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Market surveys in Mataram, Lombok, illustrate the expanse of legal and illegal Indonesian bird trade networks

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ABSTRACT

Bird keeping is deeply rooted in Indonesian culture and markets selling large numbers of birds are found across the country. We examined bird markets in Mataram on the island of Lombok. Across five market visits, 10,326 birds of 108 species were observed, with 18 of these species being nationally protected and 10 having been assessed as globally threatened by the IUCN Red List of Threatened Species. Observed protected species, as well as non-protected species with no or exceeded harvest quotas accounted for a total of 8,586 (83.1%) illegally traded birds. In terms of trade volume, 80.8% (n=8,347) of the recorded Indonesian birds were native to Lombok, suggesting that many of the birds for sale were sourced locally. However, 63% (n=65) of the encountered Indonesian species were not native to Lombok, confirming previously described intra-national bird trade flows between the Indonesian islands. We found a strong positive relation between a species' body size and its asking price. Current legislation in Indonesia is sufficient to eradicate the open trade in illegally sourced and/or protected species. Improved enforcement of these laws, in combination with strategic demand reduction efforts, is needed to curb illegal and unsustainable bird trade in the country.

ABSTRAK

Memelihara burung telah mengakar dalam budaya masyarakat Indonesia dan pasar yang menjual burung dalam jumlah besar dapat ditemukan di seluruh negeri. Kami menelaah pasar burung di Mataram, Pulau Lombok. Dalam lima kunjungan pasar, teramati 10.326 burung dari 108 spesies, dengan 18 spesies diantaranya dilindungi secara nasional dan 10 dengan status terancam secara global berdasarkan Daftar Merah IUCN. Spesies dilindungi yang diamati, serta spesies yang tidak dilindungi yang melebihi kuota panen berjumlah 8,586 (83.1%) burung yang diperdagangkan secara ilegal. Dalam hal volume perdagangan, 80.8% (n=8,347) burung Indonesia yang tercatat adalah asli Lombok, menunjukkan bahwa banyak burung yang dijual berasal dari lokal. Namun, 63% (n=65) spesies Indonesia yang ditemukan bukan asli Lombok, mengkonfirmasikan arus perdagangan burung intra-nasional yang dijelaskan sebelumnya antara pulau-pulau di Indonesia. Kami menemukan adanya hubungan positif yang kuat antara ukuran tubuh spesies dan harga permintaan. Peraturan perundang-undangan yang berlaku di Indonesia saat ini cukup untuk memberantas perdagangan terbuka spesies yang bersumber dan/atau dilindungi secara ilegal. Peningkatan penegakan hukum ini, yang dikombinasikan dengan strategi upaya pengurangan permintaan, diperlukan untuk mengendalikan perdagangan burung ilegal dan tidak berkelanjutan di negara ini.

Keywords: *bird trade, conservation, enforcement, harvest quotas, illegal wildlife trade*

INTRODUCTION

Keeping birds as a pastime in Indonesia has deep and diverse cultural roots. An estimated 60% of all Indonesian households have chickens, ducks and/or quail in their backyards (Padmawati & Nichter, 2008), one in three households keep a cage bird, and on the island of Java alone six million households keep up to 84 million cage birds (Marshall et al, 2020). Throughout Indonesia, cultural concepts exist for the way that birds are kept that are not captured by either the 'pet' or 'livestock' concepts of the West. Birds are kept as pets, they are kept as livestock, but also as something in between whereby birds add a sense of completeness to the household (Forster, 2009). Indonesia's extensive cage bird trade is widely recognized as a leading threat to many of the country's native bird species (Collar et al, 2012; Eaton et al, 2015; Harris et al, 2017; Marshall et al, 2020). Indonesia currently has the world's highest number of threatened native birds (n=175) (IUCN Red List, 2021), with illegal and unsustainable overexploitation for the pet trade being one of the major reasons for this. Songbirds, kept for their melodious song and used in highly popular singing competitions, are traded in high volumes, pushing many of these species perilously close to extinction (Chng et al, 2015; Chng, Shepherd, & Eaton, 2018a; Chng, Krishnasamy, & Eaton, 2018b; Marshall et al, 2020; Shepherd, 2006). Bird markets can be found across Indonesia with birds frequently being shipped between the country's islands and markets (Indraswari et al, 2020).

The Act of the Republic of Indonesia (No.5) of 1990 concerning Conservation of Living Resources and their Ecosystems is Indonesia's main species conservation legislation. Protected species are listed in Regulation of the Minister of Environment and Forestry no. P.106/MENLHK/SETJEN/KUM.1/12/2018, which currently includes ~30% (n=557) of Indonesia's native bird species. The harvest of unprotected species is regulated by a quota system under the Decree of the Minister of Forestry no. 447/Kpts-II/2003. Harvest and trade quotas are set annually by the country's CITES Scientific Authority (Indonesian Institute of Sciences), and its CITES Management Authority (under the Ministry of Environment and Forestry) in collaboration with traders and various other stakeholders. It is illegal to trade in unprotected species for which no harvest quotas have been set. Illegal trade in both protected and unprotected species is frequently carried out openly in markets throughout the country (Haryoko, 2010; Iskander; 2014, Iskander & Iskander; 2015; Leupen & Shepherd, 2018; Nijman, Nekaris, & Imron, 2019), and quotas are regularly ignored (Auliya, 2010; Schoppe, 2009; Shepherd, Eaton, & Chng, 2016).

Much of the research into the Indonesian bird trade has focused on specific taxa, e.g. straw-headed bulbul (*Pycnonotus zeylanicus*) (Bergin et al, 2017), black-winged myna (*Acridotheres melanopterus*) (Nijman et al, 2018), Bali myna (*Leucopsar rothschildi*) (Jepson, 2016) and Sumatran laughingthrush (*Garrulax bicolor*) (Bušina, Pasaribu, & Kouba, 2018; Shepherd, 2007; Shepherd & Gomez, 2018). Those studies focusing on a wide range, or all, of species in trade, have often been often restricted to major cities such as Indonesia's capital, Jakarta, situated on the island of Java, or Medan, the capital of the province of North Sumatra (Bušina et al, 2018; Chng et al, 2015; Harris et al, 2015; Nash, 1992; Shepherd, 2006). Only relatively few studies have focused on bird markets on smaller islands such as Bali (Chng et al, 2018b; Widodo, 2007) or in lesser-studied areas such as West Kalimantan (Rentschlar et al, 2017) and Southern Sumatra (Mutiara, Rizal, & Royan, 2020; Setioko et al, 2019). These studies have been vital in gaining a better understanding of the scale, scope, and dynamics of the Indonesian bird trade. Here we aim to contribute to this body of information, and to the overall effort to end the illegal and unsustainable bird trade in Indonesia, by reporting on findings from market surveys in Mataram on the island of Lombok, a location for which very little published bird trade data is available.

Lombok is situated just east of Bali in the province of West Nusa Tenggara and is part of the Lesser Sundas island chain, which includes Bali to the west and islands such as Sumbawa, Komodo, Flores, Sumba, Timor and Alor to the east. Although shared endemism is high among the western members of the Lesser Sundas, single island endemics are less common here (Eaton et al, 2016; Myers & Bishop, 2005). Lombok's only endemic bird species, the Rinjani scops-owl (*Otus jolandae*), was recently described in 2013 (Sangster et al, 2013; King, Verbelen, & Trainor, 2013). Since then, the island has received more interest from ornithologists and birdwatchers, where it was previously largely neglected (Suana et al, 2016). Lombok's largest city, Mataram, is the provincial capital and has just over 400,000 inhabitants. Although there are multiple smaller bird markets across the island, Lombok's main markets, Pasar Sindu and Pasar Chakranegara, are both situated in Mataram. We surveyed these markets in order to obtain an indication of trade levels and species composition, and to assess levels of illegal trade for the benefit of future enforcement efforts.

METHODS

Data Acquisition

We conducted five market visits in Mataram, Lombok; Pasar Sindu (aka Pasar Panglima) was visited on four occasions (10 June, 6 July, 19 July 2018 and 3 June 2019) and Pasar Chakranegara on one occasion (3 June 2019). During each market visit, a full inventory of the birds on sale was made. Poultry, domesticated birds and individuals with unnatural colour morphs (such as those found in captive-bred budgerigars) were not recorded. Only birds that were on open display were counted. Price information was gathered where possible. No bargaining attempts were made and only first given prices were recorded. All recorded birds were identified to a species level and, where possible, a subspecies level. National protection status, IUCN Red List of Threatened Species (hereafter IUCN Red List) classification and natural range were recorded for each species. Species names and baseline taxonomy follow the Handbook of Birds of the World (HBW) and BirdLife International Checklist of the Birds of the World Version 4.0 (2019).

Analysis

Observations from our five market visits were pooled to obtain an abundance ranking of species. Mataram's bird markets have been surveyed in 2015 and 2016 (Asrori, 2017; Syaputra, 2016) and we intended to integrate these results in our analysis. However, during review, at least part of that data was judged to be based on erroneous identifications of species. It was therefore decided to not include these studies in this analysis.

In addition to the price data gathered during our surveys, price data was extracted from online price lists, online vlogs (whereby the vlogger visits the bird market and gets quotes for a large number of bird species), published literature (Syaputra, 2016), as well as from online price lists. For several more frequently encountered species we did not manage to obtain price data for Lombok; in these cases, we used price data from

neighbouring Bali instead, which were collected during the same period as our surveys in Lombok. For species for which more than one quote was obtained, we used the mean price for analysis. All data were collected in Indonesian Rupiah; we corrected prices for inflation to November 2020 (i.e., IDR100,000 in June 2018 equals IDR102,009 in November 2020), and then converted to US Dollar (IDR100,000 = USD7.07). We calculated the monetary value of each species by multiplying the number of individuals observed by the mean price, and the overall monetary value of the trade by summation of the individual species' monetary values. For those species for which price data were obtained, we also gathered data on body size, taken from Eaton et al. (2016). To assess relationships between species abundance in the bird market, size and asking price, we log-transformed the data to approach a normal distribution more closely, and calculated Pearson's correlation coefficients. We compared body size, price, numbers, and total monetary value for protected versus non-protected species and globally threatened versus non-threatened species with unpaired t-tests. We accepted significance when $P<0.05$ in a two-tailed test.

RESULT AND DISCUSSION

Species Provenance

In total, 10,326 individual birds, belonging to 108 different species were recorded across the five market visits. Only 24 of these birds, belonging to five different species, were not native to Indonesia (Annex 1). All of these species were native to other parts of Asia (West, East and/or Southeast). Only one of the non-native species, the silver-eared mesia (*Leiothrix argentauris*), is currently listed in CITES (Appendix II). Note that Sumatran mesia (*L. laurinae*), endemic to Indonesia, is newly described and split from (*L. argentauris*) (BirdLife International, 2020). The lemon-bellied white-eye (*Zosterops chloris*) was by far the most frequently encountered species with a total of 4,217 individuals, all of which were recorded during the 2019 survey. In total, the top ten most numerous bird species (see Appendix 1) accounted for 8,499 individuals, or 82.3% of the total birds observed.

Of the encountered native species, 38 (36.9%), accounting for 8,347 (80.8%) individuals, occur on Lombok. Of the 65 native species that do not occur on Lombok, 20 are Indonesian endemics. These endemics include species restricted to the Lesser Sundas (n=5), Java (n=3), Sulawesi (n=2), Sumatra (n=2) and Bali (n=1), as well as species that occur across multiple Indonesian islands and regions (n=7) (Figure 1).

Seventeen species (15.7%), accounting for 3,546 (34.3%) individuals and all native to Indonesia, were observed in each of the surveys (see Annex 1). Two of them, black-winged myna and Javan pied starling (Gracupica jalla), are currently listed as Critically Endangered on the IUCN Red List. Commercial captive breeding occurs for both species (Eaton et al. 2015; Nijman et al. 2018). Nine individuals of Lombok's only endemic bird, the Rinjani scops-owl, were observed.

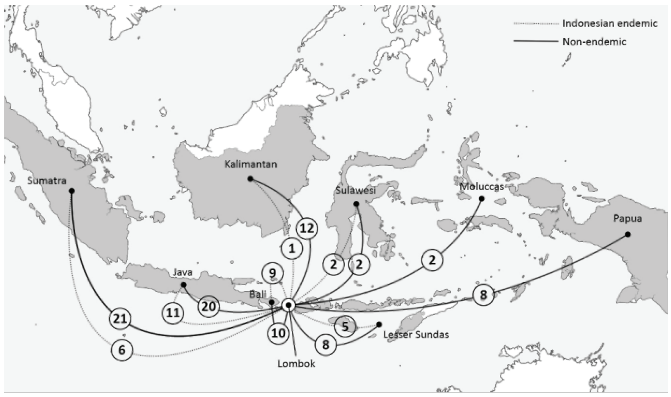

Figure 1. Provenance of Indonesian species not native to Lombok encountered in Mataram's bird markets.
Note: 28 recorded native (but not endemic) species occur across multiple Indonesian islands and regions and have therefore been included in the totals of all the locations in which the species occur. Similarly, seven of the recorded Indonesian endemic species occur across multiple Indonesian islands and regions and have therefore been included in the totals of all the locations in which the species occur.

Legality of Observed Trade

Eighteen encountered species, accounting for 378 individuals, are currently protected under Indonesian law (Appendix 1). Twelve of these species only received their protected status on 11 July 2018 when the first of that year's renewed protected species lists (the later amended Government Regulation No. 20/MENLHK/SETJEN/KUM.1/6/2018) came into effect. Of these twelve species, four had been allotted harvest and trade quotas for the months leading up to the legislative changes. Therefore, 78 of the 378 recorded individuals were lawfully traded at the time they were observed (10 June and/or 6 July 2018). Two of the four species with pre-protection harvest quotas common hill myna (*Gracula religiosa*) and fire-tufted barbet (*Psilopogon pyrolophus*) were observed in markets a few days after obtaining their protected status, albeit in low numbers (n=2 for both species). Three of the four species (common hill myna, greater green leafbird (*Chloropsis sonnerati*), and Sumatran laughingthrush) were observed in the market in 2019, a year after they had received their protected status. A small number of these individuals could be second generation captive-bred birds in which case their trade would be legal, although there was no data such as closed leg-rings or captive-breeding certificates to suggest any of them were.

Of the 108 encountered species, 33 had harvest quotas set for 2018 and/or 2019. Of the 55 non-protected native species encountered in 2018, 19 (34.5%) had allotted harvest quotas that year, as well as one

non-native species (common myna (*Acridotheres tristis*)). For one of these species, the streaked weaver (*Ploceus manyar*), more individuals (n=148) were found across the three 2018 surveys than the total annual quota (n=20) allowed. In 2019, eighteen (30.5%) of the 61 observed native non-protected species had allotted harvest quotas for that year. Again, one species, the lemon-bellied white-eye, was observed in volumes (n=4,217) that largely exceeded the national annual quota set at 110. When taken together, protected species, non-protected species without harvest quotas and non-protected species with exceeded harvest quotas, accounted for 8,586 (83.1%) illegally traded birds belonging to 84 (77.8%) different species (Table 1).

Table 1. Numbers of illegally traded birds observed across the five market visits in 2018 and 2019.

Status	No. of species	No. of illegally traded individuals
Not protected, no harvest quotas	68	3,884
Not protected, exceeded harvest quotas	3	4,423
Protected	13	279*
TOTAL	**84**	**8,586**

*Note: *Excluding the 78 individuals belonging to species that are currently protected, but for which observed trade numbers were within the limits of set harvest and trade quotas before they received their protected status.*

Ten of the encountered species, accounting for 750 individuals, are currently considered threatened by the IUCN Red List (Appendix 1). Three of these species (n=116 individuals) are classified as Critically Endangered, three (n=208) as Endangered and four (n=426) as Vulnerable. Of the remaining species, 11 are currently classified as Near Threatened and 87 as Least Concern.

Price, Protection status and Conservation Status

Price data were obtained for 62 of the 108 species, including 35 of the 40 most frequently recorded birds. This accounted for 95% of the individual birds (9,802/10,326). Some of the more valuable species were present in relatively low numbers and commanded a high individual price, i.e. common hill myna (total value: IDR145,800,000 [USD10,302]). Others were present in intermediate numbers and had mid-range asking prices, i.e. Javan myna (*Acridotheres javanicus*) (total value: IDR74,370,000 [USD5,254]), while cheaper species i.e. lemon-bellied white eye (total value: IDR113,160,000 [USD9,995]) and brown honeyeater (*Lichmera indistincta*) (total value: IDR62,230,000 [USD4,397]) were present in high numbers. The overall value of the observed birds was IDR790,071,000 (USD56,038).

We found a weak negative relationship between the observed number of birds of a given species, its body size (Pearson's R=-0.298, N=64, R^2=0.089, P=0.017) and its asking price (R=-0.436, N=64, R^2=0.190, P=0.0003). Asking price was strongly and positively related to body size (R=0.712, N=64, R^2=0.507, P<0.00001) and total monetary value of a species was positively related to the bird's body size (R=0.3122, N=64, R^2=0.098, P=0.012).

Protected species had larger body sizes than unprotected species (means of 27.0 vs 19.8 cm; t=2.734, P=0.008), commanded higher prices (means of IDR853,071 vs IDR275,208 [USD60.28 vs USD19.44]: t=4.024, P=0.0002) and were observed in smaller numbers (means of 25.7 vs 217.7: t=2.379, P=0.020). The mean monetary value of protected species did not significantly differ from that of unprotected species (means of IDR18,944,714 vs IDR10,996,770 [USD1,338.60 vs USD777.03: t=0.793, P=0.431]).

Figure 2. Relationships between body size of birds observed in the bird markets in Mataram, Lombok, Indonesia (range 9-52 cm) and price (orange: range IDR5,000-1,800,000 [USD0.35-127.19]) and economic value for each species (blue: range IDR20,000-145,800,000 [USD1.41-10,302.23]).

Globally threatened species (i.e. those listed as Critically Endangered, Endangered, Vulnerable on the IUCN Red List) did not differ in body size from non-threatened species (means of 20.9 vs 21.4 cm: t=0.098, P=0.922), nor did they differ in the numbers observed in the markets (means of 84.5 vs 188.7

individuals: t=0.035, P=0.972), their asking prices (means of IDR549,375 vs IDR384,407 [USD38.82 vs USD27.16]: t=1.265, P=0.211) or the overall monetary value (means of IDR21,106,875 vs IDR11,559,555 [USD1,491.41 vs USD816.79]: t=1.121, P=0.266).

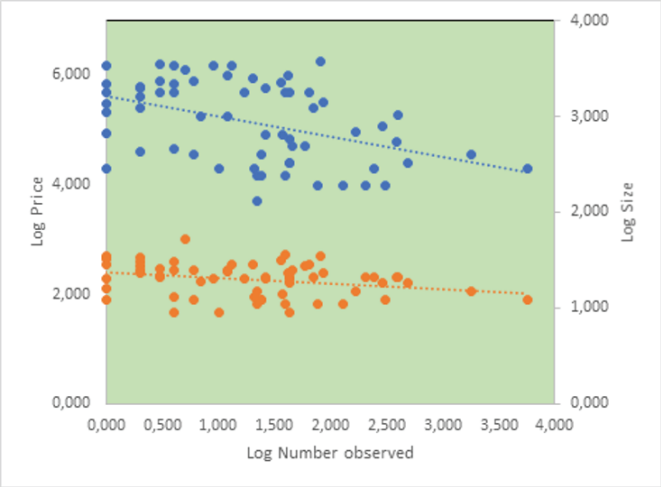

Figure 3. Relationships between the number of birds observed in the bird markets in Mataram, Lombok, Indonesia (range 1-5,658 birds / species) and price (blue: range IDR5,000-1,800,000 [USD0.35-127.19]) and size (blue: range 9-52 cm).

Local Sourcing

The observed bird volumes across this study's relatively low number of market visits indicate a large-scale songbird trade on Lombok, as seen in many other locations in Indonesia. Although the largest markets continue to be found on Java, this study reconfirms that high-volume songbird trade occurs in smaller and less populated Indonesian cities. When looking at the number of recorded individuals, Lombok native birds far outnumbered Lombok non-natives, suggesting that the majority of the individuals found in the markets were locally sourced. A good example of this is the Lemon-bellied White-eye. This Lombok native and Indonesian endemic is restricted to the Lesser Sundas, Sulawesi and parts of the Moluccas. It was by far the most frequently observed (n=4,217) white-eye – and species – of this study. The traditionally much more commonly traded Sangkar white-eye (*Zosterops melanurus*), restricted to Java and Bali, was found in much lower numbers (n=22). This is illustrative of the numerical dominance of local birds in Lombok's markets. Additionally, the much lower number of encountered Sangkar white-eyes may reflect previously identified population declines in that species as a result of trapping for trade. Chng et al (2018b) recorded a relatively high number of lemon-bellied white-eyes during recent surveys in Bali, which is outside the species' range, and suggested that the species may function as a substitute for the increasingly scarce Sangkar white-eye. Unpublished surveys on Java appear to confirm this theory, recording high volumes of lemon-bellied white-eyes in 2019 (Monitor, unpublished data), where previously such records in Javan markets were very scarce (Chng et al, 2015; Chng, Guciano, & Eaton, 2016; Chng & Eaton, 2016). The large number of lemon-bellied white-eyes found in Mataram's markets, as well as surging trade numbers in other parts of Indonesia, warrant more research into the threat trade may pose to this species.

Another bird which was found in high volumes (n=1,778) is the Brown Honeyeater. This species occurs in Australia, Papua New Guinea, Timor-Leste and Indonesia, where it is restricted to Bali, the Lesser Sundas and small parts of the Moluccas and Papua. It was previously protected under Indonesian law as part of a blanket listing of species from the Meliphagidae family. In 2018, when the country's protected species list was amended, the blanket listing was annulled, and the brown honeyeater lost its protected status. Trade records for the species outside its natural range are scarce, suggesting that the high trade numbers found during our surveys are another indication of the dominance of locally sourced birds in Lombok's markets, rather than the result of the recent legislative changes. The fact that no harvest quotas were set for the species in 2018 and 2019 and all observed trade was therefore technically illegal, further shows that demand, rather than the removal of the species' protected status, is likely to be the main explanation behind the observed high trade numbers observed during our surveys.

Other Lombok native species that were found in much higher numbers than in previous studies, and therefore indicate the predominance of locally sourced birds in Mataram's markets, are the short-tailed starling (*Aplonis minor*) (n=495) and pale-headed munia (*Lonchura pallida*) (n=150). Within Indonesia, short-tailed starlings are distributed across Java, Bali, Sulawesi and the Lesser Sundas. Nevertheless, there are no trade records for the species in Java in recent published studies (Chng & Eaton, 2016; Chng et al, 2015, 2016), nor have they been recorded in studies in Sumatra (Shepherd, 2006; Chng et al, 2018a). The only recent trade numbers for the species are from Bali (n=175) (Chng et al, 2018b) and Makassar, Sulawesi (n=42) (Shepherd & Leupen, 2021). Pale-headed munias, occurring on Sulawesi, the Lesser Sundas and Timor-Leste, have not been recorded in previously published Indonesian market surveys. The white-headed munia (*L. maja*), which occurs on Sumatra, Java and Bali and highly resembles the pale-headed munia, is much more commonly encountered in bird markets outside of Lombok. Pale-headed munias have been observed in trade in Europe, where recorded individuals are most likely derived from both captive and wild sources (S. Bruslund, in litt., December 2020). For both the brown honeyeater and the pale-headed munia, national trade is not indicated on the IUCN Red List

(BirdLife International, 2016; BirdLife International, 2018).

Observations of Lombok's only described endemic bird, the Rinjani scops-owl, have also been largely absent from the published literature, with Syaputra (2016) and Asrori (2017) being exceptions (Shepherd et al, 2020). Previously considered conspecific with the Moluccan scops-owl (*Otus magicus*), the species was described in 2013 (Sangster et al, 2013). It is restricted to the Mount Rinjani area in northern Lombok and is considered Near Threatened on the IUCN Red List, with habitat loss being indicated as the main threat to its conservation status (BirdLife, 2017). Our records show that trade may pose an additional threat to the species, as recently highlighted in Shepherd et al (2020).

The fact that several of the most numerous species in this study are native to Lombok and have not been recorded in large numbers outside their natural ranges illustrates the predominance of, and demand for, local birds in Lombok's markets. However, it must be noted that all but one of the observed Lombok natives also occur in other parts of Indonesia, making it possible that at least some of them were shipped in from other islands. Indonesia has an elaborate intra-national trade network, with birds being shipped between the different islands (Indraswari et al, 2020), as illustrated by the fact that the majority (63%) of the recorded native Indonesian species were not native to Lombok. Some of the most heavily traded species, such as sooty-headed bulbul (*Pycnonotus goiavier*) and Java sparrow (*Lonchura oryzivora*), do not naturally occur on Lombok. Non-native species can pose a threat to local biodiversity when escaped birds prey on – or compete with – local (avi-)fauna. Such risks are especially high on small islands such as Lombok. Regional supply appears to be significant in Lombok, with several of the encountered species originating from the Lesser Sundas, including cream-browed white-eye (*Heleia superciliaris*), crested white-eye (*H. dohertyi*), thick-billed white-eye (*H. crassirostris*) and yellow-spectacled white-eye (*H. wallacei*), the first two of which were found in relatively high numbers (n=21 and n=13 respectively) compared to published studies in locations outside the Lesser Sundas, from which they are mostly absent. Thick-billed white-eyes have previously been recorded in relatively large numbers in Java and Bali (Chng & Eaton, 2016; Chng et al, 2018b). Further examples of encountered Lesser Sunda endemics which have rarely been recorded in published studies outside the region are Timor leaf-warbler (*Phylloscopus presbytes*), black-fronted flowerpecker (*Dicaeum igniferum*), Timor oriole (*Oriolus melanotis*) (n=1), Timor sparrow (*Lonchura fuscata*) and tricoloured parrotfinch (*Erythrura tricolor*) (n=1). These records suggest that there are unique trade flows within the Lesser Sunda region.

Captive Breeding vs. Wild Sourcing

Of the ten recorded threatened species, nine are Indonesian endemics, with greater green leafbird being the only non-endemic. Scarlet-breasted lorikeet (*Trichoglossus forsteni*) was the only encountered threatened species native to Lombok. For some of these threatened species commercial captive breeding occurs, including Bali myna, Javan pied starling and Java sparrow, although this has not led to significant recuperation of wild populations. Other endangered species such as the Sumatran laughingthrush, Sangkar White-eye, ruby-throated bulbul (*Rubigula dispar*), greater green leafbird and Javan myna, are all assumed to be caught from the wild, with no confirmed significant commercial captive breeding taking place. The vast majority of the recorded species not assessed as threatened are also likely to have been taken from the wild, which may negatively impact their wild populations as well.

Enforcement Efforts

Open illegal trade has been recorded in all recently published surveys of Indonesian bird markets, as well as in older studies. While legislation is in place, it is often not effectively enforced, and traders do not appear to fear punitive action from enforcing bodies. This is illustrated by our observation of protected species in the markets, as well as non-protected species for which no harvest and trade quotas had been set. Only three of the non-protected species for which quotas had been set were found to have been traded in numbers that exceeded these quotas. One of these species was the zebra dove (*Geopelia striata*), which is often commercially bred, suggesting that its trade may not have been in violation of harvest quotas. However, set quotas concern the total number of birds allowed for harvest and trade per year across all of Indonesia (with harvest quotas specifying allowed offtake numbers per region). Due to the very nature of one-off surveys or spot checks on markets, the trade volumes observed during our surveys only represent a small fraction of actual annual trade numbers in Lombok's markets, let alone across the country. Total annual trade volumes across Indonesian markets are likely to far exceed set quotas for most of the observed species. Trappers and traders in Indonesia may not respect these quotas, as shown by the above-mentioned case of the Lemon-bellied White-eye for which observed numbers represented 38 times the annually set harvest quota. It must also be noted that all set quotas were for regions outside of Lombok. Technically, this means that none of the observed species may be trapped in Lombok. As mentioned above, it is nevertheless likely that a large proportion of the 8,347 observed Lombok native birds had been caught locally.

The recorded transgression of Indonesia's wildlife laws must be seen within the country's wider cultural

framework. Birds are such an integral part of Indonesian society that in some respects they are more important than legislation or regulation. Thus, despite many of the rarest bird species receiving protection on paper, in practise, protected species are commonly kept and traded (Eaton et al, 2015; Jepson, 2016). Recognition of these cultural contingencies is of high importance if future conservation efforts are to be successful.

CONCLUSION

An increasingly long list of bird species in Indonesia are being pushed towards extinction. The demand for cage birds in the country is a major driver behind these declines and therefore strategies to reduce the demand for unsustainably sourced birds should be developed and implemented. Along with improved enforcement of the existing laws, reducing such demand will be key to significantly decreasing illegal trade, and ultimately to preventing further loss of bird species in Indonesia. Continued surveys of Indonesia's physical and online bird markets will be essential to determine trade trends and flag species of concern. Local researchers should continue to carry out these surveys, with technical support where needed from other local or international experts, especially with regards to current taxonomy and species identification. The same support should be made available to law enforcement officers working to effectively regulate the trade in birds and to eliminate the illegal trade from these markets.

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Appendix 1. Bird species observed across five market visits in Mataram, Lombok in 2018 and 2019 (non-native species in bold).

No.	Species	Total no. of indiv.	IUCN Red List status	Protected
1	lemon-bellied white-eye (*Zosterops chloris*) [1]	4,217	LC	no
2	brown honeyeater *(Lichmera indistincta)* [3]	1,778	LC	no
3	short-tailed starling *(Aplonis minor)*	495	LC	no
4	Javan myna *(Acridotheres javanicus)* [1,3]	402	VU	no
5	zebra dove (*Geopelia striata*)	388	LC	no
6	scaly-breasted munia (*Lonchura punctulata*)	309	LC	no
7	chestnut-capped thrush (*Geokichla interpres*) [3]	294	NT	no
8	sooty-headed bulbul (*Pycnonotus aurigaster*) [3]	244	LC	no
9	yellow-vented bulbul (*Pycnonotus goiavier*) [3]	203	LC	no
10	Java sparrow (*Lonchura oryzivora*) [1]	169	EN	yes
11	streaked weaver (*Ploceus manyar*)	155	LC	no
12	pale-headed munia (*Lonchura pallida*)	130	LC	no
13	barred buttonquail (*Turnix suscitator*)	100	LC	no
14	orange-headed thrush (*Geokichla citrina*) [3]	85	LC	no
15	common hill myna (*Gracula religiosa*) [3]	81	LC	yes
16	white-headed munia (*Lonchura maja*)	76	LC	no
17	chestnut-backed scimitar-babbler (*Pomatorhinus montanus montanus*) [3]	71	LC	no
18	Javan pied starling (*Gracupica jalla*) [1,3]	69	CR	no
19	black-naped oriole (*Oriolus chinensis*)	64	LC	no
20	barred dove (*Geopelia maugeus*)	60	LC	no
21	chestnut-backed thrush (*Geokichla dohertyi*)	60	NT	no
22	long-tailed shrike (*Lanius schach*) [3]	45	LC	no
23	orange-spotted bulbul (*Pycnonotus bimaculatus*) [1]	43	NT	no
24a	oriental magpie-robin (*Copsychus saularis amoenus/pluto*) [3]	31	LC	no
24b	oriental magpie-robin (*Copsychus saularis musicus*) (spp)[3]	12	LC	no
25	red-chested flowerpecker (*Dicaeum maugei*)	43	LC	no
26	black-winged myna (*Acridotheres melanopterus*) [1,3]	42	CR	yes
27	helmeted friarbird (*Philemon buceroides*) [3]	40	LC	no
28	olive-backed sunbird (*Cynniris jugularis*)	40	LC	no
29	thick-billed white-eye (*Heleia crassirostris*) [1]	37	LC	no
30	black drongo (*Dicrurus macrocercus vieillot*)	36	LC	no
31	bar-winged prinia (*Prinia familiaris*) [1]	33	NT	no
32	Asian glossy starling (*Aplonis panayensis*)	26	LC	no
33	greater green leafbird (*Chloropsis sonnerati*)	26	EN	yes
34	olive-backed tailorbird (*Orthotomus sepium*) [1]	24	LC	no
35	white-rumped munia (*Lonchura striata*)	24	LC	no
36	hooded butcherbird (*Cracticus cassicus*)	23	LC	no
37	Eurasian tree sparrow (*Passer montanus*)	22	LC	no
38	Sangkar white-eye (*Zosterops melanurus melanurus*) [1]	22	VU	no
39	cream-browed white-eye (*Heleia superciliaris*) [1]	21	LC	no
40	white-rumped shama (*Kittacincla malabarica*) [3]	20	LC	no

41	Timor leaf-warbler (*Phylloscopus presbytes*)	18	LC	no
42	grey-capped emerald dove (*Chalcophaps indica*)	14	LC	no
43	crested white-eye (*Heleia dohertyi*) [1]	13	LC	no
44	Sumatran laughingthrush (*Garrulax bicolor*) [1]	13	EN	yes
45	chestnut-capped laughingthrush (*Garrulax mitratus*)	12	NT	no
46	**common myna (*Acridotheres tristis*)**	12	LC	no
47	white-breasted waterhen (*Amaurornis phoenicurus*)	12	LC	no
48	mountain warbler (*Phylloscopus trivirgatus trivirgatus*)	10	LC	no
49	scarlet-headed flowerpecker (*Dicaeum trochileum*) [1]	10	LC	no
50	Rinjani scops-owl (*Otus jolandae*) [2]	9	NT	yes
51	elegant pitta (*Pitta elegans*)	7	LC	yes
52	spotted kestrel (*Falco moluccensis*)	7	LC	yes
53	coconut lorikeet (*Trichoglossus haematodus*)	6	LC	no
54	dark-necked tailorbird (*Orthotomus atrogularis*)	6	LC	no
55	Sunda laughingthrush (*Garrulax palliatus*)	6	NT	no
56	Bali myna (*Leucopsar rothschildi*) [1]	5	CR	yes
57	Brahminy kite (*Haliastur indus*) [3]	5	LC	yes
58	brown quail (*Synoicus ypsilophorus*)	5	LC	no
59	black-fronted flowerpecker (*Dicaeum igniferum*) [1]	4	LC	no
60	black-naped monarch (*Hypothymis azurea*)	4	LC	no
61	**black-throated laughingthrush (*Garrulax chinensis*)**	4	LC	no
62	copper-throated sunbird (*Leptocoma calcostetha*)	4	LC	no
63	purple-backed starling (*Agropsar sturninus*)	4	LC	no
64	Sulawesi myna (*Basilornis celebensis*) [1]	4	LC	no
65	**black-collared starling (*Gracupica nigricollis*)**	3	LC	no
66	fire-tufted barbet (*Psilopogon pyrolophus*)	3	LC	yes
67	grey-cheeked bulbul (*Alophoixus tephrogenys*)	3	LC	no
68	iris lorikeet (*Psitteuteles iris*)	3	NT	no
69	northern variable pitohui (*Pitohui kirhocephalus*)	3	LC	no
70	orange-banded thrush (*Geokichla peronii*)	3	NT	no
71	scarlet minivet (*Pericrocotus flammeus*)	3	LC	no
72	**silver-eared mesia (*Leiothrix argentauris*)**	3	LC	no
73	yellow-spectacled white-eye (*Heleia wallacei*) [1]	3	LC	yes
74	black laughingthrush (*Garrulax lugubris*)	2	LC	no
75	black-naped fruit-dove (*Ptilinopus melanospilu*)	2	LC	no
76	black-winged kite *(Elanus caeruleus*)	2	LC	no
77	eyebrowed thrush (*Turdus obscurus*)	2	LC	no
78	island thrush (*Turdus poliocepahlus whiteheadi*) [1]	2	LC	no
79	lineated barbet (*Psilopogon lineatus*)	2	LC	yes
80	pheasant coucal (*Centropus phasianinus*)	2	LC	no
81	southern variable pitohui (*Pitohui uropygialis*)	2	LC	no
82	**white-crested laughingthrush (*Garrulax leucolophus*)**	2	LC	no
83	white-shouldered triller (*Lalage sueurii*)	2	LC	no
84	Australasian reed-warbler (*Acrocephalus australis*)	1	LC	no

85	blue nuthatch (*Sitta azurea*)	1	LC	no
86	blue-and-white flycatcher (*Cyanoptila cyanomelana*)	1	LC	no
87	blue-crowned hanging Parrot (*Loriculus galgulus*)	1	LC	yes
88	blue-masked leafbird (*Chloropsis venusta*) [1]	1	NT	no
89	brown prinia (*Prinia polychroa polychroa*)	1	LC	no
90	brush cuckoo (*Cacomantis variolosus sepulcralis*)	1	LC	no
91	chestnut-cheeked starling (*Agropsar philippensis*)	1	LC	no
92	common barn-owl (*Tyto alba*)	1	LC	no
93	common moorhen (*Gallinula chloropus orientalis*)	1	LC	no
94	grosbeak starling (*Scissirostrum dubium*) [1]	1	LC	no
95	indigo flycatcher (*Eumyias indigo*) [1]	1	LC	no
96	little pied flycatcher (*Ficedula westermanni*)	1	LC	no
97	little spiderhunter (*Arachnothera longirostra*)	1	LC	no
98	long-tailed sibia (*Heterophasia picaoides*)	1	LC	no
99	pied imperial pigeon (*Ducula bicolor*)	1	LC	no
100	racquet-tailed treepie (*Crypsirina temia*)	1	LC	yes
101	red-winged parrot (*Aprosmictus erythropterus*)	1	LC	yes
102	ruby-throated bulbul (*Pycnonotus dispar*) [1]	1	VU	no
103	scarlet-breasted lorikeet (*Trichoglossus forsteni*) [1]	1	VU	yes
104	Timor oriole (*Oriolus melanotis*)	1	LC	no
105	Timor sparrow (*Lonchura fuscata*)	1	NT	no
106	tricoloured parrotfinch (*Erythrura tricolor*)	1	LC	no
107	Wallacean drongo (*Dicrurus densus*)	1	LC	no
108	western koel (*Eudynamus scolopaceus*)	1	LC	no
	TOTAL	**10,326**		

Note: [1]Indonesian endemic, [2]Lombok endemic, [3]encountered in all five surveys