

Conservation implication and traditional ecological knowledge on trading bird: A case study in Depok bird market in Surakarta, Central Java, Indonesia

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Abstract. Putri FK, Alicia F, Noven HJ, Sholiqin M, Himawan W, Javarendra RA, Liza N, Partasasmita R, Iskandar J, Naim DM, Setyawan AD. 2021. Conservation implication and traditional ecological knowledge on trading bird: A case study in Depok bird market in Surakarta, Central Java, Indonesia. *Biodiversitas* 22: 5636-5648. Bird species have been the most popular animals in Indonesia for such a long time. Therefore, the demand for birds has been rising in urban area. The bird species are usually traded, including selling and buying activities in urban bird markets. The increase of bird trading in Indonesia also increased the economic and social benefits for Indonesian people. Consequently, there is a chance that many bird trading in bird markets are not managed carefully, without preventing the bird species extinction in rural ecosystems. This paper aimed to assess the conservation status of birds sold and the Traditional Ecological Knowledge (TEK) of bird traders in Depok bird market in Surakarta (Solo), Central Java, Indonesia. The study used a qualitative method with the ethnoornithological approach. The results showed that the diversity of birds encountered in the bird market of Depok was considered high, 55 species were recorded, representing 29 families. Seven bird species are protected by Indonesian law while 12 species are considered endemic. Moreover, 8 birds are included in IUCN Red List. The bird naming is based on particular categories that are agreed on in local community. Furthermore, social involvement through education and local wisdom might have profound impact on conservation efforts to preserve the bird population.

Keywords: Bird market, Depok bird market, status conservation, traditional ecological knowledge

INTRODUCTION

Birds are one of the most frequently traded animals in the world (Burivalova et al. 2017). The demand for birds by some people becomes a market opportunity for traders and bird catchers to gain economic benefits. In order to fulfill the needs of bird demand, traders always try to provide birds to buyers. The upwards trend in catching and selling bird species threatens bird population in Asia, with Indonesia as the epicenter of songbird crisis (Nijman et al. 2021b). This fact is reasonable as data acquired from Nijman et al. (2019) showed approximately tens of thousands of birds caught from the wild were sold in the markets in Java Island each day. Various efforts have been made to get a supply of birds, resulting in bird catching that can threaten the existence of birds in nature.

There are various reasons why people keep birds, such as respect in their community, and for cultural, entertainment and economic reasons (Mutiarra et al. 2020). Birds can be used as inspiration for artwork, for state symbols, as clothing motifs, kept in cages for hobbies, etc.

(Ghifari et al. 2016). Bird keeping is closely related to local traditions, including social and cultural life. In Javanese tradition, keeping cage-bird is considered a hobby, as well as achievement and status symbols (Chng et al. 2016; Nijman and Nekaris 2017). Moreover, that study also suggested that keeping particular bird species is a way to bring fortune and to show wealth status. However, there was no statistical data that support the mentioned relation between keeping bird and socioeconomic aspects (Alves et al. 2013). Another case in China's ethnic community showed that the major reason for keeping birds is finding sense of enjoyment, but some people refuse to do that and prefer bird watching (Dai et al. 2021).

Bird trade is often carried out in bird markets. The rise of the bird markets in Indonesia has both positive and negative impacts. There are two types of bird markets known in Indonesia, namely open and closed (black) bird markets. An open bird market is a bird market that visually appears as a market where sellers and buyers meet. The hallmark of an open market is that animals are deliberately installed with all their charms to attract as many consumers

as possible. Meanwhile, a closed bird market is an animal market that provides animals for sale, but offers and transactions are carried out in private. Usually, the closed bird market offers endangered species which should not be traded because they are protected by law (Haryanta 2011). Moreover, bird trade can also take place on online marketplace platforms. Based on study conducted in Thailand, there was a similarity between bird prices offered on online marketplace and in physical market (Siriwat and Nijman 2020). Besides the drawback it brings, online market has a benefit compared to the offline market. Online activities can be easily monitored by the authorities and conservationists as there are data about bird species being traded (Fink et al. 2021). That study also stated that online shop platforms might provide valuable information to the potential customers, such as conservation status of birds they want to purchase.

Various species of birds are natural resources that are included in the renewable category. According to Iskandar (2014), bird populations in nature experience dynamics at any time depending on the intake rate and output rate factors of bird population stocks. The intake factor means the chicks or breeding rate of the bird. Meanwhile, the output rate means the rate of decline in bird population, due to bird mortality, the effect of various causes, such as aging and/or disease, due to environmental pressures from increasing human activities (Rumanasari et al. 2017; Nurdin et al. 2018) such as habitat destruction and/or loss, the consequences of poaching of birds to be raised, traded and contested in cities. Therefore, it is necessary to make efforts to preserve birds so that they can be beneficial in a sustainable manner. In fact, bird-keeping in Indonesia has been at a level that requires conservation practice such as market-based conservation because Indonesia is assumed to be quite active in bird economy (Jepson and Ladle 2005;

Indraswari et al. 2020). There are several conservation efforts that can be done by humans as a form of responsibility for the preservation of bird species such as broadening discipline for conservation and developing social science experience (Newing et al. 2011). The existence of birds in a tourist area requires conservation efforts by providing education to tourists who come (Kamaludin et al. 2019).

Ethno-ornithology as a trans discipline has evolved over the past several decades, bringing together nature conservation and the TEK system in ecological management and biodiversity conservation (Pam 2017). It leads to forming common or vernacular names that are only based on community’s imagination, or, in other words, without systematization (Loss et al. 2014). Moreover, it is suggested that conservation effort through ethno-ornithological approach is the realistic method as it involves local knowledge system (Alcantara-Salinas et al. 2013). This paper aimed to determine the conservation status and Traditional Ecological Knowledge (TEK) of bird traders on bird species traded, based on a case study in Depok bird market, Surakarta (Solo), Central Java, Indonesia. We desire that this paper contributes to policymaking and effective measures regarding conservation of bird species.

MATERIALS AND METHODS

Study sites

This study took place in bird market of Depok, Surakarta (Solo), Central Java, Indonesia from December 2020 to January 2021. Depok bird market is located on Jalan Depok No. 14, Manahan, Banjarsari, Surakarta City, with administrative boundary maps of the city shown in Figure 1.

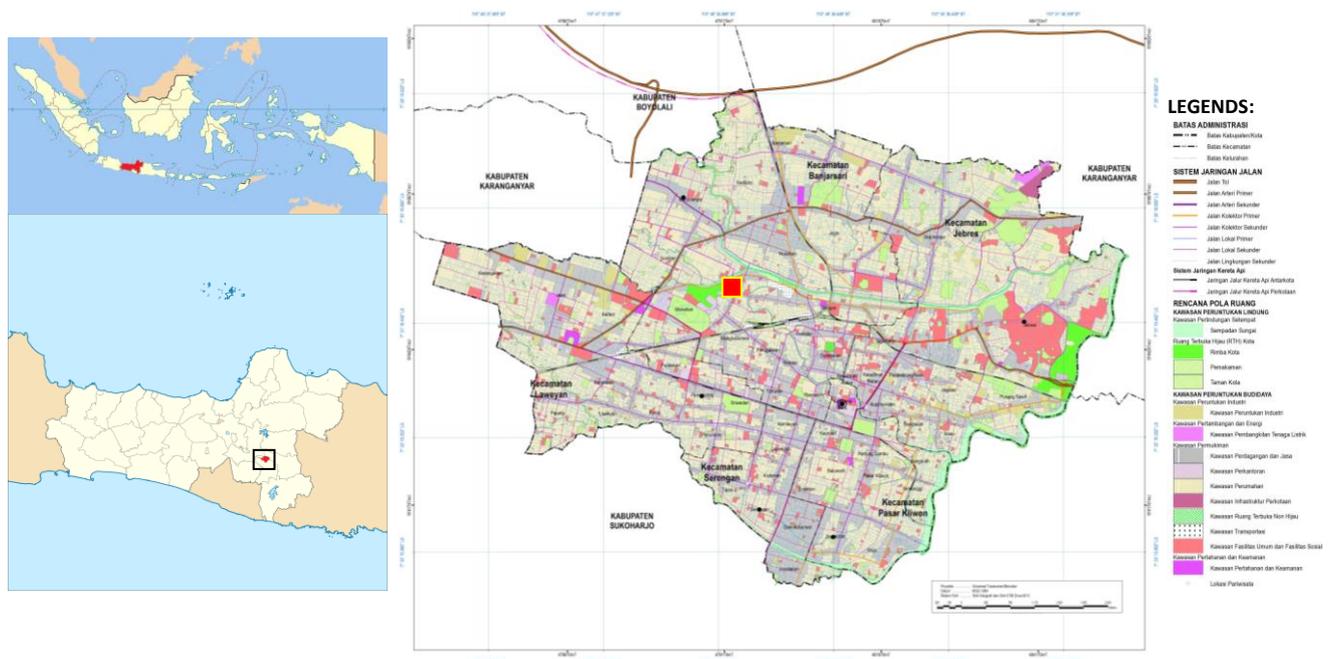


Figure 1. Study area in Depok bird market (■), Surakarta, Central Java, Indonesia (Bappeda Surakarta, <https://intip.surakarta.go.id/album-peta>)

Surakarta City is geographically located between latitudes of 7°36'00" and 7°49'30" South and between longitudes of 110°45'15" and 110°45'35" East. Depok bird market is geographically located at 7°33'09.0" E and 110°48'37.7" S. This market has a total area of 17.662 m² and consists of 3 zones, which are the front zone, the side zone, and the back zone (Figure 2). Besides birds as the main selling point, this market also provides various other pets, such as rabbits, cats, and dogs.

According to direct survey, Depok bird market has 481 traders, consisting of 64 stall traders, 226 non-permanent stall traders, and 183 traders without stalls. The other facilities found in this market are 5 toilets, 1 praying place, and 1 security post. The species of birds traded in Depok bird market are usually kept in cages placed inside the stalls. The bird cages are usually taken out from the stalls and hung in front of the stall in order to let the birds get the morning sunlight. During the daytime, the bird cages are moved to a place with a little sunlight. In the afternoon, the birdcages will be put in the closed stall. Besides selling bird species, the bird traders also sell various tools and utensils such as nest boxes, cages, wooden sticks or bamboo bird perches, bird foods, medicines, vitamins, and others sold in the stalls (Figure 3). Other activities in the bird market, include selling and buying birds and others can be seen in Figure 4)

Research procedures

This study used qualitative with ethnoornithology approach method, which is a branch of ethnozoology merged from the ethnosciences field to seek and understand people's different perspectives and interaction with faunal or avifaunal resources through history. The ethnoornithology focused on the TEK or the Local Knowledge (LK) of birds, also culturally mediated relationships between communities and other animals in the environment. Local people's knowledge begins with animal nomenclature and classification in the local idiom.

Bird survey/observation

The study collected data from the field using some techniques such as observation/survey and semi-structured interviews. Observation was used in order to observe the general condition of the Depok bird market. For observation the researchers visited the Depok market firstly in the morning, when every bird trader started to work or began to open the stalls, also to take out the bird cages or hang them. This observation consisted of two methods: (i) participant observation in which researchers were actively involved in some activities of bird traders, including providing bird foods, and (ii) non-participant observation in which researchers observed the general condition of bird market and various activities of bird traders' and buyers' activities. The field research observations took about 2 months. Firstly, the researchers visited bird traders to introduce themselves and to ask for permission to do the research on the bird market; this included asking the local authority of the bird market service for permission. In this survey species, diversity and its abundance are counted and photographed. Bird species with more than 100 individuals

are categorized as dominant.

In-depth interview

The semi-structured interview or can be called in-depth interview was used with competent respondents purposively selected by using snowball technique. This snowball technique was used to explore who are the suitable competent informants or the local expert as bird traders in the Depok market's bird trader community. Therefore, the researchers could choose the local experts who represented the individuals who are socially legitimized and have particular knowledge. The steps started with the initial contact with the bird trader community, identified the first expert, and after that this expert indicated another expert, until all the Depok's bird market community experts were involved. Researchers interviewed 15 people consisting of 10 sellers, three buyers, and two people who acted as middlemen. All are male. The average age level of these respondents is between 20 and 53 years old. In these semi-structured interviews, people were asked about the species of birds being sold, the origin/source of the birds being sold, the price, the popularity of the birds being traded and the profits earned (Figure 5). The interview information was recorded using a voice note and field notebook.

Data analysis

Primary data of this study were obtained from observation/survey and semi-structured interviews. The predominant semi-quantitative data and non-numerical data-most commonly either words or pictures were analyzed, which made critical analysis and construction of a narrative count. The qualitative analysis involved cross-checking, summarizing, and synthesizing from sources to build up a narrative account. Cross-checking was undertaken by checking data to validate data, namely researchers used triangulation that is comparing the data of observations/surveys with data obtained from interviews. The researcher compared the interview data from one informant to another. Bird species were identified using Mackinnon et al. (2010). The conservation status of the birds was referred to IUCN RedList (Kasambe 2014; <https://www.iucnredlist.org/>) and Appendix II of CITES ([cites.org](https://www.cites.org)) for international status, as well as Indonesian Ministry of Environment and Forestry Regulation (Permen LHK No. P.20/MENLHK/setjen/Kum.1/6/2018) for national status.

RESULTS AND DISCUSSION

Bird species traded

Direct observation/survey and interview with bird traders managed to record 55 bird species, representing 29 families sold in the bird market of Depok (Table 1). The bird diversity in the bird market of Depok was slightly higher than that of bird market in Bogor, West Java (54 species) but lower than that of bird market of Pasty, Yogyakarta (106 species) (Iskandar et al. 2020). This result is also less than studies in the Sukahaji bird market,

Bandung (128 species) and the Splendid bird market, Malang (116 species) (Iskandar et al. 2019).

In addition, the ratio of dominant and non-dominant bird species is similar (27 and 28 species respectively). Some of the non-dominant species are protected species. Therefore, it can be inferred that although some birds in Indonesia have been protected, there is no guarantee that those species can survive in their natural habitat or ecosystem because illegal hunting and trade in rare and protected bird species continue in many regions (Hakim et al. 2020).

The most common birds traded in this market were of family Muscipidae, consisting of 7 species (Figure 5), followed by Columbidae, Pycnonotidae, Sturnidae, and Timaliidae that shared the same number (4 species), then Cuculidae, Pistacidae, Psittaculidae, and Turdidae only represented by 2 species. Moreover, the rest families only consisted of one species each. A similar result from a study carried out in several local markets in Laos found that the largest number of species traded belong to family Muscipidae (Xayyasith et al. 2020).



Figure 2. A. The front zone; B. the side zone; and C. the back zone of Depok bird market, Surakarta, Central Java, Indonesia

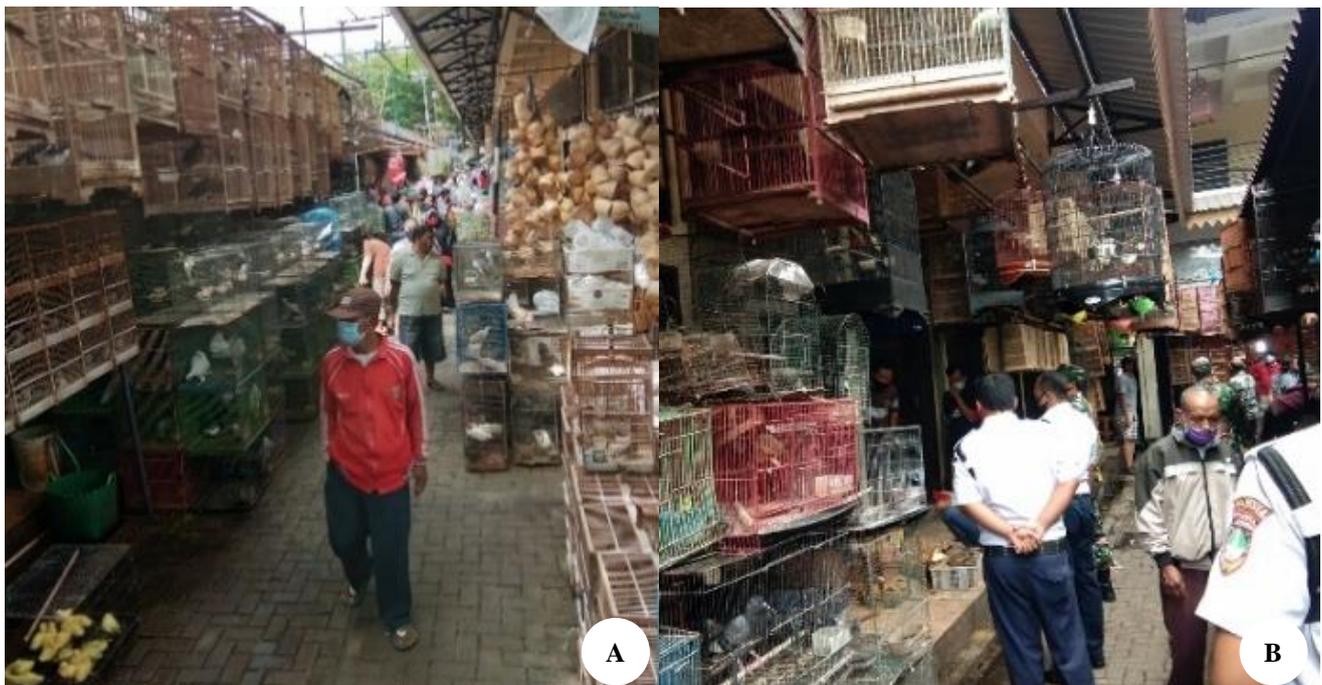


Figure 3. A. Birds are put in the cages; B. various products that are sold in Depok Depok bird market, Surakarta, Central Java, Indonesia



Figure 4. Activity of bird traders and bird buyers



Figure 5. Field research processes. A. The identifying bird species; B. The interviewing the community of traders, buyers and others

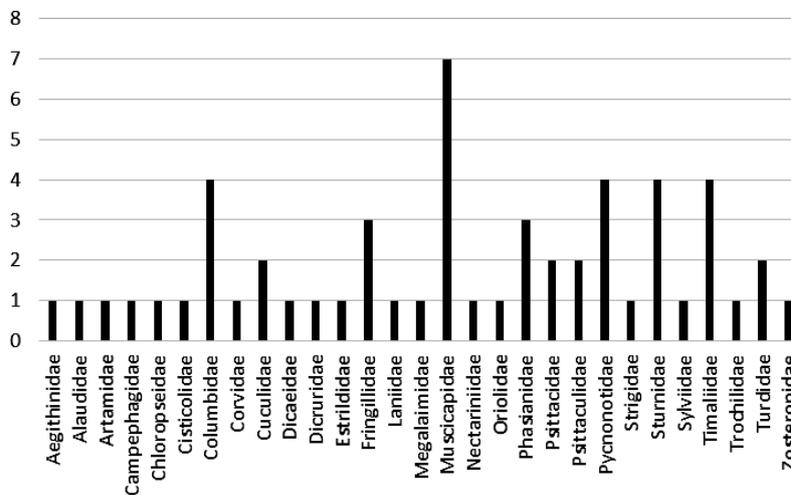


Figure 5. Families of birds offered in Depok bird market, Surakarta, Central Java, Indonesia

Table 1. Various birds encountered in the bird market of Depok, Surakarta, Central Java, Indonesia based on conducted the field research December 2020 and January 2021

Family	Species	Indonesian name	Common name	Bird sources	Selling price (Rupiah)	IUCN Conservation status	App. II of CITES	Permen LHK No.P.20/2018	Endemicity *)	Population (**)
Aegithinidae	<i>Aegithina tiphia</i>	Cipoh kacat	Common lora	Wild hunting	250.000-300.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Alaudidae	<i>Mirafra javanica</i>	Branjangan	Horsfield's bushlark	Wild hunting	200.000-1.500.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Artamidae	<i>Artamus leucorhynchus</i>	Kekep babi	White-breasted woodswallow	Wild hunting	70.000-200.000	Least Concern	-	Unprotected	Endemic ¹⁾	Non-dominant
Campephagidae	<i>Lalage nigra</i>	Kapasan	Pied triller	Wild hunting	40.000-65.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Chloropseidae	<i>Chloropsis sonnerati</i>	Cucak hijau	Greater green leafbird	Wild hunting	500.000-3.000.000	Endangered	-	Protected	Non-endemic	Non-dominant
Cisticolidae	<i>Prinia familiaris</i>	Cimblek	Bar-winged prinia	Wild hunting	80.000-500.000	Near Threatened	-	Unprotected	Non-endemic	Dominant
Columbidae	<i>Columba livia</i>	Merpati	Rock dove	Breeding	20.000-50.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Columbidae	<i>Geopelia striata</i>	Perkutut	Zebra dove	Breeding	45.000-200.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Columbidae	<i>Spilopelia chinensis</i>	Tekukur	Eastern spotted dove	Breeding	10.000-80.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Columbidae	<i>Treron vernans</i>	Punai	Pink-necked green-pigeon	Wild hunting	30.000-40.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Corvidae	<i>Corvus corone</i>	Gagak	Carrion crow	Wild hunting	1.300.000-2.000.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Cuculidae	<i>Cacomantis merulinus</i>	Kedasih	Plaintive cuckoo	Wild hunting	150.000-450.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Cuculidae	<i>Centropus sinensis</i>	But-but	Greater coucal	Wild hunting	55.000-600.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Dicaeidae	<i>Dicaeum trochileum</i>	Cabe jawa	Scarlet-headed flowerpecker	Wild hunting	20.000-80.000	Least Concern	-	Unprotected	Endemic ¹⁾	Dominant
Dicruridae	<i>Dicrurus macrocercus</i>	Srigunting	Black drongo	Wild hunting	200.000-550.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Estrildidae	<i>Lonchura leucogastroides</i>	Pipit bondol	Javan munia	Wild hunting	2.000-3.000	Least Concern	-	Unprotected	Endemic ²⁾	Dominant
Fringillidae	<i>Serinus atrogularis</i>	Kenari teng-gorokan hitam	Black-throated canary	Breeding	600.000-2.000.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Fringillidae	<i>Serinus canaria</i>	Kenari	Island canary	Breeding	170.000-2.500.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Fringillidae	<i>Serinus leucopygius</i>	Sanger	White-rumped seedeater	Breeding	450.000-1.500.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Laniidae	<i>Lanius schach</i>	Cendet	Long-tailed shrike	Wild hunting	50.000-250.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Megalaimidae	<i>Megalaima lineata</i>	Bultok	Lineated barbet	Wild hunting	350.000-800.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Muscicapidae	<i>Brachypteryx leucophrys</i>	Cingcoang	Lesser shortwing	Wild hunting	30.000-250.000	Not Evaluated	-	Unprotected	Non-endemic	Dominant
Muscicapidae	<i>Copsychus fulvicatus</i>	Murai india	Indian robin	Wild hunting	1.500.000-10.000.000	Not Evaluated	-	Unprotected	Non-endemic	Non-dominant
Muscicapidae	<i>Copsychus saularis</i>	Kacer	Oriental magpie-robin	Breeding	350.000-2.000.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Muscicapidae	<i>Cyornis rufigaster</i>	Tledakan	Mangrove blue-flycatcher	Wild hunting	35.000-250.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Muscicapidae	<i>Cyornis sanfordi</i>	Sikatan	Matinan flycatcher	Wild hunting	30.000-80.000	Endangered	-	Protected	Non-endemic	Non-dominant
Muscicapidae	<i>Erithacus rubecula</i>	Robin	European robin	Wild hunting	250.000-800.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Muscicapidae	<i>Saxicola caprata</i>	Decu	Pied bushchat	Wild hunting	100.000-350.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Nectariniidae	<i>Leptocoma sperata</i>	Kolibri	Purple-throated Sunbird	Wild hunting	20.000-350.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Oriolidae	<i>Oriolus chinensis</i>	Kepodang	Black-naped oriole	Wild hunting	550.000-1.500.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Phasianidae	<i>Coturnix ypsilophora</i>	Puyuh	Brown quail	Breeding	10.000-30.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Phasianidae	<i>Gallus gallus</i>	Ayam	Red junglefowl	Breeding	70.000-120.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Phasianidae	<i>Meleagris gallopavo</i>	Kalkun	Wild turkey	Breeding	75.000-350.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant

Psittacidae	<i>Eclectus roratus</i>	Nuri	Moluccan eclectus	Wild hunting	700.000-900.000	Least Concern	-	Protected	Non-endemic	Non-dominant
Psittacidae	<i>Melopsittacus undulatus</i>	Parkit	Budgerigar	Breeding	100.000-550.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Psittacidae	<i>Agapornis</i> sp.	Lovebird	Lovebird	Breeding	35.000-1.500.000	Least Concern	✓	Unprotected	Non-endemic	Dominant
Psittacidae	<i>Psittacula alexandri</i>	Bayan	Red-breasted parakeet	Wild hunting	400.000-700.000	Near Threatened	✓	Protected	Non-endemic	Non-dominant
Pycnonotidae	<i>Alophoixus bres</i>	Cucak jenggot	Brown-cheeked bulbul	Wild hunting	400.000-500.000	Endangered	-	Unprotected	Endemic ³⁾	Non-dominant
Pycnonotidae	<i>Pycnonotus aurigaster</i>	Kutilang	Sooty-headed bulbul	Wild hunting	20.000-35.000	Least Concern	-	Unprotected	Endemic ⁴⁾	Dominant
Pycnonotidae	<i>Pycnonotus jocosus</i>	Kutilang jambul	Red-whiskered bulbul	Wild hunting	90.000-100.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Pycnonotidae	<i>Pycnonotus melanicterus</i>	Kutilang emas	Black-capped bulbul	Wild hunting	35.000-50.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Strigidae	<i>Otus angelinae</i>	Celepuk jawa	Javan scops-owl	Wild hunting	70.000-150.000	Not Evaluated	-	Protected	Endemic ⁵⁾	Dominant
Sturnidae	<i>Acridotheres javanicus</i>	Jalak hitam	Javan myna	Breeding	75.000-150.000	Vulnerable	-	Unprotected	Endemic ⁴⁾	Dominant
Sturnidae	<i>Acridotheres melanopterus</i>	Jalak putih	Black-winged myna	Breeding	1.500.000-3.500.000	Critically Endangered	-	Unprotected	Endemic ⁶⁾	Dominant
Sturnidae	<i>Gracula religiosa</i>	Beo	Common hill myna	Wild hunting	1.500.000-3.000.000	Least Concern	✓	Protected	Non-endemic	Non-dominant
Sturnidae	<i>Gracupica contra</i>	Jalak suren	Asian pied starling	Breeding	350.000-875.000	Least Concern	-	Protected	Non-endemic	Dominant
Sylviidae	<i>Phylloscopus trivirgatus</i>	Tralisan	Mountain warbler	Wild hunting	60.000-100.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Timaliidae	<i>Garrulax canorus</i>	Wamby	Chinese hwamei	Breeding	2.000.000-6.500.000	Least Concern	✓	Unprotected	Non-endemic	Non-dominant
Timaliidae	<i>Garrulax chinensis</i>	Poksay hitam	Black-throated laughingthrush	Wild hunting	300.000-3.000.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Timaliidae	<i>Leiothrix argentauris</i>	Panca warna	Silver-eared mesia	Wild hunting	100.000-200.000	Least Concern	✓	Unprotected	Non-endemic	Non-dominant
Timaliidae	<i>Malacocincla sepiaria</i>	Pelanduk semak	Horsfield's babbler	Wild hunting	100.000-250.000	Least Concern	-	Unprotected	Endemic ⁴⁾	Dominant
Trochilidae	<i>Anthreptes malacensis</i>	Madu kelapa	Brown-throated sunbird	Wild hunting	35.000-75.000	Least Concern	-	Unprotected	Non-endemic	Dominant
Turdidae	<i>Geokichla citrina</i>	Anis merah	Orange-headed thrush	Breeding	850.000-2.500.000	Least Concern	-	Unprotected	Non-endemic	Non-dominant
Turdidae	<i>Geokichla interpres</i>	Anis kembang	Chestnut-capped thrush	Breeding	700.000-2.000.000	Endangered	-	Unprotected	Non-endemic	Non-dominant
Zosteropidae	<i>Zosterops palpebrosus</i>	Kacamata telor	Indian white-eye	Wild hunting	40.000-350.000	Least Concern	-	Unprotected	Endemic ⁴⁾	Dominant

Note: *) Endemicity: 1. Rahadian et al. (2018), 2. Kurnianto and Kurniawan (2013), 3. Herliansyah and Fitria (2018), 4. Sheldon et al. (2015), 5. Izzati and Hasibuan (2019), 6. Vernia et al. (2018). **)Dominan: > 100 individuls, non dominant <= 100 individuals. ✓ = listed in Appendix II of CITES

Conservation status and endemism of birds traded in Depok Market

The Depok market traded 55 bird species from 29 families. Out of these species checklists, a species is listed as critically endangered, 4 species as endangered, a species in vulnerable category, 2 species in near threatened status, and the remaining species in the least concern and not evaluated according to IUCN Red List (Kasambe 2014). In addition, 10 species are endemic to Indonesia (Table 1).

IUCN RedList

This study found a critically endangered bird species traded in Depok market, namely *Acridotheres melanopterus* that is also prohibited from being traded according to the Indonesian government regulation. Even though this species is worth relatively high (about Rp. 1.500.000-3.500.000), it could be easily encountered in this market, indicating that the demands from the consumer are also high. Study conducted by Shepherd et al. (2015) stated, the most significant selling number of *A. melanopterus* was in Jakarta bird markets in the price range of Rp. 2.500.000-3.000.000 each. This species, commonly known as Black-winged Myna, is considered as a species with a higher price compared to another species for instance *Lanius schach* (Nijman et al. 2021a). *A. melanopterus* has experienced dramatically declining trend since it was listed in Least Concern category by 1998, yet the status has been worsening recently (Nijman et al. 2017). In addition, in Depok market, there were four species listed as endangered species in IUCN Red List, namely *Geokichla interpres*, *C. sonnerati*, *C. sanfordi*. Unfortunately, only 2 out of 4 are protected by the nation rule. They are worth between Rp. 400.000 to Rp. 3.000.000, while *C. sanfordi* is the exception as it can be purchased only with Rp. 30.000-80.000.

Subsequently, *Acridotheres javanicus* which has been listed as vulnerable species can be easily encountered in this market. It used to be everpresent mainly in Malaysia and Singapore, but currently, it is rare to be encountered in the wild, even on its origin in Java (Chng et al. 2016). The rapid decline might be caused by over-capture and trading in the past years, and it has been declared by Irham et al. (2020) in their study in Jambi by 2017, *A. javanicus* or locally known as *Jalak hitam* became the highest traded species sold more than 2500 individuals. Aside from that, *Psittacula alexandri* status has been raised from least concern to near threatened due to its declining population (Kasambe 2014). In Indonesia, this species is categorized as a protected animal, yet it still can be found traded in bird market and is worth from Rp. 400.000 to Rp. 700.000. Another species considered as least concern was *Geokichla citrina*. This species sale in Bali market showed an increasing trend in the past years and it might be soaring high in the future (Chng et al. 2018). Although this species had a low abundance in the Depok market, the increasing trend might occur if there is no strict regulation to fulfill the community demands.

Most of the birds traded in this market were least concern and widely available. However, there is still any possibility of downward trend in the number of species in

the future. It has been predicted in a study by Yohanna et al. (2021) carried in Jambi market. It showed that unprotected birds became less available on market during five-year investigation that might be caused by overharvest of those species in nature. The government rules only drive captivity shifting from protected species to unregulated species, without completely stopping the species overexploitation (Nijman et al. 2021a).

Appendix II of Cites

At the Depok bird market, 5 bird species categorized in Appendix II of Cites, namely *Garrulax canorus*, *Psittacula alexandri*, *Agapornis* sp., *Gracula religiosa*, and *Leiothrix argenteauris*.

Garrulax canorus encountered during this survey is included in Appendix II of CITES although the status is least concern based on the current IUCN assessment. It was the Chinese government that proposed *G. canorus* or Chinese Hwamei, which is native to this country and Vietnam, be listed in Appendix II due to surge of international trading (Shepherd et al. 2020). Years later, based on that study, the export trend mainly from China and Hong Kong has declined extensively because of the implementation of this rule along with local regulation.

Permen LHK P.20/2018

Seven bird species traded in Depok market are protected by the Indonesian Ministry of Environment and Forestry Regulation No. P.20/ MENLHK/setjen/Kum.1/6/ 2018. Those species are *Otus angelinae*, *P. alexandri*, *A. melanopterus*, *Chloropsis sonnerati*, *Cyornis sanfordi*, *Eclectus roratus*, and *G. religiosa* (Figure 6). Those species were mostly less abundant in Depok market, so those are defined as non-dominant (Table 1). According to the rule, those protected birds are prohibited to raise and trade both in the forms of living birds or dead specimens without permission from the government (Department of Forestry 2007). However, *G. religiosa* became one of the most popular pets in several major cities in Indonesia and it is called a unique species (Jepson and Ladle 2009). There is no doubt that although some species have been protected by law in Indonesia, those species are still predominantly sold in many bird markets.

Endemism

Regarding endemism, 10 species are considered as native to Indonesia, namely *Artamus leucorhynchus*, *Dicaeum trochileum*, *Lonchura leucogastroides*, *Alophoixus bres*, *Pycnonotus aurigaster*, *O. angelinae*, *A. melanopterus*, *A. javanicus*, *Malacocincla sepiaria*, and *Zosterops palpebrosus*. However, only one of them is protected under Indonesian regulation. Herliansyah and Fitria (2018) reported that *A. bres* was profoundly affected by clear-cutting activity in Central Kalimantan. The result was similar to the *M. sepiaria* that significantly impacted not only by logging activity but also by parasites (Messina et al. 2021). On the other hand, increasing demand for *O. angelinae* (Javan scops-owl) was reported to be caused by the popularity of Harry Potter movies that depicted owls as companions (Nijman and Nekaris (2017).

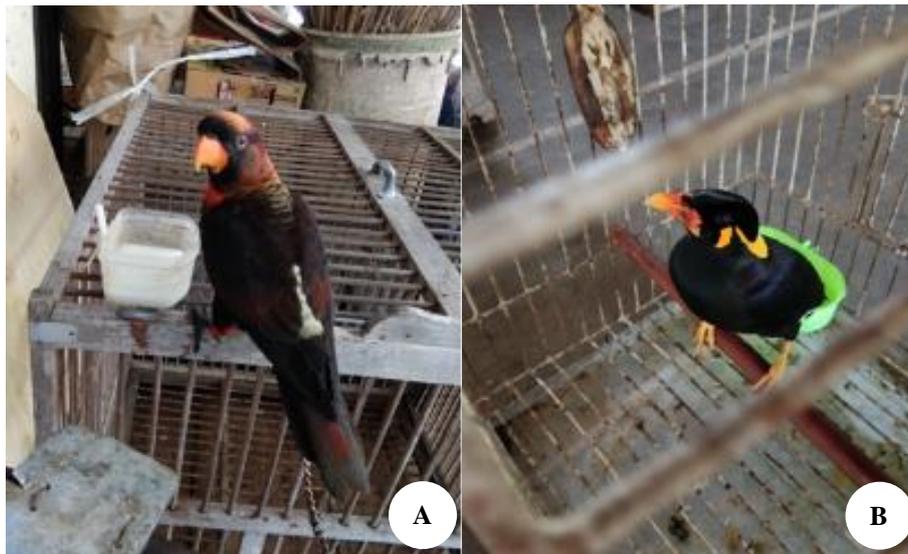


Figure 6. A. *Eclectus roratus*; B. *Gracula religiosa*

Potential invasiveness

Bird invasiveness in Indonesia is rarely discussed. Yap and Sodhi (2004) reviewed bird invasiveness in Southeast Asia. According to their study, 6 bird species in the Depok market are potentially invasive, namely: *A. javanicus*, *Columba livia*, *Geopelia striata*, *P. alexandri*, *Pycnonotus aurigaster*, and *Pycnonotus jocosus*.

Yap and Sodhi (2004) include *P. alexandri* in the list of invasive bird species. This bird can escape from the cage, and inhabit secondary forests, woodland near cultivated areas, and mangroves. It can form flocks and settle in an area. It feeds on seeds, nuts, fruits, berries, flower nectar, and leaf buds. The nest is hole, commonly in trees; lay 3 to 4 eggs. Potential as a pest of rice plants. Ironically, *P. alexandri* is a threatened species, which is categorized as near threatened by IUCN, included in Appendix II by Cites and classified as a protected species by Indonesian Ministry of Environment and Forestry Regulation (No. P.20/MENLHK/setjen/Kum.1/6/2018).

Meanwhile, *G. striata* is convincing and possible to be approached by humans, and well adapted to exploiting human-altered habitats. *C. livia* has strong commensal bonds with humans; considered a nuisance because it fouling of buildings and other structures with its droppings; can become agricultural pests; but also useful as food, bioindicator and for the study of avian biology. *A. javanicus* is tolerant of human presence; disturbing human occupants near communal nests; its droppings contaminate buildings and cars. *P. aurigaster* and *P. jacobsus* have both beneficial and detrimental impacts on agriculture and forestry. They can cause some damage to fruit and vegetable gardens, but also suppress the growth of insect pests (Yap and Sodhi 2004). Basically, invasive bird species are birds that adapt to human-altered habitats and cause harm.

Selling price

The price of a bird in Depok market varied from Rp. 2000 to Rp. 10.000.000. The cheapest species was *Lonchura leucogastroides*, only valued at Rp. 2000-Rp. 3000 each individual (Table 1). This species commonly known as Javan munia is endemic to Indonesia (Kurnianto and Kurniawan 2013) and is widely spread mainly in the west area of this country. Its vast distribution is due to excellent adaptability as this species does not require a particular area and nest material for nesting.

On the contrary, *Copsychus fulicatus* became the most costly bird species in Depok market, reaching up to Rp. 10.000.000 per individual followed by *G. canorus* as the second most expensive during this study that was individually offered from Rp. 2.000.000 to Rp. 6.500.000. Both are non-native species.

According to the direct survey, the factors determining the bird price are mostly the attractiveness of the bird's singing, feather color and behavior. These results were in accordance with studies of Regueira and Bernard (2012) and Chng et al. (2016) that bird price does not have a relation with their conservation status, but it is mostly determined by the bird's physical appearance and voice. In contrast, a study conducted by Siriwat and Nijman (2020) stated that bird price has a strong correlation with the IUCN status. It means as the species has a declining trend in its abundance in nature, it will be offered at a higher cost. Besides, the price is also determined by the bird's conditions. Generally, the bird which is caught from wild nature and directly sold to the bird markets will have a cheap price, although it is categorized as the songbirds because the trader or bird hunter does not need to take care of the new bird as it is immediately sold. Caring for new bird requires a huge effort to provide its food and poses a high risk that the bird gets sick or dies due to its inability to adapt to living in a cage; this risk has an impact on its price. As stated by Peng and Broom (2021), 75-90% of

wild-caught birds die before the point of sale. This argument is supported by the finding of Wiedarti et al. (2016) that maturity and adaptive aspects also cause the price range in bird trading to become much higher. Gender is also mentioned as a determinant factor of bird prices in Depok market. Male birds are more expensive than female because they have more attractive feather color and have more pleasant voices that makes them usually involved in the bird song contest. A study by Dai and Zhang (2017) mentioned the same result that male birds are considered more expensive compared to females because they have better singing abilities.

The bird species traded on the bird market can also be classified by bird traders into two main groups: songbirds and non-songbirds. This finding is supported by de Oliveira et al. (2020) research conducted in Brazil showing that there was a classification of birds based on their vocalization because the voice is the major determinant for buyer decision-making to purchase birds and is essential for traders to determine the price. Grouping the birds based on certain criteria can facilitate the buying and selling process. Various species of birds traded in the Depok bird market involved in contest included *C. fulvicatus*, *C. saularis*, *Agapornis* sp., *C. sonnerati*, *P. familiaris*, *S. canaria*, *L. sperata*, and *Z. palpebrosus*. Three of them were encountered in songbird competition in Jabodetabek area (Angguni et al. 2020) with the most common bird found being *Agapornis* sp. In Depok market, those birds were sold at a price range of Rp. 20.000 to Rp. 10.000.000 (Table 2), with *L. sperata* became the cheapest songbird. The traders suggested that the price offered also depends on achievement they get in songbird competitions.

Another contest is flying race, which is usually involving *C. livia*. Referring to the bird traders in Depok market, *C. livia* or Doves are separated from their capability on flying competition: ordinary and racing dove. The members from the former group are never involved in flying races, while the latter group usually consists of doves which have participated in racing contests. Furthermore, racing doves can also be divided into two groups by their flying abilities, which are tall flying and low flying racing doves. The tall flying racing dove can fly about 150 m above the ground, while the low flying racing dove can only fly about 2-3 m above the ground (Zebua et al. 2016). There are many urban citizens that are fond of this bird racing, hence the dove species are widely traded in most bird markets. Choosing the winner of a certain bird flying racing takes several rounds, the winner of bird competition usually has an increased selling price.

Market sustainability

Based on marketed bird sources, only one-third of bird species (18 out of 55) come from breeding farms, the rest come from wild hunting (Table 1). The dominance of the bird supply from wild hunting is very concerning for the sustainability of trade, because the numbers cannot be ascertained and can accelerate the extinction of birds in the wild. Therefore, it is necessary to increase the supply of birds from breeding farms.

Table 2. Species of birds traded in Depok bird market involved in songbird contests

Bird species	Selling price (Rupiah)	Conservation status
<i>Leptocoma sperata</i>	20.000-350.000	Least Concern
<i>Agapornis</i> sp.	35.000-1.500.000	Least Concern
<i>Zosterops palpebrosus</i>	40.000-350.000	Least Concern
<i>Prinia familiaris</i>	80.000-500.000	Near Threatened
<i>Serinus canaria</i>	170.000-2.500.000	Least Concern
<i>Copsychus saularis</i>	350.000-2.000.000	Least Concern
<i>Chloropsis sonnerati</i>	500.000-3.000.000	Endangered
<i>Copsychus fulvicatus</i>	1.500.000-10.000.000	Not Evaluated

Most endangered bird species in this market that are listed in the IUCN, Appendix II or Permen LHK P.20/2021 originate from wild capture; but some are from breeding captivity, namely *A. melanopterus* (CR) and *G. interpres* (En). *A. melanopterus* is the dominant species in this market. Meanwhile, *C. sonnerati* (CR), *C. sanfordi* (CR), and *A. bres* (CR) were still obtained from wild hunting. The last two species are also listed as protected species by Permen LHK P.20/2021. Other bird species protected by this regulation but still supplied from wild hunting are *E. roratus*, *G. religiosa*, and *P. alexandri*. The last two species are also listed in Appendix II of Cites. Another species that is also listed in Appendix II but is traded from wild hunting is *L. argentauris*. Meanwhile, *Agapornis* sp. and *G. canorus* that also listed in Appendix II, were obtained from breeding captivity. *Agapornis* sp. is the dominant species in the market.

The source of birds is very crucial for the sustainability of trading system in the bird market. The supply of birds that rely on wild hunting is particularly vulnerable due to the decline in bird populations in rural ecosystems, which are the main suppliers for the bird market. Therefore, the source of birds from breeding captivity should be increased. Bird trade in the bird market must be based on the concept of sustainable development, both economically, socially, and environmentally (Iskandar et al. 2019).

Naming and bird classification

Depok market is situated in Central Java, thus bird naming is highly associated with the Javanese culture. Birds are called *manuk* in Javanese and *burung* in Indonesian. Referring to Forth (2015), ethnographic conversation generated bird information in small communities, thus it can vary from one location to another. Traditional folk is suggested to have a profound role in the naming of bird species as well, such as found in Agnihorti and Si's (2012) study in an ethnic group of India named Solega regarding how a companion between birds and humans was depicted in folklores impact on bird ethnobiological nomenclature. In line with that, most birds traded at the Depok bird market have local names that have been passed from generation to generation. The naming of species is based mainly on bird vocalization, feather color, morphological characteristics, habitat, and distinctive behavior. It can be seen that most bird folk taxonomy

involves sensory observation of specific features, and thus it is easy to remember.

The birds can be classified locally by informants (folk classification) based on its voice, then the given name usually imitates or is similar to the regarded species. For instance, *S. chinensis* are called *Tekukur* because it sounds *Terkukuuu...kuk...Terkukuuu...kuk*. Moreover, *Aegithina tiphia* traditionally known as *Cipoh kacat* as a result of the voice it has (*Ciiii-paw*) (Muhammad et al. 2020). *Pipit bondol* is a name referring to *L. leucogastroides* because it sounds *Priit.....Priitt...Priitt*. All these common local names are based on the voices the people have traditionally heard according to the local Javanese community.

Several species of birds are named based on their feather color. Commonly, the name consists of the type of color that the bird has. For example, *C. sonnerati* is widely known as *cucak ijo* (*ijo* means green) as its feathers is dominated by green color. *Panca warna* is a name referring to *L. argentauris* (*Panca* means five and *warna* means color) because this species has feathers with multiple pigmentations. Subsequently, *A. melanopterus* is called *jalak putih* because its body and wings are white (Vernia et al. 2018). *Cabe Jawa* (*D. trochileum*) has bright red or orange on its chest (Rahadian et al. 2018), thus people find it is similar to *cabe* (chili) color and *Jawa* refers to its origin which is native to this region. Moreover, *kapasan* is a common name of *L. nigra* as people consider its color, which is dominated by clean white, is quite similar to the color of *kapas* (cotton). The similarity of special feature on *Z. palpebrosus*, which is white circle around the eyes, with eyeglasses which means in Indonesian is *kacamata* makes this species traditionally known as *kacamata*.

Morphological characteristic is also useful in naming bird species. *A. bres* is commonly called *cucak jenggot* because it has particular white characteristic on its chin and looks like beard (*jenggot*). Similarly, *Pycnonotus jocosus* with a pointed black crest leads to its local common name as *kutilang jambul* (*jambul* means crest).

Bird naming according to the habitat that has been mentioned also refer to *O. angelinae* as *Celepuk Jawa* because it is from Java Island. In addition, *Murai India* is a common name to call *C. fulicatus* because this bird is native to Indian subcontinent region (Praveen et al. 2020). Distinctive behavior is also a factor in bird naming. *Anthreptes malacensis*, for instance, is commonly known as *burung madu kelapa* because of its role as pollinator and it only eats *madu* or nectar (Ayat and Tata 2015). *A. malacensis* frequently encountered amongst flowers and flowering trees.

Apart from mentioned factors, the current trend also leads the way people named certain species. As Harry Potter movies gained huge popularity in Indonesia, lots of bird traders offered wide range of owl species and called them as *Burung Harry Potter* or *Harry Potter birds* no matter of what species they were (Nijman and Nekaris 2017).

Market chain system and conservation implication

The supply of birds in this market comes from both breeders and also bird hunters. They sell their captive

breeding birds to traders at a standard price, and then the bird sellers resell them at a higher price. However, bird supply from breeders only accounts for approximately 30% since only a small number of them offer their captive birds, whereas the number of birds that come from hunters is relatively large as suppliers come from different regions. Thus, birds sold in this market are commonly caught from the forests. Merchants collect huge orders because they anticipated the number of deaths during the trip as the birds traded usually come from other cities where the population is still high. Then, the rest of birds offered come from local community with a percentage of around 10%. We obtained this fact from a bird trader who has been selling at the bird market in Depok for several years.

Local inhabitants do bird hunting only on a small scale because the number of bird species that have a selling value has decreased a lot. They hunt for hobbies, fill their spare time, and only few of them consider this activity as a source of income due to unstable demand. In contrast, they prefer to raise and take care of birds themselves as later on, the birds can be sold at a higher price (especially for songbirds). Therefore, local hunters are relatively few compared to hunters from outside the region such as Pacitan, Wonogiri, Banyuwangi, Yogyakarta, Ponorogo, and Malang. Meanwhile, the traders from other islands usually come from Sumatra, Kalimantan and Lombok. The bird hunters in the Depok market stated that every bird they got from hunting must be examined for its quality and classification stage first. In other words, they sorted out which birds were in excellent condition and which that did not meet the criteria, and then sent the high-quality ones to sellers.

There is no doubt that bird keeping and trading have a high correlation with bird diversity in nature. As those activities are deeply rooted in culture, an approach involving cultural aspect needs to be taken into account. Jepson and Ladle (2009) argue that fines and law are considered by Indonesian as the ultimate way to tackle this issue. However, we argue that precaution steps need to be done before applying punishment. Thus, social and cultural involvement is considered to have a bigger impact on bird conservation. For instance, raising people's awareness about the importance of bird's role in nature through education by NGOs or the authorities is expected to lead behavioral change and to discourage people from selling and trading wild-captured birds (Bergin et al. 2017). Another method is using local wisdom approach. *Turdus poliocephalus* or Asian Thrush is considered as a sacred animal in Lawu Mountain, Central Java. It is widely believed that *T. poliocephalus* will acts as a guide to mountain climbers, thus it is prohibited to disturb this bird (Annisa 2018). Additionally, certain animals are protected by customary law as a local belief. *Rhinoplax vigil* or *rangkong* is believed by Rimba tribe in Jambi to have role in delivering messages to the god or a higher being. If this bird is disturbed or even killed, it will get god's curse (Novriyanti et al. 2014). An example from Ethiopia also suggests that local wisdom is also used to make conservation planning of the Northern Ground-hornbill (*Bucorvus abyssinicus*) (Asefa 2021). Those examples are

considered as effective solutions as prevention steps to lowering the bird-killing and hunting rate.

This study concluded that the Depok bird market traded many species of birds, mostly supplied from rural areas and some of them are protected nationally and internationally. This bird trading is deeply rooted in local culture, so the conservation of birds should involve local participation instead of using repressive actions.

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