CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Thirty-third meeting of the Animals Committee
Geneva (Switzerland), 12 – 19 July 2024

Species conservation and trade

Fauna

PANGOLINS (*MANIS* SPP.)

1. This document has been prepared by the Secretariat.

2. At its 19th meeting (CoP19; Panama City, 2022), the Conference of the Parties adopted a set of Decisions on *Pangolins* (Manis *spp.)*. Decisions 18.238 and 18.239 were renewed and new Decisions 19.200 to 19.204 were adopted. Of these, Decisions 18.238, 18.239, 19.200 and 19.203 are of most relevance to the Animals Committee:

Directed to all pangolin range States

18.238 *All pangolin range States that have not yet done so, are encouraged to take urgent steps to develop and implement* in situ *pangolin management and conservation programmes, which includes population assessments, as anticipated in paragraph 7 of Resolution Conf. 17.10 (Rev. CoP19) on* Conservation of and trade in pangolins*, and report on the implementation of this Decision to the Secretariat.*

Directed to the Secretariat

18.239 *The Secretariat shall, subject to external funding, work with the Species Survival Commission Pangolin Specialist Group of the International Union for Conservation of Nature (IUCN) and other relevant experts and in collaboration with the pangolin range States to develop conversion parameters for all pangolin species, that will enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, that can be used by Parties in cases where national legislation demands that such information be provided for court purposes.*

Directed to the Animals Committee

19.200 *The Animals Committee shall:*

a) review the conversion parameters for all pangolin species, developed in accordance with the provisions of Decision 18.239, to enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, and that can be used by Parties in cases where national legislation demands that such information be provided for law enforcement and court purposes;

b) review existing identification materials concerning pangolin species, their parts and derivatives, and consider the need for new or additional materials to be developed, including to support the identification of seized pangolin specimens at species level;

c) review any information brought to its attention by the Secretariat in accordance with Decision 19.203, paragraphs b) and e); and

d) make recommendations, as appropriate, to the Standing Committee and the Secretariat.

Directed to the Secretariat

19.203 *The Secretariat shall:*

a) issue a Notification inviting Parties, international organizations, international aid agencies and non-governmental organizations that developed tools and materials that could assist Parties in the implementation of Resolution Conf. 17.10 (Rev. CoP19) or identification materials concerning pangolin species, their parts and derivatives, to bring such materials to the attention of the Secretariat;

b) bring any materials reported in accordance with paragraph a) of the present Decision to the attention of the Animals Committee or the Standing Committee, as appropriate, together with any recommendations it may have, and taking into account any subsequent recommendations from the Animals Committee or the Standing Committee, make such materials available to the Parties;

c) subject to external funding, provide training to Parties on the identification of pangolin specimens;

d) work with its partners in the International Consortium on Combating Wildlife Crime (ICCWC) to initiate activities and support the efforts of Parties to address illegal trade in Pangolin specimens;

e) report on the implementation of Decisions 18.238 and 18.239 to the Animals Committee, together with any recommendations it may have;

f) report on the implementation of Decision 19.202 to the Standing Committee, together with any recommendations it may have; and

g) report to the 20th meeting of the Conference of the Parties on the implementation of the present Decision.

Implementation of Decision 18.238

3. Concerning the implementation of Decision 18.238, the Secretariat issued Notification to the Parties No. 2024/022 on 24 January 2024, requesting information concerning the development and implementation of *in situ* pangolin management and conservation programmes. The Secretariat noted that the reference in Decision 18.238 should refer to paragraph 10 (not paragraph 7) of Resolution Conf. 17.10 (Rev. Cop19), which reads:

   URGES range States to work with appropriate bodies and experts to develop and implement in situ *pangolin management and conservation programmes, which include population assessments, the making of non-detriment findings for trade in the species, monitoring, and management and conservation measures.*

4. Pangolin range States were invited to provide any relevant information on the development and implementation of *in situ* pangolin management and conservation programmes to the Secretariat, for inclusion in its report to the present meeting.

5. Responses were received to the Notification from the following five pangolin range States: Malaysia, Namibia, the Philippines, Singapore and Thailand. A summary of these responses is presented in Annex 1 to the present document.

6. The information, plans and strategies shared by the five Parties address the key aspects referred to in paragraph 10 of the Resolution. Although the responses did not specifically refer to non-detriment findings (NDFs), the information provided could inform NDFs. Thailand indicated that it would welcome support from relevant organizations and experts in acquiring expertise and training relating to the captive care of the species to enhance its survival.

7. Based on the data in the CITES Trade Database, trade from these five Parties from 2016 – 2022 were mainly for scientific purposes (from wild source and confiscated / seized sources).

Implementation of Decision 18.239

8. Decision 18.239 has been implemented thanks to a financial contribution from France to the Strategic Programme of the International Consortium on Combating Wildlife Crime (ICCWC). The Secretariat appreciates the support provided in this regard. The Secretariat worked with the Species Survival Commission Pangolin Specialist Group of the International Union for Conservation of Nature (IUCN), hereafter referred to as "the pangolin specialist group", to develop conversion parameters for all pangolin species, that would enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, in collaboration with the pangolin range States. The final report was presented to the Animals Committee at its 32nd meeting (AC32; Geneva, June 2023) in the Annex to document AC32 Doc. 31.

9. The report stated that "development of conversion parameters requested by the CITES Parties requires data on scale mass for each pangolin species". As published estimates were already available for the Chinese (*Manis pentadactyla)* and Sunda pangolins (*M. javanica*) (Zhou et al. 2012), the principal focus of this project was to collect primary data on scale mass for the six other pangolin species: *M. culionensis*, *M. crassicaudata*, *M. tetradactyla*, *M. tricuspis*, *M. gigantea*, and *M. temminckii.*

10. Due to the COVID-19 pandemic, international travel was not possible until April 2022, so assistance from range States and local collaborators was necessary to collect data. A sampling protocol was therefore developed to facilitate this data collection, which can be found in the Annexes to the report.

11. The report in the Annex to document AC32 Doc. 31 concluded by outlining a number of next steps that needed to be taken, including further data collection and examination of bias associated with the estimates, before scale mass estimates for all eight pangolin species can be considered robust to derive the finalised conversion parameters. The pangolin specialist group indicated that it had secured additional funding through a Pangolin Crisis Fund project titled "Developing Robust Conversion Parameters for Seized Pangolin Scales" that enabled this research to be carried out through 2022 and into 2023. The Animals Committee invited the IUCN pangolin specialist group to provide an updated report for consideration at this meeting.

12. In Notification to the Parties No. 2024/022, the Secretariat also reminded Parties and organizations of Notification to the Parties No. 2023/088, which invited Parties and institutions, such as zoos and museums, that may possess samples of carcasses and skins of pangolins (*Manis* spp.), to provide additional material for the development of conversion parameters for pangolin species. In particular, samples of *Manis crassicaudata* (Indian pangolin) and *M. temminckii* (ground pangolin) were sought. Parties and organizations willing to provide such material were invited to contact the IUCN Pangolin Specialist Group.

Updated report on conversion parameters

13. The IUCN pangolin specialist group has provided an updated report, funded by the Pangolin Crisis Fund, which is presented in Annex 2 to the present document. Based on the report, the revised data on scale mass for the eight pangolin species is shown in the table below, presented as means with 95% confidence intervals and medians:

Table 1. Scale mass estimates as conversion parameters for the eight species of pangolin, based on contributed data.

Species	Mean ± SD (95% CIs) (g)	Range (g)	Median (g)
Giant pangolin *M. gigantea*	3853.01 ± 617.22 (3815.12-3980.89)	2030 - 5448	3876.5
Temminck's pangolin *M. temminckii*	2020.1 ± 935.72 (1582.17-2458.03)	342.25 - 3911	1928.88
Indian pangolin *M. crassicaudata*	1299.95 ± 623.64 (923.08-1676.81)	56.25 - 2099.66	1096.89
Chinese pangolin *M. pentadactyla*	592.98 ± 217.63* (518.22-667.73)	129.47 - 1121.07*	573.47*
Sunda pangolin *M. javanica*	367.54 ± 161.48 (338.24-396.24)	27.19 - 824.54*	357.75
Philippine pangolin *M. culionensis*	368.28 ± 79.84 (331.93-404.62)	275 - 553	341

Black-bellied pangolin *M. tetradactyla*	322.68 ± 27.82 (320.97-324.38)	118 - 379	324
White-bellied pangolin *M. tricuspis*	184.02 ± 50.61 (165.45-202.58)	115.5 - 322.06	184.31

*This estimate was first reported in Zhou *et al.* (2012).

14. The IUCN pangolin specialist group highlights several limitations with the updated analysis presented. The substantial effort by the authors and their collaborators since 2021 has produced the best data available for each species to date. Despite this, the conversion parameters are not yet based on standardised samples of, for example, 30 adults of species, which is the case for *M. culionensis, M. crassicaudata* and *M. temminckii*. Nor is the data reflective of the intraspecific heterogeneity for which there is preliminary evidence, especially for the more widely distributed species (e.g., *M. temminckii*). There are also concerns about the condition of scales used to estimate scale masses.

15. Several steps need to be taken before scale mass estimates for all eight pangolin species can be considered robust to derive the finalised conversion parameters. Under the project "Developing Robust Conversion Parameters for Seized Pangolin Scales," work remains ongoing and the Animals Committee may wish to invite the IUCN pangolin specialist group to keep the Committee informed of any updates produced.

Implementation of Decision 19.203

16. The Secretariat issued Notification to the Parties No. 2023/051 on materials for the identification of specimens of CITES-listed species on 20 April 2023, including a request to Parties, international organizations, international aid agencies and non-governmental organizations that developed tools and materials that could assist Parties in the implementation of Resolution Conf. 17.10 (Rev. CoP19) on *Conservation of and trade in pangolins* or identification materials concerning pangolin species, their parts and derivatives to bring such materials to the attention of the Secretariat. The notification also sought to solicit samples from relevant and potential sources holding carcasses and skins, including zoos and museums, that can be used to increase the sample sizes to meet or exceed the minimum baseline of 30 specimens for those species not adequately represented, as requested by the Animals Committee at AC32. In Notification to the Parties No. 2024/022 issued in January 2024, the Secretariat also reminded Parties and organizations of this Notification regarding identification materials.

17. At the time of writing, two responses had been received from the United States of America and Shark Guardian. The following identification materials were identified and referred to the joint working group on identification materials that was established by the Animals and Plants Committees under Decision 19.142:

    - https://www.traffic.org/site/assets/files/17352/eng_identification_sea_e.pdf and
    - https://www.usaidrdw.org//pangolin-guide/

    The first link is a guide to assist in the identification of wildlife species which are commonly found in trade in southeast Asia, while the second link refers to a guide that is specific to pangolins. The Animals Committee may wish to consider these guidance materials at this meeting.

Recommendations

18. The Animals Committee is invited to:

    a) consider the response to Notification to the Parties No. 2024/022, contained in Annex 1; and the conversion parameters presented in the table in paragraph 13 above;

    b) agree that the conversion parameters presented in the table in paragraph 13 for *M. gigantea, M. javanica, M. pentadactyla, M. tetradactyla* and *M. tricuspis* can be used by Parties in cases where national legislation demands that such information be provided for law enforcement and court purposes

    c) submit the following draft decisions to the Standing Committee for its consideration and onward submission to the 20th meeting of the Conference of the Parties (CoP20):

    Directed to the Secretariat

    20.AA *The Secretariat shall, subject to external funding, work with the Species Survival Commission Pangolin Specialist Group of the International Union for Conservation of Nature (IUCN) and*

other relevant experts and in collaboration with the pangolin range States to further develop conversion parameters for all pangolin species, in particular M. culionensis, M. crassicaudata and M. teminckii, *taking into account document AC33 Doc. 35. These conversion parameters should enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, that can be used by Parties in cases where national legislation demands that such information be provided for court purposes.*

Directed to the Animals Committee

20.BB *The Animals Committee shall:*

a) review the conversion parameters for all pangolin species, developed in accordance with the provisions of Decision 20.AA, to enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, and that can be used by Parties in cases where national legislation demands that such information be provided for law enforcement and court purposes; and

b) make recommendations as appropriate to the Parties and the Standing Committee.

d) invite Parties to use the following identification materials to support the identification of seized pangolin specimens at species level:

- https://www.traffic.org/site/assets/files/17352/eng_identification_sea_e.pdf and
- https://www.usaidrdw.org//pangolin-guide/

e) agree to prioritize pangolins in the mandate of the proposed Animals Committee working group on identification materials, should it be established after CoP20; and

f) agree that Decision 19.239 has been implemented and can be proposed for deletion at CoP20.

SUMMARY OF RESPONSES TO NOTIFICATION TO THE PARTIES NO. 2024/022

Information submitted by Parties concerning the development and implementation of *in situ* pangolin management and conservation programmes

Party	Species	Document shared: plan / strategy / information	Key aspects referred to in Res. Conf. 17.10 (Rev. CoP19) Population assessments, Non-detriment findings, Monitoring, Management and conservation measures
Malaysia	*Manis javanica*	Information provided on activities implemented relating to the conservation of pangolin.	Malaysia provided an overview of efforts undertaken to implement *in situ* pangolin management and conservation initiatives. Focus on East Malaysia, Sabah. Sabah Wildlife Department (SWD) enhanced the protection status of the Sunda pangolin: totally protected (Schedule 2 in legislation) - all forms of pangolin hunting is prohibited. Collaboration with various government agencies, ministries, NGOs and private sector = support network and sharing of resources, expertise and information. Focus on protection of habitat through patrols at district level. Train community members and stakeholders to become Honorary Wildlife Wardens – empowers local individuals and increase departments enforcement capacity. Also designed to increase public awareness Population assessments hindered by elusive nature. Several organizations and institutes are conducting research on Sunda pangolin biology, behaviour, distribution, home range, habitat use, phylogeny, trade and their role in traditional beliefs and medicine. Methods for assessing the population of Sunda pangolins in Sabah incorporate both standard and modern techniques, including direct observation, transect surveys, camera trapping, nocturnal surveys, interview surveys, radio and GPS telemetry, remote sensing, and DNA sampling, covering both protected and non-protected areas. A long-term study in the Kinabatangan floodplain ecosystem provides estimates of the home range for wild female Sunda pangolins at 69 ha and for males at 116 ha. Observations of their use of diverse natural and man-made structures for sleeping sites across various habitats suggest a degree of adaptability to habitat fragmentation. It identifies critical microhabitats, primarily in mature forests with tall and large trees featuring hollows, as essential for the breeding and reproduction of Sunda pangolins, underscoring their specific habitat requirements. Camera trapping studies indicate a wide distribution across Sabah, implying a wide but pressured population due to habitat changes. A preliminary assessment of pangolin rescue operations from 2016 – 2023: Increasing number of pangolins found in human-dominated areas and approximately 300 Sunda pangolins rescued over this period of time. No specialized pangolin rescue facilities – rescued animals are promptly released / translocated. **NDF**: No NDF for pangolin from Sabah. Prohibitions in place. Actions: • Assessment of population status – gathering data on population sizes, distribution and trends through field surveys and monitoring programmes (field surveys, camera traps,

Party	Species	Document shared: plan / strategy / information	Key aspects referred to in Res. Conf. 17.10 (Rev. CoP19) Population assessments, Non-detriment findings, Monitoring, Management and conservation measures
			radio telemetry, remote sensing and GIS technologies, citizen science, etc) • Enforcement of legal protection – include monitoring trade activities to prevent illegal trade, checkpoints and collaboration with customs and law enforcement agencies • Monitoring and enforcement: monitor potential trade patterns and enforce legislation • Community engagement and awareness • International collaboration
Namibia	*Smutsia temminckii (Manis temminckii)*	Plan: Temminck's Pangolin (*Smutsia temminckii)* National Conservation and Management Plan (CMP) 2023 – 2028 (Draft) The Conservation Management Plan (CMP) was developed by the Namibian Pangolin Working Group Vision: To conserve and sustainably manage a growing free-range population of S. temminckii in suitable habitats. Temminck's Pangolin listed as specially protected species in Namibia	Objectives of the CMP address aspects referred to in the Decision and Resolution: 1. Conservation Research and Monitoring (this includes determining the population size / density and trends, home range sizes across different habitats and land uses. Also include post-release monitoring). 2. Habitat and species protection (protection of strongholds, increase anti-poaching and monitoring resident pangolins). 3. Law enforcement and monitoring illegal activities (effective responses to threats, illegal trade reduced, training for prosecutors, and hotspots for poaching and trafficking of pangolins identified). 4. Veterinary treatment, rehabilitation and release (includes the establishment of standards for rehabilitation facilities and protocols for rehabilitation and release). 5. Management plans, strategies and guidelines (refers to Action Plan Logframe included in an Annex and sets out the activities, priorities, timeframes, and stakeholders who will collaborate to implement activities relating to each objective). 6. Awareness, education and community engagement (awareness and education about pangolin conservation needs improved). 7. Administration, accountability and collaboration (includes annual review of plan and reporting on activities implemented). Implementation of the CMP rely on partnerships and collaboration with the Ministry to complete core actions.
Philippines	*Manis culionensis*	Strategy: Palawan Pangolin (*Manis culionensis*) Conservation Strategy 2018 – 2043 Updates of implementation by the Palawan Council for Sustainable Development (PCSD) in collaboration with partners	The objectives and actions included in the conservation strategy address the aspects referred to in the Decision and Resolution: 1.1 To establish a knowledge platform on pangolins for integration into the planning of relevant agencies for evaluating development proposals 1.2 Effective management of Key Biodiversity Areas through conservation finance and improved accountability mechanism 1.3 Harmonize laws, ordinances, issuances, IRRs and other relevant policy instruments and interpretation of such to reduce conflicts in land use and the management of pangolin habitats 1.4 To increase suitable habitats by conducting research to identify and delcare habitats for protection (actions include research to identify existing and potential pangolin habitats, research on the biology, ecology and dietary preferences of pangolins as well as a population study of the endemic Palawan pangolin. The development of a management plan for specific areas is included as well as engagements with mining and plantation companies to adopt pangolin conservation programs)

Party	Species	Document shared: plan / strategy / information	Key aspects referred to in Res. Conf. 17.10 (Rev. CoP19) Population assessments, Non-detriment findings, Monitoring, Management and conservation measures
			2.1 Provide timely and punitive wildlife law enforcement to prevent and stop wildlife crimes involving pangolins (actions include training with law enforcement agencies on identification of pangolins, trafficking dynamics and law enforcement best practices as well as sessions involving the judiciary and strengthening existing Wildlife Enforcement Network) 2.2 Eliminate all demand for pangolin meat and scales in the Philippines (actions include consumer research to inform behaviour change programmes and the development and implementation of behaviour change programmes) 3.1 Knowledge of the ecology and biology of the Palawan pangolin is generated (actions include the creation of a Palawan Pangolin Special Interest Group to coordinate research efforts; conducting research on pangolin populations; development of a citizen science protocol for pangolin monitoring) 3.2 Rescue and rehabilitation capacity built for pangolins in the Philippines (actions include increasing the capacity of existing rescue facilities; determine best practice for monitoring release success; develop Palawan pangolin rescue, rehabilitation and release protocol and streamlining air repatriation of pangolins) 3.3 Education materials developed and integrated into education curriculum in the Philippines (actions include devleopment of education materials for integration into school curriculum; creation and implementation of a communication plan for Palawan pangolin) 4.1 Empower and strengthen local communities for the protection of Palawan pangolin and its habitat (actions include support for product development and marketing for honey and rattan; develop volunteer programme for monitoring, first aid and rescue; and develop and distribute education materials)
Singapore	*Manis javanica*	Strategy and Action Plan: Sunda Pangolin (*Manis javanica*) – National Conservation Strategy and Action Plan 2018: Scaling up pangolin conservation in Singapore Plan implemented by Singapore Pangolin Working Group (SPWG), a multi-stakeholder working group of appropriate bodies and experts in Singapore, including the National Parks Board	The following five goals in the strategy and action plan address aspects referred to in the Decision and Resolution: 1) To gather and share information on the Sunda pangolin's status, ecology, biology and behaviour through ongoing studies and new initiatives [Objective 1.2 specifically address population status, trends and viability of pangolins in Singapore and include actions to collect and analyze data from camera traps, sightings and roadkills, etc)] 2) To ensure viable populations through habitat protection, restoration, and connectivity (Objectives include reducing habitat loss and fragmentation, increasing connectivity between habitats and eliminating poaching). 3) To establish wildlife-conscious urban planning policies and measures that protect Sunda pangolins (Objectives include incorporating conservation needs of pangolin in urban planning policies and the enforcement of wildlife impact mitigation measures). 4) To develop successful rescue, rehabilitation and release strategies for the Sunda pangolin and secure the resources to implement them (Objectives include capacity building for first responders, development of infrastructure for successful care and rehabilitation prior to release; protocols for rescue, rehabilitation and release, monitoring post release). 5) To generate collaborations, clear communication, and awareness across all relevant agencies and solidify a commitment to the conservation of Sunda pangolins (Objectives include strategies for public involvement in pangolin conservation, increased institutional understanding and

Party	Species	Document shared: plan / strategy / information	Key aspects referred to in Res. Conf. 17.10 (Rev. CoP19) Population assessments, Non-detriment findings, Monitoring, Management and conservation measures
			awareness, establish constant vigilance against trafficking of pangolin). A working group that includes the National Parks Board meets on an annual basis to review and update the action plan.
Thailand	*Manis javanica* *Manis pentadactyla*	Information provided on activities implemented relating to the conservation of pangolin.	Both species are protected species under the Wild Animal Reservation and Protection Act B.E. 2562 (2019) (WARPA) Commercial use and trade of pangolins in Thailand are prohibited. Conservation measures are focused on: • protection of the species in natural habitats • rescue of confiscated pangolins • studying the ecological characteristic of pangolins, including data and information for reintroduction of pangolins in the wild, aiming to enhance the survival rate when pangolins are released in their natural habitat. Details are provided relating to ecological and behavioural information as well as pangolin occurrence gathered through among others collared pangolins, camera trap surveys and wildlife hotline reports. Department of National Parks, Wildlife and Plant Conservation (DNP) look after injured pangolins at DNP rescue centers. Thailand welcomes support from relevant organizations and experts in acquiring expertise and training relating to the captive care of the species to enhance its survival.

DEVELOPMENT OF CONVERSION PARAMETERS TO ESTIMATE THE NUMBER OF PANGOLINS (*MANIS* SPP.) FROM QUANTITIES OF SCALES

This updated report prepared by IUCN for the CITES Secretariat thanks to funding provided by the Pangolin Crisis Fund.

Table of Contents

1. Introduction

At the 18th meeting of the Conference of the Parties to CITES (Geneva, 2019), the Parties adopted Decision 18.239. This Decision directs the CITES Secretariat, subject to external funding, to work with the Species Survival Commission Pangolin Specialist Group of the International Union for Conservation of Nature (IUCN) and other relevant experts, and in collaboration with pangolin range States, to develop conversion parameters for all pangolin species that will enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, that can be used by Parties in cases where national legislation demands that such information be provided for court purposes.

As documented in AC32 Doc. 31, the authors of this report provided available data on scale mass for the eight species of pangolin in summarised form to the 32nd meeting of the Animals Committee. AC32 Doc. 31 noted that a number of next steps needed to be taken, including further data collection, and an examination of the biases associated with scale mass estimates, before such estimates should be used as conversion parameters. To support the collection of further data, the CITES Secretariat issued Notification 2023/088 inviting Parties and institutions who possess pangolin carcasses and skins to assist in this work. This report presents an update to this work through April 2024, including analysis of available data, presents useable conversion parameters, and discusses the limitations associated with these parameters that the authors suggest that Parties consider.

Decision 19.200 is closely related to Decision 18.239. This Decision directs the Animals Committee to: a) review the conversion parameters for all pangolin species, developed in accordance with the provisions of Decision 18.239, to enable the reliable determination of the number of animals associated with any quantity of pangolin scales seized, and that can be used by Parties in cases where national legislation demands that such information be provided for law enforcement and court purposes; b) review existing identification materials concerning pangolin species, their parts and derivatives, and consider the need for new or additional materials to be developed, including to support the identification of seized pangolin specimens at species level; c) review any information brought to its attention by the Secretariat in accordance with Decision 19.203, paragraphs b) and e); and d) make recommendations, as appropriate, to the Standing Committee and the Secretariat.

2. Methodology

2.1 Data collection and curation

The methods used to collect data are detailed in AC32 Doc. 31 and are summarised here for the convenience of the reader. There are various potential approaches to determining the species of pangolin involved in seizures of scales (e.g., genetic approaches; Zhang *et al*. 2020, Ewart *et al*. 2021) and the number of pangolins involved (e.g., scale frequency; Ullmann *et al*. 2019). However, most accurately and efficiently estimating the number of pangolins involved in a given seizure of scales necessitates knowledge of 1) the proportion of body mass that comprises scales for the different species of pangolin represented in the seizure, and 2) the proportion of scales by mass from the different species in the seizure. This report focuses on the former, i.e., expected scale mass per species. The aim of this work was to collect data on scale mass for 30+ specimens each of *M. culionensis*, *M. crassicaudata*, *M. tetradactyla*, *M. tricuspis*, *M. gigantea*, and *M. temminckii*; as well as 5+ additional specimens each of *M. pentadactyla* and *M. javanica* to supplement the data in Zhou *et al*. (2012), which were shared with the authors for the purposes of this project.

A large number of collaborators, mainly in pangolin range States, collected data for this body of work and individuals were asked to do so at one of three levels according to their availability and resources. Tier 1 comprised collecting a single data point for total scale mass for each available pangolin specimen (e.g., carcass). Tier 2 comprised collecting data on scale mass for different body regions (e.g., trunk and tail) in addition to the total scale mass. Tier 3 comprised collecting data as for Tier 2 but also the collection of data on scale thickness, pliability, and the mass of selected individual scales. Data collected at Tiers 2 and 3 are being used to inform the development of tools beyond implementation of Decision 18.239. The number and source of specimens and data used to estimate conversion parameters for each species are summarised in Table 1. For *M. culionensis, M. temminckii, M. gigantea*, and *M. tetradactyla* there was a need to deviate from the method detailed in the guidance referred to above, i.e., removal of scales from carcasses, because of the lack of availability of whole carcasses for these species.

For *M. culionensis,* the Palawan Council for Sustainable Development (PCSD, Philippines) advised that they possessed 21 *M. culionensis* carcasses that had been descaled, and that they possessed the loose scales. Scale matching was therefore used. PCSD staff followed a guide

Table 1. Specimens and data used to estimate conversion parameters.

Species	No. of specimens	Source description	Source(s)
Sunda pangolin *M. javanica*	124	Scales removed from carcasses and dried for 45 days prior to data collection (n=119)	Zhou *et al.* (2012)
		Scales removed from roadkill carcasses in Singapore (n=5)	This study
Chinese pangolin *M. pentadactyla*	35	Scales removed from carcasses and dried for 45 days prior to data collection	Zhou *et al.* (2012)
Philippine pangolin *M. culionensis*	21	Loose scales from pangolin carcasses seized from a trader in the Philippines	This study
Indian pangolin *M. crassicaudata*	13	Scales removed from carcasses recovered from trade/from zoological collections	This study
White-bellied pangolin *M. tricuspis*	31	Scales removed from carcasses recovered from trade	This study
Black-bellied pangolin *M. tetradactyla*	1029	Scales removed from carcasses recovered from trade (n=9) and seized scales used to "re-construct" specimens (n=1020)	This study
Giant pangolin *M. gigantea*	1022	Scales removed from carcasses recovered from trade (n=1), from dried skins recovered from trade (n=1), and from seized scales used to "re-construct" specimens (n=1020)	This study
Temminck's pangolin *M. temminckii*	20	Scales removed from carcasses recovered from trade (n=8) and from dried skins recovered from trade (n=12)	This study

on the size and shape of scales to match each loose scale from a centralised pile of scales to a pangolin body part on a single carcass, until each scale on each specimen was accounted for (see AC32 Doc. 31). They then recorded scale mass data following the instructions for Tier 2.

For *M. temminckii*, it was possible for some collaborators to access carcasses and collect data using the guide referred to above. Other collaborators only had access to dried *M. temminckii* skins with the scales still attached (Table 1). In these circumstances, each skin was soaked individually in a solution comprising 25% ammonia and 75% water to soften the tissues making it possible to remove the scales and subsequently collect scale mass data following Tier 2 (see AC32 Doc. 31). This protocol was also implemented for one *M. gigantea* specimen in Uganda.

For *M. gigantea* and *M. tetradactyla*, only a small number of carcasses were available for this study (Table 1). To overcome this limitation, seized scales from these species were used to "reconstruct" whole specimens in terms of scales, from which scale mass estimates were taken. Using seized scales in Cameroon and Nigeria, scales morphologically identifiable as *M. gigantea* and *M. tetradactyla* were sorted into species-specific piles. These piles were then further sorted into sub-piles representing the following body regions based on scale morphology: head, limbs (fore and hind together), trunk, tail-dorsal, tail-ventral, and tail-lateral. The number, including range, of scales typically found on each body region was determined using published (Ullmann *et al*. 2019) and unpublished (M. Shirley, unpubl. data) data. A random number generator in MS Excel was then used to generate the number of scales needed for 20 random samples of loose scales for each body region. There is preliminary evidence to suggest that there is a relationship between the frequencies of scales on the three tail regions, but not between other body regions; this was accounted for in the random number generation. Initially, 20 complete specimens of both *M. gigantea* and *M. tetradactyla* were reconstructed and scale mass data were collected from these specimens at the Tier 2 level. This methodology was time consuming, and to increase the sample size, these individual body region data were also randomly recombined to generate total scale mass for 1000 additional specimens of each species, capturing known variation in tail scale frequency and collinearity. These estimates were combined with the other data collected for these species and used to estimate the conversion parameters (Table 1).

All data submitted from collaborators to the authors were checked for accuracy and any errors corrected through correspondence with the collaborators.

2.2. Data analysis

The sample size and data available for analysis differed by species (Table 1). Descriptive statistics were used to estimate the mean (and standard deviation), including 95% confidence intervals, range, and median scale mass for each species. A Shapiro-Wilks test was conducted, and a histogram produced and visually examined, to determine whether the data for each species were approximately normally distributed. The distribution of scale mass data did not deviate from normality for 5 species (*M. javanica* [W = 0.98, p = 0.07], *M. pentadactyla* [W = 0.98, p = 0.96], *M. crassicaudata* [W = 0.90, p = 0.16], *M. temminckii* [W = 0.97, p = 0.83], and *M. tricuspis* [W = 0.93, p = 0.05]), but did for 3 species (*M. culionensis* [W = 0.88, p = 0.02], *M. gigantea* [W = 0.99, p = 0.000], and *M. tetradactyla* [W = 0.89, p = <0.000]. A Kruskal-Wallis analysis of variance test was therefore used to test for significant differences in scale mass between the species. Pairwise comparisons using the Wilcoxon rank-sum test were then used to test for significant differences between pairs of species. All analyses were undertaken in RStudio version 1.4.1717.

3. Results and Discussion

3.1 Scale mass and conversion parameters

Scale mass varied significantly among the eight species of pangolin (Chi-squared = 1768.1, df = 7, p = <0.000), ranging from a median of 184 g (range: 115.5–322 g) for *M. tricuspis* to 3876.5 g (range: 2030–5448 g) for *M. gigantea* (Table 2, Fig. 1). The Wilcoxon rank-sum test indicated that there is a significant difference in scale mass among all pairwise comparisons of the eight species, except *M. javanica* and *M. culionensis*. The conversion parameters are presented as means with 95% confidence intervals and medians (Table 2). Prior to using the conversion parameters to estimate the number of pangolins in seizures of scales the authors recommend that individuals and organisations considering doing so read the limitations section of this report (Section 3.3).

Table 2. Scale mass estimates as conversion parameters for the eight species of pangolin.

Species	Mean ± SD (95% CIs) (g)	Range (g)	Median (g)
Giant pangolin *M. gigantea*	3853.01 ± 617.22 (3815.12-3980.89)	2030 - 5448	3876.5
Temminck's pangolin *M. temminckii*	2020.1 ± 935.72 (1582.17-2458.03)	342.25 - 3911	1928.88
Indian pangolin *M. crassicaudata*	1299.95 ± 623.64 (923.08-1676.81)	56.25 - 2099.66	1096.89
Chinese pangolin *M. pentadactyla*	592.98 ± 217.63* (518.22-667.73)	129.47 - 1121.07*	573.47*
Sunda pangolin *M. javanica*	367.54 ± 161.48 (338.24-396.24)	27.19 - 824.54*	357.75

Philippine pangolin *M. culionensis*	368.28 ± 79.84 (331.93-404.62)	275 - 553	341
Black-bellied pangolin *M. tetradactyla*	322.68 ± 27.82 (320.97-324.38)	118 - 379	324
White-bellied pangolin *M. tricuspis*	184.02 ± 50.61 (165.45-202.58)	115.5 - 322.06	184.31

*This estimate was first reported in Zhou *et al.* (2012).

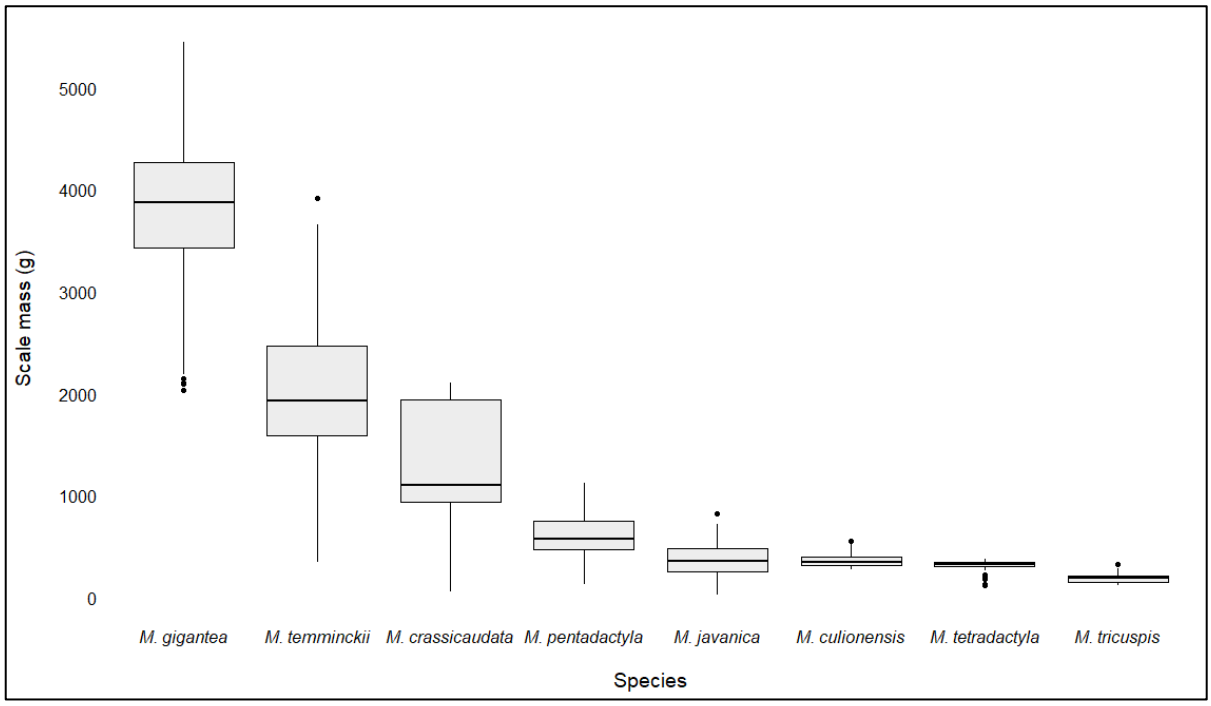

Fig. 1. Boxplot of scale mass for pangolins. The median is the line across the box.

3.2 Discussion

The mass-based conversion parameters presented here are the first such estimates for most pangolin species and comprise updated, more robust parameters than those published previously for any species of pangolin, except for *M. pentadactyla*. Most research to date that has used a mass-based approach to estimate the number of pangolins in seizures of scales has used scale

mass estimates presented by Zhou *et al.* (2012) for *M. javanica* (median = 360.51 g) and taken this estimate as representative of the scale mass of an "average" pangolin. This is, in large part, because species-specific conversion parameters have not been developed until now. Two studies have tried to address this problem by developing and/or using species-specific conversion parameters for the three species of pangolin in West Africa detected in Nigerian seizures (Emogor *et al.* 2021) and for *M. crassicaudata* (Algewatta & Perera 2022). The new and updated scale mass estimates presented in this report underscore the bias in most previous estimates of the number of pangolins in illegal (and legal) trade; mean scale mass for an "average" pangolin is likely closer to 1.126 kg than 360.51 g (Table 2, though see Section 3.3). The use of small samples sizes (e.g., Emogor *et al.* 2021) or reconstruction based estimates using scale morphotypes (e.g., Algewatta and Perera 2022), has significantly underestimated species-specific conversion parameters (by >50% for *M. tetradactyla* and ±10% for *M. gigantea*) or overestimated them (by ~300% for *M. crassicaudata*) though see limitations (Section 3.3).

The difference in scale mass among species approximately follows the reduction in overall mass of pangolins (Challender *et al.* 2020a). The terrestrial African pangolins (*M. gigantea* and *M. temminckii*) have the largest mass of scales, followed by the Asian species (*M. crassicaudata*, *M. pentadactyla*, *M. javanica*, and *M. culionensis*), with *M. crassicaudata* having a greater scale mass than the other Asian species as would be expected based on known variation in overall mass (Challender *et al.* 2020a, Algewatta *et al.* 2021). The arboreal (*M. tetradactyla*) and semi-arboreal (*M. tricuspis*) African species have the smallest scale mass. While this reflects the expected scale mass based on knowledge of pangolin morphology, the diversity in size among the eight species of pangolin means that the exact relationship and the degree of overlap between species requires further investigation, especially because of the small sample sizes for *M. crassicaudata* and *M. temminckii* included in this study. *Manis gigantea* is recognized as the largest pangolin species globally by mass (up to 43 kg; Hoffmann *et al.* 2020), but the single largest pangolin observed to date was a *M. crassicaudata* individual that weighed 48.8 kg (Algewatta *et al.* 2021) and there is a limited understanding of the size variation in this species. Similarly, evidence suggests that *M. temminckii* generally attains approximately half the size and mass of *M. gigantea* (Pietersen *et al.* 2020), but there is preliminary evidence for considerable, as yet not fully documented, heterogeneity in this species across its range (see Section 3.3).

Understanding the relationship between the size of pangolins, total mass and scale mass has important implications for how scale conversion parameters should be used. For example, taking

a given mass of seized scales (e.g., 1000 kg), the estimated number of whole pangolin equivalents (WPEs) would range from 258 *M. gigantea* to 5,426 *M. tricuspis* or 2,774 "average" pangolins using the previously used conversion parameter of 360.51 g. However, many seizures of pangolin scales contain more than one species and few efforts have been made to understand the proportion of total seizure mass (or frequency) regarding the species. Emogor *et al*. (2021) estimated that *M. tricuspis* accounted for 71% of the mass of Nigeria-linked seizures, the terrestrial African pangolins (*M. gigantea* and *M. temminckii*) accounted for 18% and *M. tetradactyla* for 11%; other studies also suggest that scales from *M. tricuspis* are the most frequently encountered in seizures (e.g., Ewart *et al.* 2021, Yeo *et al*. 2024).

The application of these frequencies suggests that number of WPEs in any given seizure of scales is likely to be considerably more than previous estimates have suggested (e.g., Challender *et al.* 2020b). Consequently, there is a need for significantly more research to understand species-specific trade dynamics involving pangolins to both more accurately estimate the number of animals removed from the wild and the impact that this has on populations of these species.

3.3 Limitations

Notwithstanding the presentation of conversion parameters in this report, there are a number of limitations that need to be highlighted. The substantial effort by the authors and their collaborators (see Acknowledgements) since 2021 has produced the best data available for each species to date. Despite this, the conversion parameters are not yet based on standardised samples of, for example, 30 adults of each species. Nor is the data reflective of the intraspecific heterogeneity for which there is preliminary evidence, especially for the more widely distributed species (e.g., *M. temminckii*). There are also concerns about the condition of scales used to estimate scale masses. These limitations are summarised below.

Sample size – A true sample size of 30+ specimens was only achieved for three species – *M. pentadactyla*, *M. javanica*, and *M. tricuspis* – the former two of which had existing and reasonably robust scale mass estimates. For two additional species – *M. tetradactyla* and *M. gigantea* – the minimum sample size was achieved through "reconstructing" specimens using seized scales, but further confidence in the conversion parameters could be gained by sampling from additional carcasses. Further data on scale mass is needed for the remaining three species – *M. culionensis*, *M. crassicaudata* and *M. temminckii* – to improve the robustness of the

conversion parameters. The deficit of data has also impeded estimation of conversion parameters for pangolins at a continental level – both Africa and Asia – and for the Family Manidae overall (e.g., mean scale mass for all eight species).

Intra-specific variation – Over the course of this work several sources of intra-specific variation and bias have been identified, which should be taken into consideration prior to using the conversion parameters. Further research is also required to fully understand the extent of the variation and biases. This variation and these biases are:

- Variation between different sex and age (adults, sub-adults, and juveniles) demographics, and a better understanding of the proportion of individuals removed from the wild from these demographic groups. The samples used in this work to date comprised a fairly even proportion of male and females, but individuals were predominantly classified as adults.
- Variation related to as yet understood preliminary evidence for divergent evolutionarily significant units and/or cryptic pangolin species within currently recognized taxa (e.g., Gaubert *et al*. 2016, Hu *et al.* 2020). This may also be related to the next limitation.
- Ecologically-driven heterogeneity resulting in size variation across individual species' ranges. For example, *M. temminckii* is smaller in the Kalahari than in other regions of southern Africa (Pietersen *et al.* 2020), all of which appear significantly smaller than individuals in East Africa and northern Central Africa (this study, and C. Okell, pers. comm.). For example, two *M. temminckii* skins from East Africa (one each from Kenya and Uganda) were sampled in this study, both of which had scale masses 10-15% greater than the largest individuals from South Africa and were nearly double the scale mass of all individuals from Namibia.
- For all species, the samples used to derive the conversion factors presented here came from relatively restricted distributions within each of their ranges. As presented above, there is evidence that variable habitats and climates, potentially driving evolutionary divergence across populations, are correlated with significant body size variation in these species but in ways not yet understood. This variation certainly impacts what is known about the mean and distribution of scale masses for each species, especially considering the little information about source populations for most species. These factors will further influence estimation of WPEs based on the most frequently extracted source populations.

Scale condition – It is as yet unclear how variation in the condition of the scales used to estimate scale mass impacts these estimates. These concerns largely relate to the length of time between the removal of scales and further measurement, including both data collected for the conversion parameters and in future consignments/seizures of scales. It may be that heterogeneity in scale condition in future seizures means that heterogeneity in the condition of scales used to derive conversion parameters can be tolerated. Other concerns are:

- State of desiccation of scales. Specifically, have the scales been purposefully dried and for how long. There is preliminary evidence from this work that scales lose significant mass as they dry. Scales from one of the *M. temminckii* carcasses included in this study were kept and weighed at regular intervals and lost 51% of their mass over 6 months. As part of the broader effort to understand the proportion of species represented in seizures (not included in this report), the seizures analysed (see Outputs) included well-kept and desiccated scales to others stored outside and constantly exposed to the elements (e.g., heavy rain and direct sunlight).
- Decomposition of scales in consignments or seizures to be converted to estimated number of pangolins. It is expected that scales stored in a dry environment and out of the sun versus those exposed to the elements will produce substantially different scale mass estimates.
- Presence of skin, dirt, and other debris attached to the scales. Only scales free of tissue, dirt, and other debris were used for the derivation of conversion parameters in this work. As part of the broader effort to understand the proportion of species represented in seizures (not included in this report), the various seizures analysed for this work variously included clean scales free of debris to scales covered in dirt and dust with significant amounts of tissue attached. It is as yet unclear if this is related to the age of the scales or the diligence of the actors trafficking scales to meet the demands of actors further along supply chains.

4. Next steps

There are several steps that need to be taken before scale mass estimates for all eight pangolin species can be considered robust to derive the finalised conversion parameters. Thanks to additional funding from the Pangolin Crisis Fund (PCF) for a project titled "Developing Robust Conversion Parameters for Seized Pangolin Scales," much of the below work is on-going by the authors of this report.

Additional data collection

- Liaison with collaborators—existing and new—to increase sample sizes to 30+ individuals for each species where this has not yet been achieved. To this end, Parties and other stakeholders are asked to continue facilitating these efforts wherever possible.
- Collection of scale mass data that enables further assessment of the variation associated with demographic groups (e.g., sex and life stage) and ecological and evolutionary variation across the range of each species.
- Further understanding how scale mass estimates vary based on condition (e.g., desiccated scales vs. wet, new vs. old, and rotten vs. intact, among other comparisons).

Assessment of species composition in seizures

- Comprehensive data have been collected on species composition within 55+ seizures (stockpile management has created confusion around the exact number of seizures involved), comprising 569 containers (e.g., bags or boxes of scales), and totalling 21,929.5 kg (i.e., 22 tonnes) from five African countries (Cote d'Ivoire, Nigeria, Cameroon, Uganda, and Kenya). Evaluation of further seizures, especially those in Asia, is needed to develop robust expectations and to model species composition based on consignment characteristics (e.g., origin, transit and destination). Parties and other stakeholders are asked to notify the authors of this report if and when seizures are made and become available for data collection and to facilitate data collection wherever possible.
- For such data already collected, several different sub-sampling regimes will be used to inform the development of guidance for Parties (see Outputs below) on assessing species composition in seizures. Metadata on seizures (e.g., country of seizure, shipping information, transit, and origin countries), will also be analysed where known, to develop geography-specific expectations of species composition.

- The conversion parameters developed – both those in Table 2 and updated versions – will be applied in analyses of seizures of scales and recommendations made for their application under different species composition scenarios.

Outputs

- Use conversion parameters presented in this report with species composition data to provide updated and more accurate estimates of the scale of pangolin trafficking globally in terms of numbers of pangolins, the species involved, and assess the impact of offtake on the eight different species where possible – which are not all expected to be impacted equally or similarly.
- Develop a guidance document (including a decision tree) on using the scale conversion parameters for use by CITES Parties and other stakeholders. This will include guidance on estimating the number of WPEs (whole pangolin equivalents) under diverse scenarios of species combination and consignment/seizure metadata, including country/region/continent models of species composition in seizures.
- Develop an illustrated pangolin scale identification guide based on data and materials (e.g., photos) collected as part of this work. Detailed photos of the different scales from each of the body regions for all eight species have been taken as part of this work. This guide will be useful for morphologically identifying scales to species when more costly genetic analyses are not accessible.
- Develop a conversion tool for use by range States and other stakeholders that includes species, genera, and geography-specific conversion parameters, as well as spatial models accounting for species composition in seizures. The tool will likely take the form of a smartphone "app" or an Excel spreadsheet with macros. In either case, users will respond to a series of questions and provide a set of input data to derive the number of WPEs.
- Devise recommendations for judiciaries on the use of conversion parameters and the estimated numbers of WPEs, considering the current legal context for pangolins (see CITES 2022). For example, pangolin species are afforded the highest level of protection in nearly every range State, but virtually no range State has defined penalty multipliers for multiple, concurrent offenses (i.e., trafficking one live pangolin versus 5,000 pangolins in scales). To the best of the author's knowledge, range States typically approach penalizing incidents of pangolin trafficking as single incidents (i.e., one consignment of scales is the same as one single pangolin). The highlighted limitations with the currently proposed conversion

parameters will have more or less impact or relevance under different approaches to justice for pangolin trafficking and related crimes.

These products will be made available to the CITES Parties, other interested stakeholders, and through peer-reviewed publications as soon as possible.

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