Boelens Python *Morelia boeleni*

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Background and summary

Boelens pythons (*Morelia boeleni*) occur only in the highlands of Papua New Guinea and the Indonesian Province of Papua. They are fully protected in Papua New Guinea but not in Indonesia, which has exported between 50 – 400 individuals per year since 1989. Prior to 2001 Indonesia allowed an annual harvest of 120 wild individuals, but no quota for wild specimens has been allocated since that time. Seemingly in response to this, all subsequent exports of *Morelia boeleni* from Indonesia have been declared as farmed or captive-bred. For more than 30 years this species has been kept in captivity by numerous zoological institutions and highly experienced python keepers, however; records indicate that the species has been successfully reproduced on fewer than 10 occasions. Because of the known difficulty in reproducing Boelens Pythons in captivity, concerns have been raised that Indonesian specimens exported as captive-bred are in fact wild-caught. If this is indeed the case, their apparent rarity and limited distribution in montane habitats has led some to express severe reservations about the impacts of collection on wild populations. The present review summarises the biology and trade of Boelens pythons to evaluate the impact of harvest on wild populations. Management recommendations are provided.

Species overview

Distribution

The Boelens Python (*Morelia boeleni*) is endemic to the mainland of New Guinea and at least one offshore island, Goodenough Island (Brongersma 1953; O'Shea 1996; Austin *et al.* 2010). A 2500 km long central cordillera spans the interior of New Guinea forming the central highlands, with many peaks exceeding 3000 m. *M. boeleni* is found only in the New Guinea highlands at altitudes greater than 1000 m above sea level and below the tree line (Fig. 1), and is often associated with steep densely vegetated, rocky summits (Baldogo & Spataro 2006). Accurate distributional data for *M. boeleni* is limited, yet the python's distribution is evenly spread between Indonesia and Papua New Guinea (Fig. 1). At least two allopatric populations occur on the Huon Peninsula and Goodenough Island in Papua New Guinea. A population study of these pythons from Papua Province, Indonesia, suggests they prefer montane, lush rainforests on exceptionally steep cliffs, located between 2000 - 2700 m above sea level (Baldogo & Spataro 2006).

Basic biology

Morelia boeleni are long (<3 m), slender, primarily diurnal snakes that feed on a variety of prey items (Baldogo & Spataro 2006). As hatchlings they will readily prey on frogs and small lizards, while juvenile and adult snakes feed upon larger mammals. It is important for wildlife authorities and customs staff to note that juvenile *M. boeleni* are a 'rufous' red colour with blotched cream stripes, but change to be jet black with anterior white stripes close to the underside once reaching approximately one meter in length. Wild *M. boeleni* are usually found at specific basking sites adjacent to underground retreats, consisting of vegetation filled openings beneath tree roots or into sunken rocks. Very little is known about the reproductive biology of *M. boeleni* in the wild, but wild-caught gravid females have produced clutches of 13 – 19 eggs.

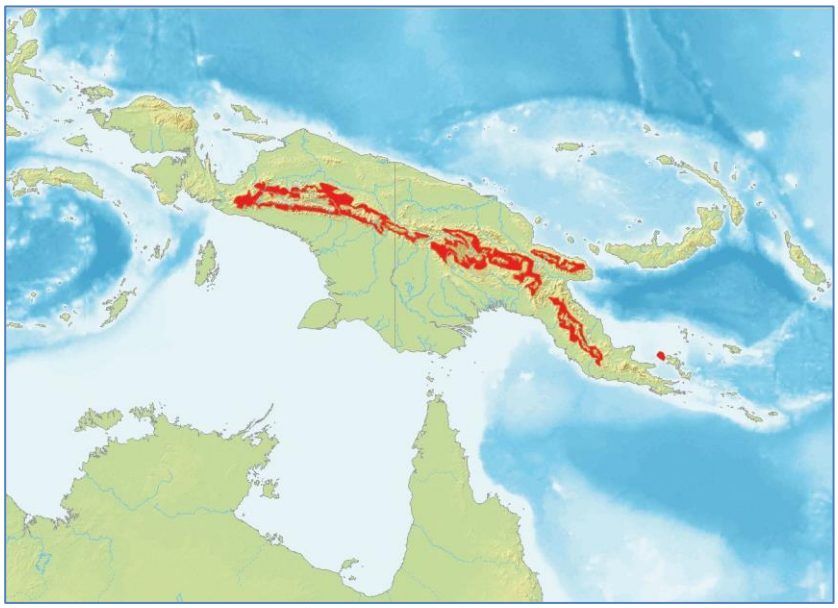

Fig. 1. The distribution of *Morelia boeleni* based on museum records and elevation. These pythons are restricted to the high mountain areas of mainland New Guinea and at least one island, Goodenough Island (Austin *et al*. 2010; reprinted with permission).

Genetically, *M. boeleni*'s closest extant relative is the scrub python, *M. amethistina* (Harvey *et al.* 2000; Rawlings *et al.* 2008), thus they are likely to share similar life history traits, such as growth rates, reproductive frequencies, and semi-arboreal nature. Austin *et al.* (2010) studied the genetic diversity of *M. boeleni* from captive-bred, wild caught, and museum specimens. Although precise localities were difficult to obtain, it is certain samples were taken from either end of the snake's distribution, and from at least one allopatric population. Results indicate that *M. boeleni* exhibit extremely low genetic diversity, possibly attributed to previous genetic bottlenecks of a potentially single, contiguous, interbreeding population throughout New Guinea's central cordillera.

Table 1. Variables that influence a species' resilience to use, and the attributes of *Morelia boeleni*.

Variable	Use resilience key[1]		Resilience of *Morelia boeleni*
	High	**Low**	
Distribution	Broad	Narrow	Medium
Habitat specificity	Broad	Narrow	Medium
Dietary specificity	Generalist	Specialist	Generalist
Reproductive output	High	Low	Medium
Growth rate	High	Low	High (in captivity)
Reproductive rate	High	Low	Unknown
Time until maturation	Short	Long	Short (in captivity)
Population size	High	Low	Unknown
Population density	High	Low	Unknown
Population connectivity	High	Low	Medium
Dispersal ability	Good	Poor	Medium
Genetic variability	High	Low	Low

[1] For example, if a species' reproductive output is high then it is more likely to have a high resilience to use than a species that has a low reproductive output.

Status and threats

Status

The distribution of *Morelia boeleni* spans the Indonesian province of Papua and the independent nation of Papua New Guinea. They are only legally protected in Papua New Guinea where they are considered to be of immense spiritual and cultural significance by some Papuan ethnic groups. (Austin *et al.* 2010; Williams & O'Shea 2008). Since 1975, *M. boeleni* has been listed in CITES-Appendix II. This species has not been evaluated by the IUCN for the Red List of Threatened Species.

Threats

The only threatening process for this species is human predation (Austin *et al.* 2010). Despite being regarded with special cultural importance and traditionally forbidden from hunting or killing (Lawong & Olo 2006), *M. boeleni* are hunted and eaten in at least some provinces to give strength to warriors before battle or simply as an opportunistic food source (Williams & O'Shea 2008). The rarity and attractive appearance of this snake has resulted in it being collected from the wild for the pet trade, which may also threaten this species at localised sites where collection is focused.

Trade characteristics

How trade operates

Morelia boeleni were once of very high commercial value (US$5,000 per animal), owing to their restricted distribution and rarity due to small volumes of trade. Global trade of the species has been rather sporadic since 1989 (Fig 2). Due to their protected status in Papua New Guinea, global exports (and presumably the snakes sourced) all originate from Indonesia.

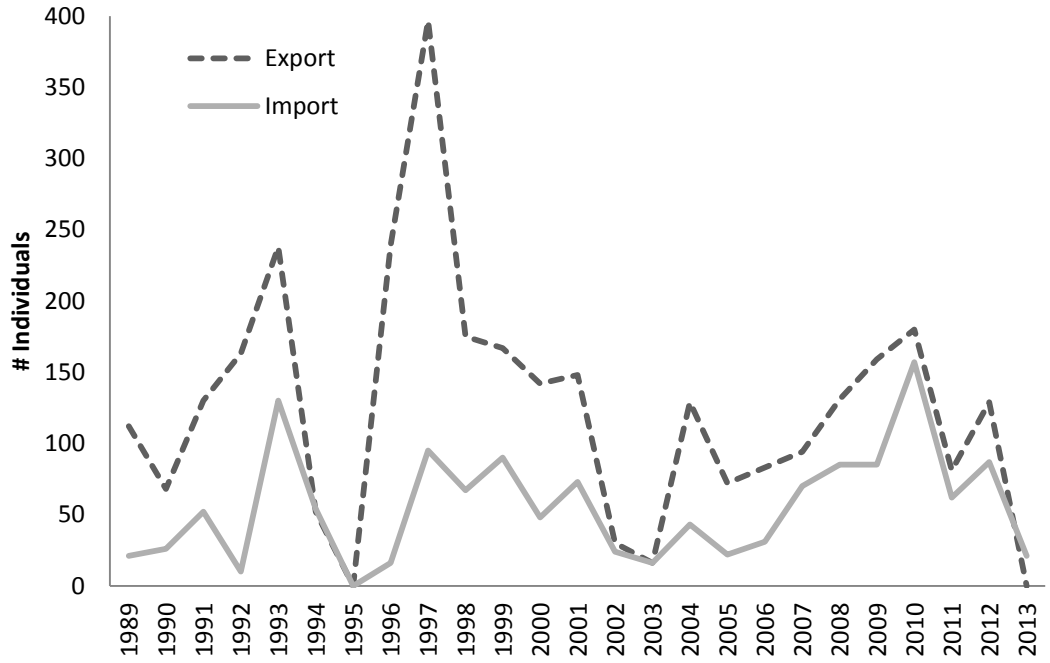

Fig. 2. Gross trade statistics for *Morelia boeleni* between 1989 and 2013, all exports are from Indonesia while imports are to a range of countries, the four major importing countries being the USA, the UK, Germany and Japan (UNEP-WCMC CITES Trade Database 2014).

Prior to 2001 Indonesia allowed the export of 120 wild *M. boeleni* caught under a quota system. However, that year the European Union Scientific Review Group suspended all imports of the species from Indonesia expressing concerns that harvesting may be detrimental to its survival (see Commission Regulation [EC] 2001). This change resulted in a significant decrease in the number of *M. boeleni* exported for several years, before exports increased again with source codes indicating specimens were farmed or captive-bred (Fig. 3).

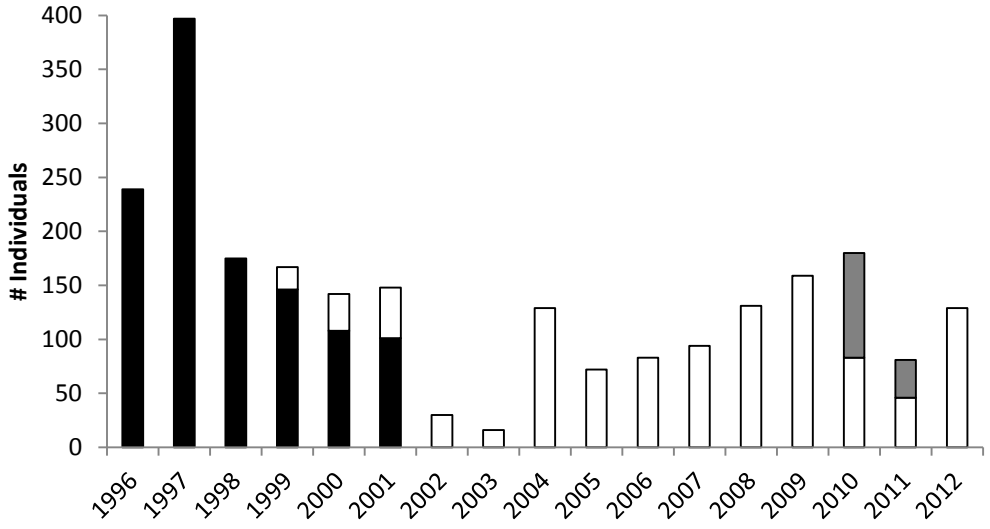

Fig. 3. The number of *M. boeleni* exported from Indonesia between the years of 1996 and 2012 (UNEP-WCMC CITES Trade Database 2014). Prior to 1996 exports did not have accurate declarations of acquisition but presumed wild caught. Individuals were declared as wild (black columns), farm-bred (white columns) or captive-bred (grey columns).

In other parts of the world, *M. boeleni* has been successfully reproduced on fewer than 10 occasions by expert python breeders and never by the 12 zoological institutions with captive stock (Table 2). Despite Indonesia exporting over 1000 individual *M. boeleni* declared as farmed or captive-bred, there has never been recorded proof of successful breeding from wild caught parents by Indonesian exporters. Surveys of 10 Indonesian breeding farms and reptile exporters in 2006 revealed that only three adult individuals were present, despite farm reports claiming 51 individuals were present at these same farms (Auliya pers. comm. 2014). Finally, Natusch and Lyons (2012) recorded 40 wild juvenile Boelens Pythons collected from gravid females in Papua and destined for Jakarta and export.

Based on the evidence available, it appears likely that the majority (if not all) *M. boeleni* exported from Indonesia are collected from the wild and laundered through breeding farms to be exported as 'farmed' or 'captive-bred'. Thus, the trade in wild collected *M. boeleni* is occurring in Indonesia and warrants further investigation.

Harvest characteristics

Morelia boeleni are well-known to the local peoples of Papua, and particularly to the Dani and Lani tribes of the Baliem Valley and western highlands, where the majority of wild-caught individuals are suspected to originate. Because this species is revered in local culture and a source of income for many communities, large adults are protected from trade. Traditional knowledge of pythons has resulted in people locating female pythons brooding eggs within underground hollows. These individuals are allowed to incubate the eggs until they hatch, at which time the neonates are removed and sold into the pet trade. Female pythons are not collected in order to allow them to reproduce in subsequent years (Natusch, unpub. data). Collection of newborn pythons also has advantages under current circumstances because, on the one hand, the pet trade prefers juvenile snakes and on the other, it gives the false impression that snakes are being effectively bred.

Table 2. Boelens Pythons currently held within ISIS registered zoological institutions worldwide.

Region	Institution	Male	Female	Unknown	Breeding successes
Europe	Chester Zoo	3	1	0	0
	London Reptile Park	4	4	0	0
North America	Fort Worth Zoo	1	3	0	0
	Milwaukee Zoo	1	0	0	0
	Oklahoma Zoo	0	0	3	0
	Zoo Atlanta	0	1	0	0
	Houston Zoo	2	2	0	0
	Dallas Zoo	2	1	0	0
	Denver Zoo	0	1	0	0
	San Diego Zoo	1	2	0	0
	St Louis Zoo	1	2	0	0
	Columbia Zoo	1	2	1	0
Total		16	19	4	0

Management

There is no management plan for wild *M. boeleni* in Indonesia or Papua New Guinea. Since the allocation of the zero quota for harvest of wild-caught specimens, all exports have been labelled as ‘captive-bred’ or ‘farmed’.

Impacts of harvest on wild populations

The impact of collection for the pet trade on wild populations of Boelens Pythons has not been studied. This owes primarily to the remote and difficult environment in which the species is found, which presents severe logistical challenges for this type of research. However, these same attributes are also responsible for shielding many populations from over-exploitation. The same hurdles faced by researchers restrict the geographic extent of harvesting to easily accessible areas and in turn limits the number of individuals that can be collected.

The remote areas which this species inhabits may also confer the impression of the rarity when that may not be the case. Boelens pythons are occasionally seen in markets in Eastern Papua New Guinea, generally being traded by local hunters for ceremonial purposes (Williams & O’Shae 2008). In October 2014 an Indonesian wildlife trader was consulted about his experiences with trading *M. boeleni*. He indicated the market demand for the species had dropped dramatically, but that they were not rare and he could obtain hundreds if required.

Collecting eggs and newborn snakes is a sustainable method of harvest that, much like crocodile ranching, focuses on the most life stages with naturally high mortality. If average annual exports from Indonesia comprise ~125 snakes, which are mostly neonates captive-hatched from wild-caught gravid or brooding females, this equates to approximately 8-10 egg clutches based on known life-history information. This suggests that approximately 8-10 females, or solely their clutches, are harvested from the wild each year. Even assuming that all of these snakes were taken from known collection sites in the Baliem Valley, Papua, such a small number will be negligible to the overall population.

Despite the absence of detailed population studies from which to draw conclusions, the type and extent of wild harvesting suggests that current trade in wild specimens is unlikely to pose any threat to the survival of Boelens Pythons.

Conclusions

Morelia boeleni was once a species of high market value; however, due to their notorious difficulty to maintain and breed in captivity they are only of high demand to a small number of individuals' world-wide. Private breeders have bred the species in captivity on fewer than 10 occasions. Because Boelens Pythons are potentially highly genetically uniform and thus susceptible to inbreeding depression, breeding programs require detailed and accurate pedigree management to maintain genetic diversity.

Illegal laundering of wild-caught *M. boeleni* as captive-bred began directly after the suspension of trade in wild specimens by the European Scientific Review Group (ESRG) of the EU (details in Annex), suggesting that mis-declaration of exports is a result of the ban. The basis upon which the ESRG's decision was made is unclear, but given the small volumes of trade, and harvest characteristics of the species, the decision may have been poorly justified. There is little or no reason to suggest that present levels of illegal wild harvest are negatively impacting wild populations of this snake. The species inhabits difficult to access habitats and has a very small trade focused on juvenile individuals.

The source code used for exports using this method of harvest should be R (ranched), rather than C (captive-bred). Because collection of juvenile stages that have a high risk of mortality is biologically safe, NDFs made under Article IV may be relatively straightforward.

Continuation of a legal wild harvest using the same methods currently being employed is a suitable option for conservation and trade in this species. Restricting export to specimens under a certain size may be one way to easily regulate take of wild individuals and would be welcomed by an industry demanding small, parasite free animals.

If wild harvest was conservatively permitted for premium sale to private collectors, levies from the sale could be reinvested into suitable monitoring research. The conservation community should also consider promoting proactive, incentive-based approaches to aid Indonesian authorities with these tasks.

Regardless of Indonesia allocating a zero harvest quota, wild harvesting is still the only way of acquiring *M. boeleni*. Suspension of trade in wild specimens has resulted in the stimulation of illegal trade given that demand has remained. Acknowledgement of this and remediation through a well-managed and legal ranching program may be the positive step towards eliminating illegal trade and increasing our biological knowledge of this species.

Recommendations

The first and most important recommendation is for the Indonesian authorities to investigate the sourcing of this species because available evidence suggests that snakes are actually wild harvested. Once this has been elucidated, the present review suggests that there are several steps for improving the trade of this species, although they are, to some degree, mutually exclusive:

1) The first recommendation is for the Indonesian authorities to allow legal harvest of wild individuals for trade. Exports of wild-caught individuals are already suspected to be occurring. When harvesting and trade is illegal, individual animals are transported covertly, resulting in higher mortality rates than if they were to be harvested and transported legally. Harvesting is unlikely to have any impact on wild populations, but

the following points should be considered for a successful wild harvest program to be implemented:

a. It is recommended that only gravid females or clutches from brooding females are removed from the wild, and females are returned to where they were collected from (thus juveniles would be exported as “Ranched”).
b. Accurate data should be collected on the location of where each snake was found, and this should be available to the distributor and customers.
c. If the snakes are of high market value and sold for a premium price, levies should be obtained and reinvested into a monitoring program for the species.

2) The second possible recommended course of action is to maintain a zero harvest quota for wild specimens and instead increase monitoring and enforcement. This should include:

a. Increased monitoring of breeding farms, exporters and wildlife traders.
b. Development and implementation of techniques to differentiate between wild and captive-bred specimens (e.g., parasite loads, stable isotopes).
c. Cooperation and capacity training by proven *M. boeleni* breeders on how to maintain and breed captive stock.

All else being equal, the present review suggests that legalising trade may be the most suitable option. Wildlife trade enforcement capacity is low in Indonesia and may be ineffective if mis-declaration of source continues to occur. Laundering of wild-caught snakes through Indonesian breeding farms is a symptom of outlawing trade in wild specimens. Legalising trade would solve this problem, and at no foreseen detriment to wild stocks.

Finally, non-detriment findings for Boelens pythons should involve surveys traders in the highlands of Papua to determine trends in number snakes harvested.

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