

Regional and local extirpation of a formerly common Sundaic passerine, the Straw-headed Bulbul *Pycnonotus zeylanicus*

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The Straw-headed Bulbul *Pycnonotus zeylanicus* has experienced marked population declines and extirpations due to unsustainable trade and habitat loss across South-East Asia. As a result, the species has been uplisted from Endangered to Critically Endangered on the IUCN Red List within a short span of two years. To ascertain the extent of its regional extirpation, we conducted a thorough review of the scientific literature, complemented with unpublished data, bird trip reports and expert opinion from 1980–2019. Temporal comparisons of occurrence data across 52 sites revealed a likely survival of the species from the pre-2000 into the post-2000 era at only ~62% of sites. Albeit substantial, this rate of decline is likely an underestimate of actual survival in 2020, given that the trade volume's greatest expansions have been over the last decade, leading to conservative estimates of survival at only ~35–40% of sites when accounting for methodological bias. Our data corroborate recent conclusions that the species is now completely extinct on Sumatra and has significantly decreased across Borneo and Peninsular Malaysia, supporting its recent uplisting. Its last stronghold is the tiny nation of Singapore. We propose a number of conservation recommendations, which include enhanced regulations and enforcement.

INTRODUCTION

Overexploitation and habitat loss are among the main drivers of biodiversity loss, both worldwide (Maxwell *et al.* 2016) and in South-East Asia (Sodhi *et al.* 2004, 2010, Wilcove *et al.* 2013, Symes *et al.* 2018). Within the tropics, South-East Asia is known to have one of the highest volumes of illegal trade in wildlife (Nijman 2010). Birds are among the most heavily traded animals in South-East Asia, with an estimated 66–84 million cagebirds kept in Indonesian Java alone (Marshall *et al.* 2019). The decline of songbirds (order Passeriformes), in particular, has recently been put in the spotlight through the formation of an International Union for Conservation of Nature (IUCN) Specialist Group specifically dedicated to the Asian songbird trade (Eaton *et al.* 2015, Lee *et al.* 2016).

Bird-keeping is ubiquitous throughout South-East Asia, where owners often value a bird's vocal prowess above all (Nijman 2010, Chng *et al.* 2015, Burivalova *et al.* 2017). The practice is ingrained within local culture and tradition, which drives a thriving domestic and international bird market (Jepson & Ladle 2005, Nijman *et al.* 2019). For example, in Indonesia a Javanese proverb says that a successful man is defined by five things—a horse, a house, a wife, a *keris* (ceremonial dagger) and a *kukilo*, a hobby which usually involves keeping pet birds (Nijman *et al.* 2017). Extensive market surveys across the region have established the sheer scale of the problem (Chng *et al.* 2015, Chng & Eaton 2016, Chng *et al.* 2016, Eaton *et al.* 2017) and characterised the ramifications of unregulated trapping on wild bird populations (Shepherd *et al.* 2016, Benítez-López *et al.* 2017, Nijman & Nekaris 2017, Nijman *et al.* 2018). To tackle the issue of songbird overexploitation, the Asian Songbird Crisis Summit was convened for the first time in 2015 with the aim of developing conservation plans to reduce demand on trade-threatened songbirds (Lee *et al.* 2016), including multiple species on the brink of extinction, such as the Critically Endangered Bali Starling *Leucopsar rothschildi*, Javan Green Magpie *Cissa thalassina* and Rufous-fronted Laughingthrush *Garrulax rufifrons*.

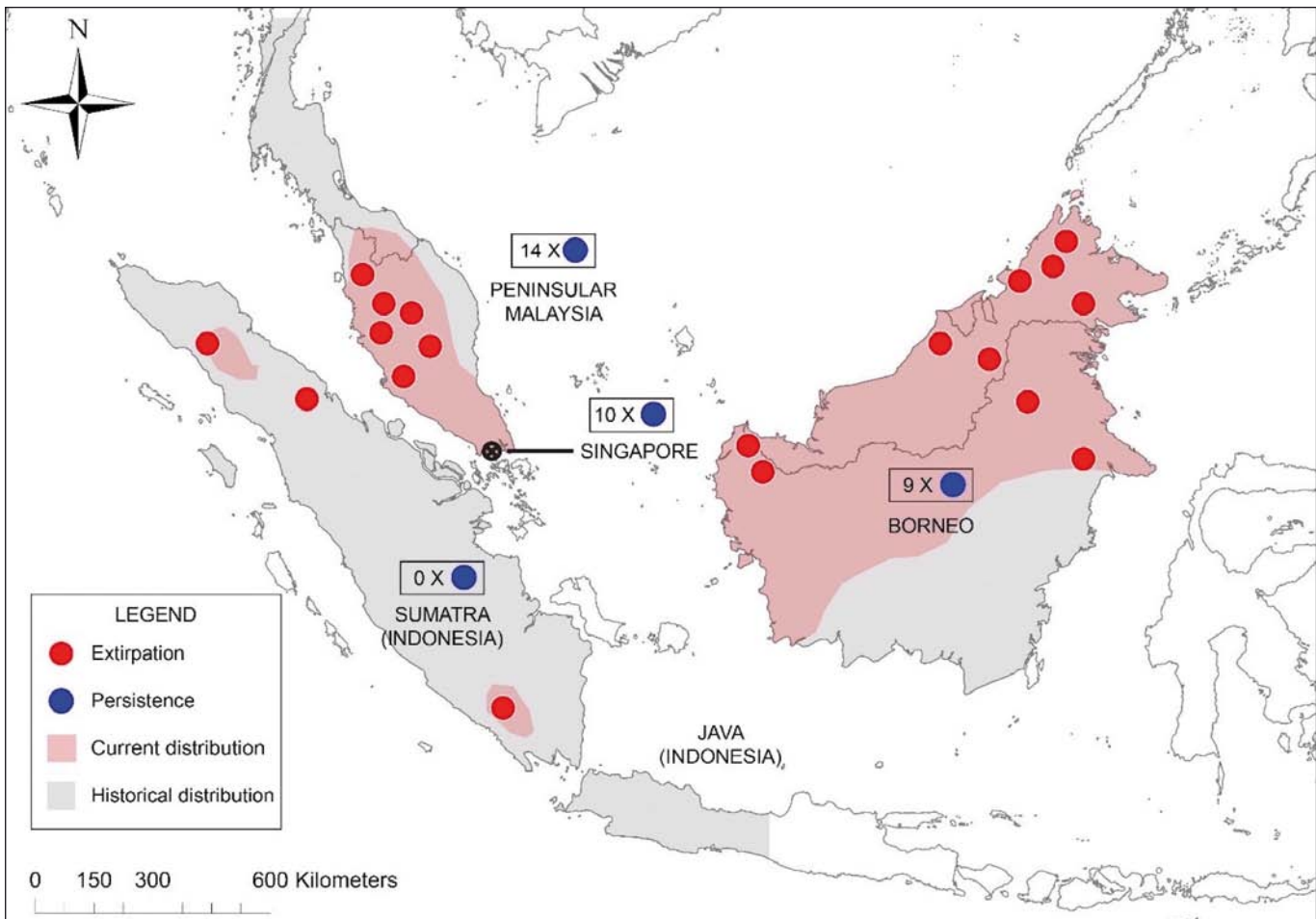
Currently listed as Critically Endangered on the IUCN Red List of Threatened Species (BirdLife International 2018), the Straw-headed Bulbul *Pycnonotus zeylanicus* is perceived to be most threatened by rampant and unchecked trade. Forest loss across its range has also impacted the species, particularly in riparian habitats and lowland forests, where it is usually encountered (Wells 2006, Eaton *et al.* 2015). The species was initially listed as Vulnerable in 1994, when extensive local and regional reductions in population

size across Indonesia were first perceived (Nash 1993). Only recently in 2016 it was uplisted to Endangered, following further declines in its population and increasing scarcity in bird markets (Shepherd *et al.* 2013, Lee *et al.* 2016). Within a short span of two years, the continued observation of steep declines warranted its uplisting to Critically Endangered (Shepherd *et al.* 2013, Bergin *et al.* 2018), with a wild population estimate of 600–1,700 mature individuals (BirdLife International 2018). Despite this rapid uplisting, the species's status within the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) Appendix II has remained unchanged since it was first listed in 1997. Furthermore, despite its fully protected status in certain range countries, the species still faces threats from unregulated trapping and trade (Brickle *et al.* 2010, Fischer *et al.* 2016).

The Straw-headed Bulbul was one of the twelve species identified by the IUCN Asian Songbird Trade Specialist Group as needing immediate conservation action to avoid extinction (Lee *et al.* 2016). Known for its rich and melodious song, it is highly sought after by bird hobbyists. As a result of this high demand, the species is trapped heavily for the cagebird trade (Eaton *et al.* 2015, Bergin *et al.* 2018). Temporal analyses of market data have shown an increase in its monetary value (Bergin *et al.* 2018, Rentschlar *et al.* 2018), likely due to population decline and increased forest accessibility to humans, among other factors (Harris *et al.* 2015, 2017). The rising scarcity and value of the species have made it a status symbol (Chng *et al.* 2016), further exacerbating its demand.

The species has a distribution typical for Sundaic forest birds, with a historical range that previously extended from southernmost Myanmar and Thailand through Peninsular Malaysia to the islands of Borneo, Sumatra and Java (Figure 1, Shepherd *et al.* 2013, Robson 2015, Bergin *et al.* 2018). Although considered a forest species, the Straw-headed Bulbul is largely encountered in freshwater or mangrove habitats, and is widely known as a riverside inhabitant that can also be found in other types of semi-aquatic forest habitat (BirdLife International 2018, Fishpool *et al.* 2018). In areas where trapping is rare, the species occurs in surprisingly degraded scrub and secondary forest, usually with waterbodies nearby (Wells 2006, Robson 2015). Based on unregulated trapping and habitat loss, it is thought to be extirpated from Thailand, Myanmar and Java (van Balen 1999, Shepherd *et al.* 2013, Eaton *et al.* 2015), and thought to have undergone a significant reduction in its distribution and population size elsewhere. Only populations in Singapore seem to be unaffected by the regional extirpation trend (Yong *et al.* 2017).

Figure 1. Map illustrating the current and historical distributions of the Straw-headed Bulbul (BirdLife International 2008, BirdLife International 2018). Blue circles represent areas with persisting records (2000–present), while red circles indicate sites with pre-2000 records but a lack of continuing records. The true geographical locations of blue circles have been concealed and aggregated. Note that the historic distribution of Straw-headed Bulbul used to encompass Java and extended further north along the Thai-Malay Peninsula into Myanmar.



In this study we aim to quantify site-level extirpations of the Straw-headed Bulbul with a review of data from the literature and expert opinion, to assess its current status across its range.

METHODS

Data compilation

To illustrate local site-level extirpations of the Straw-headed Bulbul across its range, we analysed sites that satisfy the following criteria:

- (i) Contained records from 1980–2000
- (ii) Contained more-recent records from data sources between 2000 and the present that allowed for paired comparisons

For the first category of records, we compiled the occurrence data published by BirdLife International (2001) (Appendix 1). BirdLife International (2001) has ordered its occurrence data into four categories, which include: ‘Historical: Pre-1950’, ‘Fairly recent: 1950–1979’, ‘Recent: 1980–2000’ and ‘Undated’. Sites previously identified by BirdLife International are indicated with their unique serial number in brackets (e.g. Batang Ai National Park [115]). Adapting the methodologies used by BirdLife International (2001) and Veleviski *et al.* (2015), Straw-headed Bulbul occurrence was separated into two time periods, pre- and post-2000.

We then added occurrence data compiled by the authors (WXC & AEM), including sites for which records were available despite not being mapped in BirdLife International (2001), such

as Kinabatangan Wildlife Sanctuary (Sheldon *et al.* 2009) and Ulu Muda Forest Reserve (Noramly *et al.* 2001, Sukswan 2008, BirdLife International 2019a) (Appendix 1). We also incorporated eBird data, both published and unpublished expedition reports, as well as unofficial checklists from birdwatching trip reports to further expand the dataset. In addition, semi-structured email interviews were conducted with 16 regional and local experts (Appendix 2), such as researchers and field guides, to gather up-to-date information on Straw-headed Bulbul occurrence. Sites reviewed span a spectrum of different protection levels, from protected areas (national parks and nature reserves) to recreational forests and unprotected sites.

For obvious conservation reasons, Appendix 1 is not included here. However, interested readers/researchers can contact the first author, so long as the requesting party can demonstrate their ornithological credentials and a compelling motivation for why they request access to these data.

Literature review

Literature review was conducted with Google Scholar, using the keywords: (‘avifauna’ OR ‘bird’) AND (‘checklist’ OR ‘inventory’), followed by the corresponding name of the protected area or forest reserve using all possible spellings or name combinations (e.g. Krau/Kerau wildlife reserve avifauna checklist; Ulu Lepar bird inventory). Unofficial checklists, unpublished data and bird trip reports were sourced using search engines (e.g. Google) with the same set of keywords but with the inclusion of ‘bird trip report’. Records that mentioned the possibility of escapees were omitted.

Records were further cross-checked with information provided by experts whenever possible. The literature compiled and analysed herein is listed in the Bibliography, below.

Comparison of pre- and post-2000 data

We reviewed almost two decades of post-2000 occurrence data (2000–2019, up to 15 May) across the available literature and data sources, similar in length to the pre-2000 time period (1980–2000) considered by BirdLife International (2001). Field methodologies varied across the reviewed literature, from point counts (Biun & Buang 2014) to line transects (Muhamad Aidil *et al.* 2016), opportunistic observations and mist-netting (Arif & Mohd-Azlan 2014). As such, we only recorded the presence of Straw-headed Bulbuls across the reviewed literature, defining a presence record as the main occurrence unit.

We subsequently conducted paired temporal comparisons for sites with historical and recent records, allowing us to determine trends regarding local extirpation events. For instance, a comparison of the historical (Smith 1984, Vermeulen 1996) and current (Pieterse & Wielstra 2009, Harris *et al.* 2012) literature pertaining to Poring Hot Springs [63] in Borneo revealed the likely extirpation of the Straw-headed Bulbul. On the other hand, sites with recent records are deemed as areas with persisting records of the species. In instances where sites had recent but no historical records (e.g. Lakim *et al.* 2006, Mojiol *et al.* 2009), we classified them as previously unmapped sites. However, these sites were not included in the analysis as they did not fulfil our criteria.

RESULTS

Based on the aforementioned criteria, we reviewed a total of 52 sites (Appendix 1) across the range of the Straw-headed Bulbul for which both pre-2000 and post-2000 data were available, from an initial list of 94 sites. Out of these, 19 sites were identified in Borneo (including Brunei, Malaysian Sarawak and Sabah, and Indonesian Kalimantan), 20 in Peninsular Malaysia, 10 in Singapore and three in Sumatra, Indonesia (Table 1). Of the 52 sites, 33 (~63%) still had persisting records, with the species likely extirpated in the remaining 19 sites (Table 1). Note, however, that the number of local extirpations is likely underestimated by this method, given that our local coverage of the small nation of Singapore was much more fine-grained, dividing the local Straw-headed Bulbul population there into 10 subpopulations within an area of ~700km², whereas many of these subpopulations would likely have been considered as one across larger political units. Exact locations of recent records are not displayed due to trapping concerns. Instead, occurrence sites are offset and aggregated to mask their true locations (Figure 1). Out of the 16 regional experts we contacted, 10 responded and provided input on the Straw-headed Bulbul (Appendix 2).

Site-level extirpations

The distribution of the Straw-headed Bulbul historically extended across the whole island of Borneo. However, of the 19 Bornean sites reviewed, only nine (47%) had persisting records. Multiple sites characterised by pre-2000 occurrence records—like Gunung Mulu National Park [98] and Gunung Nyiut Nature Reserve [179]—have yielded no recent records despite extensive surveys (Burner *et al.* 2016, AEM pers. obs.). Persisting records of the species were found in protected areas like Ulu Temburong National Park [138] (BirdLife International 2019b).

In Peninsular Malaysia, we found persisting records at 14 of 20 sites (70%). The species remains present in Taman Negara National Park [27], underscoring the importance of large protected areas. All 10 sites reviewed across Singapore were characterised by persisting records (Table 1), corroborating previous assertions that the species is well-protected here (Yong *et al.* 2017).

The species was previously perceived to be extirpated (Eaton *et al.* 2015) in Sumatra, with a lack of records since 2010 (Harris *et al.* 2015). Indeed, data and literature that we reviewed came up short of any recent records in Gunung Leuser National Park [192], Bukit Barisan Selatan National Park [236] and Perdagangan [202], from where pre-2000 records had been registered.

DISCUSSION

Our study provides new evidence for site-level extirpations of the Straw-headed Bulbul across its range (Table 1, Figure 1). These results strengthen the rationale for the recent uplisting of the species to Critically Endangered on the IUCN Red List and underscore the possibility of imminent local extirpation at many additional sites. We first address some of the challenges faced during data compilation, discuss the possible factors behind the decline of the species, and subsequently put forth our recommendations for the conservation of the Straw-headed Bulbul.

Methodological limitations

Presence records of the Straw-headed Bulbul reported here do not necessarily extend to the entirety of a protected area or forest reserve, and are restricted to areas surveyed by the respective authors. For instance, recent presence records of the species from Bukit Batikap Protection Forest [166] are restricted to areas surveyed by Fischer *et al.* (2016) and do not extend to the entirety of the forest. This definition of occurrence units, herein referred to as ‘sites’, enabled us to reliably quantify site-level extirpations of the Straw-headed Bulbul without the necessity for impractical comprehensive multi-year survey efforts over vast areas.

We acknowledge that differing survey effort can be a confounding factor. However, the Straw-headed Bulbul is a charismatic songbird within ornithological circles, making it a popular species that is avidly pursued by naturalists, photographers

Table 1. Summary of occurrence data for the Straw-headed Bulbul. Data are segregated into pre-defined regions (Borneo, Peninsular Malaysia, Singapore and Sumatra). ‘Extirpations’ refers to sites at which the species was present pre-2000 but not found post-2000, whereas ‘persisting records’ refers to sites with both pre- and post-2000 records.

Region	Total sites of occurrence*	Sites with survey data from both pre- and post-2000	Extirpations	Persisting records
Borneo	53	19	10	9
Peninsular Malaysia	28	20	6	14
Singapore	10	10	0	10
Sumatra	3	3	3	0
TOTAL	94	52	19	33

*From 1980–2000, with reference to Bird Life International (2001) and additional data. See Data compilation.

and ornithologists for their viewing pleasure. Although locally shy, it is highly conspicuous—being one of the largest bulbuls in the region—with a distinct and stereotypical call, often given in a chorus, that can be characterised as melodious and warbled (Wells 2006, Robson 2015). The species is known to call throughout the year, being highly territorial and responsive (Ho 2001, Myers & Allen 2009). As such, it is reasonable to assume that the species is extirpated at sites where recent search efforts did not result in positive records.

Underestimating decline

Our data indicate ‘persisting records’ of Straw-headed Bulbuls at 33 out of 52 sites (~63%) for which both pre-2000 and post-2000 data were available. We believe this result to be an underestimate of the true regional decline of the Straw-headed Bulbul. The reasons for this are twofold:

- (1) Our definition of ‘persisting records’ includes any record after (and including) the year 2000. Given the alarming speed with which the South-East Asian songbird trade has expanded just within the last five years, only a selection of our ‘persisting records’ may actually refer to areas where the species continues to survive into 2020 (at the time of writing). In fact, multiple areas labelled by us as having ‘persisting records’ saw their last Straw-headed Bulbul records in the early 2000s and are very unlikely to host surviving populations of this species now, especially in Peninsular Malaysia (e.g. Ipoh [28], Tanjung Rambutan [26], etc., Appendix 1). Conservative estimates would suggest that only around 70–80% of the 33 sites with ‘persisting records’ continue to harbour healthy and reproductively viable populations.
- (2) Because our survey efforts in Singapore have been conducted at a higher spatial resolution, the surviving Straw-headed Bulbul population of this small country was classified into 10 separate sites, which make up almost one third of all the 33 South-East Asian sites with ‘persisting records’. If we adjusted our geographic resolution for Singapore to that of larger nations by re-classifying the Singaporean bulbuls into only one or two separate subpopulations, it would further reduce the total ratio of South-East Asian sites characterised by ‘persisting records’.

Taking these two factors into account, the actual persistence of Straw-headed Bulbul survival across the region may be lower than ~63%, as indicated by our data, and perhaps closer to ~46%. However, low survey efforts, or a lack thereof, may also be a limiting factor.

Region-wide extirpations

Unsustainable levels of trapping have wiped out the Straw-headed Bulbul on Java, a process that may well have been repeated on Sumatra more recently (Eaton *et al.* 2015), as corroborated by our results (Table 1). Following the functional extinction of the species across much of western Indonesia (Java and Sumatra), trappers have begun to shift their focus towards neighbouring areas of Peninsular Malaysia and Borneo (Shepherd *et al.* 2013). In Indonesia, the species is still in high demand, with sales prices having risen to as high as USD 902 per individual in Sumatra (Chng *et al.* 2018).

On Borneo, only populations at higher elevations sub-optimal for the species may have survived, where accessibility is reduced and where human encroachment levels are less pronounced (Harris *et al.* 2012, Rentschlar *et al.* 2018, C. Lee *in litt.* 2019). Local villagers in those areas have been noted to show great interest in the species—presumably due to the high prices it can fetch—and seem very keen to know more details of its occurrence (Fischer *et al.* 2016). Trapped individuals have also been recorded for sale in East Kalimantan (Brickle *et al.* 2010).

In Peninsular Malaysia, persisting records are mostly restricted to protected areas like Krau Wildlife Reserve [37] and Taman Negara National Park [27], where regular patrols are conducted by park rangers and trapping of wild animals is a punishable offence (Shepherd *et al.* 2013). Because of its stable population, Singapore is deemed the last haven for the species (Eaton *et al.* 2015), likely due to relatively lower levels of illegal trapping as a result of strict enforcement and regulations compared to adjacent countries (Chng *et al.* 2016, Yong *et al.* 2017).

CONSERVATION RECOMMENDATIONS

The Straw-headed Bulbul, along with other trade-threatened songbirds, faces the threat of extinction in the wild if conservation measures are not enacted expeditiously. We therefore propose the following recommendations:

Enhancement of national regulations and enforcement implementation

Enhanced trade regulations and improved law enforcement across the range of the Straw-headed Bulbul are urgently required. The legal status and protection of the species have been discussed in detail for Malaysia (Shepherd *et al.* 2013), Singapore (Chng *et al.* 2016) and, more recently, Indonesia (Leupen & Shepherd 2018). While the species is protected in Malaysia and Singapore, there exists a paucity of legislative protection in Indonesia, where the species was stripped of its protected status under Indonesian legislation through lobbying by local hobbyists and breeders (Leupen & Shepherd 2018). We advocate a reinstatement on the list of protected species by the Government of Indonesia (Act of Republic of Indonesia No.5 1990), and a review of current legislation to include penalties for any transgressions.

Strengthening of international legislation

Despite being listed on Appendix II of CITES, cross-border smuggling of the Straw-headed Bulbul for the cagebird trade persists (Shepherd *et al.* 2013, Chng *et al.* 2015, Chng *et al.* 2016). To further enhance its protection in the trade, the implementation of a zero quota for commercial trade in wild specimens, or even an uplisting of the Straw-headed Bulbul to Appendix I of CITES, should be considered by policymakers (see Bergin *et al.* 2018, Leupen & Shepherd 2018). Species listed in Appendix I of CITES have a zero quota on global import and export, thereby helping to curtail the international trade of the Straw-headed Bulbul. Fundamentally, the effective implementation of CITES requires the simultaneous execution of local enforcement and regulation (Siriwat & Nijman 2018). The uplisting would therefore complement the proposed enhancements in domestic legislation and regulations mentioned above. However, a region-wide assessment of the trade or of seizure records—in addition to previous more limited studies (e.g. Shepherd *et al.* 2013, Chng *et al.* 2016, Bergin *et al.* 2018)—would have to be carried out prior to its proposed uplisting on the CITES Appendices.

Ex situ population management

A forensic (genetic) database would serve as an important tool to determine the provenance of confiscated individuals, as well as help identify individuals suspected to be wild-caught (Ahlers *et al.* 2017), contributing to *ex situ* management of the species’s population. The availability of genetic data from registered breeders would further bolster investigations into the origins of birds, facilitating work by local and international enforcement authorities. While establishing such a database may be challenging for large countries such as Indonesia, the development of such a resource is currently being explored for Singapore. Such infrastructure would require designated funding but would be promising in furnishing essential

information to strengthen law enforcement, *ex situ* breeding, and support potential future work on translocations or re-introductions.

Field research and monitoring of wild populations

Coordinated monitoring of wild populations and of the trade situation is urgently needed (Lee *et al.* 2016), allowing for local population declines to be brought to the attention of conservationists. There continues to be a dearth of targeted field surveys at some remaining sites of occurrence, particularly in Brunei and Peninsular Malaysia. We recorded a total of nine occurrence records for the species at previously unmapped sites (Appendix 1). Of these, six were in Borneo, with the remaining three in Peninsular Malaysia. However, as these sites did not have pre-2000 records, they did not meet our criteria and were omitted from analysis. These previously unmapped sites underscore the need for extensive and targeted field surveys at locations of potential past occurrence beyond the countries herein investigated (including southern Myanmar and Thailand), aiming for accurate global population estimates.

The recent uplisting of the Straw-headed Bulbul to Critically Endangered highlights the urgent need to conserve the species. Our data demonstrate numerous site-level extirpations of the species across its range, which provides further evidence to support its threatened status. To this end, we recommend that range countries and relevant governmental and non-governmental agencies launch a coordinated effort to develop and formulate a regional conservation plan for the Straw-headed Bulbul, taking into account the recommendations discussed here.

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Appendix 1. Compilation of paired presence records available for both the pre-2000 and the post-2000 review window for the Straw-headed Bulbul.

For conservation reasons, the data in Appendix 1 is not included here but may be made available for bona fide research and conservation purposes.

Appendix 2. List of 10 experts who provided input in semi-structured email interviews (out of 16 experts contacted), with a brief overview of their affiliation, in alphabetical order.

Expert name	Based in	Position/Affiliation
Chien Lee	Borneo	Independent Bird Guide
Gabriella Fredriksson	Sumatra/Java	Sumatran Orangutan Conservation Program
Gail Campbell-Smith	Borneo	International Animal Rescue
Ho Hua Chew	Singapore	Nature Society (Singapore)
Karmelee Llano Sanchez	Borneo	International Animal Rescue
Serene Chng	Peninsular Malaysia	TRAFFIC
Shavez Cheema	Borneo	1Stop Borneo Wildlife
Rajathurai Subaraj	Singapore	Independent Bird Guide
Richard Moore	Java	International Animal Rescue
Terri Breeden	Borneo	Yayasan Palung

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