

Pangolins: epitomizing the complexities of conservation

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Even amongst the wildlife specialists attending the 17th Conference of Parties to CITES in 2016 in Johannesburg, South Africa, many were unfamiliar with the giant pine cone-shaped animal mascot that ambled through the crowd. Some had never heard of a pangolin and many more had never seen one or its likeness. Given their global celebrity status today, it is hard to imagine that pangolins burst onto the conservation scene and captivated the world less than a decade ago. The circumstances that precipitated this sudden global attention were dire. After being ignored or unknown for decades, pangolins were recognized, seemingly overnight, as the most trafficked wild mammals globally. The conservation community finally took note of the massive volume of pangolins and their scales being commercialized, and sprang to action, transferring all eight species to CITES Appendix I, effectively creating a global trade ban.

In many ways, pangolins epitomize the complexities of conservation in the 21st century. They are poorly studied, with major gaps in knowledge of their basic biology, ecology, distribution and abundance (Heighton & Gaubert, 2021). For example, we currently recognize eight species, but evidence is accumulating to suggest there are additional species waiting to be formally diagnosed (Gaubert et al., 2016; Ferreira-Cardosa et al., 2020; Hu et al., 2020; Gu et al., 2023). Gu et al. (2023) tentatively described a new species after genetically sequencing scales sampled from seizures in Yunnan, China. They detected this deeply divergent lineage in the genomes of only six of the hundred or so scales pulled at random from the millions of seized scales. Only the hunters have ever seen the species alive and we have no idea where it occurs in the wild.

Pangolins are known from 53 countries, but we have no clear understanding of specifically where and, in many places, we fear local extinctions. For example, our level of knowledge is so limited for the black-bellied *Phataginus tetradactyla* and giant *Smutsia gigantea* pangolins that documented sightings merit publication, as exemplified by two articles in this issue of *Oryx*. Difouo et al. (2023) present the first ever camera-trap photo of a black-bellied pangolin in the peer-reviewed literature and the first record for Deng Deng National Park, an important protected area in Cameroon that falls within the

species' presumed distribution. Conversely, the giant pangolin is probably the pangolin most frequently detected by camera traps (Khwaja et al., 2019), but there was only a single record from Kenya prior to their invention. Although the biodiversity of Kenya is relatively well studied, Sandri et al. (2022) document a nearly 300-km range extension of this species there, emphasizing that we still have much to learn. In these studies, despite extensive effort, only one individual was detected at each site, and this low detection rate is impeding pangolin conservation. We simply do not know where to implement conservation measures.

Identification of strongholds is one of the highest priority actions in the IUCN Species Survival Commission (SSC) Pangolin Specialist Group's global action plan for pangolin conservation (Challender et al., 2014), but little progress has been made since its publication. Additionally, we do not yet have an effective, standardized methodology for monitoring pangolin populations (Ingram et al., 2019; Willcox et al., 2019; Morin et al., 2020) making it difficult to evaluate the efficacy of any interventions or implement any form of adaptive management. Trying to tackle this issue, Matthews et al. (2023) and Difouo et al. (2023) found that targeted deployment of camera traps, at giant pangolin burrows or on fallen logs for black-bellied pangolins, increases photographic capture rates. Although Matthews et al. (2023) also demonstrated increased detection probabilities in occupancy models as a result, heterogeneity in abundance and habitat across the landscape stymie extrapolation beyond the site level. An alternative approach would be to monitor harvest and trade, as is widely done for fisheries. Arguably, however, our collective failure to do so for pangolins over the past 40 years is why they are so threatened today.

Locally, pangolins are in high demand as a prized wild-meat resource—but at relatively low value—in nearly all of their range states. Simo et al. (2023) document a thriving, relatively open market for pangolins in Cameroon despite the species being fully protected there. Like many studies, their findings were equivocal about trends in availability and price. To determine whether some populations could support offtake for local or national consumption, more information is needed to link market trends with wild population trends, especially where habitat remains relatively intact and local institutions, in the broadest sense, offer a diversity of governance options. Understanding the balance of offtake for local consumption versus international demand will also be of

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critical importance. Ultimately, financial and personnel constraints in pangolin range states are severely limiting our capacity to monitor and regulate this ongoing domestic trade.

Internationally, pangolins remain in high demand—with very high value—for traditional medicinal and luxury consumptive uses. Suwal et al. (2023) evaluated seizures in Nepal since 2010 and found it may be an important transit country for pangolin products, but although there were a number of seizures, the estimated number of pangolins involved was relatively low. The generally low rate of detection for illicit products of all types suggests we simply do not know the extent of pangolin traffic to, from and through Nepal, as is the case for most pangolin range states. Although Suwal et al. (2023) tentatively suggested priority provinces for intervention, the lack of detail and resolution associated with the seizure data prevented them from resolving trafficking patterns at the fine spatial scale needed to guide interventions. Unfortunately, listing species on CITES Appendix I is often seen as an end in itself, with the unintended consequence of overly burdening already under-resourced law enforcement agencies with the mandate of combating trafficking of products that are still in high demand—as evidenced by pangolin seizure statistics. This severely limits our ability to proactively monitor and manage the ongoing international trade of pangolins, as seen in the low rate of implementation of the CITES resolution on pangolin conservation (Res. Conf. 17.10) by pangolin range states (Challender & Shirley, 2022).

For pangolins, the CITES Appendix I listing should be seen as the beginning. Knowledge gaps are steadily closing, as exemplified by the five articles in this issue of *Oryx*. There is a growing community of engaged stakeholders, representing diverse fields of expertise, committed to pangolin science and conservation—membership to the IUCN SSC Pangolin Specialist Group has doubled since 2016. As a result, there is now opportunity to embrace the ecological, cultural and socio-political complexities to better devise and implement equitable, sustainable and innovative solutions that will secure the future of these enigmatic species. Ideally, we would be in a position to do this through an inclusive and participatory governance system that values Indigenous Peoples and local and rural communities as key decision-makers and stakeholders in community-based pangolin conservation (e.g. Newing et al., 2023). It is a critical time for us to move pangolins beyond their tagline as the ‘most trafficked wild mammals globally’ to instead become symbols of effective, evidence-informed conservation.

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