

Short Communication

Significance of the globally threatened Straw-headed Bulbul *Pycnonotus zeylanicus* populations in Singapore: a last straw for the species?

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Summary

The globally threatened Straw-headed Bulbul *Pycnonotus zeylanicus* is one of South-East Asia's most imperilled songbirds due to the surging demand for the species in the regional bird trade. Recently uplisted from Vulnerable to Endangered, populations of the Straw-headed Bulbul have been extirpated from Java, Thailand and possibly Sumatra while those in Borneo and Peninsular Malaysia are in decline. Intriguingly, a significant yet rarely documented population of this species persists in Singapore. A major stronghold in Singapore is Ubin Island where a population is known since the 1920s. Using a long-term citizen science dataset rarely available for South-East Asian bird species, we determined the status and population trends of the Straw-headed Bulbul in Singapore over a 10–15 year period using Poisson regression models and standardised population indices. We found that the Straw-headed Bulbul population has increased at a rate of $3.69 \pm 1.21\%$ per annum on Ubin Island, while the population on Singapore Island remained stable (0.56% per annum) from 2000 to 2016. The population trends in Singapore contrast starkly with the declines reported elsewhere in South-East Asia. We estimated the population in Singapore to be a minimum of 202 individuals, distributed over multiple forest patches. The largest subpopulation of about 110 adult individuals persists on Ubin and which alone forms between 6.5–18.3% of the estimated global population in 2016. Given this unique situation, we recommend a number of conservation measures for the Straw-headed Bulbul to better protect the species, including: (1) an expansion of the protected area network in Singapore to include Ubin as a reserve, (2) the development of an endangered species management plan and, (3) the establishment of ex-situ conservation programmes in zoological institutions and wildlife centres in the region.

Introduction

Wild populations of many bird species are either in decline or have collapsed across South-East Asia as a result of unsustainable harvesting for the pet-bird trade, especially in Indonesia (Shepherd 2006, Eaton *et al.* 2015). Based on field surveys and interviews with bird trappers, there is a growing body of evidence to show that overharvest has decimated the wild populations of a number of species (e.g. Shepherd 2007, 2010, Harris *et al.* 2016), including species not currently red listed (Harris *et al.* 2015). In extreme cases this is best exemplified by the 'Critically Endangered'

Bali Starling *Leucopsar rothschildi*, which is nearly extinct and the only wild populations originate from reintroduced stock (van Balen *et al.* 2000, Brook and Sodhi 2006). In another example, the Rufous-fronted Laughingthrush *Garrulax rufifrons* has declined so rapidly that it is now extirpated from the majority of sites where it once occurred (Eaton *et al.* 2015). To a large extent, the booming market demand for both wild-caught and captive-bred birds is driven by the practice of keeping pet birds deeply entrenched in Indonesian tradition (Jepson and Ladle 2005, Jepson *et al.* 2011, Chng *et al.* 2015), coupled with a weak culture of nature conservation in the population (Jepson *et al.* 2011). While many conservationists recognise the need to regulate the bird trade more tightly and boost enforcement at cross-border checkpoints, this has proved challenging (e.g. Lee *et al.* 2005, Cooney and Jepson 2006) and the smuggling of high-value species remains rampant.

One of the most sought-after species in the South-East Asian bird trade is the Straw-headed Bulbul *Pycnonotus zeylanicus* (Nash 1993, Shepherd *et al.* 2013, Eaton *et al.* 2015, Chng *et al.* 2016), a globally threatened species recently uplisted to 'Endangered' on the IUCN Red List (BirdLife International 2016a, 2016b). As a result of the high demand in Indonesia, the market price of this species has swollen to more than 550 USD (c.7,500,000 IRP) per individual (J. B. C. Harris *in litt.* 2016, also Chng *et al.* 2015). Coveted for its rich song, the Straw-headed Bulbul has been extirpated from most of its distribution. Populations in Java and Peninsular Thailand have long been extirpated (Nash 1993, van Balen 1999, BirdLife International 2016a). The population in Sumatra is possibly extinct (Harris *et al.* 2015, BirdLife International 2016b) while those in Borneo and Peninsular Malaysia are on the brink of collapse (Wells 2006, Eaton *et al.* 2015). It is increasingly rare even in some of the best protected areas in South-East Asia such as the Taman Negara (BirdLife International 2016a) and Gunung Mulu national parks (Burner *et al.* 2016). In contrast with the situation elsewhere in South-East Asia, the Straw-headed Bulbul population in Singapore is not only relatively secure as a result of comparatively low trapping pressures (Lim 2009, Yong *et al.* 2013, Chng *et al.* 2016), but has also showed trends suggesting an increase (Lim and Yong 2011). Against this wider backdrop of catastrophic decline, it appears that the population of the Straw-headed Bulbul in Singapore may offer an important safeguard for the long-term survival of this endangered species.

In Singapore, the Straw-headed Bulbul is a frequently encountered species during citizen-science surveys and is familiar to most local naturalists (e.g. Tan 2001, Lim and Yong 2011). A species that is not dependent on undisturbed rainforests, it occurs mostly in patches of secondary forest and woodland across the country (Wells 2006, Lim 2009), some of which fall within areas with no formal protection (e.g. undeveloped land). In spite of this, there is little published information on its status and population trends in Singapore. The importance of these populations has therefore been overlooked in regional-level conservation assessments. In this study, we: (1) reviewed the status of the Straw-headed Bulbul across Singapore by synthesising historical and current information from varied sources, (2) estimated the population trends of the species based on our long-term data and, (3) estimated the present population of the species in Singapore (Singapore and Ubin islands). We then put forth a number of recommendations that can better conserve the Straw-headed Bulbul. We argue that securing the populations of the species in Singapore will be critical to the long-term conservation of the species (see Chng *et al.* 2016). This is because most populations of the species outside Singapore remain vulnerable to poaching in the light of weak enforcement, even in protected areas, and are likely to be extirpated.

Methods

Study site

Approximately 137 km from the equator, the Republic of Singapore (103°8'E, 1°29'N) comprises the main island of Singapore (hereafter as Singapore Island) and more than 60 smaller satellite islands at the southern tip of the Thai-Malay Peninsula (Figure 1). Although Singapore Island is

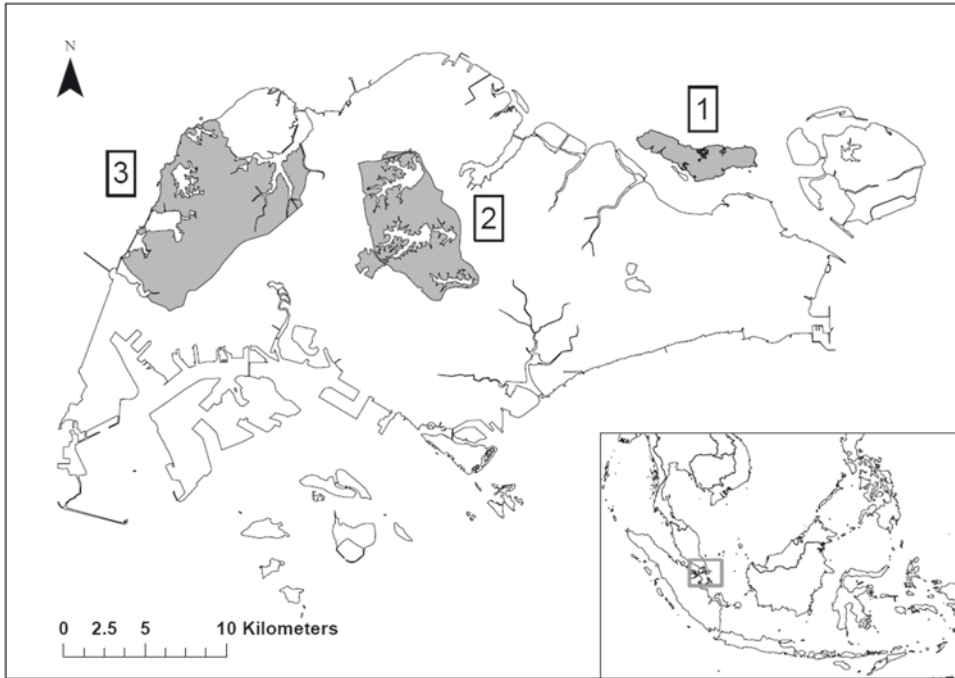


Figure 1. Key sites for Straw-headed Bulbul in Singapore mentioned in text, (1) Ubin Island, (2) Central Catchment and Bukit Timah nature reserves and, (3) Western Catchment area. We have omitted location details of specific sites to keep locality information inaccessible to poachers. **Inset.** Location of Singapore in South-East Asia.

relatively urbanised, there remain large tracts of secondary forest and abandoned plantations (e.g. Lim 2009, Yee *et al.* 2011), especially on its western frontier, an area reserved for water catchment and military training activities. The centre of Singapore Island contains four major freshwater impoundments surrounded by remnant patches of primary lowland dipterocarp and freshwater swamp forest in a wider mosaic of secondary forests. Most of this vegetation is protected within the Central Catchment and Bukit Timah nature reserves, which collectively form the largest gazetted areas for conservation in Singapore. Of Singapore's satellite islands, the largest are Ubin (10.2 km²) and Tekong Besar (24.4 km²). Both islands are little developed and mostly covered with secondary forest, old rubber plantations, abandoned fruit orchards and mangroves (Ho 2001, Lim 2009).

Review of historical records and existing studies

To determine the historical status of the Straw-headed Bulbul population in Singapore, we searched the literature for major ornithological compilations of Singapore's birdlife (i.e. Bucknill and Chasen 1927, Gibson-Hill 1949, 1952, Lim 1992, 2009). Since population estimates are not available in older publications, we used the authors' approximation of the species relative abundance as a proxy for its abundance at localities discussed in our review. In addition, we reviewed unpublished information in two major dissertations on the status and population of the species in Singapore and Ubin islands (Ho 2001, Tan 2001). These two dissertations also provide statistically robust estimates of the species population at the turn of the millennium, which were then applied in our analysis.

Data collection

Count data in our study was compiled from two major citizen science initiatives coordinated by two of the co-authors (LKS, LKC) annually, namely the Annual Bird Census (ABC) and the Mid-year Bird Census (MBC). We used data from both bird censuses. While the ABC has been carried out for 30 years (since 1986) and is the longest running citizen science project of its type in South-East Asia, the MBC has a shorter history (15 years, since 2000). Excluding the first five years due to data variability, both censuses provide at least 10 years of data for our analysis. These censuses involve the participation of more than 30 surveyors simultaneously counting birds at more than 20 sites across Singapore on a single day (see acknowledgements), including the stronghold island of Ubin (Ho 2001, Lim 2009, Yong *et al.* 2013) where the Straw-headed Bulbul has been found to be one of the commonest species in recent surveys (Lim 2016). In each census, one or more surveyor recorded species that were visually and aurally encountered along established transect routes through each designated survey site. Surveys were only carried out on days of good weather (e.g. no rains, storms), and between 07h00 and 10h30.

Statistical analysis

Using time-series count data from 2001 to 2015, we computed mean population indices based on pooled count data for one key site for the species, (1) Ubin Island (see Lim 1992, 2006) and (2) sites across Singapore Island. Sites with more than five years of missing data were excluded from the analysis. Population indices were scaled to 1.0 for the starting year of analysis for each time-series. To model the population trends for our data, we used log-linear regression models with a Poisson-error distribution. We fitted time-series, linear models to our dataset, and controlled for over-dispersion and serial correlation. To detect the influence of effort on count data, we included sampling effort per census as a categorical covariate. We used the number of surveyors as a proxy measure of sampling effort.

To estimate the goodness-of-fit for each model, the chi-square statistic and likelihood ratio for each model, and its associated *P* value were computed. All statistical analysis were carried out using the TRIM (ver. 3.54) software (Pannekoek and van Strien 2001). We then re-plotted modelled population indices and the standard error for each time point using the basic R package (R Core Team 2015).

Results

Historical status of the Straw-headed Bulbul in Singapore

The earliest records of the Straw-headed Bulbul in Singapore are based on specimens deposited at the Raffles Museum of Biodiversity Research (Ho 2001, Tan 2001). This involved two males and a female collected from Ubin Island (collectors unknown) in January 1921 and 1923 (K. K. P. Lim. *in litt.* 2016). Since there were no mention of the species in Singapore Island from older compilations such as Bucknill and Chasen (1927) and Gibson-Hill (1949), Gibson-Hill (1952) reported apparently the first records based on observations in the Bukit Timah and Tanglin area. However, Gibson-Hill (1949, 1952) acknowledged that the species occurred on Ubin Island in 'small numbers'. The first estimates of the population on Ubin was given as 50 individuals based on Lim (1992), while a major population cluster known from northern Singapore Island (Senoko) was estimated at 10 individuals (Lim 1992).

Population trend on a key site – Ubin Island

Using modelled population indices, we found that the Straw-headed Bulbul population showed an increasing trend during the study period. Based on 16 years of ABC count data from 2000 to 2015 (Figure 2), the best fitting model (Likelihood Ratio = 21.08, *df* = 23, *P* = 0.5763) showed a

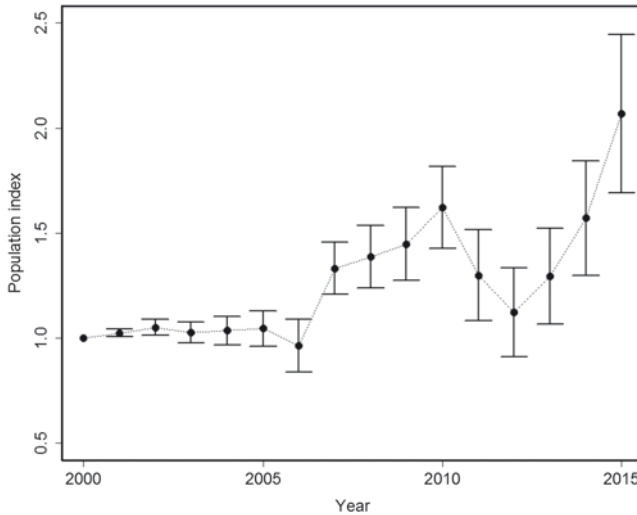


Figure 2. Modelled population indices based on Annual Bird Census count data from Ubin Island from 2000 (base year) to 2015 ($P < 0.01$).

moderate increase of $3.69 \pm 1.21\%$ per annum (Slope = 1.0369, SE = 0.0121, $P < 0.01$). This is consistent with that of the observed data which showed a highly significant increase of $4.10 \pm 1.31\%$ per annum (Slope = 1.041, SE = 0.0131, $P < 0.01$). As a covariate, sampling effort had a statistically significant effect on the regression model (Wald test statistic = 13.61, $df = 3$, $P = 0.0035$).

The population trend based on count data for 11 consecutive years of the MBC was not statistically significant even though it predicted an increasing trend (Figure 3a). The best-fitting model was weak (Likelihood Ratio = 43.73, $df = 18$, $P = 0.0006$), but predicted an increasing trend of $4.37 \pm 3.84\%$ per annum (Slope = 1.0437, SE = 0.0384, $P = 0.24$).

Population trend on Singapore Island

Our analysis showed that the Straw-headed Bulbul population on Singapore Island has remained stable over the study period. None of the models based on the data for sites on Singapore showed a significant increasing trend (Figure 3b and 4). Using 11 years of data from the ABC, the best fitting model was weak (Likelihood Ratio = 164.0, $df = 123$, $P = 0.008$) and showed a minor increase of 0.56% per annum which was not statistically significant (Overall slope = 1.0056, SE = 0.0248, $P = 0.81$). Likewise, the best fitting model using 11 years of data from the MBC (Likelihood Ratio = 153.79, $df = 131$, $P = 0.084$) did not show any clear trend of increase. The estimated increase is 0.03% per annum and is not statistically significant (overall slope = 1.0003, SE = 0.0245, $P = 0.154$).

Population estimates for Ubin and Singapore Island, and its global significance

Using the population estimates reported in 2001 (Tan 2001, Ho 2001), we calculated the present population of the Straw-headed Bulbul using trend estimates derived from modelling the data from the ABC. Ho (2001) conducted standardised counts and pair mapping across Ubin Island and estimated a minimum of 32 pairs (64 mature individuals) in 2001. Applying our estimate of an increase of $3.69 \pm 1.21\%$ per annum since 2000, the present (2016) population of the Straw-headed Bulbul on Ubin Island can be estimated at 92.4–131.2 individuals. Based on the mean

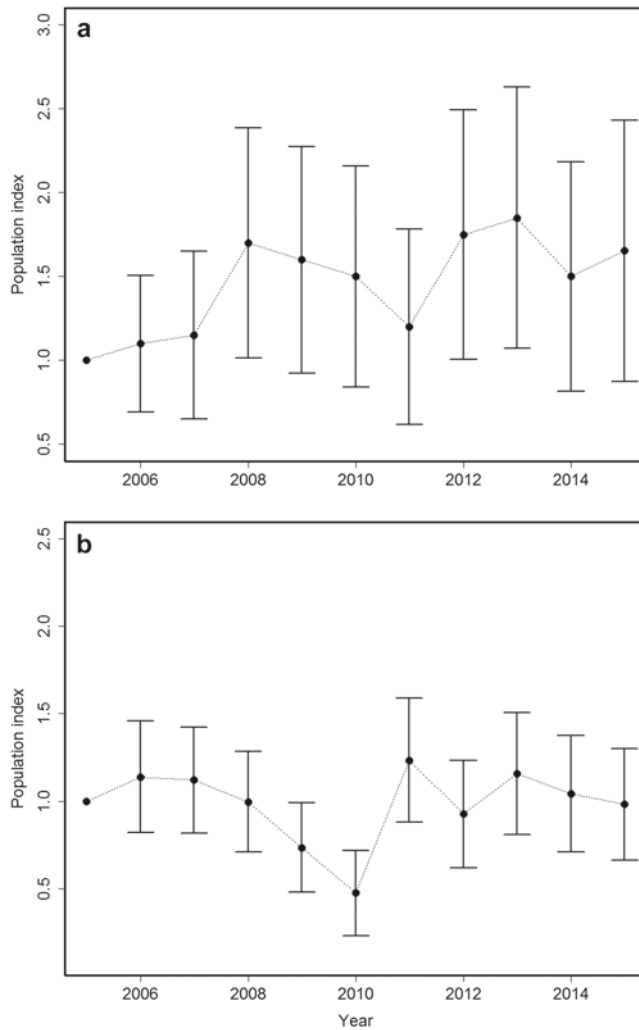


Figure 3. a. Population indices of Straw-headed Bulbul on Ubin Island from 2005 to 2015 based on data from the Mid-year Bird Census, and 3b. Population indices of Straw-headed Bulbul on Singapore Island from 2005 to 2015 based on data from the Mid-year Bird Census.

estimate of 110.2 mature individuals in 2016, Ubin alone would contain 6.5–18.3% of the global population according to BirdLife International's (2016a) latest estimates of 600–1,700 mature individuals.

Based on Tan (2001)'s estimated population of 84.6 ± 8.15 individuals and our estimate of a 0.56% increase per annum, we estimated the population on Singapore Island to be 83.1–100.8 individuals in 2016. Collectively, the population of Straw-headed Bulbuls in Singapore is estimated at a minimum of 202 individuals in 2016 (Table 1). We however consider this estimate to be conservative since Tan (2001) did not survey much of the Western Catchment area due to the restricted accessibility of the site, a significant area (c.3,250 ha) of secondary woodland otherwise known to harbour important populations of Straw-headed Bulbul (H. C. Ho pers. obs.). Applying Tan (2001)'s estimated density of 1.09 individuals/km², this area could harbour another 35 individuals or 17 pairs in 2001.

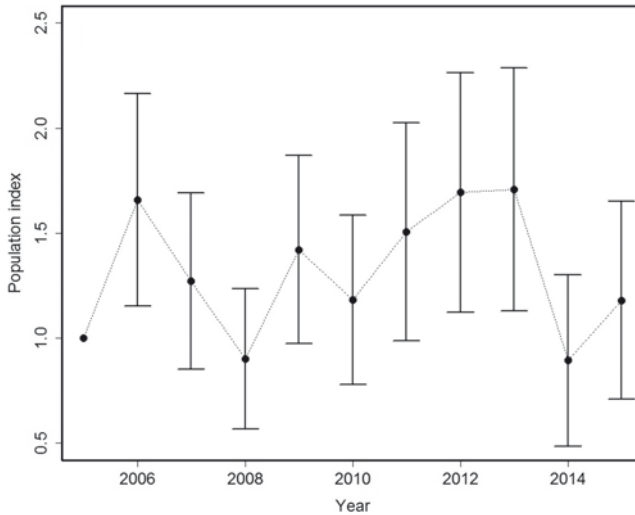


Figure 4. Population indices on Singapore Island (2005–2015) based on Annual Bird Census data.

Discussion

The Straw-headed Bulbul is one of South-East Asia’s most threatened songbirds, having suffered a spectacular decline across its entire distribution (BirdLife International 2016a). Many authors consider the species to be extinct in Java and Thailand (Nash 1993, Shepherd 2006, Eaton *et al.* 2015), while the lack of recent records from Sumatra suggests that it is likely extirpated there (Harris *et al.* 2015). Additionally, while protected areas in Peninsular Malaysia and Borneo still harbour populations, these are clearly in decline (e.g. Wells 2006, Burner *et al.* 2016). Our results indicate that against this backdrop of rapid decline across the region, populations of the Straw-headed Bulbul in Singapore are, conversely, either stable or increasing. Population increases in Singapore are as high as 4.9% per year on Ubin Island, while the population trend on Singapore Island is positive but insignificant. Excluding habitat in sites that were not surveyed due to accessibility issues, the present population in Singapore is estimated to be at least 202 adult individuals. This forms between 11.9 and 33.6% of the global population based on a current estimate of 600–1,700 mature individuals (BirdLife International 2016a).

Limitations of the data

Although our analyses revealed a significant trend for the subpopulation of the Straw-headed Bulbul in Ubin Island, we were unable to detect a statistically significant trend from Singapore Island.

Table 1. Population estimates for the Straw-headed Bulbul in Singapore and Ubin Island based on bird census-derived population trends from 2000 to 2015.

Site	Habitat area (km ²)	Estimated population in 2001	Increase per annum (%)	Estimated population in 2016
Ubin Island	10.19	64 (Ho 2001)	3.69*	110.2
Singapore Island [†]	118.0	84.6 (Tan 2001)	0.56	91.9
All Singapore [†]	128.19	148.6	-	202.1
Western Catchment area	c.30.0	c.32.7	c.0.56	c.35.7
All Singapore	158.19	181.3	-	237.8

[†]Excludes Western Catchment area which was not surveyed in 2001

*Statistically significant ($P < 0.05$)

This is in spite of the fact that recent field surveys have indicated an increasing occupancy of sites on Singapore Island based on detections of the species at remnant woodland sites where it used to be absent (H. C. Ho pers. obs.). We attribute this discrepancy to limited, regular survey effort at sites of known importance to the Straw-headed Bulbul, especially the extensive areas of secondary woodland in the Western Catchment area.

Population origins and connectivity in Singapore

Presently, there is little information to suggest that the population of the Straw-headed Bulbul on Ubin has colonised suitable habitat around the island. The paucity of records in the extensive woodland patches on Singapore Island adjacent to Ubin Island despite regular survey effort suggests that the species may be a poor disperser over open water. For instance, sporadic surveys on Tekong Island have found no recent evidence of the species despite the proximity to Ubin (c.3–4 km of open sea) (Lim 2009) except for a single pre-2000 record (H. C. Ho *in litt.* 2016). Similarly, it has been rarely observed in secondary woodland remnants in Coney Island, Changi and Pasir Ris areas based on our data and in spite of their proximity to Ubin (c.1–2 km of open sea).

Given the lack of records on Singapore Island in Bucknill and Chasen (1927), the origins of the Straw-headed Bubluls first reported by Gibson-Hill (1952) remain unclear. If the species was already popular in the pet trade before the 1950s, then it is possible that some of the individuals reported by Gibson-Hill (1952) have captive origins. However, we hypothesise that areas of agriculture land, mangroves, secondary forests, and freshwater swamp forest (e.g. Kranji forest reserve) in northern and western Singapore Island could have supported wild populations but due to inaccessibility, evaded detection by Gibson-Hill (1949) or Bucknill and Chasen (1927). It is also possible that individuals colonised western Singapore from populations in Johor (Malaysia) since the Strait of Johor is far narrower here, at 0.6 km.

Importance of Singapore's populations in conserving the Straw-headed Bulbul

As a result of the Straw-headed Bulbul's extirpation from much of its Indonesian and Thai distribution, the populations that remain on the Malay Peninsula and Borneo will be critical to its conservation (Eaton *et al.* 2015). However, as the species often occurs in riparian secondary forests, scrub and plantations accessible to trappers and at sites outside of protected areas, such populations could remain vulnerable to trapping. In fact, Wells (2006) noted that populations in Peninsular Malaysia were already in steep decline due to increasing sourcing for wild populations there for the bird trade while populations in Indonesia have been exhausted by trappers (Shepherd *et al.* 2013). In Singapore, the majority of the sites where the bulbul occurs are subject to some level of protection. For example, the population on Ubin Island is reasonably well protected due to its designation as a 'nature area' and there has been limited clearance of vegetation on the island. Ubin is currently being managed by the National Parks Board (National Parks Board 2016), a government body in charge of parks, nature reserves and coordinating conservation activities. A number of the sites occupied by the species on Singapore Island are designated as nature reserves (e.g. Bukit Timah), nature parks (e.g. Bukit Batok) (Yong *et al.* 2013), or fall under land strictly controlled by the military as training areas (e.g. Western Catchment area) (Lim 2009). Coupled with the far smaller area of protected areas to be managed and heavy usage of these parks by residents (e.g. Chng *et al.* 2016), encroachment and trapping pressure in Singapore are likely to be lower than elsewhere in South-East Asia.

Despite these caveats, there remain a number of threats to the species in Singapore. First, habitat loss may have contributed to the disappearance of some subpopulations. Straw-headed Bubluls have occurred in areas of secondary woodland not subjected to any form of protection and which were subsequently cleared. The expansion of residential and industrial areas in Singapore has resulted in the loss of large tracts of secondary forest and abandoned plantations where the species once occurred, especially in the Senoko, Sembawang, and Jurong areas (Lim 1992, 2009).

Secondary threats to the species in Singapore are localised trapping pressure (Shepherd *et al.* 2013, Chng *et al.* 2016) and the occurrence of potentially invasive bird species (e.g. White-crested Laughingthrush *Garrulax leucocephalus*) (see Yong *et al.* 2013) which may compete with the bulbul for feeding resources (Y. Muzika *in litt.* 2016). Finally, the relatively small population in Singapore may be vulnerable to inbreeding depression and diseases.

Conservation recommendations

In recognition of the threats faced, the Straw-headed Bulbul was recently uplisted from 'Vulnerable' to 'Endangered' on the IUCN Red List (BirdLife International 2016a). Such a move could potentially galvanise conservation action and resources targeting the species from government agencies and regional NGOs. Drawing from our findings, we propose a number of additional recommendations that can improve the conservation of the Straw-headed Bulbul in Singapore and across the wider region.

First, we recommend the establishment of an endangered species recovery plan coordinated by stakeholders across the range-states (i.e. Indonesia, Brunei, Malaysia and Singapore). Such a plan should initiate a regional survey of the Straw-headed Bulbul in parts of its distribution where it is poorly known and where suitable habitat remains, especially on Indonesian Borneo, Brunei and southern Myanmar (BirdLife International 2016b). With a fairly good understanding of the species habitat requirements (e.g. Ho 2001, Wells 2006), these surveys should focus on remnant secondary forests, particularly low-lying areas with a close proximity to rivers or lakes. Since many major protected areas in South-East Asia contain large tracts of lowland, hill and montane dipterocarp forests where the species does not occur, there is a need to focus these surveys on low-lying protected areas with significant riparian secondary vegetation (e.g. Danau Sentarum and Mahakam lake systems, Indonesian Borneo). In addition, searches for the species should be conducted in remnant secondary forests identified from GIS imagery, many of which are likely to lie outside of major protected areas. Identified sites should be secured for conservation if viable populations of the species are found.

Second, we recommend the setting up of an ex-situ conservation breeding programme by regional zoological institutions and South-East Asian wildlife rehabilitation centres (e.g. Cikananga Wildlife Centre, west Java) to establish captive populations for future introductions (e.g. Collar *et al.* 2012), and coordinated through an endangered species recovery plan. Similar programmes are now available for other threatened songbirds, most notably the Bali Starling and 'Endangered' Black-winged Starling *Acridotheres melanopterus* (Collar *et al.* 2012, Eaton *et al.* 2015, Cikananga Wildlife Centre 2016). Since Straw-headed Bubbles are also being captive-bred by private owners and aviculture organisations in Java (BirdLife International 2016b), conservationists can tap into the knowledge from existing ex-situ programmes and coordinate with licensed aviculturists to build breeding and holding facilities. This can be coordinated with work to identify secure and suitable sites for future reintroduction.

Third, we recommend more cautious information-sharing of the Straw-headed Bulbul populations and locality information by birdwatchers and conservationists. While there is a need to document sites where the species occurs to monitor fine-scale population trends, conservationists will need to coordinate a more opaque dissemination of online species information to prevent these data from being made available to tech-savvy poachers. Birdwatchers will need to be careful in not disclosing records of Straw-headed Bubbles in birdwatching reports, information which may be harnessed by organised bird trapping and smuggling rings (J. A. Eaton pers comm.). While such measures can be challenging to implement, major birdwatching websites like xeno-canto.org have already taken a bold step to control the downloading of online recordings of species threatened by the pet trade, in recognition of the fact that these can be exploited by poachers.

Lastly, we recommend that the authorities in Singapore increase conservation efforts targeting the species. To better understand the distribution and population status of the Straw-headed Bulbul in Singapore, birdwatchers from local conservation organisations (e.g. Nature Society,

Singapore) and volunteers from the public can be mobilised for citizen science surveys at multiple sites over a few days. This can be complemented with genetic studies to investigate the degree of gene flow between the subpopulations across Singapore (e.g. Tang *et al.* 2016). Findings drawn from both field survey and genetic data can be incorporated into an endangered species management plan coordinated among various stakeholders as a follow-up. In addition, local authorities can work with NGOs and zoological institutions to designate the Straw-headed Bulbul as a flagship species for conservation in Singapore since the species is not only locally common and charismatic, but also easy to identify by amateur naturalists.

Given that many sites where the Straw-headed Bulbul occurs in Singapore already receive some level of protection, an immediate conservation priority is to increase the national network of formally gazetted nature reserves. Ubin Island which contains possibly the single largest subpopulation of the species in the world and which falls under the Ubin-Khatib IBBA (Important Bird and Biodiversity Area SGO02) (BirdLife International 2016c) currently receives some protection as a 'nature area' according to the Singapore Green Plan (The Ministry of Environment, Singapore 1993). However, Ubin Island should be formally recognised for its importance to the species and biodiversity in general. Since nature reserves receive the highest level of protection under Singapore legislation, Ubin Island should be reviewed for gazettelement as a nature reserve in part or in full. Furthermore, we propose that areas of secondary woodland with known populations of Straw-headed Bulbul on Singapore Island be incorporated into existing nature parks and nature reserves. To complement these measures, ranger patrols should be increased across the network of sites where the species occur to deter poaching activities.

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