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A mixed black and whitelist approach for wildlife trade regulation in China: Biodiversity conservation is made of shades of gray

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Abstract

The Kunming-Montreal Global Biodiversity Framework requires effective actions to bend the curve of biodiversity loss by 2030. Wildlife trade, a direct drive of biodiversity decline, calls for more effective regulations to both protect wildlife populations in the wild and facilitate sustainable use of wildlife resources to meet human needs. This call has become particularly urgent in light of the COVID-19 pandemic. In 2021, China's *List of State Key Protected Wild Animals*, a list of fauna under the strictest protection by national legislation, has been updated in the year 2021, 32 years after its first release, increasing its coverage (from the original 13%) an 11% of species across taxa. Combined with the updated *List of State Protected Terrestrial Wild Animals* which covers species with lower protection priority, these two national lists already cover 77% terrestrial vertebrate species of China. Such a blacklist approach, placing threatened species under a list of legal protection, is a common practice globally in species conservation. We discussed pros and cons of this dominant strategy and further explored the potential integration with a whitelist approach, listing all wildlife and only permitting regulated uses of certain species. We propose a mixed approach combining black and whitelists at different administration levels which could perhaps be first adopted in China. This is mainly due to the fact that in addition to illegal harvesting from the wild, traded wildlife in China are mostly from captive breeding and related laundering of wild-caught animals.

KEYWORDS
blacklist approach, China, law enforcement, whitelist approach, wildlife protection lists, wildlife trade

1 | INTRODUCTION

The Post-2020 Global Biodiversity Framework calls for ambitious conservation goals to reverse the decline of biodiversity by the year of 2030. The COVID-19 outbreak has further elicited a discussion on how to improve wildlife trade regulation (here we use the word "trade" to describe not only wildlife selling and consumption, but also wildlife harvesting, farming, and transportation with a commercial purpose). Accordingly, China has taken several fundamental steps to improve domestic wildlife trade management since 2020. A legal decision issued in February 2020 banned wildlife food consumption and related breeding and trade (Standing Committee of the National People's Congress of China, 2020), commonly referred to as the "wildlife consumption ban." The ban prohibits the consumption and selling of all terrestrial wildlife and their captive-bred populations for food (related farms were closed and economically compensated). Neither aquatic wildlife nor nonedible uses such as medicine or pets are banned. It also allows the consumption of certain terrestrial wildlife with mature breeding techniques and low health risks, via listing them into the *Catalogue of Livestock and Poultry Genetic Resources* (Supporting information Section S2).

The ban initiated the process of amending and establishing relevant laws to safeguard both biodiversity conservation and public health in the long term. The revision of the Law of the People's Republic of China on the Protection of Wildlife (hereinafter "Law on the Protection of Wildlife") was released in December 2022, which incorporated the wildlife consumption ban. Related articles in Criminal Law were amended accordingly in December 2020 and a new criminal charge related to wildlife food consumption was created. The revision of the Animal Epidemic Prevention Law was released in September 2020 and the new Biosafety Law was issued in October 2020. This body of law is being rapidly transformed to better fit society's needs in the postpandemic era.

Alongside the rapid revision of wildlife-related laws, the protected species lists (lists of flora and fauna under the protection by national and regional legislation), were also under urgent modification to fit the transformed laws. The protected species lists form the legal basis as well as a "research and conservation guide" to wildlife management in China. The *List of State Key Protected Wild Animals* (hereinafter *state key protected species list*), was first promulgated in 1989 and tended to cover the species most vulnerable to extinction. It included 492 Classes I and II protected species which differ in threaten status and protection priorities.

Terrestrial species listed in Appendixes I and II of the Convention on International Trade in Endangered Species (CITES) but not covered by the *state key protected species list* were allocated to class I and class II protected species, respectively. While aquatic species listed in CITES Appendix follow the authorized list released by the Ministry of Agriculture, which defines the protection level of each species inside China.

The *List of State Protected Terrestrial Wild Animals with Important Ecological, Scientific and Social Values* (hereinafter *state protected terrestrial species list*) was released in 2000 and included 1591 species with lower protection priorities (Figure 1a). Together with the *Lists of Regional Key Protected Wild Animals* (hereinafter regional lists) released by provincial-level governments to supplement the two national lists, they form the major foundation to enforce the Law on the Protection of Wildlife in China, as the law defines different levels of criminal punishment based on which category the species belongs to (Figure 3).

Unfortunately, these wildlife protection lists had become outdated due to rapid changes in taxonomy, population status and threats, hampering law enforcement, and wildlife management. Despite several attempts to modify the lists by the former Ministries of Forestry and of Agriculture (Figure 1a), the final updated *state key protected species list* was not released until February 2021–32 years after it was first enacted. Additionally, the update of the *state protected terrestrial species list* was released in June 2023 and each province is currently making their own regional list of key protected species. The current revision of all these lists is thus fundamental to managing biodiversity in China.

Here, we conducted a comprehensive analysis of the changes made to the two national level wildlife protection lists (namely, the update), and compared the updated lists with the full species list of China to assess their coverage (Supporting information S1). For all species in China, we also checked their conservation status on the IUCN Red List website (IUCN, 2021), to compare the protection status of wildlife in China with international standards. Countries are encouraged to adopt more rigorous conservation measures for species facing a higher level of threat within their borders compared with their global status. Nevertheless, the IUCN criteria can be considered as the minimum standard for species protection. For species not recorded on the IUCN website, we checked all available information to identify synonymous species within the IUCN list or newly described species that used to be a subspecies of an IUCN-listed species. We restricted our analysis to the four main vertebrate taxa—mammals, birds, amphibians, and reptiles, for which the most up-to-date
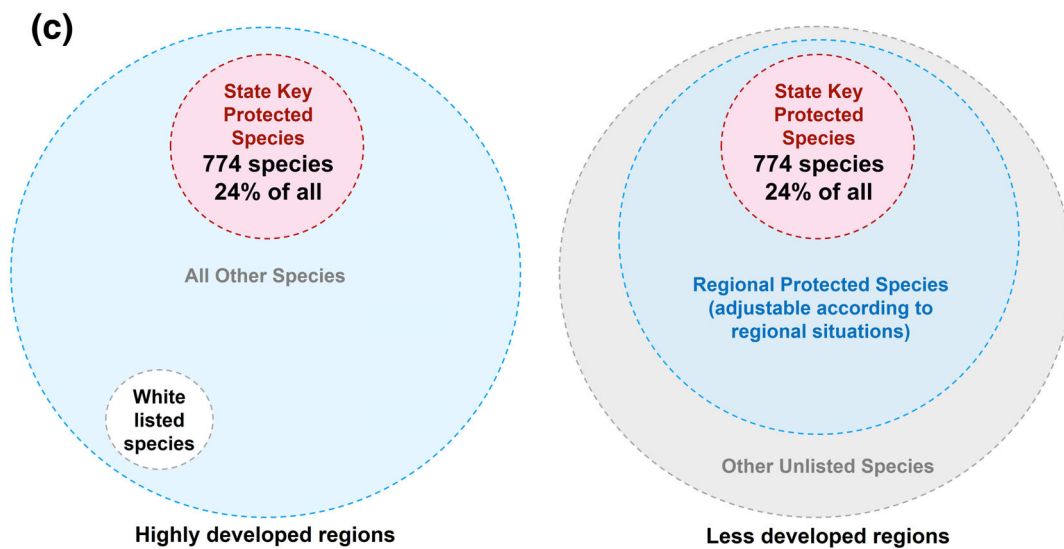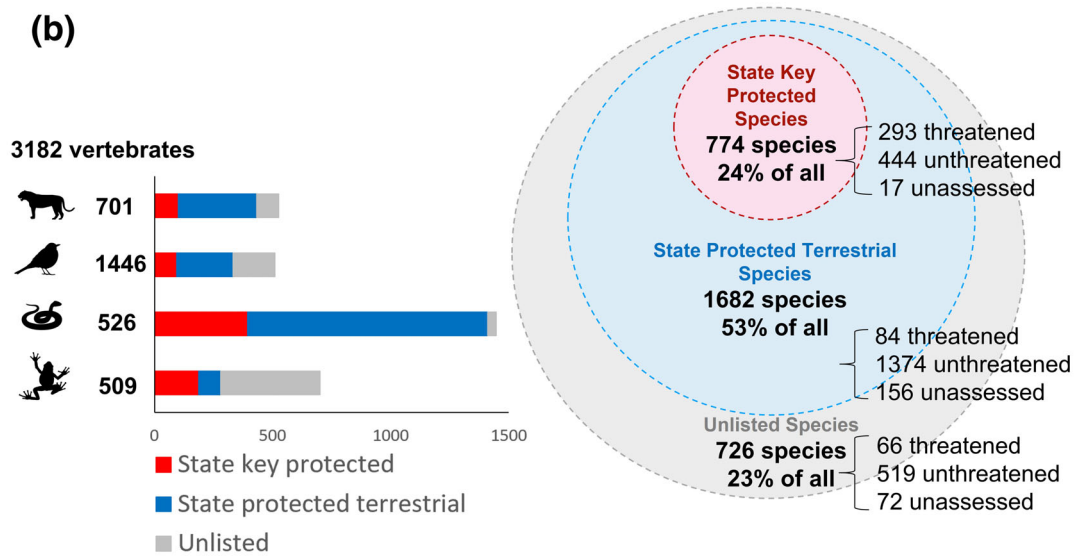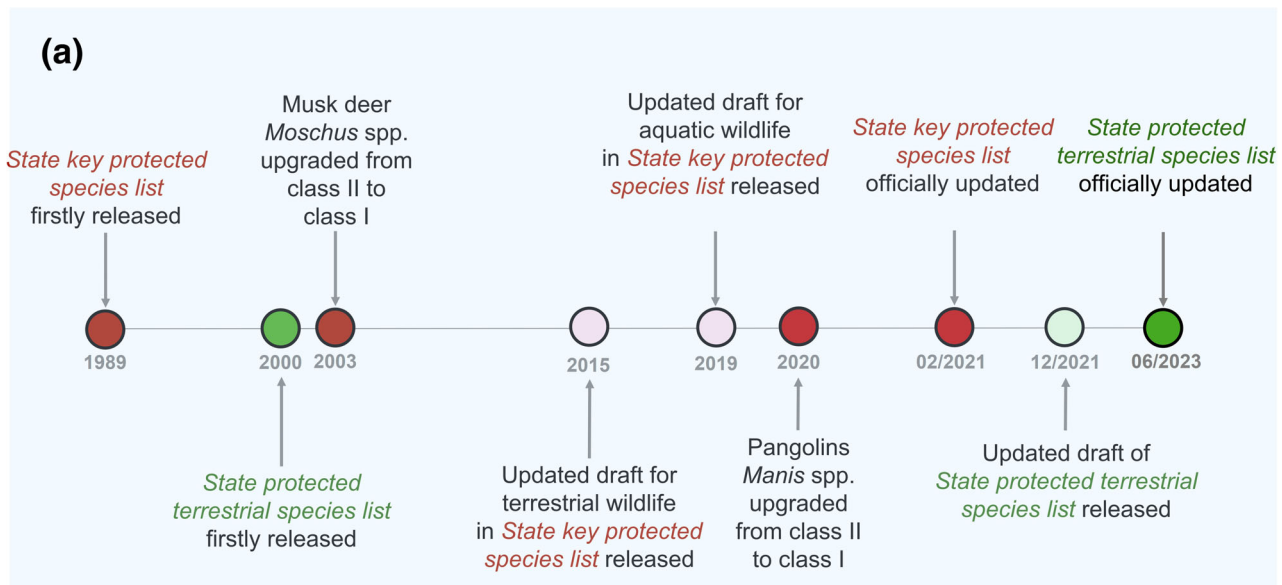
(a)

State key protected species list firstly released — 1989

State protected terrestrial species list firstly released — 2000

Musk deer *Moschus* spp. upgraded from class II to class I — 2003

Updated draft for terrestrial wildlife in *State key protected species list* released — 2015

Updated draft for aquatic wildlife in *State key protected species list* released — 2019

Pangolins *Manis* spp. upgraded from class II to class I — 2020

State key protected species list officially updated — 02/2021

Updated draft of *State protected terrestrial species list* released — 12/2021

State protected terrestrial species list officially updated — 06/2023

(b)

3182 vertebrates

701
1446
526
509

0   500   1000   1500

- ■ State key protected (red)
- ■ State protected terrestrial (blue)
- ■ Unlisted (grey)

State Key Protected Species
774 species
24% of all
— 293 threatened
— 444 unthreatened
— 17 unassessed

State Protected Terrestrial Species
1682 species
53% of all
— 84 threatened
— 1374 unthreatened
— 156 unassessed

Unlisted Species
726 species
23% of all
— 66 threatened
— 519 unthreatened
— 72 unassessed

(c)

State Key Protected Species
774 species
24% of all

All Other Species

White listed species

Highly developed regions

State Key Protected Species
774 species
24% of all

Regional Protected Species (adjustable according to regional situations)

Other Unlisted Species

Less developed regions

FIGURE 1   Legend on next page.

information is available in China. Then, we assessed the pros and cons of the current blacklist approach, which is the current international standard, and of an alternative whitelist approach. We aimed to explore potential avenues in China to overcome common issues associated with these two contrasting conservation policy strategies. Our analysis here would be focused on the management of domestic wildlife trade, not cross-border international trade regulated by CITES, as they are under two independent administrative systems in China. The suggestions could also be useful for countries adopted similar administrative framework.

2 | THE UPDATE OF THE WILDLIFE PROTECTION LISTS OF CHINA AND REMAINING LOOPHOLES

2.1 | A crucial step forward

The full species list of China we compiled for the four taxa (see Supporting information Section S1 for data sources) contains 701 mammals, 1446 birds, 509 amphibians, and 526 reptiles. The updated *state key protected species list* covers 24% of species in the four taxa (Figure 1b).
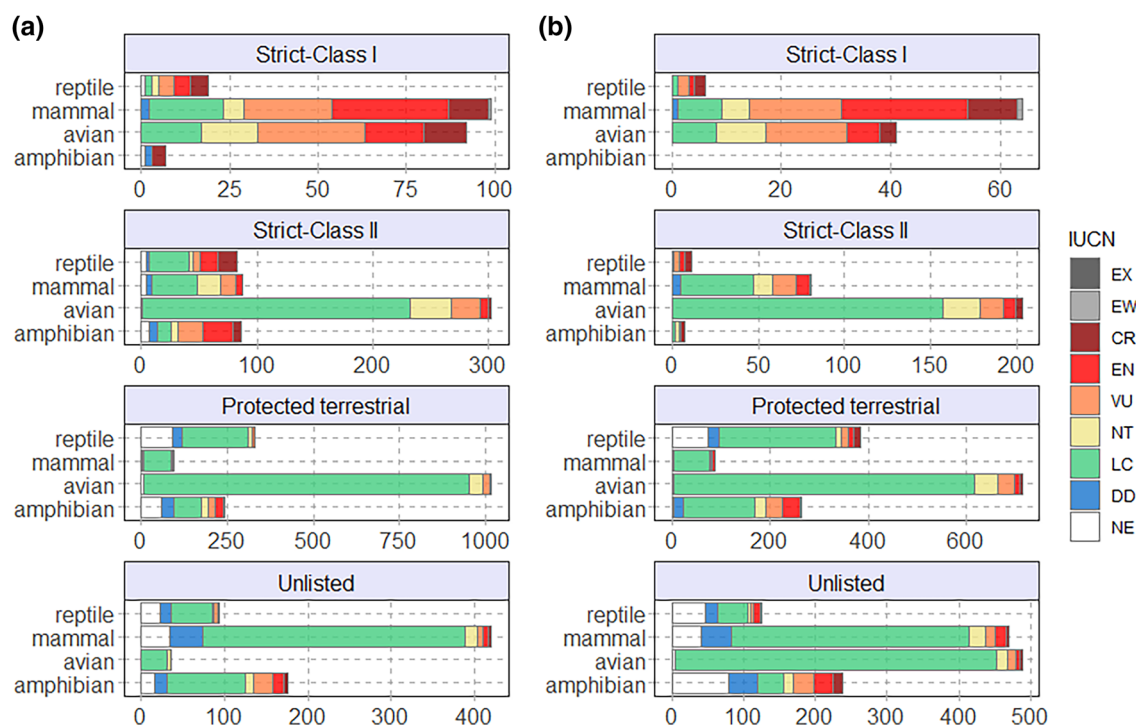

FIGURE 2 Number of reptile, mammal, avian, and amphibian species in the different protection categories before the year 2020 and after the 2021 update. (a) Species distribution of the four taxa in the different protection categories after the 2021 update. "Strict-Class I" and "Strict-Class II" are the two lists included in the *List of State Key Protected Wild Animals*. "Protected terrestrial" refers to the *List of State Protected Terrestrial Wild Animals with Important Ecological, Scientific and Social Values*. "Unlisted" are species not being currently included in any national-level protection list. (b) Previous distribution of the same taxa in the different protection categories according to the version before the year 2020.

FIGURE 1 Description of China's current protected species list system and our suggested system. (a) Timeline diagram depicting the changes in the lists of protected species since their enactment to the 2021 update. Red dots represent formal updates related to the *state key protected species list*, green dots represent formal updates related to the *state protected terrestrial species list*, pink and light green dots represent an updated draft. (b) Summary of the number of species covered (and uncovered) by the two updated national-level protected lists across the four taxa of vertebrates (mammals, birds, reptiles, and amphibians), and their status within the IUCN Red List (simplified to threatened, unthreatened and unassessed). Each regional protected species list (not shown on the graph) enacted by local governments will further cover part of the gray area, namely the "unlisted species" by the two national lists. (c) Our suggested region-specific adaptive management scheme for wildlife trade in China.
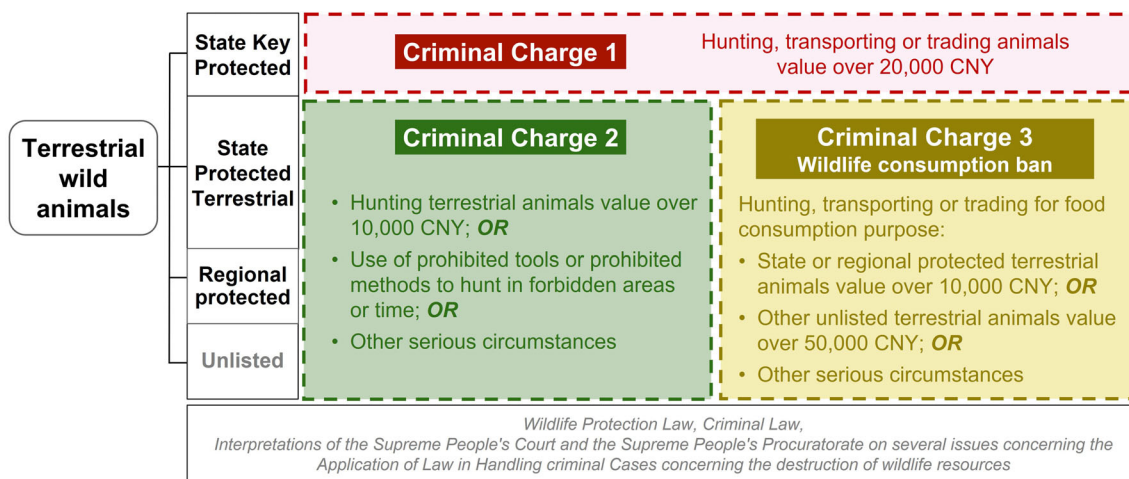
FIGURE 3 Diagram detailing how law is enforced for different criminal activities and species under different protection categories in China. For *state key protected species*, behaviors including poaching, purchasing, transporting, or selling animals or their products valued more than 20,000 CNY without a license are defined as the 'crime of harming rare and endangered wild animals' (Criminal Charge 1). These crimes are punishable with a fine and detention, and up to more than 10 years in prison. In contrast, poaching *non-state key protected species* is defined as the "crime of illegal hunting" (Criminal Charge 2) when the products are valued more than 10,000 CNY. The violator might be sentenced to <3 years of fixed-term imprisonment, detention, house arrest or a fine. Purchasing, transporting, or selling *non-state key protected species* without a license is not considered a crime before the year 2020. After 2020, purchasing, transporting or selling *non-state key protected species* for food consumption is defined as the "crime of illegally hunting, purchasing, transporting and selling terrestrial wild animals" (Criminal Charge 3), although different value thresholds were applied to species under each protected category. This newly added Criminal Charge 3 is the same as the "wildlife consumption ban."

Species coverage increased by 11% compared with the previous version of the list, which is particularly tangible for amphibians and reptiles—only 7 species of amphibians and 17 of reptiles were included in the previous version. Moreover, the updated list covers 66% of all the threatened mammals, birds, reptiles, and amphibians in China (from Extinct to Vulnerable on the IUCN Red List), a significant increase from 32% of the previous version. However, threatened amphibians are still poorly covered. Compared with other taxa (mammals 79%, birds 80%, and reptiles 75%), less than half (40%) of the threatened amphibians of China are under the strict protection category. Still, this change is already a remarkable improvement compared with the 2% coverage of threatened amphibians in the previous version.

There are 151 threatened species, representing 33% of all threatened species (according to the IUCN Red List) of China, not included in this updated *state key protected species list* across these four taxa (Figure 1B, Figure 2). More specifically, 84 species are under the relatively weaker protection status of the *state protected terrestrial species list*, while 67 threatened species are not included in any protection category. Except for marginally distributed species (only the edge of their distribution range overlaps the Chinese border) according to the IUCN Red List, all these unprotected threatened species are recently described as new species of amphibians and reptiles. Moreover, the updated *state key protected species list* covers 444 species

(19% of listed species) assessed as nonthreatened by IUCN (Near Threatened and Least Concern), while the former list only included 268 nonthreatened species. For these species, most of which are under poaching and/or habitat degradation pressure (Jiang, 2021), China is enforcing a stricter protection status than the IUCN criteria.

As a supplement to the *state key protected species list*, the recently updated *state protected terrestrial species list* covers an additional 19% of threatened species of China, as well as 59% of nonthreatened and 64% of unassessed species, according to IUCN standards (Figures 1b and 2). Compared with the original version, this updated *state protected terrestrial species list* largely increased the coverage of avian species (from 40% to 70%), while coverage for the other three taxa only increased by 3%–4%. Having into account the two national-level protection categories, only 2%, 35%, and 18% of avian, amphibian, and reptile species, respectively, remain unlisted. Notably, 421 mammal species out of 701 (60% of mammal species of China) have not been included in any of the two lists, with most of these unlisted species being small rodents and bats.

2.2 | Remaining loopholes

The update of the wildlife protection lists of China and related laws represents a crucial step forward for

biodiversity conservation, nationally and internationally. However, merely listing species and stating that they will be protected does not necessarily mean that these ambitious laws are in fact enforced. Although the coverage of species by these blacklists might seem high, the protection provided by the *protected terrestrial species list* or regional lists is relatively weak with loopholes remain even after its revision (Figure 3). Before the year 2020, purchasing, transporting or selling *protected terrestrial species*, regional protected species and other unlisted species without a license is not even considered a crime. After the 2020 "wildlife consumption ban," only purchasing, transporting or selling those species for the purpose of food consumption is newly defined as the "crime of illegally hunting, purchasing, transporting and selling terrestrial wild animals" (Criminal Charge 3 in Figure 3). Trade and transportation for other purposes such as medicine, fur, and exhibition of those species is not considered a crime. This provided an obvious loophole that allows intensive trade of species not listed under *state key protected species list* for nonfood usage without any monitoring.

The population decline of the Yellow-breasted Bunting *Emberiza aureola* exemplifies this limited deterrent effect. This species used to be one of the most abundant migrant songbirds of Eurasia, with an extensive breeding range stretching from Scandinavia to the Russian Far East and wintering in South Asia. Between 1980 and 2013, despite being a *protected terrestrial species* since 2000, its population has declined by ∼90%, contracting its range by 5000 km^2, mainly due to illegal trapping and habitat degradation across its migration routes (Kamp et al., 2015). Sharp declines of other species, such as Baer's Pochards *Aythya baeri* (Wang et al., 2012), Jankowski's Buntings *Emberiza jankowskii* (Jiang et al., 2008), and many turtle species (Wu et al., 2019), might also be linked to this lack of deterrence effect by less stringent protection categories.

3 | THE PROS AND CONS OF BLACKLIST AND WHITELIST APPROACHES

The current blacklist approach—a comprehensive list of protected species, which is the norm worldwide, places the emphasis on certain species that require special protection. Alternatively, whitelist approaches—a reduced list of species for which certain uses are allowed while protecting biodiversity as a whole, would be a natural step forward to counteract the current biodiversity crisis (Couzens, 2013). A central question in this context would be to determine to what extent this more ambitious approach is enforceable and might represent a positive conservation outcome. We analyze here the pros and cons of these two approaches by reviewing previous discussions on this issue.

Under a blacklist system, the protection of a species usually requires qualification that the species is threatened

TABLE 1 The pros and cons of blacklist and whitelist approaches (Challender et al., 2022; Couzens, 2013; Ditkof, 1982; Frank & Wilcove, 2019; Hughes et al., 2021; Macdonald et al., 2021; Marshall et al., 2020).

	Blacklist approach (e.g., CITES, "the endangered species act," "Bern convention")	Whitelist approach (e.g., "the wild bird act," "EU wild bird ban")
Pros	"Focus sufficient attention on listed species, so that, in time, they can be returned to a healthy state and removed from the list"	Would make it easier for officials to identify unfamiliar specimens, because, to avoid confiscation, the trader/user will aid the official by attempting to show that the species in question is listed
	Implementing "different degrees of protection"	"Emphasizes preventive protection, assuming that a species is endangered unless proven otherwise"
		Newly identified and newly named species would automatically become under law protection
Cons	The difficulties in species/specimen identification during law enforcement, as the number of species listed becomes larger	May act as a blanket ban and drive the illegal trade underground
	"Focusing on protection can in some situations make the threatened species even more attractive to criminal syndicates or private collectors, since it confirms the scarcity (and thus 'value') of the species in question'"	The species number might become larger after reverse listing and make the species identification even harder
	'Categorizing' species should be replaced by holistic conservation in taking biodiversity as a whole	"De-emphasizes the protection of endangered species" and "relegates those species to the background"
		Not politically feasible to change the current CITES system

Abbreviations: CITES, Convention on International Trade in Endangered Species; EU, European Union.

(a process that relies on accurate population data). The blacklist approach emphasizes the protection of endangered species and provides different degrees of protection for species under varying degrees of endangerment (Ditkof, 1982). Also, while regular revisions are implemented, it enables flexibility in which species should be subject to special protection measures. With these advantages, blacklist approaches are a common practice in biodiversity conservation. For instance, CITES presently lists ~5000 animal species actively traded on the international market (https://cites.org). In the United States, the Endangered Species Act functions as the enforcement mechanism for CITES and includes 745 native animal species (https://ecos.fws.gov). In the European Union (EU), the 1979 Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), in combination with the 1992 Habitats Directive, protects over a thousand vertebrate species, with all amphibians, reptiles and most birds falling under some protection category (Appendices II and III). In China, the two protection lists cover 77% (2456 species) of all species across the four taxa after the update. National legislations based on blacklist approaches are currently including a considerable proportion of species worldwide.

Despite widely adopted, this blacklist approach has been criticized by several scholars (Table 1; Couzens, 2013; Macdonald et al., 2021; Marshall et al., 2020; Watters et al., 2022). Couzens (2013) argued that this way of "categorizing" species is a legacy of a poor historical understanding of the complexities of biodiversity and called for a more holistic protection approach towards all species. Marshall et al. (2020) and Watters et al. (2022) both demonstrated the failure of CITES in listing traded species, especially for lesser-known species where no efficient monitoring effort was available. Ditkof (1982) and Macdonald et al. (2021) claimed that in the case of negative list (blacklist), "the burden of proof lies primarily on conservationists to demonstrate that trade is negatively affecting a given species before it is afforded the legal protection required to prevent its extinction, and given the general inadequacy of monitoring, drastic overexploitation may occur long before any checks can be effective."

Moreover, with the increasing coverage of wildlife protection lists in many countries, to prove a traded product comes from a listed species can become a huge burden for appropriate law enforcement under blacklist approaches. It can be challenging for market supervision departments to discriminate protected and nonprotected species on markets during law enforcement. Even experts cannot memorize the long list of protected species and tease apart similar species and their products under different protection statuses without laboratory tests, not to mention the difficulty of discriminating captive-bred and wild-caught individuals (Andersson et al., 2021). This situation becomes even more complicated considering the fast development of online trade websites. Online platforms may be unable to tackle illegal trade due to the huge volume of products traded there and the difficulty to discern what products come from protected species (Coalition to End Wildlife Trafficking Online, 2020; Ye et al., 2020).

Another problem repeatedly mentioned by wildlife researchers is the long delay in banning (listing) the trade of threatened species (Frank & Wilcove, 2019; Hughes et al., 2021; Marshall et al., 2020; Watters et al., 2022). During our analysis of the list update, there are significant taxonomic mismatches between the IUCN Red List and China's species lists. The scientific names of 332 species (10% out of 3182 species) in China's wildlife protection lists differed from the IUCN Red List. This situation likely is particularly prominent in regions of the world where research on species' taxonomy is currently escalating (Hughes et al., 2021). For instance, 5% of the species in the wildlife protection lists of China have not been assessed yet by IUCN (Not Evaluated [NE] in Figure 2) due to their recent discovery or because they have been updated from subspecies to species. Assessing and incorporating new species described by taxonomists into the IUCN Red List and CITES Appendix may take up to several years, hindering the protection of newly described species internationally.

All these arguments lead to a similar suggestion—a more holistic approach to protecting all species but creating a whitelist permitting sustainable use of certain species, namely a whitelist (positive list, or reverse listing) approach. Actually, the reverse listing approach was previously proposed within CITES. At the third CoP in 1981, Australia proposed listing "only those species which are not endangered or threatened" but at the next CoP withdrew the proposal, due to insufficient support. Several scholars discussed the possibilities of the reverse-listing approach and the advantages are as follows: (1) it shifts the burden of proving that a species is listed from law enforcement officers/market supervision officers to wildlife traders/importers, thus would make it easier to enforce trade restrictions especially for countries with poorly trained officials (Ditkof, 1982; Macdonald et al., 2021); (2) newly described species and species with insufficient monitoring data would be automatically protected under a reverse-listing scenario (Marshall et al., 2020); and (3) a more holistic protection scheme could avoid problems introduced by species-based conservation which overlooked the complexity of biodiversity, ecosystem, intra- and interspecies relationships (Couzens, 2013).

However, this reverse listing approach has also been criticized for several reasons (Table 1). These

discussions have mainly focused on the use of reverse listing in CITES systems (Challender et al., 2022; Ditkof, 1982). The first concern is that if there are no substantial changes in demand of wildlife species after "listing all species by default," the reverse listing approach would serve as a blanket ban that could further stimulate illegal trade and/or drive this trade "underground" (Challender, Hinsley, & Milner-Gulland, 2019; Conrad, 2012; Cooney & Jepson, 2006; Rivalan et al., 2007). The second concern is that in some countries such as the United States, the Endangered Species Act only covers over 700 species, so that reverse listing would make these lists much longer and law enforcement more complex (Ditkof, 1982). The third concern is that using a whitelist approach "de-emphasizes the protection of endangered species" and "relegates those species to the background" (Ditkof, 1982). Fourth, current federal acts utilizing reverse listing are generally regulating insecticides, drugs, and other dangerous and manmade substances, as new products could be produced quickly. Conversely, wildlife trade is relatively stable and the discovery of new species occurs infrequently (which is not the case now, especially for amphibians and reptiles as shown in several studies, i.e., Frank & Wilcove, 2019; Marshall et al., 2020; Hughes et al., 2021; Watters et al., 2022). Finally, the "feasibility and political palatability" of the whitelist approach is questioned because "even suggestions agreed by the Parties can take many years to take effect" in CITES (Challender et al., 2022). These approaches should be thus carefully assessed and implemented taking into account the sociopolitical context and law enforcement capacity of different countries.

4 | EXPLORING THE POSSIBILITY OF ADOPTING A WHITELIST APPROACH IN CHINA

Blacklist approaches are the standard in biodiversity conservation, yet there are significant normative differences between countries. Different from most other countries, the most probable channel for wild animals to enter commercial markets in China is through captive breeding and related laundering for wild-caught animals, while game hunting is very rare if not completely forbidden (Jiang et al., 2012). This is due to the Chinese strategy to tackle illegal wildlife trade through strictly controlling wildlife hunting (almost all hunting tools are forbidden in China) but creating a legal wildlife market as described below.

China adopted a supply-side approach by legalizing and regulating wildlife trade with a license system mainly focused on using captive-bred animals (Xiao et al., 2021). This industry contributed 520.6 billion RMB (about 81.54

billion USD) to the national GDP in 2016 alone (Chinese Academy of Engineering, 2017). The Law on the Protection of Wildlife states that "Anyone utilizing wildlife and the products thereof shall primarily use captive-bred populations and shall benefit the breeding and conservation of wild populations (...)." Unfortunately, these statements introduced an ambiguous situation—trade becomes legal if one claims the animals as farmed under a breeding license, considering difficulties in differentiating wild and farmed individuals. This means that breeding licenses sometimes act as the disguise for frequent wildlife laundering activities (Cunningham et al., 2016; Shi et al., 2007), which harms lawful farmers as well. Therefore, the key to regulate wildlife harvesting and trade in China is to regulate wildlife farming.

The main limitation of such a supply-side approach is that there are no science-based restrictions and criteria in China to determine which species could be granted a breeding license (Xiao et al., 2021). Wildlife trade researchers have already described a list of conditions under which supply-side interventions may yield positive conservation outcomes (Challender, Sas-Rolfes, et al., 2019; Phelps et al., 2014; Tensen, 2016). According to these guidelines, a science-based standard should be developed as the first step forward to regulate wildlife farming in China. Species with well-developed cost-effective breeding techniques, which are safe enough for both their wild populations and human health (Table S2), should be evaluated based on this standard therefore generate a whitelist for wildlife farming and trade.

Based on the discussion above, a simplified whitelist could be designed in China for wildlife species that sustainable breeding and trade focusing on captive-bred populations in specialized markets would be allowed under a licensing system. Market supervision and law enforcement would be greatly simplified, as any species not in the whitelist would be easily detected from the markets. Protecting biodiversity in a holistic way would also have the advantage of controlling zoonotic disease transmission risk associated with rodents and bats (Luis et al., 2013), which remain unlisted even after the update of protected species. Meanwhile newly described species would be automatically protected by law.

Different from United States where the Endangered Species Act only covers 745 native animal species, in China 2456 species are currently listed by the two national-level lists and only 726 species (23% out of 3182 species across the four taxa analyzed) are unlisted, an alternative reverse listing (whitelist) would make the list much shorter. Furthermore, by shifting the burden of proving that a species is listed from law enforcement officers/market supervision officers to wildlife traders/importers, a whitelist approach would greatly simplify law enforcement tasks.

Despite the advantages mentioned above, wildlife trade regulation is a complex issue and we must not rely on a single "silver bullet" to solve all problems. The sociopolitical context, local demand of wildlife products, and law enforcement capacity and complexity, should be carefully evaluated at a regional basis. Below, we provide some specific suggestions on how to combine the advantages of both approaches and explore the possibility of adopting a region-specific adaptive management scheme in China.

5 | A REGION-SPECIFIC ADAPTIVE MANAGEMENT SCHEME FOR CHINA

The current biodiversity crisis, which is bringing us to the Sixth Mass Extinction, is a defining issue of our time. In the Kunming Declaration released during the Conference of the Parties to the Convention on Biological Diversity (COP15) in October 2021, all parties committed to reverse current trends of biodiversity loss by 2030. This target demands actions to enhance the enforcement of wildlife protection laws. Given the advantages and shortcomings of blacklist and whitelist approaches detailed above, we propose here a mixed approach (Figure 1c) that would improve the efficiency and effectiveness of law enforcement and should be politically feasible under the current circumstances in China.

First, the *state key protected species list* should be retained as the country's only national-level blacklist to help allocate direct law enforcement efforts to key species. These species will still be categorized into Classes I and II lists to implement different degrees of protection and facilitate a flexible punitive approach having in mind the social context in which these laws are enforced. The list should still be revised every 5 years to enable flexibility in which species should be subject to various level of protection measures, which was the advantage of blacklisting approaches. Namely, a single, concise blacklist which covers 774 species of these 4 taxa receiving the highest degree of protection would remain at the national level.

Second, a science-based standard inspired by the existing researches should be developed at the national level first (Challender, Sas-Rolfes, et al., 2019; Phelps et al., 2014; Tensen, 2016), which would determine what species can be captive-bred and then sold in public markets (Table S2). This standard would serve as a reference for local governments to make their own whitelists and simplify monitoring of those taxa that are regularly used and found in the markets. A key condition to guarantee the efficacy of this approach is that the evaluation of whitelisted species should be based on data and evidence, instead of economic profit. After the "wildlife consumption ban", the Ministry of Agriculture in China released the *Catalogue of Livestock and Poultry Genetic Resources*, which included 16 wild species that can be legally farmed and utilized (Supporting information Section S2). While the wild populations of these species are protected by the Law on the Protection of Wildlife, captive-bred populations are regulated through the Animal Industry Act. This catalogue could serve as a starting point of a whitelist in China, at least for the four taxa analyzed here.

Third, for species other than the 774 *state key protected species*, areas with high development level, public support on low wildlife consumption and law enforcement capacity, for instance big cities like Beijing and Shanghai, could adopt the reverse listing first. Namely protecting all species with the exception of sustainable use on a few whitelisted species. To fix the current loopholes as described in Section 4 (Figure 3), not only trade on food usage, but also other purposes should be monitored and regulated. Additionally, to avoid confiscation, wildlife traders/breeders would need to provide officials with evidence that the species in question is inside the whitelist. This holistic protection approach in highly developed regions would also help to reduce the consumption of wildlife products and thus help relieve the burden of law enforcement in less developed regions.

After the official update of the *state key protected species list* in February 2021, 11 provincial-level governments updated their regional lists. For instance, in Beijing (municipalities are at the same administrative level of provinces in China), the updated regional list combined with two national lists already covers all terrestrial vertebrates, except one newly described frog species, *Kaloula borealis*, one snake species, *Lycodon liuchengchaoi*, Chinese softshell turtle, *Pelodiscus sinensis*, 16 small rodents and 12 bats. This is a persuasive evidence that reverse listing is politically feasible in highly developed regions of China.

Less developed regions with low enforcement capacity, persistent wildlife use, and lower public support, could still retain their own regional-level blacklist. This would be particularly important for public education, as blacklist approaches emphasize more the protection of endangered species. Again, for regional protected species, trade for nonfood usages should be regulated in addition to the "wildlife consumption ban." Still, capacity training about whitelist approaches for law enforcement officers could be progressively introduced. Since current coverage of the two national lists has already reached 77% of the four taxa, this focus on whitelist could markedly reduce the length of the list and the complexity of capacity training.

As the hosting country of COP15, and given its increasing political and economic influence worldwide, China is expected to take a responsible role in global conservation efforts. From the recent list updates, which are currently covering 77% of birds, reptiles, amphibians, and mammals, it seems a natural step forward to achieve a holistic biodiversity conservation in China, at least in the most developed regions of the country. We argue that it would be desirable combining the best aspects of both, black and white list approaches, as biodiversity conservation is made of shades of gray.

AUTHOR CONTRIBUTIONS

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated during and/or analyzed during this study are available in the Dryad Digital Repository with the address: https://doi.org/10.5061/dryad.8gtht76qw. Reviewer sharing link: https://datadryad.org/stash/share/xXCJ0VtV9Og0-hwFDoNIzjA3gaPGPQKINX3e1x9EEtQ.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.