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RESEARCH ARTICLE

Investigating the current implementation barriers and the potential social and ecological effects of a CITES reverse listing on the international exotic pet trade

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Abstract

1. The trade in exotic pets is a significant contributor to the unsustainable and sustainable trade of wildlife. The Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) aims to regulate sustainable wildlife trade.
2. A reverse listing (RL) has previously been proposed, which bans trade of all species until trade is proven to be sustainable, when they are added to a positive list permitting trade. Since the 1980s, this concept's effectiveness has been debated.
3. We identified zoonoses, invasive alien species (IAS), welfare, livelihoods, sustainable harvest and legal trade as six important themes in exotic pet trade literature. We used an adapted investigate, discuss, explain, aggregate (IDEA) protocol to collect expert estimates on the effects of a CITES RL on the identified socioecological themes and determined areas of uncertainty to guide future research.
4. We find that experts differ in estimates on zoonoses, IAS, livelihoods, welfare, sustainable harvest and legal trade. Responses indicate that how RL would be implemented and what it would include generated the most uncertainty in effect estimates. Experts were particularly concerned with the effect of RL on the amount of legal trade and sustainable harvest. There was concern that the frequency of legal trade in exotic pets would decrease as species would be illegally trafficked to circumnavigate new restrictions causing a decrease in harvest sustainability. This shift was predicted to negatively affect livelihoods for those dependent on the legal trade of exotic pets.
5. The results show that greater clarity on what the aims of a RL are, what would be included in the listing criteria and what would be expected by the signatories would improve the quality of research on RL. This would support more evidence-based decision-making for the future trajectory of CITES and the regulation of sustainable trade.

KEYWORDS
CITES, expert elicitation, IDEA protocol, positive listing, wildlife trade

[Correction added on 24 December 2025, after first online publication: The order of authors has been corrected.].

1 | INTRODUCTION

The international wildlife trade contributes to global and local economies, supporting livelihoods and funding conservation strategies (Hughes, 2021). However, poorly regulated trade can lead to overexploitation and biodiversity loss (Mozer & Prost, 2023). It is estimated that 22% of world wildlife trade is driven by the demand for exotic pets (Baker et al., 2013), most commonly birds, reptiles and mammals (Bush et al., 2014). The legal and illegal trade of wildlife for pets can have negative consequences by transmission of zoonoses, introduction of invasive alien species (IAS), fuelling population declines and extinctions (Shukhova & MacMillan, 2020). The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement aiming to ensure wildlife trade is legal and sustainable. Currently, CITES lists more than 40,000 species in its three appendices. Appendix I contains species threatened with extinction, where commercial trade from the wild is prohibited; Appendix II species are not necessarily threatened with extinction but may become so, and trade is permitted subject to permits and monitoring. Appendix III covers species not included on Appendices I and II, which are listed directly by a range state when they want help monitoring the trade (CITES, 2023). Appendix III has been used to regulate the trade of exotic pets, for example, for the Australian Blue-tongued Skink (*Tiliqua* spp.) (CITES, 2023). Unlisted species have no regulation under CITES, although other domestic or international regulations may apply. To add a species to the CITES Appendices, parties submit a proposal including data on population and trade trends, which must then be approved by the Conference of Parties (CoP) (CITES, 2023). A scientific authority provides a non-detriment finding (NDF) analysis which determines the specified quantity of export that will not affect their survival (TRAFFIC, 2023). Thus, reliable data and NDFs are key to ensuring sustainable and legal trade.

The effective management of wildlife trade is of vital importance as the amount of international trade increases. Analysis of the CITES Trade Database suggests that the annual volume of reported trade in CITES-listed wildlife between 1975 and 2014 increased from 25 million whole organisms to 100 million (Harfoot et al., 2018). With annual trade in exotic pets being a multi-billion-dollar business (Lockwood et al., 2019), balancing the need for people's livelihood generation with the impact on species survival should be a priority. Thus, there are constant debates on how best to regulate the wildlife trade to ensure sustainable harvest that benefits both people and nature. A CITES reverse listing (RL) (also known as white-listing, positive listing or allow listing) is a concept that has been proposed for CITES since the 1980s (Ditkof, 1982) and remains a subject of ongoing discussion (Toland et al., 2020; Warwick & Steedman, 2021; Xiao et al., 2024). It would involve the reversal from the current CITES approach of listing certain species in the Appendices that are or may be threatened by trade to automatically prohibiting the trade in all species except those that are included on a 'positive list' (Pain et al., 2006). This would replace the existing listing process in the three appendices, thereby requiring significant resources, time and funding to reorganize the Convention. Other potential challenges associated with a RL approach relate to lack of scientific data to make informed exception decisions on listings (Weissgold, 2024), the political resistance from industries or governments involved in trade, the administrative burden in identifying/managing the trade of species on a positive list (CITES, 1981) and the structural challenge of achieving consensus among 185 parties to amend the Convention and align their national legislation (Challender et al., 2025).

A RL would undeniably result in huge changes to how CITES operates and is enforced. Beyond investigating the effect of the physical change of the Convention we need to consider the conceptual shift it may have on how we perceive wildlife trade and the impacts that will have. A shift to stronger pro-regulation trade restrictions under a RL could be reinforcing the Western and environmentalist view that environmental necessity outweighs the preservation of traditional lifestyles or economic benefits—aligning with Stoett's (2002) broader argument about how protectionist environmental policies can reflect dominant Western values (Stoett, 2002). In addition, from a taxonomic perspective, it has been argued that CITES is dominated by certain taxonomic groups, with unlisted species, many of which are little known or uncharismatic, overlooked (Hughes, 2021; Marshall et al., 2020). A shift in the status quo to list all species may reframe how we perceive the legitimacy of the use and trade of different species from a default of use to a default of protection. This aligns with an emerging shift in conservation thinking from valuing nature solely for what it provides or for its inherent worth, towards valuing the relationships, responsibilities and meanings that connect people and other species (Chan et al., 2016)—moving beyond the commodification of wildlife towards recognizing more reciprocal and interdependent human–nature relations. By understanding the ecological, social and conceptual impacts of a RL approach, we can investigate wider potential implications, including whether this change may cause local communities to lose interest in protecting a species if they cannot benefit economically, undermining conservation (Stoett, 2002).

Previous research on positive lists and the exotic pet trade has primarily focused on methodological strategies to design and implement positive lists but lacks exploration into the potential negative effects. Warwick and Steedman (2021) discussed important design principles for developing positive lists for the exotic pet trade. Their research suggested that a RL would minimize problems of subjectivity in listings and improve administrative problems in regulating the exotic pet trade (Warwick & Steedman, 2021). Similarly, Toland et al. (2020) explored the feasibility of a RL by interviewing government officials on their level of interest in positive lists. They provided the legislative and practical benefits of positive lists but failed to address any potential risks. Additionally, their sample of interviewees was biased towards civil servants with pre-existing interests in positive lists, so they were more likely to report associated benefits (Toland et al., 2020). While both papers concluded that due to the uncertain nature of the exotic pet trade (insufficient research, new species discoveries and uncertainty in predicting trade patterns and demand trends) a precautionary RL would be the best approach to

regulate exotic pet trading and keeping, the existing research lacks an impartial investigation on both the positive and negative effects of a RL approach.

Before any costly amendments are made to CITES, the consequences of RL should be further explored and backed with scientific evidence. The exotic pet trade is a large contributor to the international wildlife trade and represents various stakeholders, markets, species, policies, and social and ecological concerns. It serves as a proxy to similar contributing markets in trade: medicine, food, construction and culture (TRAFFIC, 2017).

In this study, we aim to investigate (1) *how a CITES RL would affect the social and ecological effects of the international exotic pet trade*. Our objective was to investigate this research question by providing a comprehensive analysis of expert opinion on the potential effects of implementing a CITES RL for species in the international exotic pet trade. We will focus on the effects on sustainable harvest, legal trade, welfare, zoonoses, IAS and livelihood effects (Toland et al., 2020; Warwick & Steedman, 2021). Secondly, we aim to investigate (2) *what are the current barriers to implementing a CITES RL approach for species in the international exotic pet trade*. We will do this by undertaking the following objective: determine areas of uncertainty and factors influencing the feasibility of implementing a CITES RL. To address these two research questions, we will use a structured expert elicitation method, the IDEA protocol, which we used in a novel way to combine qualitative and quantitative methods to address the objectives. Expert judgements are often crucial in shaping policy and decision making, including the IUCN Red List and IPCC Assessments, but can be influenced by contextual biases and heuristics (Hemming et al., 2017). The IDEA protocol aims to minimize any bias through its structured approach, by capturing levels of uncertainty and enhancing the transparency and defensibility of any judgements being made (Hemming et al., 2017).

2 | METHODS

2.1 | Identifying main themes

We identified six key themes associated with the exotic pet trade to frame our questions: Welfare, legality, IAS, zoonoses, sustainable harvest and livelihoods. We identified these themes primarily based on key social and ecological problems that were named as relevant to positive listings by two recent papers exploring the topic by Warwick and Steedman (2021) and Toland et al. (2020). To ensure this mapped on to the key topics related to the exotic pet trade, we searched the Web of Science Core Collection for peer-reviewed scientific literature related to the exotic pet trade. Our search was for papers published at any time, but was restricted to English language articles containing 'exotic pet trade' in the title, abstract and keywords. We identified a total of 68 publications published between 1997 and 2024. For each paper, we coded key phrases into themes (Table 1). These matched the six themes identified above with the exception of attitudes, which we excluded as it overlapped in almost all cases with other themes (e.g. welfare, sustainable harvest and legality).

2.2 | IDEA protocol design

We applied the IDEA protocol, a structured expert elicitation method developed to capture expert knowledge and perspectives to inform decision-making in natural resource management and conservation (Hemming et al., 2017). For the issue of RL, for which data on the potential range of impacts are largely absent, the IDEA protocol can address a key gap by drawing on expert judgement to predict likely effects. We used guidance on the IDEA protocol from Hemming et al. (2017) to structure our data collection.

TABLE 1 Reoccurring key phrases highlighted from the literature on Web of Science under the topic search term 'exotic pet trade' grouped into themes.

Main themes	Common phrases
Attitudes	Conservation messaging, social disapproval, demand, desire, popularity, motivation, acceptance, normalisation, social media, preference, awareness, misconception, interest, status
Welfare	Animal abuse, animal welfare, wellbeing, behaviour, nutrition, mental condition, domestication, mortality, stress, physiological
Legal trade	Illegality, legislation, policy, regulation, laws, enforcement, monitoring, smuggling, unregulated, traceable
IAS	Biological invasions, non-native, invasion pathway
Zoonoses	Zoonotic disease risk, epidemics, public health, disease control, safety, disease spread, contamination, pathogens, human-animal relations, contamination, infections, transmission
Sustainable harvest	Biodiversity loss, extinction, over-harvesting, sustainability, species conservation, ecological alterations, abundances, declines
Livelihoods	Global business, tradition, stakeholders, economies, domestic and international markets, commercial, profitability

The IDEA protocol is usually used to obtain expert estimates on numerical quantities or probabilities. However, the effect of RL on zoonoses, livelihoods, IAS and welfare is difficult to provide numerical estimates for, as many of the potential impacts lack clear baselines and would be difficult to quantify (e.g. affect on livelihoods). We therefore used a novel adjusted approach that employs Likert scales and long-form responses rather than the standard approach using quantitative questions.

Experts are often difficult to define, and criteria such as peer recommendations, experience, publications or age, although useful indicators of good judgements, may result in the exclusion of knowledgeable individuals (Burgman et al., 2011). We established inclusion criteria to ensure that our sampling identified experts with sufficient knowledge within the identified themes (Table 1). We compiled a list of 50 potential participants identified based on (a) publication on the topic of RL, (b) broader publications on wildlife trade and CITES in the last 5 years and (c) professional expertise related to CITES and/or the exotic pet trade. We added to the list using snowball sampling based on recommendations from contacted potential participants. We did not contact all recommended experts as we wanted to ensure that the sample was not biased towards staff from certain organizations (who may all have similar views) or those working on the same taxonomic groups. We continued sampling until we reached the target sample number of 10, as 10–20 participants are recommended for practicality in the IDEA protocol, and empirical evidence suggests that only minor improvements are gained by having more than 6–10 participants (Hemming et al., 2017).

We asked demographic questions before data collection began, including years of professional/postgraduate experience they had within eight different fields (CITES, RLs, the exotic pet trade, livelihood impacts in conservation, animal welfare, IAS, zoonoses and sustainable harvest of species). We also asked experts to self-rate their knowledge from 0 to 10 for each field. The anonymity and confidentiality of participants was maintained throughout the study by using independently chosen nicknames for rounds 1 and 2, and by using incognito mode on the shared google document during the discussion. All research was conducted with prior informed consent, and this study was considered low risk by the Imperial College London ethical review board, who approved the project.

Following the demographic questions, we presented experts with a combination of qualitative and quantitative questions. The question sheet included a description of a CITES RL and defined key terms to ensure participants had the same contextual understanding of the questions (Appendix 1 in the Supporting Information).

Questions related to welfare, IAS, zoonoses and livelihoods required participants to imagine a scenario where a RL had been implemented. We used a Likert scale to ask experts to estimate the potential effect and provide their level of certainty (0%–100%) along with reasoning for their answers. By providing a space for reasoning, experts explained any assumptions they made on what a RL would look like and how it affected their estimates. This allowed responses to be comparable by determining what factors in a RL would be influential. To investigate sustainable harvest and legality, we formulated four-step elicitation questions. Participants were asked to estimate the proportion of exotic pets that are legally traded and sustainably harvested, both currently and in a hypothetical scenario with a CITES RL in effect. They provided the lowest and highest plausible percentages, a best estimate and their level of certainty.

2.3 | Data collection

After piloting questions with an impartial person, we implemented three phases of data collection: round one, a discussion and round two. Each phase lasted 7–14 days. All phases were conducted on Google Docs to facilitate participation from various geographical locations and allowing for synchronicity. This enabled real-time requests for elaboration and clarification on answers and maintained participant pseudoanonymity (Opara et al., 2021). In round one, participants provided their initial estimates based on their independent research and existing knowledge. During the discussion phase, all participants gained access to a shared document containing all round one responses, their percentages of certainty and space for discussion comments (See Appendix S3 in the Supporting Information for sample discussion document). Participants used different coloured text and were asked to comment on the compiled responses, either to agree, disagree and discuss variation. We encouraged participants to visit the document across different days to enable responses to new comments. The goal was not to reach a consensus but to discuss variation in responses and comment on any disagreements. Anonymity was maintained to minimize biases that could influence the results. The discussion was followed by round two, where participants made a second estimate for each question to determine if their answers or opinions had changed.

2.4 | Results processing

We used a combination of inductive and deductive coding on NVIVO to process the qualitative results of the study. Prior to reading the question responses, we developed a priori codes to sort the data into predetermined categories based on the key themes identified from the literature (Table 1). Development of the codebook was an iterative process to ensure the coding was reproducible. The initial code was tested with two people to measure its objectivity and adjusted until general agreement on the coding was met (See Appendix S2 in the Supporting Information for final codebook). The deductive codebook was used for the first cycle of coding. The second cycle of coding was inductive, where additional codes were applied to further analyse the coded text (Bingham, 2023). We grouped the quotes under themes that responded to research questions one and two.

The 4-step elicitation questions collected estimates on the proportion of exotic pets sustainably harvested and legally traded currently and after a CITES RL. We combined the round one and round two estimates for each scenario because the majority ($n = 7$) of estimates did not differ between the rounds. We combined the

lower, upper and best estimate for each scenario to show the plausible bounds set by the experts. Using the ggplot2 package in R-studio (v.12.0+369; Wickham, 2016), we generated box-and-whisker plots to visualize the variance and skew of the estimates and compare how it differed between the scenarios. This allowed us to focus on the possible ecological effect a CITES RL could have on the international exotic pet trade, addressing research question one.

The percentage level of certainties given by experts for the questions on feasibility, sustainability, legality, welfare, zoonoses and IAS were combined from rounds one and two. We used R-studio to generate a box-and-whisker plot to visualize and compare the level of certainty for each question. We used this to determine potential knowledge gaps and areas of uncertainty which serve as current barriers to implementing a CITES RL (research question two).

3 | RESULTS

We recruited a final sample of 11 participants, the majority of whom were male ($n=8$, female = 3) and aged 40–60 years ($n=7$, 20–39 years = 4). They were primarily academics ($n=8$) but also included an independent consultant, charity scientific officer and a zoologist ($n=1$ each). More than half ($n=7$) held PhDs, while the remaining had master's degrees ($n=4$). In the specified fields, nine had previously provided professional advice to a client, seven were members of committees or advisory panels, 10 had published relevant technical or peer-reviewed reports, with publication counts ranging from 1 to 45. Participants had between 1 and 45 years of experience in at least five of the fields. Self-ratings on experience levels ranged from 1 to 10, with a mode of 8. Of the 11 participants, 10 had previously heard of the concept of CITES RL. Participants had mixed views on RL, with most participants disagreeing that a RL would improve the convention ($n=3$ strongly disagreeing, $n=4$ disagreeing, $n=3$ agreeing and $n=1$ strongly agreeing).

3.1 | Sustainable harvest and legal trade

Experts estimated a slight increase in the proportion (%) of legally traded (currently = mean 66.61, SD 13.51; range 50–90, after RL = mean 67.2, SD 15.83; range 40–90) and sustainably harvested exotic pets after a RL (currently = mean 54.05, SD 23.92; range 18–95, after RL = mean 68.61, SD 17.78; range 30–95) (Figure 1).

Experts had mixed reasoning on how RL would affect legal trade and sustainable harvest in the exotic pet trade. All 11 respondents mentioned the importance of 'unknowns' such that predicting the outcome of a RL on trade is almost impossible due to the proportion of wildlife trade that goes unreported, and a lack of understanding on how a RL would be implemented (Figure 2). It was predicted that outcomes would be 'hugely dependent on exactly how a RL system is implemented' (Expert 5). Participants estimating that a RL would increase the proportion of sustainable and legal trade reasoned that a 'much shorter list of approved species would be easier to enforce' (Expert 2), excluding species which lacked reliable population data. On the other hand, experts who believed a RL would decrease the proportion of legal trade and sustainable harvest predicted an increase in the proportion of illegal trade and therefore unsustainable trade. There were concerns that unreliable data under RL would create 'plausible deniability for all actors involved in trade, providing the perfect cover for continued unsustainable extraction' (Expert 2). The wide range of estimates given for both the current situation and estimates for the scenario where a RL had been implemented highlights the lack of accurate and reliable data on the exotic pet trade.

3.2 | Welfare

Five respondents estimated that a RL would improve welfare conditions in the international exotic pet trade. Again, unknown factors related to how RL may be implemented were the most common theme arising from those predicting a positive effect of RL on welfare (Table 2). For example, Expert 8 noted that if a 'user-pays system or welfare as a condition for certification' was included, then it would improve welfare. Similarly, Expert 9 stated that welfare would be improved if there were 'enforceable standards, greater scrutiny by governments and NGOs and closer monitoring'. The other responses were dependent on the assumption that a RL would result in fewer species in trade which would 'bolster welfare proportionally' (Expert 1). Four participants predicted that RL would have no effect on welfare in the international exotic pet trade. They reasoned that if welfare was 'explicitly considered as part of the listing criteria' (Expert 5), then welfare could be improved, or that an increase in illegal trade would 'offset any benefit gained' (Expert 9) via concealment in consignments. Participants estimating that RL would negatively affect welfare in the international exotic pet trade were concerned about the trade-off effects between species. That banning trade in some species could result in an increase of illegal trade for others. With clandestine trade, there was a worry that compromised welfare during transport would result in increased mortalities and zoonoses emergence. No experts believed a CITES RL would make welfare of animals in trade significantly worse.

3.3 | Zoonoses

One respondent estimated that the frequency of zoonoses would increase slightly, due to an increase in illegal trade leading to compromised welfare, and increased frequency of zoonoses emergence (Table 3). Three participants predicted that RL would have no effect on the frequency of zoonoses, with justifications including that the exotic pet trade is not a large vector for zoonoses. One noted that 'aspects of this come down to exporting and importing countries' quarantine and health regulations … RL itself might have limited relevance' (Expert 5). Six experts estimated that a RL would reduce the frequency of zoonoses emerging from the international exotic pet trade, although they noted uncertainties. For example, experts noted that if RL led to less

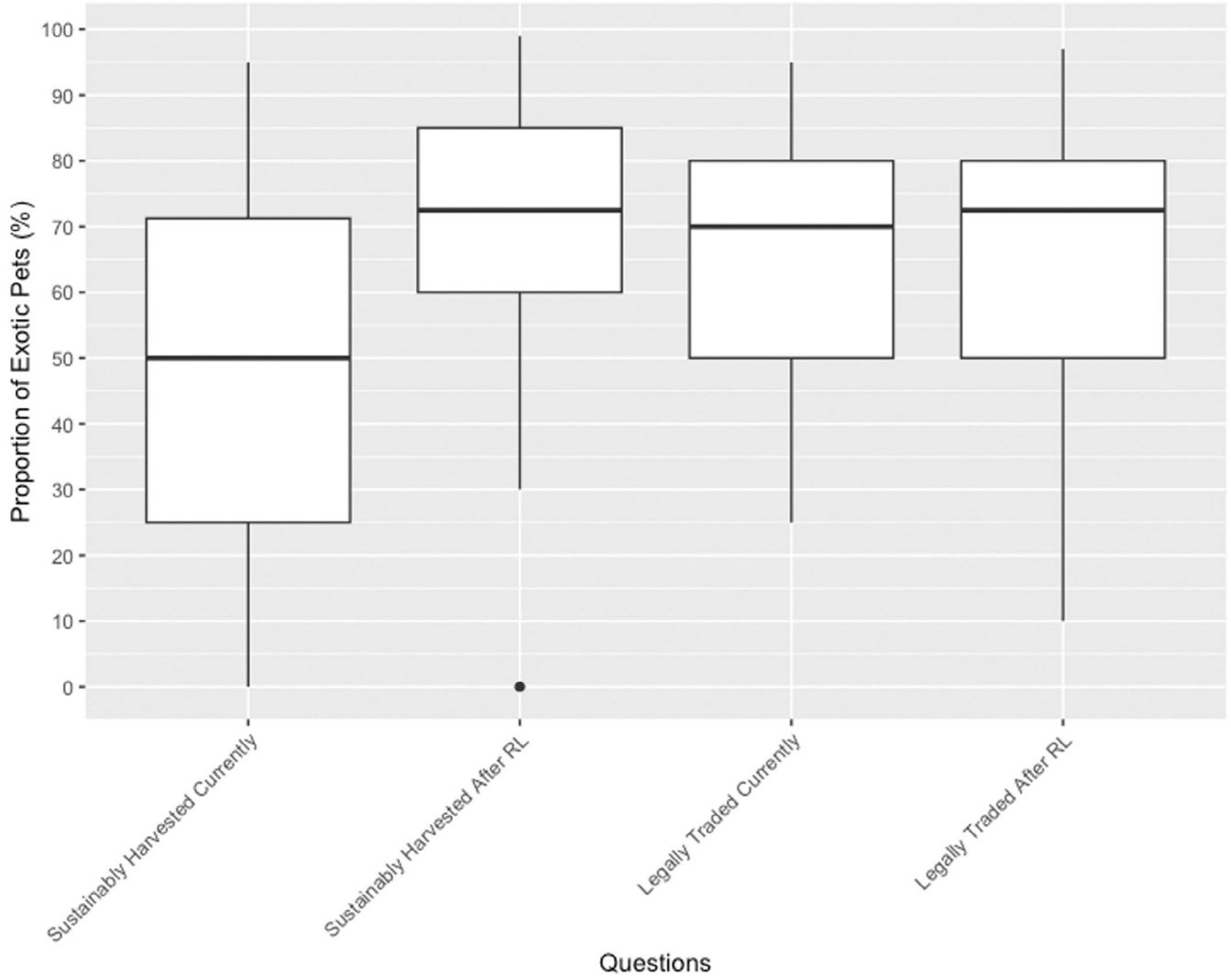

FIGURE 1 Expert estimates on the proportion of exotic pets (%) sustainably harvested and legally traded internationally every year. Estimates for the current situation and for a hypothetical scenario in which Reverse Listing has been implemented and is in effect. The question refers to the number of pets and not the number of species traded as pets. *y*-axis shows the estimated proportion of exotic pets (%) and *x*-axis labels each scenario. Each box represents the interquartile range (IQR) (middle 50% of the data). The whiskers extend to the smallest and largest values within 1.5 times the IQR from Q1 to Q3. Independent points on the graph represent individual data points that fall outside the range of the whiskers (outliers).

trade overall, as well as increased monitoring, improved traceability and better welfare conditions, then it could reduce potential zoonotic diseases emergence. Similarly, reduction of zoonoses was predicted to be dependent on corresponding changes in national and international legislation in trade to align with a CITES RL. It was mentioned that 'if RL included zoonotic risk as one of the criteria for listing, then high risk species could be removed from the pet trade' (Expert 2). No respondents predicted a significant increase in zoonoses after RL.

3.4 | Invasive alien species

Most experts ($n = 10$) predicted that RL would decrease the frequency of biological invasions (Table 4). Again, the key theme emerging from the responses was 'unknowns': that the effect is dependent on how RL was enacted. Whether IAS were specifically assessed in the criteria used to determine the species listing, how regularly reassessments of listed species were done to 'recognize new risks' (Expert 2) and finally whether RL would lead to an overall reduction in trade. If the overall frequency of trade reduced, it would 'proportionally reduce propagule pressure and the risk of biological invasions' (Expert 9). Two respondents believed that RL would not have any effect on the frequency of biological invasions. Both reasoned that a RL would increase illegal trade, which would resultantly increase the introduction of IAS through unregulated trade. No respondents predicted an increase in biological invasions due to RL.

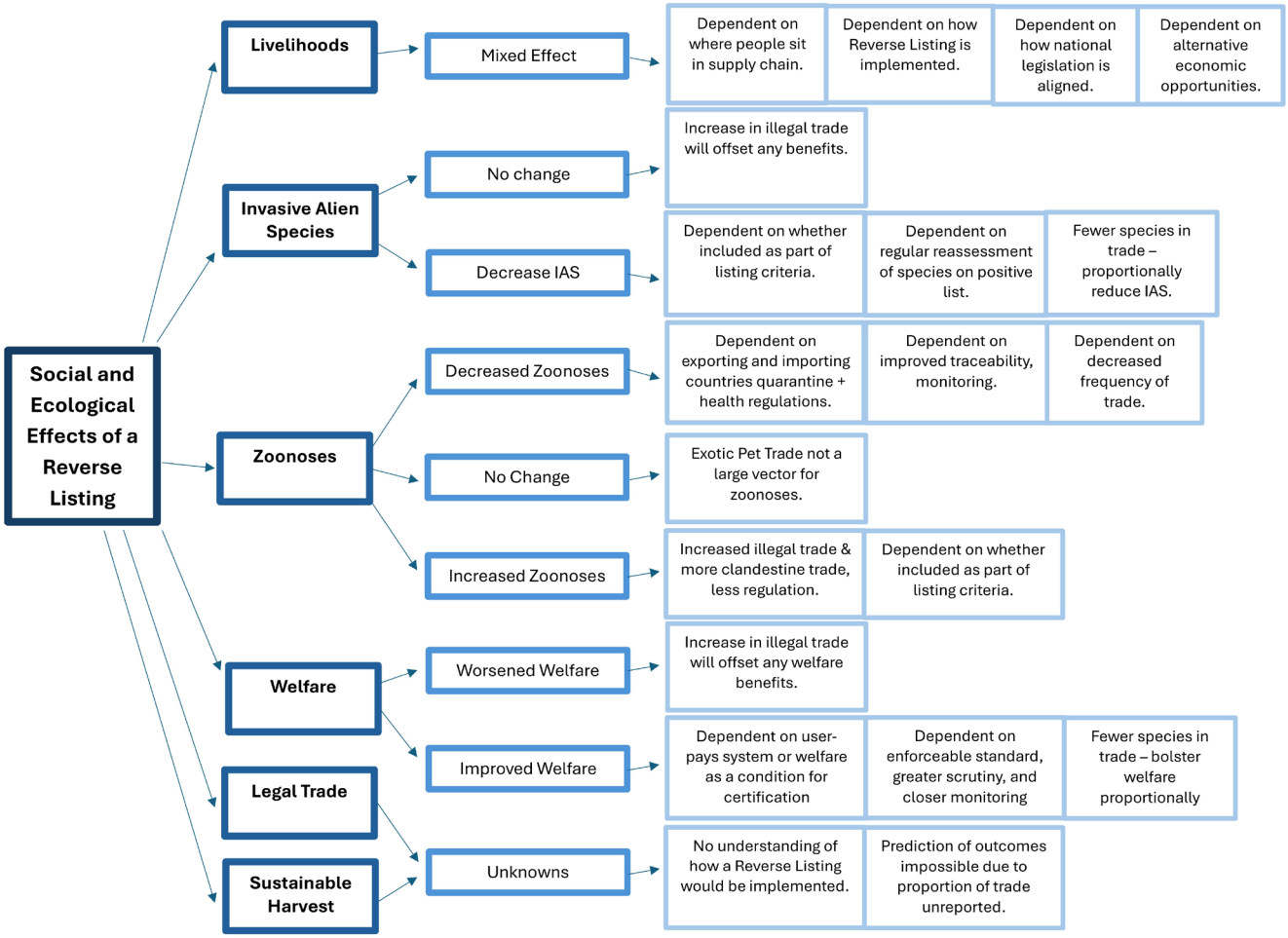

FIGURE 2 Visual demonstration of predicted social and ecological effects of a Reverse Listing (RL). The diagram demonstrates the six key themes mentioned commonly in exotic pet trade literature and a summary of the expert responses predicting the effect of a RL on each theme.

TABLE 2 Number of round 2 (R2) estimates and responses on the effect of a CITES Reverse Listing on welfare in the international exotic pet trade with corresponding quotes ($n = 10$ total responses).

Question	R2	Examples quotes
It would make welfare of animals in trade significantly better	1	'More oversight would improve conditions … and could be a condition of certification for listing and trading'. (Expert 1)
It would make welfare of animals in trade slightly better	4	'Should significantly reduce the number of animals … preventing harm to animals which otherwise would have been captured for the trade'. (Expert 2)
It would not affect the welfare of animals in trade, that is, it would be the same as now	4	'Unless the Reverse Listing structure explicitly changed the legal obligations regarding welfare, there is no reason to believe that welfare would change on its own volition'. (Expert 3)
It would make welfare of animals in trade slightly worse	1	'Extraction and trade in animals as pets will likely continue to take place illegally. People transporting the animals will seek to avoid detection, likely resulting in compromised welfare'. (Expert 4)

3.5 | Livelihoods

We found variation in estimates on the effect of RL on trade-related livelihoods. Those predicting a mixed effect ($n = 2$) reasoned that the effect would be dependent on where people sit in the trade supply chain. People operating in more profitable industries would be less affected by a RL because they have the resources to demonstrate sustainability and would be able to find

Question	R2	Example quotes
It would increase the frequency of zoonoses slightly	1	'Reverse listing will likely result in ongoing illegal extraction … due to chronic under-resourcing of law enforcement … now illegal trade takes place in a more clandestine way … undoubtedly resulting in compromised welfare and increasing the frequency of zoonoses' emergence'. (Expert 4)
It would not affect the frequency of zoonoses (i.e. it would be the same as now)	3	'People would begin using those animals for food and that is going to likely increase the risk of zoonoses … it would balance itself out such that there would be negligible change'. (Expert 6)
It would decrease the frequency of zoonoses slightly	5	'Fewer species being traded legally would likely make it easier to trace the individual health of animals and the origins of zoonotic diseases'. (Expert 7)
It would decrease the frequency of zoonoses significantly	1	'It will come down to how the listing criteria are designed and implemented'. (Expert 8)

TABLE 3 Number of round 2 (R2) estimates and responses on the effect of a CITES RL on the frequency of zoonoses emerging from the international exotic pet trade with corresponding quotes ($n = 10$ total responses).

Questions	R2	Example quotes
It would not affect the frequency of biological invasions (i.e. it would be the same as now)	2	'I worry about the potential for the Reverse Listing system to increase wildlife trafficking overall. This would then increase the risks of introduction of invasive species through unregulated and illegal markets, and thus, negate the benefits'. (Expert 7)
It would decrease the frequency of biological invasions slightly	6	'Depends on the details of how reverse listing includes the risk of being invasive as one of the criteria for a species being listed'. (Expert 9) 'If Reverse Listing decreased the total volume and diversity of trade then that may contribute to reducing the incidental risk of invasions'. (Expert 5)
It would decrease the frequency of biological invasions significantly	2	'It would depend how often these reassessments were done and whether they would be quick enough to recognise new risks'. (Expert 2)

TABLE 4 Number of round 2 (R2) estimates and responses on the effect of a CITES Reverse Listing on the frequency of biological invasions emerging from the international exotic pet trade with corresponding quotes ($n = 10$ total responses).

alternative species to trade. In contrast, those involved in smaller scale trade of poorly known species, or involved in capture of species in source countries, who operate further down the supply chain might be negatively affected.

The majority of respondents ($n = 6$) predicted that RL would have a negative effect on livelihoods. Once again, respondents noted that a critical consideration is how the RL would be introduced. It was predicted that if a RL was adopted today and included in national legislation immediately, it would require people to find other economic opportunities. Respondents were concerned with the availability of alternative livelihoods causing a 'redistribution of economic opportunity from law abiding citizens and organizations to criminals and criminal enterprises' (Expert 11).

Those predicting a neutral effect ($n = 2$) reasoned that RL would still allow the trade of species that are on the positive list. Therefore, the species which have the most livelihoods reliant on them are the species that are currently most traded and hopefully already being sustainably harvested and legally traded. If certain species that were once listed became banned, then the people who relied on these could 'pivot to those species which are still permitted' (Expert 2). This led into a discussion that the aim of CITES is 'not to support economic development but rather to conserve species' (Expert 9).

3.6 | Feasibility

Most respondents ($n = 7$) predicted that a CITES RL would not be feasible or likely to occur. The thematic coding identified four main barriers to a RL implementation. The first barrier was funding, such that CITES 'current approach is already chronically underfunded, and change is expensive … I can't imagine where the funding to enact

all this change would come from' (Expert 5). The second barrier identified was the physical capacity for CITES to enact a change in terms of lacking resources and the ability to implement a new listing procedure. 'CITES is a complex convention to implement and many countries do not have the established capacity to do so (under-resourced, national legislation, attendance of Standing Committee, listing proposals) … imagine the additional requirements if they had to do RL' (Expert 3). Different agendas were the most common barrier mentioned, that achieving consensus between the numerous ideologies and agendas would be extremely challenging. A RL 'would require >180 Parties to CITES to change their CITES-enabling legislation and legal frameworks' (Expert 10) and actors on all scales would need to be engaged. The final barrier to implementation was uncertainty on what a RL would entail. Such that 'fears of any amendments weakening the current text' (Expert 4) and 'lack of certainty over exactly what the benefits (of RL) are' (Expert 5) makes 'many stakeholders wary of the proposal until there is some flesh put on these details' (Expert 9). On the other hand, the remaining respondents ($n = 3$) agreed that getting consensus from most countries would take time; however, they believed that accelerated biodiversity loss would lead to 'enforced change in thinking' (Expert 8) that would generate pressure for CITES to do something.

3.7 | Areas of uncertainty

Variation in the levels of certainty (%) for estimates on the current proportion of legal trade and sustainable harvest and the effects of RL on feasibility, welfare, zoonoses, IAS, sustainable harvest and legal trade did not differ by a lot (range 61.67%–72.1% confidence) (Figure 3). On average, experts were most confident on estimating effects of RL on IAS (mean 72.1, SD 18.42; range 40–100) and welfare (mean 72, SD 19.33; range 40–100). The effect of RL on zoonoses had similar mean confidence levels (mean 68.6, SD 14.55; range 40–90). Experts, on average, were slightly more confident in predicting the feasibility of RL (mean 69.15, SD 21.74; range 20–99).

Estimates with the lowest mean certainty were on the current proportion of sustainable harvest (mean 62.78, SD 18.04; range

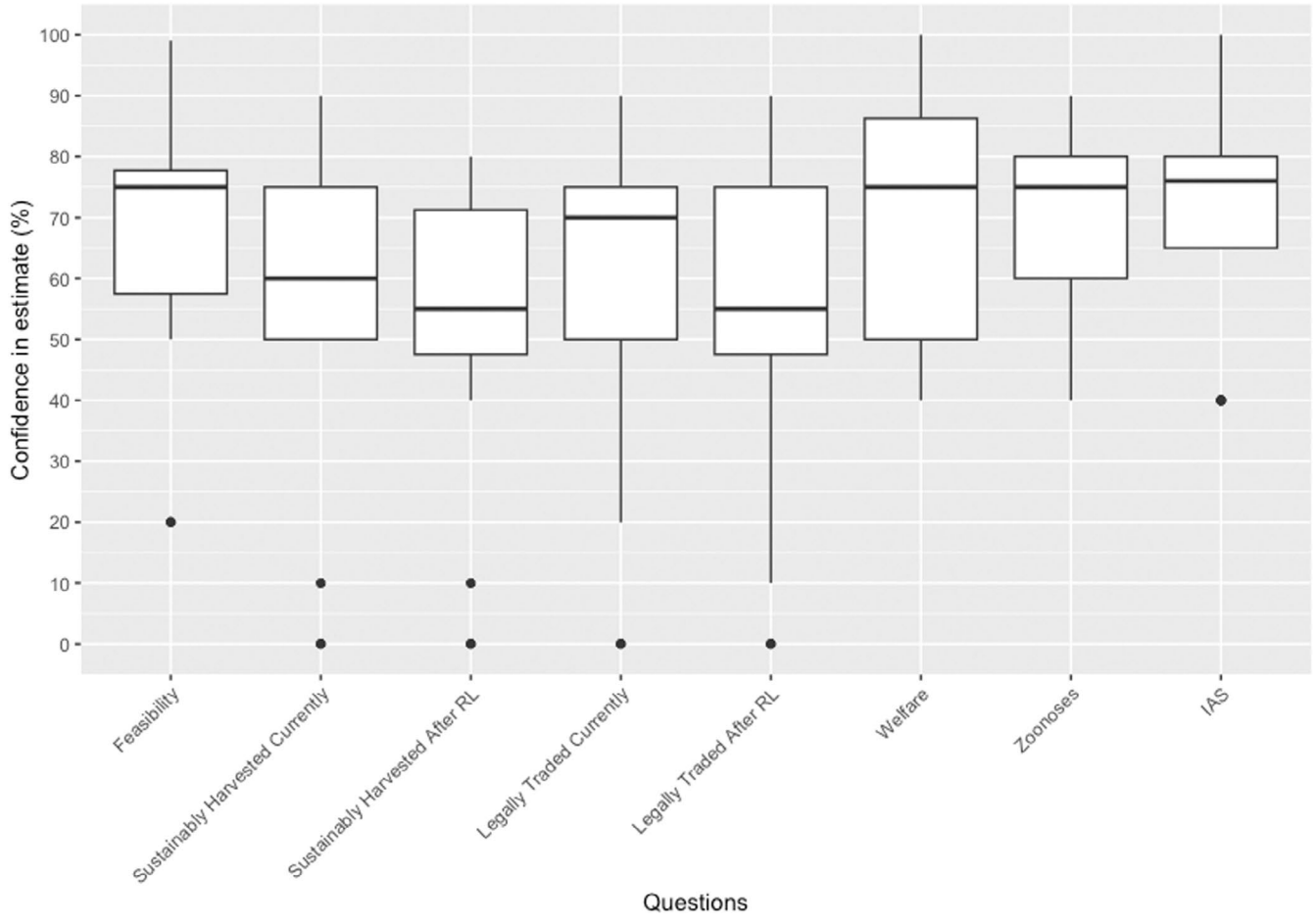

FIGURE 3 Stated level of confidence (%) in responses for each question given by $n = 10$ experts in Rounds 1 and 2. *y*-axis shows the confidence % and *x*-axis labels each question which asked for a value of confidence. Each box represents the interquartile range (IQR) (middle 50% of the data). The whiskers extend to the smallest and largest values within 1.5 times the IQR from Q1 to Q3. Independent points on the graph represent individual data points that fall outside the range of the whiskers (outliers).

10–90) and legal traded (mean 66.67, SD 16.49; range 20–90). This subsequently made estimating the effects of RL on sustainable harvest (mean 58.89, SD 17.44; range 10–80) and legal trade (mean 61.67, SD 20.21; range 10–90) uncertain.

4 | DISCUSSION

We show that current expert views on the impacts of a CITES RL are highly polarized, with varying concerns regarding its effect on enforcement, economics, trade markets and biodiversity. All these concerns are rooted in uncertainty of how a RL would be implemented and what it would involve. To effectively prioritize and allocate the limited resources available to conservation (Balmford & Whitten, 2003), there are increasing calls for more evidence-based decision-making (Sutherland et al., 2021). With increasing calls in the literature for CITES to consider a RL approach, our study provides insights into the feasibility and potential effects this might have, as well as highlighting key evidence gaps that need to be investigated in more detail. With a better understanding of the effects, we can determine the costs and benefits between maintaining the status quo or switching to a RL approach.

4.1 | Social and ecological effects

We show that experts believe that the effect on sustainable harvest, legal trade, welfare, zoonoses and IAS was dependent on what a RL aims to achieve. If the aim is to reduce the overall proportion of trade in species, then most participants assumed a proportional reduction in zoonoses, IAS and welfare implications. Any negative effect of RL on zoonoses, welfare and IAS was predicted to be dependent on illegal trade. If RL resulted in increased clandestine trade, species banned from trade would continue to be traded through already existing well-established trade routes. Research suggests that regulatory controls and changes can stimulate trade unless accounted for in decision-making (Challender et al., 2015). For example, banning the trade of a particular species can increase the commercial value of the product and generate illegal trade (Challender et al., 2015). Additionally, uplisting species to more restrictive trade, for example, from Appendices II to I, generally takes around a year after the proposal submission. Previous analyses suggest that this period results in an increase in legal volumes of trade to acquire specimens before restrictions are implemented (Rivalan et al., 2007). To manage an increase in legal trade during the transition period, there should be increased vigilance in the control and adherence to permits and quotas (Rivalan et al., 2007). To manage an increase in illegal trade, there are different approaches that can be used. Approaches must be context-dependent to account for different traded species, stakeholders and importing/exporting countries (Roe & Booker, 2019). Strategies can be applied at different points in the supply chain. For example, supply measures (protected areas, limits on harvest, physical protection and incentive-based alternatives), transactional measures (confirming legality at each step of trade through forensic analysis, close monitoring, inspection and regulation) and demand measures (consumer behaviour change campaigns or bans of consumption/possession) (t Sas-Rolfes et al., 2019). In a case where RL came into force, pro-active implementation of a range of supporting interventions would be needed to ensure that trade did not shift to illegal markets.

On the other hand, if a RL aims for more sustainable trade, rather than a reduction, then we show that the likely effects are dependent on enforcement, monitoring and legislative details implemented to manage how species are listed, how often listings are reassessed and what regulations are set. If welfare, zoonoses and IAS were considered as part of the listing process, the negative effects could be managed by regulating what species are permitted to trade. For example, IAS as a condition for listing would involve considering the ecological 'fit' of where a species is being traded to, propagule pressure (Lockwood et al., 2019) and a species' level of adaptation allowing it to invade non-native environments. If the species was considered low risk and able to be sustainably harvested, it could be placed on the positive list—ensuring safe biosecurity practices and enabling sustainable and legal trade. To incorporate these key considerations into the listing process, a structured methodology could be used, such as that proposed by Warwick and Steedman (2021) to assess the suitability for exotic pet species to be included on a positive list. This was based on criteria concerning welfare, conservation, sustainability and public and environmental considerations, and involved 10 binary questions to determine whether a species will 'pass' or 'fail' in order to be included on a positive list (Warwick & Steedman, 2021). In the case of a RL, a similar methodology could be used to assess species on their suitability for international trade and aid in determining which species should be banned from trade.

4.2 | Effects on livelihoods

Meeting consumer demand and generating profit for livelihoods (Warchol, 2004; Bush et al., 2014) are identified as key driving factors in the exotic pet trade. Similarly, our research suggests that the effect of RL on livelihoods is something that needs to be considered to ensure individuals or businesses do not turn to illegal trafficking to circumnavigate restrictions set by RL. This is particularly important for local communities in rural locations where alternative livelihoods may be unavailable. Although large organizations and industries are dominant in wildlife trade markets (Lewis, 2009), a high proportion of wildlife trade, supplying both legal and illegal markets, occurs in biodiversity-rich low-income countries (Robinson et al., 2018). Evidence suggests that when locals or stakeholders benefit directly from a resource, there is more incentive to protect it (Robinson et al., 2018). Therefore, although the primary objective of CITES is to regulate sustainable wildlife trade (t Sas-Rolfes et al., 2019), considering livelihoods can contribute significantly to benefitting conservation aims. The blanket ban of a RL is a preservationist approach and has been criticized as Western-centric, failing

to acknowledge the economic value of species for local communities (Stoett, 2002). Both sides are ideologically entrenched and future research and consideration of a RL should be holistic, maybe shifting the debate to common ground; for example, emphasizing how best we can protect ecosystems through CITES rather than simply regulating trade. Therefore, there should be careful evaluation on the species that would be placed on the positive list, considering not only the ecological impact but also the degree of reliance that local communities have on the traded species to balance global and local interests. This reflects the broader dynamic between policy and perception, where shifts in conservation frameworks like a RL can reconfigure how people understand, value, relate and consequently utilize nature.

It is essential to be wary of whether blanket-listing species could cause loss of incentives to maintain and protect populations of exotic pets. Captive breeding is also a significant contributor to the trade of exotic pets and the maintenance of livelihoods. Without details on how RL would be implemented, it is currently unclear how those proposing it would envision how captive bred specimens would be affected. We recommend further efforts to focus on how captive breeding may be treated under a RL policy, particularly how it would affect enforcement, livelihoods and conservation of wild populations. For RL to be effective and to ensure fair and sustainable conservation-compatible livelihoods, engaging with local communities and stakeholders at all levels should be a key consideration (He & Jiao, 2023).

4.3 | Barriers to implementation

The effect of RL on sustainable harvest and legal trade is not currently possible to estimate because of high levels of unmonitored and unreported trade (Symes et al., 2018). Particularly for the exotic pet trade, which relies heavily on wild-caught specimens, rarer species are often in higher demand and more frequently illegally trafficked (Altherr & Lameter, 2020) and therefore unreported. The high levels of uncertainty in our expert estimates of the current proportion of sustainable harvest and legal trade (Figure 3) highlights the lack of data available for most species. While data sources such as the CITES Trade Database, the US Lemis data and the TRAFFIC Wildlife Trade Portal offer important insights into trade, their analysis can be challenging and trade is often mischaracterized in the literature (Challender et al., 2021). Furthermore, the accuracy of the data has been called into question in some cases with misreporting or challenges with quality control (Symes et al., 2018; Weissgold, 2024). The importance of managing honest practices of reporting and enforcement means the efficiency of a RL is dependent on whether countries adhere to their own legislation and regulatory standards. One of the major justifications for a RL is that many species in trade are not CITES-listed. Watters et al. (2022) explored the composition of internationally regulated versus non-regulated trade between 2009 and 2018 and found that overall trade quantities were approximately 11 times larger for imports of unlisted species relative to CITES-listed species (Watters et al., 2022). RL would therefore affect both the current CITES listed and unlisted species. For unlisted species, there are often few limitations to trade and harvest, with minimal trade and population data available. The more 'precautionary response' of a RL would regulate the trade of all species until their trade is proved to be sustainable, which may also address issues of taxonomic bias in species receiving protection that have been suggested to affect current listings (Hughes, 2021). To predict outcomes of new conservation initiatives (such as predicting the proportion of legal trade after RL), it is important to gain accurate baseline data on currently listed and unlisted species to measure the effectiveness of an intervention.

Concerns regarding the economic capability for CITES and CITES Parties to implement a RL approach could be addressed by adapting and imitating business-pays models used in other industries. Respondents expressed that CITES is already underfunded and does not have the budget to do its core work, let alone to implement and enforce a new RL system. Set as target 5 by the Convention on Biological Diversity (CBD) on the Kunming-Montreal Global Biodiversity Framework, trade of wild species should be proven safe, sustainable and legal (CBD, 2024). Lack of financial resources was listed as one of the main barriers to meeting the 2010 CBD goals (Waldron et al., 2013). Currently, the responsibility and compliance costs fall on governments, donor organizations or non-governmental organizations acting as management or scientific authorities wanting to protect species by adding them to the CITES appendices (CITES, 2023). There is a well-established model that works well for industries, such as pharmaceuticals, where the business pays for Food and Drug Administration & European Medicines Agency (FDA/EMA) who regulate and authorize medicines; (Joppi et al., 2019) approval of drugs and funds the regulator (Glick, 2008). If this method were adopted to regulate trade, the economic responsibility for CITES Parties could be reduced by placing the burden of proving sustainable harvest on the businesses wishing to trade. While this could work well for large, well-established businesses, smaller businesses, such as those based on sustainable wild-harvest by community groups, could find this process challenging. To reduce the potential impact on smaller businesses, it would be necessary to work closely with stakeholders in the trade to identify the key barriers to demonstrating sustainability and identify where further research or modifications of the system may be needed.

As outlined by the thematic coding, different agendas are barriers to the implementation of RL; with huge variation in opinions, there is a reluctance to amend the CITES text. When first proposed at the 1981 CoP, the proposal was withdrawn and redebated in the following meeting. It became 'apparent that there was a strong divergence of opinion' (Lazarowitz & Greenwalt, 1980). Parties disagreed whether CITES should operate as a mechanism to reduce trade and stop trade or as a mechanism to enable 'rational use of wildlife as a sustainable and renewable source' (Lazarowitz & Greenwalt, 1980). Thus, the inability to achieve consensus has halted any serious considerations of adopting an alternative. The lack of consensus is significant as for any amendment in CITES to be considered, at least

one third of the 185 parties must propose the change. Furthermore, to be accepted, two thirds of parties must agree (CITES, 2023). RL would require a full structural transition; this process will be time consuming and costly. Without robust empirical evidence on the effects of a RL, parties will continue to be reluctant to open up the Convention text.

4.4 | Limitations and recommendations

We show that the IDEA protocol provides a useful tool for the investigation of hypothetical situations, and that uncertainty in expert estimates can be better understood using a mixed method approach. The IDEA protocol is primarily used in areas with limited research and available data (Hemming et al., 2017; Horscroft et al., 2022) which made it appropriate for our aims. Usually, this method excludes estimates lower than 50% certain from the analysis. However, because this research is on a hypothetical situation, uncertain estimates were worth considering. We further adapted this method by combining the standard quantitative approach associated with the protocol with qualitative methods. This mixed-method approach is increasingly encouraged in conservation, whereas data validity and quality can be improved through better understanding of local attitudes and perceptions regarding wildlife and conservation initiatives (Drury et al., 2011). This adaptation of the IDEA protocol provides a potential extension to the method. A potential improvement to this study design would be to facilitate the discussion over a group call, rather than remotely on Google Docs. Although Google Docs enabled participation regardless of location and work commitments, it may have resulted in lower engagement and some conversations remaining unresolved during the discussion. This could have affected the round two estimates. Increasing the size and diversity of the sample in terms of age, gender, cultural background, life experience, education and specialization could also have improved the results. Including perspectives from people beyond the conservation sector—such as law enforcement officers, traders and consumers—would provide valuable insights into how a RL might reshape human–nature relations. This would capture not only tangible impacts, such as changes in livelihood, but also relational dimensions, including evolving senses of cultural identity, connectedness and ethical responsibility towards traded species.

RL has been proposed multiple times in recent years as an improvement to managing trade; however, we show that there is currently very little consensus around how it would be implemented, what it would look like in practice and what the effects would be. Previous research by Toland et al. (2020) who compared the use of positive and negative listing and found no evidence to suggest that positive lists would worsen problems associated with administrative management and costs of maintaining and enforcing lists. It was suggested that a precautionary RL method, which sets a default as 'no trade', is more futureproof than the current more reactive listing method (Lanius & Johnson, 2021). This approach could alleviate the existing economic and regulatory burden on countries to continually adjust to taxonomic changes and new species descriptions, as trade in new species would be automatically monitored and regulated (Marshall et al., 2020). Our research suggests otherwise. We find that nobody knows which approach would be best and that any predicted effects are highly uncertain. To determine the effects, there needs to be clarity from those proposing RL on the aims and practical details. This would allow comparison between two courses of action. Gerber (2016) recommends a triage approach, where actions can be ranked based on impact, feasibility and vulnerability. This triage approach is easier for smaller organizations, and when used in larger organizations or multilateral treaties like CITES, should be conducted on a team-by-team basis (Sutherland et al., 2021). It is suggested that when practising evidence-based decision-making, deciding what not to assess leaves time for more intense scrutiny of the priority issues (Sutherland et al., 2021). It could be valuable for CITES to adopt this approach, categorizing key objectives and outcomes within teams, collating research and comparing the efficiency of the current system to a RL. These teams should be capable of assessing political, economic and ecological consequences of an action.

5 | CONCLUSION

Our findings show that more clarity is needed on how a CITES RL would be implemented before its feasibility or potential social and ecological impacts could be properly assessed. With little expert agreement on how it might work in practice, it is essential to explore in more detail what the reality could look like, despite increasing calls in the literature for RL to be a way forward for CITES (e.g. Toland et al., 2020; Warwick & Steedman, 2021; Xiao et al., 2024). Our analysis of RL reinforces calls for research to support evidence-based decision making in conservation, particularly when it comes to proposals for complete overhauls of large and complex conventions like CITES. Expert predictions, while providing useful insights, were highly uncertain and context-dependent; this lack of consensus supports concerns around the uncertainty associated with RL in its current proposed form (Challender et al., 2025). If these calls for radical changes to the Convention are to continue, it is essential to further investigate the potential range of impacts, ideally by working closely with stakeholders who will be impacted, including the CITES Secretariat, Parties and trade actors, to define how a list would be constructed and implemented. Discussions should focus on the criteria that would be used to list species, how research for NDFs will be funded and by whom, how often reassessments of species should be made and how to mitigate possible negative effects. With more clarity on these details, the uncertainty associated with RL as a potential strategy for improving international wildlife trade management could be reduced, and better evidence-based decisions that consider the potential effects and the range of intended and unintended consequences could be made.

AUTHOR CONTRIBUTIONS

Isabella Kortland and Amy Hinsley conceived the ideas and designed methodology; Isabella Kortland collected the data. Both Isabella Kortland and Amy Hinsley contributed to the analysis of the data; Isabella Kortland led the writing of the manuscript with advisory support from Amy Hinsley. Both authors contributed critically to the drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The responses to the questionnaires in rounds one and two of the adapted IDEA protocol have been archived and made available in anonymized form in the Oxford data archive: https://ora.ox.ac.uk/objects/uuid:92b003e6-29bb-4cb7-8fcc-52d8d332c832.

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SUPPORTING INFORMATION

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

Appendix S1. Questionnaire sheet.

Appendix S2. Codebook (deductive and inductive).

Appendix S3. Sample discussion document shared to all participants.

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