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Strengthening protection of endemic wildlife threatened by the international pet trade: The case of the Australian shingleback lizard

S. Heinrich[1,2], A. Toomes[1], C. R. Shepherd[2], O. C. Stringham[1,3], M. Swan[4] & P. Cassey[1]

1 Invasion Science & Wildlife Ecology Lab, The University of Adelaide, Adelaide, SA, Australia
2 Monitor Conservation Research Society (Monitor), Big Lake Ranch, BC, Canada
3 School of Mathematical Sciences, The University of Adelaide, Adelaide, SA, Australia
4 Department of Biodiversity, Conservation and Attractions, Kensington, WA, Australia

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Correspondence
Sarah Heinrich, Monitor Conservation Research Society (Monitor), Big Lake Ranch, BC, V0L 1G0, Canada.
Email: sarah.heinrich@adelaide.edu.au

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Abstract

Unsustainable wildlife trade threatens an increasing number of species globally. Australia has a particularly rich and endemic herpetofauna, which is coveted on the international pet market. While Australia implements domestic protection of most of its native species, there is little to no regulation of international trade once live animals have been smuggled out of the country. This is a threat for a variety of rare, unique and/or range-restricted species, subspecies and locality morphs. One of these species is the shingleback lizard (*Tiliqua rugosa*).We compiled Australian seizure data and international online trade data pertaining to shinglebacks. We found all four subspecies in trade across Asia, Europe and North America. Here we provide evidence that all four shingleback subspecies are illegally extracted from the wild in Australia and smuggled to international destinations, where they are sold and distributed globally.While shinglebacks are a protected species in Australia and can only be exported legally under a federal permit, their import into, and trade between, other countries is often not illegal, even in the absence of such a permit. These contradictory legal frameworks apply to the majority of nationally protected native fauna and must be addressed by each importing country on an individual basis; that is, by changing their legislation to cover and protect species that are nationally protected in their native range. Meanwhile, however, we argue that listing *T. rugosa* in Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora is a meaningful way to provide other countries with the legal means to confiscate illegally exported shinglebacks from Australia. Our findings and recommendations are directly relevant for potential future Appendix III consideration of other nationally protected species that are found in international trade.

Introduction

Illegal and unsustainable wildlife trade threatens an increasing number of species globally (Byard, 2016; Sinovas *et al*., 2017; Ribeiro *et al*., 2019; Marshall *et al*., 2020; McMillan *et al*., 2020). Species and their parts and derivatives are coveted for various end uses, the most prominent of which include medicine, food, luxury items or as pets (Lockwood *et al*., 2019; Svolkinas *et al*., 2020). The pet trade has grown considerably in recent years, and reptiles are among the most heavily exploited taxa for this purpose (Herrel and van der Meijden, 2014; Auliya *et al*., 2016; Marshall *et al*., 2020).

Australia has a particularly rich and unique herpetofauna, with over 98% endemism in squamate lizards and snakes (Tingley *et al*., 2019). Not all Australian species that are found in trade are directly threatened with extinction; however, trade is often an additional threat, and the majority of Australian species are relatively rare on the international pet market, making them exceptionally coveted. As such, the federal government implements strict wildlife laws pertaining to international trade of native species as part of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (see Box 1), while each Australian state individually regulates the domestic keeping and trade of native species. Despite strict import and export regulations, a number of shortcomings are known to be actively exploited to the detriment of Australian species conservation. For example, the German parrot breeder Martin Guth legally exported over

200 birds from Australia since 2014 under the false pretence for exhibition purposes (Box 1, Point 4) and subsequently sold a selection of these birds and their offspring at a huge profit (Cox and Oltermann, 2019; Borrell, 2020).

Box 1. Summary of Australian Commonwealth regulation of native wildlife export (EPBC Act).

1 The export of any live native reptile, bird, mammal or amphibian for commercial purposes is prohibited without exception
2 The export of live plants, fish and invertebrates for commercial purposes must originate from an approved commercial source and require an export permit
3 The export of any live native animal as a household pet is prohibited, except under a permit for non-commercial quantities of six parrot species
4 The export of any live native reptile, bird, mammal or amphibian for non-commercial purposes (i.e., research or exhibition) is allowed under approved circumstances and requires a permit.

While it is mostly illegal to export native live species (Box 1), the import to many consumer countries is not nor is the trade of the animals once they have entered the consumer country. In some cases, smuggled animals can sustain a limited amount of captive breeding overseas, which further supplies the international trade. With a few exceptions, such as species listed in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), there are no international regulations governing the trade of nationally protected species outside of Australia, often rendering them unprotected outside their native range. If a species is not listed in CITES, and not otherwise specifically protected in a destination country, law enforcement in these countries has limited jurisdiction to seize smuggled animals when they enter or when they are traded within the consumer country, even if they are wild-caught.

One Australian species highly prized on the international pet market is the endemic shingleback lizard (Family: Scincidae, Species: *Tiliqua rugosa*). The shingleback is also known as the stump-tailed skink, bobtail, sleepy or pinecone lizard, as well as other common names (it is hereafter referred to as 'shingleback' or '*T. rugosa*'). It occurs in the arid to semi-arid regions of Australia and is listed as Least Concern on the International Union for Conservation of Nature (IUCN) Red List (Sanderson *et al*., 2017). Currently, there are four recognized subspecies (*T. r. rugosa*, *T. r. aspera*, *T. r. konowi* and *T. r. palarra*; Fig. 1), which are variable in color to some extent as well as in their conservation status (Wilson and Swan, 2017).

Shinglebacks are monogamous (Bull *et al*., 1998). They are usually solitary animals but mate in spring *c*. 4–8 weeks after brumation (Bull *et al*., 1991). Each year they return to mate with the same partner, with whom they stay for several weeks (Bull, 1994). Monogamy in animals is sometimes anthropomorphized as 'romantic/charismatic', which may have contributed to an increase in demand for shinglebacks. Shinglebacks are viviparous and usually bear between one to two offspring per year (Bull *et al*., 1993). Under the right circumstances, they can be bred in captivity, but their low reproductive rate makes them particularly vulnerable to over-exploitation in the wild (Alacs and Georges, 2008).

Like all reptiles, shinglebacks are protected in Australia, and it is illegal to export them without the appropriate permits (see EPBC Act and Box 1). All shingleback subspecies have their full range (*T. r. konowi*, *T. r. palarra* and *T. r. rugosa*), or part of their range (*T. r. aspera*), in Western Australia (Fig. 1) and are further protected by the *Biodiversity Conservation Act 2016* (BC Act) and Biodiversity Conservation Regulations 2018. The species *T. rugosa* is widespread throughout its native range and is relatively common (Sanderson *et al*., 2017). Across their distribution, shinglebacks are susceptible to feral animal predation and are thought to be subject to illegal harvesting, particularly of desirable specimens or subspecies (Sanderson *et al*., 2017). Extraction of *T. r. konowi* from the wild is completely prohibited, and it is listed as a threatened species ('vulnerable') in accordance with the BC Act.

Here, we investigated and characterized the international trade in shingleback lizards, starting from being poached in the wild in Australia to sale on international marketplaces. We summarized Australian seizure data, as well as international online trade data pertaining to shinglebacks. We provide evidence for an informed discussion about the potential benefits of a CITES Appendix III listing for this (and similar) species, in order to curtail the illegal trade in nationally protected species found in international trade.

We gathered multiple datasets from a variety of sources: (1) incidents where attempted postal exports of *T. rugosa* had been intercepted by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) from May 2015 to September 2018; (2) domestic seizures from Western Australia of unlicensed domestic captivity and direct poaching of *T. rugosa* in the wild, supplied by the State Department of Biodiversity, Conservation and Attractions (DBCA) from April 2011 to June 2019; (3) Law Enforcement Management Information System (LEMIS) data from the US from 2015 to 2019 [acquired through a Freedom of Information Act request; see Romagosa (2014) for more detailed information about LEMIS]; (4) online trade data of *T. rugosa* obtained in April 2020 through automated data mining and manual searches of four international English language websites and one Japanese website; (5) a seizure dataset collated in April 2020 through ad hoc online news searches of seizures involving shinglebacks in Australia, using the keywords 'seizure', 'Australia', 'shingleback' and/or '*T. rugosa*' [see Siriwat and Nijman (2018) for a similar example of this methodology]. We compared all records against the available Australian seizure data to avoid duplication of records, by comparing the number of animals, location (if available) and date of the seizures. For the English-speaking websites, we chose four popular (de-identified *sensu* Hinsley *et al*. 2016) e-commerce/classified websites that traded reptiles (following the methods outlined in Stringham *et al*., 2020). For all websites, we searched for several English names and one Japanese name (マツカサトカゲ) of the shingleback. We further sent

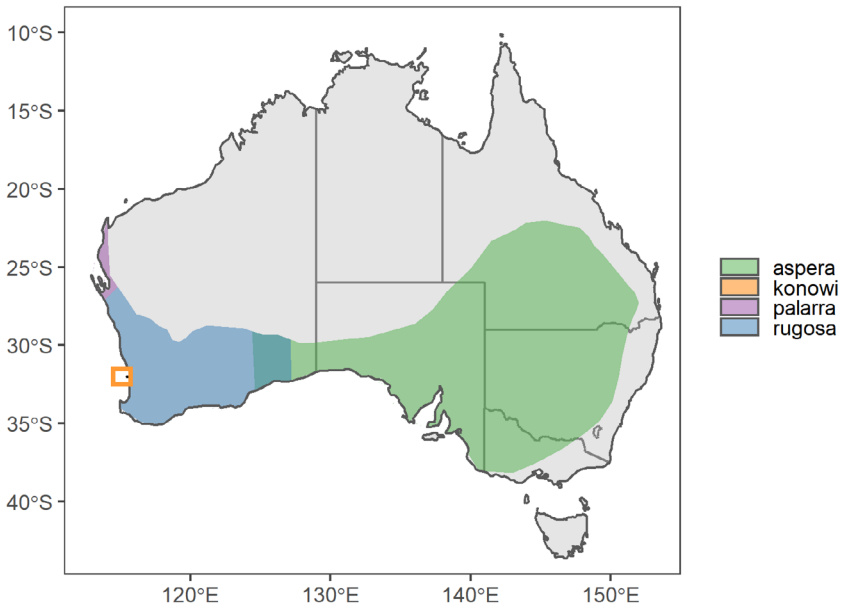

Figure 1 Distribution of the four shingleback subspecies *Tiliqua rugosa aspera* (green), *Tiliqua rugosa konowi* (orange), *Tiliqua rugosa palarra* (purple) and *Tiliqua rugosa rugosa* (blue) in Australia.

requests to the relevant authorities of Hong Kong Special Administrative Region (SAR), Thailand and Japan, which were previously identified as relevant destinations through the Australian seizure data. Where no response was received, we sent requests to local non-government organization contacts in the relevant countries or territories to obtain the seizure data.

The number of animals involved in each incident was based on the descriptions in the advertisements or seizure data. Where no exact quantity of the involved animals was given, and unless otherwise stated, we assumed that each incident involved one animal. Unless otherwise stated, if it was indicated that 'shinglebacks' (i.e., more than one) were involved, we assumed that two animals were involved (noting that it is possible that the actual number of shinglebacks involved may be higher). Prices of shinglebacks from the different websites were converted to US Dollars (USD) in September 2020 (www.xe.com). Maps were created using the 'leaflet' (Cheng *et al*. 2019), 'tmap' (Tennekes 2018) and 'ggplot2' (Wickham 2016) packages. All data were analyzed in the R software environment for statistical and graphical computing version 4.0.1 (R Core Team 2020, Vienna, Austria).

Results

Australian seizures

Between 5 April 2011 and 5 June 2019 the DBCA seized 236 shinglebacks in Western Australia, involving all four subspecies: *T. r. rugosa* (224), *T. r. konowi* (9), *T. r. palarra* (2) and *T. r. aspera* (1). While it is uncertain whether these animals were destined for international or domestic trade, there were an additional 123 shinglebacks that were seized in 36 incidents between 13 May 2015 and 19 September 2018 by DAWE. All of these were destined to be exported via mail and were seized before they could leave the country. The reported destinations are shown in Table 1 and Fig. 2. We found an additional 13 seizures through online news searches since 2009, involving at least 154 shinglebacks seized in Australia and, in all but two incidents, destined to be exported internationally (Table 1; Fig. 2). In seven incidents, involving at least 114 shinglebacks, suspects were apprehended at Australian airports by the Australian Border Force. In three more incidents, at least 24 shinglebacks were destined for Hong Kong SAR via post, and in a further two incidents, at least 14 shinglebacks (and other

Table 1 International destinations reported from Australian seizure data from 2015 to 2018 (DAWE) and 2009 to 2020 (additional seizures)

	DAWE	Additional seizures
Destination country	Number of incidents (number of animals)	Number of incidents (number of animals)
Hong Kong SAR	17 (42)	4 (26)
Mainland China	7 (21)	–
Sweden	6 (39)	–
Indonesia	5 (18)	–
Taiwan ROC	1 (3)	–
Japan	–	5 (77)
Singapore/Malaysia	–	1 (13)
Thailand	–	1 (24)

Abbreviations: DAWE, Department of Agriculture, Water and the Environment; ROC, Republic of China; SAR, Special Administrative Region.

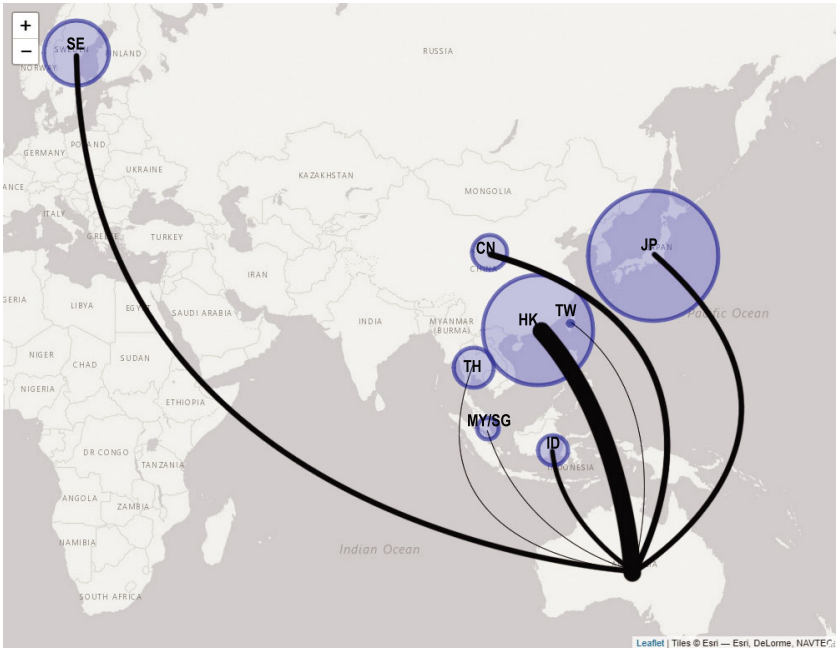

Figure 2 Destinations for *T. rugosa* that were intercepted before exiting Australia, based on the combined seizures reported in the media (from 2009 to 2019) and from DAWE (from 2015 to 2018). The thickness of the lines is proportional to the number of incidents, while the circumference of the circles is proportional to the number of animals. Location of the circles and start and end points of the lines do not represent a specific location within a given country/territory. Country/territory: CN, China; HK, Hong Kong Special Administrative Region; ID, Indonesia; JP, Japan; MY/SG, Malaysia/Singapore; SE, Sweden; TH, Thailand; TW, Taiwan ROC.

wildlife) were seized on the premises of suspects believed to belong to organized smuggling rings, as noted by law enforcement. In one incident, the final destination was unknown, while in another incident, a parcel containing shinglebacks was seized that was sent interstate within Australia.

International trade

LEMIS records indicated that from 2015 to 2019 the US has imported 113 shinglebacks in eight incidents. All but two of them were cleared for import. There were an additional six records since 2015, involving 207 unidentified *Tiliqua* skinks. Country of export information was not specified for these LEMIS records.

TRAFFIC contacts in Japan and Thailand stated that there had not been any seizures of shinglebacks in either country (TRAFFIC pers. comm., 2020). The Hong Kong SAR CITES Management Authority confirmed that between 2010 and June 2020 there had been seizures of shipments including 28 bluetongue skinks of the genus *Tiliqua* from Thailand, Germany, Indonesia and Australia. However, the species were not recorded, and it could not be confirmed whether any shinglebacks were involved.

International online trade

We found 96 listings involving at least 130 shingleback lizards on five international websites. Of these, 74 listings (71%) involved sellers offering shinglebacks for sale, while the remaining 22 listings concerned people looking for shingleback lizards to buy. In 24 listings (23%), the user reported the animals as 'captive bred'. Of these, two people were looking to buy captive bred shinglebacks, and the remaining 22 listings were offering captive bred individuals for sale. Sellers were located in at least 13 different countries (Fig. 3). Interested buyers were located in at least seven different countries, including South Korea, Iceland and Switzerland, as well as Germany, Belgium, the US and the UK.

Of the countries that we could identify, Japan and Germany featured most prominently in the trade. In Japan, we found 25 listings involving at least 25 animals. In all listings, the animals were offered for sale. In six listings the animals for sale were claimed to be captive bred, while in one listing, concerning the subspecies *T. r. palarra*, it was explicitly stated to be wild-caught. In Germany, we found 16 listings involving at least 23 animals. Eight of these listings involved four people selling at least 11 shinglebacks. Buyers were looking for at least 12 shinglebacks; one of them was simultaneously offering other Australian endemic and protected species (*Egernia depressa* and *E. stokesii*) in exchange and for sale (supporting information S1). Only one of the sellers in Germany declared in a single listing that the two lizards for sale (*T. r. rugosa* of the Goldfield locality) had been captive bred in 2015. None of the other sellers in Germany directly stated the origin of the animals for sale, but one seller indicated that the three individuals of the

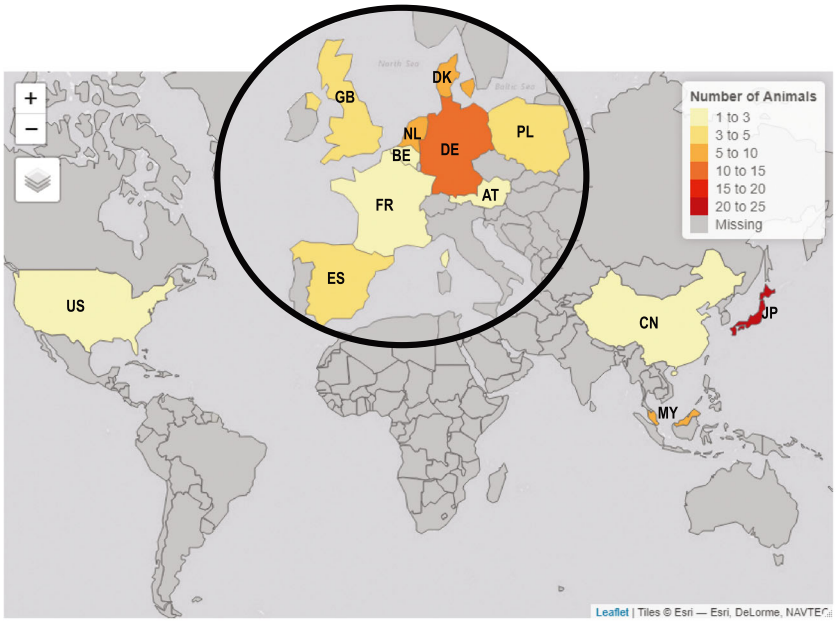

Figure 3 Number of shinglebacks offered for sale as advertised online on five international websites. In 15 instances, involving at least 18 animals, it was impossible to assign a country to the seller; these are therefore not displayed in this map. Locations of interested buyers looking for shinglebacks were also excluded. Countries/territories: AT, Austria; BE, Belgium; CN, China (including Hong Kong SAR); DE, Germany; DK, Denmark; ES, Spain; FR, France; GB, United Kingdom; JP, Japan; MY, Malaysia; NL, Netherlands; PL, Poland; US, United States of America.

subspecies *T. r. konowi*, which he was offering in exchange for the very rare New Zealand harlequin gecko (*Tukutuku rakiurae*), were not related to any of the bloodlines from Europe nor Asia.

T. r. aspera and *T. r. rugosa* had the broadest spatial distribution in trade and were found in listings of sellers in at least eight different countries each. They were followed by *T. r. konowi* in four and *T. r. palarra* in at least a single country. Prices were mostly available from the Japanese website. The average asking price for a shingleback was 467 000 Japanese Yen [*c*. 4400 USD (n = 18)]. This is similar to the prices that we found on English language websites for Europe (3500 Euros ≈ *c*. 4130 USD; from the UK for *T. r. aspera*) and the US (*c*. 5000 USD; for *T. r. aspera*). The price for *T. r. konowi* was notably higher in Japan than the average price for shinglebacks with 750 000 Yen (*c*. 7000 USD). The prices per subspecies are displayed in Table 2.

Table 2 Average prices for advertised shingleback subspecies online on international Japanese and English language websites. Note that prices were not available for all listings. '*n*' indicates the number of listings from which the prices were derived

Subspecies	Average price (USD)	Country
T. r. aspera	4565 (n = 2)	UK, US
T. r. rugosa	3790 (n = 12)	Japan
T. r. palarra	5364 (n = 5)	Japan
T. r. konowi	7083 (n = 1)	Japan

Abbreviations: USD, US dollar.

Discussion

The issue of international trade in Australian native wildlife

Despite stringent domestic regulation and enforcement of legislation, an endemic Australian reptile is being poached from the wild, illegally exported out of Australia and sold on international markets across Asia, Europe and North America. Domestic seizures from Western Australia reveal that poaching of wild shinglebacks is prevalent and, when combined with the shinglebacks seized at the point of export from Australia, demonstrates that there is strong international demand for Australia's unique herpetofauna. Despite the efforts of the various agencies who administer environmental protection legislation, the online trade data reveal that a supply chain exists and smugglers have the ability to evade detection in Australia without fear of prosecution in their own country.

Most of the online advertisements that we found did not indicate the origin of the animals, but a few sellers stated the animals had been captive bred. We could not verify any of these claims, but the average price for a single shingleback overseas of *c*. 4500 USD is very high (e.g., *cf* Stringham and Lockwood, 2018), which could indicate the illegal origin of the animals and/or that breeding shinglebacks in captivity, especially outside their native range, is challenging. If shinglebacks were easy to breed overseas, there would likely be more animals available on the international market, thus lowering the price per animal (Hall *et al*., 2008). While

it is possible that successful breeding overseas may occur in a few cases, the costs for providing the right conditions for these lizards in captivity may also contribute to the high prices per animal. Moreover, even if overseas captive breeding is established, there are a number of reasons why international trade may still drive poaching of wild individuals. For example, breeding may not take place at commercially relevant scales (e.g., Challender et al., 2019a), consumers may display preferences for wild-caught traits (Burivalova *et al*., 2017; Crudge *et al*., 2020), demand exists and regularly emerges for new morphs/localities that are not yet captively bred (Lyons and Natusch, 2013; Auliya *et al*., 2016), and new individuals may be needed to replenish genetic diversity of founder stock (Brooks *et al*., 2010; Kuhnen and Kanaan, 2014; Williams *et al*., 2014). Further considering that shinglebacks usually only bear one or two offspring per year, captive-bred animals are unlikely to satisfy international demand and it is more likely that shinglebacks are poached from the wild to be smuggled abroad.

Shinglebacks are widely distributed and, importantly for poachers, are found near large capital Australian cities, with international airports. The rarest subspecies (*T. r. konowi*) is located on an island less than 50 km from the Perth International Airport, which is easily accessible via public transport and discount charter ferry. A further 800 km to the north of Perth, another rare subset of individuals (*T. r. palarra*) can be readily accessed via private vehicle hire. Alternatively, 450 km to the east of Perth along the fly-in fly-out mining route, the highly sought after 'Goldfields' phenotype are found. We hypothesize that poachers arrive in Western Australia and hide in plain sight while collecting shinglebacks for overseas markets. Given the high prices that can be obtained for shinglebacks overseas, only a few smuggled animals are sufficient to pay for the entire trip and additionally return a huge profit at a relatively low risk.

The life-history characteristics of the shingleback make them particularly vulnerable to poaching. Shinglebacks have a relatively small home range and do not generally move very far (Bull and Freake, 1999). When they are approached, they slowly retreat or display defensive behavior by opening their mouth wide and sticking out their tongue (Abramjan *et al*., 2015). Shinglebacks are easily captured and handled, even by unskilled people who are unfamiliar with the species, and it is these characteristics, combined with their high international selling price, that make them an easy target for poachers. While our results reveal that wild shinglebacks are being poached, it is currently unknown what proportion of this is due to international versus domestic demand.

The lack of substantial geographic overlap of the destination countries identified in seizure incidents and the countries of online sale may imply that the destinations observed in seizure incidents could also serve as transit countries or countries from where the animals are captive bred, or claimed to be captive bred, and then sold. It is clear that seizure data alone do not provide a complete list of 'demand' countries. For example, apart from Sweden, European countries were never the reported destinations in the available Australian shingleback seizures. This may be because the trade route for shinglebacks encountered in the European market is often via Asia or because direct exports to Europe are simply not detected as often.

We underwent an extensive effort to document international trade of shinglebacks, but our data have biases. First, our results show that the greatest number of shinglebacks detected in trade was in 2019. Since our data mining and manual searches of online trade information were performed in 2020, it may be biased toward more recent listings, because older listings may have already been deleted by the website hosts and/or that successful listings may not always be stored on each website (e.g., after a sale had occurred). Similarly, there are a number of biases inherent to seizure data (see e.g., Underwood *et al*., 2013). We also only requested seizure data from a small number of countries and territories (Australia, Hong Kong SAR, Japan and Thailand), and it is possible that we have not captured additional seizures involving shinglebacks in other countries. We optimized our search of the online trade by collecting data from websites known *a priori* to be prominent platforms for the sale of shinglebacks; thus, it was not a comprehensive search of the trade occurring on the Internet (Stringham *et al*., 2020). Shingleback trade terms in other languages and/or terms used on other websites may have provided more data, and it is likely that online trade is conducted across a broader distribution of countries than is currently identified. This is particularly relevant since the majority of the seizure incidents in Australia indicated that the shinglebacks were on their way to countries where English is not the first language, and it is very likely that online trade occurs in these predominantly Asian countries on a large scale. Despite these shortcomings, we clearly demonstrate that shinglebacks are traded internationally.

Although the shingleback is a widespread and abundant species in Australia, threatened and range-restricted subspecies (*T. r. konowi* and *T. r. palarra*) may be negatively impacted by this trade. Moreover, while population-level impacts of poaching are unlikely to be high for abundant species, the effect on local subpopulations, as well as the broader and synergistic ecosystem impacts of habitat destruction during poaching activity (e.g., off-roading and deliberate destruction of microhabitats), is potentially severe (Geyle *et al*., 2020). Preliminary inspection of online trade (Table S1) highlights a non-exhaustive list of other rare and range-restricted endemic species that were traded or coveted in conjunction with shinglebacks, some of which may be similarly impacted. Despite Australian authorities regularly seizing shinglebacks destined for international markets, our results indicate that smugglers have some ability to evade detection. We suggest that the shingleback lizard provides a valuable and data-rich example of a species that would greatly benefit from a listing in CITES Appendix III.

Using CITES Appendix III to curtail the effects of international trade in Australian endemic species

CITES Appendix III is seldom used, compared to the other two Appendices in CITES (UNEP-WCMC 2014). It contains

species that are protected in their native country, and for which the country has requested assistance from other Parties to regulate the species' trade. A Party can list nationally protected species within its jurisdiction unilaterally at any time by notifying the CITES Secretariat, but permit requirements are not as strict as for species listed in Appendices I or II (see Articles III, IV and V of the Convention). The recommended criteria for an Appendix III listing were refined at the 18th Conference of the Parties (CoP) in Geneva in 2019 in Resolution Conference 9.25 (Rev. CoP18), and every single criterion is met at the subspecies level for *T. rugosa*. In line with the recommendations laid out in Resolution Conference 9.25 (Rev. CoP18), *T. rugosa* is not only native but also endemic to Australia, noting that endemic species are especially well suited for an Appendix III listing if other criteria are also fulfilled. It is a nationally protected species that is found in international trade, the rate of which can be reduced substantially with the help of the other Parties. As shown here, international demand for shinglebacks is ongoing, and due to their low fecundity (Bull *et al*., 1993; Alacs and Georges, 2008), it is unlikely that the captive breeding efforts overseas are able to satisfy the demand. Here, we have identified a substantial record of illegal trade, and it is likely that more trade in *T. rugosa* remains unidentified, due to the aforementioned limitations of our study.

CITES is not a panacea for every species, and its limitations have been demonstrated repeatedly (e.g., Biggs *et al*., 2013; Challender *et al*., 2019b; Outhwaite, 2020; Cooney *et al*., 2021); however, we recommend *T. rugosa* to be listed in CITES Appendix III to enable the enforcement in destination and transit countries, which need a legal basis on which to seize illegal specimens. This is currently lacking in some countries or blocks of countries, for example, within the EU, where authorities have no legal basis to confiscate nationally protected, non-CITES-listed species that are not separately listed and thereby protected in the Annexes of the EU wildlife trade regulations. The same is true for other major destinations for shingleback lizards, such as Hong Kong SAR. As confirmed by the Hong Kong SAR CITES Management Authority, non-CITES species are generally allowed to be imported regardless of protection status in their source country. Seizures only occur if the imports do not comply with Hong Kong SAR quarantine requirements. Thus, once shinglebacks (or other nationally protected animals) have left their source country (in this case Australia), they are largely unprotected. Ideally, every country would adopt legislation similar to the Lacey Act in the US, which would allow them to confiscate species that are being imported in contravention to the national laws of their origin country (see also Altherr, 2014 and Auliya *et al*., 2016). Until this happens, however, a CITES listing would allow nations to reduce the negative effects of illegal harvest on the species in question. When listing a species in CITES Appendix III, however, it is important to consider adverse effects on other similar coveted species. These sought-after species may become disproportionally affected as a result of such increased regulation. One (future) example may be a number of Australian endemic large-bodied skinks (*Egernia* spp.), which we observed being traded on international markets (Table S1). We therefore recommend that the Australian Management Authority considers the use of CITES Appendix III for additional suitable Australian species.

Australia has been a member to CITES since 1976. It has only once listed a species in Appendix III – the Great White Shark (*Carcharodon carcharias*). It was listed from 2000 to 2005, before being up-listed to Appendix II (UNEP-WCMC 2014). With the listing, Australia reportedly wanted to trace the trade routes and destinations for Great White Shark products; however, there were several issues with the listing (Willoek *et al*., 2004). For example, the predominant and most valuable trade commodities of *C. carcharias* at the time were its teeth and jaws, which were traded as souvenirs and personal effects (Willoek *et al*., 2004). However, the personal and household effects exemption for Appendix III specimens is the only 'true' exemption that exists in CITES (trade in specimens that fall under any of the other exemptions of Article VII of the Convention still requires documentation). Therefore, even though trade in Great White Sharks did occur, only a small proportion of it was ever recorded through CITES (Willoek *et al*., 2004).

A similar shortcoming for listing *T. rugosa* in Appendix III is highly unlikely to occur, as this species is mostly traded as whole, live animals. For live animals, the exemption does not apply, even if the species is only listed in Appendix III, and any trade still requires documentation, either in accordance with the provisions of Articles III, IV and V of the Convention or with Resolution Conf. 10.20 ('frequent cross-border movements of personally owned live animals'). Further, the species is, unlike many other lizards, easily recognizable and distinguishable from other species in trade, including other *Tiliqua* species. Identification issues at the species level are therefore unlikely to occur; an issue that is often encountered in wildlife trade (Mendiratta *et al*., 2017; Alfino and Roberts, 2019; de Oliveira *et al*., 2020). However, the four *T. rugosa* subspecies are very similar in physical appearance, meaning it is imperative to list the entire species in Appendix III to avoid misidentifications and attempts to launder CITES-protected subspecies as unprotected conspecifics.

Shinglebacks provide a data-rich case study and exemplify the widespread and unaddressed problem of nationally protected species that are smuggled internationally. Stronger international regulations and improved legislation in consumer countries are urgently needed to address this issue. Until such legislation is established and enforced, CITES Appendix III provides a readily implementable tool that can aid in protecting species, such as the shingleback lizard, internationally. We not only urge consideration of Appendix III for shinglebacks but also a wider application of the tool for endemic species threatened by international trade, both for Australia and other nations with diverse and endemic species vulnerable to exploitation.

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Supporting information

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

Table S1: Species found for sale, in exchange, or that people were looking for, in conjunction with *Tiliqua rugosa* on four international English language websites.