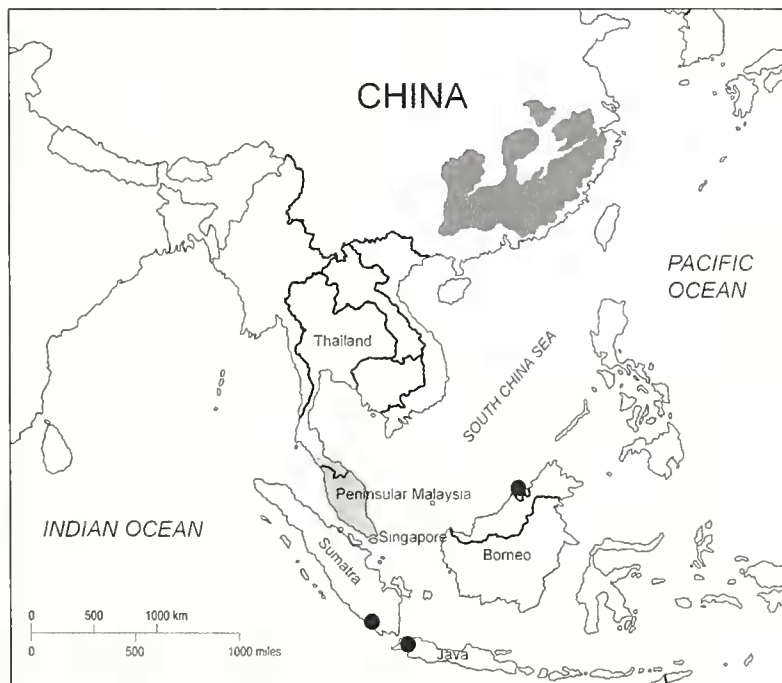
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The winter distribution and ecology of migratory East Asian passerines remains poorly studied, despite increasing habitat loss across their breeding, stopover and wintering areas. The Vulnerable Brown-chested Jungle Flycatcher *Rhinomyias brunneatus* breeds in south-central China and is a long-distance migrant to South-East Asia where the wintering range is poorly known. Using data from line transects, we estimated passage densities of 52–102 individuals/km² in Singapore in mid-October 2012, when passage appears to peak. Assuming the lower bound estimate, some 5% of the estimated global population may transit Singapore during the stopover period, highlighting the relative importance of Singapore's remaining forests for the species. Nearly all winter records were from forest habitats while stopover records occurred in a wider range of habitat types. We also identified new records of the species from Sumatra and predict that the core wintering range may lie in the lowland forests of Sumatra. Midwinter surveys in Sumatra to identify key wintering sites, and long-term sampling in China sites in the breeding season to monitor population stability, are recommended. The uncertainty about the status of the Brown-chested Jungle Flycatcher in the wintering range is symptomatic of the limited knowledge of many long-distance, migratory passerines in the eastern Palearctic and may hinder their effective conservation.

INTRODUCTION

Rapid deforestation and land-use change in Sundaic South-East Asia puts many resident and endemic birds at serious risk of extinction (Sodhi *et al.* 2010). However, little attention has been paid to eastern Palearctic passerines wintering in South-East Asia, despite the fact that many are forest-dependent and recognised as globally threatened. The rapid loss of habitat in the wintering areas could thus pose a conservation threat for such species, even if temperate forests in the breeding ranges remain relatively intact. Furthermore, climate change impacts on western Palearctic species (Both *et al.* 2010), increasing loss and degradation of temperate forests (Kurosawa & Askins 2003) especially in the Taiga (Bradshaw *et al.* 2009), and continuing habitat loss in non-breeding areas (Kirby *et al.* 2008) combine to suggest that it is timely to re-evaluate the conservation status of these migratory passerines.

Figure 1. Map of East and South-East Asia showing the breeding range in south-central China (dark grey), and currently known wintering range in the Thai-Malay peninsula (medium grey). Black dots represent locations of recent records in Sumatra, Borneo and Java.



An estimated four billion migratory birds (Newton 2007), the majority passerines, migrate annually from Eurasia to tropical Africa and Asia during the boreal winter. Western Palearctic species have generally been better studied than their eastern Palearctic counterparts, and East Asian passerines are understudied compared to the more charismatic waterbirds and raptors (Yong *et al.* 2015). Studies of breeding passerine migrants in Japan (e.g. Higuchi & Morishita 1998, Kurosawa & Askins 2003) have underscored a critical lack of knowledge of how habitat loss and degradation in South-East Asia impacts migratory passerines. Based on an analysis of ecological traits in declining breeding birds in Japan, Amano & Yamaura (2007) identified long-distance migration as one of a number of significant ecological attributes linked to species with contracting breeding ranges.

The Vulnerable Brown-chested Jungle Flycatcher *Rhinomyias brunneatus* (BirdLife International 2014) is one of the least-known migratory passerines in East Asia. It breeds in the mountains of south-east and central China (Figure 1), in a number of widely fragmented populations, with recent spring–summer records from 21 sites across nine provinces based on records in the China Bird Report database (www.birdtalker.net/report/index.asp) (Table 1). Given degradation and loss of habitat across its range, particularly the wintering range, the species is believed to be in decline, with an estimated global population of 2,500 to 9,999 mature individuals (BirdLife International 2014). The species overwinters in South-East Asia and has been recorded on passage in mainland South-East Asia (Mahood *et al.* 2013), the Thai-Malay peninsula and on islets in the Straits of Malacca (Wells 2007). In Peninsular Malaysia, up to 640 individuals were mist-netted at Fraser's Hill on autumn passage between 1965 and 1973 (BirdLife International 2001). Although a number of published sources (Wells 2007, BirdLife International 2014) describe the Malay peninsula as the core wintering range (Figure 1), the paucity of midwinter records suggest that the bulk of the population may winter elsewhere in Sundaic South-East Asia.

The objectives of our study of the Brown-chested Jungle Flycatcher were to (1) estimate the peak passage period and staging densities in Singapore in order to evaluate the conservation importance of Singapore's forest habitats for the species, (2) estimate the relative importance of different habitats to wintering and stopover birds, (3) clarify the wintering status in Sundaic South-East Asia by reviewing recent and historical records in the Thai-

Table 1. List of mostly protected sites in China with recent (2005–2012) spring–summer records. NR = nature reserve; FP = forest park.

Province	Site name	Geographical coordinates
Anhui	Jiulongpu, Huangshan FP	30.094°N 118.214°E
	Qiyushan, Xiuning	29.817°N 118.042°E
Guangdong	Nanling NR	25.575°N 112.265°E
	Shimen NR	23.626°N 113.764°E
Guangxi	Mulun NR	25.103°N 107.891°E
	Dayaoshan NR	25.127°N 113.192°E
Henan	Dongzhai NR	31.948°N 114.254°E
Hubei	Yuquansi FP	30.789°N 111.686°E
Hunan	Hupingshan NR	30.004°N 110.680°E
	Mangshan NR	24.580°N 112.490°E
Jiangsu	Laoshan FP	32.100°N 118.667°E
	Zijianshan FP	32.074°N 118.853°E
Jiangxi	Tongboshan NR	28.667°N 118.250°E
	Jinggangshan NR	26.283°N 114.040°E
Zhejiang	Daqinggu	30.195°N 120.068°E
	Gutianshan NR	29.172°N 118.064°E
	Linglongshan	30.218°N 119.685°E
	Longyangshan NR	27.682°N 119.065°E
	Longwangshan NR	30.409°N 119.450°E
	Wuchaoshan FP	30.199°N 120.012°E
Xitianmushan NR	30.325°N 119.447°E	

Malay peninsula and the Greater Sunda Islands and (4) highlight conservation priorities for this and other East Asian migrant passerines in their South-East Asian wintering grounds.

METHODS

Review of records

We searched for dated records of Brown-chested Jungle Flycatcher published in three major local birdwatching publications, Bird Conservation Society of Thailand Bulletin (Thailand), Suara Enggang (Malaysia), Singapore Avifauna (Singapore), as well as an online database (www.worldbirds.org/Malaysia) and birdwatchers' trip reports on the online trip report database (www.travellingbird.com). Although the species is not listed on the Indonesian bird checklist (see Burung Nusantara 2012), we searched for records of the species in trip reports for Sumatra and Indonesian Borneo where the species may possibly occur, geographically relevant papers published in three regional zoological journals: *Kukila*, *Forktail* and *Raffles Bulletin of Zoology*, as well as data presented in BirdLife International (2001) to locate records which may be overlooked in older ornithological literature. Records are considered as 'passage' if they were dated from 1 September to 30 November, and 'wintering' if they were dated from 1 December to the end of March, and subsequently classified by habitat type inferred from any site details provided. The three habitat types are 'non-forest habitats' (including secondary woodland and parkland), 'forest habitats' (including both undisturbed and mature secondary forests) and 'mangroves'.

Field surveys

We carried out bird surveys in Singapore (1.42°N 103.50°E) at stopover sites where the Brown-chested Jungle Flycatcher is known to occur (Lim 2009) during the migration passage period (late September–early November) and repeated these surveys during the wintering period from December to March. Searches for the species were carried out from 15 October to 10 November 2011 at the Central Catchment (c.935 ha) and Bukit Timah Nature Reserves (164 ha), Bidadari woodland (15 ha) and Bukit Batok Nature Park (30 ha). Transect sampling was carried out from 7 October

to 9 November 2012 in two major forest blocks in the Central Catchment Nature Reserve, Bukit Timah Nature Reserve and two small woodland patches where the species is known to occur—St John's Island (27 ha) and Bidadari woodland (15 ha). The selected transects were slowly walked once (c.1 km/hour) by DLY between 07h00 and 11h00 on days when the weather was good. Only trails with closed-forest cover were selected as transects, given the species's preference for dense understorey vegetation (DLY pers obs), and covered a total of 12.58 km. All sites were resurveyed between December and March in 2011–2012 and 2012–2013 along the same transects to locate wintering birds. Supplementary sampling was carried out in Panti Forest Reserve in Johor, Peninsular Malaysia, a large forested site (c.10,000 ha), from December to March to survey for wintering individuals in both seasons.

Data analysis

All contacts along transects were recorded as 'individuals' rather than 'clusters' as birds were always encountered singly, and were not stratified. As detections were relatively near transects (<12 m), we did not truncate datapoints for analysis. Density estimates and encounter rates for the species were calculated based on the optimum of four detection function candidate models using the Distance Sampling 6.0 software (Thomas *et al.* 2010). Candidate models were ranked by Akaike's Information Criterion corrected for small sample size (AICc), and the best detection function was selected based on the lowest-ranked model. Estimates of detection probability and density were bootstrapped with 999 resamples given the small sample of observations, and computed with 95% confidence bounds.

To estimate the relative importance of habitat type to wintering and passage birds, we classified all geo-referenced records of Brown-chested Jungle Flycatcher from Singapore, Thailand and Peninsular Malaysia into habitat type. We then used the Fisher's exact test to test for significant differences in proportions between wintering and passage records in the three habitat types. Lastly, we pooled dated records from our surveys with those reported by birdwatchers for one site, Bidadari woodland in Singapore, known to be important for the species during the stopover period, and which is extensively visited by birdwatchers. The maximum number of individuals reported per week on any single day was plotted from the last two weeks of September to the first three weeks of November for 2011 and 2012. This allowed us to estimate the peak passage period for the species through Singapore, although we acknowledge that year-to-year variations may exist due to fluctuations in population patterns of the species.

RESULTS AND DISCUSSION

Based on the best-ranked detection function (Table 2), density estimates of Brown-chested Jungle Flycatcher in Singapore's forests is 51.64–101.67 individuals/km², with estimated encounter rates of 1.239 individuals/km of transect during peak migration in mid-October (Figure 2a). Encounter rates were highest at Bidadari woodland (9.03 individuals/km) (Table 3), where maximum daily counts involved as many as six individuals. Assuming the lower bound estimate, more than 500 individuals may be present in Singapore's forest over the peak passage period, or some 5% of the estimated global population (BirdLife International 2014). Thus a significant proportion of the world population is likely to pass through Singapore annually on southbound migration, although it is unclear whether these birds originate from one or several of the breeding subpopulations in the mountains of China. Our observation-based dataset does not allow us to infer turnover rates for the species passing through Singapore or the mean stopover period. To obtain such insights, capture-recapture methods using mist-netting surveys and ringing are required.

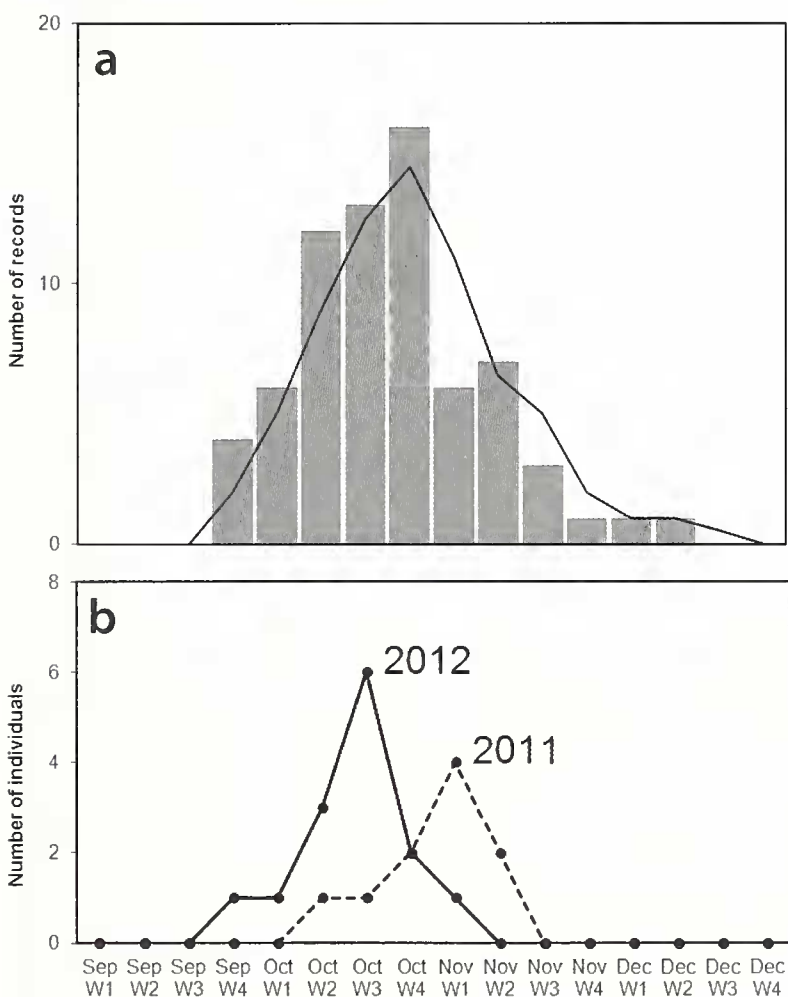
Table 2. Summary statistics for four detection function models fitted, ranked from lowest to highest Akaike's Information Criterion corrected for small sample size (AICc).

Detection function model	AICc	Detection probability f(0)	Density estimate (n/km ²)	% Coefficient variation	Degrees of freedom	95% Confidence interval (CI)
Uniform	69.5773	0.098	60.56	24.72	13.00	35.78–102.50 51.64–101.67
Half normal	71.4228	0.106	65.50	23.65	22.98	39.09–109.75 51.65–99.45
Negative exponent	71.6587	0.109	67.65	24.90	16.43	40.27–113.65 51.68–111.58
Hazard rate	74.0971	0.111	68.53	26.10	14.83	39.62–118.51 51.64–103.75

CI 1 uses bootstrap standard error and log-normal 95% intervals.

CI 2 is the 2.5% and 97.5% quantiles of bootstrap estimates.

Figure 2. (a) Records in Singapore from September to December based on *all* compiled records. (b) Maximum weekly count at one regular site (Bidadari woodland) continuously surveyed during September–December in 2011 and 2012 respectively.



In spite of the limited sample size within the passage period over one season of sampling in 2012, our data provide preliminary evidence that Singapore's remnant forests form a relatively important stopover and staging site for the Brown-chested Jungle Flycatcher on migration. This is possibly due to Singapore's proximity to Sumatra and major satellite islands (e.g. Belitung, Bintan, Lingga), all putative wintering areas with extensive suitable habitat. Also, there is increasing evidence (e.g. Gagnon *et al.* 2011) that nocturnal passerine migration does not necessarily occur along a broad front, particularly where geographical barriers, in this case the greater width of the Malacca Straits further north, are present. Based on collated records over 20 years in Singapore and regular weekly sampling at one key site over two years (Bidadari woodland) (Figure 2a, 2b), it may be inferred that the species's passage through

Table 3. Summary of sites surveyed using transects, and encounter rates at each site.

Site	Area (ha)	Habitat type	Total transect length (km)	Encounter rates (no./km)
Central Catchment Nature Reserve 935		Primary and tall secondary forest	10.554	0.95
Bukit Timah Nature Reserve	164	Primary and tall secondary forest	1.186	No detections
St John's Island	26	Young secondary forest	0.509	1.96
Bidadari woodland	15	Young secondary forest	0.332	9.03

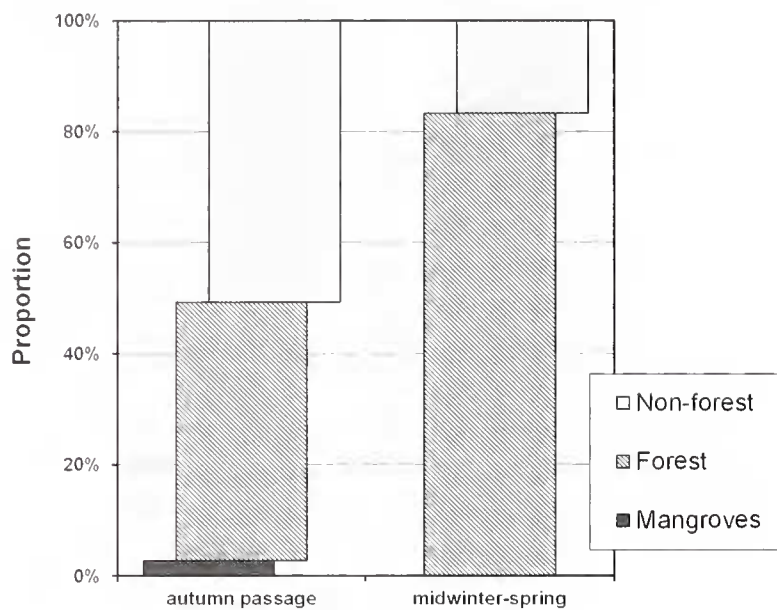
Singapore island peaks between mid-October and early November. However, our limited dataset could conceal ecologically significant year-to-year fluctuations in timing of arrival.

The species is one of the least known east Asian migrants wintering in South-East Asia. Most midwinter records are from Peninsular Malaysia and Peninsular Thailand where there are a few recent records (e.g. Hala Bala Wildlife Sanctuary). The majority of observations (86%, $n = 18$) reported in the Malaysian birdwatching literature from 1997–2012 are from September to mid-November, suggesting that the species also occurs here largely as a passage migrant. Wintering records have been reported from the Ulu Muda (Choy W.M. *in litt.*), Pasoh (Wells 2007) and Panti Forest Reserves (current study), all protected areas of undisturbed and logged lowland forests, indicating that the species depends on 'good quality' forest habitats in winter.

Given current knowledge of its movements and the distribution of records, the main wintering area is likely to be further south in western Indonesia. Not much is known about the status of wintering passerines in Indonesia, and this is compounded by limited birdwatching effort and lack of migrant-specific surveys in the winter months. Brown-chested Jungle Flycatcher has been recorded once in Java—one record from Gn Halimun National Park (Noske *et al.* 2011), and once in Borneo—a record from Bandar Sri Bengawan, Brunei (Smythies & Davison 1999). However, Sumatra seems a good candidate to be the core wintering area given its proximity to the Thai-Malay peninsula, from where the bulk of passage records are known. Moreover, the species has been recorded on autumn and spring passage from small islets in the Straits of Malacca and Straits of Singapore, indicating that birds move to and from Sumatra. Although the species is not included in van Marle & Voous (1988), Parrott & Andrew (1996) reviewed 'provisional' records in Way Kambas National Park, Sumatra, and there is now at least one confirmed wintering record from the Bukit Barisan Selatan National Park, south Sumatra (Z. bin Bakhtiar *in litt.*) in March 2012 based on photographs reviewed by the authors. In addition, a number of Grey-chested Jungle Flycatchers mist-netted at the Harapan Rainforest in 2013 are now found to have been misidentified Brown-chested Jungle Flycatchers (Hua F. *in litt.*).

Given the small size of the estimated global population of 2,500–9,999 individuals (BirdLife International 2014), wintering birds are likely to be thinly distributed across Peninsular Malaysia and Sumatra. Nearly all our midwinter records are from lowland forests (Figure 3), significantly different habitat to that used by birds on passage, confirming that lowland rain- and swamp-forests are important wintering habitats (D.R. Wells *in litt.* 1994 in BirdLife International 2001). Rapid and extensive loss of lowland forests across Sundaic South-East Asia, particularly Sumatra (Sodhi *et al.* 2010), has therefore (probably) greatly reduced wintering habitat. In contrast, in south-central and east China, where the species breeds, reform of forestry policy has apparently reduced deforestation rates (Deng *et al.* 2011). Habitat loss in the non-breeding range is clearly a major threat. Targeted surveys for Brown-chested Jungle Flycatchers should therefore be conducted in the remaining lowland forests in Sumatra to clarify distribution, habitat preference and

Figure 3. Relative proportions of habitat use based on records at passage ($n = 31$) and wintering sites ($n = 12$) (Fisher's exact $p = 0.0193$). 'Non-forest' includes plantations, parkland, scrub and urban areas; 'forest' includes dryland and swamp forests at all elevations.



densities during winter. Similarly, regular population monitoring is required in the breeding range (e.g. Dongzhai Nature Reserve, Henan province, and Dayaoshan National Nature Reserve, Guangxi province) to elucidate population trends.

The wintering ranges of many other forest-dependent East Asian migrant passerines remain poorly known (Yong *et al.* 2015). This is compounded by cost and logistical limitations of modern tracking technology in monitoring migration, relatively limited mist-netting work in South-East Asia at migration hotspots, and very little migrant-specific survey effort across the region in general. For example, virtually no information is available for a number of globally threatened species, such as Ijima's Leaf Warbler *Phylloscopus ijimae*, Rufous-headed Robin *Luscinia ruficeps* and Blackthroat *L. obscura* in their putative South-East Asian wintering ranges (BirdLife International 2001). Given that habitat in stopover and wintering sites is now rapidly being lost (Kirby *et al.* 2008), there is an urgent conservation need to survey and monitor population trends outside the breeding ranges of East Asian forest-dependent migrant passerines to evaluate cumulative impacts of habitat loss in wintering and passage sites on their breeding populations, even for presumed abundant species such as Siberian Blue Robin *L. cyane* and Eastern Crowned Warbler *P. coronatus*.

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