Songbird SKI

Annex 1: Species Knowledge Initiative to Support CITES Decisions and Recommendations for Passeriformes

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Over more than 47 years, the contributions of Species360 members have created the world's largest database on wildlife in human care. We strive to harness this wealth of data, combining it with other critical wildlife data repositories, to support the conservation of species, improve animal care, and advance science. It is our pleasure to present the Species Knowledge Initiative (SKI) on Songbirds to support the CITES decision-making process. We want to thank all our collaborators, the sponsor partners of the Species360's Conservation Science Alliance, and our +1200 members that made this work possible. We hope this information made openly available will advance the CITES Animals Committee's work. leadership, and conservation practitioners.

Jim Guenter - Species360 CEO

It is our pleasure to present the Species Knowledge Initiative to support CITES decisions on Songbirds. Providing this work to CITES is part of the University of Southern Denmark, SDU's wishes to work with the United Nations' 17 Sustainable Development Goals (SDGs) based on free, critical and independent research and education. The work presented here includes these three components by collaboration across departments (Department of Biology and Department of Mathematics and Computer Sciences). Based on a methodology published by our faculty in 2019, the SKI integrates data and expertise from NGOs, companies, public organizations and other educational and research institutions. At the same time, we are proud to have some of our students and interns as contributors. We believe that it is fundamental to provide students with opportunities for education in knowledge, skills and motivation to work with the challenges behind the UN's SDGs. We hope this is one of many future projects to support CITES and other UN Conventions.

Prof. Marianne Holmer
Dean of the Natural Sciences Faculty, University of Southern Denmark

As former President of the World Association of Zoos and Aquariums (WAZA), it is my pleasure to present the Songbirds SKI. We hope that by supporting the Species360 Conservation Science Alliance, the present work can aid CITES decisions to regulate international trade on this taxa. Furthermore, the Songbirds SKI is an essential step after the European Association of Zoos and Aquaria (EAZA) 'Silent Forest' conservation campaign. Through this songbird conservation campaign, we raised awareness and support for in situ measures directed at mitigating the severe impact of the caged bird trade on the status of an increasing number of Southeast Asian songbirds. The EAZA Songbird Taxon Advisory Group's (TAG), ongoing efforts to help fight against the songbird crisis in Southeast Asia, still dominates our TAG activities.

Prof. Theo B. Pagel
Director of Cologne Zoo, Past-President of WAZA

Acronyms

ASTSG	Asian Songbird Trade Specialist Group
AZA	Association of Zoos and Aquariums
AZE	Alliance for Zero Extinction
CCI	Cambridge Conservation Initiative
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CITES TDB	CITES Trade Database
CMS	Convention on Migratory Species
CoP	CITES Conference of the Parties
EAZA	European Association of Zoos and Aquaria
EcoD	Ecological Distinctiveness
ED	Evolutionary Distinctiveness
EDGE	Evolutionarily Distinct and Globally Endangered
GBIF	Global Biodiversity Information Facility
GROMS	Global Register Of Migratory Species
HBW	Handbook of the Birds of the World
IUCN	International Union for Conservation of Nature
LEMIS	USFWS Law Enforcement Management Information System
SiTDB	Songbirds in Trade Database
SKI	Species Knowledge Initiative
SSP	Species Survival Plan
TAG	Taxon Advisory Group
TRAFFIC	Wildlife Trade Specialist NGO
UNODC	United Nations Office on Drugs and Crime
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
USFWS	United States Fish and Wildlife Service
VGP	Vertebrate Genome Project
WAZA	World Association of Zoos and Aquariums
World WISE	UNODC World Wildlife Seizures Database
WiTIS	TRAFFIC Wildlife Trade Information System
ZIMS	Zoological Information Management System

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Summary and Overview

International trade is one of the main threats to passerine (songbird) species (CITES 2019), and this is without considering possible impacts from the domestic trade. However, out of 6,599 described extant songbird species (HBW and BirdLife International 2019) only 85 (1.3%) songbird species and subspecies are regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Because the vast majority of songbirds (98.7%) are not listed under CITES, there is limited legislation to prevent or regulate their international trade, regardless of legal protection in countries of origin. Despite the importance of unregulated, illegal, and unsustainable trade in songbirds, overall trade is poorly documented outside of CITES-listed species. To further assess trade impacts on songbirds and tackle the songbird trade crisis, the USA and Sri Lanka submitted Document 79 at the 18th meeting of the CITES Conference of the Parties, or CITES CoP18 (CITES 2019), presenting their concerns regarding songbird trade and needs for conservation management.

Here, we present a preliminary study with the main goal of identifying and ranking species in the international wildlife trade to prioritize further research on the impacts of international trade on the sustainability of the species' populations. The document presented here aims to support *Decision 18.256* on songbird trade, which was adopted at the CITES CoP18 in Geneva in 2019 in response to Document 79 and discussions it provoked (CITES 2020b). In particular, this document supports the mandate of developing a preliminary study on the scale and scope of the international songbird trade to consider the management and conservation priorities for songbird taxa.

To support *Decision 18.256*, Species360 and The University of Southern Denmark's Interdisciplinary Centre on Population Dynamics (CPop) led the Species Knowledge Initiative (SKI) for Songbirds (as stated in the CITES 31st Animals Committee (AC 31 Doc. 30), see paragraph 6). The SKI works with partners across disciplines to standardize, visualize, and consolidate information for every described vertebrate species to support evidence-based decision-making by policymakers, management authorities, zoo and aquarium leadership, and conservation practitioners.

We present here the Songbird SKI with the aims to:

1) Provide an overview of international (regulated and unregulated) trade patterns for 6,599 songbird species, with a particular focus on CITES-listed species and species in international trade (i.e., those with trade/seizure records or with evidence of international demand);
2) Identify data gaps and opportunities for research and collaboration across six knowledge areas;
3) Provide a framework to facilitate amendments to CITES listings by identifying species for which international trade may have a detrimental impact on species survival in the wild;
4) Provide a framework to identify CITES-listed species that may be susceptible to laundering as captive bred.

1. Overview of international trade in songbirds

To date, 85 songbird species and subspecies are listed by CITES (App. I: 12 spp., App II: 69 spp. [incl. 3 subspecies listings], and App III: 4 spp.) which are regulated. To assess the species both in the international regulated and unregulated trade we used different data repositories. For the regulated trade, we analysed the CITES Trade Database (CITES TDB) and data reported in the United States Fish and Wildlife Service (USFWS) Law Enforcement Management Information System (LEMIS). For the

unregulated trade we derived data from TRAFFIC's Wildlife Trade Information System (WiTIS), the United Nations Office on Drugs and Crime (UNODC) World Wildlife Seizures Database (World WISE, including CITES Annual Illegal Trade Reports), and the Songbirds in Trade Database (SiTDB). It is important to clarify that the CITES TDB reports trade transactions of both CITES-listed and non-CITES listed species (e.g., CITES de-listed species or species under EU Wildlife Trade Regulations; Figure 2). In addition, we used the SiTDB results published in Juergens et al, 2021, which compiles data on Songbirds in Trade, such as peer-reviewed and grey literature, hobbyists and breeders publications, and social media (see Juergens etal. 2021 for methods). Although its aim is to be comprehensive, we found some gaps when using seizure data from other repositories (Fig. 2). However, the SiTDB is being constantly updated with the aim to fill those gaps and is hosted by Monitor. To explore other variables that can be of interest we standardised data from 32 databases used for this project (see Annex 3), we standardized taxonomies and used as our taxonomic backbone the Handbook of the Birds of the World and BirdLife International Digital Checklist of the Birds of the World Version 4 (HBW and BirdLife International 2019). Because BirdLife splits some of the species listed in CITES into two or more species, the number of CITES-listed species according to the HBW/Birdlife taxonomy is 93 (App. I: 12 spp., App. II: 77 spp., and App. III: 4 spp.). These numbers are reported throughout this document.

For the regulated trade we focused our analysis on international live commercial trade reported in the CITES Trade Database since 2006. Of the 93 CITES-listed species, 43 species were traded internationally in both, regulated and unregulated trade, and 50 species did not have recent trade records. Of the remaining 6,506 non-CITES listed songbirds, we found that 998 species were internationally traded (in regulated and unregulated trade) and their international trade is currently not regulated by CITES. Overall, our analysis comprised 1,091 species of interest (i.e., 93 CITES-listed species and a further 998 non-CITES-listed species in international trade; Figure 1).

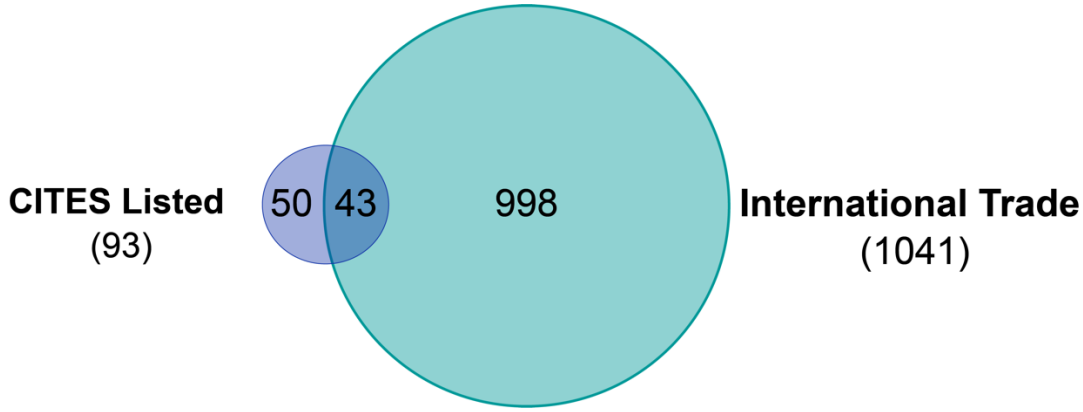


Figure 1. A total of 1,091 songbird species with CITES listings and/or evidence of recent international trade in live individuals both regulated and unregulated (i.e., illegal such as data from seizures, or trade of species that are not under CITES protection). Of the 93 CITES-listed species, 43 have transaction records in the CITES Trade Database and/or in other trade and seizure databases used for this study.

Furthermore, we developed analyses going back to 1975 to assess the changes on the trade and from 1975 to 2018 in the CITES Trade Database showed a 93% drop in CITES regulated trade after 2006. This drop has been frequently attributed to the 2005 bird importation ban in Europe (EU

2013; Reino et al. 2017; Harfoot et al. 2018). However, not only did the EU import ban play a role, but in following years decreasing numbers of transactions could have been triggered by the removal of 72 passerine species from CITES Appendix III in 2007, some of which are frequently traded (UNEP-WCMC 2007). However, for the purposes of this document we did not further analyze the drivers of these declines, which will be an important area for further research (Juergens et al. *in prep.*).

Our analyses revealed that African countries were the main exporters of wild individuals in 1975–2005 and 2006–2018 with 86% of 5.2 million total individuals exported from Senegal, Guinea and Mali in the first period, while importer countries were mainly European during the first period, with almost half of 5.2 million total individuals imported into Portugal and Belgium. From 2006 to 2018, Tanzania was the main exporter and South Africa was the main importer with 71% and 84% of all 686 live individual records, respectively. For captive-bred individuals, the main exporter during the first period was Taiwan (Province of China), and Japan was the main importer. During the second period, Taiwan (Province of China) and Cuba were the main exporters, and Japan and Mexico were the main importers (Table 4 & 5).

From analyses of the USFWS LEMIS Database, we found that imports from the regulated trade into the USA have gradually declined from 2000 to 2014, with a notable drop in 2006 for wild-caught individuals. For captive-bred individuals, we found a peak in 2002 and a gradual decline since then. From 2000 to 2014, a total 2.4 million live songbirds covering 360 species (both CITES and non-CITES listed) were imported to the USA of which 75% were captive-bred, 24% wild-caught and 1% from other sources (Eskew et al. 2020).

Although seizure data do not cover the breadth of illicit trade, seizures are an indicator of species in international markets and of authorities' capacity to detect and address illicit trade (UNODC 2020). We found 127 species in international seizure data from the UNODC World WISE Database (including CITES Annual Illegal Trade Reports) and TRAFFIC WiTIS in 2008–2020, of which 24.4% (31 spp.) were CITES listed. In TRAFFIC WiTIS, we recorded 650 confiscation incidents (international and domestic) of live or dead individuals (excluding derivatives) of CITES and non-CITES listed species across 43 countries. Since 2018, there has been a gradual increase in the number of songbird individuals seized in international illicit trade.

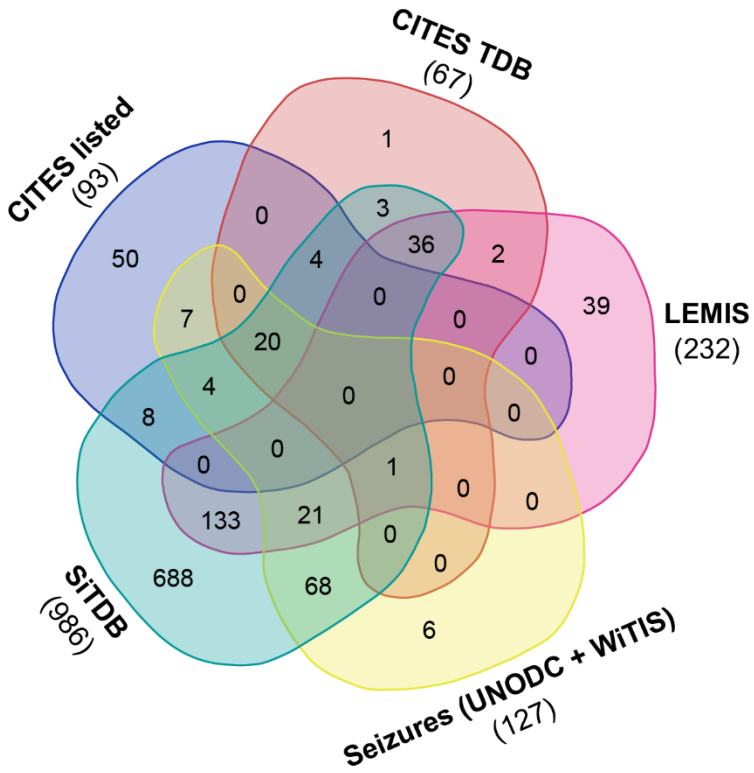


Figure 2. A total of 1,091 songbird species with either CITES listings and/or evidence of recent international trade in live individuals. Please note that we report 93 CITES-listed species as we used the Handbook of the Birds of the World as our taxonomic backbone. **CITES-listed:** species currently listed in CITES Appendices. **CITES TDB:** species with trade transactions in the CITES Trade Database (including CITES-listed and non-CITES listed species). **LEMIS:** species in the USFWS Law Enforcement Management Information System. **Seizure** record species in the databases: TRAFFIC WiTIS and UNODC World WISE (including CITES Annual Illegal Trade Reports). **SiTDB:** species with international trade records in the Songbirds in Trade Database (Juergens et al. 2021, Annex 3).

2. Data gaps and opportunities for research across knowledge areas

We assessed data availability and gaps for species biological information since it is a key component of CITES listing amendments (CITES 2020a). We included information on species threat levels together with other data such as demographic parameters (e.g., fertility and survival), geographic distribution, and species traits.

We found that 30% (28 spp.) of the 93 CITES-listed species are listed as globally threatened by the IUCN Red List (including all App. I species except *Erythropitta kochi* (11 spp.), 17 App. II and 1 App. III species) and 2.7% (27 spp.) of the 998 non-CITES species in international trade are threatened (Figure 3 and Figure 20). Of these 1,091 focal species in international trade, 10.5% (115 spp.) are highly vulnerable to climate change (Foden et al. 2013). All 3 species selected under the Alliance for Zero Extinction (AZE) are also listed under CITES (*Leucopsar rothschildi*, *Gracula robusta*, and *Zosterops albogularis*, the latter of which does not have recent international trade records). All species under AZE are considered Endangered or Critically Endangered with only a single population remaining in a conservation trigger site.

Our results showed that species in international trade were not particularly evolutionarily distinct. However, many were ecologically distinct, in that they exhibited a rare combination of biological traits (e.g., diet type, body mass, and habitat). Thus, they have quite unique roles in the ecosystems playing key roles in ecosystem function. Our results suggest that international trade may be targeting species with high ecological irreplaceability, thus the regulation of international trade for those species may have flow-on effects on the persistence of the ecosystems they inhabit.

In terms of biological information availability, we found notable data gaps for CITES-listed species. Maximum data availability was observed for generation length, movement pattern, distribution, and extent of occurrence (available from the IUCN Red List), with data available for all (100%) of the 93 CITES-listed species and 75.7% (756 spp.) of the 998 non-CITES species in international trade (Table 11 and Table 17). However, more specific information required to model population viability under the pressure of population harvesting, usually in the form of life tables or population matrices (i.e., age- or stage specific survival and fertility for at least one population of the species), was rarely available. Only three (3%) of CITES-listed species (i.e., the critically endangered *Leucopsar rothschildi* and the two least concern species *Leiothrix lutea* and *Lichenostomus melanops*) had a life table or matrix with population-level demographic data.

Songbirds make up the largest proportion of bird species held in zoos. They are extremely diverse in terms of biology and management needs. In 2020, Species360 member zoos and aquariums held 14% (892 spp.) of songbird diversity, covering 60% of families (Figure 24). Non-commercial breeding programs (usually governed by regional zoo associations, governments, or research entities) were in place for 21.5% (20 spp.) of CITES-listed species and 4.3% (43 spp.) of non-CITES species in international trade (Table 14). Commercial, hobby, or opportunistic breeding effort was recorded for 10.8% (10 spp.) of CITES-listed species and 14.4% (144 spp.) of non-CITES species in international trade (Table 14). Of focus to assess if the international trade threats the survival of the species' populations should be species that are not only found in the trade and globally threatened according to the IUCN Red List, but as well are susceptible to other threats such as being vulnerable to climate change not yet covered by CITES (i.e. species found in different trade databases and not CITES listed in Fig. 3).

From a preliminary analysis in the SiTDB, we found that 36.6% (34 spp.) of the 93 CITES-listed songbirds can be considered difficult to breed (Figure 26). In particular, 27.9% (26 spp.) also showed trade transactions since 2006 (Figure 26). Species occurring in trade that are difficult to breed or have never been bred in captivity are far more likely to origin from the wild. Further research (especially on breeding knowledge) could help ascertain whether such species are targets for laundering as captive bred in international markets.

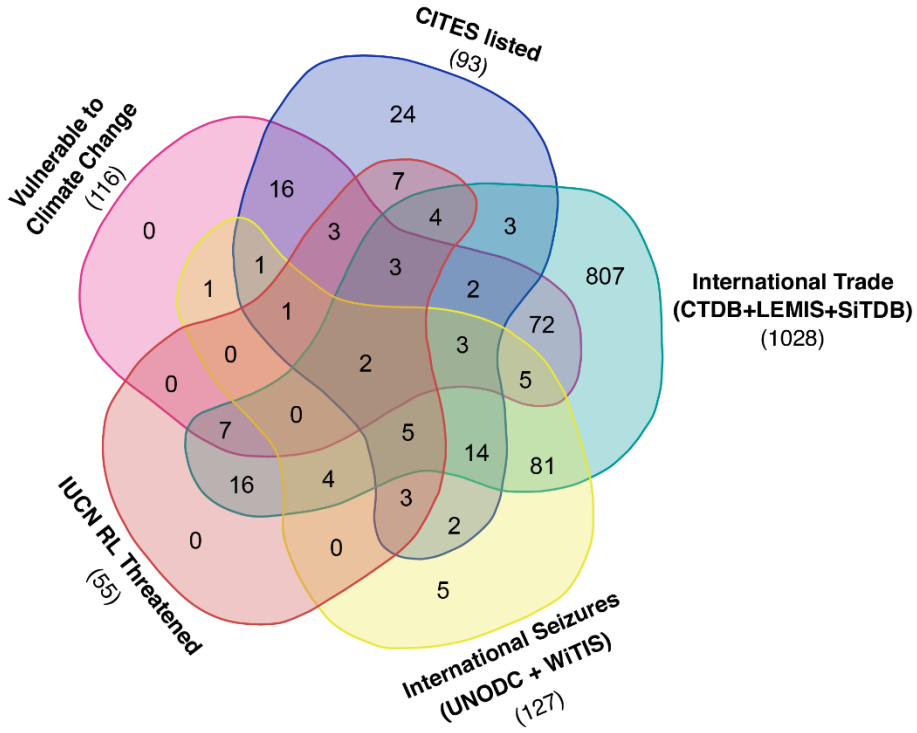


Figure 3. Representation of 1,091 songbird species in international trade that were found across different databases used: **1)** highly vulnerable to climate change as assessed by the IUCN Climate Change Specialist Group; **2)** CITES-listed species, **3)** recent international trade in live individuals from the CITES Trade Database, LEMIS, or SiTDB; **4)** records of seizures from the databases: TRAFFIC WiTIS and UNODC World WISE (including CITES Annual Illegal Trade Reports); and **5)** listed as threatened (i.e., Vulnerable, Endangered, or Critically Endangered) by the IUCN Red List.

3. Prioritizing species for further research to support CITES listing amendments

Including a species under CITES Appendix I, II, or III requires a detailed assessment of trade and species biology (*Resolution Conf. 9.24 Rev. CoP17*; CITES 2020a). Evidence that trade is detrimental or may harm species survival is based on trade estimates (or demand) and biological considerations. Thus, high amount of data is needed to support CITES decisions. Here, we developed a simple framework to identify species found in international trade for which research may be more urgent based on the following criteria (Figure 4):

1) Species with records, publications, or reports referring to international trade (i.e., species not currently CITES listed), resulting in 998 species identified;

2) For the 998 non-CITES species in international trade, we collated the following risk assessments based on similar biological criteria as those used by CITES:

- **a)** Species assessed as globally threatened by the IUCN Red List (i.e., categories of Vulnerable, Endangered, and Critically Endangered), resulting in **27 species under high priority** (of which 14, 8, and 5 were listed as Vulnerable, Endangered, and Critically Endangered, respectively);
- **b)** Species not globally threatened but assessed to be Near threatened or Least Concern with populations declined and or **highly vulnerable to climate change by the IUCN Climate Change Specialist Group (Foden et al. 2013) and/or with decreasing**

population trends as reported by the IUCN Red List, resulting in **319 species under medium priority**;

c) Species not in a) or b), resulting in **652 species under low priority**.

Our basic framework using the IUCN Red List and other species prioritization schemes provides a good starting point to lead the development of research initiatives. We found that among the 998 non-CITES species in international trade, some families had a higher proportion of priority species, notably the laughingthrushes (Leiotrichidae; high priority: 12.2% and medium priority: 78%). These are followed by the leafbirds (Chloropseidae; high priority: 25% and medium priority: 62.5%).

The 27 species identified as high research priority were distributed within 58 (24%) out of 244 countries and dependent territories (hereafter countries), and Indonesia hosted the highest number of high-priority species (10 spp.). Medium research priority species were distributed across 216 (88%) countries. China had the highest number of medium research priority species within its territory (128 spp.). The 652 species with a low research priority were found in 219 (90%) countries, including China (177 spp.), Sudan (171 spp.), and Kenya (161 spp.) (Figure 30.

The SiTDB reported trade as a threat for 48.1% (13 spp.) of the 27 high-priority species. However, note that the SiTDB does not differentiate between international and domestic trade for this category ('trade as threat'), which indicates if the trade affects the sustainability of the species, or a population based on the peer-reviewed literature. Thus, a more in-depth review is still needed for all prioritized species. For the categories of medium and low priority, the impacts of trade are unknown for 82.4% and 91.7% of species.

We want to highlight the need to update the prioritization framework with national species threat assessments in the future. Indeed, global species threat assessments may not pinpoint all species for which international trade could be a threat (at national or regional levels). More research to assess international and domestic trade impacts is particularly needed for the 26 species in medium or low-priority categories for which trade is reported as a threat to populations in the SiTDB (Table 1).

Table 1. Impact of international and domestic trade on species survival by research priority. Note 'threat' is assigned by the SiTDB when the peer-reviewed literature considers trade as a threat to species. The categories of plausible and unknown are based on a qualitative assessment by the SiTDB (see Annex 3).

Trade impact	Research priority		
	High	Medium	Low
Threat	13 (48.1%)	17 (5.3%)	9 (1.4%)
Plausible threat	9 (33.3%)	39 (12.2%)	45 (6.9%)
Impact unknown	5 (18.5%)	263 (82.4%)	598 (91.7%)
Total number of species	27	319	652

4. Identifying CITES-listed species susceptible to laundering as captive bred

While captive breeding can diminish pressure on animal populations compared to harvesting animals from the wild, there is evidence that criminal groups use breeding facilities to supply the licit market with illicit wild-taken individuals (UNODC 2020). Furthermore, CITES has expressed concern about either the misuse of source codes referring to captive breeding or deliberate use to launder wild-caught specimens as captive bred in international markets (CITES 2016).

We developed a framework to help identify species that warrant further research on breeding difficulty and levels of trade in captive-sourced individuals. We identified 21 CITES-listed species in the CITES Trade Database with records of commercial transactions as captive sourced in 2006–2018 (Table 18). We found that 61.9% (13 spp.) of the 21 species had breeding programs in zoos, while 38% (8 spp.) of species had commercial or hobby breeding efforts as reported in the SiTDB. Of the 21 species, 2 were deemed "easy" to breed by the SiTDB, 8 "normal" to breed, 9 "hard" to breed, and 2 "challenging" to breed. The two species commercially traded under Appendix I since 2006 (*Leucopsar rothschildi* and *Spinus cucullatus*) were "normal" to breed.

Of particular interest are species that are noted as "hard" or "challenging" to breed in captivity yet are traded in relatively high numbers under source code C (i.e., captive bred); this was the case for *Gracula religiosa* and *Parotia carolae*. For such species, further investigations are needed to characterize breeding difficulty, especially by commercial breeders. Trade levels under different source codes should also be interpreted considering biological information available for each species (Table 11), although detailed information is scant for CITES-listed species.

Table 2. Songbird species traded as Appendix I captive-bred species (D), captive bred (C), captive born (F), or ranched (R) in the international commercial live trade (2006–2018) with importer and exporter quantities. Color shading indicates breeding difficulty from SiTDB. Breeding program refers to programs that manage species to ensure their welfare, and demographic and genetic sustainability by coordinating efforts across different organizations (i.e., Zoo regional associations breeding programs). Breeding effort indicates breeding for commercial or hobby purposes, for which we do not have records of demographic or genetic management.

Species	CITES App.	Breeding difficulty	Breeding program	Breeding effort	Source	Imp. quant.	Exp. quant.
Lonchura oryzivora	II	easy	✓	✓	C F	242,567 0	0 65
Poephila cincta	II*	easy		✓	C	10	0
Garrulax canorus	II	normal	✓		C	20	0
Gubernatrix cristata	II	normal	✓	✓	C	47	0
Leiothrix lutea	II	normal	✓	✓	C	23	0
Leucopsar rothschildi	I	normal	✓	✓	C D	40 0	 22
Paroaria coronata	II	normal	✓	✓	C F	6 0	 49
Pycnonotus zeylanicus	II	normal	✓	✓	C	3	0
Spinus cucullatus	I	normal	✓	✓	C	126	0
Spinus yarrellii	II	normal			C	30	29
Amandava formosa	II	hard			C	0	20
Cicinnurus regius	II	hard	✓		C	6	6
Gracula religiosa	II	hard	✓		C F	1,941 5	0 0
Hydrornis guajanus	II	hard	✓		C	1	1
Leiothrix argentauris	II	hard	✓		C	0	4
Paradisaea apoda	II	hard	✓		C	6	6
Paradisaea minor	II	hard			C	6	6
Rupicola peruvianus	II	hard			C F R	0 0 2	6 4 0
Rupicola rupicola	II	hard			F	3	0
Cephalopterus penduliger	III	challenging			C	0	4
Parotia carolae	II	challenging			C	300	0

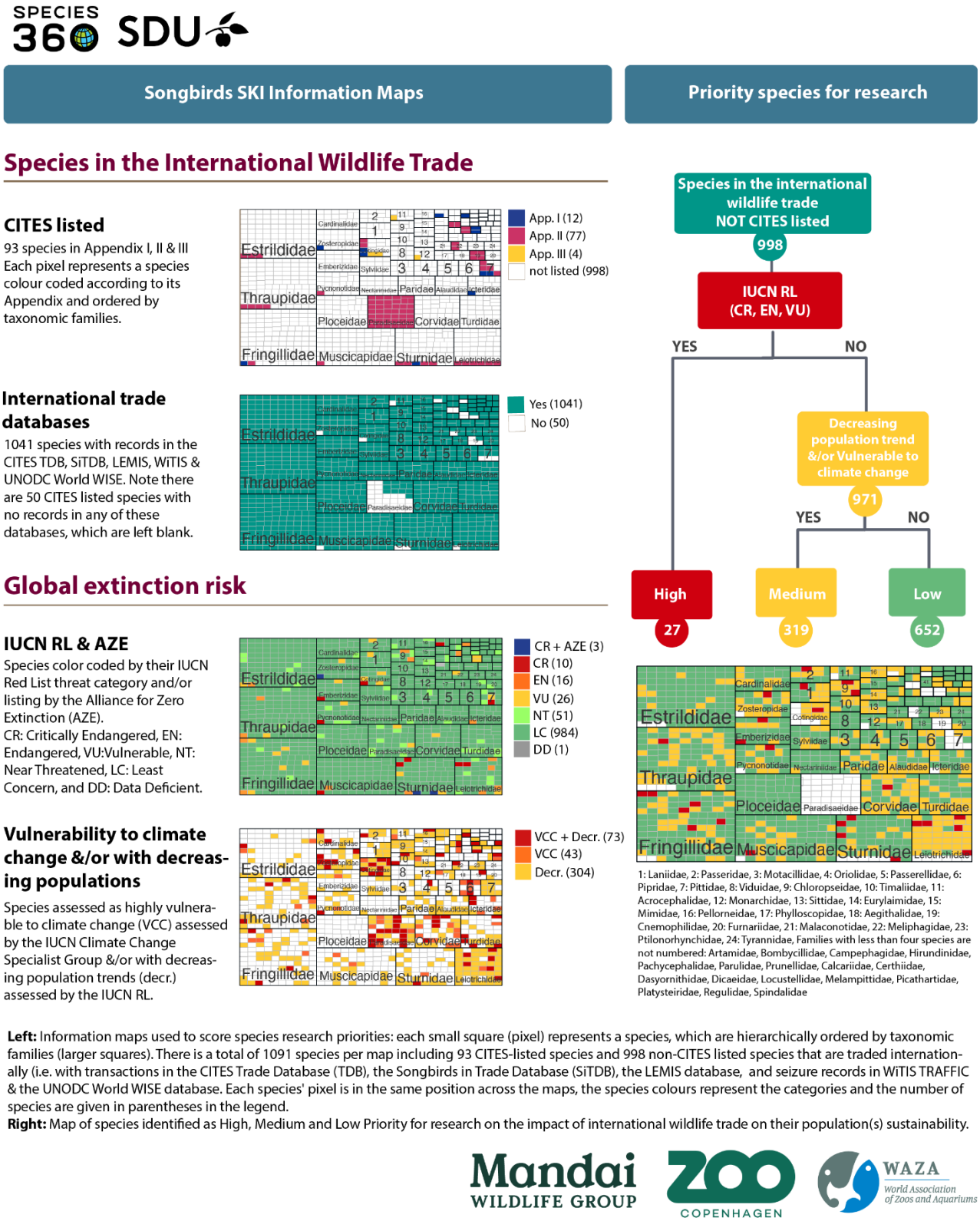


Figure 4. Infographic summary of the priority species identified by the Songbird Species Knowledge Initiative (SKI).

Species	VCC	EcoD	TradeT	Dom.
Acridotheres melanopterus		✓	✓	✓
Emberiza aureola		✓	✓	✓
Garrulax courtoisi			✓	
Garrulax rufifrons	✓	✓	✓	✓
Gracupica jalla		✓	✓	✓

Species	VCC	EcoD	TradeT	Dom
Chloropsis media		✓	✓	✓
Chloropsis sonnerati		✓	✓	✓
Copsychus sechellarum		✓	plausible	✓
Crithagra flavigula			plausible	
Garrulax bicolor	✓		✓	✓
Sporophila maximiliani		✓	✓	✓
Trochalopteron ngoclinhense	✓		plausible	
Trochalopteron yersini	✓	✓	plausible	✓

Species	VCC	EcoD	TradeT	Dom
Acridotheres cinereus			plausible	✓
Acridotheres javanicus		✓	✓	✓
Crithagra xantholaema	✓			
Emberiza rustica		✓	✓	✓
Gymnorhinus cyanocephalus	✓	✓		
Hesperiphona vespertina		✓	plausible	
Lanius meridionalis				✓
Passer italiae				✓
Procnias nudicollis		✓	plausible	✓
Pyrrhula murina	✓	✓		
Pyrrhula waterstradti		✓	plausible	✓
Rubigula dispar		✓	✓	✓
Serinus syriacus		✓	plausible	
Zosterops melanurus			✓	✓

Species	VCC	EcoD	TradeT	Dom
Cracticus louisiadensis	✓			✓

Figure 5. Infographic of the priority species identified by the Songbird Species Knowledge Initiative (SKI) across five knowledge categories.

Introduction

Over the past century, the average rate of vertebrate extinctions has been approximately 100-fold higher than the geological background rate (Ceballos et al. 2015). Population declines continue to increase globally, and given the rate of current species extinctions, evidence-based policies and well-informed management are becoming critical to conserving species at risk.

The Species Knowledge Initiative (SKI) works with partners across disciplines to standardize, visualize, and consolidate information for every described vertebrate species with the overall goal to support decision-making by policymakers, management authorities, zoo and aquarium leadership, and conservation practitioners. The original concept of the SKI stems from the Demographic Species Knowledge Index (Conde et al. 2019), which is now being refined and expanded to other knowledge areas across taxonomic groups. Currently, most projects feeding into global biodiversity indices (such as the SKI) are of a global nature and aimed at supporting global-level policy processes, such as CITES. However, the SKI can and will be further developed to be used and applied at regional and national levels.

Here, we present the results of the SKI methodology for songbirds. Songbirds (i.e., species in the order Passeriformes) comprise 6,599 extant species, representing more than half of all described birds (HBW and BirdLife International 2019). Unfortunately, songbird populations have been declining dramatically in many parts of the world (Butchart et al. 2004). Currently, 10% (684 spp[1].) of songbirds are listed as globally threatened by the International Union for Conservation of Nature Red List of Threatened Species™ (i.e., the IUCN Red List).

International trade is a major threat to songbirds, and songbirds are traded for a variety of reasons (CITES 2019). Songbirds are attractive in the international and domestic trade due to their singing abilities, with songbird competitions being a major pastime in several consumer countries (Jepson & Ladle 2005; Chng 2015; Lee, Chng & Eaton 2016; Harris et al. 2017). Many species are traded as ornamental cage birds for their colorful plumage (Shepherd, Eaton & Chng 2015), for religious purposes (Gilbert et al. 2012), or, to a lesser extent, for their meat (Kamp et al. 2015). Threatened songbirds are also traded for their perceived rarity, with price and desirability increasing as wild populations decrease (Courchamp et al. 2006). Consumers of songbirds also vary. For example, a recent study on Indonesian songbird keepers identified three main consumer groups: hobbyists (who typically own cheaper native birds as pets), contestants (who own more valuable birds for competition), and breeders (who keep a large array of species to produce birds with high-quality songs and plumage)(Marshall et al. 2020)[2].

The exact scale of the current international songbird trade remains unknown; however, it is thought to have peaked in the 1970s (Inskipp 1990). Since then, national export bans for wild-caught birds in source countries (e.g., India, Columbia, and Bolivia) and import bans in consumer areas (e.g., the USA and EU) have contributed to decreasing international trade (CITES 2019). Nevertheless, international trade continues and appears to be on the rise in some regions, with little international monitoring, regulation, or enforcement.

As a response to unregulated international trade, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was formed as an agreement between governments and includes 183 countries to date. CITES lists around 5,800 animal and 30,000 plant

[1] The 684 threatened bird species are based on the Birdlife taxonomic backbone downloaded in Dec. 2019, which includes the 2019 RL status.

[2] Although this use has been assigned mostly to domestic trade.

species in three Appendices accounting for different levels of threat and trade impacts (CITES 2018). International commercial trade in Appendix I species is prohibited except under exceptional circumstances and requires both an import and export/re-export permit for transactions. For Appendix II species, typically only an export/re-export permit is required. Captive-bred specimens of Appendix I species can be treated as Appendix II species, while permit requirements are the least stringent for Appendix III species (CITES 1973).

Currently, 85 (1.3%) of the 6,599 described songbird species are included in a CITES Appendix, with 12 species listed in Appendix I, 66 in Appendix II (of which 3 are subspecies), and 4 in Appendix III (UNEP-WCMC 2020). Because the vast majority of songbirds (98.8%) are not listed in CITES Appendices, there is typically no legislation to prevent or regulate international trade, regardless of legal protection in countries of origin. For example, although the EU banned the import of exotic wild-caught birds in response to the bird flu, once a wild-caught bird not covered by the EU Wildlife Trade Regulations is smuggled into the EU, it can be traded freely within and among member states (Box 1). The Indonesian endemic Sumatran laughingthrush (*Garrulax bicolor*; Heinrich et al. 2021) is protected in Indonesia yet is increasingly observed for sale in the Netherlands, France, and other European countries (SiTDB). As it is not listed in CITES Appendices or covered by the EU Wildlife Trade Regulations, there is currently little that can be done to support Indonesia's efforts to protect this species from international exploitation.

Box 1. European Union Wildlife Trade Regulations

Since 1984, CITES provisions in the EU have been implemented through a set of laws, often referred to as the European Union Wildlife Trade Regulations. Like CITES, the Regulations follow an Appendix system, consisting of four Annexes (i.e., A, B, C, and D). Annex listings predominantly follow CITES listings. Annex A, the strictest category, prohibits commercial use and mainly includes CITES Appendix I species. Annex B includes primarily CITES Appendix II species, and Annexes C and D predominantly comprise CITES Appendix III species. The Regulations go beyond CITES in that they may list non-CITES species and CITES Appendix II or III species in any of the four Annexes, including Annexes A and B, if they are under stricter protection in the EU. The EU Wildlife Trade Regulations cover 126 songbird species, 13 of which are listed in Annex A, 69 in Annex B, 3 in Annex C, and 41 in Annex D. The EU Birds Directive, which regulates the EU's native species, comprises 53 songbirds.

Captive breeding can potentially diminish trade impacts on wild populations; however, individuals can be labeled as captive bred when in fact, they have been extracted from the wild. To detect any laundering of wild-caught individuals, it is essential to monitor when trade volumes surpass what could be theoretically produced in captive-breeding facilities. Thus, it is crucial to assess which species labeled as captive-bred in trade may not be suitable for commercial breeding due to biological, ecological, or dietary traits. Still, consumers often prefer wild-caught birds, as they are perceived to have superior singing abilities (Burivalova et al. 2017), creating further incentives to extract individuals from the wild. Currently, it is unknown how often wild-caught individuals are traded as captive bred, limiting our capacity to assess the sustainability of international trade.

Supporting CITES Decisions and Recommendations

To tackle the crisis in songbird trade, the USA and Sri Lanka submitted Document 79 (CITES 2019) at the 18th meeting of the CITES Conference of the Parties (CoP18, Geneva, 2019). In this document, the USA and Sri Lanka stressed the importance of further assessing trade impacts on songbirds, recognizing that songbird trade is poorly documented outside of CITES-listed species, despite the importance of unregulated, illegal, and unsustainable trade. Document 79 recommends developing background information on the trade and establishing a working group to explore songbird trade, with the goal of presenting a new document to the CITES Standing Committee and Animals Committee during the 19th meeting of the CITES Conference of the Parties (CoP19). The goal of the proposed working group is to consider the different issues related to international songbird trade, including biological information, implementation, and enforcement.

Furthermore, at the CoP18 (Geneva, 2019), *Decisions 18.256 to 18.259 on Songbird trade and conservation management* (CITES 2020b) were adopted. In *Decision 18.256*, the Secretariat was directed to 1) commission a preliminary study on the scale and scope of international songbird trade; 2) consult with appropriate technical experts in the preparation of documents on the conservation, trade, management, enforcement, and regulatory priorities of songbird taxa in a workshop; and 3) make the results of the study and workshop, together with recommendations, available to the Animals Committee for consideration. Decision 18.257 directs the Animals Committee to review the workshop results and report referred to in the previous decision (18.256) together with Document 79 (CITES 2019). Decision 18.258 directs the Standing Committee to consider the recommendations from the Animals Committee to make its own recommendations for the 19th meeting of the Conference of the Parties. Decision 18.259 referred to funding support for the development of the study and workshop.

The goal of the present report is to act on the recommendations of (CoP18) and provide information to support *Decision 18.256* (CITES 2020b). The information summarized here and expanded in the associated scientific data paper (Juergens et al. 2021, see Annex 3) is part of the Songbird Species Knowledge Initiative (SKI). We developed the Songbird SKI by considering paragraph 21–18.AA in Document 79 (CITES 2019). Thus, we included data on songbird conservation priorities and species management (with a particular focus on ex-situ management) together with data on biology and threats. To support resolutions on enforcement related to trade, we included data on illegal wildlife trade seizures and confiscations, thanks to the support of TRAFFIC Southeast Asia and the United Nations Office on Drugs and Crime (UNODC).

We also introduce the Songbirds in Trade Database (SiTDB) as an initial effort to identify species traded both internationally and domestically from 2006 to 2020. To support the technical workshop proposed in paragraph C of *Decision 18.256*, we have made the standardized dataset openly available (Juergens et al. 2021, see Annex 3). The current document is based on extensive global collaboration and the support of key partners, yet it remains biased toward publications in English and studies conducted in Southeast Asia. BirdLife International and the Cambridge Conservation Initiative (CCI) are leading a study on wild bird trade that will not only include songbirds but also enhance our understanding of country-specific trade patterns (Box 2). We hope the information provided here can further support CCI's efforts.

Box 2. A Quantitative Review of Global Trade in Wild Birds

Contributed by BirdLife International and the Cambridge Conservation Initiative

To inform conservation policy and practice in response to bird trade, the Cambridge Conservation Initiative (CCI) is supporting a collaborative project to produce the first quantitative overview of global bird trade, identifying key species, trade sectors, and trade countries. The project is led by BirdLife International, working together with CCI members including IUCN, TRAFFIC, the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), the University of Cambridge, and the Cambridge Infectious Diseases Interdisciplinary Research Centre. The CITES Secretariat has expressed its support, and the project will engage with other relevant organizations and experts worldwide.

Trade in wild birds is rapidly growing in key hubs, affecting multiple species across sectors and uses. However, trends and impacts of songbird (and other wild bird) trade remain largely unknown. This project aims to undertake, publish, and promote the conclusions of this wild bird trade overview (whether international, domestic, legal, or illegal) and apply its findings to guide conservation policy and practice at multiple levels. The project will determine which species are most frequently traded and threatened by trade (and in which countries), examine national and international legislation and IUCN Red List documentation, and assess the effectiveness of actions to mitigate negative trade impacts. The review will be conducted through expert consultation; data collection, collation, and analysis (including existing databases); quantitative assessments; national case studies; reviews of mitigation measures; and dissemination of conclusions.

Species Knowledge Initiative

The Species Knowledge Initiative (SKI) aims to integrate multiple sources of data to not only quantify current knowledge for every species but also monitor and track changes in knowledge levels. Using a landscape ecology perspective, the SKI methodology maps data from different knowledge areas to individual species (Figure 6). The SKI uses data-processing algorithms from open-data repositories, thereby harnessing information from existing open databases.

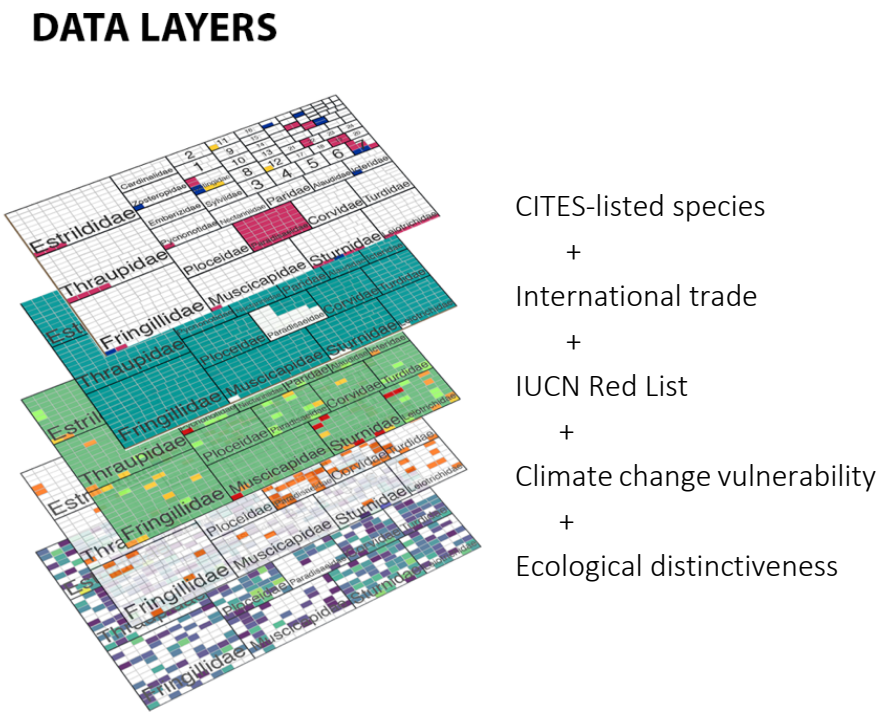


Figure 6. The Species Knowledge Initiative (SKI) maps and integrates data across knowledge areas to support conservation decisions. Here, we show examples of data layers used in the Songbird SKI. Each small rectangle (pixel) is a species, organized taxonomically by family (big squares). The position of each species is the same across data layers, allowing data integration and visualization.

To date, we have only included data in English in the SKI, limiting the scope of mapping. This bias should be considered when using this document and the data provided. The SKI currently holds information at a global scale, such as species threat assessments and regulations. However, further developing the SKI at national scales will be an excellent opportunity to expand its applications, including working with CITES Parties. Currently, the SKI is static, meaning computational routines must be re-run to extract, standardize, and map the data. We are establishing a network of collaborators and seeking funding to update the SKI on an annual basis using computational technology. This will allow us to flag changes in threat status, legislation, and new data to policymakers, conservation organizations, and scientists. Future developments will therefore extend the SKI from its current mapping focus to a monitoring system for species knowledge.

The SKI's first publication was the Demographic Species Knowledge Index (DSKI), published in 2019 (Conde et al. 2019), which serves as the first step towards our ambitious goal of mapping all biodiversity knowledge. The DSKI has been recommended for implementation in the post-2020 European Union (EU) Biodiversity Strategy (p. 5, paragraph 5), supported by WWF, BirdLife International, The Nature Conservancy, and 17 other conservation organizations.

Following the success of the DSKI, it is our pleasure to present the Songbird SKI. The data are openly available in the Species360 Conservation Science Alliance Open Data Portal. To support the prioritization of songbirds for CITES listing, we show available information and relationships among six knowledge areas: 1) international trade (including regulated and unregulated trade), 2) extinction risk, 3) conventions and treaties, 4) management opportunities (with a focus on ex-situ interventions), 5) biological information, and 6) species value (Table 3).

The CITES mandate is to ensure that international trade is legal, sustainable, and traceable. CITES selects species under their mandate when there is evidence that international trade threatens species survival or when international demand may be detrimental to species sustainability. Therefore, CITES prioritizes species based on biology and the impact of international trade on species populations (CITES 2020a). Here, we present a decision framework to identify species for which research on the impacts of international trade on species survival is warranted based on the following criteria. First, we identified species with records, publications, or reports referring to unregulated international trade (i.e., species not currently listed by CITES). Of those, species currently listed as threatened by the IUCN Red List of Threatened Species™ were deemed of high research priority. If species were not threatened but assessed as either vulnerable to climate change by the IUCN Climate Change Specialist Group or as having decreasing population(s) by the IUCN Red List, these species were deemed of medium research priority. Finally, the remaining species in unregulated international trade were deemed of low research priority.

We then present data available across the six knowledge areas for all songbirds in international trade and for each research priority category. This was done to facilitate the identification of data gaps at the global level. For CITES-listed species, we assessed which species under CITES source codes captive bred (C and D), born in captivity (F), and ranched (R) were easy to breed and if the species or genus were held in a zoo.

To support decision making using the SKI, we have developed three forms of data visualization to support the identification and prioritization of species across areas of knowledge:

1) Venn diagrams to show the overlap of species in 2 to 5 datasets (Figure 7);
2) UpSet plots to show the overlap of species across more than 5 datasets (Figure 8);
3) Treemaps to map information for each species (Figure 9).

Venn Diagrams

Venn diagrams use overlapping shapes to visualize relationships in 2 to 5 datasets. The numbers within the shapes represent the number of species within each dataset and overlap (Figure 7).

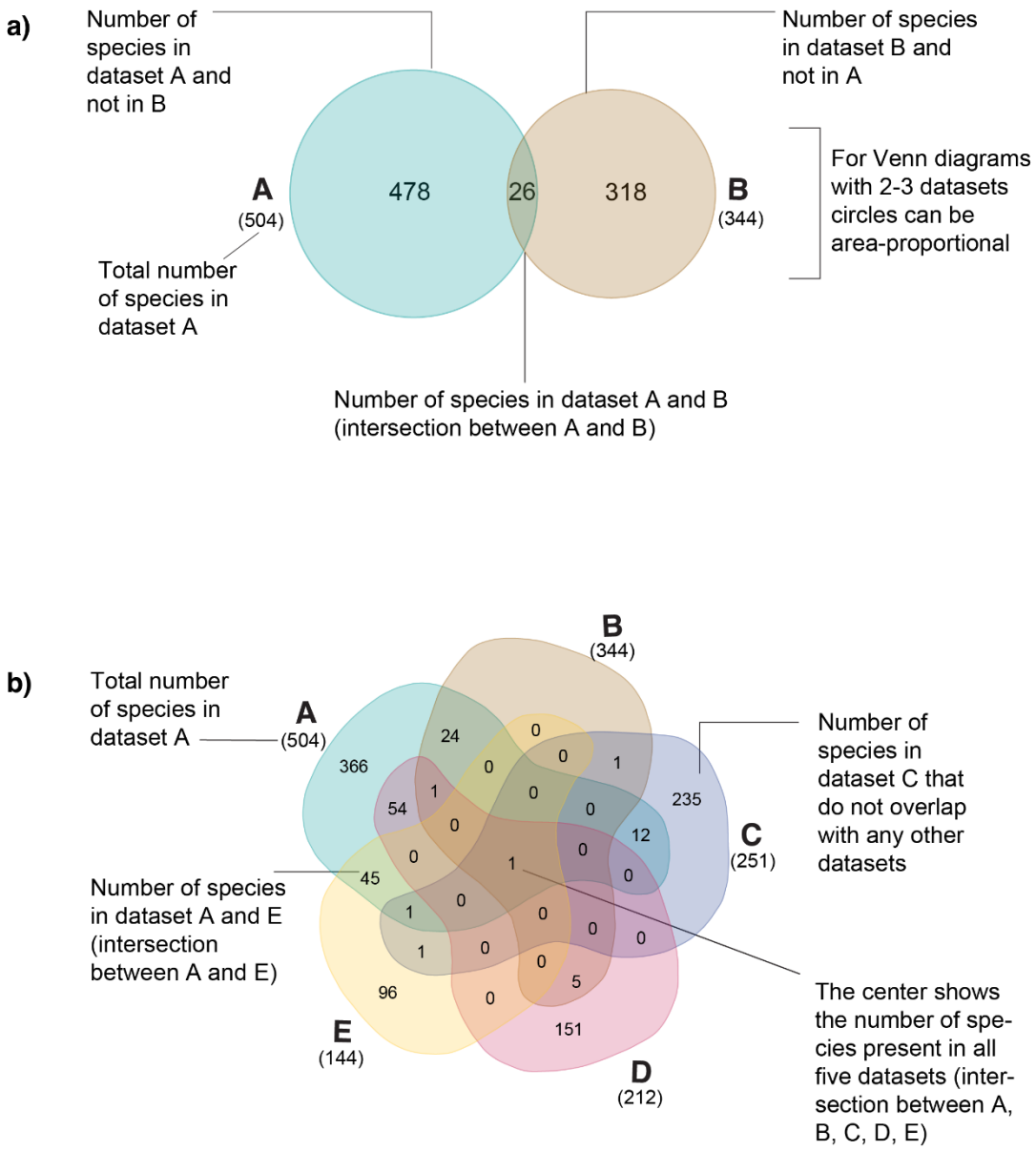


Figure 7. Venn diagrams use overlapping shapes to visualize relationships in 2 (see panel a) to 5 (see panel b) datasets.

UpSet Plots

UpSet plots display more complex relationships in more than 5 datasets, where Venn diagrams are unsuitable. UpSet plots show intersections across datasets using an intersection matrix and bar plots (Figure 8). UpSet plots allow the identification of species with different characteristics across datasets, allowing easy communication with decision-makers.

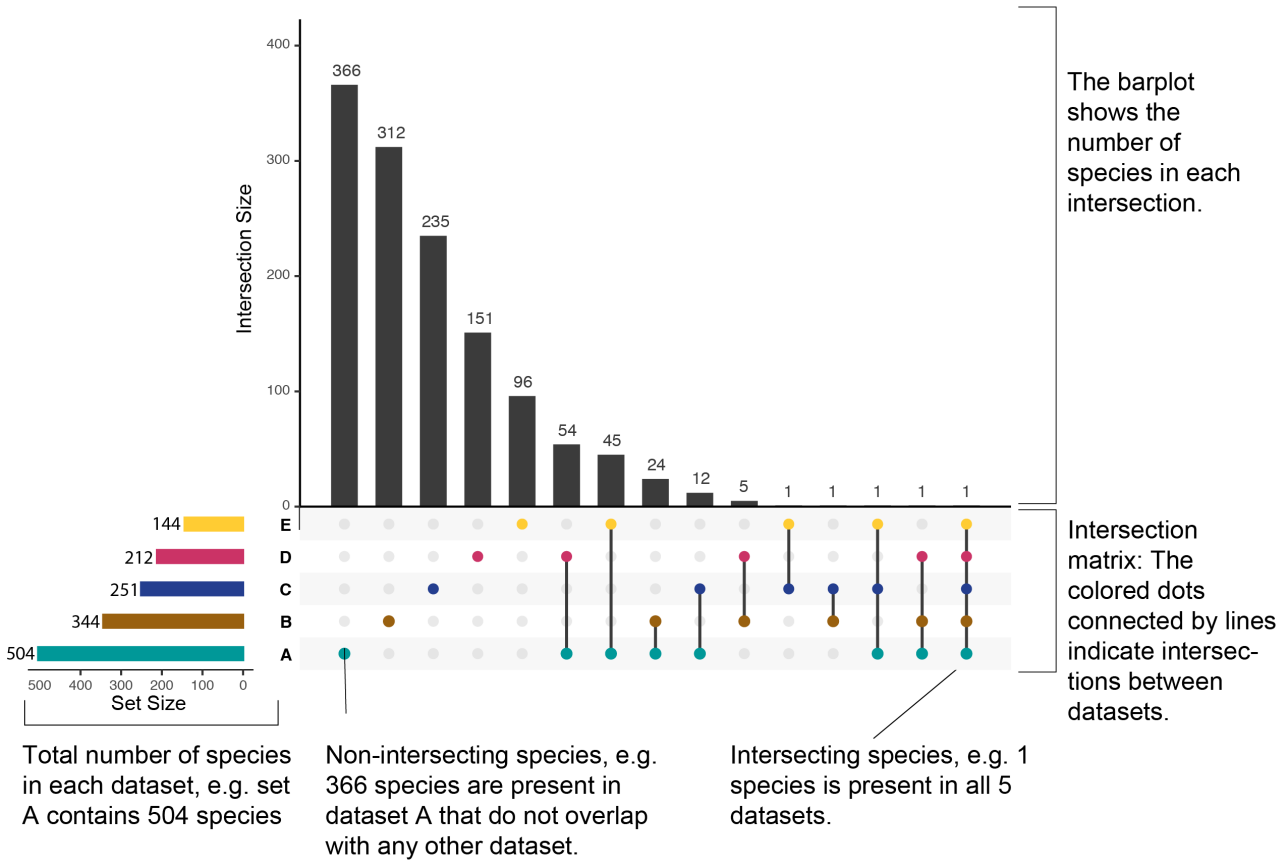


Figure 8. UpSet plots display complex relationships in more than 5 datasets. Here, we use a simple example using the same 5 datasets as in the Venn diagram (Figure 7).

Treemaps

Treemaps use nested rectangles to visualize hierarchical data. Here, the smallest rectangles represent a species, grouped by taxonomic family (Fig. 4). The color of the species rectangles corresponds to an attribute of the data (e.g., the level of trade). The species rectangles always have the same position across different treemaps, allowing easy comparison across features of interest. For example, the top map in Fig. 4 shows all songbird families that contain CITES-listed species, while the following map shows the same species with their IUCN Red List status.

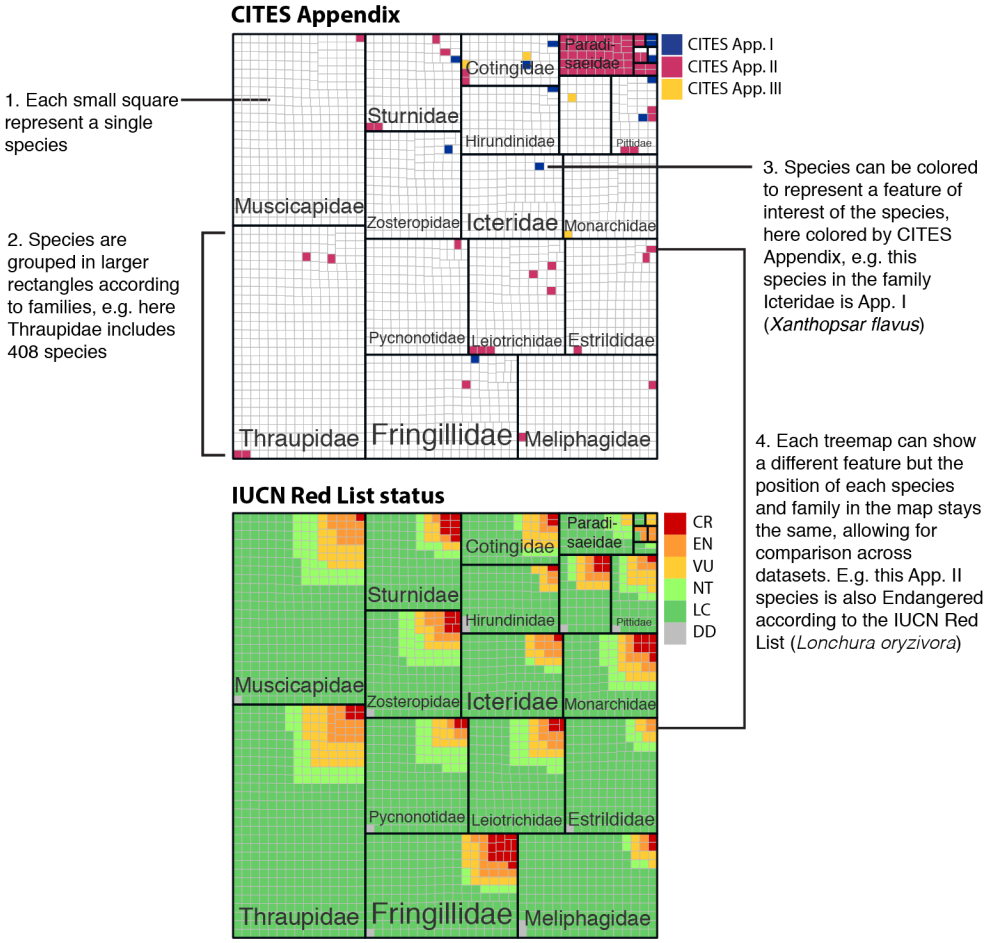


Figure 9. Treemaps use nested rectangles to visualize hierarchical data. The smallest rectangles represent a species grouped into bigger rectangles by family. The color of species rectangles can be mapped to a feature of interest (e.g., CITES Appendix or IUCN Red List status). Shown here are all songbird species in families that contain CITES-listed species.

Methods

The Songbird SKI integrates and maps information to develop a decision framework to support *Decision 18.256* on songbird trade and conservation management adopted at the CITES CoP18 (Geneva, 2019). The SKI maps information across 32 English-language data repositories for 6,599 passerine species. To support the identification of candidate species to list under CITES and those for which trade enforcement is needed, we integrated data on conservation priorities, species management (with a focus on ex-situ management), biology, species use, ecological and evolutionary values, and evidence on illegal wildlife trade. We focused on six knowledge areas listed in Table 3. To assess species in international trade not yet listed in CITES, we used information from seizures from the following databases: TRAFFIC WiTIS, USFWS LEMIS, and UNODC World WISE (including CITES Annual Illegal Trade Reports), as well as the Songbirds in Trade Database (SiTDB), led and curated by Simon Bruslund (Juergens et al. 2021, see Annex 3). For the songbirds in trade analyses, we did not use data from the IUCN Red List specifying if the species was in international or domestic trade, because the assessment was outdated at the time of the analysis and is currently being redone (pers. comm. BirdLife). However, we report these numbers for comparison in Annex 3 and an analysis by IUCN will be available in the future that will be key to incorporate in any trade studies (see Box 2).

To integrate data across the 32 databases used for this project, we standardized species names using as our taxonomic backbone the nomenclature in the Handbook of the Birds of the World (HBW) and BirdLife International Digital Checklist of the Birds of the World Version 4.0 (current as of December 2019). We used the HBW/BirdLife Checklist because BirdLife is the IUCN Red List authority for birds (IUCN 2020). The taxonomy is based on an objective scoring system (Tobias et al. 2010) and the illustrated compendia from Lynx Editions (del Hoyo, Elliott & Sargatal 2016) provides additional information on the level of confidence with which taxonomic decisions have been made (a feature not usually available in traditional checklists). In addition, the HBW/BirdLife taxonomy is being implemented as taxonomic references for birds in the Species360 ZIMS database (Species360 2020).

Here, we present information at the species level (i.e., genus and species epithet). Subspecies were only included as part of their parent species. Therefore, subspecies were not singled out for analyses. By aggregating subspecies into species, CITES covers a total of 85 songbird species (App. I: 12 spp., App II: 69 spp., App III: 4 spp.). Due to the taxonomic standardization with HBW/BirdLife Checklist, we obtained a total of 93 species listed by CITES (App. I: 12 spp., App. II: 77 spp., and App. III: 4 spp.) and those were used for this report (taxonomic standardization data can be downloaded from Juergens et al. 2021, see Annex 3).

The HBW/BirdLife 2019 taxonomy describes 6,599 extant species of songbirds. We retrieved 4,349 scientific synonyms using the HBW/Birdlife Checklist and Avibase Birdlife Synonyms; hence the average number of synonyms per species was 1.5. For more than half of the species (i.e., 3,845 spp.), we did not retrieve a synonym. The species with the highest numbers of scientific synonyms were the African blue tit (*Cyanistes teneriffae*) and the black saw-wing (*Psalidoprocne pristoptera*), each with 10 synonyms (Juergens et al. 2021, see Annex 3 for a list of synonyms).

Table 3. Sources of information and references used across six knowledge areas. Further details can be found in Juergens et al. 2021, see Annex 3.

Knowledge area	Reference
1. Conventions & international treaties	
CITES (historical)	UNEP-WCMC (Comps.), Checklist of CITES species, Hist. CITES List. (2014)
CITES (2020)	UNEP, The Species+ Website, Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK (2020)
Convention on Migratory Species (2020)	UNEP, The Species+ Website, Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK (2020)
EU Wildlife Trade Regulations (2020)	UNEP, The Species+ Website, Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK (2020)
List of birds of the European Union	Council Directive 2009/147/EC on the conservation of wild birds, Official Journal L 020, p. 7 (2009).
2. Trade and other uses	
CITES Trade Database (exports, imports, and volumes)	UNEP-WCMC CITES trade statistics derived from the CITES Trade Database, Cambridge, UK (2020).
Songbirds in Trade Database (SiTDB)	See Juergens et al. 2021, Annex 3. See here for a continously updated online version of the database.
Species recorded by the USFWS Law Enforcement Management Information System (LEMIS)	Eskew et al., United States wildlife and wildlife product imports from 2000–2014, *Scientific Data* 7 (2020) 1–8.
TRAFFIC Wildlife Trade Information System (WiTIS)	TRAFFIC, Passerine Incidents 2008–2020, Incident Dataset (2020).
Species list from seizures from UNODC World WISE Database (1999–2006, 2006–2018) including CITES Annual Illegal Trade Reports.	List of Songbirds Records in Seizures, kindly provided by the United Nations Office on Drugs and Crime (UNODC) from the World WISE database.
CITES List of Species Use in Traditional Medicine	CITES, AC18 Doc. 13.1., List of species traded for medicinal purposes (2002).
Quantitative Assessments of the Diversity and Levels of Threat to Birds Used in African Traditional Medicine	Williams et al., in: Alves, Rosa (Eds.), Anim. Tradit. Folk Med., Springer, Heidelberg (2013), 383–420.
Species considered to be threatened by international trade by IUCN RL which only includes 7 confirmed sp.	IUCN, IUCN Red List of Threatened Species, Version 2019-1 (2019).
3. Extinction risk	
Species in Alliance for Zero Extinction and trigger sites	Alliance for Zero Extinction, 2018 Global AZE Map (2020).
Species assessed as Climate Change Vulnerable (IUCN SSC)	Foden et al., PLoS One. 8 (2013).
IUCN Red List Status	Handbook of the Birds of the World and BirdLife International, Version 4 (2019) and IUCN, IUCN Red List of Threatened Species, Version 2019-1 (2019).
Priority Species from the Asian Songbird Trade Summit	J.G.H. Lee, et al., Conservation Strategy for Southeast Asian Songbirds in Trade (2016).
4. Management opportunities	
Species in Zoos	Species360, Zoological Information Management System (ZIMS) (2020).
Species managed in EAZA Regional Collection Plan for Songbirds: 2018	D. Jeggo, T. Pagel, EAZA Passerine Taxon Advisory Group Regional Collection Plan for Songbirds, in: S. Bruslund (Ed.), 1st ed., Cologne & Heidelberg, 2018: Table 6, pp. 6 - 11
Species managed in EAZA Regional Collection Plan of the Passeriformes 2019	D. Jeggo, S. Bruslund, K. Traylor-Holzer, W. Van Lint, R. Van der Meer, Regional Collection Plan of the EAZA Passeriformes Taxon Advisory Group, Asian Songbirds – Edition One., 2019: Table 2, 8 – 17 pp
Species managed in AZA Species Survival Plans	M. Brauns, *personal communication*.
5. Biological information	
Median body mass, clutch size, and diet	R.S.C. Cooke, et al., Global trade-offs of functional redundancy and functional dispersion for birds and mammals, *Glob. Ecol. Biogeogr.* 28 (2019) 484–495.
Species with a Genome: Vertebrate Genome Project Database – VGP Phase I Genomes	K.-P. Koepfli, et al., The Genome 10K Community of Scientists, The Genome 10K Project: A Way Forward, *Annu. Rev. Anim. Biosci.* 3 (2015) 57–111.
Species with Genomes: Bird 10 000 Genomes (B10K) Project – Passeriformes	G. Zhang, Bird sequencing project takes off, *Nature* 52 (2015).
Species with sequences in GenBank	D.A. Benson, et. al, GenBank, Nucleic Acids Res. D1 (2017) D37–D42.
Species distribution in the IUCN Red List	IUCN, IUCN Red List of Threatened Species, Version 2019-1 (2019).
Demographic Species Knowledge Index (survival & fertility traits)	Conde et al. 2019, LINK Paper & LINK DATA
Global Register of Migratory Species (GROMS)	K. Riede, The Global Register of Migratory Species Database, Landwirtschaftsverlag, Münster, 2001.
Species considered invasive in the Global Invasive Species Database	Invasive Species Specialist Group ISSG, The Global Invasive Species Database, Version 2015.1 (2015), accessed September 14, 2020.
Invasive species from the Alien Species in the EU and IAS of Union Concern	European Commission - Joint Research Centre, European Alien Species Information Network (EASIN) (2020).
Species occurrence data - all records & observations only	GBIF Occurrence Download (2020).
6. Value	
Ecological distinctiveness of birds and mammals at the global scale	R.S.C. Cooke, et al., Ecological distinctiveness of birds and mammals at the global scale, *Glob. Ecol. Conserv.* 22 (2020) e00970.
Evolutionary Distinctiveness – Birds	Zoological Society of London, EDGE of Existence, EDGE List Birds (2019).

Overview of Songbird Trade

Songbirds in International Trade

Of 6,599 extant songbird species, we found 998 species (15.1%) to be internationally traded based on the SKI. We also found 93 species (1.4%) listed on CITES. However, only 43 of those were reportedly traded from 2006 to 2018 (i.e., with reported transactions of live commercial trade in the CITES Trade Database or other databases). As a result, we found evidence of recent international trade for 1,041 species (998 + 43 spp.), that is, 15.4% of songbird species. In addition, we found 1,151 species in domestic trade (1,137 in SiTDB and 220 in WiTIS) that may be traded internationally in the future (Figure 19).

To derive these numbers and identify internationally traded species from 2006 to 2018, we derived data from five databases (Figure 2):

1) CITES Trade Database: A total of **67 species** had records in the CITES Trade Database from 2006 to 2018, including:

   a) 24 species currently listed in CITES Appendices I, II, and III (out of 93 CITES-listed species).

   b) 43 species that were either previously listed in CITES or are/were previously listed under the EU Wildlife Trade Regulations (Box 1) with transactions of live commercial trade from 2006 to 2018.

2) USFWS LEMIS: We identified **232 species** from the USFWS Law Enforcement Management Information System (LEMIS) in 2006– 2014.

3) TRAFFIC WiTIS: We identified **83 species** recorded in confiscations from TRAFFIC's Wildlife Trade Information System (WiTIS) in 2008–2020.

4) World WISE Database: We included a list provided by UNODC of **70 species** recorded from seizures by the World WISE Database, including CITES Annual Illegal Trade Reports.

5) SiTDB: We identified **986 species** in the Songbirds in Trade Database (SiTDB).

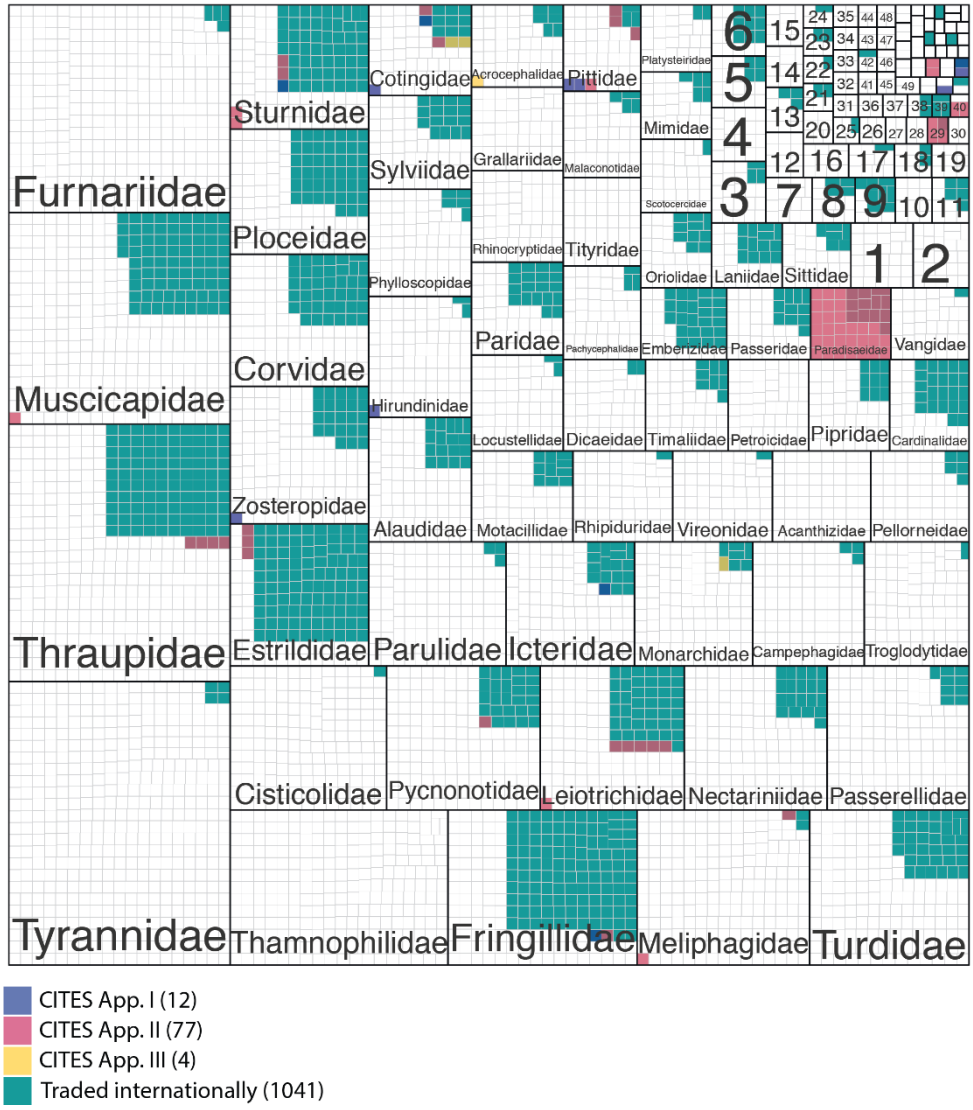
Although the datasets varied slightly in their temporal coverage based on underlying data collation schedules, resulting patterns broadly reflect the period 2006–2018. In Figure 2, we show the overlap in species identified by different datasets (please note, we have singled out CITES-listed species and combined records as seizures from the databases TRAFFIC WiTIS and UNODC World WISE (including CITES Annual Illegal Trade Reports). The Songbirds in Trade Database (SiTDB) identified 688 species not captured in the other four datasets (Figure 2), including 7 species that were threatened by international trade on the IUCN Red List. We expect that the number of birds assessed by the IUCN Red List as threatened by international trade will increase given current red listing efforts. However, current IUCN Red List records for threats are too sparse to underpin a full trade assessment (Box 3).

Box 3. Species Threatened by International Trade in the IUCN Red List

By Dan Challender

IUCN (with UNEP-WCMC, partners from the Universities of Oxford and Kent, and the Zoological Society of London, among others) is currently conducting research to determine the identity and number of species threatened by international trade according to the IUCN Red List. The project also involves identifying which of these species are included (or not) in the CITES Appendices. Those not currently included in CITES may be of interest to the CITES Parties in discussions about future listing proposals. IUCN is not advocating for such proposals or listings, but rather is disseminating the results of this analysis to the CITES Parties for information purposes.

Figure 6 shows a treemap with 6,599 described passerines, including CITES-listed species and species traded internationally. We found some families, such as Estrilidae and Emberizidae, with more than 50% of species not listed in CITES showing evidence of international trade as reported in the literature, surveys, and commercial websites. This contrasts with the families Thamnophilidae and Acanthizidae, where no species are traded. This bias in species selection could be due to characteristics preferred in the commercial trade (e.g., remarkable plumage or singing abilities) or biases in research toward particular regions (e.g., Europe and Southeast Asia) where trade has been historically more common.



Families: 1: Maluridae, 2: Dicruridae, 3: Artamidae, 4: Macrosphenidae, 5: Ptilonorhynchidae, 6: Viduidae, 7: Polioptilidae, 8: Aegithalidae, 9: Chloropseidae, 10: Conopophagidae, 11: Eurylaimidae, 12: Formicariidae, 13: Prunellidae, 14: Bernieridae, 15: Cinclosomatidae, 16: Melanocharitidae, 17: Remizidae, 18: Certhiidae, 19: Stenostiridae, 20: Climacteridae, 21: Calcariidae, 22: Calyptomenidae, 23: Regulidae, 24: Cinclidae, 25: Pomatostomidae, 26: Psophodidae, 27: Aegithinidae, 28: Callaeidae, 29: Cnemophilidae, 30: Hyliotidae, 31: Melanopareiidae, 32: Mitrospingidae, 33: Pardalotidae, 34: Phaenicophilidae, 35: Philepittidae, 36: Pnoepygidae, 37: Ptiliogonatidae, 38: Spindalidae, 39: Bombycillidae, 40: Dasyornithidae, 41: Falcunculidae, 42: Irenidae, 43: Modulatricidae, 44: Mohouidae, 45: Neosittidae, 46: Nicatoridae, 47: Oreoicidae, 48: Orthonychidae, 49: Paramythiidae, Families with fewer than three species are not numbered (families with traded species are maked with asterisks): Acanthisittidae, Atrichornithidae, Buphagidae*, Calyptophilidae, Chaetopidae, Corcoracidae, Donacobiidae, Dulidae, Elachuridae, Eulacestomidae, Eupetidae, Hypocoliidae*, Hylocitreidae, Ifritidae, Machaerirhynchidae, Melampittidae, Menuridae, Nesospingidae, Notiomystidae, Picathartidae*, Promeropidae, Panuridae*, Peucedramidae, Pityriasidae, Platylophidae*, Rhagologidae, Rhodinocichlidae, Sapayoidae, Teretistridae, Urocynchramidae, Zeledoniidae.

Figure 10. Treemap of internationally traded and/or CITES-listed songbirds, with each small square (pixel) representing one of 6,599 species ordered by taxonomic family (larger squares). The teal color indicates internationally traded species from five databases (SiTDB, USFWS LEMIS, TRAFFIC WiTIS, UNODC World WISE (including CITES Annual Illegal Trade Reports)), and the CITES Trade Database (including species not listed in CITES but with trade records). The white color indicates species not listed in CITES or the five databases.

Songbirds in Trade Database

The Songbirds in Trade Database (SiTDB) is led and curated by S. Bruslund and includes information on 1,553 traded species (i.e., 23.5% of all songbirds) from 2006 to 2020. Of these, 986 are internationally traded, and 1,137 are domestically traded (Figure 11).

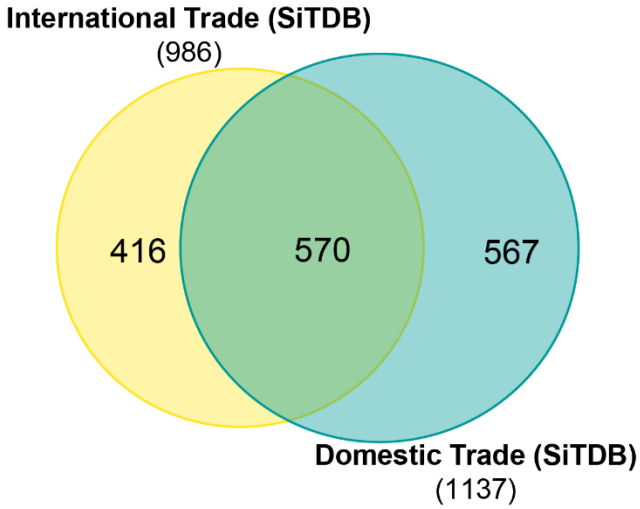


Figure 11. Numbers of songbird species traded internationally and domestically in the Songbirds in Trade Database (SiTDB) from 2006 to 2020.

The SiTDB provides information on the international and domestic trade of live individuals based on the peer-reviewed and gray literature, expert opinion, adverts, and visits to animal markets. The database includes the type of trade (i.e., domestic or international), evidence of trade (e.g., through expert observation, monitoring, surveys, or trade adverts), the primary source of trade (i.e., wild caught vs. captive bred), perceived and relative trade volumes based on expert knowledge (Figure 12c), trade as a contributing threat to wild populations (i.e., from the literature and field experts; Figure 12d), information on ex-situ management (including difficulty of captive breeding, domestication, and management), trade routes, EU trade, and affected subspecies. A continuously updated version of the database can be found here. Figure 12 shows data for 1,043 songbird species traded internationally in SiTDB and/or CITES-listed (i.e., the 986 species identified by SiTDB and a further 57 CITES-listed species not in SiTDB). Treemaps such as those in Figure 12 visually identify (a) CITES-listed species, (b) records in SiTDB, (c) perceived levels of trade, and (d) whether trade is a contributing threat. For detailed explanations for each of these variables and the SiTDB methodology, please see Juergens et al. 2021, see Annex 3.

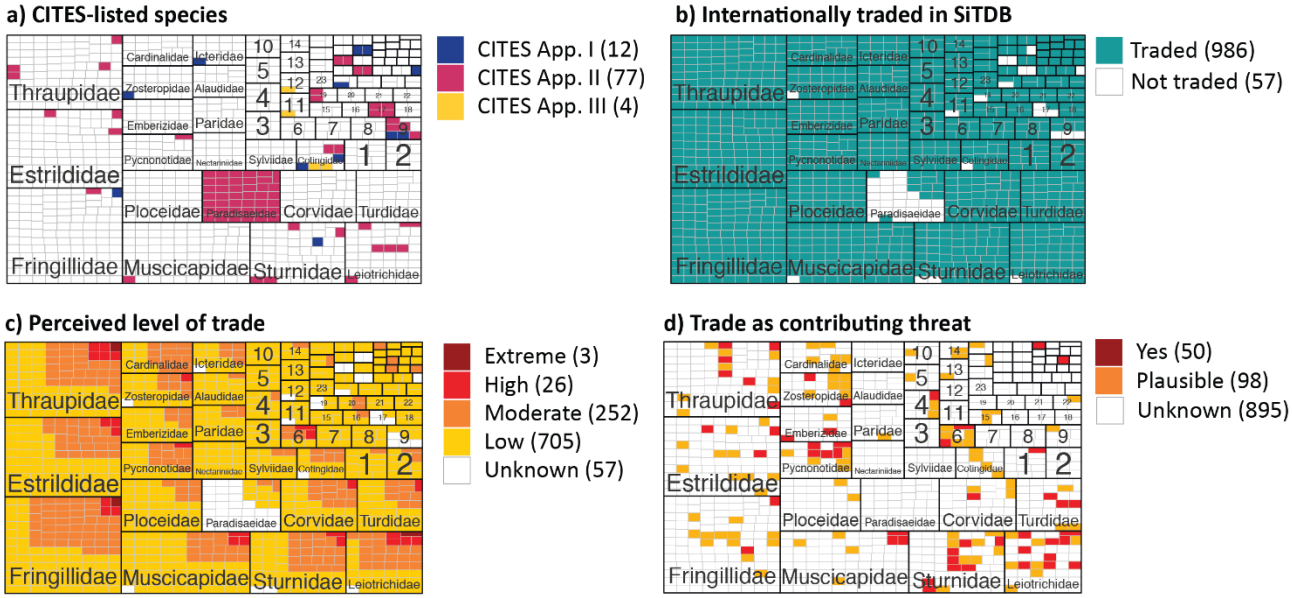


Figure 12. Treemaps of 1,043 songbird species listed in CITES and/or traded internationally in the Songbirds in Trade Database (SiTDB). Note, d) refers to both international and domestic trade.

The SiTDB classifies perceived level of trade based on a qualitative assessment based on the scientific and gray literature as well as social media, with categories shown in Figure 12 as:

- **Extreme**: When there is recurring documentation of trade in the literature or social media or when the trade is of thousands of individuals. This category also accounts for proportionally high trade in threatened species with very small populations. For references used to measure trade level, please see Juergens et al. 2021, Annex 3.
- **High:** Species for which the documentation of trade is recurring and frequent, including species consistently found in the hundreds of individuals. This category also accounts for proportionally high trade in threatened species with very small populations.
- **Moderate:** Species in the SiTDB with trade occurring regularly, also applies to species with few individuals being traded.
- **Low:** Species found in trade that appear in one or few publications or data sources; also applies when one or few individuals are reported in trade.
- **Unknown:** Species for which the SiTDB reports evidence of trade, but there is no information on volumes suitable for qualitative assessment.

The SiTDB presents a preliminary assessment of the trade as a contributing threat to populations (Fig. 12d). However, the SiTDB does not differentiate between international and domestic trade for this particular category. It only reports ("yes") for species for which trade is reported to threaten the species in the peer-reviewed literature. It reports threat as "plausible" when a species is globally threatened according to the IUCN Red List and is traded with volumes in the above categories of "high" or "extreme". Trade is categorized as a "plausible" threat for species with range-restricted or small populations according to the BirdLife International Data Zone (HBW and BirdLife International 2019), even if trade volumes are in the "low" or "moderate" categories.

International Regulated Trade

Of the 93 species listed in CITES, we found records of transactions of live trade for 24 species in the CITES Trade database (2006–2018); the remaining 69 species showed no live trade. During the same period, we found records of live trade for 43 species not listed in CITES. These 43 species were either previously listed in CITES or are/were listed under the EU Wildlife Trade Regulations.

Our results show that international songbird trade mostly comprises live individuals. From 1975 to 2018, 92% of songbird records were for live individuals across 158 species currently or previously listed by CITES or the EU Wildlife Trade Regulations. While live records represented the majority of transactions during this period, from the total of 17,740 imports and exports (1975–2018), the remaining 8% refer to parts and derivatives. Most live individuals were traded for commercial purposes (77–100%) according to importer- or exporter-reported quantities, respectively, since records differ between importers and exporters (Figure 13 and Figure 14).

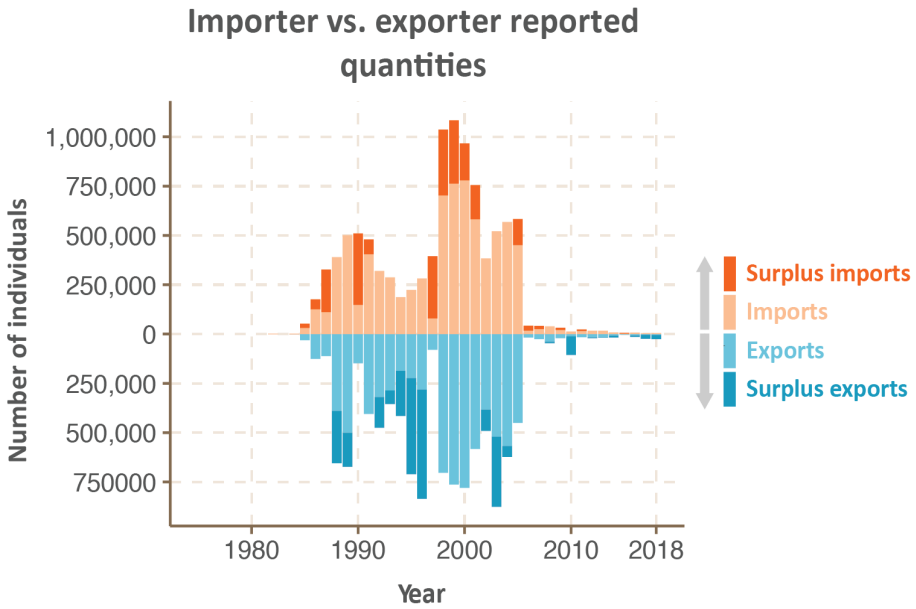


Figure 13. Comparison of importer-reported (upper orange bars) and exporter-reported (lower blue bars) quantities of live-traded songbirds in the CITES Trade Database. Note that importer- and exporter-reported quantities do not always mirror each other, with some surpluses (i.e., the absolute difference between exports and imports) reported for either source in some years (darker colored bars).

From 1975 to 2018, most of the trade occurred before 2006, with a 93% drop since 2006 (Figure 14). This drop is frequently attributed to the bird importation ban into Europe from 2005 onward (Harfoot et al. 2018, Reino et al. 2017, EU 2013). However, based on a preliminary analysis (Juergens et al. *in prep.*), we found that not only did the EU import ban play a role, but in following years, decreasing numbers of transactions could have been triggered by the removal of 72 passerine species from CITES Appendix III in 2007, some of which are frequently traded (UNEP-WCMC 2007).

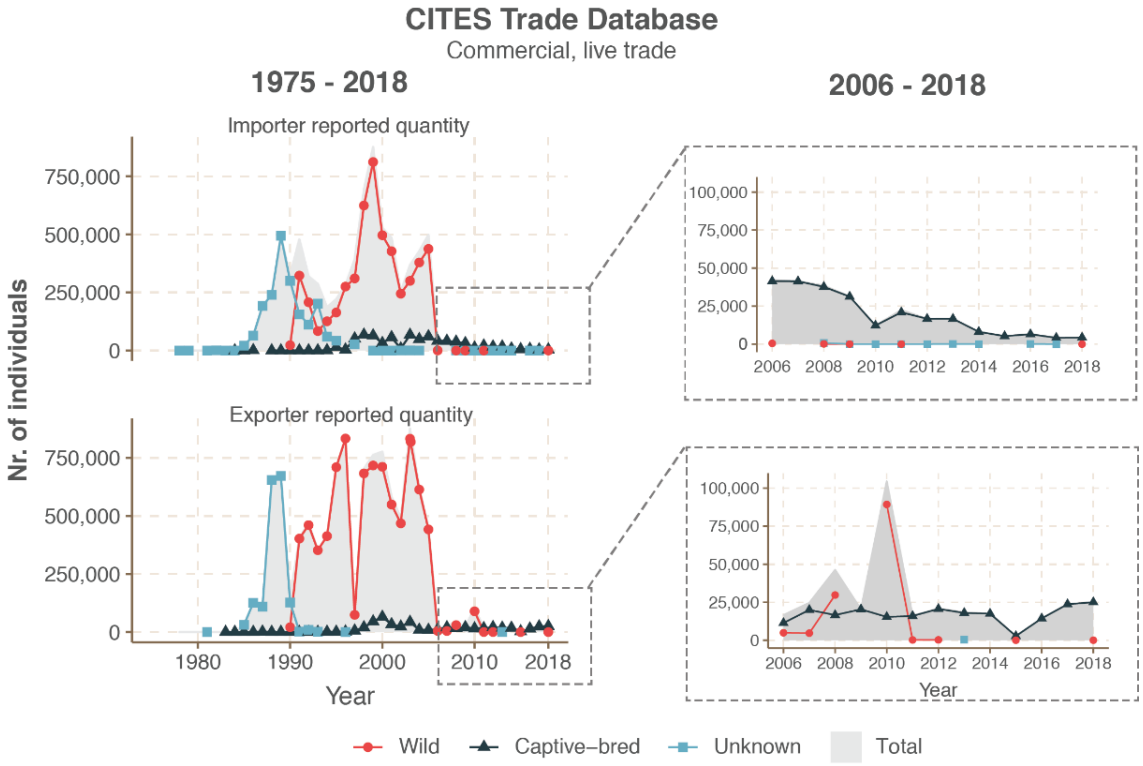


Figure 14. Trends in the international trade of live songbirds traded for commercial purposes reported in the CITES Trade Database (1975–2018 and insets for 2006–2018) based on importer-reported (top) or exporter-reported (bottom) quantities. Gray areas in each plot show total trade across categories.

African countries were the leading exporters of wild individuals in 1975–2005 and 2006–2018, while importer countries were mainly European during the first period, with almost half of the 5.2 million total individuals imported into Portugal and Belgium. From 2006 to 2018, South Africa was the leading importer with 84% of 686 wild-caught individuals (Table 4 and Figure 15). Regarding transactions of captive-bred individuals during the first period, Taiwan (Province of China) was the leading exporter, with 61% of transactions, and Japan was the main importer (58% of transactions; Table 4). During the second period, Taiwan (Province of China) and Cuba were the main exporters of captive-bred individuals, and Japan and Mexico were the main importers (Table 4).

Table 4. Exporter and importer countries of live individuals under the purpose code 'commercial' (i.e., code T) in the CITES Trade Database for 1975–2005 and 2006–2018. Wild caught refers to source code W, and captive bred refers to source code C in the CITES Trade Database. Data are based on importer-reported quantities, but discrepancies with exporter-reported quantities can be substantial (see Fig. 9).

Period	Number of individuals	Number of exporter countries	Top exporter countries (%)	Number of importer countries	Top importer countries (%)
Wild caught (W)					
1975–2005	5,235,159	42	Senegal (41%) Guinea (24%) Mali (21%) China (5%) Tanzania (5%)	32	Portugal (25%) Belgium (17%) Spain (12%) Netherlands (11%) Germany (11%)
2006–2018	686	7	Tanzania (71%) Guinea (15%) Senegal (11%) Indonesia (2%) Peru (2%)	4	South Africa (84%) Germany (13%) USA (2%) Panama (1%)
Captive bred (C)					
1975–2005	478,287	45	Taiwan (Prov. of China) (61%) China (10%) Pakistan (5%) Netherlands (3%) Cuba (3%)	43	Japan (58%) Spain (7%) Singapore (5%), Brazil (4%) Portugal (4%)
2006–2018	246,438	27	Taiwan (Prov. of China) (51%) Cuba (34%) Netherlands (6%) Czech Republic (2%) Belgium (2%)	27	Japan (47%) Mexico (30%) UAE (9%) Qatar (3%) Malaysia (3%)

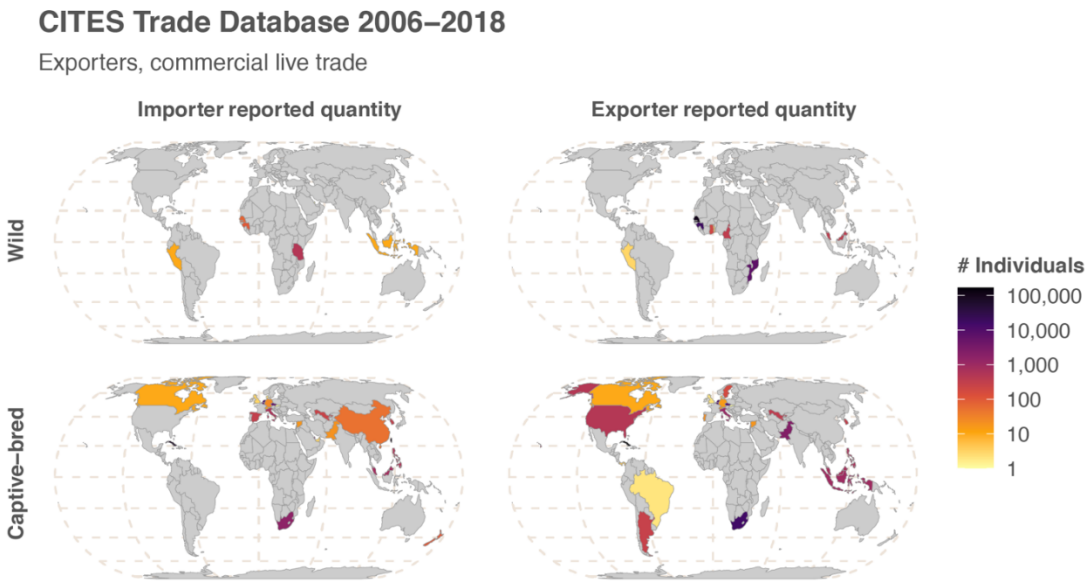


Figure 15. Exporter countries of live commercial trade in the CITES Trade Database (2006–2018) for the two most traded sources (i.e., wild caught and captive bred). Both importer-reported (left column) and exporter-reported quantities (right column) are shown. Note the logarithmic scale (log10) ranging from 1 to 165,945 individuals.

International Trade Entering the USA

LEMIS is the Law Enforcement Management Information System from the United States Fish and Wildlife Service (USFWS). LEMIS imports from 2000–2014 into the USA comprised 2.4 million live songbirds covering 360 species, both CITES and non-CITES listed. Here, we only included 341 non-CITES listed species to avoid replicating analyses from the CITES Trade Database.

We found that commercial imports into the USA gradually declined from 2000–2014, with a peak in 2003 and a drop in 2006 for wild-caught individuals (Figure 16). For captive-bred individuals, we found a peak in 2002 and a gradual decline since then (Figure 16). Of the individuals traded, nearly all imports were cleared (i.e., considered legal), with only a few individuals being seized (955) or abandoned (722). Most of the trade (98%) was for commercial purposes (T), similar to the global international trade reported in the CITES Trade Database. Overall, 75% of the commercial transactions in LEMIS were of captive-bred individuals (Table 5).

For wild-caught individuals, of 38 exporting countries, Trinidad and Tobago and Tanzania exported more than half (59%) of individuals to the USA (2000–2005; Table 5). However, in the second period (2006-2014), of 32 countries, Senegal alone exported 57% of individuals to the USA. For captive-bred individuals, of a total of 31 exporting countries during the first period, more than half of imports (57%) came from Belgium, Taiwan (Republic of China), and Tanzania (Table 5). During the second period, almost half of imports (48%) to the USA came from Taiwan (Republic of China) and Senegal.

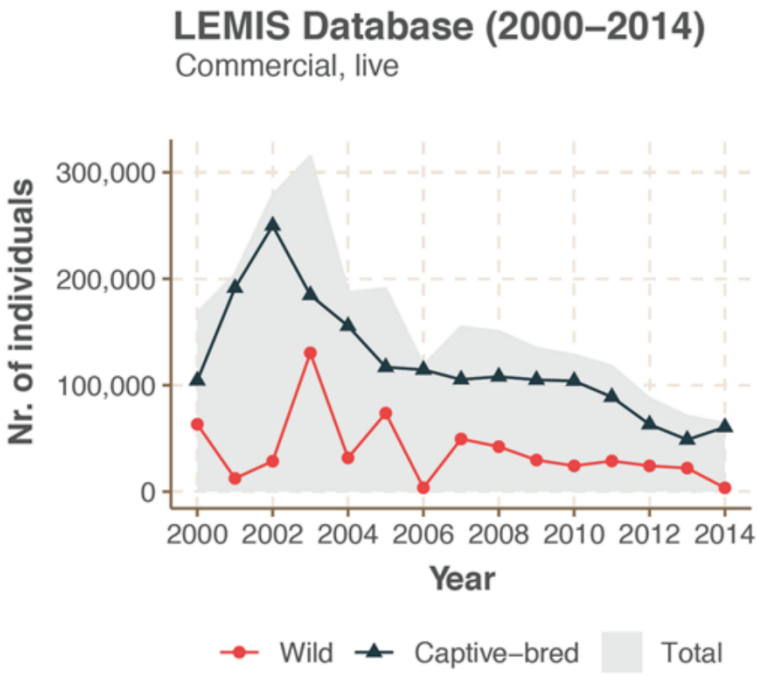


Figure 16. Trends in the live commercial trade of songbirds entering the USA as reported in the USFWS LEMIS database (2000–2014). The gray area shows total trade across categories.

Table 5. Main exporting countries in USFWS LEMIS for two periods (2000–2005 and 2006–2014).

	Wild caught (W)		Captive bred (C)	
	2000–2005	**2006–2014**	**2000–2005**	**2006–2014**
No. of individuals	340,162	227,985	1,002,643	798,203
No. of exporters	38	32	31	28
Top 5 exporters (%)	Trinidad and Tobago (32%) Tanzania (28%) Russia (7%) Malaysia (6%) Belgium (5%)	Senegal (57%) Guinea (10%) Uzbekistan (9%) Mozambique (8%) Suriname (5%)	Belgium (20%) Taiwan (Prov. of China) (19%) Tanzania (19%) Australia (7%) Malaysia (7%)	Taiwan (Prov. of China) (24%) Senegal (24%) Australia (19%) Belgium (10%) Tanzania (8%)

Table 6. Volumes of live traded songbirds in the CITES Trade Database and LEMIS. Values are given as ranges due to discrepancies in importer- and exporter-reported quantities (Figure 13). Pers.: personal; Trophy: hunting trophy; Edu.: education; Scien.: scientific. For LEMIS data, we excluded CITES-listed species to prevent double-counting of records.

	No. live individuals	No. species	Percent individuals per purpose code							
			Commercial	Unknown	Pers.	Trophy	Edu.	Scien.	Zoo	Other *
CITES Trade Database										
1975–2018	10,280,244 – 10,642,211	158**	76.7–99.8%	0.01–23.3%	<0.06%	<0.2%	<0.01%	<0.01 %	<0.01%	<0.5%
2006–2018	254,052–355,320	78	98.4–98.9%	<1.0%	<0.23%	<0.6%	0%	<0.01 %	<0.12%	<1.0%
LEMIS										
2000–2014	2,434,739	341	98.3%	<0.01 %	0.16%	0.08%	0.01%	0.36%	0.25%	<1.0%

* Includes the following purpose codes: medical (M), reintroduction/introduction into the wild (N), law enforcement/judicial/forensic (L), breeding in captivity (B), and circus or traveling exhibition (Q).
** Includes currently or previously CITES-listed species, in addition to 39 species recorded as 'N' due to listing in the EU Wildlife Trade Regulations.

Table 7. Volumes of live songbirds traded only under purpose code commercial (T), with percentages of individuals in each source code. Values are given as ranges due to discrepancies in importer- and exporter-reported quantities (Figure 13). For LEMIS data, we excluded CITES-listed species to prevent double counting of records.

	Million individuals	No. species	No. families	Percent individuals per source				
				Wild	Captive bred	Captive born	Ranched	Unknown
CITES Trade Database								
1975–2018	7.88–10.65	136*	21	66–79%	5–9%	<0.01%	<0.01%	16%–24%
2006–2018	0.03–0.35	67	12	0.3–37%	63–99%	<0.2%	<0.01%	<0.5%
LEMIS								
2000–2014	2.39	286	43	23.8%	75.4%	0.05%	0.13%	0.65%

* Includes currently or previously CITES-listed species, in addition to 72 species listed as 'N' due to listing in the EU Wildlife Trade Regulations.

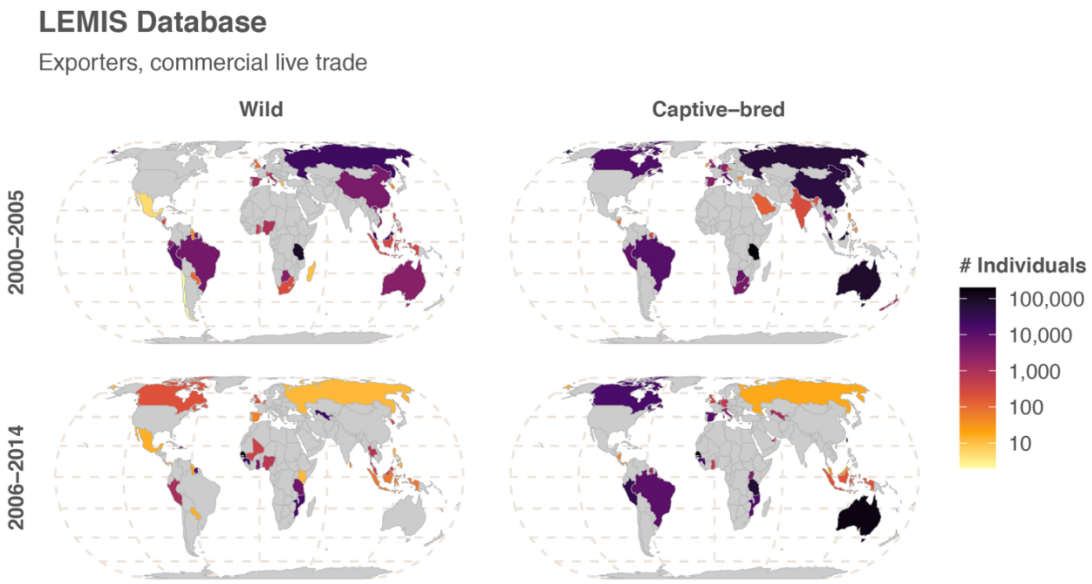


Figure 17. Countries exporting live songbirds for the commercial trade to the US. Data were extracted from the LEMIS database for 2000–2005 and 2006–2014 for wild and captive-bred sources. Note the logarithmic scale (log10) ranging from 2 to 196,061 individuals.

Songbird Seizures

We analyzed data from the Wildlife Trade Information System (WiTIS) managed by TRAFFIC. We also analyzed a list of species in seizures kindly provided by the United Nations Office on Drugs and Crime (UNODC), derived from the World WISE Database, including CITES Annual Illegal Trade Reports (Box 4). Seizure data are an indicator of both illicit trade and the capacity of relevant authorities to address it (UNODC 2020).

From 2008 to 2020, WiTIS included 650 open-source confiscation incidents of live or dead individuals (excluding derivatives) of CITES and non-CITES listed species, either reported at the order, family, genus, species, or subspecies level across 43 countries (Table 8). WiTIS records data from a variety of sources and we found that the majority (63.5%) of records were from the media, 14.5% from CITES management authorities and other government agencies (incl. government reports), 11.2% from open-source data, 5.2% from the police, 3% from NGOs, and <3% from other data sources. Most records were for domestic trade, however, since 2018, we observed an increase in the number of songbird individuals seized in the international illicit trade (Figure 18).

Table 8. Number and characteristics of songbird confiscation incidents reported in the TRAFFIC WiTIS Database (2008–2020).

TRAFFIC WiTIS data	Total	International	Domestic	Unknown
Number of incidents	650	123	487	40
Number of countries	43	32	32	11
Number of individuals	169,898	34,699	131,751	3,448
Number of families	43	26	40	15
Number of genera	153	66	132	33
Number of species	262	83	222	42
Number of CITES-listed species	24*	15	19	7
Number of non-CITES listed species	237	68	203	35
Percentage of incident types				
Seizures	96.6%	95.9%	98%	82.5%
Enforcement actions and prosecutions	2.2%	3.2%	0.8%	10 %
Organized crime, illegal harvesting, smuggling or animal welfare	1.2%	0.8%	1.2%	7.5%
Percentage of transport mode				
Water (on sea, lake, river)	16.3%	16.3%	17.4%	2.5%
Land (foot, train, vehicle)	16.5%	17.1%	17%	7.5%
Air	13.8%	53.7%	4.9%	0%
Other	0.9%	2.4%	0.6%	0%
Unknown	52.5%	10.6	60%	90%

* Includes 2 species in CITES Appendix I and 22 species in Appendix II.

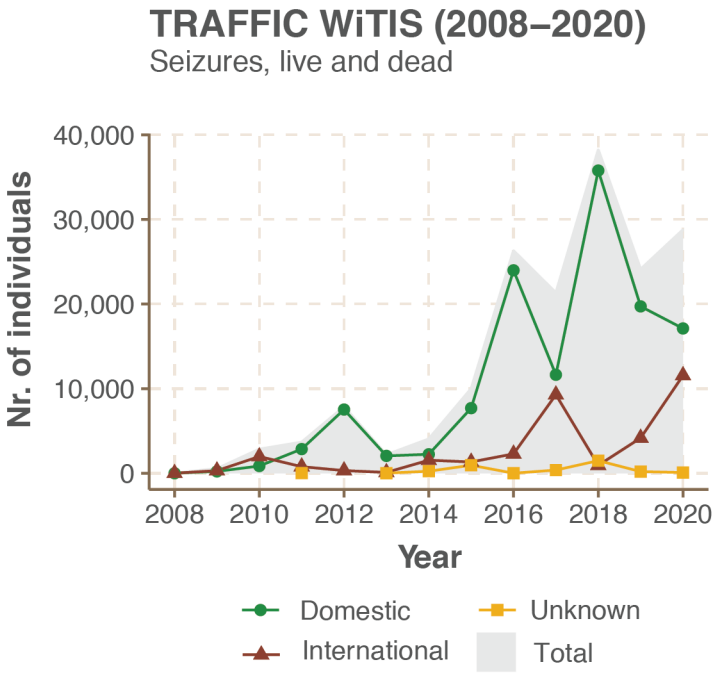


Figure 18. Trends in the seizure trade from the TRAFFIC WiTIS database (2008–2020). The gray area shows total trade across categories.

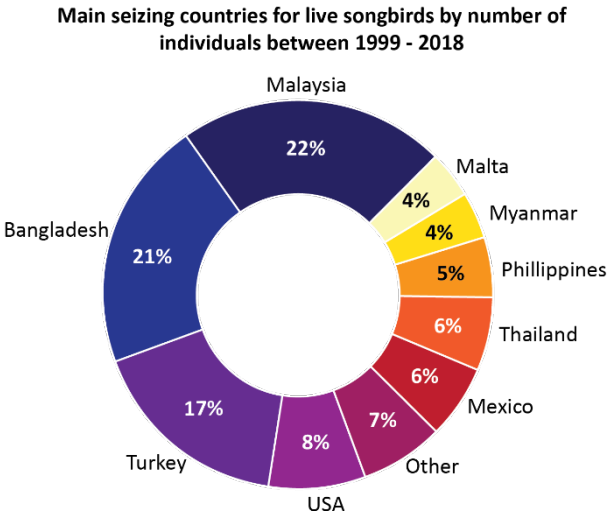
From the World WISE database (Box 4), we found that half of seizures were made in Southeast and South Asia, followed by Turkey (17%). Research on songbird trade also focuses on Southeast Asian countries (Juergens et al. 2021). As a result, the Species Survival Commission of the IUCN has a Specialist Group focusing on the Asian Songbird Trade (Box 5). Increasing monitoring in other regions will be important to better understand existing or emerging regions of songbird trade and species in demand. For example, research in Brazil is summarized in Box 6.

Box 4. Analyses of Songbird Seizures by the UNODC

By Wildlife Crime Research Section, United Nations Office on Drugs and Crime (UNODC)

The UNODC's World WISE database compiles data on wildlife seizures made in 150 countries around the world. The current release of the dataset includes nearly 180,000 songbird seizures from 1999 to 2018 (UNODC 2020), allowing for an analysis of global and country-specific seizures, keeping in mind that seizures represent only a fraction of ongoing trafficking.

Songbird trade involves a range of species, but we found that the most commonly seized species included the European goldfinch (*Carduelis carduelis*), scaly breasted munia (*Lonchura punctulata*), red-whiskered bulbul (*Pycnonotus jocosus*), common hill myna (*Gracula religiosa*), and chestnut munia (*Lonchura atricapilla*) as well as a number of species that could not be identified in the following genera: sparrows (Passeridae), bulbuls (Pycnonotidae), and finches (Carduelis). Of the 26,014 songbird or songbird-derived products recorded in the World WISE Database (includes CITES Annual Illegal Trade Reports), live birds made up the bulk (96%), followed by bodies (1.6%; possibly the result of death of live songbirds in transit) and feathers (0.7%). The following analysis includes bodies, assuming these were originally live birds killed in transit.



Focusing on the live bird trade (and bodies), World WISE seizures mainly originated from Bangladesh followed by Belgium. These were mostly destined for Syria, Malta, Italy, the USA, and the Philippines. Origin and destination data for these seizures, though, are limited, hence countries where seizures occurred may be more relevant. We found that 92% of the live songbirds seized were intercepted by authorities in nine countries: Malaysia, Bangladesh, Turkey, the USA, Mexico, Thailand, the Philippines, Myanmar, and Malta (see Figure to the right). Third-party tips were the most common method of detection of shipments by authorities (primarily customs and CITES agencies).

There appears to be some geographic preference for certain genera, which may result from consumer preferences and species availability. For example, European countries primarily report seizing finches (Carduelis), starlings (Gracula), laughing thrushes and allies (Leiothrix), and cotingas (Rupicola), while Southeast Asian countries seized a more diverse range of genera including waxbills (Amandava and Lonchura), flycatchers and chats (Cyornis), laughing thrushes and allies (Garrulax), starlings (Gracula), starlings (Leucopsar), birds of paradise (Paradisaea and Seleucidis), pittas (Pitta), bulbuls (Pycnonotus), monarch flycatchers (Terpsiphone), and white-eyes and yuhinas (Zosterops). The USA also seized a large range of genera.

While some of these differences could be due to the ability of law enforcement to identify various CITES-listed species (e.g., if those are native to the country or familiar to inspectors), they

could also reflect a more diversified or specialized trade based on geographical location and local use. Case studies of trade and use in various countries could provide more detailed assessments, highlighting the importance of relating quantitative seizure data to field-based and interview-based information.

Note: The list of songbirds with seizures (2006–2018) provided by UNODC (including CITES Annual Illegal Trade Reports) can be seen in Juergens et al. 2021, see Annex 3. However, information on countries of seizure, origin, and volumes is not provided.

United Nations Office on Drugs and Crime 2020. *The World Wildlife Crime Report*. Available at: https://www.unodc.org/unodc/en/data-and-analysis/wildlife.html.

Box 5. IUCN SSC Asian Songbird Trade Specialist Group

By Jess Lee (Mandai Wildlife Group) and David Jeggo (Cologne Zoo)

Southeast Asia is home to almost 1,000 bird species. In addition to being a social status symbol, songbird keeping and trade are also driven by cultural practices such as songbird competitions and religious releases. As a result, the region sees a huge demand for domestic and international bird trade involving hundreds of species, many of which are facing catastrophic declines.

Together with other global experts, Mandai Widlife Group (MWG) played a key role in the formation of the Asian Songbird Trade Specialist Group (ASTSG), which was formally convened and recognized by the IUCN Species Survival Commission (IUCN SSC) in 2017. The Group is dedicated to preventing the imminent extinction of Asian songbirds threatened by illegal and unsustainable trapping for trade.

The ASTSG is the first multidisciplinary specialist group of its kind, and prior to its establishment, there was no official conservation body under the IUCN SSC focusing on songbirds and threats arising from illegal trade. The songbird trade conservation issue is highly complex, with many perspectives and challenges. The coordinated effort under this Specialist Group creates synergies by bringing together a range of subject matter experts and global conservation (e.g., BirdLife International and IUCN) and trade authorities (e.g., CITES and TRAFFIC) to find solutions to reverse the growing threat to songbird species and improve the conservation status of all species involved.

Currently, conservation efforts are led by a core team and broadly centered on in-situ research into wild populations, genetic research, trade monitoring and legal protection, ex-situ conservation breeding and upcoming release programs, as well as education and community engagement. Interventions carried out by ASTSG members target actors along the trade chain, from trappers to traders and buyers, and range from local to international levels.

Javan Pied Starling *Gracupica jalla* is considered functionally extinct in the wild and ironically it only survives today due to the trade interest and commercial captive breeding efforts (Baveja et al. 2020). Image: Mandai Wildlife Group in the Jurong Birdpark, Singapore.

Box 6. Brazilian Transborder Trade in Songbirds

By Juliana Machado Ferreira, Freeland-Brasil, and Sandra Charity, Independent Consultant

Two of the known routes of wildlife trafficking in the region, which were confirmed by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and the Brazilian Federal Police agents interviewed (Charity & Ferreira 2020), are inverse trafficking routes for passerine songbirds from Venezuela and Peru into Brazil.

The most prevalent birds in this type of trade are subspecies of the saffron finch *Sicalis flaveola flaveola* (with occurs in Colombia, Venezuela, Guyana, Suriname, French Guiana, and Trinidad) and *S. flaveola valida* (which occurs in Peru and Ecuador), the latter subspecies being preferred. These are bigger than the Brazilian subspecies and are trafficked to Brazil to be hybridized with local subspecies, so that the bigger and more aggressive offspring can be used in illegal saffron finch fighting competitions.

In addition, numerous sources (Verheij 2019; local news articles) suggest there may be strong trade in passerine songbirds along the borders of Brazil, French Guiana, Suriname, Guyana, and Venezuela. Species frequently found in seizures in these regions include the chestnut-bellied seed-finch (*Sporophila angolensis*) and the broad-billed seed-finch (*Sporophila maximiliani*). Despite regulations and the existence of legal trade, seizures of birds of these species are common in Brazil. In the Amazon region alone, 1,171 illegal *S. angolensis* individuals were seized 2012–2019. Although there is no information on the intended destination of the seized *S. angolensis*, bird-singing contests with this species are now common, not only in Latin American countries but also in the USA.

On the other hand, seizures of *S. maximiliani* are becoming uncommon, probably due to the scarcity of the species in the wild (Cabral. R, presentation at a workshop organized by Freeland Brasil and the Public Prosecutor's Office of São Paulo State, May 2019), since the population in Brazil is estimated at no more than 250 individuals (MMA 2014) and is declining (IUCN 2020). At the time of analysis, 10 specimens had been seized in 2017 (looking only at seizures of 10 or more individuals), but in 2019, some 26 specimens had been seized by September, a considerable increase in comparison to previous years. In the analysis conducted for this paper, with IBAMA seizure data (all seizures) between 2013 and 2017, 747 *S. maximiliani* individuals were seized. However, according to IBAMA agents, due to their scarcity in the wild, these individuals may not have all been poached from nature, rather, they may have originated from illegal captive breeding.

Similar to other *Sporophila* spp. in the northeast and southeast of Brazil, the famous twatwa or large-billed seed-finch (*Sporophila crassirostris*) is a popular songbird in Suriname and other neighboring countries, where it is used in singing contests (Verheij 2019). Twatwas have been completely extirpated in Suriname due to decades-long systematic harvesting from the wild, fueling illegal trade of the species, with birds being smuggled from Venezuela via Guyana and Brazil.

Charity, S, Ferreira, JM 2020. *Wildlife trafficking in Brazil*, TRAFFIC International, Cambridge, UK.

IUCN 2020. *The IUCN Red List of Threatened Species*, Version 2020-2. Available at: http://www.iucnredlist.org.

MMA 2014. *Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção*. Portaria No 444, de 17 de dezembro de 2014. Diário Oficial da União - Seção 1. Nº 245, quinta-feira, 18 de dezembro de 2014.

Verheij, P 2019. *An assessment of wildlife poaching and trafficking in Bolivia and Suriname*, IUCN, Amsterdam, Netherlands.

Domestic and International Trade

Domestic trade is not under CITES mandate and the proportion of the species that are both domestically and internationally traded varies across taxa. Here, we provide basic information on the number of species identified in the domestic trade in the SiTDB and WiTIS (Figure 19 and Juergens et al. 2021, Annex 3).

We found that 17.4% (1,151 spp.) of the 6,599 extant songbirds were in domestic trade and that the majority of seizure records in WiTIS were domestic. Overall, 9.1% (600 spp.) were recorded in both domestic and international trade. To better understand the linkages between domestic and international trade for those 600 species, it will be essential to work with the CITES Parties to integrate international and domestic trade information. This could involve using species' national Red List statuses and national legislations to better contextualize the role of trade on species population declines at national and global levels. Currently, Legal Atlas is compiling legislation at species and national levels with the goal of expanding their efforts to songbirds (Box 7).

Box 7. Legal Atlas

By James Wingard, Legal Atlas Co-Founder and Legal Director

Legal Atlas is an award-winning social enterprise focused on providing global legal intelligence to foster legal reform in the fight against illegal wildlife trade, organized crime, environmental crime, cybercrime, corruption, and other key challenges.

The Legal Atlas® platform uses a variety of technologies to compile legal, enforcement, and implementation data for use in mapping, analytics, international treaty compliance assessments, and national gap analyses. We believe obtaining detailed data on all laws impacting wildlife trade at the national, regional, and international levels could help CITES better assess the implementation of the Convention in national law and develop a fuller understanding of national levels of species protection, allowing for more rapid responses to evolving conservation needs and trade.

To date, Legal Atlas has published legal frameworks covering wildlife trade for more than 75 jurisdictions and is continuing to expand to others. We are also working on extracting, mapping, and standardizing data for threatened species legislation across the globe. Given the dramatic increase in songbird trade both internationally and regionally, we plan to develop resources to map and assess important information that can help policymakers, scientists, and enforcement agencies better manage and conserve these species.

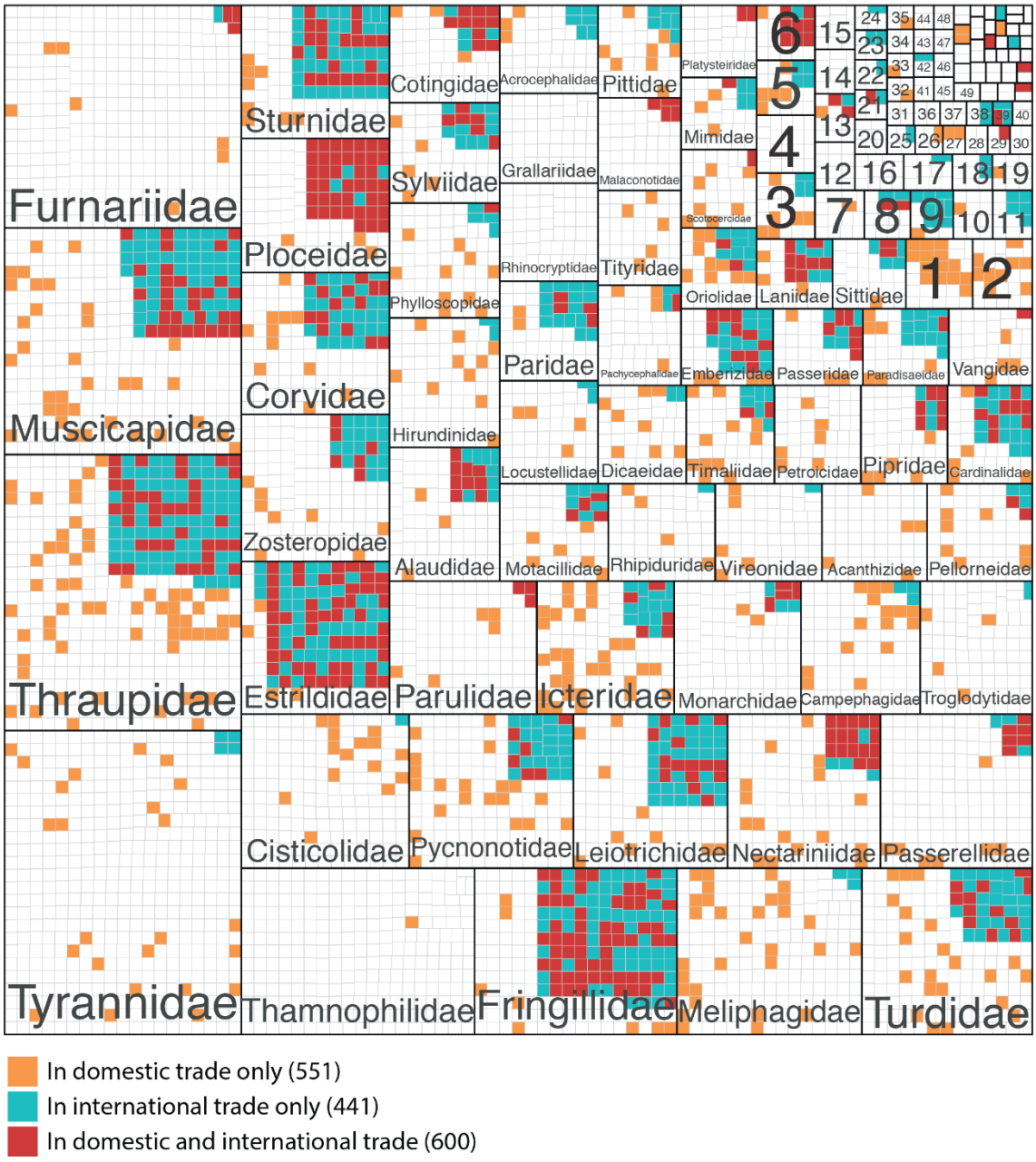


Figure 19. Treemap of all passerine birds. Each small square (pixel) represents one of 6,599 species hierarchically ordered by taxonomic family (larger squares). Species are colored by either their presence in domestic trade (551 spp.), international trade (441 spp.), or both (600 spp.). For all internationally traded species (1,041 spp.), see teal color in Figure 10. Species not in international or domestic trade are in white. International trade combines data from the CITES Trade Database, SiTDB, LEMIS, WiTIS, and World WISE UNODC (including CITES Annual Illegal Trade Reports). Domestic trade was derived from SiTDB and WiTIS.

Box 8. Songbird Trafficking and Confiscations in Brazil

By Juliana Machado Ferreira, Freeland-Brasil Executive Director and Sandra Charity, Independent Consultant

An analysis of Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) data investigating seizures of birds in the Order Passeriformes (2013–2017) found 83,353 individuals seized, including 65,386 with scientific names and 17,967 with common names or 'birds' as a label. Individuals with scientific names belonged to 224 species, including 11 species with >1,000 specimens seized. The globally Endangered great-billed seed-finch (*Sporophila maximiliani*, 747 specimens) and yellow cardinal (*Gubernatrix cristata*, 10 specimens) also appeared in the analysis, fetching high prices in domestic and international markets. This analysis also revealed that the saffron finch (*Sicalis flaveola*) was by far the most seized species, with 45% (24,522 individuals) of all birds seized. However, the numbers of individuals of this species seized by state-level police forces were much higher than those detected through IBAMA open data. According to seizure data cited by Charity and Ferreira (2020) collated by the Environmental Military Police of São Paulo (CPAmb-SP), 16,233 *S. flaveola* individuals were seized in the State of Sao Paulo from 2017 to mid-2019. Of the over 256,000 wild animals seized from 2008 to 2016, ~86% were birds, corroborating other data sources. In addition, 24 of the 30 most confiscated species from the Brazilian illegal trade (2005–2009) were birds (mostly passerines), comprising 80% of domestic illegal wildlife trade and 81% of all animals received by Wildlife Screening Centers (CETAS).

Charity, S, Ferreira, JM 2020, *Wildlife trafficking in Brazil*, TRAFFIC International, Cambridge, UK.

Global Extinction Risk and Trade

Approximately 14% of the extant 11,147 bird species are globally threatened with extinction, including 10.3% (684 spp.) of songbirds (HBW and BirdLife International 2019). BirdLife International identified 223 Critically Endangered birds (Box 9), with passerines accounting for 42% (94 spp.; Table 9). Of the 93 CITES-listed songbirds, 30% (28 spp.) are threatened. We only found live commercial transactions for 18 of those species since 2006 in the CITES Trade Database, SiTDB, LEMIS, WiTIS, or World WISE Databases. This could be attributed to the success of the Convention in stopping the trade of those species. Issues with species identification and trade as derivatives may also explain this result.

We also found 27 non-CITES listed species that are globally threatened and internationally traded in the following databases: SiTDB, LEMIS, WiTIS, and World WISE (including CITES Annual Illegal Trade Reports). Those species may require particular attention toward understanding population trends and the degree to which international trade may be contributing to populations declines (see Priority Species for CITES Listing Amendments).

Box 9. BirdLife International

Text by BirdLife International

BirdLife International is a global partnership of conservation organizations working in over 100 countries to conserve birds, their habitats, and global biodiversity and to promote the sustainable use of natural resources. Each BirdLife partner is an independent environmental or wildlife not-for-profit NGO that maintains its individual national identity within the global partnership. Partners work in a collaborative and coordinated fashion across national boundaries and are facilitated by a Secretariat with regional offices. Rigorous science informed by practical feedback from on-the-ground projects enables BirdLife to implement successful conservation programs benefiting both nature and people.

BirdLife International is the official IUCN Red List Authority for birds and, in this capacity, coordinates the classification and documentation of all bird species for the IUCN Red List. Trade is a recognized threat to many species, and BirdLife is involved in efforts to address this through a wide range of science, policy, information management, awareness raising, and conservation actions. BirdLife strongly supported discussions at CITES CoP18, which led to *Decisions 18.256 to 18.259 on Songbird trade and conservation management*.

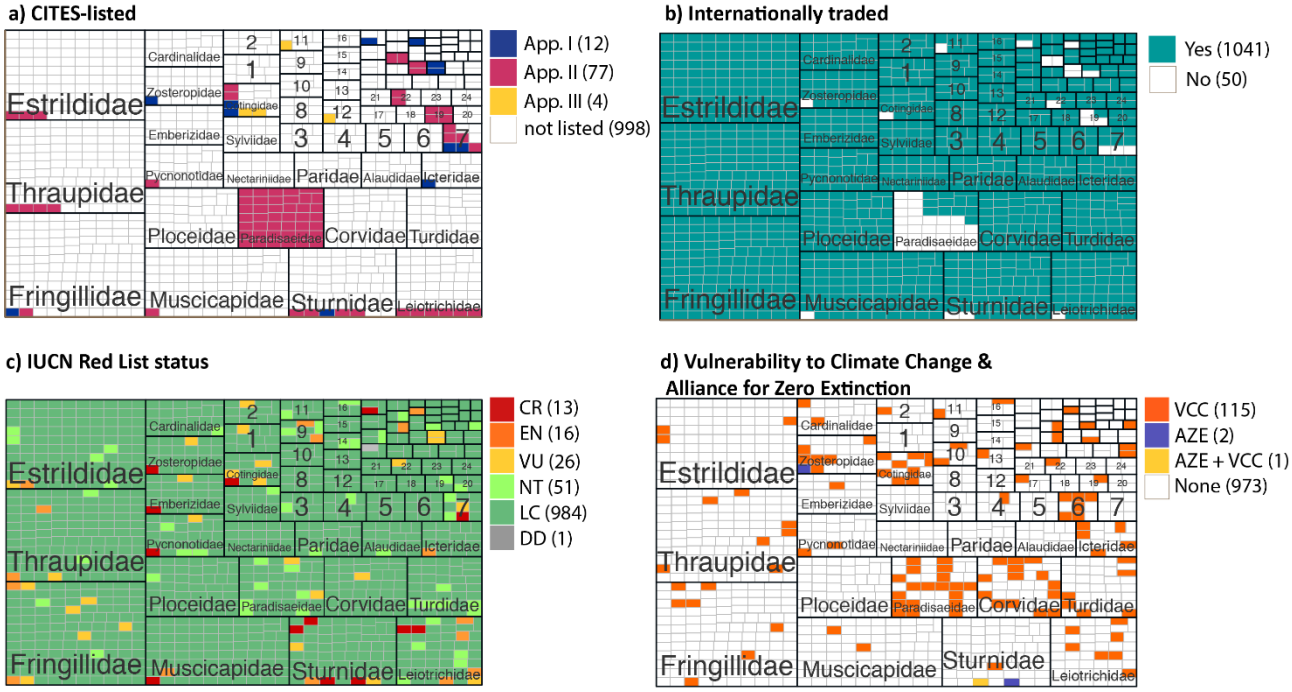
BirdLife is particularly active in tackling hunting and trade threats to birds in Asia, with activities concentrated on songbirds, parrots, the helmeted hornbill (having coordinated the development of an international conservation plan), and the illegal killing of birds. The BirdLife songbird program focuses on Indonesia, where the goal of Burung Indonesia (the national BirdLife partner) is to reverse the decline in songbird populations by reducing the trapping and trading of wild-caught birds. Within Indonesia, Java is key, and the objective remains to significantly reduce the sale of wild songbirds in markets and contests across the island.

Action is also being taken for other species outside Indonesia, notably a national action plan for the straw-headed bulbul in Singapore, the last stronghold of this formerly widespread but now Critically Endangered species. BirdLife also leads community engagement in the IUCN SSC Asian Songbirds Trade Specialist Group.

Table 9. Numbers of songbirds in international trade per IUCN Red List category, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, and DD: Data Deficient.

	LC	NT	Threatened			EW	DD	Total
			VU	EN	CR			
Species	5,358	527	374	216	94	1	29	6,599
CITES listed	53	12	12	8	8	0	0	93
CITES listed in international trade	22	3	10	5	3	0	0	43
Non-CITES listed in international trade	931	39	14	8	5	0	1	998

The IUCN Climate Change Specialist Group identified 17.7% (1,169 spp.) of songbirds as vulnerable to climate change. Regarding species in international trade, we found that CITES listings covered 6 of the 13 species that were both globally threatened and vulnerable to climate change (Figure 20 and Figure 21). We further identified 105 species to be internationally traded but not listed in CITES, including 20 globally threatened species, 78 species vulnerable to climate change, and 7 species both globally threatened and vulnerable to climate change. A notable example is the Sumatran laughingthrush, an Endangered species whose main threats are habitat loss and trapping for trade, yet it is not listed in CITES (BirdLife International 2020a; Box 10).



1: Laniidae, 2: Passeridae, 3: Motacillidae, 4: Oriolidae, 5: Passerellidae, 6: Pipridae, 7: Pittidae, 8: Viduidae, 9: Chloropseidae, 10: Timaliidae, 11: Acrocephalidae, 12: Monarchidae, 13: Sittidae, 14: Eurylaimidae, 15: Mimidae, 16: Pellorneidae, 17: Phylloscopidae, 18: Aegithalidae, 19: Cnemophilidae, 20: Furnariidae, 21: Malaconotidae, 22: Meliphagidae, 23: Ptilonorhynchidae, 24: Tyrannidae, : Artamidae, Bombycillidae, Campephagidae, Hirundinidae, Pachycephalidae, Parulidae, Prunellidae, Calcariidae, Certhiidae, Dasyornithidae, Dicaeidae, Locustellidae, Melampittidae, Picathartidae, Platysteiridae, Regulidae, Spindalidae.

Figure 20. Treemaps of 1,091 species listed as either CITES-listed and/or internationally traded, including species with records in the CITES Trade Database, LEMIS, WiTIS, World WISE (including CITES Annual Illegal Trade Reports), and SiTDB. **a)** 93 CITES-listed species (colored) and 998 species non-CITES-listed species found in international trade. **b)** 1,041 species internationally traded (teal) and 50 species CITES-listed but not in international trade. **c)** IUCN Red List status. **d)** Vulnerability to climate change (VCC) and Alliance for Zero Extinction (AZE) species. One species in the family Sturnidae is listed in both VCC and AZE. IUCN Red List Status: LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, and DD: Data Deficient.

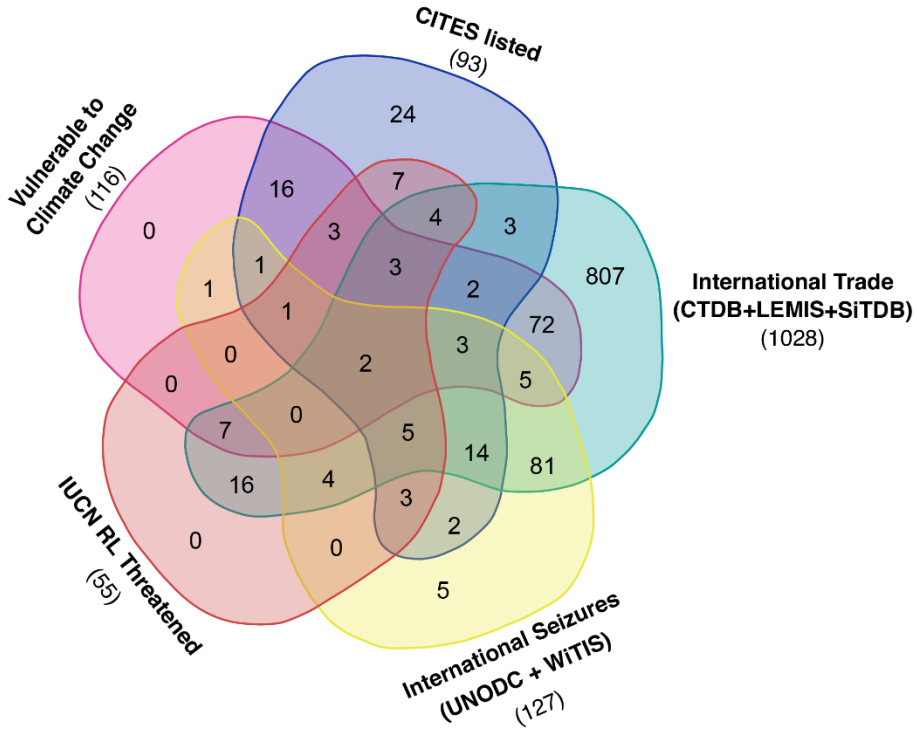


Figure 21. CITES-listed songbird species and/or species in international trade (1,091 spp.): **1)** highly vulnerable to climate change as assessed by the IUCN Climate Change Specialist Group, **2)** CITES-listed species, **3)** international trade in live individuals from the CITES Trade Database, LEMIS, or SiTDB, **4)** listed as threatened (Vulnerable, Endangered, or Critically Endangered) by the IUCN Red List, and **5)** records of seizures from the databases: TRAFFIC WiTIS and UNODC World WISE (including CITES Annual Illegal Trade Reports).

Box 10. Sumatran Laughingthrush Trade

By Chris R. Shepherd and Boyd T. C. Leupen, Monitor Conservation Research Society

The Sumatran laughingthrush is endemic to the island of Sumatra, Indonesia. It is only known from a few sites scattered on the north and south of the island in sub-montane and montane forests (van Marle & Voous 1988; Collar 2006; Eaton et al. 2016). Existing populations are now considered small and severely declining (Harris et al. 2015). This decline is primarily attributed to the songbird trade in Indonesia, which is fueling this species's indiscriminate and persistent poaching and driving it ever closer to extinction (Shepherd & Gomez 2018). The Sumatran laughingthrush is protected by national legislation in Indonesia, and no capture (or trade) of this species is allowed. Regardless of legal protection, trade in this species is common in Indonesian bird markets and is carried out openly, indicating a lack of effective enforcement. Our research has found an increase in international trade in this species (Shepherd & Gomez 2018). Sumatran laughingthrushes are increasingly available for sale in the EU. As the species is not listed in CITES Appendices, few options are available to counter the trade in illegally sourced birds.

Sumatran Laughingthrush (*Garrulax bicolor*) at Bristol Zoo © Simon Bruslund

van Marle, JG & Voous, KH 1988. *The birds of Sumatra*, British Ornithologists' Union (Checklist 10), Tring, UK.

Collar, NJ 2006. A partial revision of the Asian babblers (Timaliidae), *Forktail*, 22, pp. 85–112.

Eaton, JA, van Balen, B, Brickle, NW & Rheindt, FE 2016. *Birds of the Indonesian Archipelago*, *Greater Sundas and Wallacea*, Lynx Edicions, Barcelona, Spain.

Harris, JBC, Green, JM, Prawiradilaga DM, Giam, X, Hikmatullah, D, Putra, CA & Wilcove, DS 2015. Using market data and expert opinion to identify overexploited species in the wild bird trade, *Biological Conservation*, 187, 51-60.

Shepherd, CR & Gomez, L 2018. Trade and conservation efforts involving the Sumatran laughingthrush Garrulax bicolor in Indonesia, *Journal of Indonesian Natural History*, 6, 2, pp. 23-29.

We identified which songbirds with evidence of international trade were prioritized by the Alliance of Zero Extinction (AZE). The AZE focuses on the most vulnerable and irreplaceable sites on Earth with the aim of preventing extinctions (Box 11). To date, 1.5% (101 spp.) of songbirds are prioritized in AZE trigger sites. The two AZE species with records of international trade are already listed on CITES: *Gracula robusta* (App. II) and *Leucopsar rothschildi* (App. I). Both species are from Southeast Asia. *Leucopsar rothschildi* is also listed as vulnerable to climate change (Figure 22). A third AZE songbird (*Zosterops albogularis*) is listed by CITES (App. I). However, we did not find records of international trade since 2006 (Figure 22). The species may be functionally extinct since it has not been sighted since 2006 (BirdLife International, 2018).

Box 11. Alliance for Zero Extinction

By Amy Upgren, Director of Alliance for Zero Extinction (AZE) and Key Biodiversity Area Programs, American Bird Conservancy

The Alliance for Zero Extinction (AZE), formed in 2005 and currently comprising over 110 member organizations, works to identify and safeguard the most important sites to prevent extinctions (i.e., single sites globally threatened species are restricted to). Each of the world's 853 AZE sites holds the last remaining population of at least one Critically Endangered or Endangered species as assessed by the IUCN Red List. Since AZE sites are the only home of one or more highly threatened species, the loss of a single site is likely to lead to extinction, at least in the wild.

AZE engages governments committed to protecting their most threatened endemic species while meeting obligations by the Convention on Biological Diversity (CBD). To date, 28 countries have included the conservation of AZE sites in their National Biodiversity Strategies and Actions Plans (NBSAPs). All AZE sites are a subset of Key Biodiversity Areas, which are important sites for the global persistence of biodiversity.

Three CITES-listed songbird species have triggered the identification of AZE sites (*Gracula robusta*, *Leucopsar rothschildi*, and *Zosterops albogularis*). The future of these species seems bleak. However, other bird AZE species, such as Lear's macaw (*Anodorhynchus leari*), have substantially improved. Lear's macaw had a single population reduced to only 60 individuals in 1985, and in 1987, it was added to CITES Appendix I. In 1995, its only site of occurrence was added to the AZE list. Today, due to conservation actions focused on reducing trafficking, there are over 1,300 Lear's macaws in the wild.

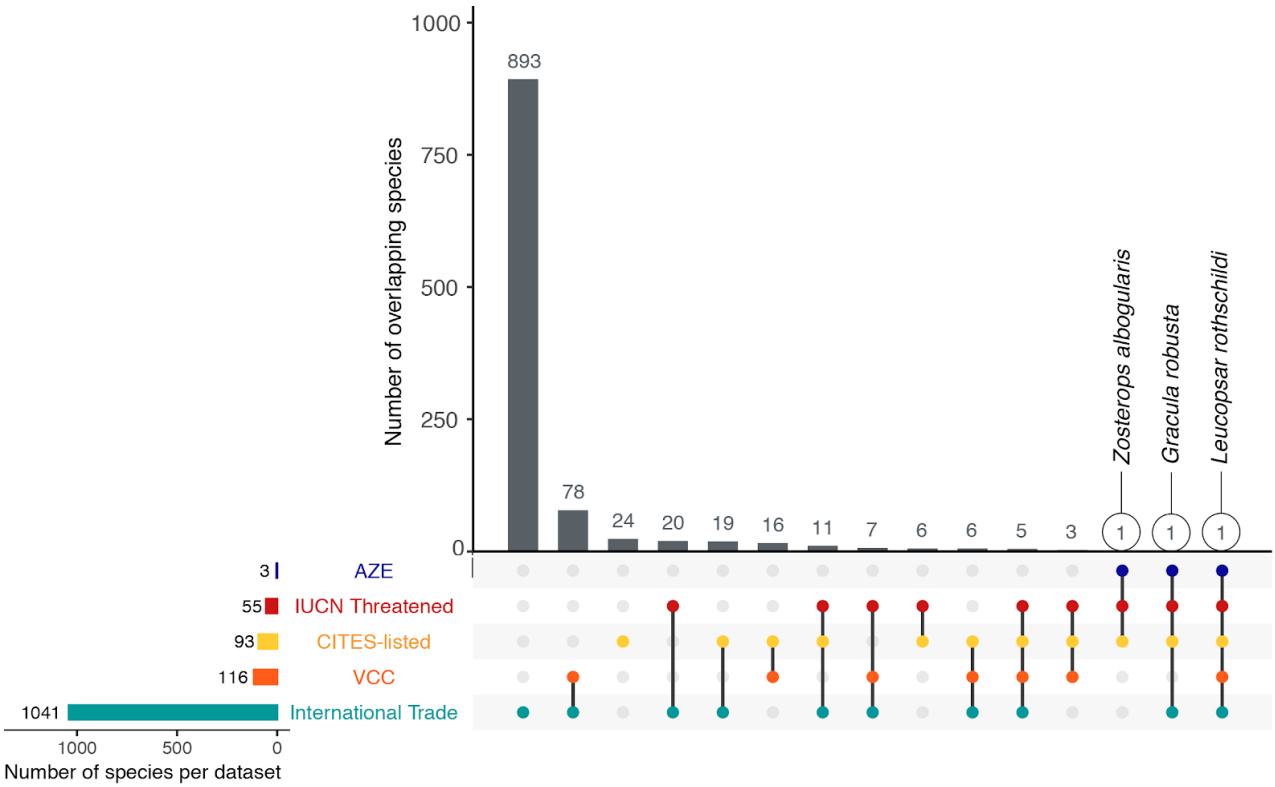


Figure 22. Total of 1,091 species listed by CITES and/or in international trade, and their overlap with three threat databases: **1)** threatened according to the IUCN Red List (Vulnerable, Endangered, or Critically Endangered), **2)** vulnerable to climate change (VCC), and **3)** listed by the Alliance for Zero Extinction (AZE). Colored bar plots on the left show each dataset's total number of species. The intersection matrix and the upper gray bar plot show overlaps among datasets. The three AZE species have been highlighted.

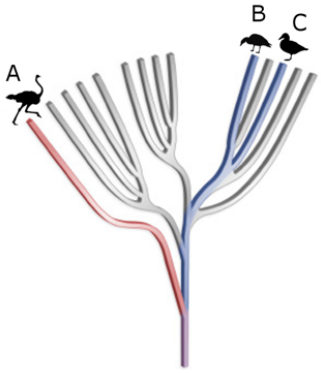
Evolutionary and Ecological Distinctiveness

CITES listings do not consider species' evolutionary distinctiveness. However, we have included this information for each songbird to assess whether there is a pattern in international trade targeting evolutionarily or ecologically distinct species (Cooke, Bates & Eigenbrod 2019). The Evolutionary Distinct and Globally Endangered (EDGE) program was developed by the Zoological Society of London (ZSL; Box 12).

Box 12. Evolutionary Distinct and Globally Endangered

Rikki Gumbs [1,2] and Olivia Couchman[1]
[1] EDGE of Existence Programme, Zoological Society of London [2] Imperial College London

The EDGE metric prioritizes species based on two criteria, (1) evolutionary distinctiveness (ED) and (2) global endangerment (GE), to identify the world's most evolutionarily unique and threatened species (EDGE Species) for conservation action. Evolutionary distinctiveness is a measure of species uniqueness calculated from the phylogenetic tree of life. Species with few or no close relatives (species A in the Figure to the right) sit alone at the tips of longer branches and are therefore highly evolutionarily distinct. In contrast, species with numerous close relatives (species B and C) sit at the tips of short branches of the tree, surrounded by many closely related species. Evolutionarily distinct species account for the persistence of large amounts of unique evolutionary history across the tree of life, the preservation of which is linked to multiple conservation values. Global endangerment is a measure of vulnerability, reflecting the extinction risk of a species derived from IUCN Red List categories. The more severe the extinction risk of the species (from Least Concern to Critically Endangered), the greater the GE score.



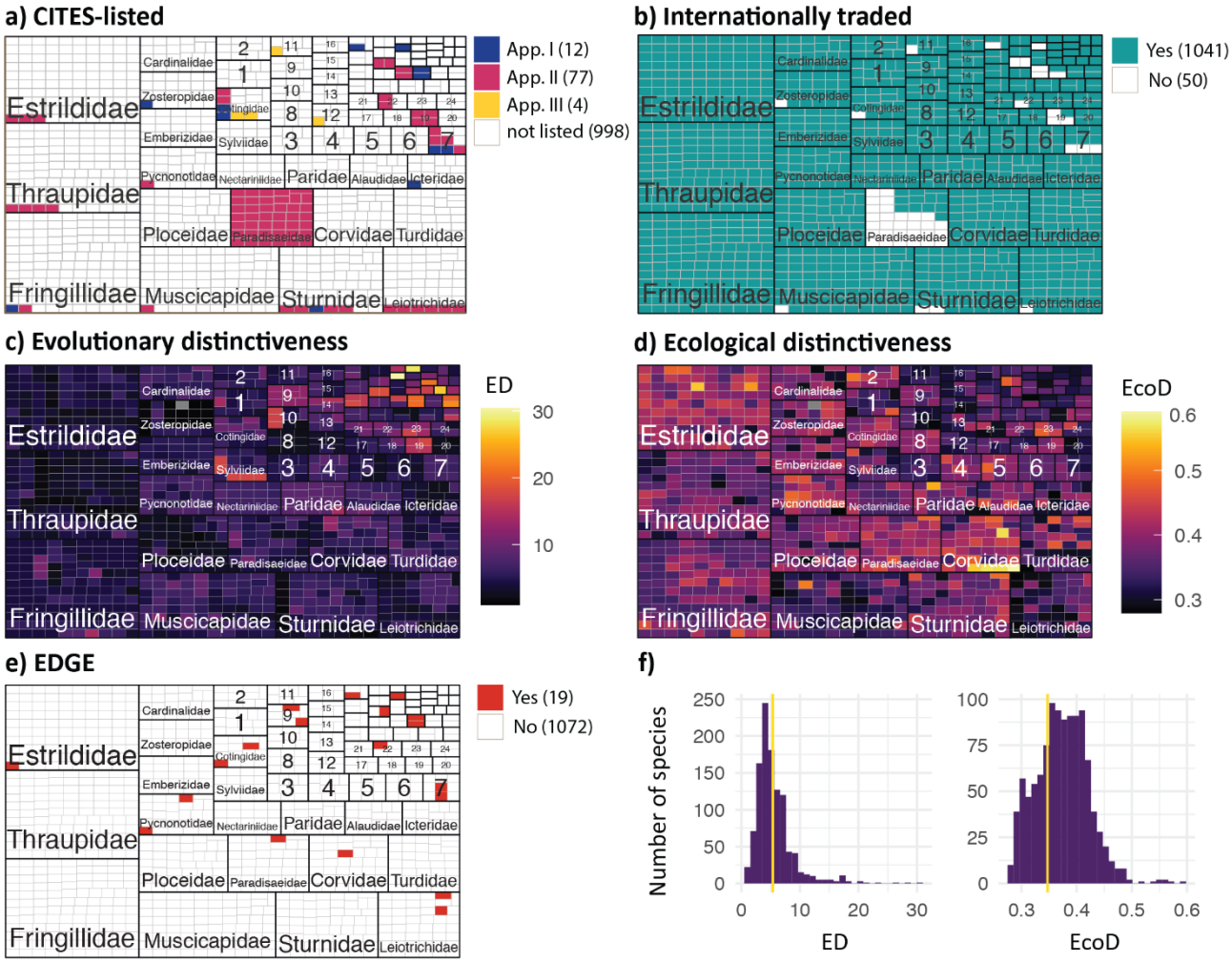
The EDGE metric weighs a species' evolutionary distinctiveness, or irreplaceability, by its global endangerment, or vulnerability, to generate EDGE scores. These EDGE scores can then be ranked from largest to smallest to generate species priority rankings for conservation action. EDGE species are identified as the highest priority species by subsetting EDGE rankings to include only threatened species (i.e., Vulnerable, Endangered, or Critically Endangered on the IUCN Red List) and those responsible for greater than median evolutionary history.

The first EDGE list was published in 2007 for the world's mammals, and EDGE Lists now exist for amphibians, birds, corals, reptiles, sharks, and gymnosperms (i.e., flowerless plants), with more lists in development. The most prominent use of EDGE lists is by the Zoological Society of London's EDGE of Existence program, where EDGE lists direct the implementation of conservation actions.

A species' evolutionary distinctiveness (ED) is a measure of the distance along the tree of life from one species to its next living relative and is, therefore, a measure of its evolutionary uniqueness. A species scoring highly on ED that is also globally endangered according to the IUCN Red List is considered an EDGE species. We found that CITES lists 4.9% (12 spp.) of the 246 EDGE songbirds. An additional 7 EDGE species are in international trade but not listed by CITES (Figure 23). We found that internationally traded species may not be particularly evolutionarily unique. Indeed, only 46.2% (43 of 93 spp.) of CITES-listed species had an ED greater than the median for songbirds. Similarly, 41.3% (430 of 1,041 spp.) of species in international trade had an ED greater than the median for songbirds. These results may, therefore not deviate from random expectation.

Ecologically distinct species are those with a higher level of ecological irreplaceability (Cooke et al. 2020). Ecological distinctiveness (EcoD) is an assessment of how rare the traits of a species are compared to all other species globally. Ecological distinctiveness is based on six biological trait combinations that reflect species' ecological strategies (Cooke, Bates & Eigenbrod 2019; Table 10). Species with low EcoD values are those with common ecological strategies, in contrast to those with higher EcoD values (i.e., with unique ecological strategies). If a species with high EcoD goes extinct, there will be fewer opportunities for other species to replace it within its ecological niche, with potentially higher impacts on ecosystem function.

Our results show that CITES listings, particularly target songbirds that are more ecologically irreplaceable since 78.5% of species (73 of 93 spp.) have a higher EcoD than the median value for songbirds. Likewise, our results show that of the 1,041 species found in international trade, 70.2% (731 of 1,041 spp.) have an EcoD value greater than the median value for songbirds (Figure 23). Our results suggest that international trade may be targeting species with high ecological irreplaceability. Thus, the regulation of international trade for those species may have flow-on effects on the persistence of the ecosystems they inhabit. It is also important to highlight that many biological traits used to assess a species' ecological distinctiveness are used under the biological criteria to amend CITES-listed species (CITES 2020a).



1: Laniidae, 2: Passeridae, 3: Motacillidae, 4: Oriolidae, 5: Passerellidae, 6: Pipridae, 7: Pittidae, 8: Viduidae, 9: Chloropseidae, 10: Timaliidae, 11: Acrocephalidae, 12: Monarchidae, 13: Sittidae, 14: Eurylaimidae, 15: Mimidae, 16: Pellorneidae, 17: Phylloscopidae, 18: Aegithalidae, 19: Cnemophilidae, 20: Furnariidae, 21: Malaconotidae, 22: Meliphagidae, 23: Ptilonorhynchidae, 24: Tyrannidae, Families with less than four species are not numbered: Artamidae, Bombycillidae, Campephagidae, Hirundinidae, Pachycephalidae, Parulidae, Prunellidae, Calcariidae, Certhiidae, Dasyornithidae, Dicaeidae, Locustellidae, Melampittidae, Picathartidae, Platysteiridae, Regulidae, Spindalidae

Figure 23. Treemaps of 1,091 species listed by CITES and/or in international trade. Each small square (pixel) represents a species hierarchically ordered by taxonomic family (larger squares). **a)** CITES Appendix, **b)** internationally traded, **c)** Evolutionary Distinctiveness (ED), **d)** Ecological distinctiveness (EcoD), **e)** Evolutionary Distinct and Globally Endangered (EDGE), **f)** histograms showing the distribution of ED (range: 0.96–30.4) and EcoD values (range: 0.28–0.59), yellow vertical lines show median values for all songbirds (ED: 5.3, EcoD: 0.35).

Table 10. Summary of the traits used to assess ecological distinctiveness (EcoD) by Cooke et al. 2020.

Trait	Description of Rationale for EcoD	Reference
Body mass	Type and amount of resources that species consume and release.	Chillo & Ojeda 2012; Cooke et al. 2019
	Scale at which species respond to their environment; species' dispersal ability and their susceptibility to disturbances.	Jordano et al. 2007; Ripple et al. 2014, 2015; Sekercioğlu 2006; Sekercioğlu et al. 2004.
	Species contributions to functions such as pollination, predation, and seed dispersal.	Fritz et al. 2009; Luck et al. 2012; Newbold et al. 2013
Litter/clutch size	Species' reproductive strategies and output (fecundity) and their contribution to trophic processes.	Newbold et al. 2013
Habitat breadth	Species' habitat specialism and extent of resource use and the functional influence of a species across habitat types.	Chillo & Ojeda 2012; Cooke et al. 2019
	Species' ability to utilize and compete in a diversity of environments.	Luck et al. 2013
Diet type	Species' ecological roles and trophic interactions.	Burin et al. 2016; Chillo & Ojeda 2012; Duffy 2002
	Species functions (i.e., scavenging, pollination, seed dispersal, and nutrient cycling).	Ripple et al. 2017; Sekercioğlu 2006; Wenny et al. 2011
Diet diversity	Indicator of how a species responds to changes in resource availability. Summarizes the diversity of food web interactions for a species.	Burin et al. 2016; Duffy 2002; Newbold et al. 2013
Generation length	Turnover rate of breeding individuals in a population, reflects the different rates at which taxa survive and reproduce.	Cooke et al. 2018; IUCN Standards and Petitions Committee 2014
	Species' ability to recover after perturbations, where species with short generation lengths can repopulate or recolonize more quickly after a disturbance.	Newbold et al. 2013

Biological Information

Species' biological information is a crucial component for CITES decision-making, including data on population declines, species conservation status, and demographic parameters (i.e., fertility and survival). Demographic parameters are essential in setting harvesting quotas for developing non-detrimental findings. Species demographic information is usually available in the form of averages for species (e.g., average clutch size, broods per year, or offspring recruitment). However, population viability analyses for modelling the impact of harvesting on the species population growth rate typically require data on species survival and reproduction probabilities across ages or stages (i.e., juveniles, sub-adults, or adults). This information is usually available in the form of population matrix models or life tables that contain information such as the average proportion of an age cohort surviving in the following year and the proportion of births recruited in the population.

Such data can be challenging to obtain across a large range of species. Conde et al. (2019) developed the Demographic Species Knowledge Index (DSKI) to gather and estimate data availability for demographic traits and rates for all terrestrial vertebrates. The DSKI estimated that only 1.3% of terrestrial vertebrates have life tables and/or population matrices to develop population viability analyses. For birds and songbirds, respectively, these proportions are 2.4% and 1.9%, with data usually available from open-source repositories such as COMADRE and DATLife (Conde et al. 2019).

For the 93 CITES-listed songbird species, general information such as clutch size was available for 49% (46 spp.) of species (Table 11). However, more specific information required to model the effects of population harvesting, usually in the form of life tables or population matrices, was rarely available. For example, only three (3%) of CITES-listed species had either a life table or matrix with population-level demographic data (*Leucopsar rothschildi* (life table), *Leiothrix lutea* (matrix), and *Lichenostomus melanops* (matrix)). Overall information on songbird demography is likely higher since the DSKI only used information in English (Conde et al. 2019). It will therefore be essential to expand access to biological information in other languages to inform the development of non-detrimental findings.

In Annex 3, we provide standardized species-level data for all 6,599 songbirds. However, we only indicate if data are available for population-level data in the form of life tables and population matrices as data can be downloaded openly from COMADRE or DATLife. We include information on body weight since it can be used to quantify volumes of individuals in trade markets by transforming weights of derivatives into individuals (Cooke, Bates & Eigenbrod 2019). We also provide the types of observations on songbirds globally recorded and openly available from the Global Biodiversity Information Facility (GBIF 2020) and whether information is available from the Global Register of Migratory Species (GROMS 2020). We also indicate if information on species habitat, generation length, population size, and population number is available from the IUCN Red List. These data can be directly retrieved from the IUCN Red List website, and since we are using the same taxonomy, they can be merged easily with other data provided in this document.

We explored the number of species with sequences of population-level molecular markers and genomes in the B10K database and/or prioritized by the Vertebrate Genome Project (VGP), which is part of the Earth Biogenome Project. This can support the prioritization of species for sequencing molecular markers or full genomes to facilitate the enforcement of international trade regulations. For example, sequencing and/or genomic data can assist in the development of species identification tools and help infer the source of confiscated individuals (Zhao et al. 2019 and Box 13).

Table 11. Biological information available for all songbirds (6,599 spp.) and CITES-listed species (93 spp.). Detailed descriptions of data and methods are available Juergens et al. 2021, see Annex 3.

Category	All songbirds (6,599 spp.)	CITES Appendix		
		I (12 spp.)	II (77 spp.)	III (4 spp.)
B10K Database records	959 (14.5%)	4 (33%)	19 (25%)	1 (25%)
Body mass (Cooke et al. 2019)	5,847 (88.6%)	11 (92%)	70 (91%)	4 (100%)
Diet (Cooke et al. 2019)	5,766 (87.4%)	11 (92%)	68 (88%)	4 (100%)
DSKI Age at first reproduction	415 (6.3%)	1 (8%)	0 (0%)	0 (0%)
DSKI Broods per year	621 (9.4%)	0 (0%)	3 (4%)	0 (0%)
Clutch size (DSKI & Cooke et al. 2019)	3,615 (54.8%)	7 (58%)	36 (47%)	3 (75%)
DSKI Crude mortality	427 (6.5%)	0 (0%)	1 (1%)	0 (0%)
DSKI Inter-clutch interval	19 (0.3%)	0 (0%)	0 (0%)	0 (0%)
DSKI Life table	5 (0.1%)	1 (8%)	0 (0%)	0 (0%)
DSKI Matrix mortality & fertility	86 (1.3%)	0 (0%)	1 (1%)	0 (0%)
DSKI Matrix with mortality	115 (1.7%)	0 (0%)	1 (1%)	0 (0%)
DSKI Maximum lifespan	584 (8.9%)	0 (0%)	1 (1%)	0 (0%)
DSKI Prop. of reproductive females	11 (0.2%)	0 (0%)	0 (0%)	0 (0%)
DSKI Recruitment	1 (0.02%)	0 (0%)	0 (0%)	0 (0%)
GBIF Number of occurrences	6,105 (92.5%)	11 (92%)	68 (88%)	4 (100%)
GenBank Sequences	4,971 (75.3%)	11 (92%)	62 (81%)	2 (50%)
GROMS Migration	980 (14.9%)	2 (17%)	1 (1%)	0 (0%)
IUCN Distribution	6,599 (100%)	12 (100%)	77 (100%)	4 (100%)
IUCN Extent of occurrence	6,596 (99.9%)	12 (100%)	77 (100%)	4 (100%)
IUCN Generation length	6,566 (99.5%)	12 (100%)	77 (100%)	4 (100%)
IUCN Location number	641 (9.7%)	10 (83%)	16 (21%)	2 (50%)
IUCN Lower limit of elevation	2,144 (32.5%)	7 (58%)	29 (38%)	2 (50%)
IUCN Movement patterns	6,591 (99.9%)	12 (100%)	77 (100%)	4 (100%)
IUCN Population size	1,038 (15.7%)	12 (100%)	20 (26%)	2 (50%)
IUCN Subpopulation Number	694 (10.5%)	11 (92%)	18 (23%)	2 (50%)
IUCN Upper limit of elevation	4,160 (63.0%)	10 (83%)	44 (57%)	3 (75%)
VGP Status	3 (0.05%)	0 (0%)	0 (0%)	0 (0%)

Box 13. Genomic Methods

By Tomas Marques, Full Professor University Pompeu Fabra, Spain

The analysis of DNA from confiscated animals remains a unique and powerful tool to regulate international wildlife trade. Genomics can help uncover trade routes, determine the origin of animals, and ultimately help fight illegal wildlife trade. A notable example was the use of genomic analyses on elephants to detect poaching hotspots in Africa (Wasser et al. 2015). Using the whole genome of chimpanzees, it was also possible to find genomic stratification at a country level (de Manuel et al. 2016) with applications to the EAZA community (Frandsen et al. 2020). Thanks to these efforts, which enable the genetic referencing of geo-stratified terrestrial species, one can use genetic information to geo-localize unknown samples and create an atlas of poaching, determine trade routes, and improve reintroduction efforts.

In this new field, prior information on species' territorial genetic makeup must be obtained to assess the origin of unknown specimens. Genomic data availability to geo-localize individuals is emerging for terrestrial species, thanks to research efforts such as those led by the Laboratory of Comparative Genomics in Barcelona. For birds, this methodology is still novel and for most species only a reference genome is available, which means it will be necessary to sample genetic backgrounds at different regional levels. Research should also focus on assessing whether clines of genetic identities are also present in birds and to which extent they could be used to ascertain the origin of confiscated animals.

De Manuel, M, Kuhlwilm, M, Frandsen, P, Sousa, VC, Desai, T, Prado-Martinez, J, Hernandez-Rodriguez, J, Dupanloup, I, Lao, O, Hallast, P & Schmidt, JM 2016. Chimpanzee genomic diversity reveals ancient admixture with bonobos, *Science*, 354, 6311, pp. 477-481.

Frandsen, P, Fontsere, C, Nielsen, SV, Hanghøj, K, Castejon-Fernandez, N, Lizano, E, Hughes, D, Hernandez-Rodriguez, J, Korneliussen, TS, Carlsen, F & Siegismund, HR 2020. Targeted conservation genetics of the endangered chimpanzee, *Heredity*, 125, 1, pp. 15-27.

Wasser, SK, Brown, L, Mailand, C, Mondol, S, Clark, W, Laurie, C & Weir, BS 2015. Genetic assignment of large seizures of elephant ivory reveals Africa's major poaching hotspots, *Science*, 349, 6243, pp. 84-87.

Ex-Situ Management

In this section, we provide an overall summary of songbird ex-situ management, to support the CITES Secretariat's recommendation on identifying species that can be raised in captivity and best practices (paragraph F, p. 5 in CoP18 Doc. 79; CITES 2019). Furthermore, we developed a decision framework to support CITES in assessing whether wild specimens could have been laundered as captive bred in international markets.

To fulfill those aims, we collated information on **1)** species in Species360 zoos and aquariums with standardized records in the Zoological Information Management System (ZIMS), **2)** species where zoo populations are managed in regional breeding programs to ensure genetic and demographic sustainability, **3)** species managed for commercial purposes or government programs, for which there is no traceable record keeping ensuring welfare and demographic/genetic sustainability, and **4)** species identified by the SiTDB as difficult to breed in captivity. All data and detailed methods are available in Juergens et al. 2021, Annex 3.

Songbirds in Species360 Member Zoos and Aquariums

Members of Species360 hold ex-situ records on songbirds in ZIMS (Box 14), with records dating back to 1873. From 1873 to December 2020, 29% (1,939 spp.) of songbird species have been held in zoos and aquariums, representing 78% of the 137 taxonomic families (Figure 24). In 2020, Species360 members held 14% (892 spp.) of songbird diversity, covering 60% of families (Figure 24). The number of species under human care has steadily increased since 1873, with a maximum of 960 species held in 2000 and 892 in 2020 (Figure 25a). The number of Species360 members has also significantly increased since 1974 and currently includes 671 institutions holding songbirds. From 1873 to 2020, 276,556 individual songbirds have been recorded in ZIMS. The number of songbird individuals under human care was low until 1975. In 1975, zoos held 3,306 individuals compared to 35,548 in 2020. In 2020, the number of ex-situ individuals per species ranged from 1 to 5,418 individuals, with an average population size of 51 individuals (SD ± 244). Of particular importance is the number of captive-bred individuals. Until 1998, the relative proportions of captive-bred versus wild-hatched individuals were similar, with about one-third of individuals being of captive, wild-hatched, or unknown sources, respectively (Figure 25b). Since then, the proportion of captive-bred birds has almost doubled, with 65% of births being captive (vs. 17% and 19% for wild-hatched and unknown, respectively).

Box 14. Species360 and ZIMS

Species360 is a non-profit, member-driven NGO and a leader in providing evidence to support wildlife care and conservation. Species360's focus has mainly been on ex-situ populations, with a recent extension towards in-situ populations. Species360 mobilizes a network of more than 1,240 organizations, including aquariums, zoos, rescue centers, wildlife sanctuaries, universities, research institutes, and government members across 99 countries. Species360 members address today's most urgent wildlife issues, including the establishment of best practices in animal husbandry, medical care, welfare, reproduction, population management, and biodiversity conservation.

Together, Species360 members curate the Zoological Information Management System (ZIMS), the world's most comprehensive database on ex-situ animals, covering more than 22,000 species, 10 million individuals, and 800 million medical records. ZIMS has vastly increased the zoological knowledge base for thousands of species and is instrumental in identifying conservation strategies for many species assessed as threatened or extinct in the wild.

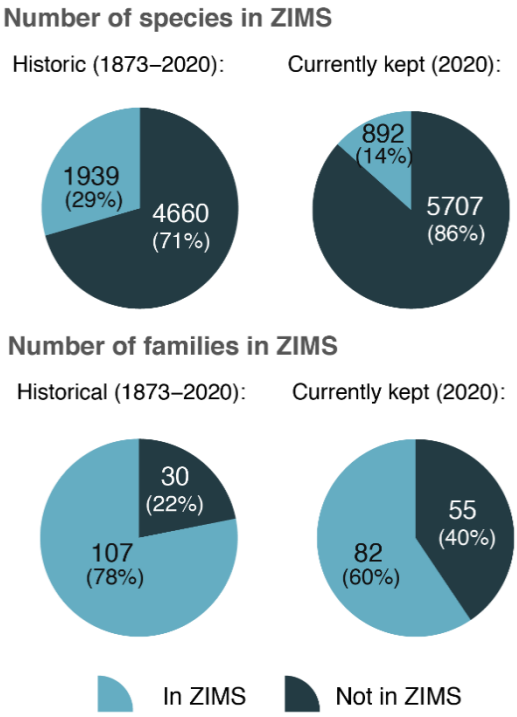


Figure 24. Number and percentage of songbird species and families in the Species360 ZIMS database, based on historical records (1873–2020) and current records (2020).

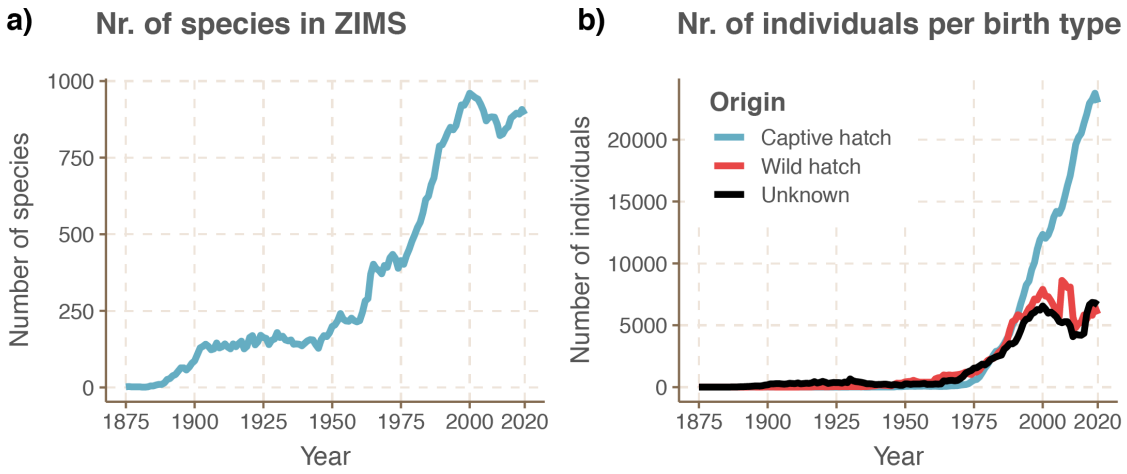


Figure 25. Songbirds in the Species360 ZIMS database (1873–2020). **a)** Number of songbird species in ZIMS. **b)** Number of individuals per source.

Breeding and Monitoring Programs

Songbird breeding and monitoring programs include non-commercial breeding programs, usually governed by regional zoo associations (Table 12) and a species coordinator (i.e., studbook keeper). The biggest breeding programs are summarized in Table 13 and a list of species can be found in Juergens et al. 2021, Annex 2. The SiTDB also includes breeding programs managed by governments or research institutes.

Table 12. Regional zoo associations providing standards for cooperation among member institutions. For some regional associations, we include a summary of the association's work on songbirds in Annex 2.

Acronym	Regional association	Region
PAAZAB	African Association of Zoological Gardens and Aquaria	Africa
AZA	Association of Zoos & Aquariums	North America (Annex 2)
EARAZA	Eurasian Regional Association of Zoos and Aquariums	Eurasia
EAZA	European Association of Zoos and Aquaria	Europe, Middle East, Asia
ALPZA	Latin-American Zoo and Aquarium Association	South America
AMACZOOA	Meso-American and Caribbean Zoo and Aquarium Association	Central America and Caribbean
SEAZA	Southeast Asian Zoo Association	Southeast Asia (Annex 2)
ZAA	Zoo and Aquarium Association	Australasia (Annex 2)
WAZA	World Association of Zoos and Aquariums	Worldwide

Table 13. Description of ex-situ species management programs and the number of songbird species they encompass. We focus on programs by the American Association of Zoos and Aquariums (AZA), the European Association of Zoos and Aquariums (EAZA), and the World Association of Zoos and Aquariums (WAZA).

Program	Description	No. species	No. species in international trade*
EAZA Ex-situ Programme (EEP) and European Studbook (ESB)	Species that have the highest management intensity, with a dedicated Species Committee that oversees species demographic and genetic management to ensure the sustainability of populations, with clear targets (i.e., population growth or a steady population structure and genetic variability) usually managed through a studbook across institutions with clear record-keeping of each individual's origin, pedigree, and other husbandry. Ex-situ efforts to manage songbirds are being developed under the EAZA Silent Forest campaign (Box 17).	47	39
EAZA monitoring breeding program by one person (MON-P)	Species with lower management intensity, with only a basic studbook.	19	18
EAZA monitoring breeding program by a Taxon Advisory Group (MON-T)	Species with population trends monitored by a Taxon Advisory Group.	178	154
AZA Species Survival Plan® Programs	Species under SSP® programs are cooperatively managed by expert advisors that collaborate to maximize genetic diversity and appropriately manage the demographic distribution and long-term sustainability of TAG-recommended Animal Programs within AZA member institutions. Thus, EAZA EEPs and ESBs are comparable to AZA SSPs®.	31	28
WAZA Global Species Management Plans (GSMP)	Exchange among experts from various regional zoo associations, encouraging complementarity of effort and formal cooperation in regional ex-situ species management on a global level, with the goal to manage *Garrulax courtoisi*.	1**	1

* Listed in CITES and/or with records in international trade (i.e., in the CITES Trade Database, LEMIS, WiTIS, World WISE [including CITES Annual Illegal Trade Reports], or SiTDB).
** Under review for global management

Accredited zoos and aquariums cooperate in breeding and management programs to maintain sustainable and viable populations of species within their care under accredited organizations, such as the Association of Zoos and Aquariums (AZA), the European Association of Zoos and Aquaria (EAZA), or other regional associations (Table 12). For the most part, responsible zoos strive to self-support their populations to avoid collecting animals from the wild. Many Species360 zoos and aquariums rescue animals confiscated in the illegal trade (Box 15) but tracing these individuals can be difficult due to current record-keeping practices. Thus, improved traceability in ZIMS will be an important effort to further understand patterns of illegal trade as well as ex-situ management efforts.

Box 15. Zoos as Rescue Centers: Yellow Cardinals in Argentina

By Alicia de la Colina, Fundación Temaikèn

The yellow cardinal is listed as Endangered by the IUCN (IUCN 2020) and is included in CITES Appendix II. This South American passerine was originally distributed along the southern tip of Brazil (Río Grande do Sul), Uruguay, and central Argentina. Its main threats are capture for cage pets (particularly singing males, a practice carried out for over 100 years) along with habitat modification for agriculture. According to BirdLife International (2020b), its current global population is 1,000–2,000 individuals, with a clear downward trend.

Fundación Temaikèn
Protegiendo juntos la naturaleza

Fundación Temaikèn, an Argentina-based conservation NGO, has led a management plan through its Species Rescue Center, receiving yellow cardinals confiscated from illegal trafficking by government agencies since 2012. Birds usually come from private collectors, exotic bird breeders, or illegal brokers and are kept in poor conditions (e.g., birds suffer from muscle atrophy, among other problems). It is therefore critical to develop a well-managed and comprehensive recovery process, including both clinical and natural behavioral aspects. For this purpose, handling protocols have been generated and shared with other wildlife rescue centers.

Studies carried out in the Buenos Aires University Ecology and Animal Behavior Laboratory (LEyCA-UBA) have described genetic differences among yellow cardinal populations (Domínguez et al. 2017). To re-introduce these rescued animals, it is necessary to consider genetic variability since it may relate to morphological and behavioral differences that could be fundamental to population survival. Accordingly, each individual is tested with genetic analysis with the aim of selecting an appropriate location for reintroduction. Following reintroduction, birds are followed with a post-release monitoring and assessment program using radio-tracking methods. To date, 59 animals have been translocated to the wild, with another group of 28 birds planned for October 2020.

Yellow cardinal (*Gubernatrix cristata*) © Gonzalo Prados

BirdLife International 2020. *Species factsheet: Gubernatrix cristata*. Downloaded from http://www.birdlife.org on 15/10/2020.

IUCN (2020). *The IUCN Red List of Threatened Species*, Version 2020-2. Downloaded from https://www.iucnredlist.org/ on 15/10/2020.

Domínguez, M, Tiedemann, R, Reboreda, JC, Segura, L, Tittarelli, F & Mahler, B (2017). Genetic structure reveals management units for the yellow cardinal (*Gubernatrix cristata*), endangered by habitat loss and illegal trapping, *Conservation Genetics*, 18, pp. 1131–1140.

While all species under accredited zoos and aquariums are managed, some species are prioritized for breeding programs to ensure genetic and population sustainability. Members of a regional association cooperate by establishing Taxon Advisory Groups (TAGs). TAGs are formed by experts to develop guidelines to secure sustainable populations, considering a species' genetics and demography across zoos and aquariums. TAGs work in collaboration with program leaders, program coordinators, and studbook keepers who curate essential records (e.g., births, hatchings, and transfers of ex-situ populations) to develop Regional Collection Plans (RCPs). The goals of TAGs include promoting excellence in husbandry and management, identifying conservation priorities, creating connections between ex-situ management and in-situ conservation, and maintaining sustainable populations for key species through studbooks and RCPs (Table 12). RCP collection planning considers the husbandry needs of a species, available space to house individuals, welfare, institutional interests in maintaining the species, conservation messaging, and global, regional, and local conservation priorities. TAGs coordinate international programs (i.e., Global Species Management Plans; GSMPs) through the World Association of Zoos and Aquariums (WAZA). Species under RCPs share their studbooks in real-time through ZIMS, led and developed by Species360 (Box 14). Songbirds in zoos make up the largest order of birds under human care. They are extremely diverse in terms of biology and management needs. For example, AZA's Passerine TAG currently manages 31 songbird Species Survival Plans (SSPs; Table 13), including for Critically Endangered species such as the Bali myna (*Leucopsar rothschildi*; Box 16) and the blue-crowned laughingthrush (*Garrulax courtoisi*), which is also considered under a Global Species Management Plan (GSMP; Table 13).

The management of songbirds poses many challenges as songbirds are generally small with short generation times. While space requirements may be small compared to large mammals, large

numbers of individuals and continued breeding success are required to ensure demographic stability. Some species may be difficult to breed, making it challenging to maintain a genetically and demographically healthy population while establishing and improving husbandry expertise in multiple facilities. Space constraints, competition with other species, divergent priorities, and budget limitations may impede breeding success or can result in the need to limit offspring numbers.

Moving forward, collaboration between regional TAGs will be essential in assessing species for ex-situ management and creating plans to sustain populations in the future. This cooperation can give program leaders and coordinators the ability to capitalize on expertise and space outside of regional constraints. While the blue-crowned laughingthrush is the first songbird species to be managed formally under this global framework, it will likely not be the last, as global efforts to manage and conserve songbirds expand and grow.

Box 16. Breeding Programs for Bali Myna

By Sunny Nelson, Lincoln Park Zoo

The Critically Endangered Bali myna (*Leucopsar rothschildi*) is an example of a species being cooperatively managed in multiple zoo associations. In North America, the species is managed with a Species Survival Plan (SSP) under AZA. In Europe, it is cooperatively managed with an EAZA Ex-situ Programme (EEP), while Indonesia manages a studbook under their national zoo association.

Bali mynas have been under human care for several decades and are also of high conservation concern. Between the 1980s to the early 2000s, various stakeholders, including Indonesian officials, AZA and EAZA program managers, and IUCN reintroduction specialists, have worked together to conduct population viability analyses, develop reintroduction plans, and secure funds to support conservation initiatives.

The captive populations of Bali mynas outside Indonesia were part of assurance populations for the reintroduction program. This inter-regional cooperation meant birds could be transferred among regions to improve genetic and demographic diversity within each regional population, thereby optimizing the potential for the reintroduction population.

An advantage of this type of cooperative management is an increase in shared knowledge in the form of husbandry, veterinary care, and population biology. Regular population assessments allow for both demography and genetics to be assessed routinely to maintain a stable population without the need for imports. This intense management is often needed if captive populations are to grow or remain stable over time. As of 2020, AZA's Bali myna population is over 150 birds. Assuming cooperative management continues to be a priority, the AZA Bali myna population is planned to grow to the regional target population size.

Since 2016, an International Advisory Board involving practitioners from both AZA and EAZA was established, serving as advising support to the Indonesian-led breeding and recovery effort with the Indonesian Ministry of Environment and Forestry, Bali Barat National Park Service, the Indonesian Zoo Association (PKBSI), and the Bali myna conservation society (APCB), together with other NGOs and research entities.

Released captive-bred Bali myna (*Leucopsar rothschildi*) in Bali Barat National Park in 2017 © Simon Bruslund

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Box 17. EAZA Silent Forest Campaign 2017–2019

By Myfanwy Griffith EAZA Silent Forest campaign

The European Association of Zoos and Aquaria (EAZA) is a non-profit membership organization that sets the standard for progressive zoos and aquariums across Europe, Western Asia, and beyond. EAZA has over 400 member institutions in 48 countries and is the world's largest regional zoo and aquarium association. EAZA strives to define and demonstrate excellence in integrated species conservation through a transparent and collaborative approach to population management, wild animal care, and welfare, representation with international organizations, conservation education, and scientific research.

EAZA has been running conservation campaigns since 2000, with the Silent Forest campaign launched in 2017 in response to the crisis facing Asian songbirds. These wild songbirds are threatened with extinction due to excessive and culturally rooted consumption for trade, songbird competitions, export, traditional medicine, and food. The campaign aimed to conserve several songbird species by increasing knowledge, awareness, and commitment to take action within and beyond the zoo community.

EAZA recognized the scale of the crisis and engaged campaign partners, including the IUCN Species Survival Commission Asian Songbird Trade Specialist Group (ASTSG), BirdLife International, and TRAFFIC. The campaign included 258 participants (incl. 55 non-EAZA members) from 32 countries. Over €550,000 was raised from activities carried out in EAZA zoos and aquariums, as well as private, direct, or in-kind donations and merchandise sales. The funds were disbursed to six pre-selected in-situ projects focusing on building regional capacity and protecting Asian songbirds. The amount raised enabled the second round of project funding to further increase the number of projects supported.

A key component of the campaign was raising awareness. The Silent Forest website contains a wealth of information and continues to be curated after the official end to the campaign in 2019 to promote ongoing work. EAZA produced a Position Statement on Songbird Trafficking which was communicated widely, including being presented to the CITES team of the European Commission. This statement was also used to develop Motion 120 Action against Asian songbird trafficking for the IUCN World Conservation Congress.

The campaign also contributed to ex-situ conservation programs. Threatened Asian songbirds underwent a new Regional Collection Planning (RCP) process under the EAZA Songbird Taxon Advisory Group (with internal and external stakeholders) to recommend which species to curate and why. This process resulted in 24 species being managed as EAZA Ex-situ Programmes (EEPs) for population management, including the Bali myna, black bulbul, blue-crowned laughingthrush, and white-rumped shama. Best practice guidelines for songbird species, such as the Javan green magpie, Sumatran laughingthrush, rufous-fronted laughingthrush, and straw-headed bulbul are also available from the EAZA website.

Species Managed for Commercial Purposes

The SiTDB categorizes species under a breeding effort when bred for commercial, hobby, or opportunistic purposes. These efforts are most likely not undertaken with consistent record keeping or with evidence-based breeding decisions to ensure the welfare and the genetic or demographic sustainability of the population. Therefore, it is unlikely that these efforts are under a regional breeding plan beyond the personal needs of the breeder. The SiTDB lists 34 species (all of which are in international trade) that can be considered "domesticated" (i.e., specifically bred to produce a particular size or color). This list is available in Juergens et al. 2021, Annex 3.

Species Difficulty to Breed in Captivity

The SiTDB classifies the difficulty of captive breeding based on available knowledge and technology to breed a species reliably. Information in the SiTDB was derived from a preliminary assessment based on expert elicitation from zoo employees, private breeders, journals, avicultural magazines, and S. Bruslund's expertise as a bird curator (see methods in Juergens et al. 2021, Annex 3). Breeding is considered "easy" when species breed routinely in captivity without much effort. Species for which breeding effort is "normal" are those with consistent breeding when good conditions are available. Species are considered "hard" to breed when breeding is only possible in specialized settings and with considerable effort. Finally, species are considered "challenging" to breed when there have only been reports of accidental breeding success or no reports of breeding.

From this preliminary analysis, we found that 36.6% (34 spp.) of the 93 CITES-listed songbirds can be considered "hard" or "challenging" to breed (Figure 26). In particular, 27.9% (26 spp.) also showed trade transactions since 2006 (Figure 26). Further research could help ascertain whether such species are targets for laundering as captive bred in international markets. There is evidence that criminal groups use breeding facilities to supply the licit market with illicit wild-taken individuals (UNODC 2020).

Zoos and aquariums often focus on establishing breeding programs for species known to be challenging to breed. We found this to be the case for 23 species (Table 14). However, further

research on breeding knowledge for CITES and non-CITES listed species in international trade will be essential to identify species susceptible to laundering as captive bred by criminal groups.

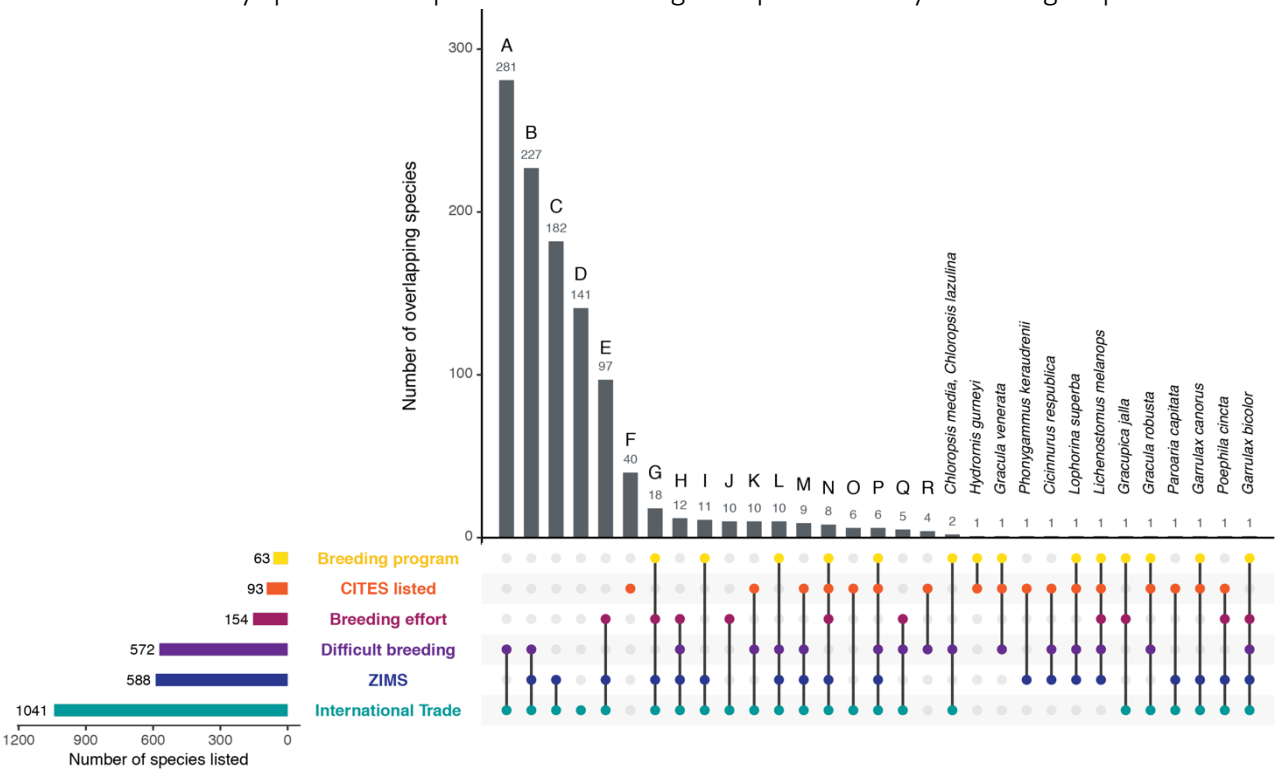


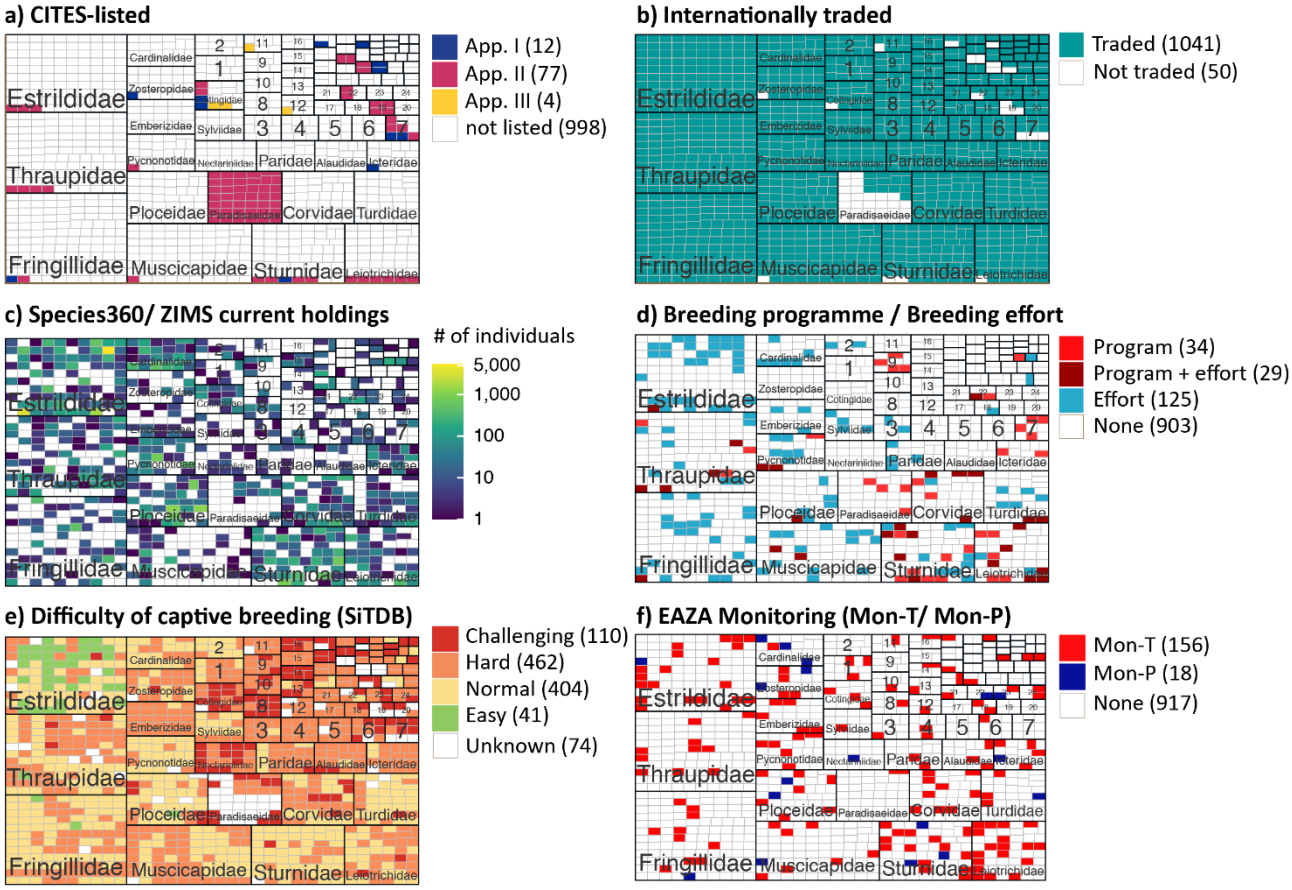
Figure 26. Species (1,091 spp.) listed by CITES and/or in international trade and their overlap with five schemes: **1)** Breeding program: species for which demography, genetic sustainability, and welfare are at the core of management decisions, **2)** CITES-listed species, **3)** Breeding effort: species bred for commercial, hobby, or opportunistic purposes, **4)** Difficulty of breeding: species "hard" or "challenging" to breed according to the SiTDB, **5)** ZIMS: species with current records in Species360 ZIMS, and **6)** species in international trade (2006–2018). The intersection matrix and upper gray bar plots show overlaps among datasets. Species names were added for bars with one or two species.

Table 14. Difficulty of breeding for CITES-listed species and non-CITES species in international trade. Species can be in more than one category (e.g., in ZIMS and breeding programs).

	Challenging	Hard	Normal	Easy	Unknown	Total
CITES-listed species						
ZIMS	5	13	9	2	1	30
Breeding program*	1	9	8	1	1	20
Breeding effort**	0	1	7	2	0	10
Monitoring (EAZA, Mon-T/P)	0	4	2	0	1	6
Total	16	18	11	2	46	93
Non-CITES species in international trade						
In ZIMS	43	207	262	35	11	558
Breeding program*	4	9	30	0	0	43
Breeding effort **	0	18	101	25	0	144
Monitoring (EAZA, Mon-T/P)	11	56	87	12	1	167
Total	94	444	393	39	28	998

*Non-commercial breeding programs, usually governed by regional zoo associations or, in some cases governments or research entities.

**Species under commercial, hobby, or opportunistic breeding effort.



1: Laniidae, 2: Passeridae, 3: Motacillidae, 4: Oriolidae, 5: Passerellidae, 6: Pipridae, 7: Pittidae, 8: Viduidae, 9: Chloropseidae, 10: Timaliidae, 11: Acrocephalidae, 12: Monarchidae, 13: Sittidae, 14: Eurylaimidae, 15: Mimidae, 16: Pellorneidae, 17: Phylloscopidae, 18: Aegithalidae, 19: Cnemophilidae, 20: Furnariidae, 21: Malaconotidae, 22: Meliphagidae, 23: Ptilonorhynchidae, 24: Tyrannidae, Families with less than four species are not numbered: Artamidae, Bombycillidae, Campephagidae, Hirundinidae, Pachycephalidae, Parulidae, Prunellidae, Calcariidae, Certhiidae, Dasyornithidae, Dicaeidae, Locustellidae, Melampittidae, Picathartidae, Platysteiridae, Regulidae, Spindalidae

Figure 27. Treemaps of 1,091 species listed by CITES and/or in international trade. Each small square (pixel) represents a species hierarchically ordered by taxonomic family (larger squares). **a)** CITES-listed species, **b)** internationally traded species, **c)** number of individuals currently in Species360 ZIMS species holdings (588 species), **d)** non-commercial breeding programs and commercial breeding effort, **e)** difficulty of captive breeding according to the SiTDB, and **f)** EAZA Ex-situ Management Programme (Mon-T/Mon-P, see Table 13).

Table 15. CITES-listed songbirds in Alliance for Zero Extinction (AZE) conservation trigger sites. Seizures from international trade were reported in the following databases: WiTIS and/or World WISE (including CITES Annual Illegal Trade Reports), domestic trade was reported in SiTDB and WiTIS, and VCC denotes vulnerability to climate change. Trade levels and impact were reported in SiTDB, see Juergens et al. 2021, Annex 3.

Species	International seizures	Domestic trade	VCC	Ex-situ management	Trade level and impact	AZE trigger site
Leucopsar rothschildi (App. I)	Yes	Yes	Yes	• Ex-situ plan (EAZA & AZA) and other ex-situ efforts. • Difficulty breeding: normal. • 912 individuals in ZIMS.	• Moderate trade level. • High volumes of trade in the EU. • Trade as threat.	Bali Barat, Indonesia
Gracula robusta (App. II)	No	Yes	No	• Ex-situ plan as EEP. • Difficulty breeding: hard. • 10 individuals registered as *G. religiosa robusta* in ZIMS	• Moderate trade level. • Trade as threat.	Pulau Nias-Banyak Islands, Indonesia
Zosterops albogularis (App. I)*	No	No	No	• No breeding programs. • Not in ZIMS.	• No records in SiTDB.	Norfolk Island, Australia

*No trade transactions of this species in the CITES Trade Database or other trade databases since 2006.

Priority Species for CITES Listing Amendments

To facilitate amendments to CITES listings, we developed a decision framework to identify species for which additional research is needed on the impacts of international wildlife trade. First, we included all species with records of international trade in the six databases analyzed and excluded the 93 species already listed by CITES, resulting in 998 species (Figure 28).

Second, we identified which songbirds in international trade are globally threatened with extinction, as noted by their IUCN Red List assessment. This included species in the categories Vulnerable (VU), Endangered (EN), and Critically Endangered (CR). We consider the 27 species identified to have the highest priority for research since the biological characteristics that make these species globally threatened with extinction are also used in the biological criteria for species listings in Appendix I (CITES 2020a, see Annex 3).

Third, we identified 319 species with a medium research priority that, although not assessed as globally threatened, are considered highly vulnerable to climate change by the IUCN Climate Change Specialist Group (Foden et al. 2013), and/or their populations are declining according to the IUCN Red List. Finally, the remaining 652 species in international trade were deemed low research priority. We also present a treemap of the distribution of priority species among taxonomic families (Figure 29).

Although this is a first step for prioritization, our framework has limitations. We did not include national or regional threat levels; thus, a species of medium priority can still be highly threatened by international wildlife trade in a specific area. Second, the information used may have a regional bias if research on wildlife trade has focused on certain areas, for example, those where trade may be a problem. Third, seizure data are only an indicator of illegal trade, reflecting a country's capacity for legal enforcement rather than an in-depth analysis of trade as can be achieved with the CITES Trade Database or LEMIS. Therefore, species in illicit international trade but with no seizures may not have been captured by our framework. Our framework provides a first step to narrowing down the 6,599 extant species of songbirds to 998 species with evidence of international trade, including 27 species of high research priority and 319 species of medium research priority.

The 27 species identified as high research priority were distributed within the limits of 58 countries (with an average of 1.5 species per country; Figure 30). Indonesia hosted the highest number of high-priority species (10 spp.). Medium research priority species were distributed across 215 countries (averaging 30.8 species per country). China had the highest number of medium research priority species within its territory (128 sp.). The remaining 652 species with low research priority were found in 217 countries, including China (177 spp.), Sudan (171 spp.), and Kenya (161 spp.). Overall, China had the highest number of resident species in international trade (Figure 30).

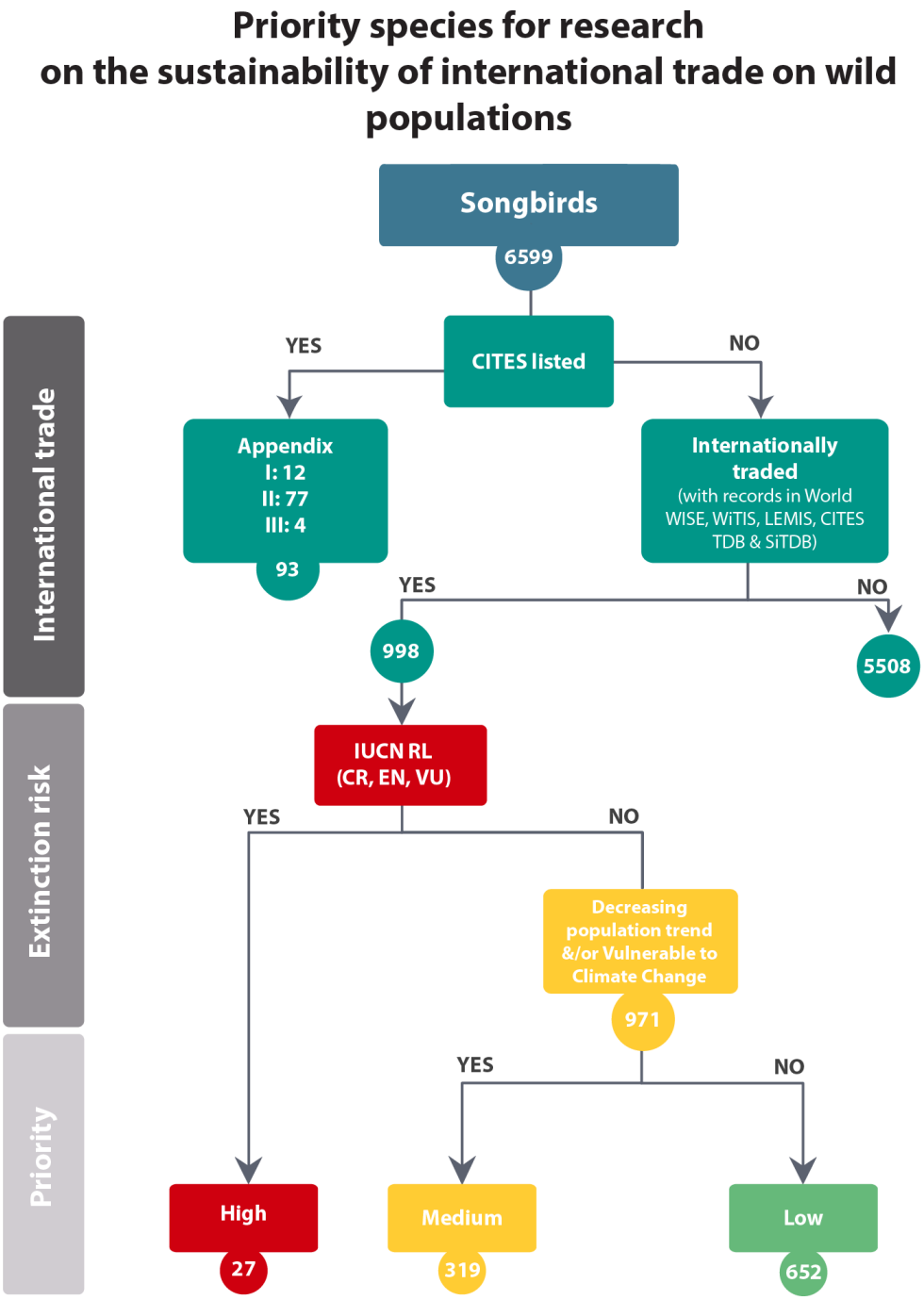


Figure 28. Decision framework for 6,599 songbird species to identify species in international trade that may warrant further research to inform potential amendments to CITES listings.

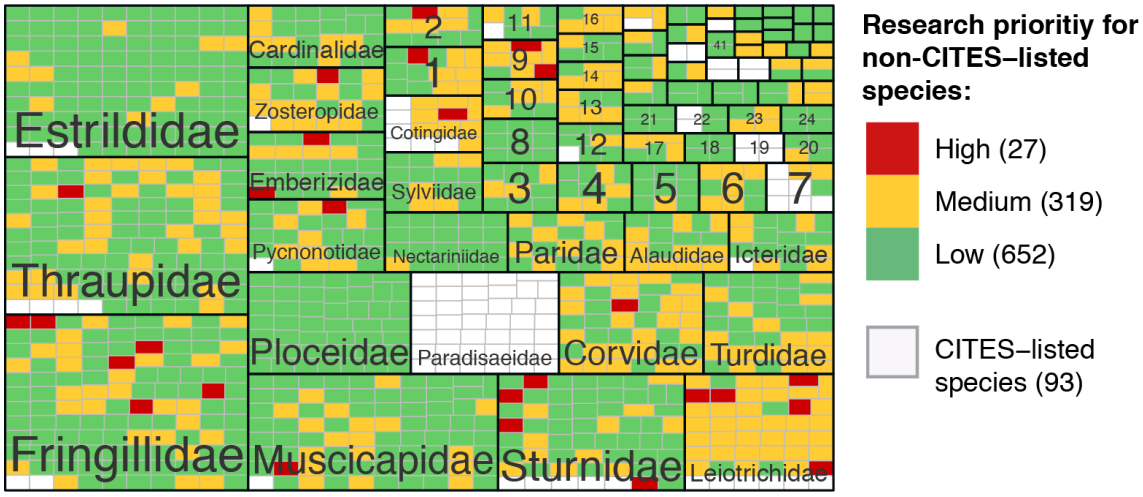


Figure 29. Treemap of 1,091 CITES-listed species and/or internationally traded species. Each small square (pixel) represents a species hierarchically ordered by taxonomic family (larger squares). Species are colored by their priority ranking for non-CITES listed species. CITES-listed species are left blank.

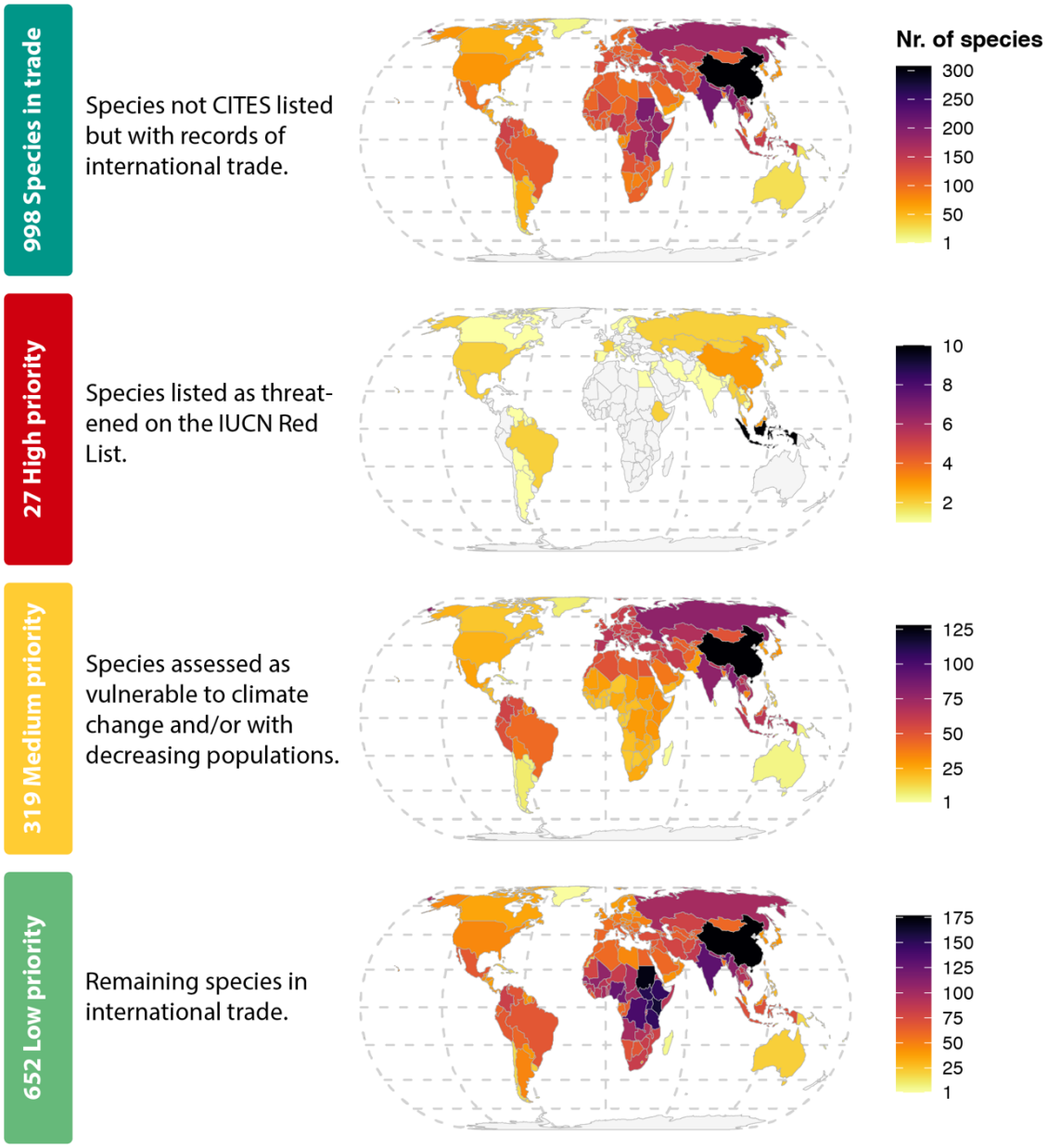


Figure 30. Distribution of species of high, medium, and low research priority to assess the impact of international trade on species survival. **a)** 988 non-CITES listed species identified in international trade. Within those, **b)** 27 species with high research priority, listed as threatened on the IUCN Red List (i.e., Vulnerable, Endangered, or Critically Endangered); **c)** 319 species with medium priority, assessed as highly vulnerable to climate change and/or with decreasing population trends according to the IUCN Red List; and **d)** 652 remaining species with low priority.

One of the Songbird SKI goals is to integrate data across knowledge areas to identify gaps and opportunities for research and collaboration to support species conservation. Here, we present the number of species in each priority category with available data for four knowledge areas (see Table 3 for full data sources). We present biological information separately in Table 17.

Overall, we found a relatively low representation of priority species in international conventions and treaties (Table 17). For example, in the Convention on Migratory Species, we found

7% (2 spp.) of high priority species, 13% (40 spp.) of medium priority species, and 16% (103 spp.) of low priority species. For the EU Wildlife Trade Regulations, we found only 4% (1 spp.) of high priority species, 2% (7 spp.) of medium priority species, and 2% (15 spp.) of low priority species. These numbers highlight opportunities to enhance knowledge sharing and collaboration for species conservation.

Similarly, the representation of priority species in trade datasets was fairly low. For example, no high priority species had records in the CITES Trade Database, USFWS LEMIS, or UNODC World WISE (including CITES Annual Illegal Trade Reports). However, 15% (4 spp.) of high-priority species had records concerning international trade in TRAFFIC WiTIS, and SiTDB and WiTIS held data on domestic trade for 70% (19 spp.) of high-priority species. For medium and low-priority species, international trade data were available for 0–26% of species across datasets. Information on domestic trade was available in SiTDB and WiTIS for 50–67% of low to medium priority species.

The second criterion to prioritize species was the IUCN Red List, for which all 27 species under high priority are listed as threatened, of which 5, 8, and 14 are in the categories of Critically Endangered, Endangered, and Vulnerable, respectively. Those species not threatened but with decreasing populations, according to the IUCN Red List, fall into the medium priority; of those, 36, 282, and 1 species are listed as Near Threatened, Least Concern, and Data Deficient, respectively. We found that 24% (78 spp.) of the species in medium priority have been assessed as highly vulnerable to climate change (Foden et al. 2013). We also found 24% (7 spp.) of high-priority species to be highly vulnerable to climate change, indicating that these may suffer from climate impacts in addition to being in a threatened category. All species in the Alliance for Zero Extinction trigger sites are already listed by CITES.

For high-priority species, perceived levels of trade (as categorized in SiTDB) were low to moderate for 89% (24 spp.) of species. Only 11% (3 spp.) showed high levels of trade. Similar patterns were observed for medium and low-priority species, with 92% and 94% of species showing low to moderate trade. However, it is important to highlight that we did not include the level of international trade in the prioritization since this is based on a qualitative assessment by the SiTDB, for which further revision and standardization with information from other sources will be important to generate a comprehensive overview. Based on a preliminary trade impact assessment by the SiTDB, trade was assessed as a threat to 48% (13 spp.) of high-priority species. Trade was a plausible threat to a further 33% (9 spp.) of species, and trade impacts were unknown for 19% (5 spp.) of species. Trade impacts were mostly unknown for medium (82%; 263 spp.) and low priority (92%; 598 spp.) species.

Finally, we found that most priority species (52–67%) showed an evolutionary distinctiveness value lower than the median for songbirds. Conversely, the majority of priority species (67–71%) showed an ecological distinctiveness value higher than the median for songbirds, indicating that internationally traded species tend to be ecologically unique. This finding suggests that these species may play unique ecological roles in their host ecosystems and that their extinction or population decline may lead to the loss of ecological function and diversity. Finally, we found that 26% (7 spp.) of high-priority species were listed as Evolutionarily Distinct and Globally Endangered (EDGE), perhaps reflecting the fact that both our prioritization and the EDGE system are based on IUCN Red List threatened categories.

Regarding biological information, we found that general information regarding body mass, diet, and distribution was available for the majority of priority species (74–100%). Similarly, most

species (89–98%) had records of occurrence in the Global Biodiversity Information Facility (GBIF), and GenBank sequences were available for 63–88% of species).

However, we found that the type of information required to estimate the effects of harvesting on a population was rarely available for priority species in the form of life tables or population matrix models. For example, we found that life tables were available for no high or low priority species, and only 1% (2 spp.) medium priority species had life tables. Similarly, population matrices with both mortality and fertility data were available for only 7% (2 spp.) of high priority species, 8% (27 spp.) of medium priority species, and 2% (16 spp.) of low priority species.

Our basic framework using IUCN Red List and other species prioritization schemes provides a starting point to lead the development of research initiatives. The SiTDB reports trade as a threat for 48.1% (13 spp.) of high-priority species based on the peer-reviewed literature (Table 16). However, for the categories of medium and low, the impacts of trade are unknown for 82% and 92% of species, respectively. It is important to highlight that the SiTDB does not differentiate between international and domestic trade. Thus, a more in-depth review is still needed for all prioritized species.

We want to highlight the need to include in the prioritization country-level species threats assessments, when available since global assessments only pinpoint some of the species that international trade may be impacting. For example, focusing only on high-priority species may overlook the 26 medium or low-priority species for which trade is listed as a threat in the SiTDB, which therefore require further research on trade impacts (Table 16).

Table 16. Data availability for the 998 priority songbird species across four knowledge areas. Breakdowns of categories are also available for perceived level of trade and trade impact (both from SiTDB) and IUCN Red List categories. Please note, we did not explore the 'management opportunities' and 'biological information' knowledge areas here. NA: Not Applicable.

Knowledge area and dataset	Research priority		
	High (27 spp.)	Medium (319 spp.)	Low (652 spp.)
1. Conventions & international treaties			
Convention on Migratory Species	2 (7%)	40 (13%)	103 (16%)
EU Wildlife Trade Regulations	1 (4%)	7 (2%)	15 (2%)
2. Trade and other uses			
CITES TDB (species with trade records)	0 (0%)	1 (0%)	42 (6%)
USFWS LEMIS	0 (0%)	60 (19%)	172 (26%)
UNODC World WISE (including CITES Annual Illegal Trade Reports)	0 (0%)	15 (5%)	28 (4%)
TRAFFIC WiTIS (international trade)	4 (15%)	30 (9%)	34 (5%)
SiTDB & WiTIS (domestic trade)	19 (70%)	214 (67%)	327 (50%)
SiTDB perceived level of trade			
Extreme	0 (0%)	0 (0%)	0 (0%)
High	3 (11%)	11 (3%)	9 (1%)
Moderate	11 (41%)	86 (27%)	141 (22%)
Low	13 (48%)	206 (65%)	470 (72%)
Unknown	0 (0%)	16 (5%)	32 (5%)
SiTDB trade impact			
Threat	13 (48%)	17 (5%)	9 (1%)
Plausible threat	9 (33%)	39 (12%)	45 (7%)
Unknown impact	5 (19%)	263 (82%)	598 (92%)
3. Extinction risk			
IUCN Red List categories			
Critically Endangered	5	NA	NA
Endangered	8	NA	NA
Vulnerable	14	NA	NA
Near Threatened	NA	36	3
Least Concern	NA	282	649
Data Deficient/Not Evaluated	NA	1	0
Highly vulnerable to climate change	7 (26%)	78 (24%)	NA
6. Value			
Evolutionary distinctiveness > songbird median	9 (33%)	152 (48%)	254 (39%)
Ecological distinctiveness > songbird median	18 (67%)	219 (69%)	462 (71%)
EDGE listed	7 (26%)	NA	NA

Table 17. Biological information available for the 998 priority songbird species in international trade. Detailed descriptions of data, variables, and methods are available in Annex 3, Juergens et al. 2021. Please see Table 11 for biological information availability for all songbirds and CITES-listed songbirds.

Category	Research Priority		
	High (27 spp.)	Medium (319 spp.)	Low (652 spp.)
B10K Database records	3 (11%)	79 (25%)	117 (18%)
Body mass (Cooke et al. 2019)	20 (74%)	309 (97%)	625 (96%)
Diet (Cooke et al. 2019)	20 (74%)	309 (97%)	625 (96%)
DSKI Age at first reproduction	6 (22%)	70 (22%)	95 (15%)
DSKI Broods per year	7 (26%)	95 (30%)	152 (23%)
Clutch size (DSKI & Cooke et al. 2019)	13 (48%)	221 (69%)	522 (80%)
DSKI Crude mortality	3 (11%)	67 (21%)	101 (15%)
DSKI Inter-clutch interval	0 (0%)	1 (0%)	1 (0%)
DSKI Life table	0 (0%)	2 (1%)	2 (0%)
DSKI Matrix mortality & fertility	2 (7%)	27 (8%)	16 (2%)
DSKI Matrix with mortality	3 (11%)	36 (11%)	26 (4%)
DSKI Maximum lifespan	7 (26%)	85 (27%)	127 (19%)
DSKI Prop. of reproductive females	1 (4%)	3 (1%)	2 (0%)
DSKI Recruitment	0 (0%)	0 (0%)	0 (0%)
GBIF Number of occurrences	24 (89%)	313 (98%)	632 (97%)
GenBank Sequences	17 (63%)	280 (88%)	564 (87%)
GROMS Migration	7 (26%)	96 (30%)	206 (32%)
IUCN Distribution	27 (100%)	319 (100%)	652 (100%)
IUCN Extent of occurrence	27 (100%)	319 (100%)	652 (100%)
IUCN Generation length	27 (100%)	316 (99%)	650 (100%)
IUCN Location number	13 (48%)	5 (2%)	1 (0%)
IUCN Lower limit of elevation	19 (70%)	86 (27%)	117 (18%)
IUCN Movement patterns	27 (100%)	317 (99%)	651 (100%)
IUCN Population size	21 (78%)	79 (25%)	83 (13%)
IUCN Subpopulation Number	14 (52%)	9 (3%)	1 (0%)
IUCN Upper limit of elevation	19 (70%)	206 (65%)	327 (50%)
VGP Status	0 (0%)	0 (0%)	2 (0%)

Priority Species for Potential Laundering as Captive Bred

CITES reports that 96% of animals in international trade from 1975 to 1989 were wild taken (CITES 2021). However, the trade of captive bred animals has recently increased across taxa (Harfoot et al. 2018). While CITES recognizes that there are advantages to captive breeding compared to harvesting animals from the wild, there is growing concern about either the misuse of source codes referring to captive breeding or its deliberate use to launder wild-caught specimens as captive-bred in international markets (CITES 2016). For songbirds, our analyses of the CITES Trade Database showed that from 1990 to 2006, more than half of transactions for commercial purposes (both exports and imports records) were of wild-taken animals. However, from 2006 to 2018 onward, the number of imports of captive bred individuals surpassed those of wild caught (Figure 14).

We developed a framework to help identify species that warrant further research on breeding difficulty and levels of trade in captive-sourced individuals. This may include research on the potential laundering of wild-caught individuals as captive-sourced in international markets. We identified 21 CITES-listed species in the CITES Trade Database with records of commercial transactions as captive sourced in 2006–2018 (Table 18). This included two species listed in CITES Appendix I (*Leucopsar rothschildi* and *Spinus cucullatus*), 18 in Appendix II, and one in Appendix III (*Cephalopterus penduliger*). Please note that CITES lists *Poephila cincta* at the subspecies level; however, here, we report results for the species level.

For each species, in Table 18, we noted the number of individuals recorded in ZIMS, which may indicate ease of keeping and breeding within zoological institutions. In addition, we noted the number of species from the focal species' genus held in ZIMS as this may further indicate keeping and breeding expertise for the genus. For example, the average number of individuals held in ZIMS for species listed as "easy" to breed was 1,761, compared to 220.4 individuals for "normal", 61.4 for "hard", and 1.5 for "challenging". We also found that 61.9% (13 spp.) of the 21 species had breeding programs in zoos, while only 38% (8 spp.) of species had reported commercial or hobby breeding efforts as reported in the SiTDB. Species in breeding programs in zoos were "easy", "normal", or "hard" to breed, with no "challenging" species in breeding programs. All species with reported breeding efforts showed either "easy" or "normal" breeding difficulty.

Finally, we noted the number of importer- and exporter-reported quantities (2006–2018) for each source code and species to aid decision-making. We found one species (*Leucopsar rothschildi*) with transaction records for source code D (i.e., captive-bred individuals of Appendix I species; see Table 19 for definitions). In addition, 20 of the 21 species had transaction records for source code C (i.e., captive bred), while five species (*Lonchura oryzivora*, *Paroaria coronata*, *Gracula religiosa*, *Rupicola peruvianus*, and *Rupicola rupicola*) had transactions under source code F (i.e., captive born). Only one species (*Rupicola peruvianus*) was reported as traded under source code R (i.e., ranched). These patterns warrant further research and may indicate different levels of expertise in successfully keeping versus breeding species in captivity over multiple generations.

Of particular interest are species that are noted as "hard" or "challenging" to breed in captivity yet are traded in relatively high numbers under source code C (i.e., captive bred). For example, under source code C, 1,941 importer-reported transactions were reported for *Gracula religiosa.* This species is categorized as "hard" to breed by SiTDB yet has 229 individuals in ZIMS and is the subject of a zoo breeding program. On the other hand, 300 individuals were reported by importers for *Parotia carolae* under source code C, but the species is categorized as "challenging" to breed by SiTDB with zero individuals in ZIMS and no zoo breeding program. For such species, further

investigations are needed to further characterize breeding difficulty, especially by commercial breeders, who in some cases may have higher breeding expertise and levels of breeding success compared to zoo breeding programs. Trade levels under different source codes should also be interpreted in light of biological information available for each species (Table 11), although detailed information is scant for CITES-listed species.

Guide to the Annexes

Together with this document (Annex 1), we provide three additional Annexes. Annex 2 is a compendium of case studies of songbirds edited by Simon Bruslund, Annex 3 is an openly available peer-reviewed data article used to develop the content presented here (Juergens et al. 2021). Annex 4 contains metadata, data curation, standardization methods, and links to download data.

Table 18. Songbird species traded as captive bred for Appendix I species (D), captive bred (C), captive born (F), or ranched (R) in the international commercial live trade (2006–2018). Color shading indicates breeding difficulty from SiTDB.

	Species	CITES App.	No. individuals in ZIMS	No. spp. of genus in ZIMS	Breeding difficulty	Breeding program	Breeding effort	Source	Importer quant.	Exporter quant.
1	*Lonchura oryzivora*	II	3,456	16	easy	✓	✓	C F	242,567 0	0 65
2	*Poephila cincta*	II*	66	3	easy		✓	C	10	0
3	*Garrulax canorus*	II	83	19	normal	✓		C	20	0
4	*Gubernatrix cristata*	II	109	1	normal	✓	✓	C	47	0
5	*Leiothrix lutea*	II	378	2	normal	✓	✓	C	23	0
6	*Leucopsar rothschildi*	I	912	1	normal	✓	✓	C D	40 0	 22
7	*Paroaria coronata*	II	137	4	normal	✓	✓	C F	6 0	 49
8	*Pycnonotus zeylanicus*	II	40	14	normal	✓	✓	C	3	0
9	*Spinus cucullatus*	I	104	9	normal	✓	✓	C	126	0
10	*Spinus yarrellii*	II		9	normal			C	30	29
11	*Amandava formosa*	II		2	hard			C	0	20
12	*Cicinnurus regius*	II	34	3	hard	✓		C	6	6
13	*Gracula religiosa*	II	229	2	hard	✓		C F	1,941 5	0 0
14	*Hydrornis guajanus*	II	3	1	hard	✓		C	1	1
15	*Leiothrix argentauris*	II	71	2	hard	✓		C	0	4
16	*Paradisaea apoda*	II	7	4	hard	✓		C	6	6
17	*Paradisaea minor*	II	49	4	hard			C	6	6
18	*Rupicola peruvianus*	II	103	2	hard			C F R	0 0 2	6 4 0
19	*Rupicola rupicola*	II	57	2	hard			F	3	0
20	*Cephalopterus penduliger*	III	3	1	challenging			C	0	4
21	*Parotia carolae*	II		1	challenging			C	300	0

* CITES Appendix refers to subspecies, which here is assigned to the species level.

Table 19. Definitions of source codes for captive-sourced transactions as defined by the *Guide to the Application of CITES Source Codes*.

Source code and description	Definition
D Captive bred (App. I)	Appendix I animals bred in captivity for commercial purposes in operations included in the Secretariat's Register, in accordance with Resolution Conf. 12.10 (Rev. CoP15), and Appendix-I plants artificially propagated for commercial purposes, as well as parts and derivatives thereof, exported under the provisions Article VII, paragraph 4, of the Convention.
C Bred in captivity (App. I, II, III)	Animals bred in captivity in accordance with Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof, exported under the provisions of Article VII, paragraph 5.
F Born in captivity (App. I, II, III)	Animals born in captivity (F1 or subsequent generations) that do not fulfil the definition of 'bred in captivity' in Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof.
R Ranched (App. I, II, III)	Specimens of animals reared in a controlled environment, taken as eggs or juveniles from the wild, where they would otherwise have had a very low probability of surviving to adulthood.

Recommendations

For CITES Parties

- Action for High and Medium Priority species
  Consider and assess legal and illegal trade levels and their legal and regulatory measures for the 27 high-priority species identified. Parties with resources should also prioritize this effort to include key species traded in higher volumes among the 319 medium-priority species.

- Use the Songbird SKI for national assessments
  The SKI currently holds information at a global scale, such as species threat assessments and regulations. Further developing the SKI at a national scale will be an excellent opportunity to expand its application and improve species trade regulation and management. To enable this, Parties are encouraged to submit national-level information on native songbird species, such as national Red Listing assessments, legislation, quotas allowed for domestic and international trade, and more. Parties are also encouraged to use the SKI for species native to or traded within their country to identify potential species for further monitoring and assessment. We recommend that the CITES Secretariat coordinates this process.

- Scrutinize species potentially being laundered as captive bred
  For the 11 species deemed "hard" or "challenging" to breed in captivity yet are traded in relatively high numbers under source code C, their captive breeding and trade operations should be further assessed as potential species of concern under Resolution 17.7 on captive breeding to verify that no laundering may be taking place.

Future research priorities to develop the Songbird SKI

- Update the SiTDB and Songbird SKI with information from upcoming research, especially from underrepresented regions and countries.
- Develop and test a comprehensive risk assessment framework (or decision tree) based on the Songbird SKI to identify species that may warrant consideration by Parties for listing on CITES.
- Develop a detailed framework to identify species that may be deliberately misdeclared as captive bred (Resolution 17.7 on captive breeding). Further research is needed to characterize breeding difficulty, especially by commercial breeders. Trade levels under different source codes should also be interpreted in light of biological information available for each species.
- Update the Songbird SKI with legislation at species and national levels when the legal framework is complete.
- Seek funding to support the Songbirds in Trade Database in collecting data on songbird trade in underrepresented regions or regions of importance.
- Ensure the SKI can be updated to support policymakers and conservation practitioners. Currently, the SKI is static, meaning computational routines must be re-run to extract, standardize, and map the data. We are establishing a network of collaborators and seeking funding to update the SKI on an annual basis using computational technology. This will allow us to flag changes in threat status, legislation, and new data to policy makers, conservation organizations, and scientists.

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Sponsors and Contributors

Main Sponsor Organizations

Mandai Wildlife Group

Mandai Wildlife Group (MWG) contributes to conserving Southeast Asian biodiversity through various initiatives as a world-leading and globally recognized zoological and conservation institution. In addition to providing local and regional support to songbird conservation efforts, MWG carries out wildlife research, education, and community outreach campaigns to raise awareness and tackle the illegal songbird trade.

Together with experts of the national and international songbird communities, MWG played a crucial role in forming the IUCN SSC Asian Songbird Trade Specialist Group (ASTSG). MWG is also the host institution for ASTSG and its secretariat (coordinator) office. The role of the secretariat office of the ASTSG is multipronged. It includes engaging and strengthening local and regional conservation partnerships, including government and non-government stakeholders. Additionally, the secretariat oversees, supports, and implements conservation action for songbird species while ensuring these actions are aligned with the regional conservation strategy. MWG contributes in other capacities toward songbird conservation, such as through the conservation breeding of various threatened species of songbirds at Jurong Bird Park (e.g., the straw-headed bulbul, *Pycnonotus zeylanicus*, and the greater green leafbird, *Chloropsis sonnerati*), which may serve as future assurance populations for release into the wild. Another contribution to conservation is building capacity and conservation competency of regional partners, such as rescue centers and government authorities, allowing them to implement conservation actions for songbirds.

Mandai Wildlife Group is a Founding Member of the Species360 Conservation Science Alliance.

Copenhagen Zoo

Copenhagen Zoo Southeast Asia Biodiversity Programme, since 2014, with Baluran National Park, have worked together to rehabilitate more than 1000 ha of open savanna resulting in increasing populations of ungulates. To prevent the loss of the last Grey-backed Mynas, they are formulating a conservation programme that aims at developing a conservation breeding centre in Baluran NP with the purpose of breeding enough birds to release back into the park and, concurrently, raise local awareness, explore potential associated community income, and combat ongoing illegal trapping in the park. In Annex 2 is an expanded description of this project.

Copenhagen Zoo is a Founding Member of the Species360 Conservation Science Alliance.

WAZA

The World Association of Zoos and Aquariums (WAZA) is the global alliance of progressive zoos and aquariums, their regional and national associations, dedicated to the care and conservation of animals and their habitats around the world. WAZA's membership consists of nearly 300 leading institutions and organisations around the world, and this number continues to grow.

Since 2010, the CITES Secretariat and WAZA share a Memorandum of Understanding to facilitate the use of the expertise available in the WAZA network to benefit the conservation and sustainable use of species of wild fauna and flora, to assist CITES Parties in implementing the Convention and to assist in the activities of the CITES Secretariat.

As a founding member of the Species360 Conservation Science Alliance, WAZA is proud to support this report. WAZA zoos and aquariums are actively involved in the conservation of Songbirds through Ex situ actions at the service of the scientific and broader society. The support provided includes, but is not limited to, providing care and placement of confiscated animals, providing valuable scientific information for decision making, communicating and creating awareness about the status of this taxon, establishing sustainable breeding programmes, and providing capacity-building opportunities, as well as fundraising.

The World Association of Zoos and Aquariums is a Founding Member of the Species360 Conservation Science Alliance.

Main Contributing Organizations

Marlow Bird Park

By Simon Bruslund and Matthias Haase

Marlow Bird Park is a non-profit zoo in the countryside of north-eastern Germany. Conservation support is integrated into the institution's purpose and has grown in strength since 2019 with the introduction of the "conservation Euro", a voluntary visitor contribution of one Euro per visitor. In addition to investing over €100,000 in conservation projects annually, a staff member is assigned to support conservation research and provide technical support for conservation partners.

Songbirds have become a priority group for Marlow Bird Park conservation work and staff who co-coordinate the SAVE Magiao project, which is centered on raising awareness for the Nias myna (*Gracula robusta*), a species flagged by the Songbird SKI and the Alliance for Zero Extinction (Table 15). Marlow Bird Park is also involved in the coordination of the EAZA Silent Forest campaign (Box 17), working with several regional projects under the EAZA Songbird TAG. Technical and financial

support is currently rendered for different partner projects aiming to protect the Fatu Hiva monarch (*Pomarea whitneyi*), Alagoas antwren (*Myrmotherula snowi*), red siskin (*Spinus cucullatus*), locally threatened populations of the white-rumped shamas (*Kittacincla malabarica*) in Indonesia, and crested larks (*Galerida cristata*) in Germany.

Marlow Bird Park's conservation philosophy is: **1)** Together for Conservation: We prefer partnerships in projects we support to ensure the sharing of resources. We also aim to incorporate our visitors, sponsors, and partners to live by our motto: "Together for Conservation". We appreciate and value the power of networking. **2)** Worldwide: We do not have geographical or political restrictions and aim to direct our support where it is most needed to have the most significant effect. **3)** Make every € count: To protect "conservation investments" we keep close contact with our conservation partners and provide technical support and mentoring where needed. **4)** Birds and more: We are a bird park and use our experience and knowledge but do not place restrictions on the species we support. We do, however, favor species without a lobby. **5)** Emergencies: We aim to strengthen abilities for rapid response.

Monitor Conservation Research Society

By Chris R. Shepherd and Boyd T. C. Leupen

Monitor Conservation Research Society (Monitor) focuses on the illegal and unsustainable trade in lesser-known wildlife species and related policy and enforcement issues. By doing so, it fills an often overlooked niche. Monitor consists of a small, dedicated team of wildlife trade experts who stand for objective and evidence-based research.

Recognizing the urgency of the matter, Monitor has emphasized the Asian songbird crisis. Monitor's Executive Director, Chris R. Shepherd, has been working on the Asian songbird trade since the mid-1990s, while Programme Officer, Boyd Leupen, has specialized in the subject for the past four years. As members of the ASTSG, they continue to conduct extensive research into the issue. Monitor is also a partner of the Asian Species Action Partnership (ASAP). As such, it prioritizes efforts to relieve local trade threats to Critically Endangered songbirds in Southeast Asia, such as the straw-headed bulbul (*Pycnonotus zeylanicus*). In addition to regional and local investigations, Monitor has widened its research scope to include analyses of international and intercontinental trade flows.

Monitor centers its work on providing evidence to key stakeholders to support effective regulation and protection at national and international levels. It strongly supports the increased use of CITES to prevent or document overexploitation of the world's songbirds. In addition to sharing and publishing research findings, Monitor works to address conservation gaps, advise policy and conservation interventions, and create and raise consumer awareness and public concern. Through these efforts and in collaboration with strategic partners, Monitor works toward its ultimate goal: significantly reducing illegal and unsustainable trade in Asian songbirds.

TRAFFIC Southeast Asia

By Kanitha Krishnasamy, Director for Southeast Asia, and Serene Chng, Programme Officer (TRAFFIC International – Southeast Asia)

TRAFFIC is a leading non-governmental organization working globally on trade in wild animals and plants in the context of biodiversity conservation and sustainable development. TRAFFIC's trade monitoring and analysis of the songbird trade in Asia dates back to the 1990s. In the past decade, this has expanded significantly, with comprehensive surveys providing proof of the unprecedented scale of the songbird trade. Snapshot market inventories in Indonesia, Singapore, Thailand, and Vietnam have found over 86,000 birds in 13 cities between 2014 and 2018.

Research showed several worrying trend changes: species common in the markets (and in the wild) in the past are less common today, with local extirpations occurring. There is an apparent shift to species not typically seen in trade before (e.g., from less accessible islands or montane habitats) due to overexploitation to meet the insatiable demand. Traders are also turning to neighboring countries to source birds as local populations decline, as evidenced by government enforcement efforts. Thousands more continue to be documented for sale online in almost all Southeast Asian countries. The predominant issue is that trade is poorly regulated, involving native and non-native species. In Vietnam, pioneering consumer research on bird keepers was carried out to better understand their profile, behavior, and motivations to inform demand reduction interventions.

The work of TRAFFIC and others led to the Asian Songbird Trade Crisis Summit in 2015. This was the genesis for actions, including identifying key songbird species most threatened by trade, a regional strategy to address the problem, and the formation of the ASTSG. This work also contributed to decisions leading to Indonesia's updated Protected Species List in 2018, including many songbirds heavily harvested for trade. Information from TRAFFIC's research also contributed to IUCN Red List updates to recognize this trade threat.

ERASMUS +

The internship of Jacqueline Juergens was financed through an ERASMUS+ traineeship, which offers internships abroad for students currently enrolled in higher education institutions. ERASMUS+ is the EU programme for education, training, youth, and sport. See details here.

EAZA Silent Forest Campaign

See Box 17.

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