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VKM, Hugo de Boer, Maria G. Asmyhr, Daniel Flø, Berit Gehrke, Matthew Grainger, Jo S. Hermansen, Alexander Kopatz, Katrine Eldegard, Joost A. M. Raeymaekers, Eli K. Rueness

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Preparation of the opinion

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) appointed a project group to draft the opinion. The project group consisted of 4 VKM members and 2 VKM staff. Two referees commented on and reviewed the draft opinion. The Committee, by the Panel on CITES, assessed and approved the final opinion.

Authors of the opinion

The authors have contributed to the opinion in a way that fulfils the authorship principles of VKM (VKM, 2019). The principles reflect the collaborative nature of the work, and the authors have contributed as members of the project group and/or the VKM Panel on CITES.

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Competence of VKM experts

Persons working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third-party interests. The Civil Services Act instructions on legal competence apply for all work prepared by VKM.

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Summary

This report provides a scientific risk assessment of the effects that international trade in selected species of pythons (Pythonidae spp.) and python products may have on populations of these species. The assessment is based on the criteria given under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The risk assessment is limited to species in the genera *Apodora*, *Aspidites*, *Liasis*, *Malayopython*, *Morelia,* and *Python* imported/exported to/from Norway since 2010 (ToR §3). Risk assessments to determine species-specific detriment (cf. Res. Conf. 16.7 (Rev. CoP17) Non-detriment findings) were made for 17 species using a standardized approach. Significant data gaps affected the degree of uncertainty associated with the assessments. Data gaps are mostly related to populations, trends, and illegal trade. Population and trade data for many species was more than a decade old and might therefore not reflect the current situation for these species. Based on the species-specific detriment assessments VKM concludes no detriment for 12 species (*Apodora papuana, Aspidites melanocephalus, Liasis mackloti, Malayopython reticulatus, Morelia bredli, Morelia spilota, Morelia viridis, Python anchietae, Python bivittatus, Python breitensteini, Python brongersmai, Python curtus*). For one species, VKM concludes detriment (*Morelia boeleni*). For two species, a split conclusion is made based on the region of origin (*Python regius* and *Python sebae*). Furthermore, sufficient data was lacking for *Malayopython timoriensis* and VKM is therefore unable to make a detriment assessment. The final species, *Python molurus*, is CITES Appendix I listed and should not be traded for commercial purposes. The degree of uncertainty associated with each assessment varied based on data availability and this is indicated as a confidence level of the individual assessments (low to high).

Key words: *Apodora*, *Aspidites*, CITES, *Liasis*, *Malayopython*, *Morelia*, NDF, non-detriment finding, Norwegian Environment Agency, Norwegian Scientific Committee for Food and Environment, *Python*, Pythonidae, pythons, risk assessment, trade, VKM

Sammendrag på norsk

Denne rapporten er en vitenskapelig risikovurdering av effekter som internasjonal handel med utvalgte arter av pytonslanger (Pythonidae spp.) og produkter laget av pytonslanger, kan ha for bestander av disse artene. Vurderingen er gjort med basis i kriteriene gitt under Konvensjonen om internasjonal handel med truede arter av vill fauna og flora (CITES). Risikovurderingen er begrenset til arter i slektene *Apodora*, *Aspidites*, *Liasis*, *Malayopython*, *Morelia* og *Python,* som er blitt innført/utført til/fra Norge siden 2010 (ToR §3). Ved hjelp av en standardisert tilnærming ble det utført risikovurderinger for 17 arter for å fastslå hvorvidt handel er til skade for artenes bevaringsstatus (jf. Res. Conf. 16.7 (Rev. CoP17) Non-detriment findings). Det er betydelige datamangler, hovedsakelig relatert til bestander, trender og ulovlig handel, som påvirker graden av usikkerhet ved vurderingene. For mange arter var bestands- og handelsdata over ti år gamle. Derfor gjenspeiler de kanskje ikke den nåværende situasjonen for disse artene. Basert på artsspesifikke vurderinger konkluderer VKM med at handel ikke er til skade for artenes bevaringsstatus for 12 av artene (*Apodora papuana*, *Aspidites melanocephalus*, *Liasis mackloti*, *Malayopython reticulatus*, *Morelia bredli*, *Morelia spilota*, *Morelia viridis*, *Python anchietae*, *Python bivittatus*, *Python breitensteini*, *Python brongersmai*, *Python curtus*). VKM konkluderer med at handel er til skade for artens bevaringsstatus én art (*Morelia boeleni*). For to arter (*Python regius* og *Python sebae*) konkluderer VKM med at skade/ikke skade for artens bevaringsstatus avhenger av hvilken region eksemplarene kommer fra. For *Malayopython timoriensis* manglet det tilstrekkelig data til at VKM kan foreta en vurdering. Den siste arten, *Python molurus*, er oppført i CITES Appendix I og kommersiell handel er ikke tillatt. Graden av usikkerhet knyttet til vurderingene varierte med basis i tilgjengelighet av data, og er indikert som et konfidensnivå for de enkelte vurderingene (lav til høy).

Abbreviations

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

GBIF – Global Biodiversity Information Facility

IUCN – International Union for Conservation of Nature

NDF – Non-detriment finding

UNEP – United Nations Environment Programme

Background as provided by the Norwegian Environment Agency

CITES regulates international trade in endangered species. This includes many species of Pythons. Imports to Norway generally require both export permits from foreign CITES authorities and import permits from the Norwegian Environment Agency. Export or re-export of these species also require permits issued by the Norwegian Environment Agency.

The Norwegian Environment Agency receives applications regarding permits for Pythons and specimens or products containing the species. Consequently, a scientific risk assessment (Non-Detriment Finding - NDF) is needed.

The risk assessment shall be used by the Norwegian Environment Agency in the evaluation of applications in accordance with the Norwegian Regulation on importation, exportation, possession, etc. of endangered species of wild fauna and flora (CITES regulation).

Terms of reference as provided by the Norwegian Environment Agency

Assignment

1. The Norwegian Environment Agency asks VKM for a scientific risk assessment of trade in Pythons (Pythonidae spp.) listed in the CITES appendices and specimens thereof, based on the criteria given under the Convention on International Trade in Endangered Species (CITES). The Norwegian Environment Agency also asks VKM to give an estimate as to when the risk assessment should be updated.

2. The assessment shall be based on the Norwegian CITES Regulation, relevant articles in the convention text and resolutions. The assessment shall contain available knowledge on the following:

a. Name, distribution, life history, habitat, role in ecosystem

b. Populations and trends

c. Legal / illegal harvesting, captive breeding and trade

d. Assessment of the threat(s) posed by trade

e. Brief summary of other threats and conservation status

f. Population monitoring programs in the range area

g. National regulations / legislation and in the range countries

h. Current management in the range countries, including harvest quotas

i. Overall assessment of data quality

3. Limitation: The risk assessment primarily concerns the species imported/exported to/from Norway since 2010.

Background documents:

- Norwegian CITES regulation FOR - 2018-06-15-889

- Convention text, especially CITES Articles II, III, IV, VII, IX, og XIV.

- Res. Conf. 7.12 (Rev. CoP15) Marking requirements for trade in specimens of taxa with populations in both Appendix I and Appendix II

- Res. Conf. 8.3 (Rev. CoP13) Recognition of the benefits of trade in wildlife

- Res. Conf. 8.13 (Rev. CoP17) Use of coded-microchip implants for marking live animals in trade

- Res. Conf. 9.21 (Rev. CoP18) Interpretation and application of quotas for species included in Appendix I

- Res. Conf. 9.24 (Rev. CoP17) Criteria for amendment of Appendices I and II

- Res. Conf. 10.3 Designation and role of the Scientific Authorities

- Res. Conf. 10.16 Specimens of animal species bred in captivity

- Res. Conf. 10.17 (Rev. CoP14) Animal hybrids

- Res. Conf. 10.21 (Rev. CoP16) Transport of live specimens

- Res. Conf. 11.16 (Rev. CoP15) Ranching and trade in ranched specimens of species transferred from Appendix I to Appendix II

- Res. Conf. 12.10 (Rev. CoP15) Registration of operations that breed Appendix-I animal species in captivity for commercial purposes

- Res. Conf. 13.2 (Rev. CoP14) Sustainable use of biodiversity: Addis Ababa Principles and Guidelines

- Res. Conf. 14.7 (Rev. CoP15) Management of nationally established export quotas

- Res. Conf. 16.6 (Rev. CoP18) CITES and livelihoods

- Res. Conf. 16.7 (Rev. CoP17) Non-detriment findings

- Res. Conf. 17.12 Conservation, sustainable use of and trade in snakes

- Res. Conf. 18.6 Designation and role of Management Authorities

- CITES 'Non-detriment findings' background - http://cites.org/eng/prog/ndf/index.php

- Interpretation and application of quotas for species included in Appendix I: http://www.cites.org/eng/res/09/09-21R13C15.php

1 Introduction

1.1 Risk assessment of threat posed by trade to wild populations

This report provides a scientific risk assessment of trade in pythons (Pythonidae spp.) listed in the CITES appendices, and specimens thereof, based on the criteria given under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The assessment is based on the Norwegian CITES Regulation as well as relevant articles in the CITES convention text and resolutions. The species lists in the Norwegian CITES Regulation (FOR-2023-02-23-249) correspond with the CITES appendices in the following way: CITES Appendix I is equal to CITES forskrift vedlegg I, liste A; Appendix II to vedlegg I, liste B; Appendix III to vedlegg I, liste C. In this report VKM refers only to the CITES Appendices. CITES is an international agreement adopted and implemented by Norway that aims to ensure that international trade in wild animals and plants does not threaten their survival. In addition to CITES documents, Res. Conf. 7.12 (Rev. CoP15), Res. Conf. 9.24 (Rev. CoP17), Res. Conf. 10.3, Res. Conf. 10.17, Res. Conf. 12.10 (Rev. CoP15), Res. Conf. 14.7 (Rev. CoP15), Res. Conf. 18.6, AC28 Inf. 5, AC30 Doc. 27.2, the following CITES convention documents are specifically relevant for the trade in pythons:

- Res. Conf. 8.3 (Rev. CoP13) on the recognition of the benefits of trade in wildlife emphasizes the need to manage trade in a sustainable way. It acknowledges the role of trade in wildlife in promoting conservation and sustainable use of species.
- Res. Conf. 16.6 (Rev. CoP18) on CITES and livelihoods recognizes the important role that CITES plays in supporting the livelihoods of people who depend on wild species for their economic, social, and cultural well-being. It emphasizes the need to balance conservation and sustainable use objectives with the needs of local communities.
- Res. Conf. 13.2 (Rev. CoP14) on sustainable use of biodiversity emphasizes the importance of using species in a way that maintains their populations, ecosystems, and ecological processes. The principles and guidelines set out in this document are relevant to the trade in pythons as they promote the sustainable use of pythons in trade.
- Res. Conf. 17.12 deals specifically with conservation, sustainable use of and trade in snakes. It recognizes the important role that snakes play in ecosystems and the need to manage their trade in a sustainable way, and also emphasizes the importance of involving local communities in the management of snake populations.
- Considering potential laundering of wild-caught specimens, Res. Conf. 10.16 on specimens of animal species bred in captivity is also considered. It emphasizes the importance of ensuring that specimens of captive-bred animals are not laundered into the illegal trade and are traded in a sustainable way.
- AC29 Doc 31.1 [(Non-Detriment Findings for Snakes: Guidance for CITES Scientific Authorities IUCN-SSC Boa and Python Specialist Group) 2017]. It presents a method for CITES Scientific Authorities to make NDF assessments for issuing export permits.

The risk assessment is limited to species in the genera *Apodora*, *Aspidites*, *Liasis*, *Malayopython*, *Morelia* and *Python* traded with Norway since 2010 (ToR §3). Risk

assessments to determine species-specific detriment (cf. Res. Conf. 16.7 (Rev. CoP17) Non-detriment findings) are made for 17 species.

1.2 Snakes and pythons

Snakes are a diverse group of reptiles that are found throughout the world. They belong to the order Squamata and are characterized by their elongated bodies, lack of limbs, and unique feeding strategies. Pythons are a group of non-venomous snakes belonging to the family Pythonidae (Reynolds et al., 2014; Barker et al., 2015). They are found in a variety of habitats, ranging from rainforests to deserts, and are native to Africa, Asia, and Australia. Pythons are known for their impressive size and strength, as some species can grow up to 9 meters in length and weigh over a hundred kilograms (Osterloff, 2023). However, some of the smaller species reach less than 1 meter in adulthood. Pythons are constrictors, meaning that they suffocate their prey by coiling their bodies around them and squeezing tightly until the animal can no longer breathe, or blood flow is restricted causing cardiac arrest (Hardy, 1994). They primarily feed on small mammals, birds, and reptiles, although larger species have been known to take down prey such as deer and wild pigs.

1.3 Snakes native to Norway and as pets in Norway

In Norway, there are three species of snake that occur naturally: the common European adder (*Vipera berus*), the grass snake (*Natrix natrix*) and the smooth snake (*Coronella austriaca*). All species are protected under Norwegian law (Lovdata, 2009). While the adder and grass snake are Norwegian Red-List assessed as Least Concern (LC) (Dervo et al., 2021a; Dervo et al., 2021b), the smooth snake is assessed as Near Threatened (NT) (Dervo et al., 2021c).

There are not any Pythonidae native to Norway or Northern Europe. While snakes are rarely kept as pets in Norway, there is a growing interest. From 1977 to 2017, it was forbidden by law in Norway to keep snakes as pets (Lovdata, 1976; Lovdata, 2017). During this prohibition period, an assessment by NINA estimated that nevertheless 35,000 snakes were kept in Norway (Dervo et al., 2012). From 2017, 19 species of reptiles, including 9 snakes were exempted from prohibition with the Norwegian Food Safety Authority providing guidance on documents and registration (Lovdata, 2017; Mattilsynet, 2017). Three of these nine species are species in the Pythonidae family and listed on CITES Appendix II, and thus requiring import permits from the Norwegian CITES Management Authority. These are *Python regius* (Norwegian: kongepyton), *Morelia spilota* (Norwegian: teppepyton) and *Morelia viridis* (Norwegian: grønn trepyton) (Lovdata, 2017).

Pythons are among the most popular pet snakes in Norway. Many of the pythons that are popular as pets are highly prized for their exotic appearance, docile temperament, and fascinating behavior. However, there are concerns related to the keeping of pythons as pets. One of the main concerns is the impact of trade on wild populations. Many pet pythons are bred in captivity, but a significant number are also captured from the wild and transported to other countries for sale in the pet trade. This can lead to over-harvesting of wild populations, particularly in areas where the species is already Threatened or Near Threatened. The release of pet pythons into the wild can also pose a threat to native wildlife and ecosystems (Wilson et al., 2017; Dorcas et al., 2018; Miller et al., 2018; Soto-Shoender et al., 2020).

1.4 Drivers and issues with trade

In addition to the pet trade (Auliya et al., 2016; Jensen et al., 2019), there are several other drivers of trade in snakes. Snakes are also exploited globally for skin-derived products (Kasterine et al., 2012; Luiselli et al., 2012), and as sources of food and traditional medicine (Klemens and Thorbjarnarson, 1995; Alves et al., 2009; Somaweera and Somaweera, 2010). This trade has potential detrimental effects on wild populations. The dominant drivers of international trade in pythons are skin derived-products (Kasterine et al., 2012; Luiselli et al., 2012) and pet trade (Green et al., 2020).

1.5 Threats to python populations

Pythons face several threats in their native habitats, including habitat loss, hunting for their skins and meat and for the pet trade. As a result, several species of python are listed in the IUCN Red List of Threatened Species. Currently, the legal, international trade of 164 snake species is regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Hierink et al., 2020; CITES, 2023). Although, some species in the Pythonidae family are thought to be in global decline, data deficiencies hinder our ability to accurately assess snake conservation status and the role of human exploitation in driving population trends (Schlaepfer et al., 2005; Natusch et al., 2016; Nijman, 2022). In the review by Hierink et al. (2020) of 40 years of global trade in CITES-listed snakes, they note that traded snakes in recent years are increasingly comprised of captive-bred animals. However, the majority are still wild-sourced (> 60% between 2015 and 2017), including IUCN Red-listed species, with potentially detrimental impacts on conservation status. The accuracy of species labelling as captive bred versus wild caught has been questioned by some authors (Lyons and Natusch, 2015; Hogg et al., 2018). To assess the accuracy and dependability of sourcing recorded on CITES permits is beyond the scope of this report.

1.6 Threats on native environments caused by imported pythons

In addition to the direct threats to pythons as a result of trade, python trade also poses a significant risk to native species in areas where invasive species have established viable populations. For example, the Burmese python (*Python bivittatus*) has had a major negative impact on local ecosystems in Florida (Reed et al., 2012; Sovie et al., 2016). Burmese pythons were first introduced to Florida as pets, but many were released or escaped into the wild. They thrive in the warm, humid climate with an abundance of prey, and reproduce rapidly. Today, the Burmese python population in Florida is estimated to number in the tens of thousands (Hunter et al., 2015). Burmese pythons are apex predators and have been known to prey on a wide range of species, including birds, mammals, and reptiles. They have been linked to declines in populations of native species such as rabbits, raccoons, and deer, and may also have indirect effects on the food web (Dorcas et al., 2012). It is unlikely that pythons are going to get established outside human care in Norway due to the cold winter climate. Another threat associated with python trade is their role as vectors of parasites and zoonotic diseases (Ursula et al., 2014; Miller et al., 2020; Glidden et al., 2021). Pythons can carry infectious diseases that can be transmitted to humans (Hernandez-Divers and Shearer, 2002; Ullmann et al., 2016). Overall, the risks posed by pythons as parasite vectors and for the spread of zoonotic diseases highlight the need to monitor international trade and import carefully.

1.7 Sustainability and legality

Trade in species can be sustainable or unsustainable and legal or illegal. However, there is no one-on-one relationship between sustainability and legality. A species can be traded legal and sustainable; legal and unsustainable; illegal but sustainable; and illegal and unsustainable. Previous studies have reported reasonable suspicion that parts of the python trade occur above and beyond agreed quotas, that wild-caught individuals are laundered as captive-bred, that specimens are harvested that, based on domestic legislation, are not allowed to be harvested (gravid females; individuals under a certain size), or that animals are exported from countries in which they do not occur (Lyons and Natusch, 2011; Auliya et al., 2016; Nijman, 2022). Data on legal trade is available through the CITES Trade Database, but discrepancies between reported export and import quantities yield some uncertainty to the actual trade volumes. In contrast, data on illegal trade is always based on estimates, with the true volume of trade being impossible to determine. Circumventing national and international legislation is inferred to be common and a driver of 'wildlife laundering'.

2 Methodology and Data

2.1 Data and information gathering

The primary sources for an initial assessment of available data are the assessments published by the IUCN Red List of Threatened Species (IUCN, 2023); Species+, the centralised portal for accessing key information on species of global concern (UNEP, 2023); and the CITES Trade Database (CITES Trade Database, 2023). Based on the initial assessment a standardized literature search and selection strategy was employed for each species assessment as described below.

2.2 Literature search and selection

Structured literature searches were performed in ISI Web of Science Core Collection, 10 May 2023. Interface 'Editions: All' was used with 'Topic search' that searches title, abstract and indexing and Publication Date: All years (1987-2023). Search terms for each species included scientific name and synonyms and English common name and synonyms as listed in the Species+ database (www.speciesplus.net) (Appendix I). This yielded lists of peer-reviewed scientific literature per species. Screening and qualitative assessment of papers was performed independently by each member of the project group assigned to the specific initial species assessment.

Additional manual searches for papers and relevant grey literature were also performed. Manual searches included "snowballing", i.e., checking articles that were referred to in papers found in the main literature, as well as searches in Google and Google Scholar using scientific name and synonyms and English common name and synonyms as listed in the Species+ database as search terms. These searches helped identify reports and other documents detailing for example confiscations and seizures as well as estimates of illegal trade. See Appendix II for flow charts summarizing the literature search.

2.3 Taxonomy

Scientific species nomenclature is based on priority and our current consensus on evolutionary relations and classification. Relevant changes in species names of pythons have been taken into consideration in making this risk assessment. The relevant changes include species complexes that have been split into several species considering novel research insights, as well as species that have been recognized as belonging to other genera. The nomenclature table (Table 2-1) shows the nomenclature applied in this report including the standard author notations for those taxa. The nomenclature follows the CITES taxonomy. The CITES taxonomy is relatively slow to reflect changes in nomenclature as nomenclatural changes are processed by the CITES nomenclature specialists and submitted to the Conference of the Parties for approval. Therefore, we are also including the GBIF Backbone Taxonomy which in turn is updated regularly through an automated process in which the Catalogue of Life acts as a starting point (GBIF Secretariat, 2022). The most relevant nomenclature for the

expected lifespan of this report is the GBIF Backbone Taxonomy as adoption of these names by CITES is expected. Each individual species assessment also includes the scientific synonyms listed in Species+. This is less than the full synonymy, but includes the most commonly encountered synonyms in the literature.

Table 2.3-1. Scientific nomenclature of the assessed python species.

Applied nomenclature	GBIF taxonomy	CITES taxonomy
Apodora papuana (Peters & Doria, 1878)	*Apodora papuana*	*Apodora papuana*
Aspidites melanocephalus (Krefft, 1864)	*Aspidites melanocephalus*	*Aspidites melanocephalus*
Liasis mackloti Duméril & Bibron, 1844	*Liasis mackloti*	*Liasis mackloti*
Malayopython reticulatus (Schneider, 1801)	*Malayopython reticulatus*	*Malayopython reticulatus*
Malayopython timoriensis (W. Peters, 1876)	*Malayopython timoriensis*	*Malayopython timoriensis*
Morelia bredli (Gow, 1981)	*Morelia bredli*	*Morelia bredli*
Morelia spilota (Lacépède, 1804)	*Morelia spilota*	*Morelia spilota*
Morelia viridis (Schlegel, 1872)	*Morelia viridis*	*Morelia viridis*
Python anchietae Bocage, 1887	*Python anchietae*	*Python anchietae*
Python bivittatus Kuhl, 1820	*Python bivittatus*	*Python bivittatus*
Python breitensteini Steindachner, 1881	*Python breitensteini*	*Python breitensteini*
Python brongersmai Stull, 1938	*Python brongersmai*	*Python brongersmai*
Python curtus Schlegel, 1872	*Python curtus*	*Python curtus*
Python molurus (Linnaeus, 1758)	*Python molurus*	*Python molurus*
Python regius (Shaw, 1802)	*Python regius*	*Python regius*
Python sebae (Gmelin, 1789)	*Python sebae*	*Python sebae*
Morelia boeleni (Brongersma, 1953)	*Simalia boeleni*	*Morelia boeleni*

Worth noting is the novel combination of *Python reticulatus* and *Python timoriensis* in the genus *Malayopython* as *M. reticulatus* and *M. timoriensis*. This nomenclatural change is based on results from the molecular phylogeny by Reynolds et al. (2014) that warranted the split of the genus *Python*. The name change was adopted by CITES at CoP19, CoP19 Doc. 84.1. Furthermore, *Morelia boeleni* has recently been placed in the genus *Simalia* as *S. boeleni* based on results from the same molecular phylogeny by Reynolds et al. (2014). Another taxonomic note that is of relevance to the assessment is the split of the species *Python curtus*. Prior to 2004, the three species of short-tailed pythons, *Python curtus*, *P. brongersmai* and *P. breitensteini* were treated as three sub-species belonging to the *Python curtus* group. Keogh et al. (2001) used a molecular phylogenetic framework to elevate these sub-species as distinct species. The taxonomic change was accepted by CITES in 2004. In 2011, *P. kyaiktiyo* was recognized as an additional species in this species complex (Zug et al., 2011).

2.4 Data from CITES trade database

Trade data for the Pythonidae family were downloaded from the CITES Trade Database on 31 March 2023 in the format of comparative tabulation reports.

Downloaded data included all export countries, all import countries, all sources, all purposes, and all terms and spanned the entire time range from 1975 – 2022. Trade data were subsetted to the 17 species included in the assignment.

Data are presented following the procedures of Hierink et al. (2020), which adopted the approach by Harfoot et al. (2018). Trade data are thus presented in the format of Whole Organism Equivalents (WOEs) which assumes that each of the trade terms "live", "bodies", "skins", "gall bladder", "skulls", "heads", "tails", "trophies", and "skeletons" equate to one organism. Some terms cannot be converted to WOEs (e.g., derivatives, shoes, leather items, etc.) and are therefore, again following Hierink et al. (2020), excluded from the analysis.

To prevent double counting of trade quantities, re-exports were excluded from the dataset. Following the guidelines for using the CITES trade database, direct trade which involves trade exported directly from the country of origin (i.e., is not a re-export) was identified by blank "origin" fields in the data file.

Following Hierink et al. (2020) we compared trade in wild-sourced and captive-bred snakes based on recategorization of the source variable. Wild-sourced snakes included the sources "wild specimens" (W category in the CITES Trade Database), "unknown source" (U), "specimens taken from the marine environment" (X), and "ranched specimens" (R), whereas captive-bred snakes included the sources "captive bred" (C and D), "artificially propagated" (A), and "animals born in captivity" (F). Confiscated or seized specimens (I), pre-convention specimens (O), and unreported source (NA) were excluded from the analysis.

2.5 Data assessment and recommendation

The species assessments synthesize relevant knowledge to make a scientific non-detriment finding based on available data. This includes data on scientific and vernacular nomenclature, distribution, life history, habitat, role in ecosystem, populations and trends, legal and illegal harvesting, captive breeding and trade, assessments of the threat posed by trade, other threats, conservation status, population monitoring programs in the range area, national regulations and legislation in the range countries, current management in the range countries, including harvest quotas, as well as an overall assessment of data quality.

In synthesizing the species assessment data to determine detriment as a result of international trade, the species IUCN Red List assessment provided an important primary indicator to determine overall threat to species survival. This deviates to a degree from the Natusch et al. (2017) NDF guidance for snakes included in CITES AC29 Doc 31.1 that recommends a two-stage assessment in which the primary evaluation considers annual harvest level, area of occupancy, life-history and additional risk factors. VKM chose not to follow the NDF guidance for snakes (Natusch et al. 2017) as it is a procedure optimized for scientific authorities of the state of export to determine possible detriment, whereas this report was commissioned to provide an NDF covering all range states to be used by the state of import. In contrast, IUCN Red List assessments consider primarily population and decline but factor in attributes

including generation time, population stability and number of mature individuals. The second stage in the Natusch et al. (2017) NDF guidance considers observed, estimated, inferred, or suspected continuing decline in any of the following: i. population abundance; ii. national area of occupancy; iii. number of locations or subpopulations; iv. number of mature individuals; v. mean body sizes; vi. minimum sizes at sexual maturity; vii. catch per unit effort, and/or viii. other factors indicative of unsustainable harvesting. In our approach, secondary indicators were literature-reported distribution, life history, habitat, role in the ecosystem, populations and trends, legal and illegal harvesting, captive breeding and trade, assessments of the threat posed by trade, other threats, conservation status, population monitoring programs in the range area, national regulations and legislation in the range countries, current management in the range countries, including harvest quotas, as well as an overall assessment of data quality. Among these, specific focus was given to the source of traded material (wild or captive-bred); whether captive-bred trade was from range states or non-range states; population and trends – especially reported after publication of the IUCN Red List assessment; reported levels of illegal harvesting, wildlife laundering and illegal international trade (including legislation and compliance in range states). In species native to multiple range states, this assessment was done for each country as far as the data enabled it. The overall assessment of these factors was used to determine presence or absence of detriment, with specific considerations explained in the species assessments.

The confidence of each detriment assessment was indicated from low to high to reflect the strength, completeness, and timeliness of the underlying data. Confidence was assessed as high if all indicators pointed to sustainability (stable population trends, high reproduction, strong law enforcement, dominance of captive-bred trade, little data to suggest illegal trade, laundering and supplementing), moderate if indicators pointed to sustainability but with a level of conflicting data or data uncertainties, and low if indicators data uncertainties had a major impact on the assessment.

3 Species assessments

The individual species assessments follow in the sections below. The species assessments follow a standard structure compiling data on a) Name, distribution, life history, habitat, and role in the ecosystem; b) Populations and trends; c) Legal / illegal harvesting, captive breeding, and trade; d) Assessment of the threat(s) posed by trade; e) Brief summary of other threats and conservation status; f) Population monitoring programs in the range area; g) National regulations / legislation and in the range countries; h) Current management in the range countries, including harvest quotas; i) Overall assessment of data quality. The overall assessment of trade through data in the CITES Trade Database (2023) provides insight into the global trade in python snakes. The data covers the period 1975-2022 for most species, except those that were recognized only after *Python curtus* was split and treated as such in 2004. Table 3-1 below shows the global reported numbers of exported snakes as Whole Organism Equivalents (WOEs). Trade differs greatly from species to species both in terms of parts traded and traded volumes. Some species are traded in small volumes only at all and concern live animal trade, such as *Aspidites melanocephalus*, *Python anchietae*, and *Morelia bredli*. Generally, species traded in the skin trade are traded in much larger WOE volumes, e.g., *Malayopython reticulatus* with nearly 10 million skins legally traded in this period.

Table 3-1. Global reported quantities of exported snakes expressed as Whole Organism Equivalents (WOEs) disaggregated by CITES term and python species in the period 1975-2022.

Taxon	Bodies	Gall bladders	Heads	Live	Skeletons	Skins	Skulls	Tails	Trophies	Total
Apodora papuana	0	0	0	6,070	0	0	0	0	0	6,070
Aspidites melanocephalus	0	0	0	493	0	0	0	0	0	493
Liasis mackloti	42	0	0	12,431	0	0	0	0	0	12,473
Malayopython reticulatus	22	2,519	0	126,223	1	9,260,919	5	100	0	9,389,789
Malayopython timoriensis	0	0	0	1,151	0	0	0	0	0	1,151
Morelia boeleni	0	0	0	3,915	0	8	0	0	0	3,923
Morelia bredli	0	0	0	1,267	0	0	0	0	0	1,267
Morelia spilota	1	0	0	34,307	0	3	0	0	0	34,311
Morelia viridis	0	0	0	110,586	0	7	1	0	0	110,594
Python anchietae	1	0	0	634	0	0	0	0	0	635
Python bivittatus	5	40	200	241,269	0	3,278,329	204	0	2	3,520,049
Python breitensteini	0	0	0	19,746	0	173,580	0	0	0	193,326
Python brongersmai	0	0	0	60,679	0	708,169	0	0	0	768,848
Python curtus	1	0	0	50,314	0	1,052,491	0	0	0	1,102,806
Python molurus	28	0	0	734	0	806	0	0	0	1,568
Python regius	6	0	0	3,090,284	0	98	0	0	2	3,090,390
Python sebae	7	0	0	54,088	4	196,062	8	0	100	250,269
Total	113	2,559	200	3,814,191	5	14,670,472	218	100	104	18,487,962

Comparing importer and exporter reported quantities also shows some differences (Figure 3-1). The overall data shows a slow decrease in trade from a peak around the turn of the millennium for both captive and wild specimens (Figure 3-1 A, B). Similarly, Table 3-1, Figure 3-1 C, D show the dominance of skin trade in pythons, followed by live specimens, over all other parts traded. The figures do not show the reported purpose codes of the trade, but an analysis of data from the CITES Trade Database for the same species shows that 82.3% of all trade transactions and 99.9% of all traded quantities are for commercial purposes.

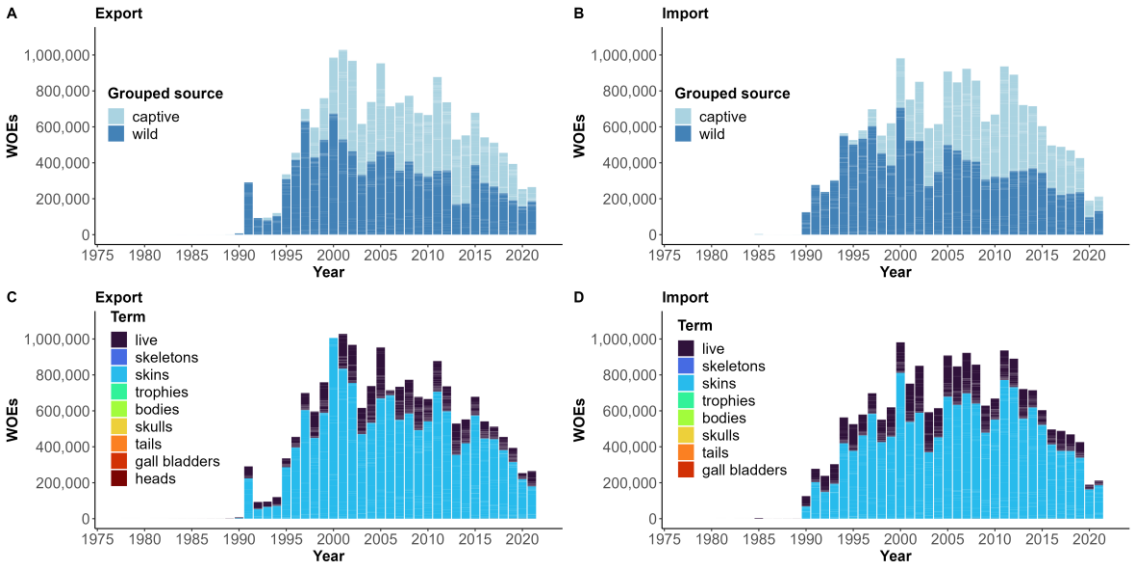

Figure 3-1. Global reported quantities of exported (A and C) and imported (B and D) snakes belonging to the 17 species, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and trade term. Data from CITES trade database, downloaded 30 March 2023.

Furthermore, a closer inspection of the discrepancies between importer and exporter reported quantities reveals that discrepancies change over time (Figure 3-2). Widely divergent data suggest widespread inaccuracies that may distort the perceived risk of targeted wildlife exploitation, leading to misallocation of management resources and less effective conservation strategies (Blundell and Mascia, 2005). Discrepancies could be due to numerous reasons, including differences in CITES compliance, typographical errors, smuggling, taxonomic miscategorization, unitless data, and other recording and data management errors (Blundell and Mascia, 2005; Berec et al., 2018; Robinson and Sinovas, 2018). As compliance improves and new systems for electronic CITES (eCITES) permitting are implemented, these differences will hopefully be reduced.

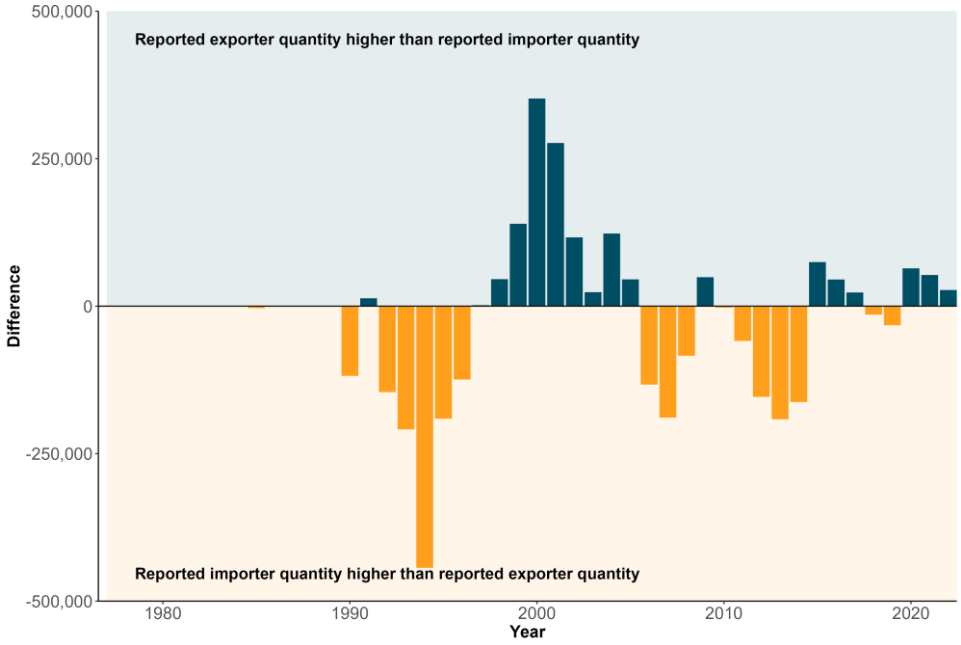

Figure 3-2. Global reported trade discrepancies over time. Reported exporter quantity versus reported importer quantity of snakes belonging to the 17 species, expressed as whole organism equivalents (WOEs). Data from CITES trade database, downloaded 30 March 2023.

Breaking down the data by species (Figure 3-3 A, B) shows that the three most dominant species in trade are *M. reticulatus*, *P. regius* and *P. bivittatus*. All three species are abundant in both the global skin and pet trade, and they are also widely bred in captivity.

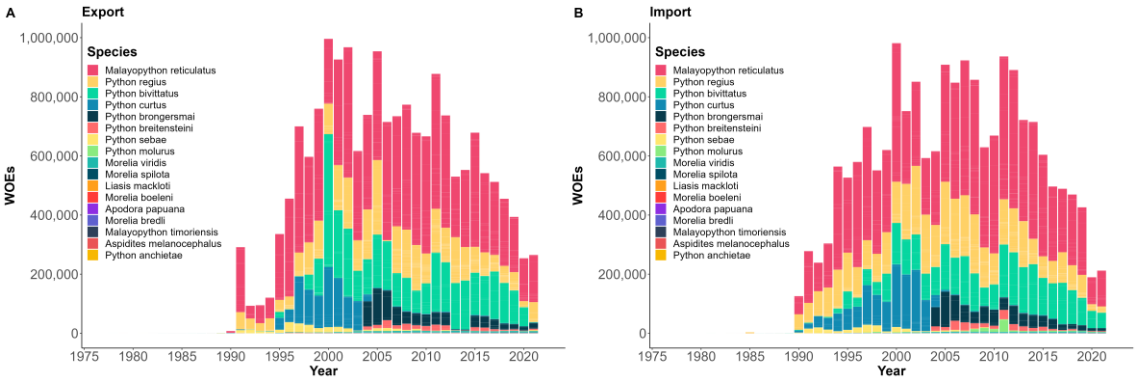

Figure 3-3. Global reported quantities of exported (A) and imported (B) snake Whole Organism Equivalents (WOEs) disaggregated by year and python species. Data from CITES trade database, downloaded 30 March 2023.

It should be noted that even for the species for which we have the most data on conservation and trade, we have very little data as compared to that available for mammal or reptile species in Europe. It should be stressed that a lot of the data is old, based on single studies or surveys, and from a small part of the species' range.

3.1 *Apodora papuana*

Summary and conclusion

The Papuan python (*Apodora papuana*) is endemic to the island of New Guinea. Its natural habitat includes forests and savannah, and it has also been reported from gardens and other inhabited areas. Papuan pythons are reported to be common, and to occur in several protected areas. Trade data suggests that the species is mostly sold as pets and rarely used for skin products. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate-high confidence. This is based on the current IUCN Red List status LC, the limited number of specimens traded, and that legal trade is dominated by live specimens for the pet trade. However, sufficient population data and monitoring efforts in New Guinea are lacking.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Apodora papuana* (Peters & Doria, 1878).

Common name: Papuan python, Papuan olive python.

Scientific synonyms: *Liasis maximus* Stimson, 1969; *Liasis olivaceus papuanus* Gray, 1842; *Liasis papuanus* Peters & Doria, 1878; *Liasis tornieri* Werner, 1897; *Morelia papuana* (Peters & Doria, 1878).

Taxonomic note:
Previously included in the genus *Liasis*. Currently the only species recognized in the genus *Apodora*.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species 2018 (Tallowin et al., 2018): Least Concern (LC).

Distribution:
Throughout most of New Guinea, from Misool to Fergusson Island (O'Shea, 1996; Tallowin et al., 2018).

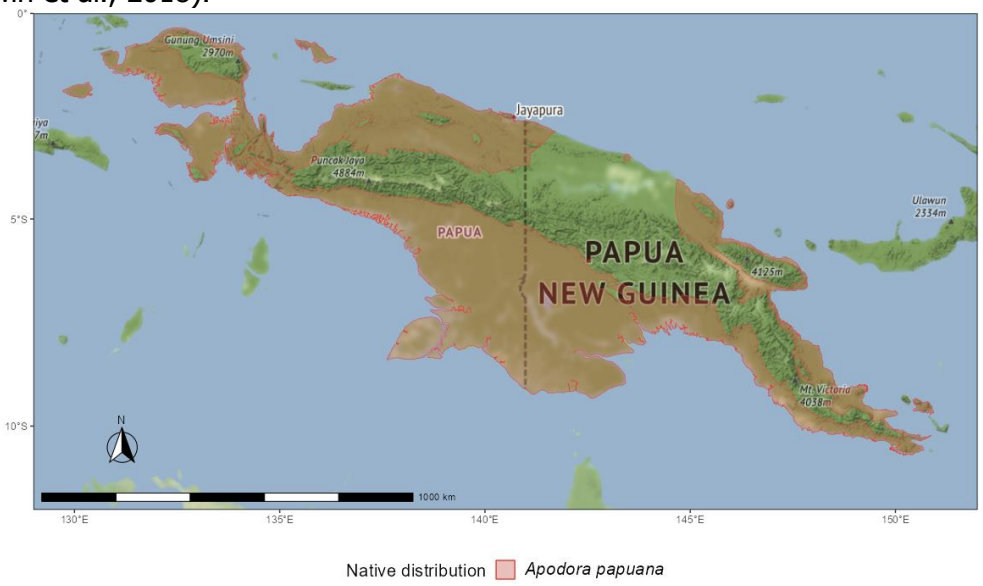

Figure 3.1-1. Distribution of *Apodora papuana*. Data from IUCN 2017. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
The species grows somewhat slowly and will reach maturity after six to eight years. It is oviparous and lays 10-20 eggs (O'Shea, 2007).

Habitat:
Apodora papuana lives in dense lowland monsoon and rainforest, and savanna woodlands from the coast lines well into the mainland (O'Shea, 1996; 2007).

Role in the ecosystem:
Papuan python diet consists primarily of smaller mammals and birds, but it also eats reptiles including other pythons (O'Shea, 1996; 2007). As predators, Papuan pythons keep prey populations in balance whilst serving as prey for larger birds and other predators.

b) Populations and trends

Reliable data on the natural distribution and population trends of Papuan pythons are lacking (Nijman, 2022). The IUCN Red List for Threatened Species reports populations as stable and the species is listed as Least Concern (Tallowin et al., 2018). Sufficient data to evaluate this assessment is lacking in the IUCN assessment.

c) Legal / illegal harvesting, captive breeding, and trade

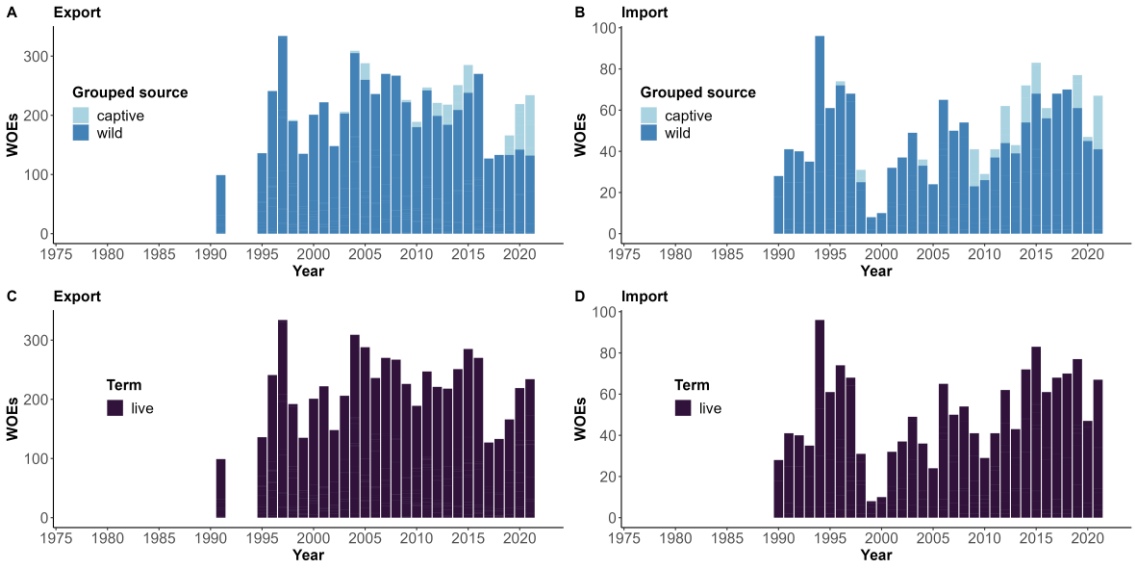

Figure 3.1-2 Reported quantities of exported (A and C) and imported (B and D) *Apodora papuana* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (only live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

This species does not have protected status per se in Western New Guinea, Indonesia, but its harvest is regulated; the species is only allowed to be harvested for the pet trade, 90 percent of which is intended for international trade (Indonesian Ministry of Environment and Forestry, 2023). In Papua New Guinea laws prohibit the commercial exploitation of its wildlife, especially by outside commercial interests (O'Shea, 1996). Low level trade (below 1,000 specimens per year) seems to occur from Western New Guinea (Yuwono, 1998) especially from Jayapura and the Vogelkop (Natusch and

Lyons, 2012). Indonesia has an export quota in place (Indonesian Ministry of Environment and Forestry, 2023).

d) Assessment of the threat(s) posed by trade

Captive bred specimens seem to dominate the live Papuan python market in Europe and North America while international trade is mostly still relying on wild caught specimens despite an increase in numbers reported as captive bred in recent years (Figure 3.2-1). Live snake trade is currently unlikely to contribute to a detrimental species decline in the wild as it continues to be listed as Least Concern in the IUCN Red List of Threatened Species (Tallowin et al., 2018) despite nearly constant level of trade in the last 20 years. The species does not seem to be commonly exploited for skins.

e) Brief summary of other threats and conservation status

The species is currently listed as Least Concern in the IUCN Red List of Threatened Species (Tallowin et al., 2018). Habitat destruction is likely to be the main threat to Papuan pythons.

f) Population monitoring programs in the range area

Papuan pythons occur in a number of protected areas but there does not seem to be any monitoring of wild populations or trade in place.

g) National regulations / legislation and in the range countries

In Indonesia, some pythons are specifically named as being protected under domestic legislation (Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia, Nomor P.20/MENLHK/SETJEN/KUM.1/6/2018). Indonesian domestic legislation defines protected species of flora and fauna and their habitats, and provides rules for preservation efforts, designated conservation institutions, rules on shipping and transporting protected species, and overall control and monitoring.

h) Current management in the range countries, including harvest quotas

Trade in Papuan pythons is regulated through CITES. In Indonesia harvest and export quotas have been established and are reviewed on an annual basis by the Indonesian Institute of Science (LIPI) (Indonesian Ministry of Environment and Forestry, 2023). However, annual export quotas are reported to get arbitrarily set, as well as sustainability estimates are suspected not to be based on scientifically sound research (Soehartono and Mardiastuti, 2002).

i) Overall assessment of data quality

There are very few publications available on *A. papuana* and population level data sufficient for assessment is lacking. The IUCN Red List assessment (Tallowin et al., 2018) and other recent publications such as that of Nijman (2022) are based on very scarce data.

References

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Natusch D.J.D., Lyons J.A. (2012) Exploited for pets. The harvest and trade of amphibians and reptiles from Indonesia New Guinea. Biodiversity Conservation 21:2899-2911.

Nijman V. (2022) Harvest quotas, free markets and the sustainable trade in

pythons. Nature Conservation 48:99–121. doi:10.3897/natureconservation.48.80988.

O'Shea M. (1996) A Guide to the Snakes of Papua New Guinea. Independent Publishing, Independent Group Ltd., Port Moresby, PNG.

O'Shea M. (2007) Boas and Pythons of the World. New Holland, London.

Shine R., Ambariyanto, Harlow P.S., Mumpuni. (1999) Ecological attributes of two commercially-harvested python species in northern Sumatra. Journal of Herpetology 33:249-257. DOI: 10.2307/1565722.

Soehartono T.R., Mardiastuti A. (2002) CITES and its Implementation in Indonesia Jakarta: Nagao Environment Foundation.

Tallowin O., O'Shea M., Parker F. (2018) *Apodora papuana*. The IUCN Red List of Threatened Species 2018: e.T13300623A13300631. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T13300623A13300631.en. Accessed on 16 February 2023.

Yuwono F.B. (1998) The trade of live reptiles & amphibians in Indonesia, in: W. Erdelen (ed.) Conservation, Trade & Sustainable Use of Lizards & Snakes in Indonesia. Mertensiella 9:9-16.

3.2 *Aspidites melanocephalus*

Summary and conclusion

Aspidites melanocephalus is widely distributed in the northern part of Australia. The species was assessed as Least Concern on the IUCN Red List for Threatened Species 2017. It is illegal to harvest individuals from the wild in Australia. Trade is in captive-bred individuals and there is no indication that there is significant illegal trade in this species. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with high confidence. This is based on the current IUCN Red List status LC, the prohibition of wild harvest, strong law enforcement in the range state, and that legal trade is dominated by captive-bred live specimens for the pet trade.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Aspidites melanocephalus* (Krefft, 1864)

Common name: Black-headed python, woma.

Scientific synonyms: No synonyms listed in Species+.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species 2017 (Shea et al., 2017): Least Concern (LC).

Distribution:
Australia (Northern Territory, Queensland, Western Australia) (Shea et al., 2017).

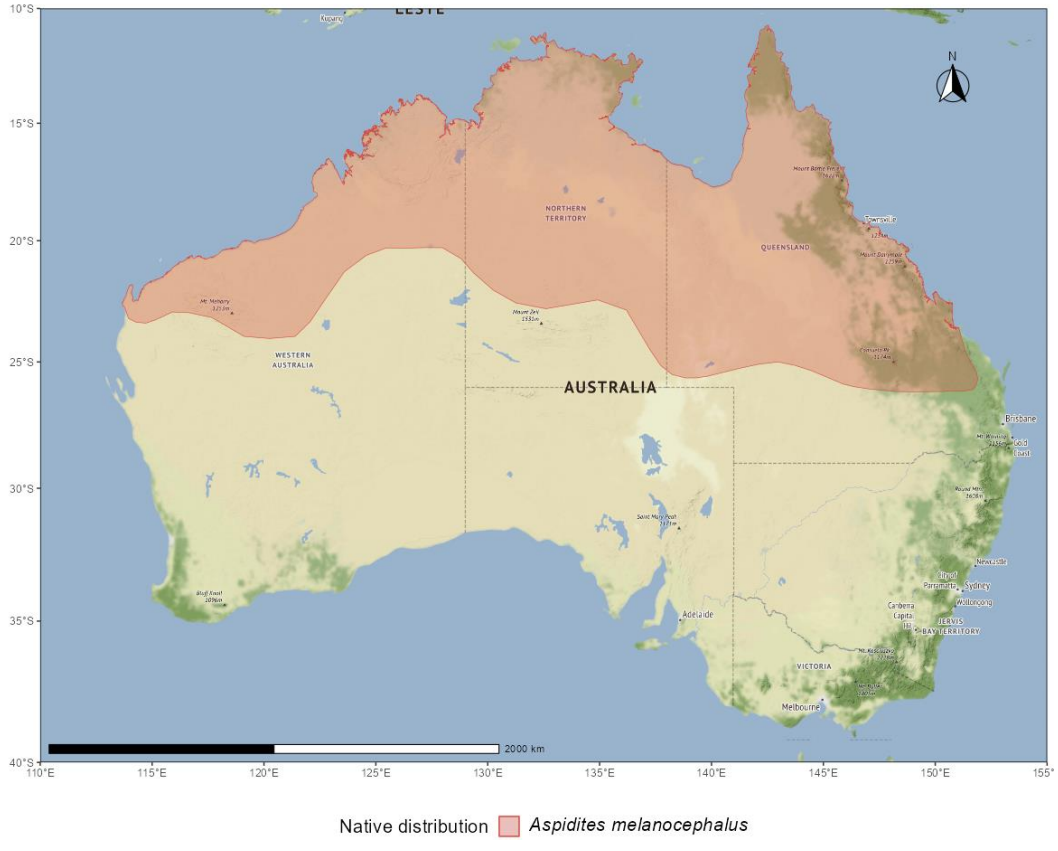

Figure 3.2-1. Distribution of *Aspidites melanocephalus*. Data from IUCN, Stewart MacDonald, Reid Tingley 2017. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
Aspidites melanocephalus is a nocturnal species, which spends a significant part of its time underground in burrows. The species is oviparous, mating occurs from July to September, and 6 to 18 eggs are laid between October and November (Shea et al., 2017 and references therein).

Habitat:
Aspidites melanocephalus is widely distributed in the northern part of Australia and inhabits a wide range of different habitats including humid coastal forests, seasonally dry tropical woodlands, and arid areas in the interior (Shea et al., 2017).

Role in the ecosystem:
Aspidites melanocephalus is a predator (non-venomous constrictor) that feeds on different types of reptiles, including goannas (*Varanus* spp.), dragons (Agamidae), blue-tongued skinks (*Tiliqua* spp.), venomous snakes (Shea et al., 2017), and rarely mammals and birds (O'Shea, 2011).

b) Populations and trends

The population trend is estimated to be stable, and the species is thought to be widely distributed within its range (Shea et al., 2017).

c) Legal / illegal harvesting, captive breeding and trade

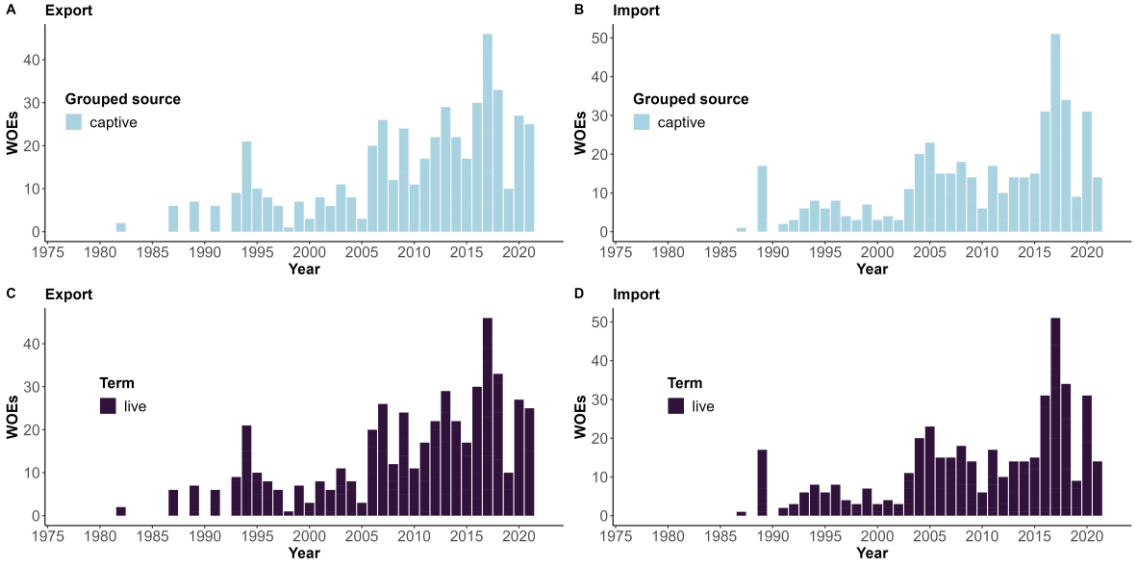

Figure 3.2-2. Reported quantities of exported (A and C) and imported (B and D) *Aspidites melanocephalus* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (only live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

The species has been collected for food by Aboriginals (Russell-Smith et al., 1997 in Shea et al., 2017).

Legal trade: *Aspidites melanocephalus* is popular in the international pet trade market. Between 2010 and 2022, all but one registration in the CITES trade database is of live individuals, none of them registered as wild caught. On the website terraristik.com there are many ads for *A. melanocephalus* from a range of different countries, including Sweden, Germany, Denmark, Spain, Switzerland, and Japan

(https://www.terraristik.com/tb/buy-and-sell/all-herp-ads/01/?ftsearch=Aspidites%20melanocephalus). *A. melanocephalus* is for sale for 1500 € (https://www.terraristik.com/tb/buy-and-sell/liasis-olivaceus-1-1-cb18-and-1-1-aspidites-melanocephalus-cb20/a971910/).

Illegal trade: No evidence of illegal trade in this species was found.

d) Assessment of the threat(s) posed by trade
The species is traded as a pet but breeds in captivity and there is thus low demand for wild-caught individuals (see for example https://reptilesmagazine.com/keeping-and-breeding-black-headed-pythons/ or https://reptilesmagazine.com/black-headed-python-snake-breeding/). Trade does not appear to threaten this species.

e) Brief summary of other threats and conservation status
IUCN Red List of Threatened Species status: Least Concern (LC) (Shea et al., 2017). According to Shea et al. (2017) the species is widespread within its area of distribution and is not considered threatened.

f) Population monitoring programs in the range area
This species has been recorded from many protected areas (Shea et al., 2017).

g) National regulations / legislation and in the range countries
In Australia, snakes are protected under the *Nature Conservation Act 1992.* It is an offence to kill, injure or take snakes from the wild (https://www.qld.gov.au/environment/plants-animals/animals/living-with/snakes).

h) Current management in the range countries, including harvest quotas
See g) above.

i) Overall assessment of data quality
There are only a few publications available on *A. melanocephalus*. Most of the information in the current NDF assessment is based on the IUCN Red List assessment, which is relatively sparsely written and with very few references. Shea et al. (2017) highlights research needs including population size, distribution and trends, life history and ecology and threats as well as monitoring needs including population and habitat trends. The aforementioned research and monitoring needs, as well as very few hits when searching for the species in scientific databases indicate that knowledge about this species is limited, and that the data quality of this assessment therefore is deficient.

References
O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Russell-Smith J., Lucas D., Gapindi M., Gunbunuka B., Kapirigi N., Namingum G., Lucas K., Giuliani P., Chaloupka G. (1997) Aboriginal resource utilization and fire management practice in Western Arnherm Land, Monsoonal Northern Australia: notes for prehistory, lessons for the future. Human Ecology 25:159-195.

Shea G., Ellis R., Wilson S. (2017) Aspidites melanocephalus. The IUCN Red List of Threatened Species 2017: e.T13300710A13300718. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T13300710A13300718.en. Accessed on 12 December 2022.

3.3 *Liasis mackloti*

Summary and conclusion

As currently defined taxonomically, *Liasis mackloti* occurs in Indonesia and Timor-Leste (NB Timor-Leste is not a Party to CITES) and has a distribution covering parts of the Lesser Sunda Islands, including Timor (incl. Timor-Leste), Roti, Semau and Alor. The presence on Babar and Atauro Island is uncertain. The species is traded in the international pet trade and most specimens are reported to be collected from the eastern Lesser Sunda Islands. The species is listed as Least Concern in the IUCN Red List for Threatened Species as the species has a wide range, there is no evidence suggesting major population decline, and trade numbers indicate little impact of trade. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, the limited number of specimens traded, and that legal trade is dominated by live specimens for the pet trade. However, there is a lack of information on population size and trends, as well as levels of illegal trade.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Liasis mackloti* (Duméril & Bibron, 1844).

Common name: Freckled python, water python, Macklot's python.

Scientific synonyms: *Liasis savuensis* Brongersma, 1956; *Morelia mackloti* (Duméril & Bibron, 1844); *Python timorensis* Müller, 1844.

Taxonomic note:
The taxonomic status of this species is not fully resolved (Arida et al., 2021 and references therein). Current taxonomic practice restricts the range of *L. mackloti* to Timor (incl. Timor-Leste), Roti, Semau and Alor (Barker et al. 2015), albeit further research may reveal that its range also includes the Northern Territory in northern Australia (Arida et al., 2021).

CITES listing and IUCN assessment:
CITES: Appendix II (04/02/1977);
IUCN Red List of Threatened Species 2021 (Arida et al., 2021): Least Concern (LC).

Distribution:
Following current taxonomic practice (Barker et al., 2015), this species is present on the eastern Indonesian islands of Timor (incl. Timor-Leste), Roti, Semau and Alor (de Lang, 2011a). Presence on Babar and Atauro Island uncertain (Rawlings et al., 2004; Barker et al., 2018; Arida et al., 2021). No exact data available on elevation range albeit believed to be a lowland species (Arida et al., 2021).

Figure 3.3-1. Distribution of *Liasis mackloti*. Data from IUCN 2017. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
Information on natural ecology appears to be lacking. Captive individuals reach maturity in 3-4 (male) or 4-5 (female) years and lay clutches of 8-20 (mean 15) eggs (de Lang, 2011b in Arida et al., 2021).

Habitat:
Uncertain. Believed to be associated with lowland, coastal habitats (Arida et al., 2021). O'Shea (2011) states that these snakes spend most of their time in freshwater.

Role in the ecosystem:
Predator (non-venomous constrictor). According to O'Shea (2011) these snakes prey primarily on vertebrates visiting watercourses, including hatchling freshwater crocodiles. Adult individuals include waterbirds and their eggs in their diet, whereas juveniles prey on frogs, fish, and lizards.

b) Populations and trends

Data on population size and trends is lacking. IUCN Red List assessment (Arida et al., 2021) states there is no evidence suggesting major population decline, and that trade numbers indicate little impact of trade.

c) Legal / illegal harvesting, captive breeding, and trade

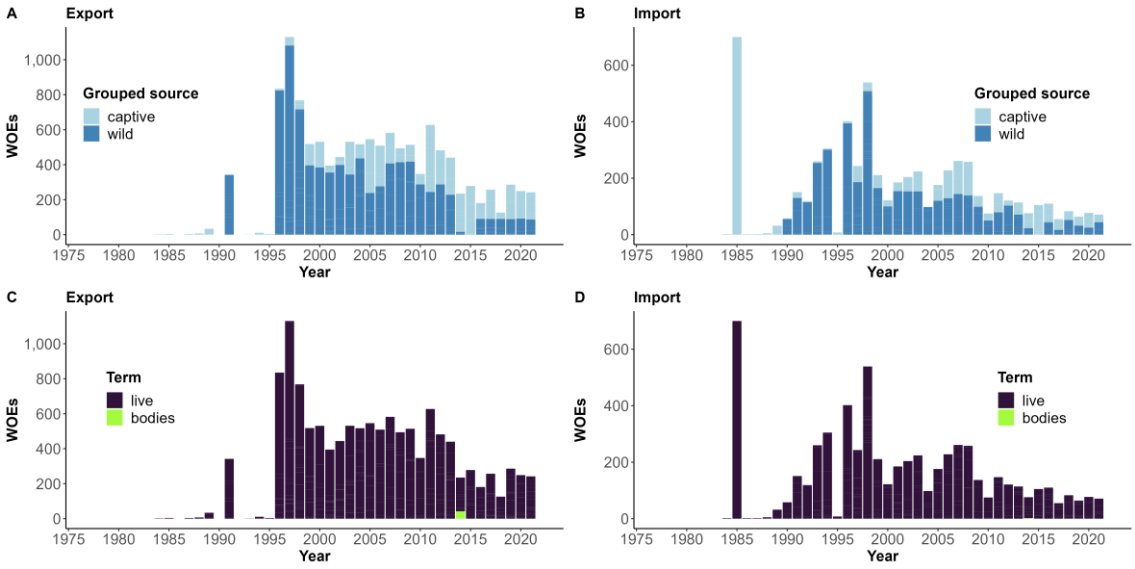

Figure 3.3-2. Reported quantities of exported (A and C) and imported (B and D) *Liasis mackloti* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

Liasis mackloti is traded in the international pet trade for which most specimens are reported to be collected from the eastern Lesser Sunda Islands (Yuwono, 1998 in Arida et al., 2021; de Lang, 2011b in Arida et al., 2011).

Between 2000-2018, 7,900 specimens were reported as exported from Indonesia: 916 reported as captive-bred, 1,983 as captive-born (farmed) and 5,001 as wild specimens. Importantly, these numbers do not distinguish between *Liasis mackloti* as now understood and the taxa now treated as the distinct species *L. dunni* and *L. savuensis* (Arida et al., 2021).

As seen in Figure 3.3-2, trade reported in the CITES Trade Database is a mix of live captive-and wild-sourced specimens and the trade quantities are modest and decreasing over time.

d) Assessment of the threat(s) posed by trade

According to the IUCN Red List assessment, the international pet trade is among the major threats to this species (Arida et al., 2021 and references therein). However, Arida et al. (2021) also state that although it is found in the pet trade, there is no evidence to suggest a major decline in its population, and recent trade figures suggest numbers in trade are low.

e) Brief summary of other threats and conservation status

According to the IUCN Red List assessment, other threats to this species include road mortality (Arida et al., 2021 and references therein).

f) Population monitoring programs in the range area

Information lacking.

g) National regulations / legislation and in the range countries
See section h)

h) Current management in the range countries, including harvest quotas
The species occurs within several protected areas (Arida et al., 2021).

As of 2023, Indonesia had a total harvest quota of 100 live specimens (5 domestic, 95 export) of this species (Indonesian Ministry of Environment and Forestry, 2023).

As of 4 November 2022, Indonesia has a CITES export quota of 95 individuals (live [pets]). There are no current CITES suspensions in place for this species.

i) Overall assessment of data quality
Due to lack of information, the current NDF assessment is based largely on the IUCN Red List assessment (Arida et al., 2021), which itself is based on few (and to a large extent pers. comm.-type) references. Data on population size or trends is lacking. In sum, the quality of the data underlying this assessment is deficient. Arida et al. (2021) highlight that more research is needed to clarify the biology of this species.

References
Arida E., Gillespie G, Reilly, S. (2021) *Liasis mackloti*. The IUCN Red List of Threatened Species 2021: e.T83776644A83776677. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T83776644A83776677.en

Barker D.G., Barker T.M., Davis M.A., Schuett, G.W. (2015) A review of the systematics and taxonomy of Pythonidae: an ancient serpent lineage. Zoological Journal of the Linnean Society 175:1-19.

Barker D.G., Auliya M., Barker T.M. (2018) Pythons of the World, Volume III: The Pythons of Asia and the Malay Archipelago. VPI Library, Boeme, Texas.

de Lang R. (2011a) The Snakes of the Lesser Sunda Islands (Nusa Tenggara) Indonesia. Asian Herpetological Research 2:46-54.

de Lang R. (2011b) The Snakes of the Lesser Sunda Islands (Nusa Tenggara) Indonesia. A Field Guide to the Terrestrial and Semi-aquatic Snakes with Identification Key. Editions Chimaira, Frankfurt.

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Rawlings L.H., Barker D., Donnellan S.C. (2004) Phylogenetic relationships of the Australo-Papuan *Liasis* pythons (Reptilia: Macrostomata), based on mitochondrial DNA. Australian Journal of Zoology 52:215-227.

Yuwono F.B. (1998) The trade of live reptiles & amphibians in Indonesia, in: W. Erdelen (ed.) Conservation, Trade & Sustainable Use of Lizards & Snakes in Indonesia. Mertensiella 9:9-16.

3.4 *Malayopython reticulatus*

Summary and conclusion

Malayopython reticulatus (formerly *Python reticulatus*), the reticulated python, is one of the most traded species in the world, chiefly for its use in the leather trade. Captive breeding is thought not to be economically viable and is probably supplemented with wild caught individuals. Characteristics of the species, such as a relatively rapid population growth rate are thought, by some, to mitigate for the high level of exploitation. Concerns about harvest of immature individuals have led to calls for minimum length requirements (enforced in Malaysia). Data on the species is relatively good but is often old and needs updating. Legal and illegal trade have the potential to impact on the survival of the species in the wild, although so far local extinction has been rare although declines across the range are evident. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, the relatively rapid population growth rate, and the contribution of captive-bred specimens to trade. However, to address suspected overexploitation and illegal trade, additional data and better monitoring are needed.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Malayopython reticulatus* (Schneider, 1801).

Common name(s): Regal python, reticulated python, Java rock python, Asian reticulated python.

Scientific synonyms: *Boa phrygia* Shaw, 1802; *Boa reticulata* Schneider, 1801; *Boa rhombeata* Schneider, 1801; *Broghammerus reticulatus* (Schneider, 1801); *Coluber javanicus* Shaw, 1802; *Morelia reticulatus* (Schneider, 1801); *Python reticulatus* (Schneider, 1801); *Python schneideri* (Merrem, 1820).

Taxonomic note:
Formerly known as *Python reticulatus* but transferred to the more newly erected genus *Malayopython* which includes *M. timoriensis* and *M. reticulatus* (Reynolds et al., 2014). The name change was adopted by CITES at CoP19, CoP19 Doc. 84.1.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Stuart et al., 2018): Least Concern (LC).

Distribution:
Widespread across much of Southeast Asia with a northerly limit of central Vietnam, northern Thailand, and northern Myanmar. The single record in India is thought to be a vagrant from Myanmar or Bangladesh (Stuart et al., 2018). Mitochondrial genomic data suggests prominent phylogenetic structure with two geographically distinct groups, a group with Philippine, Bornean and Sulawesian populations distinct from the remainder of the populations (Murray-Dickson et al., 2017).

Figure 3.4-1. Distribution of *Malayopython reticulatus*. Data from IUCN 2018. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:

Malayopython reticulatus is the longest snake species in the world. It can reach 10 m in length, but the average is around 4 m (Shine et al., 1999). Females are generally longer than males. Females lay 24.2 eggs on average every two to four years (in Sumatra; Shine et al., 1999), although it is important to note that fecundity is thought to vary longitudinally (Stuart et al., 2018) making it difficult to extrapolate this value to other regions in the range.

Habitat:

It has wide habitat tolerances which vary across its range. The species can occur in rainforest, woodland, and adjacent grasslands (Stuart et al., 2018). The species is a strong swimmer and was among the first species to colonize the volcanic island of Anak Krakatau (Stuart et al., 2018). It is adapted to human-modified habitats and can be found in urban areas, for example it is described as occurring in sewers in Singapore, Indonesia, and Malaysia (Stuart et al., 2018).

Role in the ecosystem:
It feeds on a wide range of prey; including birds (including domestic chickens), reptiles, deer, wild boar, smooth coated otter, domestic cats, macaques, shrews, squirrels, and rats (Devan-Song et al., 2017). The predation of rodents by the species highlights its potential as a biocontrol agent in farming and plantation areas (Lim, 1999).

b) Populations and trends

The species is listed on the IUCN Red List as Least Concern (Stuart et al., 2018). It was last assessed in September 2011. Knowledge and data on the population status is varied across the range. In Thailand and the Philippines, the species is often found in human habitation (Stuart et al., 2018). Populations in southern Vietnam are thought to have declined at a rate of 80% or higher over ten years around the change of the millennium (Dang et al., 2007). A decline is suspected in Laos as well.

Declines throughout Indochina are probably due to habitat conversion and overharvesting. Habitat loss may have been mitigated through large scale palm oil plantations where the snake is thought to be common (Stuart et al., 2018).

c) Legal / illegal harvesting, captive breeding, and trade

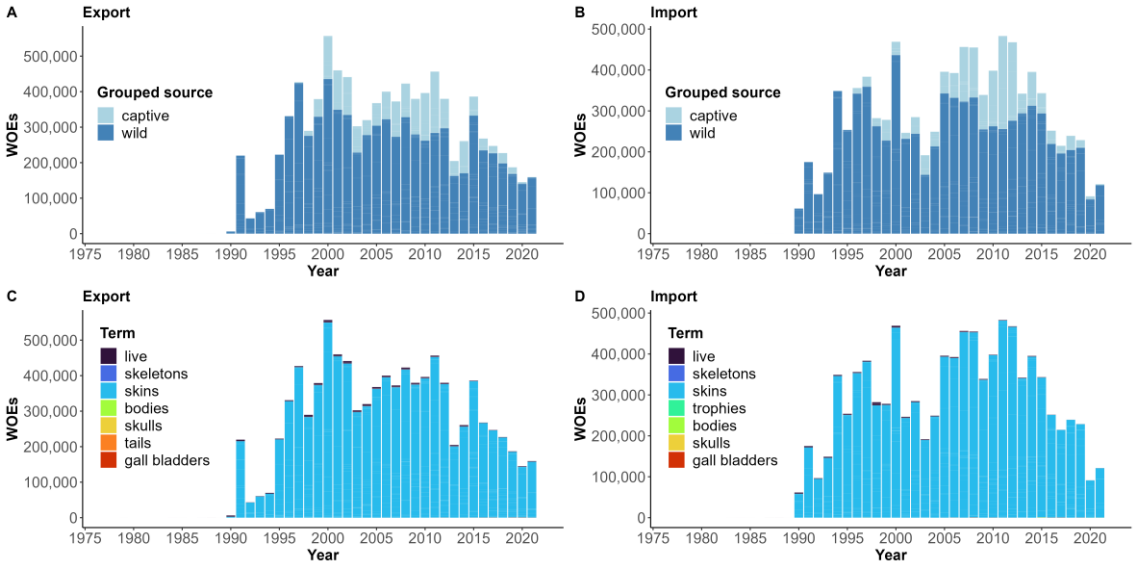

Figure 3.4-2. Reported quantities of exported (A and C) and imported (B and D) *Malayopython reticulatus* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly skins have been reported). Data from CITES trade database, downloaded 30 March 2023.

The species is heavily hunted in some parts of the range (Stuart et al., 2018). It is targeted for its skin, meat, fat and use in traditional medicines (Wahab et al. 2020). It is thought to be the most traded species in Southeast Asia (Kasterine et al., 2012) with a large proportion of skins traded coming from wild caught individuals (~80%).

In Indonesia and Malaysia some 300,000 reticulated pythons are harvested from the wild. There are serious concerns about the sustainability of this trade (Natusch et al., 2016). There is a disconnect between harvest quotas and the offtake level, and this led

to the European Union to ban imports of wild-sourced reticulated python skins from Peninsular Malaysia in 2002 (Natusch et al., 2016).

In South Sulawesi, Indonesia, Wahab et al. (2020) investigated the python harvest, and recorded a harvest of between 20 and 200 individuals per hunter per month. The local quota was 29,282 individuals per year, and this was not always realised (data from 2009 to 2019, quota realised in 7 years: 2011, 2012, 2013, 2018 and 2019).

There appears to be some conflicting opinions over the sustainability of the harvest. The species is a generalist and has a relatively rapid population growth rate, early maturation, and high reproductive output (Shine et al., 1999). Harvest can sometimes be difficult from the wild as populations are remote and collection is opportunistic (Kasterine et al., 2012). This might mean that despite the high numbers of individuals harvested the population will not be extirpated because of these life-history traits and trade constraints. However, the evidence from harvest indicates that animals may be harvested at an age below sexual maturity, leading to a population with few reproductive adults (Shine et al., 1999; Kasterine et al., 2012).

Illegal trade is potentially highly lucrative. Traders interviewed in Kasterine et al. (2012) suggested that the illegal trade was equivalent in size to the legal trade. Illegal trade can be concealed within legal shipments, mis-declared (whole skins as skin pieces) and misuse of CITES permits (false declaration of source). There is evidence of illegal or unscrupulous trade practices across the major trading countries (Kasterine et al., 2012). Export from Vietnam, for example, of greater than 100,000 skins per year (of both *M. reticulatus* and *Python bivittatus*) do not match up with the breeding potential of captive breeding facilities; this suggests wild harvest is still commonplace (Natusch and Lyons, 2014).

In the Philippines (Notification to the Parties No. 2010/038; https://cites.org/sites/default/files/eng/notif/2010/E038.pdf) and India (Notification to the Parties No. 2018/031; https://cites.org/sites/default/files/notif/E-Notif-2018-031.pdf) there are additional suspensions limiting export from wild populations and un-registered captive breeders. In the USA (Notification to the Parties NO 2015/019; https://cites.org/sites/default/files/notif/E-Notif-2015-019.pdf) there is an import suspension of live individuals to limit the risk of the species becoming invasive in areas such as the Florida Everglades.

d) Assessment of the threat(s) posed by trade

The species is listed on Appendix II of CITES. It is one of the most heavily traded species (mostly for skin) and there is some uncertainty around the sustainability of legal trade and the potential for illegal trade is high. Given that the species is highly adaptable to different habitats and populations grow relatively quickly some have suggested that the scale of the harvest is sustainable. Kasterine et al. (2012) recommended better monitoring of harvest with quotas determined using an adaptive management approach, increased ecological understanding to better determine bounds for a sustainable off-take of pythons, and a mandated legal minimum skin size limit to ensure that immature individuals are not harvested (effecting the populations long term sustainability). Natusch et al. (2020) suggests that geographic differences in the stretch of skins between Indonesian and Malaysian skins indicates a need to set country-specific minimum size requirements for trade.

e) Brief summary of other threats and conservation status

Other threats include habitat loss and ecosystem conversion, as well as direct persecution (Stuart et al., 2018).

Population monitoring programs in the range area
An exhaustive search of all available literature did not turn up information about monitoring programs.

National regulations / legislation and in the range countries
Occurs in at least one protected area (Stuart et al., 2018).

Current management in the range countries, including harvest quotas
Quotas are listed for Indonesia, Malaysia, and Laos (https://speciesplus.net/species#/taxon_concepts/65759/legal). In Malaysia export of skins is restricted to specimens greater than 240 cm in snout to vent length. In Indonesia, only reticulated pythons with a snout-to-vent length of >240 cm (stretched length of skin 260 cm) are allowed to be harvested, whereas no gravid females are allowed to be harvested. Natusch et al. (2016) report that 19.4% of the snakes brought into the slaughterhouses in North Sumatra are too small (less than 240 cm) and 10.1% of those in the South. Considering the harvest quota of 180,000 this suggests that some 25,000 reticulated pythons are harvested when they are juveniles or simply too small.

f) Overall assessment of data quality

The data for this species is relatively comprehensive because of its status as a highly traded species. It is worthwhile to note that much of the data we have from this, and other highly traded species comes mainly from a few slaughterhouses, rather than from field surveys (Nijman, 2022). That a skin originates from a slaughterhouse is no guarantee that it was bred in captivity. In 2010 and 2011, Vietnam exported 112,000 and 122,000 captive-bred (hence second generation and above) reticulated pythons, suggesting the presence of large commercial well-established breeding facilities. In 2012, the export of captive-bred individuals dropped to 45,000 but bounced back to 86,000 in 2014. From then on, gradually the numbers of captive-bred individuals dropped to 4,000 in 2020. This either suggests a collapse of the python captive-breeding industry, or it is indicative that there never was such an industry to begin with. A similar, but less extreme, case can be made for Laos where between 2010 and 2013 over 100,000 captive-bred reticulated pythons were exported, but none thereafter (Kasterine, 2012). In summary, most data is probably out-of-date. The data used for the IUCN Red List assessment is from 2011.

References

Lim B.L. (1999) Reptiles as potential biocontrol agents of pest rodents in plantation areas. Proceedings of the Symposium on Biological Control in the Tropics held at MARDI Training Centre, Serdang, Malaysia. 1999. Pp.82–84.

Dang, N.T., Tran K., Dang H.H., Nguyen C., Nguyen N.T., Nguyen H.Y., Dang T.D. (2007) The Vietnam Red Data Book. Natural Science and Technology Publishing House, Hanoi.

Devan-Song A., Luz S., Mathew A., Low M.-R., Bickford D.P. (2017) Pythons, Parasites, and Pests: Anthropogenic Impacts on Sarcocystis (Sarcocystidae) Transmission in a Multi-Host System. Biotropica 49:706–15. https://doi.org/10.1111/btp.12458

Kasterine A., Arbeid R, Caillabet O, Natusch D. (2012) The Trade in Southeast Asian Python Skins. Technical paper, 54 pp, International Trade Centre (ITC), Geneva.

Murray-Dickson G., Ghazali M., Ogden R., Brown R., Auliya, M. (2017) Phylogeography of the reticulated python (*Malayopython reticulatus* ssp.): Conservation implications for the worlds' most traded snake species. PloS One 12:e0182049. https://doi.org/10.1371/journal.pone.0182049

Natusch D.J.D., Lyons J.A. (2014) Assessment of Python Breeding Farms Supplying the International High-End Leather Industry. A report under the 'Python Conservation Partnership' programme of research. Occasional Paper of the IUCN Species Survival Commission 50. Gland, Switzerland: IUCN. 56pp.

Natusch D.J.D., Lyons J.A., Mumpuni, Riyanto A., Shine R. (2016) Jungle giants: Assessing sustainable harvesting in a difficult-to-survey species (Python reticulatus). PLoS One 11:e0158397. https://doi.org/10.1371/journal.pone.0158397.

Natusch, D.J.D., Lyons J.A., Riyanto A., Khadiejah S. (2020) Applying skin-size limits for management of trade in Asian reptile skins. Wildlife Research 47:89–98.

Nijman V. (2022) Harvest quotas, free markets and the sustainable trade in pythons. Nature Conservation 48:99-121.

Reynolds R.G., Niemiller M.L., Revell L.J. (2014) Toward a Tree-of-Life for the boas and pythons: Multilocus species-level phylogeny with unprecedented taxon sampling. Molecular Phylogenetics and Evolution 71:201-213.

Shine R., Ambariyanto, Harlow P.S., Mumpuni. (1999) Ecological attributes of two commercially-harvested python species in northern Sumatra. Journal of Herpetology 33:249-257. DOI: 10.2307/1565722.

Stuart B., Thy N., Chan-Ard T., Nguyen T.Q., Grismer L., Auliya M., Das I., Wogan G. (2018) *Python reticulatus*. The IUCN Red List of Threatened Species 2018:e.T183151A1730027. https://dx.doi.org/10.2305/IUCN.UK.20182.RLTS.T183151A1730027.en. Accessed on 19 March 2023.

Wahab DA, Maulany RI, Nasri, Nirsyawita. (2020) Hunting and trading activities of reticulated python (*Python reticulatus*) in South Sulawesi, Indonesia: A report from the field. IOP Conference Series: Earth and Environmental Science 486:012029. IOP Publishing. DOI 10.1088/1755-1315/486/1/012029.

3.5 *Malayopython timoriensis*

Summary and conclusion
Malayopython timoriensis is endemic to the Lesser Sunda islands of Indonesia. The species is traded in the international pet trade for which specimens are typically collected from the eastern Lesser Sunda Islands. The species is protected by law in Indonesia, and only export of captive bred (F2) specimens is permitted. The species was recently listed as Vulnerable in the IUCN Red List of Threatened Species under criteria A4d (inferred potential population size reduction), and the assessment concluded that the major threat to the species is overharvesting for the international pet trade. The IUCN Red List assessment moreover stated that improved enforcement of trade restrictions on this species is needed to prevent laundering of wild or farmed individuals. There is, however, a lack of information on population size and trends, as well as levels of illegal trade. The conclusion in the IUCN Red List assessment is also in contrast to that of the IUCN SSC Snake Specialist Group which states that current offtake from trade will have no impact on the viability of wild populations (D. Natusch, pers. comm. 2023). VKM concludes that it has insufficient data to conclude whether trade is detrimental to the survival of this species with low confidence. This is based on a lack of population data, trends, legal and illegal trade while the species is assessed to be rare.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Malayopython timoriensis* (W. Peters, 1876).

Common names: Timor python.

Scientific synonyms: *Australiasis timoriensis* (Peters, 1876)*; Broghammerus timoriensis* (Peters, 1876); *Liasis amethistinus timoriensis* (Schneider, 1801); *Liasis petersii* Hubrecht, 1879; *Malayaopython timoriensis* (Peters, 1876); *Morelia timoriensis* (Peters, 1876); *Python timoriensis* (Peters, 1876).

Taxonomic note:
Formerly known as *Python timoriensis* but recently transferred to the newly erected genus *Malayopython* which includes *M. timoriensis* and *M. reticulatus* (Reynolds et al., 2014). The name change was adopted by CITES at CoP19, CoP19 Doc. 84.1.

CITES listing and IUCN assessment:
CITES: Appendix II (04/02/1977);
IUCN Red List of Threatened Species 2021 (Lilley et al., 2021): Vulnerable (VU;
Criterium: A4d – an inferred potential population reduction of more than 30% over three generations (12 years).

Distribution:
Endemic to the Lesser Sunda Islands of Indonesia (de Lang, 2011 in Lilley et al., 2021; Barker et al., 2018). Presence confirmed on the islands of Flores, Solor, Lembata, Adonara, Lomblen, and Pantar whereas presence on the islands of Alor and Timor is unconfirmed (O'Shea, 2011). Erroneously reported from Lombok. Distribution ranges from sea level to approximately 500 m asl (Lilley et al., 2021).

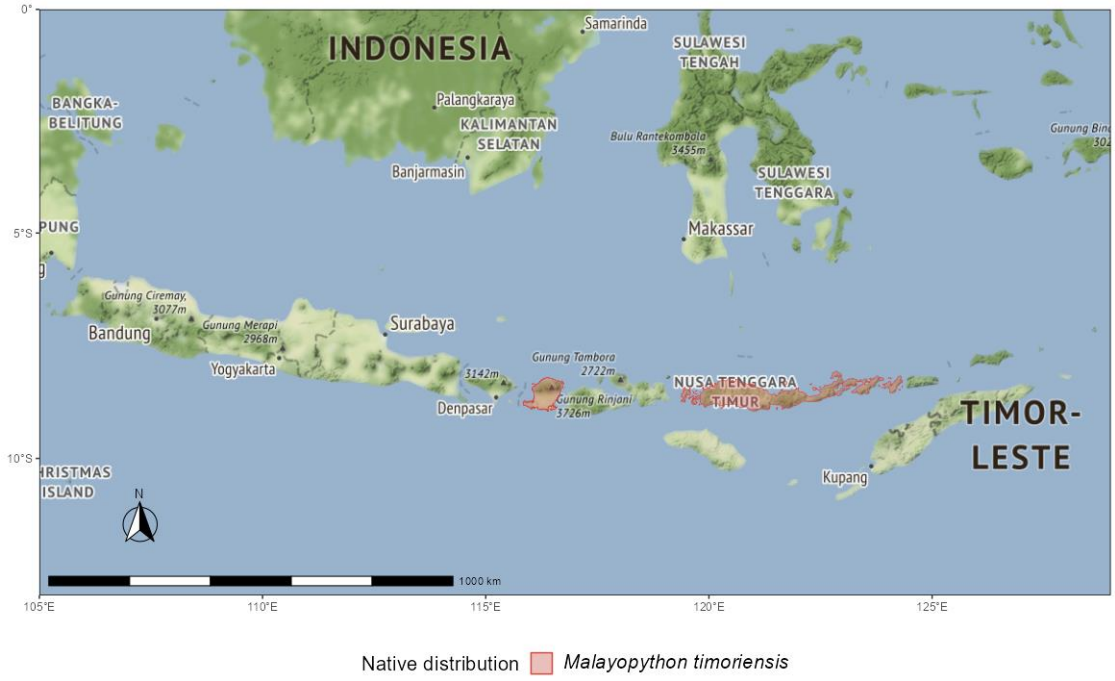

Figure 3.5-1. Distribution of *Malayopython timoriensis*. Data from IUCN 2019. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023. Note that presence on Lombok is uncertain.

Life history:
Oviparous with clutch size ranging from 4-6 eggs (O'Shea, 2011). Generation time is 4 years (Lilley et al., 2021).

Habitat:
Associated with grassland and hilly landscapes with open monsoon forests (O'Shea, 2011; Barker et al., 2018; Lilley et al., 2021). Also observed in coastal caves preying on bats, as well as in mangroves and shrublands (Lilley et al., 2021). A single specimen has been observed inside a village house (Lilley et al., 2021).

Role in the ecosystem:
Partly arboreal predator (non-venomous constrictor) that probably preys on mammals and birds (O'Shea, 2011).

b) Populations and trends

Believed to be a rare species (de Lang, 2011 in Lilley et al., 2021) although monitoring data on population size and trends is lacking. The IUCN Red List assessment states that it seems reasonable that a combination of several threats (see sections d and e below) will likely result in a decline by over 30% in a 12-year window – estimated to correspond to three generations – from the past to the future (Lilley et al., 2021). The IUCN Red List assessment does not refer to any data in this regard, making it difficult to assess this conclusion.

c) Legal / illegal harvesting, captive breeding, and trade

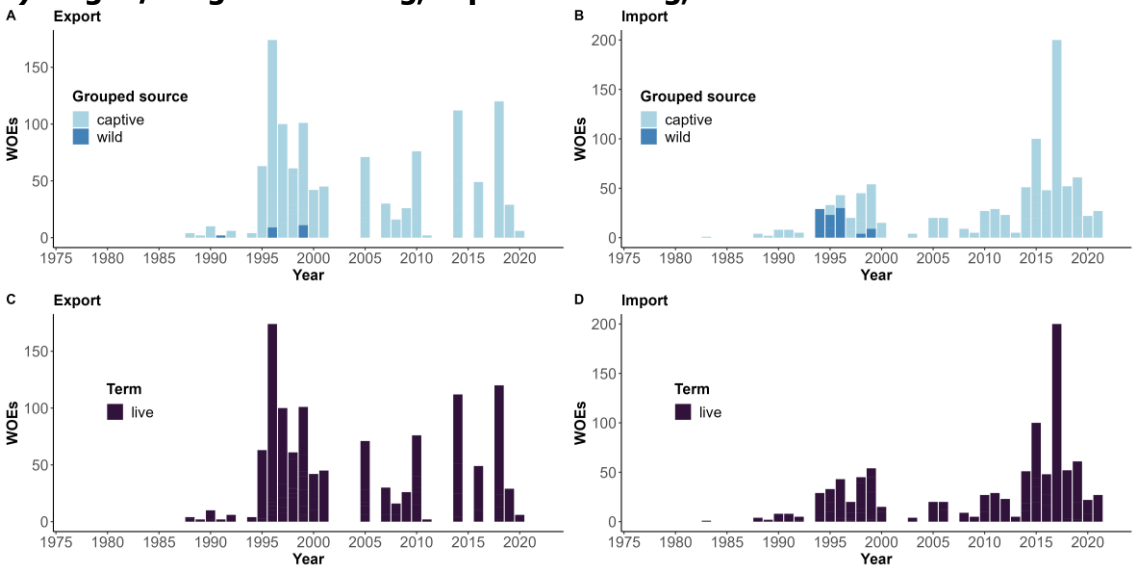

Figure 3.5-2. Reported quantities of exported (A and C) and imported (B and D) *Malayopython timoriensis* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (only live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

Malayopython timoriensis is traded in the international pet trade, and specimens are typically collected from the eastern Lesser Sunda Islands (de Lang, 2011 in Lilley et al., 2021). Information on the demographic segment of the population being traded is lacking. The species is protected by Indonesian law and only captive-bred (F2) specimens are permitted to be exported from the country implying that only F2-generation specimens are exported from Indonesia (Lilley et al., 2021).

Between 2010-2018, more than 450 live specimens documented as captive bred were exported from Indonesia. In the same period, approximately 250 specimens were exported from Indonesia labelled as farmed, which has been deemed likely to be an underestimate when confronted to other trade data (Lilley et al., 2021). Additional export of live specimens under the name of other species is suspected (Lilley et al., 2021).

The IUCN Red List assessment states that the species is in high and seemingly increasing demand in international pet trade (Lilley et al., 2021). Markets in Europe and the USA sell the species between 700–800 Euros per specimen (Lilley et al., 2021) and prices in the international pet trade have increased over the last few years (Lilley et al., 2021).

As seen in Figure 3.5-2, trade reported in the CITES Trade Database is live captive-sourced specimens and the trade quantities are modest and largely stable over time. However, large interannual differences over the last ten years in the export of captive-bred individuals, including several years with zero export and other years with export exceeding 100 individuals, raises suspicion on the reality of captive-breeding. As a commercial business it is not viable to have years with zero export only to be able to export large numbers the following year (V. Nijman, pers. comm. 2023).

d) Assessment of the threat(s) posed by trade

The IUCN Red List assessment concludes that the major (and considerable) threat for this species is overharvesting for the international pet trade, and that the demand for the species is high and seemingly increasing (Lilley et al., 2021). Trade in concert with other threats is assessed by IUCN Red List for Threatened Species as likely to result in a population reduction by over 30% in a 12-year window (Lilley et al., 2021). The IUCN Red List assessment does not refer to any data in terms of overharvesting, demand, and trade, making it difficult to assess this conclusion. The species appears to be rare, has a limited distribution, there is no monitoring in place, trade seems to be erratic in terms of numbers (some years >100, other years none) (Lilley et al., 2021; V. Nijman, pers. comm. 2023). The conclusion of the IUCN Red List assessment is in contrast to that expressed by the IUCN SSC Snake Specialist Group which states that current offtake from trade will have no impact on the viability of wild populations as this is a highly sedentary, cryptic, adaptable species that does not need to expose itself to thermoregulate and thrives on commensal rodents (D. Natusch, pers. comm. 2023).

e) Brief summary of other threats and conservation status

The IUCN Red List assessment states that other potential threats to this species include habitat loss driven by road construction and land clearing for small agriculture and plantations, as well as tourism development (Lilley et al., 2021).

f) Population monitoring programs in the range area

Information lacking.

g) National regulations / legislation and in the range countries

The species is protected by Indonesian law (Indonesian Government Regulation No. 7/1999). Only captive-bred (F2) specimens are permitted to be exported from Indonesia (Lilley et al., 2021). Domestic trade in captive bred specimens of the species is restricted to 10 percent of the permitted international trade and no domestic trade in wild-caught specimens is permitted (Indonesian Ministry of Environment and Forestry, 2023).

h) Current management in the range countries, including harvest quotas

No quotas exist.

i) Overall assessment of data quality

Due to lack of information, the current NDF assessment is largely based on the IUCN Red List assessment (Lilley et al., 2021), which itself is based on few (and to a large extent pers. comm.-type) references. Data on population size or trends is lacking. In sum, the quality of the data underlying this assessment is deficient. Lilley et al. (2021) highlight that more research is needed to clarify the taxonomy, distribution, ecology, and habitats of this species.

References

Barker D.G., Barker T.M., Davis M.A., Schuett G.W. (2015) A review of the systematics and taxonomy of Pythonidae: An ancient serpent lineage. Zoological Journal of the Linnean Society 175:1-19.

de Lang R. (2011) The Snakes of the Lesser Sunda Islands (Nusa Tenggara) Indonesia. Chimaira, Frankfurt.

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Lilley R., Rusli N., Stubbs A., Arida E. (2021) *Malayopython timoriensis*. The IUCN Red List of Threatened Species 2021: e.T104842394A104854030. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T104842394A104854030.en. Accessed on 08 February 2023.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Reynolds R.G., Niemiller M.L. Revell, L.J. (2014) Toward a Tree-of-Life for the boas and pythons: Multilocus species-level phylogeny with unprecedented taxon sampling. Molecular Phylogenetics and Evolution 71:201-213.

3.6 *Morelia boeleni*

Summary and conclusion

Morelia boeleni is widespread in mid-montane rainforest above 1,000 meters in Indonesia and Papua New Guinea (Austin et al., 2010, Tallowin et al. 2018), but its actual abundance appears to be rather low. Its low abundance is also likely reflected in the high prices that can be achieved by sellers of the species, especially when traded internationally. Further, the species' rarity is represented by the comparably low number that has been registered in trade databases. In its natural distribution range, *M. boeleni* is threatened by hunting, deforestation, mining, and habitat fragmentation and destruction (Natusch and Lyon, 2012). Low population density is likely to make the species vulnerable to over-collection, however, the small volumes in international trade suggest that trade is not currently a major threat. Sufficient data, especially on abundance, harvest, and trade, for a comprehensive assessment and status of the species is currently lacking and therefore it is currently categorized as Data Deficient in the IUCN Red List of Threatened Species. VKM concludes that, currently, international trade poses a threat to the continued survival of the species in the wild with low confidence. This is based on the current IUCN Red List status DD, apparent illegal trade and laundering of wild-caught specimens, absence of captive-breeding facilities, and the dominance in trade of specimens originating from Indonesia (i.e., not trade in captive-bred from non-range states).

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Morelia boeleni* (Brongersma, 1953).

Common name: Boelen's python, black python.

Scientific synonyms: *Liasis boeleni* Brongersma, 1953; *Liasis taronga* Worrell, 1958; *Python boeleni* (Brongersma, 1953); *Simalia boeleni* (Brongersma, 1953).

Taxonomic note:
Reynolds et al. (2014) transferred *Morelia boeleni* to the genus *Simalia* with the combination *Simalia boeleni* (Brongersma, 1953). CITES maintains the name *Morelia boeleni*.

CITES listing and IUCN assessment:
CITES Appendix II (01/07/1975);
IUCN Red List for Threatened Species (Tallowin et al., 2018): Data Deficient (DD).

Distribution: The species is endemic to the island of New Guinea and occurs in both Western New Guinea (Indonesia) and Papua New Guinea (Tallowin et al., 2018).

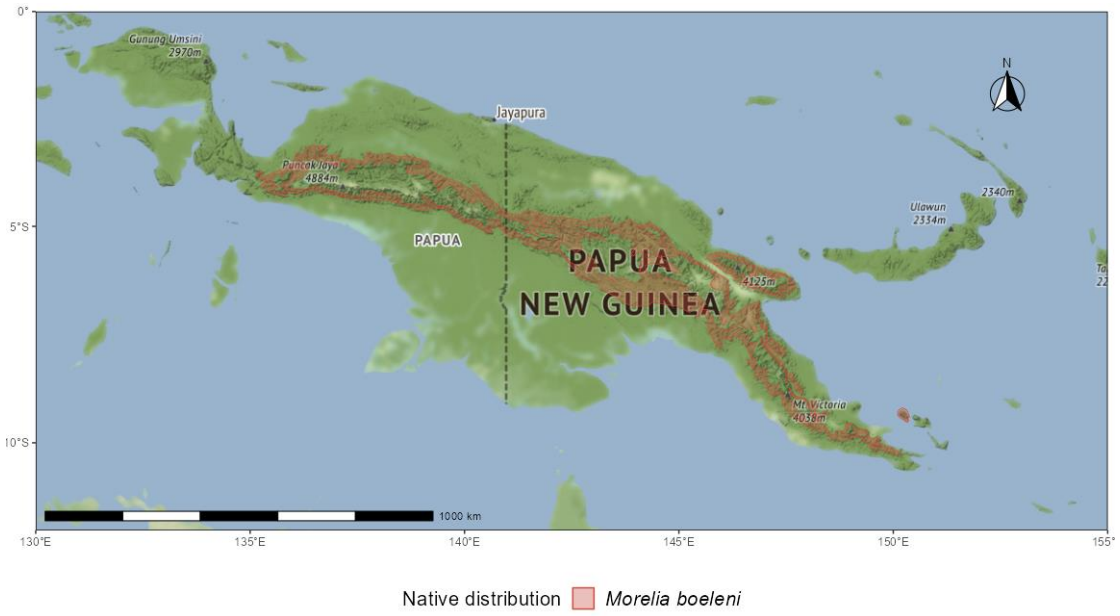

Figure 3.6-1. Distribution of *Morelia boeleni*. Data from Temple University, Bishop University 2014. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: At the age of around one year the species is about 1 meter long. Adults can be up to 3 meters in length. It is an oviparous species with a clutch size of at least 14 eggs (Tallowin et al., 2018).

Habitat: *Morelia boeleni* is a montane New Guinea endemic found in highlands above 1,000 meters and below the tree line (Austin et al., 2010) and in forests up to 2,000 meters (Harrington et al., 2018, Tallowin et al., 2018).

Role in the ecosystem: The species is a non-venomous constrictor that probably feeds primarily on small mammals and birds (O'Shea, 2011; Tallowin et al., 2018).

b) Populations and trends

Despite its large distribution area, trends on the status of the species and populations remain unknown (Tallowin et al., 2018).

c) Legal / illegal harvesting, captive breeding, and trade

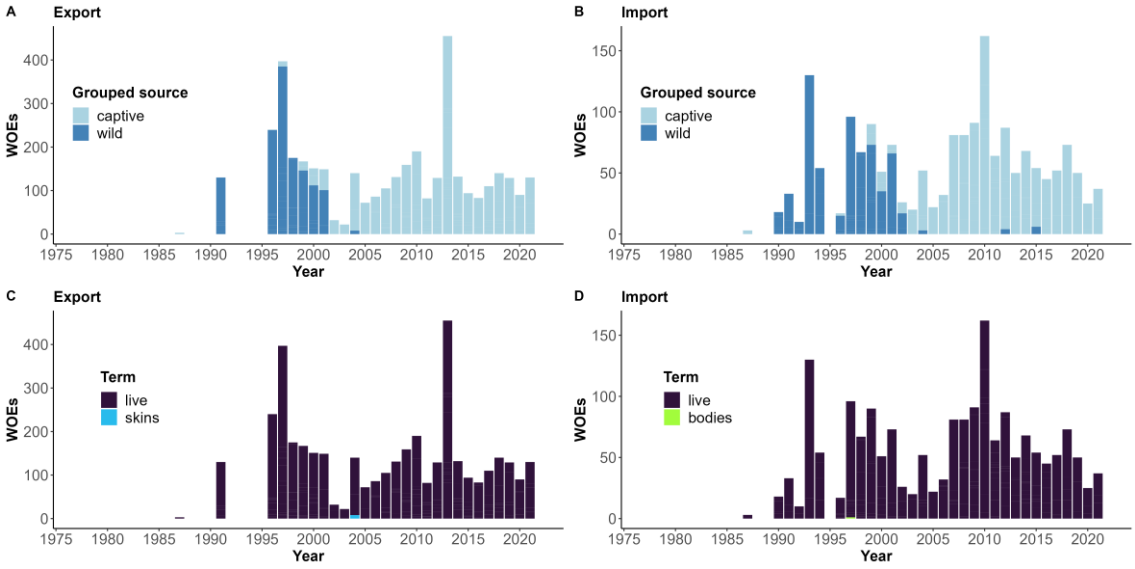

Figure 3.6-2. Reported quantities of exported (A and C) and imported (B and D) *Morelia boeleni* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

The species is fully protected in Papua New Guinea but not in Indonesia. The species is mainly exported from Indonesia. Wild harvest is not allowed, and only captive-bred specimens can be granted CITES permits for international trade. Wildlife traders can achieve high prices when selling the species (Tallowin et al., 2018) which may decrease its abundance in New Guinea (Natusch and Lyons, 2012). Indonesia set annual harvest quotas but has ceased to do so from 2001 (https://speciesplus.net/species#/taxon_concepts/3079/legal). As for now, no current export quota exists (Austin et al., 2010), but nearly all legal trade originates from Indonesia (CITES Trade Database, 2023). In some areas on Papua New Guinea, the species is of cultural and spiritual significance (Austin et al., 2010; Natusch and Lyons, 2012). Among indigenous people the species is used as totem animal as well as for food (Tallowin et al., 2018).

It has been reported that Indonesia exported over 1,000 individuals declared as "captive-bred", despite the lack of evidence of successful captive breeding of the species. The species has been established in the pet trade for over 30 years, but according to Lettoof (2015) the species has been successfully reproduced on fewer than 10 occasions. This suggests that it is unlikely that captive breeding in Indonesia can sustain such high numbers of individuals without supplementing wild captures of *M. boeleni* through false declaration as "captive-bred" or "farmed" of wild caught specimens (Natusch and Lyons, 2012).

d) Assessment of the threat(s) posed by trade

The contradiction of extreme challenges with successful reproduction in pet captivity versus Indonesia exporting in excess of 1,000 captive-bred specimens suggest most trade from Indonesia is sourced from the wild. Limited information or data is available on illegal trade, but citing traders as source, Natusch and Lyons (2012) wrote that *M. boeleni* had become particularly scarce due to over-collection and habitat loss. The

limited distribution, current rarity, and reported increasing scarcity suggests that trade followed by habitat loss are the two main threats to the species.

e) Brief summary of other threats and conservation status

The species' rarity and appearance make it highly attractive for pet trade and collection (Natusch and Lyon, 2012; Tallowin et al., 2018). The species is hunted, used as pets, and consumed as food. Its habitat is under threat due to destruction caused by deforestation, mining, infrastructure development (Natusch and Lyon, 2012), and possibly oil and gas drilling.

f) Population monitoring programs in the range area

No information available.

g) National regulations / legislation and in the range countries

Morelia boeleni is fully protected in Papua New Guinea and in Indonesia (Western New Guinea) (Tallowin et al., 2018; Indonesian Ministry of Environment and Forestry, 2023).

h) Current management in the range countries, including harvest quotas

There is no management plan for wild *M. boeleni* in Indonesia or Papua New Guinea.

i) Overall assessment of data quality

Sufficient data on the number of individuals and distribution is lacking to adequately assess population status and trends.

References

Austin C.C., Spataro M., Peterson S., Jordan J., McVay J.D. (2009) Conservation genetics of Boelen's python (*Morelia boeleni*) from New Guinea: reduced genetic diversity and divergence of captive and wild animals. Conservation Genetics 11:889-896.

Harrington S.M., de Haan J.M., Shapiro L., Ruane S. (2018) Habits and characteristics of arboreal snakes worldwide: arboreality constrains body size but does not affect lineage diversification. Biological Journal of the Linnean Society 125:61–71.

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Lettoof D. (2015) Boelens Python *Morelia boeleni*. Species trade and conservation. Snake trade and conservation management (Serpentes spp.). An assessment of the impact of the pet trade on five CITES-Appendix II case studies. *Morelia boeleni*. AC28 Inf. 5:1-8. Available online at: https://cites.org/sites/default/files/eng/com/ac/28/Inf/E-AC28-Inf-05.pdf

Natusch D.J.D., Lyons J.A. (2012) Exploited for pets. The harvest and trade of amphibians and reptiles from Indonesia New Guinea. Biodiversity Conservation 21:2899-2911.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Reynolds R.G., Niemiller M.L., Revell L.J. (2014) Toward a Tree-of-Life for the boas and pythons: Multilocus species-level phylogeny with unprecedented taxon sampling. Molecular Phylogenetics and Evolution 71:201-213.

Tallowin O., O'Shea M., Parker F. (2018) *Simalia boeleni*. The IUCN Red List of Threatened Species 2018: e.T42494046A42494055. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T42494046A42494055.en. Accessed on 24 January 2023.

3.7 *Morelia bredli*

Summary and conclusion

Morelia bredli, the Central carpet python is thought to have a stable population trend and is listed as Least Concern on the IUCN Red List. Information on species threats (pet trade and habitat loss) appears to be out of date. Expert-based knowledge suggests that the species is relatively unharmed by trade. Wild populations are possibly shielded as captive breeding largely satisfies the demand for the pet trade. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with high confidence. This is based on the current IUCN Red List status LC, strong law enforcement in the range state, and low-level trade for pets only reported as being from captive-bred origin.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Morelia bredli* (Gow, 1981).

Common name(s): Centralian carpet python, Central carpet python, Centralian carpet snake.

Scientific synonyms: *Python bredli* Gow, 1981.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Cogger et al., 2017): Least Concern (LC).

Distribution:
Python bredli occurs in central Australia in the arid southern parts of the Northern Territory in the MacDonnell Ranges (Cogger, 2014; O'Shea, 2011).

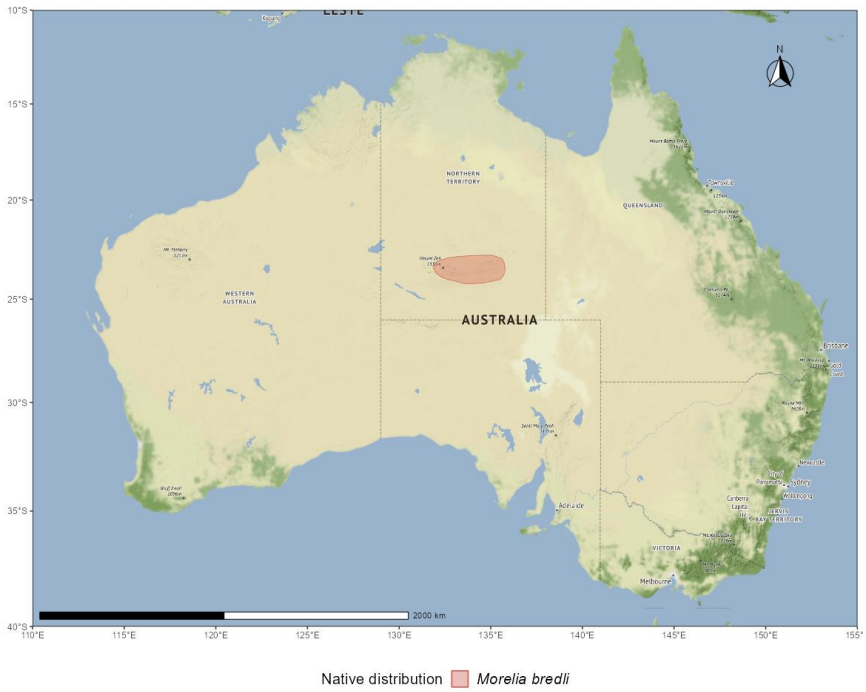

Figure 3.7-1. Distribution of *Morelia bredli*. Data from IUCN, Stewart MacDonald, Reid Tingley 2017. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
Morelia bredli is nocturnal during the summer months but becomes almost diurnal during spring and autumn when night-time temperatures get too low. It feeds on tree-hole nesting birds, marsupials (possums and rock wallabies) and occasionally exotic mammals (feral cats and rabbits). It is presumed that mating takes place in August and September. It is an oviparous species and the eggs (13-47, average clutch size 23.5) are laid between late October and December, hatching occurring during January and February (Barker and Barker, 1994; O'Shea, 2011).

Habitat:
This species occurs in freshwater wetlands, rock outcrops, and ridges. It is normally arboreal and may occur in trees or shrubs, particularly bordering riverbanks (Cogger, 2014) and sparse *Acacia* woodland. Animals seek shelter in caves and deep rock crevices.

Role in the ecosystem:
It feeds on birds, marsupials, and non-native mammals (O'Shea, 2011).

b) Populations and trends

The species is listed on the IUCN Red List as Least Concern (Cogger et al., 2017). It was last assessed in June 2017 and is thought to be a common species with a stable breeding population. Declining habitat quality and extent (including fragmentation) are ongoing threats to the species. There are no estimates of population size.

c) Legal / illegal harvesting, captive breeding, and trade

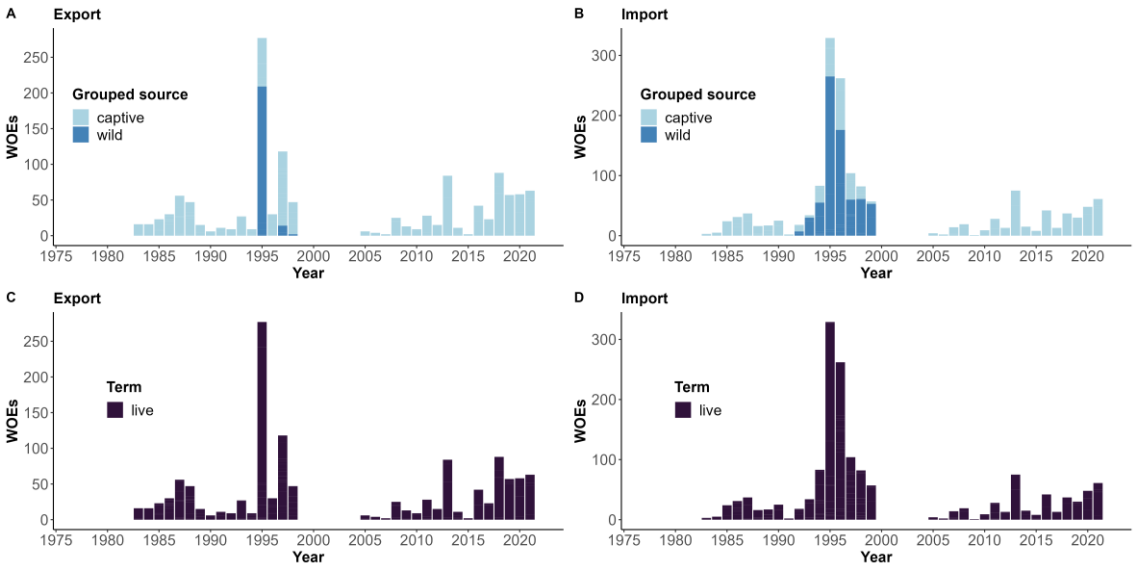

Figure 3.7-2. Reported quantities of exported (A and C) and imported (B and D) *Morelia bredli* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (only live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

Globally, trade in the species has been relatively small scale with most current trade supplying captive bred, live individuals (Cogger et al., 2017). Except for one record of trade in the early 1980s, the numbers of individuals in trade are low (generally much

less than 100 individuals per year; Auliya, 2003). We were not able to find any voluntary export quotas.

d) Assessment of the threat(s) posed by trade

The species is listed on Appendix II of CITES. Records of wild-sourced trade in the species stopped in 1999 (see Figure 3.7-2). Current trade in the species is predominately of living specimens for commercial trade and this suggests the pet trade. There are no records of live trade of wild individuals post 2000. Trade of captive-bred live specimens does not pose a threat to the species as no supplementation from the wild is recorded.

e) Brief summary of other threats and conservation status

The IUCN Red List Species Assessment (Cogger et al., 2017) identifies a reduced habitat extent and habitat quality decline, but there is no clear quantified evidence of this. In addition, no major threats are recorded (Cogger et al., 2017).

f) Population monitoring programs in the range area

An exhaustive search did not reveal any existing monitoring programs.

g) National regulations / legislation and in the range countries

Occurs in at least one protected area in its native rage in Australia (Cogger et al., 2017).

h) Current management in the range countries, including harvest quotas

None found.

i) Overall assessment of data quality

Data on the species is limited. Information on the species threats (pet trade and habitat loss) appears to be out of date.

References

Auliya M. (2003) Hot Trade in Cool Creatures: A Review of the Live Reptile Trade in the European Union in the 1990s with a Focus on Germany. TRAFFIC Europe, Brussels.

Barker D.G., Barker T.M. (1994) Pythons of the World: Australia. Vol. 1. Advanced Vivarium Systems: Escondido, CA.

Cogger H. (2014) Reptiles and Amphibians of Australia. CSIRO Publishing, Collingwood, Melbourne.

Cogger H., Fenner A., Hutchinson M., McDonald P. (2017) *Morelia bredli*. The IUCN Red List of Threatened Species 2017: e.T42494066A42494080. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T42494066A42494080.en. Accessed on 19 March 2023.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

3.8 *Morelia spilota*

Summary and conclusion
The Carpet python (*Morelia spilota*) has a broad distribution in Australia and the island of New Guinea. It has low habitat specificity and occurs in a wide range of different habitats including secondary vegetation and cultivated areas. It is a generalist ambush predator preying on common prey species. It has a large distribution, fast growth rate, relatively high fecundity, and adaptability. Trade data suggests that Indonesian harvest quotas are exceeded, but it is not clear what impact this has on the wild population. An analysis of trade from Indonesia suggests laundering of wild-caught specimens as captive-bred specimens, and this should be considered when assessing non-detriment for import from Indonesia. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, high reproductive rate, predominant trade for pets only and reported as being from captive-bred origin. Data suggests that most specimens from Indonesia are wild-caught but laundered as captive-bred specimens.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Morelia spilota* (Lacépède, 1804).

Common name: Carpet python, diamond python, Western australian carpet python.

Scientific synonyms: *Coluber argus* Linnaeus, 1766; *Coluber spilotus* Lacépède, 1804; *Morelia argus* (Linnaeus, 1766); *Morelia cheynei* Wells & Wellington, 1984; *Morelia imbricata* Wells & Wellington, 1984; *Morelia mcdowelli* Wells & Wellington, 1984; *Morelia metcalfei* Wells & Wellington, 1985; *Morelia punctata* (Merrem, 1820); *Morelia variegata* Gray, 1842; *Python peronii* Wagler, 1828; *Python punctatus* Merrem, 1820; *Python spilotus* (Lacépède, 1804).

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Tallowin et al., 2017): Least Concern (LC).

Distribution: It has a distribution across the Sahul shelf: Mainland Australia, and widely distributed throughout the forest regions of Southwest Australia; Irian Jaya (Indonesia); Papua New Guinea (Tallowin et al., 2017).

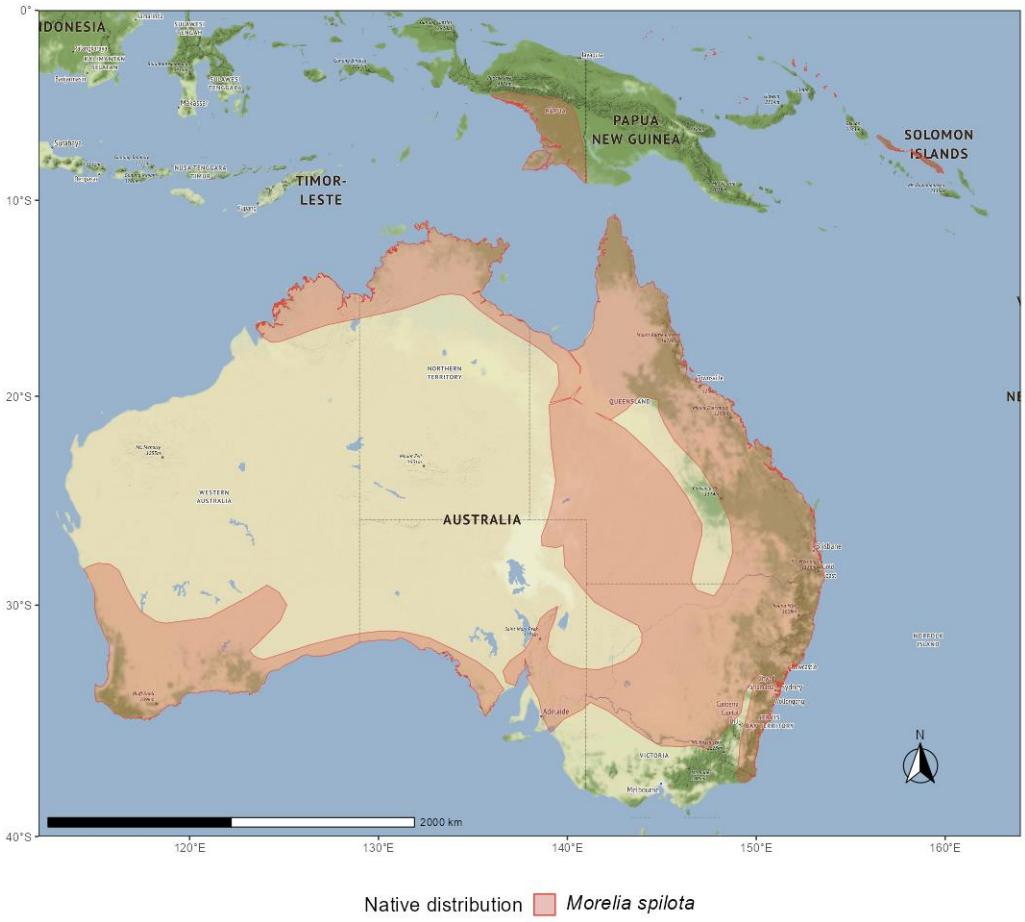

Figure 3.8-1. Distribution of *Morelia spilota*. Data from IUCN, Stewart MacDonald, Reid Tingley 2017. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: The species is oviparous and lays a clutch of about 15-25 eggs (Greer, 1995; Wilson and Swan, 2010). Carpet pythons exhibit maternal care and females coil around their eggs and guard them until they hatch. At hatching, carpet pythons are about 40 cm in length and weigh between 22-26 g (Wilson and Swan, 2010).

Habitat: Carpet pythons occur in a wide range of habitats, and are found in dense moist lowland forest, shrubland, grassland and rocky areas of various altitudes and temperature ranges (Wilson and Swan, 2010). This species is also common in agricultural and urban areas (Tallowin et al., 2017).

Role in the ecosystem: Carpet pythons are ambush predators, and mammals are the primary food source. In Australia, the diet consists of rats, mice, possums, sugar gliders, bandicoots, rabbits, insects, frogs, birds and bird eggs, lizards, snakes, as well as domestic pets including aviary birds, chickens, ducks, turkeys, and guinea pigs (Slip and Shine, 1988).

b) Populations and trends

M. spilota is common and widespread in many areas, but localized declines were reported as early as the 1990s (Shine, 1994; Bush et al., 1995; Shine and Fitzgerald, 1996). The current population trend is decreasing (Tallowin et al., 2017). It should be noted that several subspecies exist, and that population trends for the different subspecies might differ.

c) Legal / illegal harvesting, captive breeding, and trade

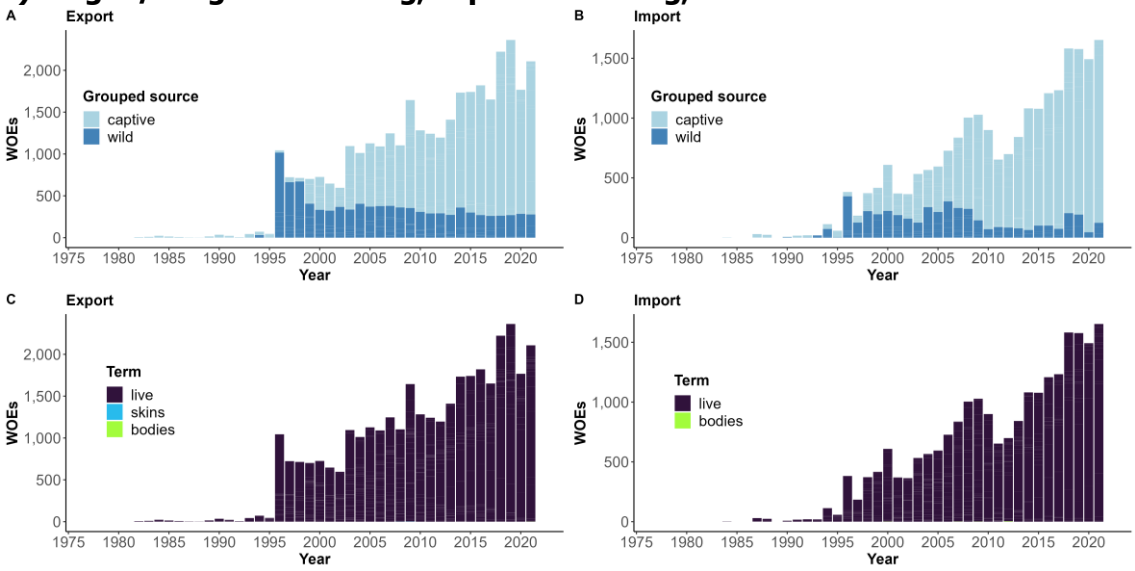

Figure 3.8-2. Reported quantities of exported (A and C) and imported (B and D) *Morelia spilota* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

M. spilota has been traditionally hunted for human consumption by Aboriginals in Australia (Russell-Smith et al., 1997). In Australia, the species is well established in captivity and common in the domestic pet trade, but the trade is restricted to Australia (Leseberg and Campbell, 2015). The species is prominent in the international pet trade and has been collected from the wild in Indonesia and traded for this purpose since at least 1992. CITES has adopted export trade quotas on *M. spilota* from Indonesia from 1997 to 2022. Export trade quotas cover live animals for the pet trade. Quotas started at 1400 in 1997 and sharply dropped to around 300 from 2000 onwards (Species+, 2023). The CITES Trade Database suggests that Indonesia exceeded their quota for this species in several years (Tallowin et al., 2017). Nijman and Shepherd (2009) in their TRAFFIC report conclude that as the cost of producing large number of snakes in captivity is greater than collecting similar numbers from the wild, it is likely that wild-caught carpet pythons are laundered as captive-bred snakes.

d) Assessment of the threat(s) posed by trade

This species is popular in the international pet trade, but the impact of collection from the wild is not well documented (Tallowin et al., 2017). Natusch and Lyons (2011) suggest that the current harvest from Indonesia – even though it exceeds national quotas – is most likely sustainable, due to the species' large distribution, relatively high fecundity and adaptability, but stress that data gaps make it impossible to conclude this with confidence.

e) Brief summary of other threats and conservation status

The species is currently listed by IUCN as Least Concern. Habitat loss and fragmentation do affect the species, and some subspecies and populations are in decline (Corey and Doody, 2016; Tallowin et al., 2017). Invasion of cane toads may also affect population trends (Pearson et al., 2014). In South Australia conservation status of the species is assessed as Rare (Atlas of Living Australia, 2023).

f) Population monitoring programs in the range area
Not known.

g) National regulations / legislation and in the range countries
This species has protected status in Australia and Papua New Guinea (Natusch and Lyons, 2012).

h) Current management in the range countries, including harvest quotas
There are no management plans for the species in the range states. Indonesia sets harvest quotas for export, and these are in the range of 200-300 specimens a year (Indonesian Ministry of Environment and Forestry, 2023; https://speciesplus.net/species#/taxon_concepts/7469/legal)

i) Overall assessment of data quality
Overall data quality is adequate. There is some data deficiency on the current populations and trends in especially Irian Jaya (Indonesia) and Papua New Guinea.

References

Atlas of Living Australia. (2023) *Morelia spilota*. Available at: https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/8abc16cd-d2b6-43e7-853e-0275a2ed7697. Accessed on 14 February 2023.

Bush B., Maryan B., Browne-Cooper R., Robinson, D. (1995) Guide to the Reptiles and Frogs of the Perth Region. University of Western Australia Press, Nedlands, Australia.

Corey B., Doody, J.S. (2016) Black box and attics: Habitat selection and resource use by large threatened pythons in landscapes with contrasting human modification. Austral Zoology 41:6-15.

Greer A. (1997) The Biology and Evolution of Australian Snakes. Surrey Beatty & Sons, Chipping Norton, Australia.

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Leseberg N., Campbell I. (2015) Birds and Animals of Australia's Top End: Darwin, Kakadu, Katherine, and Kununurra. Princeton University Press, Princeton, New Jersey.

McDiarmid R.W., Campbell J.A., Touré T. (1999) Snake Species of the World: A Taxonomic and Geographic Reference, Volume 1. Herpetologists' League, Washington, DC. 511 pp.

Natusch, D.J.D., Lyons, J.A. (2011) Distribution, ecological attributes and trade of the New Guinea carpet python (*Morelia spilota*) in Indonesia. Australian Journal of Zoology 59:236-241.

Natusch D.J.D., Lyons J.A. (2012) Exploited for pets. The harvest and trade of amphibians and reptiles from Indonesia New Guinea. Biodiversity Conservation 21:2899-2911.

Nijman V., Shepherd C.R. (2009) Wildlife trade from ASEAN to the EU: issues with the trade in captive-bred reptiles from Indonesia. TRAFFIC Europe Report for the European Commission, Brussels, Belgium.

Pearson D., Webb J., Greenlees M., Phillips B., Bedford G., Brown G., Thomas J., Shine, R. (2014) Behavioural responses of reptile predators to invasive cane toads in tropical Australia. Austral Ecology 39:448-454.

Russell-Smith J., Lucas D., Gapindi M., Gunbunuka B., Kapirigi N., Namingum G., Lucas K., Giuliani P., Chaloupka, G. (1997) Aboriginal resource utilization and fire management practice in Western Arnherm Land, Monsoonal Northern Australia: notes for prehistory, lessons for the future. Human Ecology 25:159-195.

Shine R. (1994) The Biology and Management of the Diamond Python (*Morelia spilota spilota*) and Carpet Python (*M. s. variegata*) in New South Wales. Species Management Report No. 15. New South Wales National Parks and Wildlife Service, Sydney, Australia.

Shine R., Fitzgerald M. (1996) Large snakes in a mosaic rural landscape: the ecology of carpet pythons *Morelia spilota* (Serpentes: Pythonidae) in coastal eastern Australia. Biological Conservation 76:113-122.

Slip D.J., Shine R. (1988) Habitat use, movements and activity patterns of free-ranging Diamond Pythons, *Morelia spilota spilota* (Serpentes: Boidae): a radiotelemetric study. Australian Wildlife Research 15:515-531.

UNEP (2023) The Species+ Website. Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK. Available at: www.speciesplus.net. Accessed on 14 February 2023.

Tallowin O., Parker F., O'Shea M., Vanderduys E., Wilson S., Shea G., Hobson, R. (2017) *Morelia spilota*. The IUCN Red List of Threatened Species 2017: e.T62232A21649539. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T62232A21649539.en. Accessed on 14 February 2023.

Wilson S., Swan, G. (2010) A complete guide to reptiles of Australia (Third Ed.). Reed New Holland Publishers, Australia.

3.9 *Morelia viridis*

Summary and conclusion

The Green tree python (*Morelia viridis*) is endemic to the Sahul shelf area with a broad distribution from northern Australia, the Indonesian Aru islands to the island of New Guinea. It has a large distribution and seemingly stable population sizes across its range. Trade data suggests the species is mostly traded as a live pet at low levels compared to python species traded for their skin products. It is not clear what impact trade has on the wild population as data on population size is lacking across its range. An analysis of trade to and from Norway suggests that most specimens traded in Norway are of captive-bred specimens. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, predominant trade for pets only and reported as being from captive-bred origin. It should be noted that data suggests that most specimens from Indonesia are wild-caught but laundered as captive-bred specimens. To discourage this trade a ban on import of the species from Indonesia could be considered.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Morelia viridis* (Schlegel, 1872).

Common name: Green tree python, green python.

Scientific synonyms: *Chondropython azureus* Meyer, 1874; *Chondropython pulcher* Sauvage, 1878; *Chondropython viridis* Schlegel, 1872; *Morelia azurea* (Meyer, 1874); *Python viridis* Schlegel, 1872.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Tallowin et al., 2018): Least Concern (LC).

Distribution:
Northeast Australia (Cape York Peninsula), Indonesia (some islands), Papua New Guinea and associated offshore islands (Natusch and Lyons, 2014; Tallowin et al., 2018).

Figure 3.9-1. Distribution of *Morelia viridis*. Data from IUCN, Stewart MacDonald, Reid Tingley, Allen Allison 2018. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
Oviparous with clutches of 6 to 32 eggs (O'Shea, 2011). Hatchlings are lemon-yellow, golden or orange-red usually changing color at a few months of age. Adult individuals are green, yellowish-green, or bluish.

Habitat:
It inhabits a wide range of closed forest habitats, generally living in trees. Also found in gardens and secondary growth to 2,000 m asl (O'Shea, 2011).

Role in the ecosystem:
Green tree pythons hunt mostly small lizards during their juvenile stage and small mammals as adults, and occasionally capture birds (Natusch and Lyons, 2014). As predators, green tree pythons keep prey populations in balance while they are being eaten by birds and other larger predators.

b) Populations and trends

Morelia viridis has a widespread distribution and is fairly abundant within that range. The species can be found within several protected areas. There are two genetically distinct but morphological identical lineages: a southern lineage found in Australia, Aru Islands, and New Guinea south of the central highlands, and a northern lineage inhabiting New Guinea north of the central highlands, Vogelkop Peninsula, and Biak Island (Rawlings and Donnellan, 2003; Wilson and Heinsohn, 2007; Natusch et al., 2020). Many green tree python populations seem robust, however observations indicate that the species continues to decline on some islands due to overharvesting

and habitat destruction (Natusch and Lyons, 2012), especially on islands like Biak Island in Papua Province, Indonesian New Guinea.

c) Legal / illegal harvesting, captive breeding, and trade

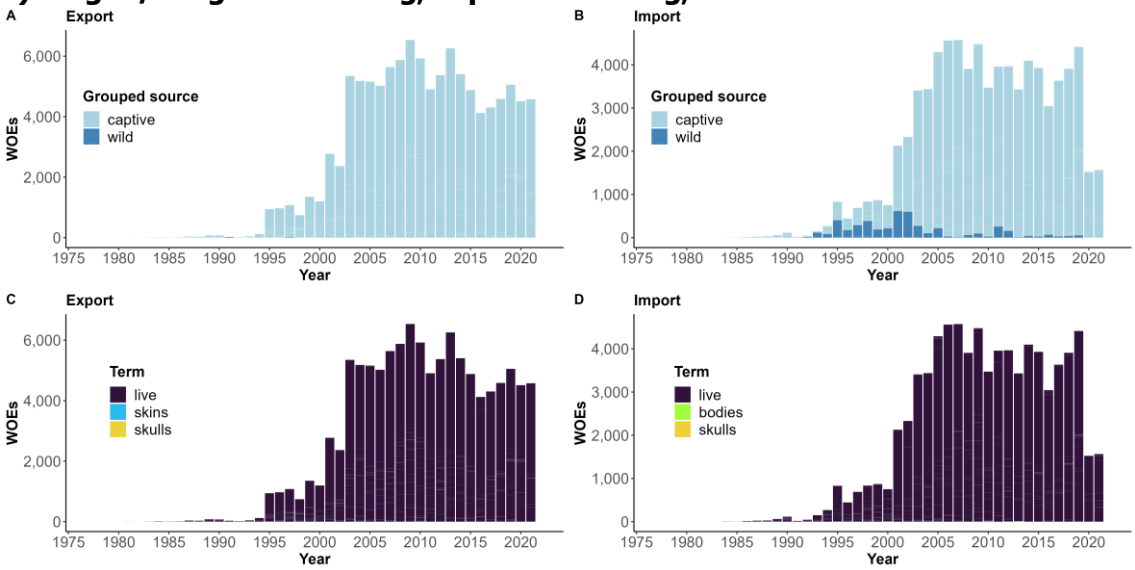

Figure 3.9-2. Reported quantities of exported (A and C) and imported (B and D) *Morelia viridis* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

M. viridis is one of the most commonly traded pet reptile species in Indonesian New Guinea and locally caught as food but has not been reported as harvested for skins in significant numbers. The latter might occur illegally as wild harvesting is only allowed for pets. Wild harvest is illegal in Australia and Papua New Guinea, but the species is reported as being traded in Western New Guinea (Indonesia) and presumably of wild origin (Natusch and Lyons, 2012). Export from Indonesia for commercial purposes is only allowed for F2 stock from captive breeding programs (CITES AC30 Doc. 27.2, 2018). In the US and European internet trade, animals are commonly advertised as captive bred and described as being easier to handle and breed from captive bred lines (Marshall et al., 2020). Five live individuals illegally traded from Indonesia were seized by customs in the Netherlands in 2010 (Janssen and Blanken, 2016), confirming that illegal trade to the EU occurs.

On the website finn.no *M. viridis* sells for 12,000 NOK https://www.finn.no/bap/forsale/ad.html?finnkode=273020842. Animals on offer in Europe and US are advertised as captive breed and cost between 600 and 1,600 Euros (https://www.quoka.de/tiermarkt/baumpython/sc_48.html or https://www.terraristik.com/tb/kaufen-und-verkaufen/verkauft-wird-ein-gruener-baumpython-morelia/a911131/) or (350-) 500 to more than 800 USD https://undergroundreptiles.com/product-category/animals/snakes/green-tree-pythons/ or https://www.wilbanksreptiles.com/collections/green-tree-pythons-1 (all links last accessed 23.12.2022).

Recent studies on *Morelia viridis* (Lyons and Natusch, 2011) concluded that wildlife laundering through breeding farms is a common problem in Indonesia and estimated

that up to 80% of the individuals exported annually by Indonesia were in fact wild-sourced.

d) Assessment of the threat(s) posed by trade

Green tree pythons seem to be traded mainly as live pets and only occasionally for skin or as food. In Western countries captive bred specimens seem to dominate the market (Natusch and Lyons, 2012; Robinson et al., 2015; Figure 3.9-2). CITES trade database records about 4,100-6,300 individuals being trades per year worldwide between 2010 and 2021. It has been suggested that most animals (c. 80%) caught in and traded from Indonesia are wild harvested (Natusch and Lyons, 2012) despite CITES trade database suggesting a high proportion of farmed animals in trade. The low number of individuals traded makes it unlikely that trade is currently a significant threat to the species. However, overharvesting could locally lead to decline of wild populations, such as in Biak and neighboring islands (Natusch and Lyons, 2012). There seem to exist a flourishing illegal trade out of Indonesia for which wildlife breeding farms serve as conduits to funnel wild-caught green tree pythons (Lyons and Natusch, 2011; Kufnerova, 2021). No breeding farms for green tree pythons seem to exist in Eastern Asia outside New Guinea. There are discrepancies between what is reported by Indonesia (no wild-caught individuals enter the international trade), and that what is reported by importing countries (here 1.7% of the trade is labelled wild-caught; 695/40,366). Almost all of these are imported into the USA (V. Nijman, pers. comm. 2023). The issue of regional decline in some of the distribution range and the illegal trade from Indonesia are concerning

e) Brief summary of other threats and conservation status

Habitat destruction is currently likely to be a bigger threat to the species than (over-) harvesting animals in the wild for the pet trade. Captive bred specimens seem to be dominating the market in Europe, including Norway, as well as the US (Natusch and Lyons, 2012; Robinson et al., 2015; Figure 3.9-2).

f) Population monitoring programs in the range area

Extensive search did not reveal any information on existing monitoring programs.

g) National regulations / legislation and in the range countries

In New Guinea the species is not protected. Export requires a permit issued by the Department of Environment and Conservation under the Papua New Guinea International Trade (Fauna and Flora) (Amendment) Act 2003.The species is protected under Indonesian domestic legislation (Indonesian Government Regulation No. 7/1999 listed as *Chonropython viridis*). Trade is only allowed from captive breeding facilities which need to be registered in the Indonesia CITES MA (Government regulation No. 19/Menhut-II/2005).

In Australia, snakes are protected under the Nature Conservation Act 1992. It is an offence to kill, injure or take snakes from the wild (https://www.qld.gov.au/environment/plants-animals/animals/living-with/snakes).

h) Current management in the range countries, including harvest quotas

Indonesia only allows export of captive bred individuals (Lyons and Natusch, 2011). Species+ includes no current existing quotas (https://speciesplus.net/species#/taxon_concepts/11140/legal).

i) Overall assessment of data quality

There are few publications available on *M. viridis*. The IUCN Red List assessment, one of the most relied on publications for this assessment, includes only a few references. Overall, the data on population size, population trends, and impact of trade regulations is insufficient.

References

Janssen J., Blanken L.J. (2016) Going Dutch: An analysis of the import of live animals from Indonesia by the Netherlands. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Kufnerova J. (2021) A novel approach of using shed skins of the green tree python, *Morelia viridis*, for forensic purposes. European Journal of Environmental Sciences 11:107–112.

Kunz K. (2017) Die Pythons Neuguineas. Von altbekannt bis geheimnisumwittert. Reptilia (Münster) 22:16-21.

Lyons J.A., Natusch D.J.D. (2011) Wildlife laundering through breeding farms: illegal harvest, population declines and a means of regulating the trade of green pythons (*Morelia viridis*) from Indonesia. Biological Conservation 144:3073–81. doi:10.1016/j.biocon.2011.10.002.

Marshall B.M., Strine C., Hughes A.C. (2020) Thousands of reptile species threatened by under-regulated global trade. Nature communications 11:4738.

Natusch D.J.D., Lyons J.A. (2012) Exploited for pets. The harvest and trade of amphibians and reptiles from Indonesia New Guinea. Biodiversity Conservation 21:2899-2911.

Natusch D.J.D., Lyons J.A. (2014) Geographic and sexual variations in body size, morphology, and diet among five populations of Green pythons (*Morelia viridis*). Journal of Herpetology 48:317-323.

Natusch D.J.D., Esquerré D., Lyons J.A., Hamidy A., Lemmon A.R., Lemmon E.M., Riyanto A., Keogh J.S., Donnellan S.C. (2020) Species delimitation and systematics of the Green pythons (*Morelia viridis* complex) of melanesia and Australia. Molecular Phylogenetics and Evolution 142:106640.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Rawlings L.H., Donnellan S.C. (2003) Phylogeographic analysis of the Green python, *Morelia viridis*, reveals cryptic diversity. Molecular Phylogenetics and Evolution 27:36-44.

Robinson J.E., St John F.A., Griffiths R.A., Roberts D.L. (2015). Captive reptile mortality rates in the home and implications for the wildlife trade. PLoS One 10:e0141460. doi: 10.1371/journal.pone.0141460.

Tallowin O., Parker F., O'Shea M., Hoskin C., Couper P., Amey A. (2018) *Morelia viridis*. The IUCN Red List of Threatened Species 2018: e.T177524A21649845. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T177524A21649845.en Accessed on 15 May 2023.

Wilson D., Heinsohn R. (2007) Geographic range, population structure and conservation status of the green python (*Morelia viridis*), a popular snake in the captive pet trade. Australian Journal of Zoology 55:147-154.

3.10 *Python anchietae*

Summary and conclusion

Python anchietae have been declared as one of the rarest snake species in Africa and the species occurs in a restricted, transborder area across southwestern Angola and northern Namibia at elevations up to 1,800 meters (Bauer et al., 1993; Branch, 2018). The species is protected in Namibia. Knowledge, documentation on abundance, population size and ecology are very limited. It is listed by the IUCN Red List as Least Concern and population trends have been described as stable, therefore trade is unlikely to threaten *P. anchietae* populations on a global scale. VKM concludes that international trade is not likely to pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, reported stable population trends, limited pet trade reported as being from captive-bred origin, but limited information on populations and abundance.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python anchietae* Bocage, 1887.

Common name: Angolan python, Anchieta's dwarf python.

Scientific synonyms: No synonyms listed in Species+.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Baptista et al., 2021): Least Concern (LC).

Distribution: This non-venomous snake species is endemic to southern Angola and northern Namibia, and the range extends from Lobito in Angola down to Maltahohe in Namibia (Bauer et al., 1993; Branch, 2018).

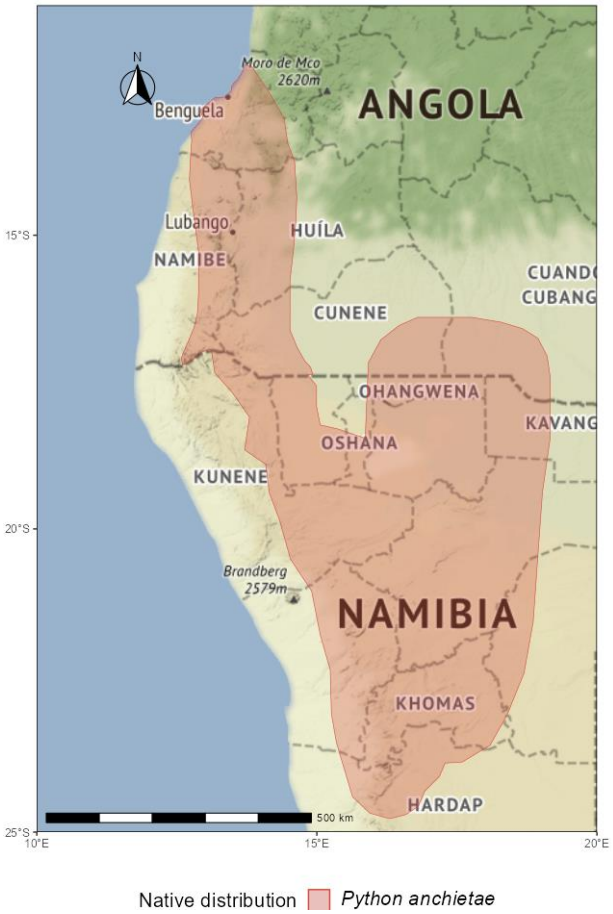

Figure 3.10-1. Distribution of *Python anchietae*. Data from IUCN 2019. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: *Python anchietae* can reach sizes up to 183 centimeters. The species mainly feeds on small mammals and birds. In captivity clutch size consists of 5 to 10 eggs that hatch after about 70 days (Baptista et al., 2021). Individuals reach maturity after around three years.

Habitat: The species occurs in rocky outcrops on mountain terrain or scrublands at elevations up to 1,800 m asl (Baptista et al., 2021).

Role in the ecosystem: Predator (non-venomous constrictor) that preys primarily on mammals and birds (O'Shea, 2011; Baptista et al., 2021). Knowledge on the ecology and role in the ecosystem of *P. anchietae* is very limited.

b) Populations and trends

Although reports encountering the species are rare, the trend of the population is considered stable (Baptista et al., 2021). It is assumed that numbers may have declined in areas easy to access for humans, while being more stable in inaccessible areas (Hermann and Branch, 2013; Baptista et al., 2021). The population trend is declared as stable.

c) Legal / illegal harvesting, captive breeding and trade

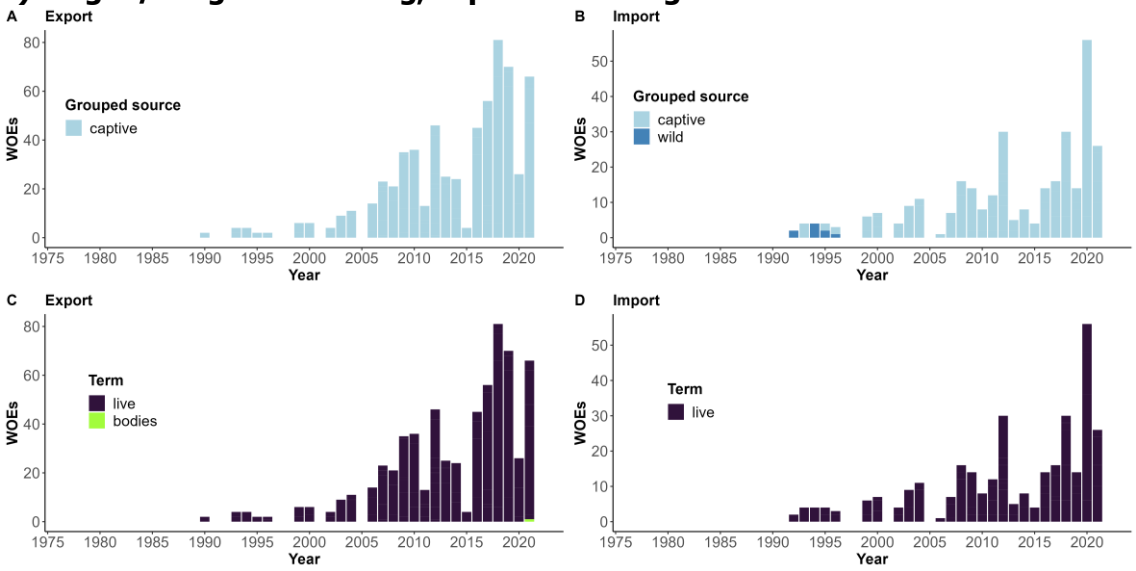

Figure 3.10-2. Reported quantities of exported (A and C) and imported (B and D) *Python anchietae* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

Although attractive, the trade volume of the species is likely low due to its rarity. Initially as the species entered trade it fetched retail prices up to 65,000 US$ (Hermann and Branch, 2013; Douglas and Alie, 2014). However, these prices dropped as the rarity in trade decreased, and Nijman reported in 2014 that retail prices were down to below 1,000 US$ (Nijman, 2014).

d) Assessment of the threat(s) posed by trade

The species is traded locally and internationally as a pet but is considered rare in private and public collections (Jauch, 2009; Hermann and Branch, 2013) and is thus of high value for sellers and collectors. Individuals likely originate from captivity breeding, but individuals are also collected in the wild. The former rare availability of the species may be due to inaccessible habitat mainly caused by remains of weaponry and explosives from the civil war and Namibian export restrictions. However, it seems the species is more and more commonly on offer (Jauch, 2009).

e) Brief summary of other threats and conservation status

No other threats are documented, and the population is "stable and unlikely to be globally threatened" (Baptista et al., 2021).

f) Population monitoring programs in the range area

Not known.

g) National regulations / legislation and in the range countries

Python anchietae is strictly protected in Namibia (Jauch, 2009). National regulations or legislation for Angola is not known.

h) Current management in the range countries, including harvest quotas

None or unknown.

i) Overall assessment of data quality

No empirical and hardly any scientific assessments or other literature exists.

References

Baptista N., Becker F., Conradie W., Bauer A.M., Ceríaco L.M.P. (2021) *Python anchietae*. The IUCN Red List of Threatened Species 2021: e.T177539A120594491. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T177539A120594491.en Accessed on 07 March 2023.

Bauer A.M., Branch W.R., Haacke, W.D. (1993) The herpetofauna of the Kamanjab area and adjacent Damaraland, Namibia. Madoqua 18:117-145.

Branch W.R. (2018) Snakes of Angola: An annotated checklist. Amphibian & Reptile Conservation 12:41-82.

Douglas L.R., Alie, K. (2014) High-value natural resources: Linking wildlife conservation to international conflict, insecurity, and development concerns. Biological Conservation 171:270-277.

Herrmann H.W., Branch W.R. (2013) Fifty years of herpetological research in the Namib Desert and Namibia with an updated and annotated species checklist. Journal of Arid Environments 93:94-115.

Jauch H. (2009) Captive propagation of *Python anchietae* in Namibia. African Herp News 48:8-14.

Nijman V. (2014) Fact or fiction. Be prudent and accurate when attaching monetary value to threatened wildlife (a comment to Douglas and Alie (2014)). Biological Conservation 179:148-149.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

3.11 *Python bivittatus*

Summary and conclusion

Python bivittatus, the Burmese python, is widely distributed throughout Southeast Asia, with invasive populations in Singapore and Florida, USA. It is traded for skin and as well as in the pet trade. Commercial captive breeding is widespread, but some evidence of supplementation of wild caught individuals exists. National protections across the range states are in place to protect wild individuals but with varying levels of enforcement. The population in Thailand appears to be stable with declines in all other range-states. Harvest of this species is highly likely to be detrimental to the wild population. However, trade has increasingly shifted to captive bred skins and live specimens. VKM concludes that international trade is not detrimental to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status VU, the perceived detriment of wild harvest, and the suspected supplementation of wild caught specimens in captive breeding, contrasted by the increasing dominance of captive-bred specimens in trade.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python bivittatus* Kuhl, 1820.

Common name(s): Burmese python.

Scientific synonyms: *Python molurus bivittatus* (Linnaeus, 1758); *Python molurus bivittatus* Kuhl 1920.

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Stuart et al., 2012): Vulnerable (VU) under criteria A2acd.

Distribution:
The species is widely distributed throughout Southeast Asia (Stuart et al., 2012). Range countries include Bangladesh, Cambodia, China (Yunnan, Sichuan, Hainan, Guangxi, Guangdong, Fujian), Hong Kong, India (Arunachal Pradesh), Indonesia (Bali, Java, Sulawesi), Lao People's Democratic Republic, Myanmar, Nepal, Thailand, and Vietnam. The species has been introduced to Singapore and the United States (in the State of Florida).

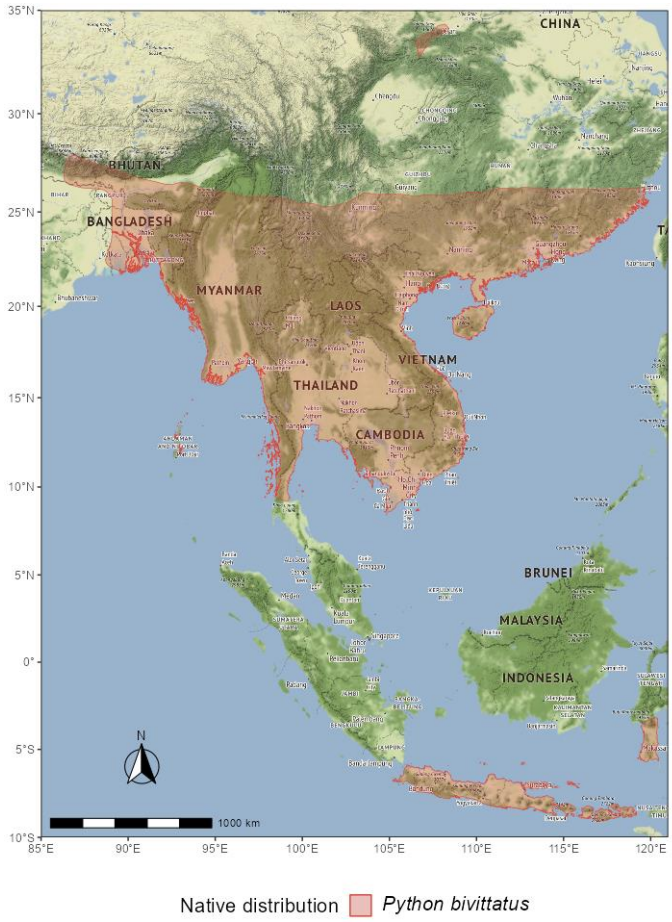

Figure 3.11-1. Distribution of *Python bivittatus*. Data from IUCN, CI 2012. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
The species is mainly nocturnal and can climb and swim in pursuit of prey (Stuart et al., 2012). Pythons may lay one clutch of 12 to 50 eggs (but larger females may lay up to 100 eggs) once every three years. Breeding occurs in December to February and eggs are laid in spring (between March and June). In captivity lifespan can be up to 20 years. It is sympatric throughout its range with the Reticulated python (*Malayopython reticulatus*) but is thought to tolerate more arid conditions (Zug et al., 2011)

Habitat:
Python bivittatus is chiefly a forest species including mangrove forests and rainforests but is also found in wetlands and waterways. It prefers wet/damp areas. It can be found in and around villages and buildings (Stuart et al., 2012).

Role in the ecosystem:
It targets small to large mammals in particular, but will also predate birds, reptiles and amphibians (Stuart et al., 2012).

b) Populations and trends

The species is considered rare in Myanmar, Cambodia, Lao PDR, Viet Nam, mainland China and Indonesia (Dang et al., 2007; Wang and Xie, 2009; Zug et al., 2011). Legal conservation protections in Thailand appear to be working and the species is considered common (Stuart et al., 2012). There is evidence of extensive and

widespread population declines, but the scale of this is not well known across the range (Dang et al., 2007; Wang and Xie, 2009; Stuart et al., 2012). However, it is listed as Critically Endangered in two major areas (Vietnam: Dang et al., 2007; Chinese mainland: Wang and Xie, 2009) within its range due to localized declines greater than 80% over a ten-year period and exhibits apparently high but unquantified rates of decline throughout its distribution (Stuart et al., 2012). This snake is conservatively estimated to have declined by at least 30% (up to 50%) over the past ten years across its global range as a result of over-harvesting for a variety of uses. This loss is to some extent compounded by the effects of habitat loss, and the drivers of this decline have not ceased. It was IUCN Red List assessed as Vulnerable in 2011 (Stuart et al., 2012), and a reassessment is urgently needed.

c) Legal / illegal harvesting, captive breeding, and trade

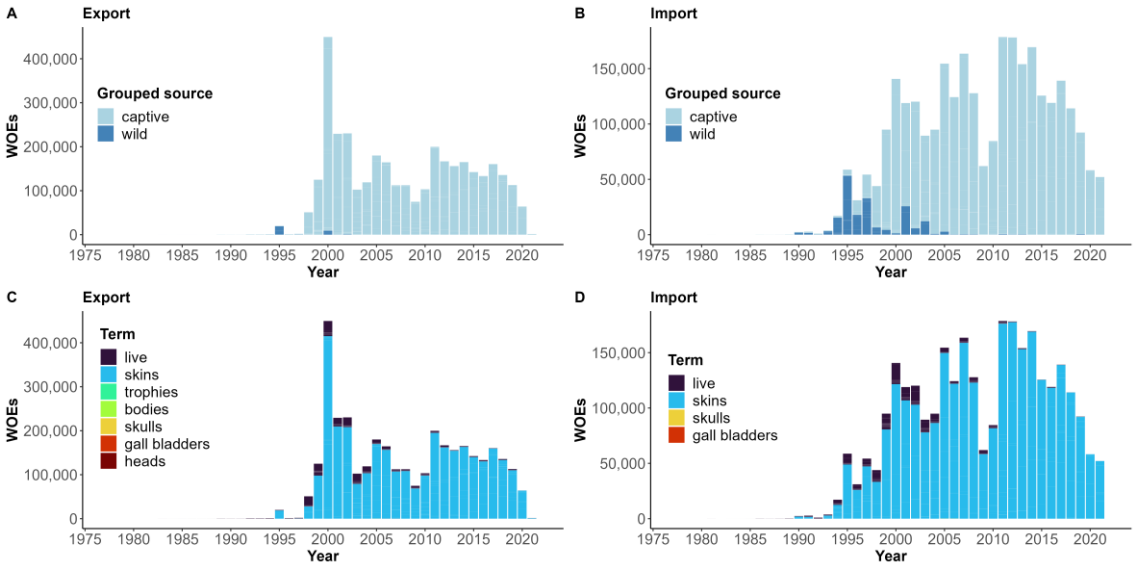

Figure 3.11-2. Reported quantities of exported (A and C) and imported (B and D) *Python bivittatus* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly skins have been reported). Data from CITES trade database, downloaded 30 March 2023.

The species has been impacted in its native range through extensive harvest for skin, traditional medicine, and pet trade. CITES Trade data show a relatively large number of imports, which has increased since 2000. Live imports of *P. bivittatus* have decreased, and captive bred individuals now dominate this aspect of the trade.

Vietnam exports the majority of skins traded, and these are declared to be sourced from captive bred animals. However, there are some doubts around the true captive status of these individuals, with circumstantial evidence indicating that wild caught individuals may supplement the captive bred animals (Kasterine et al., 2012).

There are no voluntary export quotas listed (https://speciesplus.net/species#/taxon_concepts/8396/legal). Although import of the species into the United States of America is prohibited (from 2012-03-26; https://cites.org/sites/default/files/eng/notif/2012/E031.pdf) and India has put in place stricter domestic measures, banning the export (commercial) of wild-caught specimens

of all species on Appendices I, II and III (https://cites.org/sites/default/files/notif/E-Notif-2018-031.pdf).

d) Assessment of the threat(s) posed by trade

The species is listed on Appendix II of CITES. Commercial trade of skin and derived products dominates the trade in the species with the vast majority being reported from captive-breeding. Populations of the species have declined over much of its range, but trade has also increasingly shifted from wild to captive-bred. Up-to-date population trends are lacking, but several conservation measures have been put in place. Concerns remain with supplementation with wild caught specimens, but it is not clear to what extend it currently affects species survival.

e) Brief summary of other threats and conservation status

Slash and burn agriculture in upland habitats may reduce species prey-base having an indirect effect on the species (Stuart et al., 2012)

f) Population monitoring programs in the range area

An exhaustive search of all available literature did not turn up information about ongoing monitoring programs

g) National regulations / legislation and in the range countries

Thailand has strong protection in place for the species and it is a protected species in Vietnam, China, and Indonesia (Stuart et al., 2012). It is listed as Critically Endangered in the Vietnam Red Data Book (Dang et al., 2007) and the Chinese National Red List (Wang and Xie, 2009).

h) Current management in the range countries, including harvest quotas

There are no current quotas for this species (https://speciesplus.net/species#/taxon_concepts/8396/legal).

i) Overall assessment of data quality

Data on the species appears to be mostly out-of-date being more than 10 years old. The IUCN Red List assessment needs updating.

References

Dang, N.T., Tran K., Dang H.H., Nguyen C., Nguyen N.T., Nguyen H.Y., Dang T.D. (2007) The Vietnam Red Data Book. Natural Science and Technology Publishing House, Hanoi.

Kasterine A., Arbeid R, Caillabet O, Natusch D. (2012) The Trade in Southeast Asian Python Skins. Technical paper, 54 pp, International Trade Centre (ITC), Geneva.

Stuart B., Nguyen T.Q., Thy N., Grismer L., Chan-Ard T., Iskandar D., Golynsky E., Lau M.W.N. (2012) *Python bivittatus* (errata version published in 2019). The IUCN Red List of Threatened Species 2012: e.T193451A151341916. https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T193451A151341916.en. Accessed on 19 March 2023.

Wang S., Xie Y. (2009) China Species Red List. Vol. II Vertebrates-Part 1, High Education Press, Beijing.

Zug G.R., Gotte S.W., Jacobs J.F. (2011) Pythons in Burma: Short-tailed python (Reptilia: Squamata). Proceedings of the Biological Society of Washington 124:112-136.

3.12 *Python breitensteini*

Summary and conclusion
The Borneo short-tailed python (*Python breitensteini*) has a broad distribution in Borneo with low habitat specificity. It is a generalist preying on common prey species. It has a high growth rate, medium reproductive rate, medium reproductive output, and short maturation time. Harvest data shows that juveniles constitute a significant part of the harvest of the species, and this suggests skewing of the population demographic due to resource overexploitation. Sustainable wild harvest of the species should be possible but would require national management plans and specific export quotas. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC and the high reproductive rate of the species. However, the estimated levels of illegal trade are unsustainable and the significance of juveniles in trade alarming.

a) Name, distribution, life history, habitat, role in ecosystem
Species name: *Python breitensteini* Steindachner, 1880.

Common name: Borneo short-tailed python, Bornean short-tailed python.

Scientific synonyms: *Python curtus breitensteini* Schlegel, 1872.

Taxonomic note: Although initially described as a separate species in 1880, it has been considered as a subspecies of *Python curtus* for most of the previous century. Members of the "Python curtus group" are now considered as distinct species based on molecular evidence (Keogh et al., 2001; Rawlings et al., 2008).

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List for Threatened Species (Inger et al., 2012): Least Concern (LC).

Distribution: The island of Borneo (Bornean Malaysia, Brunei, Kalimantan Indonesia).

Figure 3.12-1. Distribution of *Python breitensteini*. Data from IUCN, CI 2012. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: Females lay around 12 to 16 eggs in one clutch, and after a few weeks, the hatchlings break the shell open (Shine et al., 1999). Borneo short-tailed pythons become sexually mature by 18 months. Breeding happens from November to March yearly. Life span is more than 20 years in captivity (Reptiles Cove, 2023). In the wild, Borneo pythons have a lifespan of around 20-25 years (Frye, 1991).

Habitat: The IUCN Red List assessment by Inger et al. (2012) includes a synthesis on habitat of *P. breitensteini*. The snake is most frequently encountered in agricultural lands, both croplands and plantations (including oil palm, coconut, and cocoa), adjacent to forested areas (M. Auliya pers. comm. September 2011 in Inger et al., 2012). A strong swimmer, the snake may use irrigation canals and other waterbodies to move, and there are historical reports of this python from wetlands (M. Auliya pers. comm. March 2012 in Inger et al., 2012).

Role in the ecosystem: Little is known specifically about the ecology of *P. breitensteini*. However, a study by Shine et al. (1999) on the closely related species *P. curtus* from West Sumatra suggests that the species is a predator of mainly commensal rodents such as Wood rat (*Rattus tiomanicus*), Rice-field rat (*R. argentiventer*), and Norway rat (*R. norvegicus*). It is also known to consume birds and larger mammals (Shine et al., 1999).

b) Populations and trends

Population size and trends are unknown. The species is most frequently encountered in agricultural lands, both croplands and plantations (including oil palm, coconut, and cocoa), adjacent to forested areas (M. Auliya pers. comm. September 2011 in Inger et al., 2012).

c) Legal / illegal harvesting, captive breeding and trade

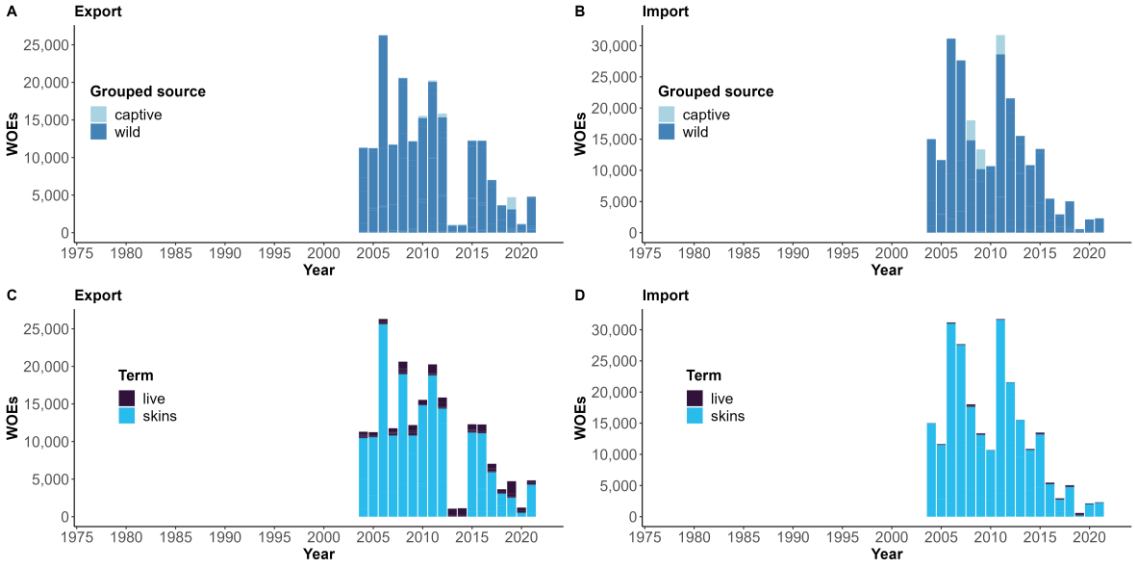

Figure 3.12-2. Reported quantities of exported (A and C) and imported (B and D) *Python breitensteini* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly skins have been reported). Data from CITES trade database, downloaded 30 March 2023.

Significant legal trade in *P. breitensteini* exists (CITES Trade Database). In the years 2017-2022, CITES permits were issued for an average of 6,000-11,000 units (the span is caused by discrepancies between exporter and importer reported quantities). Kasterine et al. (2012) estimated that approximately 18,000 skins were exported from Malaysia and Indonesia annually in the period 2004-2010. Most of the trade concerns wild harvested specimens for the skin trade. CITES has adopted export trade quotas on *P. breitensteini* from Indonesia from 2004 to 2022. Export trade quotas have covered skins and skin products from the outset, and from the 2010s also live animals. The latter reflects an increasing importance and volume of the pet trade. The EU suspended import of *P. breitensteini* (as syn. *P. curtus*) from Brunei Darussalam in 1997 (EU No 2551/97), 1998 (No 2473/1998) and 1999 (No 1968/1999). The EU currently has a ban in place on skins sourced from Malaysia (Kasterine et al., 2012). Natusch et al. (2020) report that for this species there is a strong correlation between skin size and size of the live snake, and they argue that inspection of the size of skins can be used to enforce harvest-size limits and focus harvesting away from sexes and life stages most critical for population persistence. Inconsistencies in CITES export permits from Peninsular Malaysia, the East Malaysian states and Indonesia lead Kasterine et al. (2012) to estimate an illegal harvest of up to 20,000 individuals a year mainly in Indonesia (Kalimantan).

d) Assessment of the threat(s) posed by trade

The Borneo short-tailed python has a broad distribution in Borneo with low habitat specificity. It is a generalist preying on common prey species. It has a high growth rate, medium reproductive rate, medium reproductive output, and short time to maturation (Kasterine et al., 2012). Data in Shine et al. (1999) shows that juveniles constitute a significant part of the harvest of the species, and this suggests resource overexploitation if exploitation skews the population demographic of the species. Sustainable wild harvest of the species should be possible but would require national management plans and specific export quotas. Although data on populations and trends are lacking, proper harvest management strategies are absent, and trade seems to target individuals indiscriminately, trade seems to pose little threat to the species. This is likely due to the low habitat specificity, medium reproductive rate and output, and high growth rate to maturation.

e) Brief summary of other threats and conservation status

No other major threats are identified for the species and there are no concerns for its conservation (Inger et al., 2012).

f) Population monitoring programs in the range area

Not known.

g) National regulations / legislation and in the range countries

The species is not protected in the range states.

h) Current management in the range countries, including harvest quotas

There are no management plans for the species in the range states.

i) Overall assessment of data quality

There is some data deficiency as the species was not recognized as a separate species from *P. curtus* until molecular evidence supported this split (Keogh et al., 2001). CITES adopted the new taxonomy in 2004, and trade data exists only from 2004. Data on the current population size and trends is absent. Inconsistencies in permitting suggest that illegal harvest in Indonesia is laundered through Malaysia.

References

Frye F.L. (1991) Reptile care: an atlas of diseases and treatments. Tfh Pubns Inc; 636 pp.

Inger R.F., Iskandar D., Lilley R., Jenkins H., Das, I. (2012) *Python breitensteini*. The IUCN Red List of Threatened Species 2012: e.T192013A2028005. https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T192013A2028005.en Accessed on 12 February 2023.

Kasterine A., Arbeid R, Caillabet O, Natusch D. (2012) The Trade in Southeast Asian Python Skins. Technical paper, 54 pp, International Trade Centre (ITC), Geneva.

Keogh J.S., Barker D.G., Shine R. (2001) Heavily exploited but poorly known: systematics and biogeography of commercially harvested pythons (*Python curtus* group) in Southeast Asia. Biological Journal of the Linnean Society 73:113-129.

Natusch D.J., Lyons J.A., Riyanto A., Khadiejah S. (2020) Applying skin-size limits for

management of trade in Asian reptile skins. Wildlife Research 47:89-98.

Rawlings L.H., Rabosky D.L., Donnellan S.C., Hutchinson, M.N. (2008) Python phylogenetics: inference from morphology and mitochondrial DNA. Biological Journal of the Linnean Society 93:603-619.

Reptiles Cove, 2023. https://reptilescove.com/care/snakes/borneo-short-tailed. Accessed 12.02.2023.

Shine R., Ambariyanto, Harlow P.S., Mumpuni. (1999) Ecological attributes of two commercially-harvested python species in northern Sumatra. Journal of Herpetology 33:249-257. DOI: 10.2307/1565722.

3.13 *Python brongersmai*

Summary and conclusion
The blood python or Brongersma's short-tailed python (*Python brongersmai*) has a broad distribution from Thailand to Vietnam to the Indonesian archipelago. It has a wide distribution in Southeast Asia and relatively high ecological adaptability. Blood pythons are now reported to be more common in oil palm plantations than in natural areas. Trade data suggests that Indonesian harvest quotas are regularly exceeded, and it has been suggested that high levels of laundering of wild-caught specimens as captive-bred individuals occurs, but it is not clear what impact this has on the wild population. Issues with lack of monitoring and false declaration of wild caught snakes should be considered when assessing detrimental impact of import of specimens of Indonesian origin. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status LC, the ecological adaptability of the species, and its high reproductive rate. However, sufficient population data and monitoring efforts are lacking and high levels of laundering of wild-caught specimens as captive-bred.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python brongersmai* (Stull, 1938).

Common name: Red short-tailed python, blood python, Brongersma's short-tailed python.

Scientific synonyms: *Python curtus brongersmai* Schlegel, 1872.

Taxonomic notes: *Python brongersmai* (blood pythons), *P. curtus* and *P. breitensteini* (short-tailed pythons) have long been treated as a single species (*Python curtus*), with three subspecies differing in colour, size and geographic distribution. Today all three are recognized as separate species (Keogh et al., 2001) in addition to *P. kyaiktiyo* which was recognized as a distinct species in 2011 and which is only know from the type locality in Myanmar (Zug et al., 2011).

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Grismer and Chan-Ard, 2012): Least Concern (LC).

Distribution:
Southern Thailand, Vietnam, Peninsular (West) Malaysia and eastern Sumatra (Indonesia, east of the central dividing range of mountains, Bangka Island and other islands in the Strait of Malacca, including the Lingga Islands, Riau islands, and Pinang) (Keogh et al., 2001) as well as potentially southern Myanmar and Sumatra (Zug et al., 2011). It occurs at elevations up to 650 m asl.

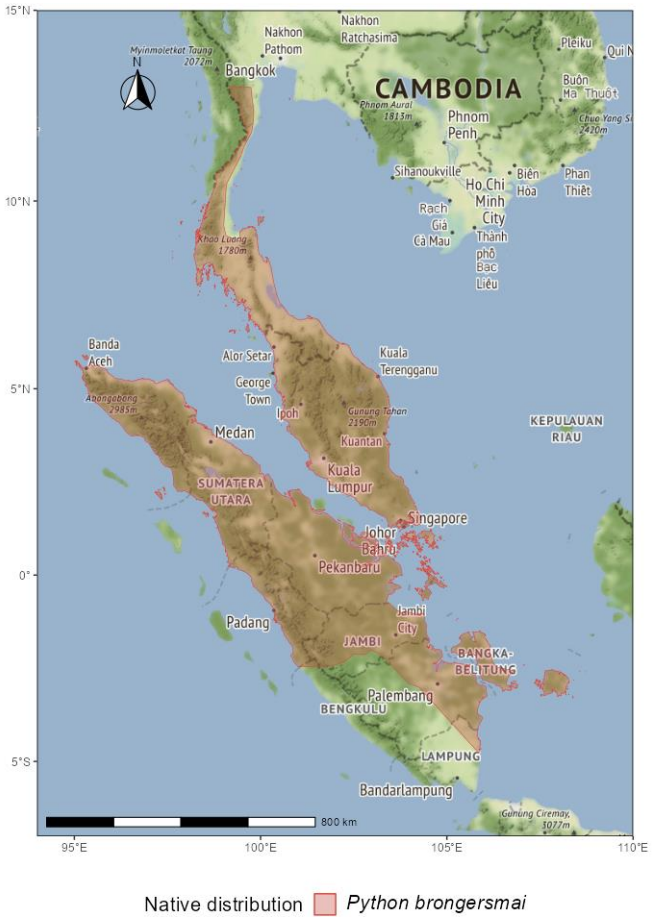

Figure 3.13-1. Distribution of *Python brongersmai*. Data from IUCN, CI 2012. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
The species is oviparous, and reproduces biennially, with an average of 12 to 16, but up to 30 eggs, being laid at a time (Shine et al., 1999). The female coils around her eggs to incubate them. Brongersma's short-tailed python are described as being site-loyal in its natural habitat and active at dusk and at night. In order to hide or to ambush prey, it tends to burrow into the damp ground or lie in wait under dense vegetation. The species can live up to about 20 years in captivity.

Habitat:
Python brongersmai inhabits marshes and tropical swamps in forest (Grismer and Chan-Ard, 2012).

Role in the ecosystem:
Predator (non-venomous constrictor) that preys on small mammals and birds (O'Shea, 2011).

b) Populations and trends

Python brongersmai was long treated as a subspecies of *P. curtus* (as *P. c. brongersmai*) but is now recognized as a separate species (Pauwels et al., 2000; Keogh et al., 2001). Blood python populations are disjunct in Southeast Asia. Few data exist on the natural distribution of short-tailed pythons and considerable levels of transport

of blood pythons within Southeastern Asia are suggested to occur (Nijman, 2022). In Thailand animals confiscated from wildlife traders shall after national policy get released in the closest national park, obscuring the exact native range of this species (Zug et al., 2011). Reports indicate that blood pythons in northern Sumatra are now more common in oil palm plantations there than in natural areas (Natusch et al., 2019). Oil palm plantations seem to host a high density of rats combined with suitable hiding places for the snakes under dead palm leaves. As oil palm plantations expand across Sumatra, *P. brongersmai* numbers have been predicted to increase steadily while other native snakes such as the reticulated python (*Malayopython reticulatus*) are declining (Shine et al., 1999).

c) Legal / illegal harvesting, captive breeding and trade

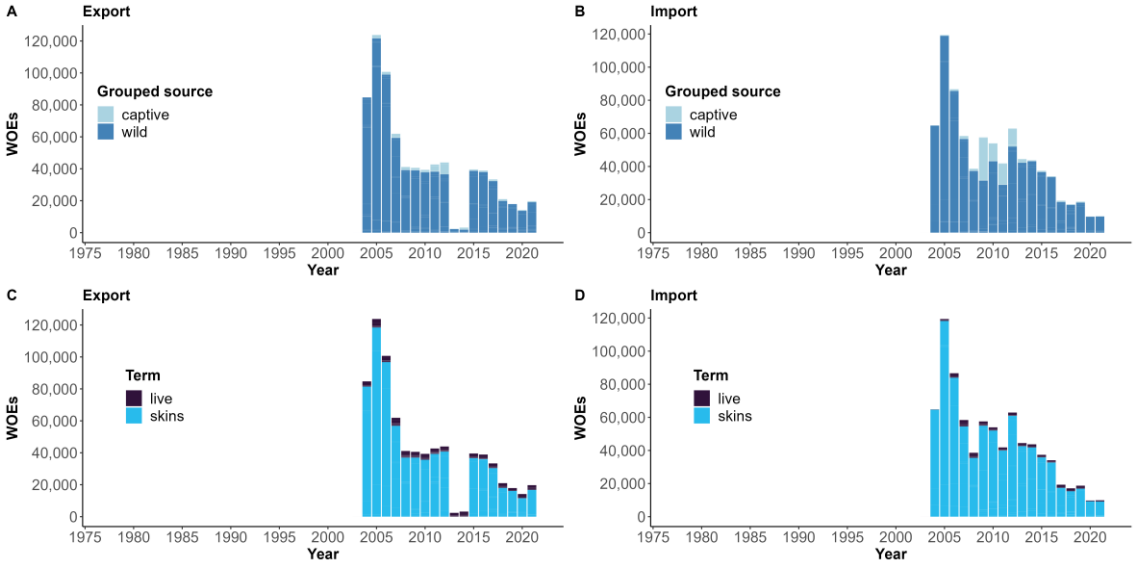

Figure 3.13-2. Reported quantities of exported (A and C) and imported (B and D) *Python brongersmai* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly skins have been reported). Data from CITES trade database, downloaded 30 March 2023.

Python brongersmai is harvested in the wild for the live pet market and for the international leather trade (Shine et al., 1999; Auliya, 2006) with Indonesia reported to be the main supplier of both skins and live blood pythons (Groombridge and Luxmoore, 1991; Nijman, 2022). Harvest is reported to occur most notably in palm oil farms while there seem to be few facilities that raise captive bred animals. Nijman (2022) suggests that most *P. brongersmai* skins exported as captive bred are likely of wild origin and illegally mislabeled, arguing that captive breeding of blood pythons is not economically viable. The snakes thrive in palm oil plantation but there is a lack of information on population trends from primary vegetation.

Blood python hides are available in back-cut bleached style and approximately 0.6/0.8 mm thick, while the Burmese averages only 0.5/0.7 mm. (https://www.panamleathers.com/blog/bid/360469/Learning-about-Exotic-Leather-Short-Tail-Python-Skin) (accessed 27.12.2022).

Captive-raised blood pythons are reported to be more mild-tempered and more predictable as adults than those caught in the wild. The pet industry in the US and Europe seems to be supplied mainly from captive breeding, particularly of sought-after captive-colored bloodlines, which is helping to boost the popularity of these snakes among reptile hobbyists. On the website finn.no individuals sell for 12,000 NOK https://www.finn.no/bap/forsale/ad.html?finnkode=273020842 (Accessed 27.12.2022). Animals on offer in Europe and the US are advertised as captive bred and cost between 2,000 and 20,000 NOK (https://www.morphmarket.com/us/c/reptiles/pythons/blood-pythons?page=4 or Available (bloodpythons.com) (Accessed 27.12.2022).

d) Assessment of the threat(s) posed by trade

Commercial skins or skin leather products seem to be the main driver for harvesting of large numbers of *P. brongersmai*. There is substantial evidence of underreported and illegal international trade in *P. brongersmai* especially in the form of skins or skin leather products. There is no evidence to suggest that the harvest of *P. brongersmai* is sustainable (Nijman, pers. comm. 2023). Oil palm plantations are likely being the main source of wild caught animals and plantations being the largest habitat today of *P. brongersmai* (Nijman, 2022). Captive-bred specimens seem to dominate the live blood python market in Europe and the US and are unlikely to contribute to species decline in the wild. Similarly, trade in wild-sourced specimens does not pose a major threat to the species, and population trends suggest an increase in populations as the species thrives in palm oil plantations.

e) Brief summary of other threats and conservation status

The species is currently listed by IUCN as Least Concern. Habitat destruction is likely to be aggravating the population decline due to overharvesting of animals in the wild for the skin trade, despite the species thriving on palm oil plantations.

f) Population monitoring programs in the range area

Python brongersmai occurs in a number of protected areas (Grismer and Chan-Ard, 2012) but we were unable to find reports of any existing monitoring of wild populations.

g) National regulations / legislation and in the range countries

In Indonesia several pythons are protected under domestic legislation (Indonesian Ministry of Environment and Forestry, 2023). In Malaysia it is forbidden to harvest pythons in protected areas. Trade of wild pythons was banned in Thailand in 1992 (Wild Animal Reservation and Protection Act, 1992; www.ThaiLaws.com).

h) Current management in the range countries, including harvest quotas

In Indonesia harvest and export quotas have been established and are reviewed on an annual basis by the Indonesian Institute of Science (LIPI) (Indonesian Ministry of Environment and Forestry, 2023). However, the annual export quotas are reported to get arbitrarily set, and literature suggests that sustainability estimates are not based on scientifically sound research (Soehartono and Mardiastuti, 2002).

i) Overall assessment of data quality

There are very few publications available on *P. brongersmai* and population level data sufficient for an assessment is lacking. The IUCN red list assessment and a recent publication by Nijman (2022), which are heavily relied on for this report, are based on very scarce data.

References

Grismer L., Chan-Ard T. (2012) *Python brongersmai.* The IUCN Red List of Threatened Species 2012: e.T192169A2050353. https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T192169A2050353.en. Accessed on 27 December 2022.

Groombridge B., Luxmoore R.A. (1991) Pythons in South-East Asia: a review of distribution, status and trade in three selected species. A report to the CITES Secretariat. https://www.biodiversitylibrary.org/item/98576#page/3/mode/1up

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Keogh J.S., Barker D.G., Shine R. (2001) Heavily exploited but poorly known: systematics and biogeography of commercially harvested pythons (*Python curtus* group) in Southeast Asia. Biological Journal of the Linnean Society 73:113-129.

Natusch D.J.D., Lyons J.A., Riyanto A., Mumpuni, Shine R. (2019) Interspecific divergence in biological attributes of short-tailed pythons (*Python breitensteini* and *P. brongersmai*) from Kalimantan and Sumatra. Australian Journal of Zoology 66:272-278.

Nijman V. (2022) Harvest quotas, free markets and the sustainable trade in pythons. Nature Conservation 48:99-121.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Pauwels O.S.G., Laohawat O.-A., David P., Bour R., Dangsee P., Puangjit C., Chimsunchart C. (2000) Herpetological investigations in Phang-Nga Province, southern Peninsular Thailand, with a list of reptile species and notes on their biology. Dumerilia 4:123-154.

Shine R., Ambariyanto, Harlow P.S., Mumpuni. (1999) Ecological attributes of two commercially-harvested python species in northern Sumatra. Journal of Herpetology 33:249-257. DOI: 10.2307/1565722.

Soehartono T.R., Mardiastuti A. (2002) CITES and its Implementation in Indonesia. Nagao Environment Foundation, Jakarta.

Zug G.R., Gotte S.W., Jacobs J.F. (2011) Pythons in Burma: Short-tailed python (Reptilia: Squamata). Proceedings of the Biological Society of Washington 124:112-136.

3.14 *Python curtus*

Summary and conclusion
Python curtus in the strict sense is endemic to Sumatra in Indonesia. *Python brongersmai* and *P. breitensteini* were split from *P. curtus* species in 2001. *Python curtus* reproduces biannually and produces between 12 and 16 eggs. The species occurs in captivity around the world, and captive bred individuals seem to dominate the pet trade market in Europe. Legal harvest for and trade in skins seem to rely more on wild caught individuals. There may also be illegal harvest and trade, and there are concerns that the species quota is exceeded. *Python curtus* is assessed to be of Least Concern by the IUCN Red List of Threatened Species. The assessment, however, is from 2014 and contains no population size nor trend data. There is a lack of information on population size and trends, as well as levels of illegal trade. VKM concludes that international trade does not currently pose a threat to the continued survival of the species in the wild with moderate-high confidence. This is based on the current IUCN Red List status LC, the dominance of captive-bred specimens in the pet trade, and the high reproductive rate of the species.

a) Name, distribution, life history, habitat, role in ecosystem
Species name: *Python curtus* Schlegel, 1872.

Common name: Sumatran short-tailed python.

Scientific synonyms: *Aspidoboa curtus* (Schlegel, 1872); *Python curtus curtus* Schlegel, 1872.

Note on taxonomy: The three species of short-tailed pythons, *Python curtus*, *P. brongersmai* and *P. breitensteini* were previously treated as three sub-species belonging to the *Python curtus* group, but are now considered distinct species (Keogh et al., 2001). The taxonomic change was accepted by CITES in 2004. In 2011, *P. kyaiktiyo* was recognized as an additional species in this species complex (Zug et al., 2011).

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Inger et al., 2014): Least Concern (LC).

Distribution: Indonesia (Sumatra). The species is endemic to Sumatra, where it is restricted to the west side of the Barisan mountain range (Inger al., 2014).

Figure 3.14-1. Distribution of *Python curtus*. Data from IUCN 2014. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history:
Females are slightly larger than males and produce a clutch size of approximately 12 to 16 large eggs. Reproduction is highly seasonal and adult females reproduce biennially (Shine et al., 1999).

Habitat:
This forest species is frequently found in tree plantations and is known to inhabit a wide range of forested habitats from lowlands to montane habitat up to 1,000 meters above sea level (Inger et al., 2014).

Role in the ecosystem:
P. curtus is a nocturnal ambush predator (non-venomous constrictor), known to be sedentary and spending extended periods within rodent burrows and under dense vegetation (Auliya, 2006). *P. curtus* diet consists mainly of terrestrial rodents but they will also consume birds and larger mammals (Shine et al., 1999).

b) Populations and trends
No available data on trends or population size (Inger et al., 2014). However, traders have claimed that compared to *P. brongersmai*, *P. curtus* are difficult to find. Iskandar (pers. comm. 2011 in Inger et al. 2014) noted that it was not possible to find any *P. curtus* specimens in the areas where it is known to be native for the last 30 years, and therefore believed that *P. curtus* is relatively uncommon.

c) Legal / illegal harvesting, captive breeding, and trade

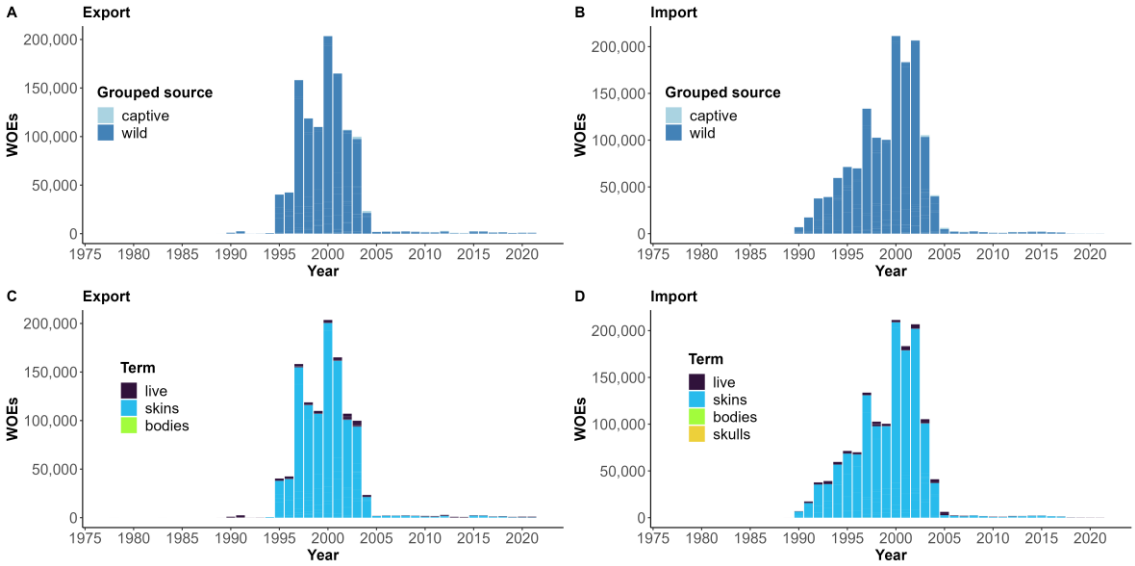

Figure 3.14-2. Reported quantities of exported (A and C) and imported (B and D) Python curtus specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly skins have been reported). Data from CITES trade database, downloaded 30 March 2023.

Legal harvest and trade:
For 2022, the *P. curtus* quota was 627 live individuals (for pets), 2185 skins (including meat and body organs) (CITES). Legal exports from Indonesia reported to the CITES trade database between 2010 and 2022 were: 23,545 importer reported quantities and 18,555 exporter reported quantities. For skins and leather products, snakes were reported as wild-caught. For live individuals, probably destined for the pet trade, about 50% were reported as wild caught whereas the rest were reported as being either captive bred (source code C) or as being born in captivity (source code F) (CITES trade database).

Prior to the taxonomic split of the three species of short-tailed pythons in 2001 (referred to as the *Python curtus* group), between 150,000 and 200,000 *P. curtus* skins were registered as exported from Malaysia (82%) and Indonesia (Kasterine et al., 2012). Except for 1% of skins which were declared as "pre-convention" or from seized illegal shipments, all of these skins were declared as wild harvested (Kasterine et al., 2012).

Illegal harvest and trade
Kasterine et al. (2012) highlight the difficulties connected to the monitoring and regulation of trade in short-tailed pythons, as the skins from the three species (*P. curtus, P. brongersmai* and *P. breitensteini*), especially when dried, are very similar. Therefore, there may be both intentional and accidental misrepresentation of species on CITES permits.

Between 2000 and 2004 more than 600,000 *P. curtus* skins were exported by Malaysia. However, various sources cited in Kasterine et al., (2012) suggest that short-tailed pythons were not harvested in Borneo and Sarawak and are not common in Peninsular Malaysia. According to Chiew (2003, in Kasterine et al., 2012), this information suggests that these animals most likely originated from Indonesia and that hundreds of thousands wild-caught short-tailed pythons were being illegally traded every year.

Once the species were split, trade registered as *P. curtus* declined since *P. brongersmai* which is a much more common and commonly traded, was recognized as a separate species.

In general, there is a strong financial incentive for illegal trade in python skins as they have high value and are easy to conceal in shipments (Kasterine et al., 2012). Inger et al. (2014) suspect that the species is likely to be exploited over the permitted numbers. Meanwhile there is no indication of a significant decline in species numbers and experts in Eastern Asian python trade expressed the opinion that there is currently no indication of overharvesting in the region (D. Natusch, pers. comm. 2023).

Captive breeding:
A significant part of the snakes exported from Indonesia are registered as captive bred, which could be a way to conceal illegal harvest (Kasterine et al., 2012). From both European and US websites, captive bred individuals of *P. curtus* are advertised, see for example:
https://www.morphmarket.com/us/c/reptiles/pythons/sumatran-short-tailed-pythons
https://snakesatsunset.com/black-blood-pythons-for-sale-python-curtus/
https://reptilerapture.net/sumatran-short-tail-python-m-artemis.html
Prices are in the range from US $169 to $1,000.

d) Assessment of the threat(s) posed by trade
Due to lack of population size and trend data it is unclear whether the current quotas for wild harvest are sustainable. The skin trade is likely to be most problematic in regard to illegal harvesting and misdeclaration of wild caught individuals as captive bred. As for the European pet trade, snakes seem to breed well in captivity (based on the number of web sites that sell captive bred individuals) and this will thus not threaten the species survival in the wild.

e) Brief summary of other threats and conservation status
P. curtus is listed as Least Concern on the IUCN Red List of Threatened Species (Inger et al., 2014). The quality and extent of its habitat are known to be declining.

f) Population monitoring programs in the range area
Inger et al. (2014) highlights the need for research on population size, distribution, and trends.

g) National regulations / legislation and in the range countries
Protected in Indonesia (Indonesian Ministry of Environment and Forestry, 2023)

h) Current management in the range countries, including harvest quotas
The species is protected in Indonesia (Indonesian Ministry of Environment and Forestry, 2023). While *P. brongersmai* and *P. breitensteini* are now considered distinct species, and the Indonesian Authorities have established separate quotas for each species (Indonesian Ministry of Environment and Forestry, 2023; for 2023 CITES export quotas are: *P. curtus* pet quota: 627; *P. curtus* skin quota: 2185; *P. brongersmai* pet quota: 2184; *P. brongersmai* skin quota: 37890; *P. breitensteini* pet quota: 617; *P. breitensteini* skin quota 11875), it is unclear to what extent enforcement of this is carried out.

P. curtus is known to be present in several national parks, including Kerinci Seblat National Park, Rimbo Panti Nature Reserve, Batang Gadis National Park and Siberut, Mentawai Islands (Inger et al., 2014).

i) Overall assessment of data quality

Up to date information about population size and trends is not available, and there is also limited evidence to demonstrate whether current trade levels are either detrimental or sustainable. The IUCN Red List assessment was done in 2012 based on data existing at that time (Inger et al., 2014), and the status of the species today is unclear.

References

Chiew H. (2003) Wildlife Trade Heaven: The Emergence of Peninsular Malaysia as a regional wildlife transit centre. Reuters Foundation Paper No. 221. Green College Oxford.

Indonesian Ministry of Environment and Forestry (2023) Kuota Pengambilan Tumbuhan Alam Dan Penangkapan Satwa Liar Apendiks Cites Periode Tahun 2023.

Inger R.F., Iskandar D., Lilley R., Jenkins H., Das, I. (2014) *Python curtus*. The IUCN Red List of Threatened Species 2014: e.T192244A2060581. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T192244A2060581.en. Accessed on 04 January 2023.

Kasterine A., Arbeid R, Caillabet O, Natusch D. (2012) The Trade in Southeast Asian Python Skins. Technical paper, 54 pp, International Trade Centre (ITC), Geneva.

Keogh J.S., Barker D.G., Shine R. (2001) Heavily exploited but poorly known: systematics and biogeography of commercially harvested pythons (*Python curtus* group) in Southeast Asia. Biological Journal of the Linnean Society 73:113-129.

Shine R., Ambariyanto, Harlow P.S., Mumpuni. (1999) Ecological attributes of two commercially-harvested python species in northern Sumatra. Journal of Herpetology 33:249-257. DOI: 10.2307/1565722.

Zug G.R., Gotte S.W., Jacobs J.F. (2011) Pythons in Burma: Short-tailed python (Reptilia: Squamata). Proceedings of the Biological Society of Washington 124:112-136.

3.15 *Python molurus*

Summary and conclusion
Python molurus is widely distributed in India and Sri Lanka. *P. molurus* was previously divided into two subspecies, the Indian python *P. molurus ssp. molurus* and the Burmese python, *P. m. bittivatus*, but the latter is now considered a separate species. The species is listed as Near Threatened on the IUCN Red list of Threatened Species because of an inferred population decline of 30% over the past 10 years, however, there is no data supporting this claim. *Python molurus* reaches sexual maturity at 2-3 years of age and females may lay between 6 and 100 eggs. The species is protected in India, and harvest of wild caught individuals is prohibited. The species is CITES Appendix I listed and should not be traded for commercial purposes. The Management Authority of the State of import should only issue an import permit if the specimen is not to be used for primarily commercial purposes and if the import will be for purposes that are not detrimental to the survival of the species. Current trade is mainly restricted to captive bred individuals.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python molurus* (Linnaeus, 1758).

Common name: Indian python, Asiatic rock python, tiger python, Burmese python.

Scientific synonyms: *Boa albicans* Schneider, 1801; *Boa castanea* Schneider, 1801; *Boa cinerea Schneider*, 1801; *Boa orbiculata* Schneider, 1801; *Boa ordinata* Schneider, 1801; *Coluber boaeformis* Shaw, 1802; *Coluber molurus* Linnaeus, 1758; *Python bora* Daudin, 1803; *Python jamesonii* Gray, 1842; *Python molurus molurus* (Linnaeus, 1758); *Python molurus pimbura* (Linnaeus, 1758); *Python ordinatus* (Schneider, 1801); *Python tigris* Daudin, 1803.

Taxonomic note: *Python molurus* was previously divided into two subspecies: the Indian python *P. molurus molurus* and the Burmese python *P. molurus bittivatus*, but since 2009 they have been considered separate species (Jacobs et al., 2009).

Originally listed by CITES as *Python molurus molurus*, which elevated to *Python molurus* in 2023, following taxonomic changes adopted at CoP19.

CITES listing and IUCN assessment:
CITES Appendix I (04/02/1977);
IUCN Red List of Threatened Species (Aengals et al., 2021): Near Threatened (NT).

Distribution: *P. molurus'* current range countries are India, Nepal, Bangladesh, Sri Lanka. The species is widely distributed in Sri Lanka and India. There are subpopulations in Nepal and along the India-Bangladesh border (Aengal et al., 2021).

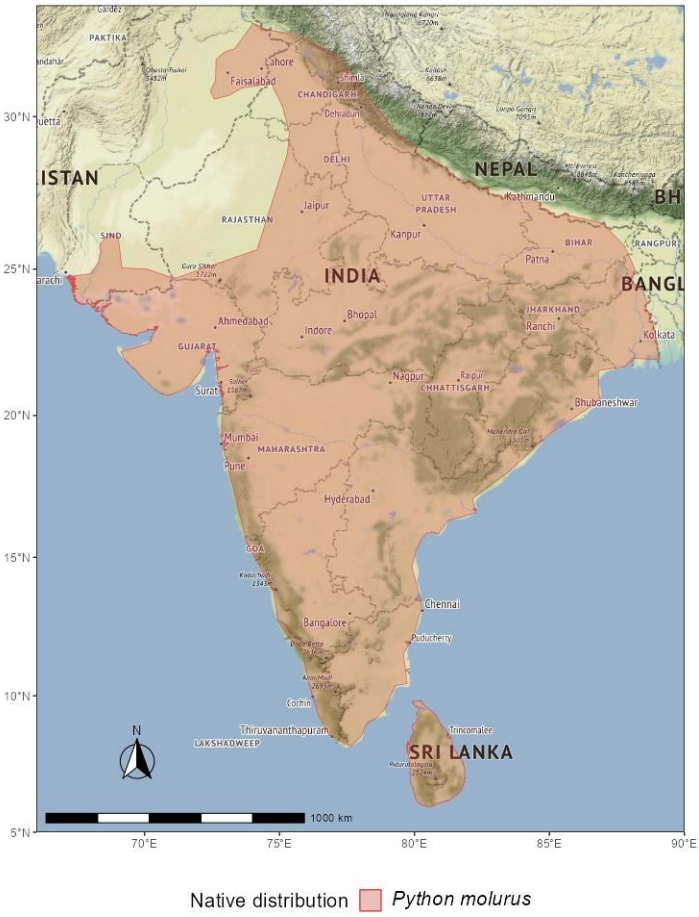

Figure 3.15-1. Distribution of *Python molurus*. Data from Western Ghat Reptile CAMP & IUCN 2020. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: The species is a good climber and an expert swimmer, and is mostly nocturnal (Aengal et al., 2021). *Python molurus* is an iteroparous and oviparous species, with sexual reproduction. They are solitary animals, and aggregate in pairs at the time of sexual reproduction only. *Python molurus* reaches sexual maturity at 2-3 years of age, dependent on food availability and environmental conditions. In India, mating takes place between December and February, and the females may lay between 6 and 100 eggs (Babar et al., 2019). Egg incubation period lasts for 2 to 3 months, and the average number of offspring is 40 per mating (Babar et al., 2019).

Habitat: *Python molurus* is mostly found in tropical areas and thrives in areas such as woody areas which provide good hiding places, scrublands, grassy marshes, and rocky hills near water pools (Babar et al., 2019).

Role in the ecosystem: *Python molurus* is a non-venomous constrictor that preys upon small to large mammals, birds, reptiles and amphibians, particularly rodents, and has an important ecological role in controlling prey populations (Bhupathy et al., 2014; Babar et al., 2019).

b) Populations and trends

The population trend is declining (Aengal et al., 2021). The population decline is caused by illegal trade for skin and pet trade, as well as habitat loss (Aengal et al., 2021).

c) Legal / illegal harvesting, captive breeding, and trade

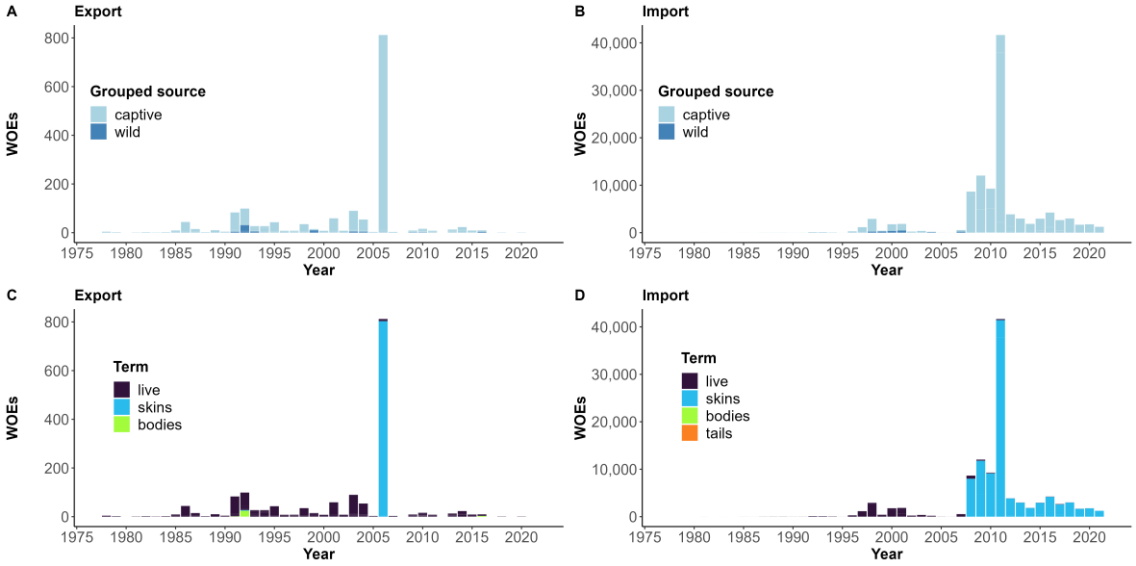

Figure 3.15-2. Reported quantities of exported (A and C) and imported (B and D) *Python molurus* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term. Data from CITES trade database, downloaded 30 March 2023.

Legal harvesting and trade:
The government of India has banned all harvest and export of wild sourced individuals of *P. molurus*. The species is present in several zoos around the world and is also commonly advertised for sale: https://snakesnaddersonline.co.uk/pythons, https://strictlyreptiles.tv/ball-python-breeder/pythons-for-sale/ https://www.facebook.com/groups/Python.Molurus/ Prices seem to range from £549 to £1,250. However, from the CITES trade database it seems that the species is predominantly traded for skins.

Illegal harvesting and trade: The collection of snakes is banned by law in India, but still occurs. Aengal et al. (2021) stress that the species is under threat due to local as well as international markets for the illegal demand in the leather industry and there are records of individuals being collected and smuggled for the pet trade.

Captive breeding: Captive breeding of this species seems to be common as the source code C (captive bred) is used for the majority of the records in the CITES trade database.

d) Assessment of the threat(s) posed by trade

The majority of the trade registered in the CITES trade database is with captive bred individuals. There is a major discrepancy between exporter-reported quantities and importer-reported quantities, but this is connected to changes in python taxonomy (Jacobs et al., 2009). Thus, international legal trade does not seem to pose a significant threat to this species.

e) Brief summary of other threats and conservation status

Python molurus is classified as Near Threatened (A2.d) on the IUCN Red List for Threatened Species (Aengal et al., 2021). The classification is justified by population decline of nearly 30% over the past 10 years, inferred by levels of over-exploitation,

habitat destruction and degradation. Some animals are killed when preying on livestock and the species is also under threat from habitat degradation and habitat loss due to anthropogenic activities (Aengal et al., 2021).

f) Population monitoring programs in the range area

According to Aengal et al. (2021) there are several research needs for this species, including population size, distribution and trends, and threats. There are no population monitoring programs for this species.

g) National regulations / legislation and in the range countries

Python molurus is included in the list for the Schedule I of Indian Wildlife Protection Act (IWPA) 1972 and it is listed in Appendix II of CITES. *Python molurus* is also listed as Endangered under the US Endangered Species Act.

h) Current management in the range countries, including harvest quotas

There are no current quotas for this species. The species occurs within several protected areas (Aengal et al., 2021).

i) Overall assessment of data quality

Very little information is available for this species. For example, it is claimed that the population has declined with 30% over the past 10 years but no data are presented to back up this claim.

References

Aengals A., Das A., Mohapatra P., Srinivasulu C., Srinivasulu B., Shankar G., Murthy, B.H.C. (2021) *Python molurus*. The IUCN Red List of Threatened Species 2021: e.T58894358A1945283. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T58894358A1945283.en. Accessed on 17 January 2023.

Babar M.E., Mughal M.S., Hussain T., Javed M.M., Sherzada S., Khan S.A., Ali A. (2019) Biology, habitat and conservation of Indian rock python – a brief review. Journal of Animal and Plant Sciences 29:349-352.

Bhupathy S., Ramesh C., Bahuguna A. (2014) Feeding habits of Indian rock pythons in Keoladeo National Park, Bharatpur, India. Herpetological Journal 24:59-64.

Jacobs H.J., Auliya M., Böhme W. (2009) On the taxonomy of the Burmese Python, *Python molurus bivittatus* KUHL, 1820, specifically on the Sulawesi population. Sauria 31:5-11.

3.16 *Python regius*

Summary and conclusion

Python regius is likely the most popular pet snake in the world. This is supported by the fact that it is one of the most traded CITES-species exported from Africa. A large proportion of traded specimens originate from ranched or captive-bred individuals. *Python regius* has a comparably quick reproduction rate and wide distribution in Central and West Africa. However, harvest is targeting mainly gravid females and neonates for ranching. In combination with the overall decreasing population trend likely due to exploitation the species is listed as Near Threatened on the IUCN Red List of Threatened Species. Therefore, trade should be kept under control and numbers monitored as continued trade will have further negative impact on the survival of *Python regius* wild populations. VKM concludes that international trade from Western Africa is likely to be detrimental, whereas that from Central Africa is currently not likely to pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status NT, the declining populations in western Africa contrasted by the more stable Central African populations, combined with the dominance of captive-bred specimens in trade.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python regius* (Shaw, 1802).

Common name: Ball python, royal python.

Scientific synonyms: *Boa regia* Shaw, 1802; *Cenchris regia* (Shaw, 1802); *Enygrus regius* (Shaw, 1802); *Hortulia regia* (Shaw, 1802); *Python bellii* Gray, 1842.

CITES listing and IUCN assessment: CITES Appendix II (04/02/1977);
IUCN Red list of Threatened Species (D'Cruze et al., 2022): Near Threatened (NT).

Distribution: *Python regius* occurs fragmentally across Central Africa and sub-Saharan West Africa and is native to Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, the Democratic Republic of Congo, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, South Sudan, Togo, and Uganda (Toudonou, 2015; D'Cruze et al., 2022).

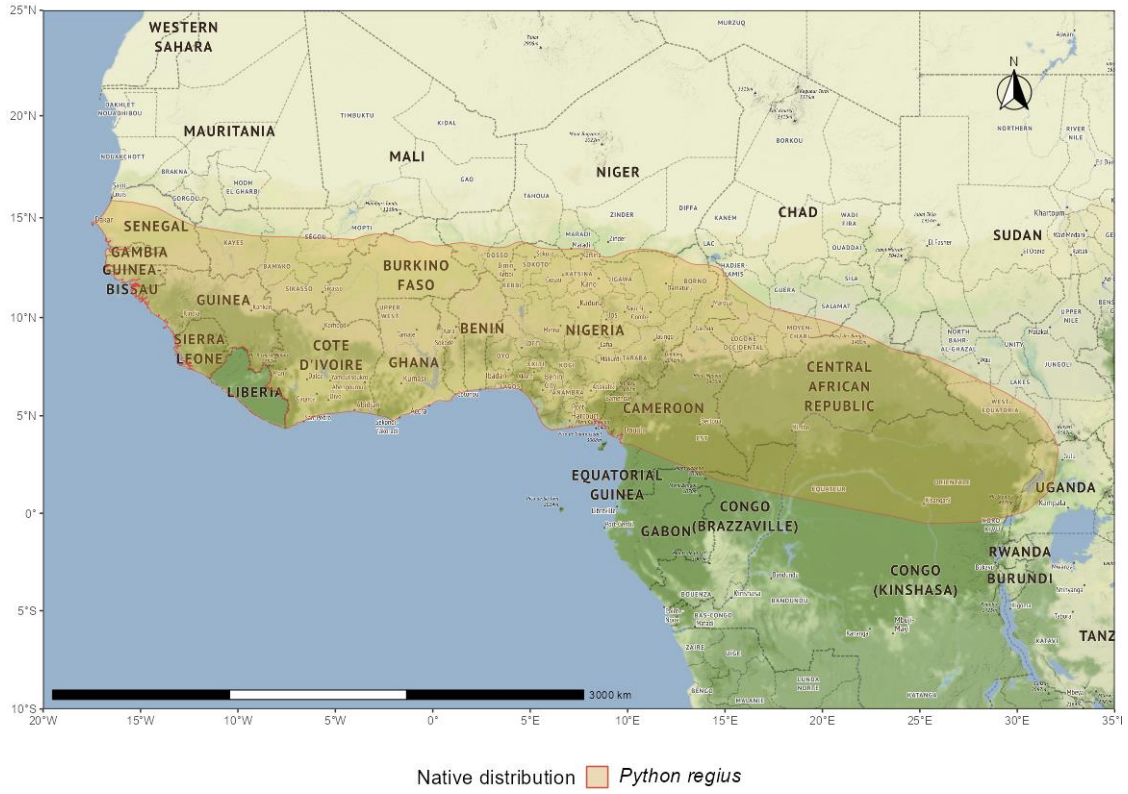

Figure 3.16-1. Distribution of *Python regius*. Data from IUCN 2012. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: *Python regius* lives about 10 years in the wild and up to 30 years in captivity (Conant, 1993). Reproductive age for females is reached from about 27-31 months and for males 16-18 months. The species is oviparous and females lay 6 to 18 eggs with hatching emerging usually two months later (Tinkle and Gibbons, 1977; O'Shea, 2011)

Habitat: *Python regius* inhabits humid and dry regions (although extreme aridity seems challenging for the species), from open forests, savanna, shrubland, grassland as well as agricultural landscape from 0 up to 1,000 meters elevation (Toudonou, 2015; D'Cruze et al., 2022).

Role in the ecosystem: *Python regius* is a predator feeding mainly on rodents and may act as pest control, and regionally also birds (Toudonou, 2015; D'Cruze et al., 2022). In areas outside its native range where it is introduced it poses substantial risk to native species (Reed, 2005).

b) Populations and trends

The population trend has been described as decreasing, with individuals annually declining by 69.8% (males) and 82.3% (females) in four protected sites in Nigeria between 1999 and 2008 (Reading et al., 2010; D'Cruze et al., 2022).

c) Legal / illegal harvesting, captive breeding, and trade

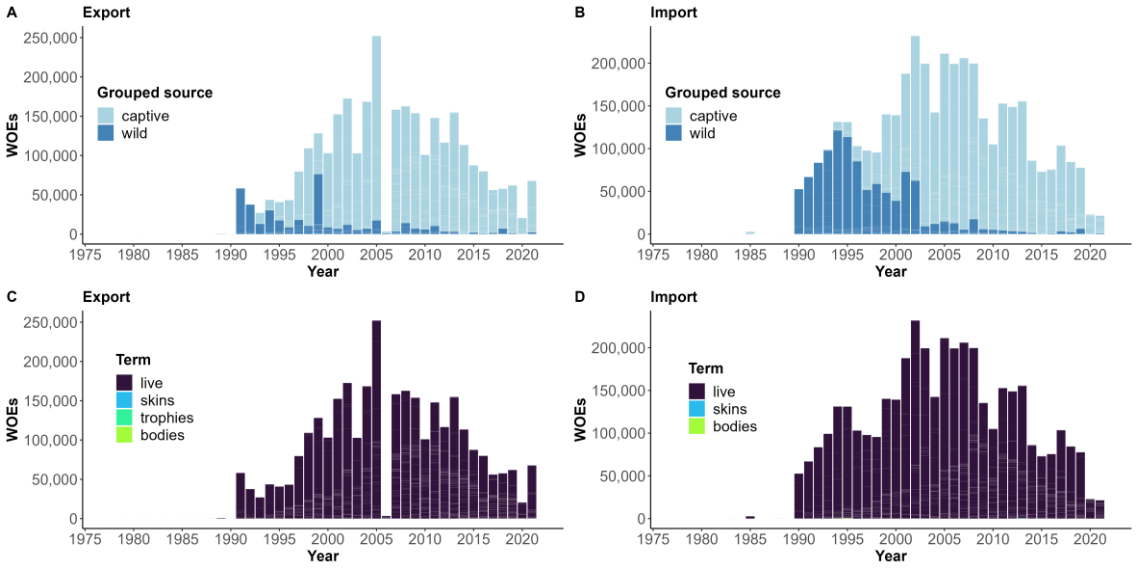

Figure 3.16-2. Exported quantities of exported (A and C) and imported (B and D) *Python regius* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

From Benin, Ghana and Togo, nearly all specimens were exported to the USA and EU since 1976, with the majority originating from ranches and therefore exported under CITES source code "R". Between 2000 and 2013, over 2.2 million Ball pythons have been exported from Benin, Ghana, and Togo (Harrington et al., 2020; D'Cruze et al., 2020a). Research has shown a shift from African python species to Asian species, as well as an associated reduction in trade volumes with a shift towards the pet trade (Luiselli et al., 2012). Pythons are also used in Cameroon, Nigeria, Benin, Togo, and Ghana in traditional medicine (D'Cruze et al., 2020b; Toudonou et al., 2020).

Some range countries have adopted the use of ranching to produce ball pythons for export (e.g., Ineich, 2006). "Ranching" is defined by CITES as "rearing, in a controlled environment of animals taken as eggs or juveniles from the wild where they would otherwise have had a very low probability of surviving to adulthood" (Lyons et al., 2017). After a potential link to bush meat and food trade was discovered in Benin, ranching was prohibited in the country. Although ranching puts pressure on wild populations, the prohibition of ranching increased demand in Benin and led to decreasing population numbers (Waller et al., 2015). The pressure ranching puts on wild populations should not be underestimated, and in Togo collectors have reported that finding ball pythons is increasing difficult (D'Cruze et al., 2020c). A study by Auliya et al. (2020) on genetic diversity in the species showed a lack of population structure, an absence that might be the result of population admixture resulting from the release of ranched surplus specimens.

d) Assessment of the threat(s) posed by trade

Python regius trade is predominantly in live specimens from ranching and captive-breeding. It is a thriving trade with large numbers exported annually, although with a decreasing trend. Parallel to this trade in ranched and captive-bred specimens, population trends show decline in range states in West Africa resulting from wild harvest for ranching and other purposes. Individuals in their most vulnerable biological

stages (neonates or gravid females) are mainly harvested. Trade poses a threat to the species as a result of unsustainable wild harvest for ranching.

e) Brief summary of other threats and conservation status

Ball pythons are hunted and poached for food, leather, and traditional medicine. The species is further threatened by habitat destruction due to intensified and industrial agricultural activities and pesticide use (Toudonou, 2015). Several studies highlight that the current threats may lead to the extinction of the species in West Africa, but the species may survive in Central Africa due to lower pressure (Spawls et al., 2018).

f) Population monitoring programs in the range area

Currently no systematic monitoring is occurring within the range of the species (D'Cruze et al., 2022).

g) National regulations / legislation and in the range countries

No control of sustainable harvest is currently in place (D'Cruze et al., 2022).

h) Current management in the range countries, including harvest quotas

Exports through the three major source countries in West Africa (Benin, Ghana, and Togo) are based on annual export quotas; most individuals are reported as "ranched". In 2022, these export quotas were 62,500 (Togo), 60,000 (Ghana), and 32,000 (Benin) ranched individuals (https://speciesplus.net/species#/taxon_concepts/5467/legal).

i) Overall assessment of data quality

Statistics on trade seem reliable and reflective of the intensive harvest and export of specimens of ball python from its distribution zone.

References

Auliya M., Hofmann S., Segniagbeto G.H., Assou D., Ronfot D., Astrin J.J., Forat S., Ketoh G.K.K., D'Cruze N. (2020) The first genetic assessment of wild and farmed ball pythons (Reptilia, Serpentes, Pythonidae) in southern Togo. Nature Conservation 38:37-59. DOI: 10.3897/natureconservation.38.49478.

Conant R. (1993) The oldest snake. Bulletin Chicago Herpetological Society 28:77-78.

D'Cruze N., Harrington L.A., Assou D., Green J., Macdonald D.W., Ronfot D., Segniagbeto G.H., Auliya M. (2020a) Betting the farm: A review of Ball Python and other reptile trade from Togo, West Africa. Nature Conservation 40:65-91. DOI: 10.3897/natureconservation.40.48046.

D'Cruze N., Assou D., Coulthard E., Norrey J., Megson D., Macdonald D.W., Harrington L.A., Ronfot D., Segniagbeto G.H., Auliya M. (2020b) Snake oil and pangolin scales: insights into wild animal use at "Marche des Fetiches" traditional medicine market, Togo. Nature Conservation 39:45-71. DOI: 10.3897/natureconservation.39.47879.

D'Cruze N., Harrington L.A., Assou D., Ronfot D., Macdonald D.W., Segniagbeto G.H., Auliya M. (2020c) Searching for snakes: ball python hunting in southern Togo, West Africa. Nature Conservation 38:13-36. DOI: 10.3897/natureconservation.38.47864.

D'Cruze N., Wilms T., Penner J., Luiselli L., Jallow M., Segniagbeto G., Niagate B.,

Schmitz A. (2022) *Python regius* (amended version of 2021 assessment). The IUCN Red List of Threatened Species 2022: e.T177562A220378972. https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T177562A220378972.en. Accessed on 07 March 2023.

Harrington L.A., Green J., Muinde P., Macdonald D.W., Auliya M., D'Cruze N. (2020) Snakes and ladders: A review of ball python production in West Africa for the global pet market. Nature Conservation 41:1-24. DOI: 10.3897/natureconservation.41.51270.

Ineich, I (2006) Les élevages de reptiles et de scorpions au Bénin, Togo et Ghana, plus particulièrement la gestion des quotas d'exportation et la définition des codes "source" des spécimens exportés. Rapport d'étude réalisée pour le Secrétariat de la CITES. Projet CITES A- 251:1–113.

Luiselli L., Bonnet X., Rocco M., Amori G. (2012) Conservation Implications of Rapid Shifts in the Trade of Wild African and Asian Pythons. Biotropica 44:569-573. DOI: 10.1111/j.1744-7429.2011.00842.x.

Lyons J.A., Natusch D.J.D., Jenkins R.W.G. (2017) A Guide to the application of CITES source codes. International Union for Conservation of Nature (IUCN). Rue Mauverney 28:1196. Gland, Switzerland.

O'Shea M. (2011) Boas and pythons of the world. Princeton University Press, Princeton, New Jersey.

Reading C.J., Luiselli L.M., Akani G.C., Bonnet X., Amori G., Ballouard J.M., Filippi E., Naulleau G., Perason D., Rugiero, L. (2010) Are snake populations in widespread decline? Biology Letters 6:777-780.

Reed R.N. (2005) An ecological risk assessment of nonnative boas and pythons as potentially invasive species in the United States. Risk Analysis 25:753-766. DOI: 10.1111/j.1539-6924.2005.00621.x.

Tinkle D.W., Gibbons J.W. (1977) The distribution and evolution of viviparity in reptiles. Miscellaneous Publications of the Museum of Zoology, University of Michigan 154:1-55.

Toudonou C.A.S. (2015) Ball python *Python regius.* Case species. An assessment of the impact of the pet trade on five CITES-Appendix II case studies, in: BPSG Summary Report: Impact of the trade of five species of snakes. IUCN SSC Boa and Python Specialist Group (BPSG). AC28 Doc. 14.1, Annex 4.

Toudonou C., Elwin A., Penner J., Coulthard E., Norrey J., Megson D., Rodel M.O., Sinsin B., Harrington L.A., Auliya M., D'Cruze N. (2022) Seeking serpents: Ball python trade in Benin, West Africa. Nature Conservation 50:85-114. DOI: 10.3897/natureconservation.50.86352.

Waller T., Lichtschein V., Montgomery C., Luiselli L., Toudonou C., Lettoof, D. 2015. An assessment of the impact of the pet trade on five CITES-Appendix II case studies. In: BPSG Summary Report: Impact of the trade of five species of snakes. IUCN SSC Boa and Python Specialist Group (BPSG). AC28 Doc. 14.1, Annex 4.

3.17 *Python sebae*

Summary and conclusion

Python sebae is the largest snake found on the African continent. Due to its popularity, the population trend has been decreasing and the species has been categorized as Near Threatened by the IUCN Red List. Besides for international export and trade, *P. sebae* is popular for its skin and demanded in the bushmeat trade, specifically in Western Africa. VKM concludes that international trade from Western Africa is likely to be detrimental whereas that from Eastern Africa is not likely to pose a threat to the continued survival of the species in the wild with moderate confidence. This is based on the current IUCN Red List status NT, the declining populations in Western Africa contrasted by the more stable Eastern African populations, combined with the decreasing trade in the species.

a) Name, distribution, life history, habitat, role in ecosystem

Species name: *Python sebae*, Gmelin, 1789.

Common name: African rock python, African python.

Scientific synonyms: *Boa hieroglyphica* Schneider, 1801; *Boa liberiensis* (Hallowell, 1845); *Coluber sebae* Gmelin, 1788; *Coluber speciosus* Bonnaterre, 1790; *Heleionomus variegatus* Gray, 1842; *Hortulia natalensis* (A. Smith, 1833); *Hortulia sebae* (Gmelin, 1788); *Python houttuyni* Daudin, 1803; *Python jubalis* Pitman, 1936; *Python liberiensis* Hallowell, 1845; *Python saxuloides* Miller & H. M. Smith, 1979; *Python sebae* Duméril & Bibron, 1844; *Python sebae sebae* Broadley, 1983.

Note on taxonomy: *Python sebae* was elevated to full species status by Broadley et al. (1999) supported by phylogenetic assessment (K. A. Tolley, Unpublished data, 2019 in Alexander et al., 2021). For CITES, *Python sebae* was split into *Python sebae* and *Python natalensis* on 23 June 2010, following taxonomic changes adopted at CoP15 (https://speciesplus.net/species#/taxon_concepts/10209/names).

CITES listing and IUCN assessment:
CITES Appendix II (04/02/1977);
IUCN Red List of Threatened Species (Alexander et al., 2021): Near Threatened (NT).

Distribution: *Python sebae* occurs in northern and central sub-Saharan Africa and is native to Benin; Burkina Faso; Cameroon; Central African Republic; Chad; Congo; Côte d'Ivoire; Equatorial Guinea; Eritrea; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Liberia; Mali; Mauritania; Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; Tanzania, United Republic of; Togo; Uganda. The species may have been introduced into the wild in Florida, USA (Alexander et al., 2021).

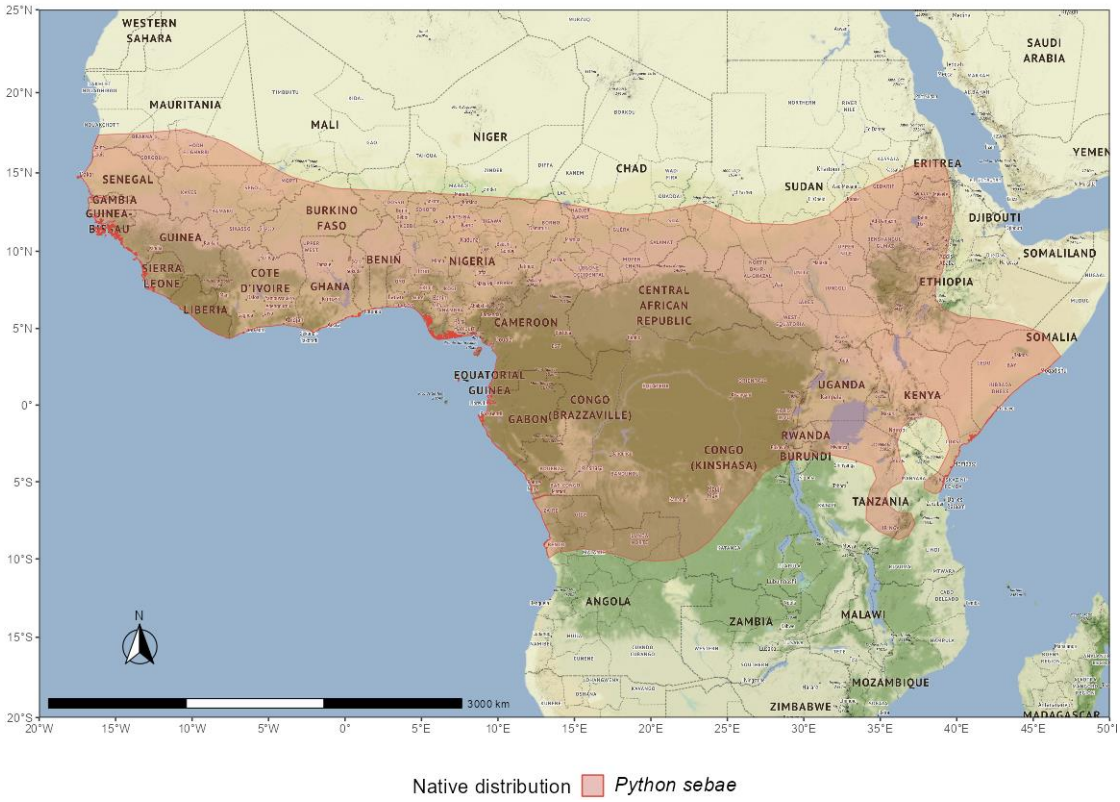

Figure 3.17-1. Distribution of *Python sebae*. Data from IUCN 2019. The IUCN Red List of Threatened Species. Version 2022-2. Shape file downloaded on 31 March 2023.

Life history: Generation time in *Python sebae* is unknown, but it is assumed to excess 15 years, as assumed for long-living snakes (Branch, 1998; Areste and Cebrian, 2003; Spawls et al., 2018 in Alexander et al., 2021). It has been reported that in captivity individuals can live for more than 27 years. The species is oviparous with a clutch size of 60 to 100 eggs. The mother protects the eggs until they hatch; newborn *Python sebae* are independent (Branch, 1998; Areste and Cebrian, 2003; Alexander et al., 2021). Mainly mature individuals of 10 to 13 years of age reach large sizes of four meters and longer. The record size was an individual of 7.5 meters. Adult individuals weigh between 44 to 55 kg, with 91 kg being the maximum reported so far.

Habitat: *Python sebae* is a skilled swimmer and can also climb trees. The species prefers outcrops in moist and sometimes swampy habitat, e.g., such as near the banks or permanent watercourses, marshlands, and mangroves (Alexander et al., 2021 and references therein). Rare or absent in cooler alpine and arid regions such as eastern Ethiopia, eastern Eritrea as well as Somalia. It may occur in moderately arid areas in West Africa, e.g., Sudan (Alexander et al., 2021 and references therein).

Role in the ecosystem: *Python sebae* is a predator, and feeds on mammals, birds and sometimes livestock as well as monkeys, crocodiles, and antelopes (Luiselli et al., 2001).

b) Populations and trends

Current population trend is decreasing (Alexander et al., 2021). Due to heavy exploitation for leather and bushmeat, *Python sebae* showed high rates of decline (Alexander et al., 2021). In Western Africa, declines exceeded 60% over the last 15

years. It is assumed that in Eastern Africa, populations were not that substantially declining.

c) Legal / illegal harvesting, captive breeding, and trade

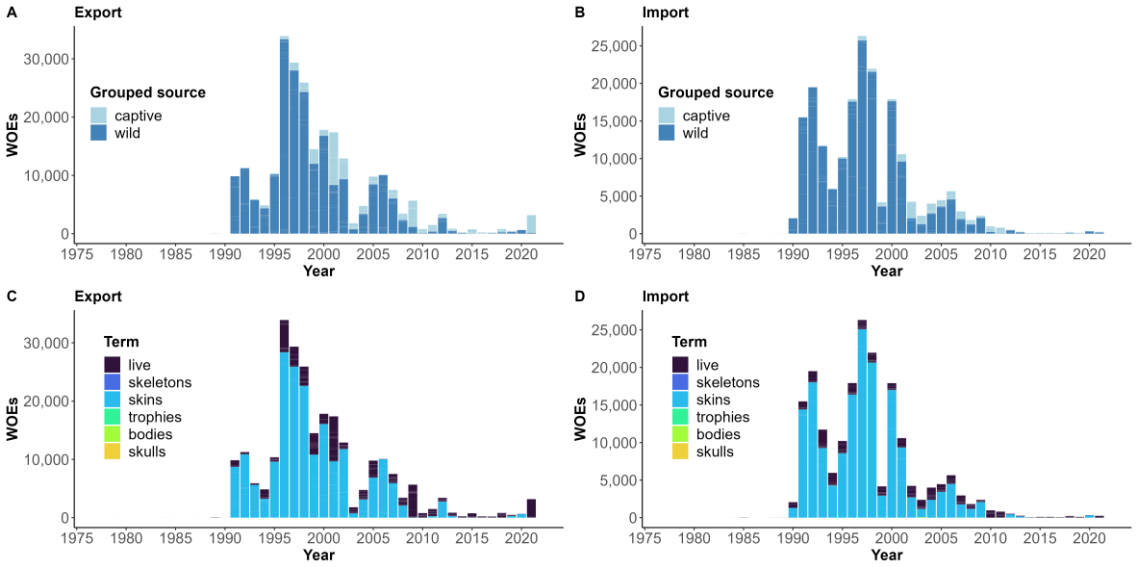

Figure 3.17-2. Reported quantities of exported (A and C) and imported (B and D) *Python sebae* specimens, expressed as whole organism equivalents (WOEs). In panel A and B reported quantities are disaggregated by year and source (captive or wild) and in panel C and D by year and term (predominantly live specimens have been reported). Data from CITES trade database, downloaded 30 March 2023.

The species is heavily exploited across its range in western Africa. Over 200,000 products from *Python sebae* have been exported between 2006 and 2018. Pythons are also used in Cameroon, Nigeria, Benin, Togo, and Ghana in traditional medicine (D'Cruze et al., 2020). Central and Eastern African populations experience lower pressure and have therefore not shown similar declines in numbers. This is likely due to lower hunting pressure as the species is not hunted for food and skins in Eastern Africa (Alexander et al., 2021). Research has shown a shift from African python species to Asian species, as well as an associated reduction in trade volumes with a shift towards the pet trade (Luiselli et al., 2012).

d) Assessment of the threat(s) posed by trade

Wild *P. sebae* exports are low and decreasing. Current trade levels do not appear to constitute a major threat for this species (Luiselli et al., 2012), whereas rapid urbanization and intensive deforestation do (Luiselli et al., 2001). Wild-caught specimens are cheaper than captive-bred ones, but less ethical and harder to feed (Luiselli et al., 2012).

e) Brief summary of other threats and conservation status

The species is further under pressure caused by deforestation and to some degree by hunting, as it is perceived to be a threat to livestock and also humans (Jensen et al., 2017; Fuashi et al., 2019; Alexander et al., 2021).

f) Population monitoring programs in the range area

Not known.

g) National regulations / legislation and in the range countries
Not known.

h) Current management in the range countries, including harvest quotas
The species occurs in numerous protected areas and therefore it is assumed that the species overall is not at risk (Spawls et al., 2018 in Alexander et al., 2021). Specific harvest quotas of wild and ranched specimens are set for most range states. Trade from Guinea, Somalia, Liberia has been suspended. Import of the species to the United States of America is prohibited.
(https://speciesplus.net/species#/taxon_concepts/10209/legal).

i) Overall assessment of data quality
Due to its popularity data and records of export are available and allow a feasible assessment.

References

Alexander G.J., Tolley K.A., Penner J., Luiselli L., Jallow M., Segniagbeto G., Niagate B., Howell K., Beraduccii J., Msuya C.A., Ngalason W. (2021) *Python sebae*. The IUCN Red List of Threatened Species 2021: e.T13300572A13300582. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T13300572A13300582.en Accessed on 07 March 2023.

Areste M., Cebrian R. (2003) Snakes of the World. Sterling Publishing Co., Inc., New York.

Branch B. (1998) Field Guide to Snakes and Other Reptiles of Southern Africa. Ralph Curtis Books, Sanibel Island, Florida.

Broadley D.G. (1999) The Southern African Python, *Python natalensis* A. Smith 1840, is a valid species. African Herp News 28:31-32.

D'Cruze N., Assou D., Coulthard E., Norrey J., Megson D., Macdonald D.W., Harrington L.A., Ronfot D., Segniagbeto G.H., Auliya M. (2020b) Snake oil and pangolin scales: insights into wild animal use at "Marche des Fetiches" traditional medicine market, Togo. Nature Conservation 39:45-71. DOI: 10.3897/natureconservation.39.47879.

Fuashi N.A., Ekane M.M., Jacqueline E., Zeh F.A. (2019) An evaluation of poaching and bushmeat off takes in the Ebo Forest Reserve (EFR), Littoral Region, Cameroon. Journal of Ecology and The Natural Environment 11:14-25.

Jensen T.J. (2017) Snakes of Africa: Exploitation and Conservation. MSc thesis. Aalborg University.

Luiselli L., Angelici F., Akani G. (2001) Food habits of *Python sebae* in suburban and natural habitats. African Journal of Ecology 39:116-118.

Luiselli L., Bonnet X., Rocco M., Amori G. (2012) Conservation Implications of Rapid Shifts in the Trade of Wild African and Asian Pythons. Biotropica 44:569-573.

Spawls S., Howell K., Hinkel H., Menegon, M. (2018) Field Guide to East African Reptiles, 2nd Edition. Bloomsbury Publishing, London.

4 Conclusions (with answers to the terms of reference)

The Norwegian Environment Agency requested VKM to conduct a scientific risk assessment of trade in pythons (Pythonidae spp.) listed in the CITES appendices and specimens thereof, based on the criteria given under the Convention on International Trade in Endangered Species (CITES). The Terms of Reference specified that the assessment shall be based on CITES, the Norwegian Cites Regulation, relevant articles in the convention text and resolutions. Additionally, paragraph 3 of the Terms of Reference specified that the risk assessment should be limited to species traded with Norway since 2010. VKM conducted scientific risk assessments of all 17 species in the genera *Apodora*, *Aspidites*, *Liasis*, *Malayopython*, *Morelia,* and *Python* that were traded into or out of Norway since 2010 and made species specific assessments of detriment resulting from trade (Table 4-1).

Table 4-1. Overview of detriment risk assessments for snake species in the Pythonidae family traded into or out of Norway since 2010.

Species	CITES Appendix	IUCN Red List	Detriment Assessment	Confidence
Apodora papuana	II	LC	NDF	Moderate-High
Aspidites melanocephalus	II	LC	NDF	High
Liasis mackloti	II	LC	NDF	Moderate
Malayopython reticulatus	II	LC	NDF	Moderate
Malayopython timoriensis	II	VU	DD[1]	Low
Morelia boeleni	II	DD	DF	Low
Morelia bredli	II	LC	NDF	High
Morelia spilota	II	LC	NDF	Moderate
Morelia viridis	II	LC	NDF	Moderate
Python anchietae	II	LC	NDF	Moderate
Python bivittatus	II	VU	NDF	Moderate
Python breitensteini	II	LC	NDF	Moderate
Python brongersmai	II	LC	NDF	Moderate
Python curtus	II	LC	NDF	Moderate-High
Python molurus	I	NT	CITES App I	High
Python regius	II	NT	WA DF, CA NDF[2]	Moderate
Python sebae	II	NT	WA DF, EA NDF[3]	Moderate

[1]Data deficient, and no assessment can be made; [2]Detriment for Western African populations, but no detriment for Central African populations. [3]Detriment for Western African populations, but no detriment for Eastern African populations.

Based on the species-specific detriment assessments VKM concludes no detriment for 12 species (*Apodora papuana, Aspidites melanocephalus, Liasis mackloti, Malayopython reticulatus, Morelia bredli, Morelia spilota, Morelia viridis, Python anchietae, Python bivittatus, Python breitensteini, Python brongersmai, Python curtus*).

It also concludes detriment for one species (*Morelia boeleni*). For two species, a split conclusion is made based on the region of origin (*Python regius* and *Python sebae*). Furthermore, data was lacking for *Malayopython timoriensis* and VKM was not able to assess detriment as a result of trade for this species. The final species, *Python molurus*, is CITES Appendix I listed and should not be traded for commercial purposes. The confidence of each assessment varied based on data availability.

It should be noted that for many taxa VKM found significant data deficiencies that affected the confidence of assessments. Data gaps are mostly related to populations, trends, and illegal trade. Additionally, data for many species was more than a decade old and might not reflect the current situation for these species. For many of these species, trade is a significant risk to continued survival of the species in the wild. The risk assessments for all species that are IUCN Red-List assessed as Least Concern (LC) can be applied without update for a period of ten years unless a new assessment establishes an increased level of threat for the species. The risk assessments for all species that are IUCN Red-List assessed as Near Threatened (NT), Vulnerable (VU) or Data deficient (DD) can be applied without update for a period of five years, unless a new assessment establishes an increased level of threat for the species. In case a new IUCN Red-List assessment increases the threat level for a species, VKM recommends an update of the non-detriment finding for the species.

5 Data gaps and uncertainties

Reports on the snake trade for both pet and skin trade provide a general overview of the trade dynamics and concerns relevant for the risk assessments in this report. However, significant data gaps reduce the confidence of some of the assessments. The overall assessments of data quality provided for each species assessment highlight some of the main concerns regarding data gaps. The most prevalent data gap is access to recent data as many of the IUCN Red-List assessments are based on data that is more than 10 years old, and thus VKM lacked up-to-date information about population sizes and trends. Gaps in knowledge on populations and species delimitation make it hard to estimate whether wild harvest leads to demographic and genetic attrition of species or populations. Our approach to analysing the CITES Trade Database as Whole Organism Equivalents (WOEs) assumes that each of the trade terms equate to one organism. Some terms cannot be converted to WOEs (e.g., derivatives, shoes, leather items, etc.) and are therefore excluded from the analysis. These assumptions introduce a potential bias as we might overestimate trade assuming that each WOE originates from unique individuals (former) or underestimate trade by excluding ambiguous terms (latter). Hierink et al. (2020) discusses these potential biases, and although they report that nearly 24% of transactions are excluded, they conclude that the effect is minimal. Furthermore, accurate trade data beyond the CITES Trade Database is lacking for many species, and illegal trade is hard to assess. Using extant data VKM could determine the risk of detriment from trade for all but one species. However, data gaps and uncertainties affect the confidence of these conclusions. In order to reflect the influence of data gaps on the detriment findings confidence levels for each species assessment were provided. *Malayopython timoriensis* lacked sufficient data for a conclusion on detriment to be made.

6 References

Authors of the opinion

VKM (2019) Kriterier for forfatterskap og faglig ansvar i VKMs uttalelser. https://vkm.no/download/18.48566e5316b6a4910fc2dbd6/1561035075341/VKMs%20forfatterskapskriterier_revidert%20versjon%2020.06.2019.pdf

Acknowledgement

VKM (2018) Rutine for godkjenning av risikovurderinger. https://vkm.no/download/18.433c8e05166edbef03bbda5f/1543579222271/Rutine%20for%20godkjenning%20av%20risikovurderinger.pdf

Chapter 1: Introduction

Chapter 1.1: Risk assessment of threat posed by trade to wild populations

Chapter 1.2: Snakes and pythons

Barker D.G., Barker T.M., Davis M.A., Schuett G.W. (2015) A review of the systematics and taxonomy of Pythonidae: an ancient serpent lineage. Zoological Journal of the Linnean Society 175:1-19 DOI:10.1111/zoj.12267

Reynolds R.G., Niemiller M.L., Revell L.J. (2014) Toward a Tree-of-Life for the boas and pythons: Multilocus species-level phylogeny with unprecedented taxon sampling. Molecular Phylogenetics and Evolution 71:201-213.

Hardy D.L. (1994) A re-evaluation of suffocation as the cause of death during constriction by snakes. Herpetological Review 229:45-47.

Osterloff E. (2023) What is the biggest snake in the world? Natural History Museum London. Accessed online 13.04.2023: https://www.nhm.ac.uk/discover/what-is-the-biggest-snake-in-the-world.html

Chapter 1.3: Snakes native to Norway and as pets in Norway

Dervo B.K., Olstad K., Kraabøl M., Qvenild, M. (2012) Vurdering av risiko for det biologiske mangfoldet ved innførsel og hold av eksotiske reptiler og amfibier i Norge - NINA Rapport 820. 54 pp.

Dervo B., Strøm B.S., van der Kooij J. (2021a). Amfibier og reptiler: Vurdering av buorm *Natrix natrix* for Norge. Rødlista for arter 2021. Artsdatabanken. https://www.artsdatabanken.no/lister/rodlisteforarter/2021/8589

Dervo B., Strøm B.S., van der Kooij J. (2021b). Amfibier og reptiler: Vurdering av hoggorm *Vipera berus* for Norge. Rødlista for arter 2021. Artsdatabanken. https://www.artsdatabanken.no/lister/rodlisteforarter/2021/26627

Dervo B., Strøm B.S., van der Kooij J, (2021c). Amfibier og reptiler: Vurdering av

slettsnok *Coronella austriaca* for Norge. Rødlista for arter 2021. Artsdatabanken. https://www.artsdatabanken.no/lister/rodlisteforarter/2021/15970

Dorcas M.E., Willson J.D., Reed R.N., Snow R.W., Rochford M.R., Miller M.A., Meshaka W.E. Jr., Andreadis P.T., Mazzotti F.J., Romagosa C.M., Hart K.M. (2012) Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. Proc Natl Acad Sci USA 109:2418-22. doi: 10.1073/pnas.1115226109.

Lovadata (1976) FOR-1976-11-20-3. https://lovdata.no/dokument/SFO/forskrift/1976-11-20-3

Lovdata (2009) LOV-2009-06-19-100 https://lovdata.no/lov/2009-06-19-100

Lovdata (2017) FOR-2017-05-11-597. https://lovdata.no/dokument/SF/forskrift/2017-05-11-597

Mattilsynet (2017) https://www.mattilsynet.no/dyr_og_dyrehold/kjaledyr_og_konkurransedyr/eksotiske_dyr/reptilene_som_er_lovlige_i_norge.27196

Miller M.A., Kinsella J.M., Snow R.W., Hayes M.M., Falk B.G., Reed R.N., Mazzotti F.J., Guyer C., Romagosa C.M. (2018) Parasite spillover: indirect effects of invasive Burmese pythons. Ecology and Evolution 8:830-840.

Soto-Shoender J.R., Gwinn D.C., Sovie A., McCleery R.A. (2020) Life-history traits moderate the susceptibility of native mammals to an invasive predator. Biological Invasions 22:2671-2684.

Willson J.D. (2017) Indirect effects of invasive Burmese pythons on ecosystems in southern Florida. Journal of Applied Ecology 54:1251-1258.

Chapter 1.4: Drivers of snake trade

Alves R.R.N., Neto N.A.L., Santana G.G., Vieira W.L.S., Almeida W.O. (2009) Reptiles used for medicinal and magic religious purposes in Brazil. Applied Herpetology 6:257–274. https://doi.org/10.1163/157075409X432913

Auliya M., Altherr S., Ariano-Sanchez D., Baard E.H., Brown C., Brown R.M., Cantu J.-C., Gentile G., Gildenhuys P., Henningheim E., Hintzmann J., Kanari K., Krvavac M., Lettink M., Lippert J., Luiselli L., Nilson G., Nguyen T.Q., Nijman V., Parham J.F., Pasachnik S.A., Pedrono M., Rauhaus A., Córdova D.R., Sanchez M.- E., Schepp U., van Schingen M., Schneeweiss N., Segniagbeto G.H., Somaweera R., Sy E.Y., Türkozan O., Vinke S., Vinke T., Vyas R., Williamson S., Ziegler T. (2016) Trade in live reptiles, its impact on wild populations, and the role of the European market. Biological Conservation 204 (Part A):103–119. https://doi.org/10.1016/j.biocon. 2016.05.017.

Green J., Coulthard E., Megson D., Norrey J., Norrey L., Rowntree J.K., Bates J., Dharmpaul B., Auliya M., D'Cruze, N. (2020) Blind trading: a literature review of research addressing the welfare of ball pythons in the exotic pet trade. Animals 10:193.

Jensen T.J., Auliya M., Burgess N.D., Aust P.W., Pertoldi C., Strand J. (2019) Exploring the international trade in African snakes not listed on CITES: highlighting the role of the internet and social media. Biodiversity and Conservation 28:1–19. https://doi.org/10. 1007/s10531-018-1632-9.

Kasterine A., Arbeid R, Caillabet O, Natusch D. (2012) The Trade in Southeast Asian Python Skins. Technical paper, 54 pp, International Trade Centre (ITC), Geneva.

Klemens M.W., Thorbjarnarson J.B. (1995) Reptiles as a food resource. Biodiversity and Conservation 4:281–298. https://doi.org/10.1007/BF00055974

Luiselli L., Bonnet X., Rocco M., Amori G. (2012) Conservation implications of rapid shifts in the trade of wild African and Asian pythons. Biotropica 44:569–573. https:// doi.org/10.1111/j.1744-7429.2011.00842.x.

Somaweera R., Somaweera N. (2010) Serpents in jars: the snake wine industry in Vietnam. Journal of Threatened Taxa 2:1251–1260. https://doi.org/10.11609/JoTT. o2361.1251-60.

Chapter 1.5: Threats to python populations

CITES (2023) https://cites.org/eng/app/appendices.php

Hierink F., Bolon I., Durso A.M., de Castañeda R.R., Zambrana-Torrelio C., Eskew E.A., Ray N. (2020) Forty-four years of global trade in CITES-listed snakes: Trends and implications for conservation and public health. Biological Conservation 248:108601.

Hogg C.J., Dennison S., Frankham G.J., Hinds M., Johnson R.N. (2018) Stopping the spin cycle: genetics and bio-banking as a tool for addressing the laundering of illegally caught wildlife as 'captive-bred'. Conservation Genetics Resources 10:237-246.

Lyons J., Natusch D. (2015) Methodologies for differentiating between wild and captive-bred CITES-listed snakes. AC28 Inf, 9, p.35.

Natusch D.J.D., Lyons J.A., Mumpuni, Riyanto A., Shine R. (2016) Jungle giants: Assessing sustainable harvesting in a difficult-to-survey species (*Python reticulatus*). PLoS One 11:e0158397. https://doi.org/10.1371/journal.pone.0158397.

Nijman V. (2022) Harvest quotas, free markets and the sustainable trade in pythons. Nature Conservation 48:99-121.

Schlaepfer M.A., Hoover C., Dodd C.K. (2005) Challenges in evaluating the impact of the trade in amphibians and reptiles on wild populations. BioScience 55:256–264. https://doi.org/10.1641/0006-3568(2005)055[0256:CIETIO]2.0.CO;2.

Chapter 1.6: Threats to native environments caused by imported pythons

Dorcas M.E., Willson J.D., Reed R.N., Snow R.W., Rochford M.R., Miller M.A., Meshaka W.E. Jr., Andreadis P.T., Mazzotti F.J., Romagosa C.M., Hart K.M. (2012) Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. Proc Natl Acad Sci USA 109:2418-22. doi: 10.1073/pnas.1115226109.

Glidden C.K., Nova N., Kain M.P., Lagerstrom K.M., Skinner E.B., Mandle L., Sokolow S.H., Plowright R.K., Dirzo R., De Leo G.A., Mordecai E.A. (2021) Human-mediated impacts on biodiversity and the consequences for zoonotic disease spillover. Current Biology 31:R1342-R1361.

Hernandez-Divers S.J., Shearer D. (2002) Pulmonary mycobacteriosis caused by *Mycobacterium haemophilum* and *M marinum* in a royal python. Journal of the American Veterinary Medical Association 220:1661-1663.

Hunter M.E., Oyler-McCance S.J., Dorazio R.M., Fike J.A., Smith B.J., Hunter C.T., Reed R.N., Hart, K.M. (2015) Environmental DNA (eDNA) sampling improves occurrence and detection estimates of invasive Burmese pythons. PloS One 10:e0121655.

Miller M.A., Kinsella J.M., Snow R.W., Falk B.G., Reed R.N., Goetz S.M., Mazzotti F.J., Guyer C., Romagosa, C.M. (2020) Highly competent native snake hosts extend the range of an introduced parasite beyond its invasive Burmese python host. Ecosphere 11:e03153.

Reed R.N., Willson J.D., Rodda G.H., Dorcas M.E. (2012) Ecological correlates of invasion impact for Burmese pythons in Florida. Integrative Zoology 7:254-270.

Sovie A.R., McCleery R.A., Fletcher R.J., Hart K.M. (2016) Invasive pythons, not anthropogenic stressors, explain the distribution of a keystone species. Biological Invasions 18:3309-3318.

Ullmann L.S., Dias R.D.N., Cagnini D.Q., Yamatogi R.S., Oliveira J.P., Nemer V., Teixeira R.H.F., Biondo A.W., Araújo J.P. (2016) *Mycobacterium genavense* infection in two species of captive snakes. Journal of Venomous Animals and Toxins including Tropical Diseases 22:27.

Ursula H., Rüdiger K., Frank M., Monika, R. (2014) Blood parasites in reptiles imported to Germany. Parasitology Research 113:4587-4599.

Chapter 1.7: Sustainability and legality

Auliya M., Altherr S., Ariano-Sanchez D., Baard E.H., Brown C., Brown R.M., Cantu J.-C., Gentile G., Gildenhuys P., Henningheim E., Hintzmann J., Kanari K., Krvavac M., Lettink M., Lippert J., Luiselli L., Nilson G., Nguyen T.Q., Nijman V., Parham J.F., Pasachnik S.A., Pedrono M., Rauhaus A., Córdova D.R., Sanchez M.- E., Schepp U., van Schingen M., Schneeweiss N., Segniagbeto G.H., Somaweera R., Sy E.Y., Türkozan O., Vinke S., Vinke T., Vyas R., Williamson S., Ziegler T. (2016) Trade in live reptiles, its impact on wild populations, and the role of the European market. Biological Conservation 204 (Part A):103–119. https://doi.org/10.1016/j.biocon. 2016.05.017.

Lyons J.A., Natusch D.J.D. (2011) Wildlife laundering through breeding farms: Illegal harvest, population declines and a means of regulating the trade of green pythons (*Morelia viridis*) from Indonesia. Biological Conservation 144:3073-3081. DOI: 10.1016/j.biocon.2011.10.002.

Nijman V. (2022) Harvest quotas, free markets and the sustainable trade in pythons. Nature Conservation 48:99-121.

Chapter 2: Methodology and Data

Chapter 2.1: Data and information gathering

CITES Trade Database (2023). Compiled by UNEP-WCMC for the CITES Secretariat. Available at: trade.cites.org. Accessed 31 March 2023.

IUCN (2023). The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org

UNEP (2023). The Species+ Website. Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK. Available at: www.speciesplus.net.

Chapter 2.2: Literature search and selection

Chapter 2.3: Taxonomy

GBIF Secretariat (2022) GBIF Backbone Taxonomy. Checklist dataset https://doi.org/10.15468/39omei accessed via GBIF.org on 2023-05-29.

Reynolds R.G., Niemiller M.L., Revell L.J. (2014) Toward a Tree-of-Life for the boas and pythons: Multilocus species-level phylogeny with unprecedented taxon sampling. Molecular Phylogenetics and Evolution 71:201-213.

Keogh J.S., Barker D.G., Shine R. (2001) Heavily exploited but poorly known: systematics and biogeography of commercially harvested pythons (*Python curtus* group) in Southeast Asia. Biological Journal of the Linnean Society 73:113-129.

Zug G.R., Gotte S.W., Jacobs J.F. (2011) Pythons in Burma: Short-tailed python (Reptilia: Squamata). Proceedings of the Biological Society of Washington 124:112-136.

Chapter 2.4: Data from CITES trade database

Harfoot M., Glaser S.A., Tittensor D.P., Britten G.L., McLardy C., Malsch K., Burgess N.D. (2018) Unveiling the patterns and trends in 40 years of global trade in CITES-listed wildlife. Biological Conservation 223:47–57. https://doi.org/10.1016/j.biocon.2018.04.017

Hierink F., Bolon I., Durso A.M., de Castañeda R.R., Zambrana-Torrelio C., Eskew E.A., Ray N. (2020) Forty-four years of global trade in CITES-listed snakes: Trends and implications for conservation and public health. Biological Conservation 248:108601.

Chapter 2.5: Data assessment and recommendation

Natusch D., Waller T., Micucci P., Lichtschein V. (2017) Non-detriment findings for snakes: Guidance for CITES Scientific Authorities. IUCN-SSC Boa and Python Specialist Group. AC29 Doc. 31.1 Annex.

Chapter 3: Species assessments*

Berec M., Vršecká L., Šetlíková, I. (2018) What is the reality of wildlife trade volume? CITES Trade Database limitations. Biological Conservation 224:111-116.

Blundell A.G., Mascia M.B. (2005) Discrepancies in reported levels of international wildlife trade. Conservation Biology 19:2020-2025.

Robinson J.E., Sinovas P. (2018) Challenges of analyzing the global trade in CITES-listed wildlife. Conservation Biology 32:1203-1206.

*References for the individual species assessments are given at the end of each individual species assessment.

Chapter 4: Conclusions (with answers to the terms of reference)

Chapter 5: Data gaps and uncertainties

Hierink F., Bolon I., Durso A.M., de Castañeda R.R., Zambrana-Torrelio C., Eskew E.A., Ray N. (2020) Forty-four years of global trade in CITES-listed snakes: Trends and implications for conservation and public health. Biological Conservation 248:108601.

7 Appendix I

7.1 Search strings used in literature search

Search performed in Web of Science Core Collection, Editions: All, 10 May 2023
Topic search: Searches title, abstract and indexing
Publication Date: All years (1987-2023)

Generic form of search
TS=("scientific name" OR "scientific synonyms" OR "common name" OR "common name synonyms")

Scientific synonyms and English common names were used as listed in Species+ (https://speciesplus.net/) 10 May 2023.

***Apodora papuana*:**
TS=("Apodora papuana" OR "Liasis maximus" OR "Liasis olivaceus papuanus" OR "Liasis papuanus" OR "Liasis tornieri" OR "Morelia papuana" OR "Papuan Python" OR "Papuan olive python")

***Aspidites melanocephalus*:**
TS=("Aspidites melanocephalus" OR "Black-headed Python" OR "Woma")

***Liasis mackloti*:**
TS=("Liasis mackloti" OR "Liasis savuensis" OR "Morelia mackloti" OR "Python timorensis" OR "Water Python" OR "Macklot's Python")

***Malayopython reticulatus*:**
TS=("Malayopython reticulatus" OR "Boa phrygia" OR "Boa reticulata" OR "Boa rhombeata" OR "Broghammerus reticulatus" OR "Coluber javanicus" OR "Morelia reticulatus" OR "Python reticulatus" OR "Python schneideri" OR "Regal Python" OR "Reticulated Python" OR "Java Rock Python" OR "Asian reticulated python")

***Malayopython timoriensis*:**
TS=("Malayopython timoriensis" OR "Australiasis timoriensis" OR "Broghammerus timoriensis" OR "Liasis amethistinus timoriensis" OR "Liasis petersii" OR "Malayaopython timoriensis" OR "Morelia timoriensis" OR "Python timoriensis" OR "Timor Python")

***Morelia boeleni*:**
TS=("Morelia boeleni" OR "Liasis boeleni" OR "Liasis taronga" OR "Python boeleni" OR "Simalia boeleni" OR "Boelen's Python" OR "Black Python")

***Morelia bredli*:**
TS=("Morelia bredli" OR "Python bredli" OR "Centralian carpet python" OR "Central carpet python" OR "Centralian carpet snake")

***Morelia spilota*:**
TS=("Morelia spilota" OR "Coluber argus" OR "Coluber spilotus" OR "Morelia argus" OR "Morelia cheynei" OR "Morelia imbricata" OR "Morelia mcdowelli" OR "Morelia metcalfei" OR "Morelia punctata" OR "Morelia variegata" OR "Python peronii" OR

"Python punctatus" OR "Python spilotus" OR "Carpet Python" OR "Diamond Python" OR "Western australian carpet python")

***Morelia viridis*:**
TS=("Morelia viridis" OR "Chondropython azureus" OR "Chondropython pulcher" OR "Chondropython viridis" OR "Morelia azurea" OR "Python viridis" OR "Green Tree Python" OR "Green python")

***Python anchietae*:**
TS=("Python anchietae" OR "Angolan Python" OR "Anchieta's dwarf python")

***Python bivittatus*:**
TS=("Python bivittatus" OR "Python molurus bivittatus" OR "Python molurus bivittatus" OR "Burmese python")

***Python breitensteini*:**
TS=("Python breitensteini" OR "Python curtus breitensteini" OR "Borneo Short-tailed Python" OR "Bornean short-tailed python")

***Python brongersmai*:**
TS=("Python brongersmai" OR "Python curtus brongersmai" OR "Red short-tailed python" OR "Blood Python" OR "Brongersma's short-tailed python")

***Python curtus*:**
TS=("Python curtus" OR "Aspidoboa curtus" OR "Python curtus curtus" OR "Sumatran Short-tailed Python")

***Python molurus*:**
TS=("Python molurus" OR "Boa albicans" OR "Boa castanea" OR "Boa cinerea" OR "Boa orbiculata" OR "Boa ordinata" OR "Coluber boaeformis" OR "Coluber molurus" OR "Python bora" OR "Python jamesonii" OR "Python molurus molurus" OR "Python molurus pimbura" OR "Python ordinatus" OR "Python tigris" OR "Indian Python" OR "Asiatic Rock Python" OR "Tiger Python" OR "Burmese Python")

***Python regius*:**
TS=("Python regius" OR "Boa regia" OR "Cenchris regia" OR "Enygrus regius" OR "Hortulia regia" OR "Python bellii" OR "Ball Python" OR "Royal Python")

***Python sebae*:**
TS=("Python sebae" OR "Boa hieroglyphica" OR "Boa liberiensis" OR "Coluber sebae" OR "Coluber speciosus" OR "Heleionomus variegatus" OR "Hortulia natalensis" OR "Hortulia sebae" OR "Python houttuyni" OR "Python jubalis" OR "Python liberiensis" OR "Python saxuloides" OR "Python sebae" OR "Python sebae sebae" OR "African Rock Python" OR "African Python")

8 Appendix II

8.1 Flow charts summarizing the literature search

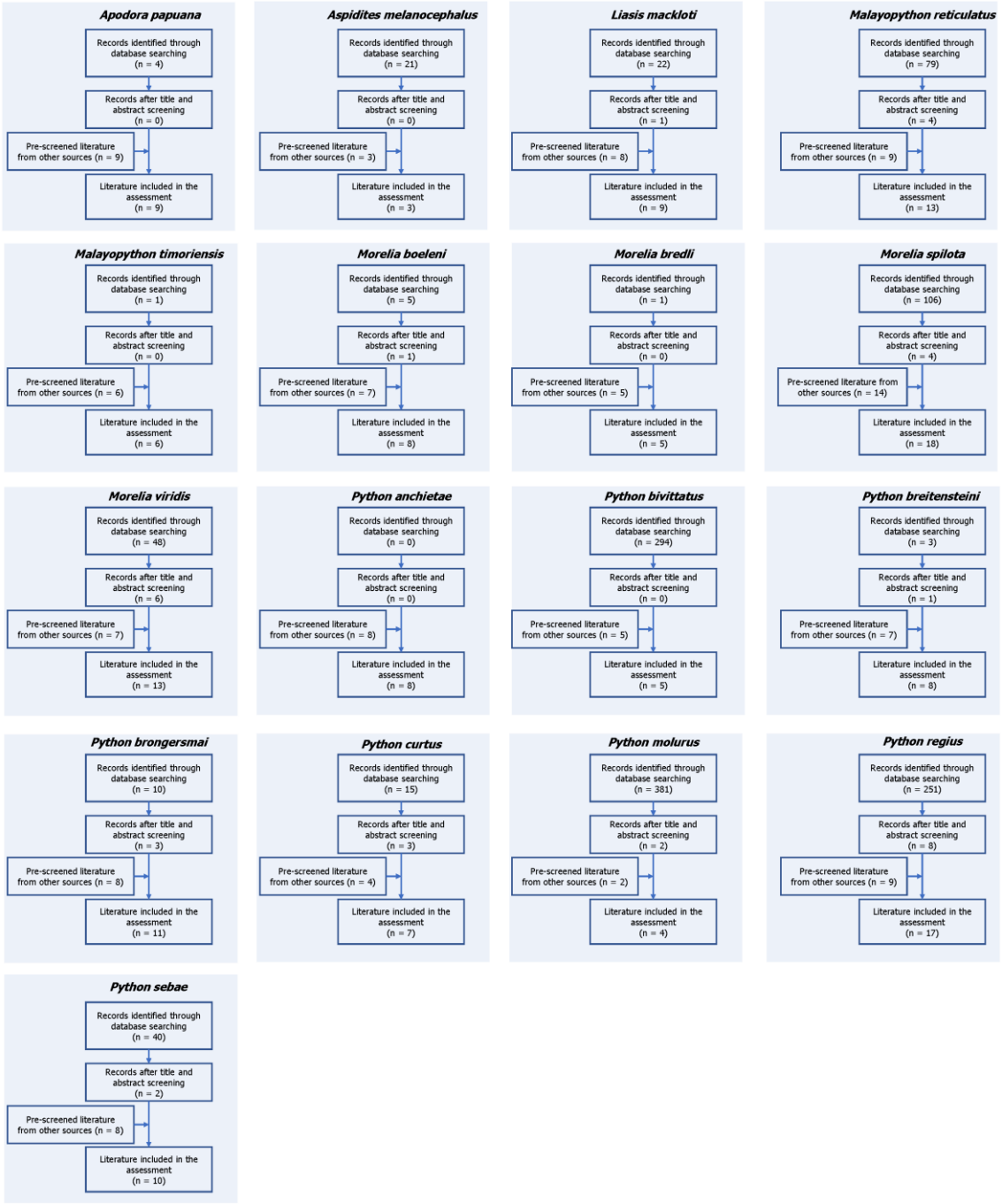

Figure 8.1-1. Flow charts summarizing the literature search for each of the 17 assessed species. The structured literature search and screening is described in section 2.2 and detailed in Appendix I. Pre-screened literature from other sources refers to the manual searches for papers and relevant grey literature also described in section 2.2.