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Risk of Secondary Extinction in the Asian Songbird Trade, as Exemplified by the Selling of Crested Jayshrikes as Master Birds

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ABSTRACT

The Asian Songbird Crisis—the recognition that trade is the major threat to the conservation of Asian songbirds—has hitherto largely focused on species valued for their singing abilities and those that enter into songbird competitions. To increase the repertoire and variability in the songs of these competition species, competitors use so-called master birds. These are caged near competition birds to train them through vocal mimicry. Here, we focus on one such master bird, the crested jayshrike *Platylophus galericulatus*. Recognizing the negative effect trade has had on wild populations, the Indonesian government added this species to its list of protected species in 2018. We used data from 21 bird markets surveyed between 2011–2018 (119 surveys) and 2018–2025 (105 surveys) to assess whether this legal protection was effective. We recorded crested jayshrikes openly offered for sale, with most surveys documenting one or two individuals. We found a strong contrast between the brown crested jayshrike *P. g. coronatus* from Borneo and Sumatra and the Javan crested jayshrike *P. g. galericulatus*. The former was favored because of its superior singing abilities and more varied, piercing song. Almost three-quarters of individuals traded were brown crested jayshrikes, and they commanded significantly higher prices. Overall, remarkably little change was detected over the 15-year period, and legal protection appears to have had limited effect. We found no significant change in the number of markets offering the species (16 vs. 15), in market-level abundance trends (10 decreases, 5 no change, 6 increases), in temporal patterns, or in prices (brown: US$103 vs. US$110; Javan: US$57 vs. US$41 at the start and end of the study, respectively). The mean abundance decline slightly (1.6 vs. 1.3 birds per survey). Although crested jayshrikes themselves do not enter singing competitions, they are an integral part of the competitive songbird industry as master birds, with thousands caught illegally every year. As a result, they face a risk of extinction driven indirectly by the demand for increasingly complex songs in competing species. These secondary extinctions highlight the need to rethink how best to manage, and where appropriate curb, trade in wild songbirds across Asia.

Summary

In Asia songbirds, many of them sourced from the wild, are used in singing competitions. To increase the quality and complexity of the song, master birds are used; these are species that do not enter into competitions, but they are used to train those birds that do. Master birds are likewise taken from the wild. We investigated the trade of one such master bird, the crested jayshrike, in Indonesia over a 15-year period to see if any changes had occurred over time. Legal protection, implemented midway during our study, had little effect on the availability of crested jayshrikes in the markets or their prices, but it may have had a limited effect on the average numbers for sale. Trade remained completely in the open. The continued trade in crested jayshrikes despite their legal protection, and despite the birds themselves not being valued for their song but only to better the song of other bird species, leads to their increased rarity in the wild. Crested jayshrikes are on a path to secondary extinction and effectively curbing their now illegal trade is essential to prevent this from happening.

- **Practitioner Points**
  - Crested jayshrikes are caught from the wild in the forests of Java, Sumatra and Borneo, to be used as master birds, improving the songs of bird species that compete in singing contests.
  - We found little had changes in their trade over a 15-year period despite the introduction of legal protection midway during our study.
  - Effective enforcement of existing laws, shutting down the open trade in crested jayshrikes in the bird markets, is needed urgently to prevent a secondary extinction.

1 | Introduction

People have traded birds, including songbirds, for a variety of reasons, probably almost as long as people have engaged in economic activities. In Southeast Asia, there has been a long-standing tradition of both keeping songbirds and entering them into songbird competitions (Nash 1993; Jepson and Ladle 2005, 2009; Mirin and Klinck 2021). Given that in the past most, if not all, of these birds were sourced from the wild, increased affordability, expansion of trade networks, and growing popularity of songbird competitions have collectively intensified pressure on wild songbird populations (Eaton et al. 2015). Economic growth in Southeast Asia has been steady, especially since the economic crisis in 1997 (Lee and Hong 2012), and increasing numbers of people now have disposable income to spend on hobbies and leisure activities. Combined with sustained human population growth, this has driven a continuous rise in demand for songbirds. This phenomenon has led to what is now termed the Asian Songbird Crisis, referring to the massive declines and local extinctions of wild songbird populations caused by trade (Harris et al. 2017; Sykes 2017; Marshall et al. 2020; Nijman, Campera, et al. 2021; Lees and Yuda 2022). Indonesia is the epicenter of this crisis, and some of the most heavily affected species are those eligible for entry into songbird competitions. These competitions, where individual caged birds are hoisted up high poles and judged for their vocal performance, are particularly popular in western Indonesia but also occur in other parts of Asia, as well as the Caribbean and South America (Mirin and Klinck 2021). Birds are evaluated based on song quality, song loudness, and song complexity, and on the bird's spirit and endurance.

There is a myriad of ways in which competitors attempt to enhance the singing abilities of their birds (Jepson 2012; J. Iskandar and Iskandar 2015; B. S. Iskandar et al. 2019; J. Iskandar et al. 2020; V. Nijman unpublished data). For some species, this relates to geographic origin, with wild-caught birds from certain islands being favored over others. For other species, there are actual or perceived differences between wild-caught and captive-bred birds. Husbandry practices—including cage type, food, and access to mates—also play a role, as do individual traits such as age, sex, and molting status. Especially in the run-up to a competition, competitors follow highly specific (and often closely guarded) regimes of feeding and bathing to maximize performance. One peculiar aspect of these singing competitions is the role of so-called master birds (burung masteran). These are birds that themselves do not enter the competition (as competitions are restricted to specific taxa) but are kept by competitors to improve the singing quality, the song complexity, and the uniqueness of those birds that do enter (e.g., white-rumped shama *Copsychus malabaricus*, Oriental magpie-robin *C. saularis*, greater green leafbird *Chloropsis sonnerati*, lesser green leafbird *C. cyanopogon*, and straw-headed bulbul *Pycnonotus zeylanicus*). On non-competition days, master birds are caged near competition birds, which incorporate elements of the master birds' songs or sounds into their songs through vocal mimicry.

Here, we focus on the trade in one such master bird, the crested jayshrike *Platylophus galericulatus*, over a 15-year period on the Indonesian islands of Java, Bali, and Lombok. The crested jayshrike is a monotypic species, being the sole representative of the family Platylophidae (Gaudin et al. 2021). It is largely confined to lowland and hill forests, its populations are declining, and little is known about its biology (e.g., Hellebrekers and Hoogerwerf 1935; Van Balen and Nijman 1996; BirdLife International 2019; Marsden et al. 2023). On the IUCN Red List of Threatened Species, it is classified as Near Threatened and stated to be "relatively scarce," "generally uncommon," and "declining moderately rapidly overall, as a result of ongoing habitat loss and trapping for the cagebird trade" (BirdLife International 2019). The crested jayshrike's song comprises a combination of chattering, loud rattling, and high-pitched whistling (see Supporting Information S2: video). Three subspecies are recognized, which differ morphologically and, importantly for the purpose of this paper, in their vocalizations and singing abilities. Two of the subspecies are found in Indonesia: the Javan crested jayshrike *P. g. galericulatus* from Java, and the brown crested jayshrike *P. g. coronatus* from Sumatra and Borneo (a third subspecies, the Malay jayshrike *P. g. ardesiacus*, is found on the Thai–Malay Peninsula and is not considered further here). The two Indonesian subspecies are easily recognized (Figure 1). The nominate form is entirely black, except for a long white patch on the side of the neck and two small white dots near the eye; its eyes are pale blue. The brown crested jayshrike, as its name suggests, is predominantly brown, with a white neck patch fringed by black and reddish-brown eyes. The Javan crested jayshrike has the smallest geographic range and the least remaining habitat of the three subspecies.

FIGURE 1 | Trade in crested jayshrikes in Indonesia. From top left: Javan crested jayshrike *P. g. galericulatus* singing; Javan crested jayshrike for sale in Bali (note damaged crest); brown crested jayshrike *P. g. coronatus* sourced from Sumatra (credit: Vincent Nijman and Jessica Chavez); Javan crested jayshrike in the wild (credit: Gideon Lam, CC-BY-NC).

Eaton et al. (2015) noted that it was nearing extinction due to excessive trapping for the master bird trade. The IUCN/SSC Asian Songbird Trade Specialist Group has classified the Javan crested jayshrike as a "Tier 1" species, meaning it is severely impacted by trade and represents a high priority for conservation, with extinction considered imminent if no action is taken (IUCN SSC ASTSG 2025).

The trade in crested jayshrikes on Java and Bali has previously been reported in some markets (e.g., Semarang and Yogyakarta: Djuwantoko 1986; Denpasar: Widodo 2005) but not in others (Jakarta: Basuni and Setiyani 1989; Bandung, Garut, Taskimalaya: Haryoko 2010). Nash (1993) conducted 39 surveys of 12 bird markets in western Indonesia (34 of which were on Java and Bali) and recorded crested jayshrikes during 23 surveys, making them among the more commonly traded bird species at the time. Over the last decade, numerous studies have been conducted in the bird markets of Java, and to a lesser degree, in the markets of Bali and Lombok. While these studies provide insights into the dynamics of the trade, they often lack detailed information on species identity and the numbers of birds observed (e.g., Bandung: Mulyadi and Dede 2020; Malang: Prakosa and Kurniawan 2015; Surabaya: Wijaya et al. 2021; Semarang, Salatiga, Ambarawa: Azizah et al. 2025). A major limitation of studies reporting crested jayshrikes is that few researchers differentiate between the brown and Javan subspecies. Given the differences in their geographic ranges, rarity in the wild, and conservation status, this distinction is important for interpreting trade patterns and subsequent management implications.

To address this gap, we set out to: (1) provide a comprehensive overview of the trade in crested jayshrikes in bird markets on Java, Bali, and Lombok, and place this in a conservation context; (2) test a series of null hypotheses related to factors intrinsic to the birds (e.g., rarity, geographic range), local economic conditions, asking prices, and temporal trends, including gradual changes, or potential changes associated with the 2018 legislative amendment (Table 1).

2 | Methods

2.1 | Study Area

The island of Java is Indonesia's economic and political center. It is one of the most densely populated areas in the world and is home to some 156 million people, accounting for more than half of Indonesia's population. The three major ethnic groups on Java—Betawi, Sundanese, and Javanese—all have long traditions of songbird keeping (Jepson et al. 2011). Singing competitions are held most weekends, and those in major cities such as Jakarta and Surabaya attract large numbers of competitors, feature multiple categories (e.g., species, age, experience, ringed birds), and offer substantial prize money. Following a win, birds can change ownership for large sums of money (Jepson 2008). In Java, there are one or more bird markets in nearly every major city (Nash 1993; Jepson et al. 2011; Marshall et al. 2020, 2021; Nijman, Ardiansyah, et al. 2021; Nijman, Campera, et al. 2021), and most are open daily, with a few only operating on specific days of the Javan calendar (e.g., Pon, Wage). The markets included in this study comprised four in the capital Jakarta, five in the province of West Java, four in central Java, and three in eastern Java. These markets vary greatly in size, from small markets with around a dozen shops, such as Kerkhof and Cikurubuk, to what is probably the largest bird market in Asia—Pramuka—with over 100 shops (Chng et al. 2015). In terms of bird trade networks, many species are sourced locally within Java, but the island is also well connected to Sumatra and, to a lesser degree, Indonesian Borneo (Chng et al. 2015).

TABLE 1 | Null hypotheses concerning the trade of brown crested jayshrike *P. g. coronatus* from Borneo and Sumatra, and Javan crested jayshrike *P. g. galericulatus* from Java in the bird markets of Java, Bali, and Lombok (2011–2025).

Null hypothesis	Variables tested	Alternative explanations
There is no difference between the number of brown and Javan crested jayshrikes in markets, and both are observed in an equal number of markets	Total number of brown and total number of Javan crested jayshrikes recorded across all markets	– The markets are mainly situated on Java (and nearby Bali and Lombok), so Javan crested jayshrikes are more common locally – The geographic range of brown crested jayshrikes in Indonesia is eight times larger than that of Javan crested jayshrikes, making them more common in trade
There is no difference in price between brown and Javan crested jayshrikes, and prices are similar across markets	Asking prices across all markets; city-level prices	– Javan crested jayshrikes are rare and therefore more expensive, and prices reflect rarity; there are intrinsic qualities of Javan crested jayshrikes that increase their appeal – Brown crested jayshrikes are more expensive as they are brought in from other islands, 100s of kms away, and prices reflect the additional transport costs; there are intrinsic qualities of brown crested jayshrikes that increase their appeal – Asking prices of Javan crested jayshrikes have increased more over time than that of brown crested jayshrikes as the former becomes rarer and the latter is used as a replacement – Prices of brown crested jayshrikes reflect the distance from where they were sourced, with higher prices in markets further away from Sumatra and Borneo – Prices of both Javan and brown crested jayshrikes reflect the purchasing powers of the cities in which they are offered for sale, with higher prices in more affluent cities
There are no temporal changes in trade	Annual abundance; number of markets showing increases in mean number of jayshrikes compared to the ones where we see decreases; asking prices corrected for inflation by year	– Numbers have increased, as songbird contest have become more popular and more numerous, transport costs have decreased, and expendable income has increased. – Numbers have decreased, as birds have become less common and more difficult to obtain from the wild, and there is less need for master birds as technology allows for recorded calls to be used
Prior to 2018 there was no legal harvest quota for wild birds and legal protection has no effect on numbers or prices	Number of crested jayshrikes in market before and after 2018; asking prices corrected for inflation before and after 2018	– Numbers have decreased because of enforcement actions and general awareness of their newly protected status; birds are offered in fewer markets – Crested jayshrikes become more desirable because of their protected status, and traders start selling wild-caught individuals as captive-bred ones to circumvent the legislation – Prices have increased as the illegality of the trade increased costs (bribery, loss of birds due to seizures)

Bali is much smaller than Java, has a smaller human population (~4 million), and its economy is more reliant on tourism than any other region of Indonesia (Antara and Sumarniasih 2017). Bird keeping is common on Bali (Widodo 2005; Chng et al. 2018; Chavez et al. 2025), but the obsession with songbirds is less pronounced than on Java. Nevertheless, there is a sizeable number of Javanese living on the island (around 10% of the total). There are regular singing competitions, especially in the capital, Denpasar, although more serious competitors typically enter their birds in competitions on Java. Bali has three major bird markets: Sanglah and Satria, which are open daily, and Beringkit, which is open only on Sundays and Wednesdays. Birds traded in Bali are largely sourced locally (most bird species found on Bali also occur on Java), but a substantial number are imported from eastern Java (Chng et al. 2018).

Lombok is comparable in size to Bali, with a similar human population size. Bird keeping is less well established here than it is on Bali and Java, and songbird competitions are still in their infancy. The bird markets are small and are largely confined to the capital, Mataram, where we surveyed the Sindu market. Lombok's avifauna is distinctly different from that of Java and Bali, and its trade networks are closely linked to eastern Indonesia as well as to Bali and Java (Leupen et al. 2022).

2.2 | Market Surveys, Discussions With Traders and Songbird Keepers, and Survey of Literature

From 2012 onwards, we surveyed more than 30 bird markets across Sumatra, Borneo, Java, Bali, Lombok, and Sulawesi (e.g., Nijman, Ardiansyah, et al. 2021; Nijman, Campera, et al. 2021; Nijman et al. 2022; Leupen et al. 2022; Nijman 2022; Chavez et al. 2025; Imron et al. 2025). Initially, these surveys focused on a small number of target species, but from 2016 onwards, we aimed to record all non-domesticated bird species encountered. Between 2016 and 2019, more surveys were conducted in Jakarta, Banten, and West Java, with occasional visits to Central and East Java, Bali, and Lombok. From 2022 to 2025, the pattern was reversed. We conducted fewer surveys in 2020–2021 due to COVID-19 restrictions. In a typical market survey, one or two surveyors walked slowly through the market and recorded all birds that were openly on display. Observations were either entered directly into a phone while walking or were noted down in a notebook immediately after having left the market (Nijman, Ardiansyah, et al. 2021). The bird markets are open to the public, and anyone can observe and record species offered for sale (Chavez et al. 2025). Surveys on Sumatra were conducted by V.N. and A. Abdullah; on Java by V.N., A. Ardiansyah, K.H., R.H., A.L., and K.A.-I.N.; on Bali by V.N., J.C., I.N.A.D.P., E.S., and D.K.T.S.; on Lombok by V.N. and J.C.; and on Sulawesi and Indonesian Borneo by V.N.

Over the course of the study, we revisited many bird markets repeatedly, and vendors increasingly recognized us from earlier visits. This allowed us to build rapport easily, and vendors freely gave us specifics about the trade in crested jayshrikes. Likewise, over the 15-year study period, we interacted with numerous songbird keepers at songbird competitions, in their homes, and in the markets. These informal conversations gave us a better understanding and a greater appreciation of songbird keeping practices and the dynamics of the songbird trade.

In August 2025, we searched for additional records of complete surveys of bird markets in Java, Bali, and Lombok, as well as Sumatra, Indonesian Borneo, and Sulawesi. Our initial search was on Google Scholar, and we searched for both English- and Indonesian-language reports. In Indonesian, the crested jayshrike is known as *tangkar ongklet*, but in the bird trade, both the Javan and brown jayshrike are commonly referred to as *cililin* or sometimes *cililin coclat* (brown *cililin*) and *cililin hitam* (black *cililin*). We subsequently screened the reference lists of relevant publications we found in our initial search. Through this process, we included data from Syaputra (2016), Wiedarti et al. (2016), Chng and Eaton (2016), Chng et al. (2016, 2018), B. S. Iskandar et al. (2019), Humaero et al. (2023), and Azizah et al. (2025). Data from Chng et al. (2015) and Leupen et al. (2022) were already incorporated within our own survey dataset.

2.3 | Price Data

We opportunistically obtained price data during our market surveys, either by directly questioning vendors about the asking price, by vendors volunteering price information without prompting, or by observing the sale of a crested jayshrike. Most price data were collected from the 21 bird markets included in our analysis (see below), with two additional records obtained from the Curug market in Tangerang. Further price information was drawn from earlier publications. To supplement these data, we searched online platforms for crested jayshrikes offered for sale and for price lists from specific bird markets posted by hobbyists.

Each year, the Indonesian government publishes recommended minimum monthly wages for cities and regions across the country. We obtained these data for 2024 for all the cities from which we had price records for crested jayshrikes. These recommended minimum monthly wage values serve as a proxy for regional purchasing power and, within our study area, ranged from US$138 in Garut to US$325 in Jakarta. For each of the cities for which we had price data on the brown crested jayshrike, we calculated the straight-line distance to the nearest area of natural habitat, located either on Sumatra or Indonesian Borneo.

2.4 | Data Preparation and Analysis

We were interested in changes that occurred following the 2018 legal protection of crested jayshrikes. We therefore included only bird markets for which we managed to collect data from at least two surveys (and up to 12 surveys) conducted before 2018 and at least two surveys (and up to 9 surveys) conducted after 2018. These data were derived from our own market surveys, published reports, and often a combination of both. Twenty-one bird markets met these criteria (see Supporting Information S1: Table S1 for a map showing market locations). Inspection of data from bird markets that were visited at short intervals (weekly or fortnightly) suggests that individual crested jayshrikes can remain in markets for up to a month or longer. Accordingly, we included only surveys conducted at least 1 month apart (nine survey intervals were slightly shorter than this threshold). The mean interval between surveys was 8.0 ± 0.8 months. In total, we conducted 249 surveys, yielding 228 repeat surveys.

An analytical challenge we faced was the large number of zero detections and the possibility of false negatives. In a substantial number of our surveys, no crested jayshrikes were recorded; in most cases, these zero detections represent the true absence of the species in that market during that survey. In a small number of cases, however, these may represent false negatives, that is, the species was present but not recorded. For instance, during our surveys of what is probably the largest bird market in Southeast Asia, Pramuka in Jakarta, we recorded the species in 15 of 18 complete surveys, with an average of 4.93 ± 0.87 individuals on display when present. However, in three seemingly complete surveys of Pramuka no crested jayshrikes were recorded, and given the sheer size of the market, it is well possible that individuals were present but overlooked. Likewise, Putri et al. (2021) conducted at least two (but probably more) surveys of the large Depok market in Surakarta in December 2020 and January 2021, and did not list crested jayshrikes among the 48 non-domesticated birds they recorded. In contrast, we did find crested jayshrikes during our own surveys of Depok and documented approximately twice as many bird species as Putri et al. (2021) (99 ± 8 per survey; range 77–121 species). This discrepancy suggests either true absence during Putri et al.'s (2021) surveys or incomplete species reporting. For our own surveys, when no crested jayshrikes were observed, we

checked whether the total number of species we recorded was markedly lower than at other times (suggesting an incomplete survey). In such cases, we treated the observation as a false negative and excluded it from the dataset. Across the 21 bird markets, we had no indication that false negatives were more prevalent before or after the 2018 protected species listing, nor that they were more common in certain markets. We therefore retained zero detections in the final analyses.

We employed two complementary statistical approaches to test for changes in the markets over time and differences between pre- and post-legal protection periods. First, for markets with sufficient sample sizes before and after 2018, we used non-parametric statistics to test for differences (Mann–Witney *U* test, χ^2 test, binomial test, and sign test). These tests handle zeros effectively, as all zeros are assigned the same rank. In the sign test—used to test if there is a difference in the number of markets where we observed an increase in the number of crested jayshrikes compared to the ones where we observed a decrease, irrespective of the magnitude of change—zero change values are excluded from the analysis. For the second approach, we grouped markets into three geographic regions: (1) Jakarta and western West Java (nine bird markets), (2) Cirebon (bordering Central Java), Central Java, and Yogyakarta (five bird markets), and (3) East Java, Bali, and Lombok (seven bird markets). We fitted a Generalized Additive Model (GAM) using the *mgcv* package, with the number of crested jayshrikes found in bird markets as the response variable and protected status, geographic region (with Cirebon, Central Java, and Yogyakarta as reference categories), and date as predictors. Survey date was included as a smoothing term using a cyclic cubic regression spline to account for the time-series structure of the data. We compared several count-data distributions (Poisson, tw, nb, ziP) and selected the tw family based on model residuals using the *appraise* function in the *gratia* package. To account for repeated sampling of the same markets, we additionally fitted a Generalized Additive Mixed Model (GAMM) using the *gamm* function, with market identity included as a random effect.

All price data were given in Indonesian rupiah (IDR). For analysis, we only included price data that were for either brown or Javan crested jayshrikes and for which the year of collection was known; more generic price estimates were excluded. Price data were all based on initial asking prices. Although bargaining typically reduces final sale prices—especially when more than one bird is purchased at a time—we did not engage in bargaining or purchase any birds. Following a reviewer's concern that the initial price quoted to foreign buyers might be inflated relative to those quoted to Indonesian nationals, we tested for this effect and found no evidence supporting this assumption (see Results). For analytical consistency, we treated identical prices quoted by a single seller for multiple birds as a single independent data point. Prices were corrected for inflation to August 2025 (e.g., IDR1,000,000 in January 2011 equals IDR1,658,000 in August 2025) and converted to US dollars using the August 2025 exchange rate (IDR16,300 = US$1). When appropriate, price data were log-transformed prior to analysis to better approximate a normal distribution of data.

For consistency and ease of interpretation, we present means ± one standard error, even when using non-parametric statistics. We accept significance when $p < 0.05$ (two-tailed test).

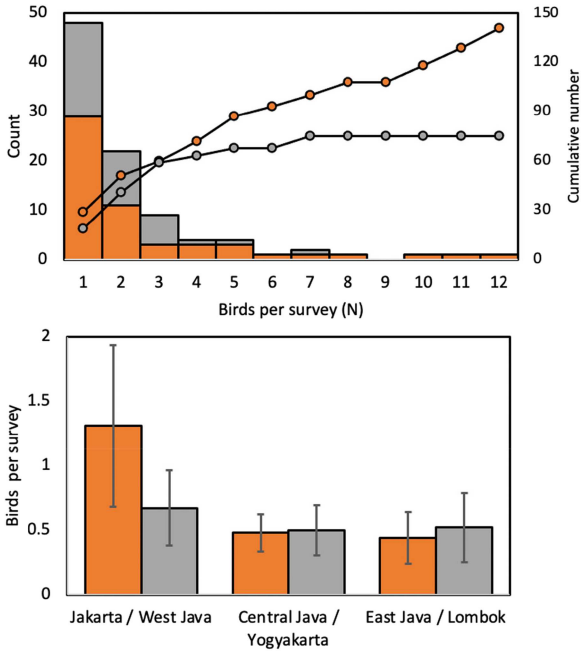

FIGURE 2 | Top: Number of crested jayshrikes *P. galericulatus* recorded during 94 surveys of bird markets in Java, Bali, and Lombok. Bottom: Changes in the mean number of crested jayshrikes recorded in bird markets in western Java, central Java, eastern Java, Bali, and Lombok (means ± s.e.m.). Surveys conducted before 2018 are shown in orange and those after 2018 in gray.

3 | Results

3.1 | Numbers in Trade and the Effect of the 2018 Change in Protected Status

We recorded 141 crested jayshrikes in 55 of the 137 surveys conducted before 2018, and 75 crested jayshrikes in 39 of the 112 surveys conducted after 2018. Most birds were identified to species level only; however, where a distinction was made between the two subspecies, 17 individuals were identified as Javan crested jayshrikes and 44 as brown crested jayshrikes, a significant difference (binomial test, $p = 0.0008$). The proportion of birds identified as Javan versus brown crested jayshrikes did not differ between surveys conducted before or after 2018 (Javan: 11/141 vs. 5/75; brown: 29/141 vs. 15/75; $\chi^2 = 0.011$, $p = 0.918$). The proportion of Javan versus brown crested jayshrikes differed somewhat among regions, but this did not reach statistical significance (Jakarta and West Java: 7 vs. 29; Central Java and Yogyakarta: 3 vs. 3; East Java, Bali, and Lombok: 7 vs. 12; $\chi^2 = 3.494$, $p = 0.174$). During most surveys, only one or two individual birds were present in the markets, and this pattern did not change over time (1–2 birds vs. 3–12 birds before and after 2018, Fisher's exact probability test, $p = 0.807$; Figure 2).

We recorded crested jayshrikes in 17 of the 21 markets before the species became legally protected and in 15 of the 21 markets after protection was enacted. Only in three markets (Jatinegara, Pon, and Sanglah) did we fail to record the species both before and after the legal change (Table 2). In none of the 10 markets for which sample sizes before and after 2018 were sufficiently large did we detect a statistically significant decrease or increase in numbers. Irrespective of statistical significance, the number of crested jayshrikes offered for sale decreased in 10 markets, remained unchanged in 5

TABLE 2 | Records of crested jayshrikes *P. galericulatus* in bird markets on Java, Bali, and Lombok in the period before and after legal protection (January 2011 to June 2018, 'before protection' and July 2018 to December 2025, 'after protection').

Province, town, market	Before protection	After protection	MW-U (z-value, p value)
Jakarta			
Jakarta, Pramuka	5.44 ± 1.25 (9)	2.29 ± 1.02 (7)	1.69, $p = 0.091$
Jakarta, Barito	0.22 ± 0.15 (9)	0.14 ± 0.14 (7)	0.21, $p = 0.834$
Jakarta, Jatinegara	0 (10)	0 (6)	0.05, $p = 0.960$
Jakarta, Cipinang	0.50 ± 0.50 (2)	1.00 ± 0.58 (3)	
West Java			
Bogor, Tanjakan Empang	0.50 ± 0.29 (3)	0 (6)	
Bandung, Sukahaji	3.58 ± 0.92 (12)	1.89 ± 0.39 (9)	1.14, $p = 0.254$
Garut, Kerkhof	0.40 ± 0.22 (10)	0.56 ± 0.44 (9)	0.16, $p = 0.873$
Garut, Mawar	0.55 ± 0.16 (11)	0 (4)	
Tasikmalaya, Cikurubuk	0.60 ± 0.22 (10)	0.17 ± 0.17 (6)	1.08, $p = 0.280$
Cirebon, Plered	0.64 ± 0.31 (11)	0.40 ± 0.40 (5)	0.40, $p = 0.689$
Central Java			
Semarang, Karimata	0.60 ± 0.40 (5)	0.60 ± 0.40 (5)	0.10, $p = 0.920$
Semarang, Pon	0 (2)	0 (2)	
Surakarta, Depok	0.33 ± 0.33 (3)	0.33 ± 0.33 (3)	
Yogyakarta			
Yogyakarta, Pasty	0.83 ± 0.54 (7)	1.17 ± 0.40 (6)	0.80, $p = 0.424$
East Java			
Malang, Splendid	0.67 ± 0.33 (3)	0.50 ± 0.50 (2)	
Surabaya, Bratang	0.25 ± 0.25 (4)	0 (2)	
Surabaya, Kupang	1.50 ± 1.19 (4)	2.00 ± 0.00 (2)	
Bali			
Denpasar, Satria	0.40 ± 0.40 (5)	0.71 ± 0.42 (7)	0.64, $p = 0.522$
Denpasar, Sanglah	0 (4)	0 (3)	
Mengwi, Beringkit	0 (4)	0.20 ± 0.20 (5)	
Lombok			
Mataram, Sindu	0.50 ± 0.50 (2)	0.20 ± 0.20 (5)	

Note: Values are presented as means ± s.e.m., with the number of surveys shown in parentheses. Bird markets are listed from west to east. Differences between periods were assessed using the Mann–Whitney U test (MW-U); z-values and associated p values are reported where applicable.

(including the 3 where the species was never recorded), and increased in 6 markets (sign test, $p = 0.317$). Crucially, in both periods crested jayshrikes were openly offered for sale, and the introduction of legal protection did not result in trade becoming more concealed, hidden or clandestine. In none of the 112 post-2018 surveys were we shown crested jayshrikes that were initially hidden or kept out of sight in the back of the shops.

The results from the GAM and the GAMM were broadly consistent with those presented above (Table 3). Fewer crested jayshrikes were recorded in bird markets after the species was added to the protected species list. The difference was close to reaching statistical significance in the GAM without a random effect, but it became significant when market identity was included as a random effect in the GAMM (Table 3). Survey date did not have a significant effect on the number of crested jayshrikes observed, indicating no detectable long-term increase or decrease in numbers over time. We did, however, observe higher numbers of crested jayshrikes in trade in Jakarta and West Java compared to the two more eastern regions (Table 3). This regional pattern was largely driven by two of the nine markets in Jakarta and West Java (Pramuka and Sukahaji; Supporting Information S1: Figure S2), with both having significantly higher numbers than the other markets. When market identity was included as a random effect, the regional difference was no longer significant (Table 3).

3.2 | Price Differences and Changes Over Time

We obtained 50 independent asking prices, comprising 33 for the brown crested jayshrike and 17 for the Javan crested jayshrike. There was a clear difference between the two subspecies, with brown crested jayshrikes commanding a significantly higher mean price (US$128 ± 8) than Javan crested jayshrikes (US$51 ± 4; $t = 6.388$, $p < 0.0001$). Focusing on price data collected by our own research team in physical bird markets, we did not find an effect of surveyor nationality on asking prices. For Javan crested jayshrikes, the mean asking price was US$52 ± 11 when the survey team comprised only Indonesians and US$56 ± 9 when a foreign researcher was present; this

TABLE 3 | Top: Results of the Generalized Additive Model (top) and Generalized Additive Mixed Models (bottom) examining factors associated with the number of crested jayshrikes *P. galericulatus* recorded in bird markets.

				Smooth term	
Predictor	**Estimate**	**s.e.m.**	***t*-value, *p* value**	**edf**	***F*-value**
Intercept	−0.265	0.286	−0.928, $p = 0.355$		
Protected	−0.508	0.279	−1.818, $p = 0.070$		
East Java, Bali, and Lombok	−0.371	0.399	−0.930, $p = 0.354$		
Jakarta and West Java	0.625	0.289	**2.160, $p = 0.032$**		
Date				0.862	0.190
Intercept	−0.616	0.606	−1.017, $p = 0.301$		
Protected	−0.517	0.257	**−1.818, $p = 0.045$**		
East Java, Bali, and Lombok	−0.462	0.794	−0.582, $p = 0.561$		
Jakarta and West Java	0.077	0.732	0.105, $p = 0.917$		
Date				0.774	1.030

Note: In both models, Cirebon, Central Java, and Yogyakarta served as the reference region. In the mixed models, market identity was included as a random effect. *edf* indicates exponential dispersion family. Bold are the statistically significant relationships.

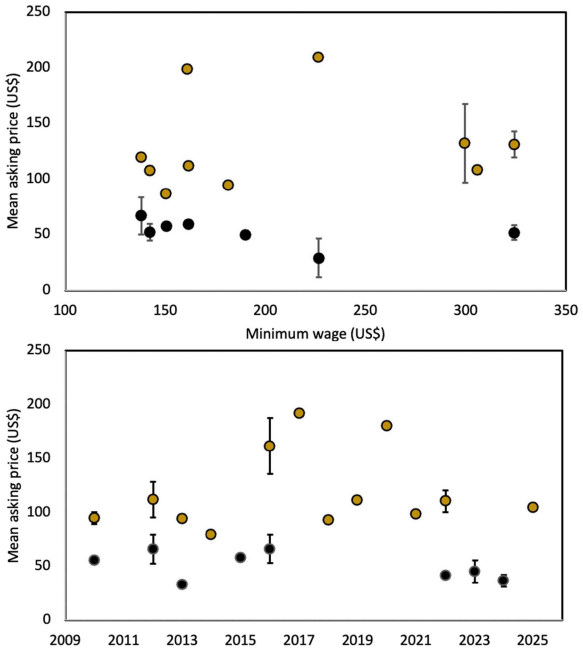

FIGURE 3 | Top: Relationship between a city's minimum monthly wage (Java and Bali) and the mean asking price of crested jayshrikes in bird markets. Bottom: Changes over time in asking prices of crested jayshrikes (corrected for inflation to 2025) in bird markets in the Greater Jakarta area. Brown circles represent brown crested jayshrike *P. g. coronatus* from Sumatra and Borneo; black circles represent Javan crested jayshrike *P. g. galericulatus*.

difference was not statistically significant ($t = -0.318$, $p = 0.758$). Similarly, for brown crested jayshrikes, mean asking prices were US$115 ± 13 for Indonesian-only survey teams and US$98 ± 7 when a foreign researcher was present, again with no significant difference ($t = 0.813$, $p = 0.440$).

Asking prices were not related to the purchasing power of the city in which the birds were traded, using minimum wage as a proxy for purchasing power (Javan crested jayshrike: Pearson's $R = -0.437$, $p = 0.364$; brown crested jayshrike: $R = 0.1069$, $p = 0.769$; Figure 3). For the six cities on Java for which we obtained price data for both subspecies, we found a strong inverse relationship between their prices (log-transformed data: $R = -0.848$, $p = 0.033$). One possible explanation for this is that where Javan crested jayshrikes were relatively cheap and perhaps easily obtainable, brown crested jayshrikes commanded a higher price, and conversely, where brown crested jayshrikes were relatively cheap, presumably as they were easily obtainable, Javan crested jayshrikes were relatively more expensive.

Within the Greater Jakarta area, we did not see a change in asking prices over time for either subspecies (Javan crested jayshrike: $R = -0.504$, $p = 0.203$; brown crested jayshrike: $R = 0.156$, $p = 0.628$; Figure 3). The mean asking price of brown crested jayshrikes was also not affected by the distance between the market where the bird was sold and the nearest location where the species is found in the wild (southern Sumatra or the southern coast of Indonesian Borneo; $R = -0.351$, $p = 0.320$), despite substantial difference in transport distance (ranging from just over 100 km for birds sourced from Sumatra and sold in Tangerang to more than 500 km for ones sourced from Borneo and sold in Kediri or Yogyakarta).

4 | Discussion

4.1 | General Observations and Replacements

While some early research quantified aspects of Indonesia's bird trade and exports (e.g., King 1974; Diamond et al. 1987; Basuni and Setiyani 1989; Nash 1993; Jepson and Ladle 2005; Widodo 2005; Shepherd 2005), the past 15 years have seen an increase in the number of studies addressing the Asian Songbird Crisis. When these studies focused on particular taxa, they predominantly examined species that participate in songbird competitions (e.g., J. Iskandar and Iskandar 2015; Leupen et al. 2018; Nijman, Campera, et al. 2021; Imron et al. 2025). Other work has concentrated on individual bird markets, reporting on all bird species that were present (e.g., Prakosa and Kurniawan 2015; Chng et al. 2015, 2016, 2018; Chng and Eaton 2016; B. S. Iskandar et al. 2019; J. Iskandar et al. 2020; Mulyadi and Dede 2020; Leupen et al. 2022; Azizah et al. 2025).

In this study, we tested a series of null hypotheses concerning the trade in two morphologically distinct—and, according to birdkeepers, vocally and behaviorally different—forms of the same species. For several of these hypotheses, we found support in the sense that we did not find statistically significant differences. Specifically, there were no big regional differences in trade patterns, no relationship between asking price and city-level affluence, and no marked temporal trends in the number of crested jayshrikes observed in markets. Importantly, the 2018 change in legal protection did not result in a substantial reduction in market presence, nor did it affect the proportion of markets offering the species for sale. For brown crested jayshrikes, asking prices were also unrelated to the distance between the market and the island of Sumatra or Borneo from which the birds were sourced. In contrast, we found clear differences between the two subspecies in both abundance and price. Brown crested jayshrikes were almost three times more frequently observed than Javan crested jayshrikes and commanded, on average, prices approximately two-and-a-half times higher. This pattern appears to be driven by strong preference among birdkeepers and songbird competitors for the brown crested jayshrike, which is widely regarded as a superior master bird due to its song quality and singing abilities.

Eaton et al. (2015) noted that "the Javan nominate of crested jay [shrike] is now being replaced in markets by the Sumatran and Bornean subspecies *coronatus*" and "In bird markets, [Javan crested jayshrike] *galericulatus* has evidently virtually disappeared, being generally substituted by [brown crested jayshrike] *coronatus*." Likewise, based on a 2018 personal correspondence with David Jeggo, the Chair of the IUCN SSC Asian Songbird Trade Specialist Group, BirdLife International (2019) stated that "The species is captured for the cagebird trade. Particularly subspecies *galericulatus*, which occurs on Java, is now so rare in the wild that subspecies *coronatus* is increasingly targeted to compensate for the scarcity of *galericulatus* on the market." While our results confirm that brown crested jayshrikes are more prevalent in trade, Javan crested jayshrikes continue to be recorded. In addition, discussions with traders and bird keepers, together with our price data, suggest that brown crested jayshrikes do not simply function as replacements for Javan crested jayshrikes. Instead, they are treated as fundamentally distinct birds—almost as a separate species—each with its own perceived value. Notably, we found no change in the relative number of brown versus Javan crested jayshrikes recorded in the markets before and after 2018. If a process of replacement had taken place, we would expect it to be most evident in markets with easy access to Sumatra or Borneo, such as Jakarta and Tangerang (proximate to Sumatra) or Surabaya (with strong maritime links to Borneo). Our data do not support such a pattern.

Yohanna et al. (2021), analyzing sales records of bird wholesalers in Jambi, southern Sumatra, for a 5-year period, reported that 18 and 47 crested jayshrikes were sold in 2017 and 2018, respectively, but none in 2019 or 2020. Although not focused exclusively on crested jayshrikes, they noted a broader post-2018 shift from protected to unprotected species. While we likewise recorded a modest decline in the average number of crested jayshrikes offered for sale in Java, Bali, and Lombok following the species' inclusion on Indonesia's protected species list, this decline was far less pronounced than that reported by Yohanna et al. (2021) and it did not translate to reduced market occurrence. Furthermore, although numbers decreased markedly in some areas (e.g., Jakarta), we also observed small increases in others (e.g., Bali), suggesting that the dynamics of crested jayshrike trade may vary geographically, depending on sourcing routes and local market conditions.

4.2 | Trade in Crested Jayshrikes in Other Parts of Indonesia

In addition to the markets included in our main analysis—those for which we had data from at least two surveys from before and after the 2018 legislative change—we also surveyed two cities in Sumatra (Banda Aceh in 2019 and 2024; Medan in 2023), one city in Indonesian Borneo (Balikpapan in 2025), and one in Sulawesi (Makassar in 2025). We did not record any crested jayshrikes in these four cities, but others have (e.g., Medan: Shepherd 2006; Eaton et al. 2015).

Although we conducted some surveys in Sumatra and Sulawesi, our primary focus was on the bird trade in Java, Bali, and Lombok. Few reports are available on the trade in crested jayshrikes in other parts of Indonesia, and here we give a brief overview, starting with Sumatra. Shepherd (2006), reporting on 59 monthly surveys of the bird trade in Medan between 1997 and 2001, found 15 brown crested jayshrikes and nine Javan crested jayshrikes. Eaton et al. (2015) note that seven Javan crested jayshrikes (and possibly an unknown number of brown crested jayshrikes) were recorded during weekly surveys in the bird markets in Medan over a 3-months period in 2012. Iqbal (2015), monitoring the online bird trade in South Sumatra over a 1-month period, found four instances in which a single crested jayshrike was offered for sale. Chng et al. (2018) reported on one brown crested jayshrike during surveys of six bird markets in four cities in Sumatra. Krishna et al. (2019), working in Jambi city, observed two crested jayshrikes during market surveys, while records kept by an unreported number of traders in that city over a 20-month period (2013–2015) revealed that 365 crested jayshrikes had been sold. Krishna et al. (2019) noted that, based on traders' reports, the number of crested jayshrikes sold decreased over time, accompanied by increasing asking prices, but no further details were given. Yohanna et al. (2021), also relying on records kept by (wholesale) traders, reported that 65 crested jayshrikes were received over a 5-year period (2016–2020). Saputra et al. (2024) recorded two brown crested jayshrikes during market surveys conducted in Padang in September–October 2024. Fewer data are available from Indonesian Borneo than from Sumatra. Rentschlar et al. (2018) conducted extensive surveys throughout western Kalimantan over a 2-year period (2015–2017) and recorded 68 crested jayshrikes offered for sale. Juhardiansyah et al. (2019) found two crested jayshrikes during a single survey in Ketapang in 2018.

Only some of these studies distinguish between brown and Javan crested jayshrikes. Given that brown crested jayshrikes are native to Sumatra and Borneo, it is reasonable to assume that most individuals recorded in these regions belong to this subspecies. However, the data presented by Shepherd (2006) and Eaton et al. (2015) demonstrate that this was not always the

case, as Javan crested jayshrikes were also traded in Sumatra during the late 1990s and early 2000s, and in 2012.

4.3 | Price Data, Sourcing, and Changes Over Time

Eaton et al. (2015) cautioned against using certain market data uncritically to infer population status of birds in the wild and used the crested jayshrike to illustrate this point: "A key indicator of the increasing rarity of a taxon is the price it commands in markets [and] the inverse relationship between price and volume of a traded species is a dependable signal of its wild status. [B]ut it may not work so well if there are similar taxa to substitute for them when their numbers are depleted. For example, the [Javan crested jayshrike] is now being replaced in markets by the [brown crested jayshrike] and—although we do not have records to prove it—we doubt that the price of the nominate has risen in line with its rarity, simply because a similar relative can easily substitute for it." Indeed, assuming that the Javan crested jayshrike has continued to decline in the wild over the 14 years of our study, this has not been reflected in an increase in asking prices once corrected for inflation. Nor were we able to demonstrate a clear increase in asking prices for brown crested jayshrikes over time. It is possible that more subtle changes in pricing dynamics may become apparent if additional price data become available, particularly from a wider range of cities and over a longer time period.

When birds are sourced locally and traded over relatively short distances, asking prices may reflect local affluence, with lower prices in less affluent regions (as documented, for instance, for rufous-fronted laughingthrush *Garrulax rufifrons*: Nijman et al. 2020). In contrast, this pattern is often absent in species that are traded over large distances (e.g., Chinese hwamei *G. canorus*: Shepherd et al. 2020). In our study, asking prices were not correlated with the purchasing power of the cities in which birds were offered for sale, and this held true for both Javan and brown crested jayshrikes. This may suggest that not only brown, but also Javan crested jayshrikes are traded over considerable distances. Supporting this, both subspecies have been recorded outside their natural ranges, including on Bali. Javan crested jayshrikes have additionally been documented in Lombok, Sumatra, and Indonesian Borneo (Shepherd 2006; Iqbal 2015; Chng et al. 2018; this study). We did not find a correlation between asking price and straight-line distance between markets on Java and the nearest natural habitat of brown crested jayshrikes on Sumatra or Borneo. This further suggests that these birds are routinely traded over long distances, such that the additional transport within Java contributes little to overall costs.

Prices varied between traders and cities, but most strongly reflected perceived singing ability and the degree to which birds had adapted to living in captivity. For example, in 2023, a trader in Java offered newly caught brown crested jayshrikes for US$65 and newly caught Javan crested jayshrikes for US $32. Prices approximately doubled for birds that were suitable for use as master birds, and increased up to threefold for brown crested jayshrike masters that were fully adapted to commercial feed. While this variability complicates direct comparisons between subspecies—given that a master Javan crested jayshrike may command a similar price to a newly caught brown jayshrike, and prices for individuals of the same subspecies can vary threefold within a single shop—our dataset was sufficiently robust to detect consistent overall differences between subspecies.

4.4 | Caveats and Limitations

As noted above, analyses of market data for rare species are challenged by zero detections and the possibility of false positives. As we show, crested jayshrikes are almost always caged individually in bird markets and, when present, are typically represented by a single individual. Although the species is morphologically distinctive, it can easily be missed during surveys, especially when cages are placed high above eye level, in dark corners of shops, or when markets contain very large numbers of birds and species. In the Depok market of Surakarta, for instance, we recorded on average 7695 ± 671 non-domesticated birds per survey (representing 99 ± 8 species), yet each time we recorded crested jayshrikes, only a single individual was present. Under such conditions, overlooking the species is entirely plausible. We expect that other surveyors have faced the same challenge, and that this is thus reflected in the published literature. A further analytical challenge arises when assessing temporal changes in markets where crested jayshrikes were never recorded, despite repeated surveys both before and after the species became legally protected. The Jatinegara market in Jakarta is a clear example: it was surveyed sufficiently often across both periods, yet the species was never observed. Even if legal protection were highly effective and no crested jayshrikes were offered for sale after 2018, such markets would still appear as showing "no change" in comparative analyses. If this pattern were common throughout the trade, it could mask any real changes that have taken place. In our dataset, this situation applied to 3 of the 20 markets included in the analysis. It is also important to note that our surveys focused exclusively on the open trade in physical bird markets. We did not assess the wholesale trade or other components of the supply chain, which may be markedly different from what is visible at retail level (e.g., Yohanna et al. 2021; Bušina et al. 2021). As such, our results should be interpreted as reflecting trends in open market availability rather than total trade volume. Finally, we documented clear differences between brown and Javan crested jayshrikes in terms of numbers offered for sale, asking prices, and consumer preference. Unfortunately, in 149 of the 210 market records, the subspecies was not differentiated. A similar lack of taxonomic resolution is evident in much of the published literature (Chng and Eaton 2016; Chng et al. 2016; Wiedarti et al. 2016; B. S. Iskandar et al. 2019; Azizah et al. 2025).

We have been publishing on the wildlife trade in Indonesian markets for over two decades, and reviewers have repeatedly suggested that asking prices in these markets are substantially higher for non-Indonesian buyers. We have now explicitly tested this assumption on five occasions. Twice for the rufous-fronted laughingthrush (mean prices were higher for foreigners than for Indonesians, but not significantly so; asking prices were twice lower and three times higher for foreigner buyers) (Nijman et al. 2020), once for the common palm civet *Paradoxurus hermaphroditus* (mean prices were lower for foreigners than for Indonesians, again without statistical significance) (Nijman et al. 2024), once for the Javan crested jayshrike

(mean prices were higher for foreigners than for Indonesians, but not significantly so) and once for the brown crested jayshrike (mean prices were lower for foreigners than for Indonesians, but not significantly so). Across these five tests, we therefore find no consistent evidence of a difference in asking prices in bird markets for foreign compared to Indonesian buyers. To our knowledge, comparable tests have not been reported by other research teams working on the Indonesian wildlife market trade.

4.5 | Conservation and Management Implications

We found a sustained and continued presence of crested jayshrikes in the bird markets of Java, Bali, and Lombok. Although numbers were never high, their presence in the majority of the markets surveyed, combined with the open nature of this trade (indicating little or no enforcement of existing legislation), is cause for concern. Crested jayshrikes were consistently offered as single birds, and even when we recorded more than one individual in a market, they were caged separately and often offered for sale by different vendors. Birds were never advertised or sold as pairs, nor caged in pairs, nor did we observe any chicks or juveniles in the markets. No individuals carried legbands, which are commonly applied only to birds bred in captivity and are used as an indicator of captive origin. Therefore, it is reasonable to assume that most, if not all, crested jayshrikes observed in markets were taken directly from the wild.

Marshall et al. (2020) conducted a survey of over 3000 households on Java and found that only one household kept a single crested jayshrike. While this suggests low ownership prevalence, extrapolation to the human population of Java (~50–60 million households, plus 2 million on Bali and Lombok) implies that several thousand, and perhaps up to 10,000, crested jayshrikes may be kept in captivity. This estimate is broadly consistent with our market observations. Assigning equal weight to each of the 21 markets included in our study, and assuming these are representative of approximately 40 additional bird markets operating across Java, Bali, and Lombok (Nijman, Campera, et al. 2021), we estimate that between 75 and 90 crested jayshrikes are available for sale on any given day. As noted in the Methods, certain birds were observed during repeat surveys in the same shops, suggesting turnover could be slow. However, because these birds are stocked for sale rather than display, assuming a conservative average turnover of 1 month suggests that between 900 and 1100 crested jayshrikes are sold annually through physical markets alone. While we did not observe crested jayshrikes during five surveys of four cities in Sumatra, Indonesian Borneo and Sulawesi, others have (e.g., Shepherd 2006; Eaton et al. 2015; Chng et al. 2018; Rentschlar et al. 2018; Juhardiansyah et al. 2019; Krishna et al. 2019; Yohanna et al. 2021; Saputra et al. 2024), and this adds to the total number that are sold in physical markets in Indonesia. And even this figure likely underestimates total extraction from the wild. What we, and others observe, are the birds that do make it to the markets, and more birds likely perish during capture in the forest, during storage at intermediate stages, and during transport. In addition, a substantial proportion of the trade in songbirds now occurs online (e.g., Iqbal 2015; Okarda et al. 2022), which is not captured by physical market surveys. Taken together, the available evidence suggests that several thousand legally protected crested jayshrikes are taken from the wild each year.

While it is important to acknowledge that the bird trade in Asia does not only concern songbirds, other species, such as eagles, owls, galliforms, and parrots, are also affected (Jepson and Ladle 2009; Nijman 2022; Nijman and Nekaris 2017; Nijman et al. 2009; Widodo 2005). It is the songbirds, however, and especially those that are used in competitions, which have received considerable attention from the conservation community in the last 15 years or so. Our findings suggest that this focus may have an unintended consequence: by prioritizing competition species, conservation efforts risk overlooking "secondary" species that are captured from the wild to enhance the performance of those competitors. Crested jayshrikes are one of such species, as are gray-cheeked bulbuls *Alophoixus tephrogenys* and melodious bulbul *A. bres*, among others. These species are heavily exploited to support songbird competition culture, placing them at risk of secondary extinction.

From a practical management perspective, this suggests the need for a more comprehensive strategy addressing the trade chain from the point of capture to the point of sale. Effective intervention will require improved enforcement of all relevant pieces of existing national legislation to serve as a strong deterrent, greater attention to non-competition species involved in the songbird trade network, and coordinated action targeting traders, middlemen, and end users. Without such measures, the crested jayshrike and other master bird species may continue to decline unnoticed due to over-exploitation, despite being legally protected.

Author Contributions

Conceptualization: V.N., M.C., and D.K.T.S. Formal analysis: V.N. and M.C. Funding acquisition: V.N., M.C., J.C., K.H., and K.A.-I.N. Investigation: V.N., A. Abdullah, A. Ardiansyah, J.C., R.H., A.L., I.N.A.D.P., and D.K.T.S. Methodology: V.N., M.C. Project administration: V.N., M.C., K.H., K.A.-I.N., and D.K.T.S. Supervision: V.N., M.C., K.A.-I.N., and D.K.T.S. Visualization: V.N. and J.C. Writing – original draft Preparation: V.N. and M.C. Writing – review and editing: V.N., A. Abdullah, A. Ardiansyah, M.C., J.C., K.H., R.H., A.L., K.A.-I.N., I.N.A.D.P., and D.K.T.S.

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Ethics Statement

No identifiable information on individuals or businesses was collected during this study. This study did not involve any experiment on animals or research involving human participants, and while we did not require

institutional permission for observational research in wildlife markets, they were added to Oxford Brookes University's Register of Activities Involving Animals, which was approved annually over the period 2016–2025. The research was conducted with approval from the Indonesian Institute of Sciences (LIPI), Ministry of Research and Technology (RISTEK), and National Research and Innovation Agency (BRIN). Our research was underpinned by MoUs between Oxford Brookes University and Gajah Mada Univeristy and Warmadewa University.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the corresponding author upon a reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.
Figure S1: Study area showing the islands of Sumatra, Borneo, Java, Bali, and Lombok (province names in italics) and the locations of surveyed bird markets. **Figure S2:** Random effects of bird markets derived from the Generalized Additive Mixed Models. **Supplementary video.** Vocalization of a brown crested jayshrike (*Platylophus galericulatus coronatus*). supmat.