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How "science" can facilitate the politicization of charismatic megafauna counts

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Population trends of endangered megafauna, such as India's tigers, must be inferred with rigor. When large uncertainties are unreported or not effectively communicated, science can inadvertently facilitate inappropriate, counterproductive politics. Image credit: Ramki Sreenivasan (photographer).

Ideally, the practice of science stays independent, informs policy in real time, and facilitates learning. However, when large uncertainties go unreported or are not effectively communicated, science can, inadvertently, facilitate inappropriate politics.

This unfortunate circumstance has likely occurred in the case of India's official tiger (*Panthera tigris*) monitoring program and will conceivably reoccur during efforts to quantify population trends of African lions (*P. leo*). Attempts to arrive at population estimates at national and continent-wide scales are often so unreliable—the result of inappropriate questions, methods, or data—that interpreting population change may become a political, rather than a scientific, exercise. To minimize politicization of charismatic megafauna numbers or other quantities of interest to policymakers, researchers, and the general public (e.g., severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2] cases, atmospheric CO_2 levels) and generate conclusive evidence of change, we highlight the importance of realistically accounting for scale when designing and implementing rigorous science-based monitoring programs.

Political Populations

Estimates of population numbers and their trends are central to the conservation agenda. These parameters are simple in concept and expected by a broad

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spectrum of society. They are also generally interpreted as providing indisputable evidence for the utility of conservation policy, demonstrating the success or failure of conservation action, and determining whether resources have been strategically channeled (1). Pressure is often applied by international bodies, policymakers, and the general public to provide single estimates of abundance at national, regional, or international scales.

But estimating animal abundance is complicated in practice. Logistical and methodological limitations give rise to scientific uncertainty which, under resource constraints, increases at larger scales. In practice, reliable knowledge on abundance of a species may, at best, be achievable in small areas. But practitioners, to meet public needs, often attempt to extend these inferences to areas several orders of magnitude larger (e.g., at a country or continent level). In doing so, researchers employ *ad hoc* extrapolation and aggregation methods, which are subject to high uncertainties that are typically unacknowledged.

Political populations of wildlife emerge when governments or other stakeholders, lacking scientific evidence, make claims related to population trends to suit a broader agenda (2). These agendas can be driven by factors outside the ambit of mainstream science. For example, in charismatic megafauna conservation (e.g., large carnivores), relevant authorities or stakeholders may wish to advance politically attractive narratives to help ensure project funding and support, prevent criticisms of conservation efforts, or help prevent sanctions on trade in particular species.

Unfortunately, conservation monitoring programs meant to estimate key parameters of interest can be scientifically compromised, for example owing to inappropriate framing of scientific questions, unsuitable methods, or nonrigorous data collection. In an environment of such high uncertainty, practitioners faced with the responsibility of reporting important findings may tend to advance politically attractive (but scientifically weak) claims rather than scientifically accurate (but politically unattractive) ones. This problem may have influenced claims of tiger population trends in India and lion population trends in Africa—two charismatic and potentially “political” species.

A Political Tiger Population

In 2010, tiger range states gathered at a high-profile meeting in St. Petersburg, Russia, and made a commitment to double tiger numbers by the year 2022. For India, which is believed to harbor more than half of the world’s tigers, this challenge had a profound resonance. Beginning in 2004, India established an extensive monitoring system, which replaced the failed “pugmark census” protocol (3), to document national population change. India’s official tiger monitoring program involves a large-scale survey, conducted once every four years, using camera traps, on-ground foot surveys, and statistical analyses to arrive at a national estimate of tiger abundance. So far, four such surveys (in 2006, 2010, 2014, and 2018) have used this new monitoring protocol (4), and a fifth survey is now underway.

Amid much enthusiasm in July 2019, India’s Prime Minister announced that India had already met the “doubling” target between 2006 and 2018, based on a summary report. The surveys reported increases of 20% to 35% in tiger numbers over each four-year period leading to an increase in the tiger population from approximately 1,411 individuals in the year 2006 (one standard error limit ranged from 1,165 to 1,657) to approximately 2,967 in 2018 (one standard error limit ranged from 2,603 to 3,346) (5).

However, scientific studies demonstrated that these claims were indefensible. The estimates were based primarily on an index-calibration (IC) model, which was developed on a partial dataset from one of India’s official national tiger surveys (6). IC models attempt to relate indirect tiger signs, such as tracks and scats, with estimated densities. Such models have failed to demonstrate reproducibility with respect to tigers (7), and also lions (8), owing to high variability in their predictions over space and time. An apparent defense of this model (9) was also subsequently refuted when the missed identity relating detection probability to abundance (10), and the associated variability, was also corroborated empirically (4, 6). A popular media article also found basic errors in the individual identification of tigers in a critical examination of the 2014 survey report (11).

The results were further undermined by inexplicable ecological patterns; a U-shaped occupancy–abundance relationship that violates the expected, monotonically increasing form (10), and meant that tigers in India immigrated en masse from marginal habitats (sinks) into key populations (sources) from 2006 to 2010, and then suddenly reversed the direction of their migration from 2010 to 2014. Coincidentally, this reversal occurred after a 2011 letter published in *Science* (12) questioned the validity of the first part of this pattern.

Furthermore, when the sampling area was subsequently expanded in India’s official tiger surveys, tiger densities decreased progressively within most key populations where tigers are expected to breed (13), thereby suggesting that such reversals at large spatial but short temporal scales are not plausible. Indeed, India’s claim of a 12-year doubling in tiger numbers contradicts growing scientific evidence that doubling-times for tiger recovery, especially at regional scales and in unfenced circumstances, are likely to be much greater despite effective conservation interventions (14, 15).

These contradictions and concerns cast doubt on India’s official claims of rising tiger numbers and imply that they involved far greater uncertainty than reported. This necessitates a complete reanalysis of India’s official tiger data in line with a call for increased transparency in an editorial in *Nature* (7, 16).

Despite these concerns, on International Tiger Day in 2020, India released the same tiger numbers within a broader report and reiterated earlier claims. The report was subjected to an unusual process of scientific endorsement through which external researchers certified rather than critically examined whether, and to what extent, the research questions, data collection, and statistical methods were appropriate to assess tiger population change with the necessary precision (4). A valid critique would have addressed, for example: 1) how India’s monitoring program dealt with the thorny problem of sampling-based overdispersion; 2) how these data, which produced highly inconsistent model predictions, were reanalyzed; 3) what the underlying scientific hypotheses being confronted were; and 4) how the monitoring program has ensured transparency during implementation.

Failing to adequately address these scientific concerns could well prove to be detrimental for tiger conservation. About 15 years ago, while India relied on the faulty pugmark census methodology to claim that their tiger population size had risen to 3,642, it was found that tigers were extirpated in two key tiger reserves (3, 7). We must therefore be similarly concerned about the recently reported extirpations in three tiger reserves (4).

Globally, flawed inferences on tiger population trends extend beyond India (see 15). This year, 2022, is the Year of the Tiger, and tiger range states are expected to meet in September at the Global Tiger Summit to assess the promises made 12 years ago in St. Petersburg. This summit will provide another opportunity for India, with its hegemonistic status in determining global population trends, to disregard earlier claims and change course to provide a scientifically accurate, even if politically unattractive, account of their tigers.

Fluctuating Lion Numbers

A similar situation is emerging for Africa's lion numbers. With the exception of Kenya's recent survey (17), no country in Africa has attempted to systematically and rigorously estimate their lion populations. Nonetheless, several estimates have been provided at a continental scale, fluctuating from approximately 20,000 to 39,000, many with detailed national and site-specific subtotals that have been used to infer large-scale population change in numerous scientific publications. In 2015, while categorizing the threat status of lions, the International Union for Conservation of Nature (IUCN) Red List drew on 47 sites for which there was temporal data and inferred a 43% decline in lion population numbers between 1993 and 2014 (18).

While it is intuitively appealing to draw conclusions on population trends at site, national, and continental scales, the large variation in the continent-wide estimates is indicative of large uncertainties around them. These uncertainties most likely arise from the fact that population estimates at local levels are typically based either on different, and often unreliable, methods (19) or are simply the product of "expert opinion." Furthermore, relatively little attempt is made to appropriately quantify potentially large variances emerging from methodological, model, and parameter uncertainties during such large-scale aggregations. Consequently, when such aggregated estimates are provided, without correspondingly rigorous estimates of uncertainty, it can distort the conservation outlook about population size and trend at large scales.

In reality, estimating lion or other large carnivore numbers is notoriously difficult. More recently, search-encounter–based spatial capture–recapture approaches have helped to provide robust estimates of lion numbers at least within key source populations [e.g., in Kenya (17)]. But before these methods can be widely accepted, we will need to confront a major science communication challenge, especially where previous estimates were based on methods with inherently high (e.g., spoor counts) or indeterminable (e.g., expert opinion) uncertainties—which were not appropriately estimated or communicated—but accepted into public consciousness.

We are not minimizing the plight of lions or suggesting that their populations are anything but declining. Nor are we suggesting that tiger population numbers, at least in some areas, are not increasing. However, we do anticipate that the continued provision of abundance estimates over large scales using oversimplified aggregation or extrapolation methods could devolve into an inappropriate politicization of charismatic megafauna numbers. Therefore, we must avoid fostering the perception that population trends can be determined according to any politically desirable need.

A Full-Fledged Science

The process of reliable estimation of animal abundance, which is simplistically seen only as a measurement, is closely tied to the very practice of science itself. Over the past three to four decades, the use of model-based inferences to estimate animal abundance has risen, especially of large carnivores. Here, a candidate set of models (hypotheses) are defined and confronted with data from planned surveys. Abundance occurs as a parameter in these candidate models. As researchers favor one (or more) models from the candidate set, using a rigorous model selection procedure, we learn more about the population in consideration and, as a byproduct, we obtain the most reliable estimate of abundance (20). This is very different from the typical situation we have discussed here, in which generating abundance estimates is seen as a simple exercise in "counting" and is a process independent of formal scientific inquiry and learning.

We argue that it may be ineffectual to monitor abundance of threatened large carnivores at national, regional, or continent levels with existing monitoring technologies and limited available resources. Given the risks of producing contradictory or misleading inferences on the ground, we do not recommend an uncritical and hasty scaling up of abundance monitoring programs by policymakers, authorities, and researchers. We propose that any expansion in monitoring is justified only if relevant questions are posed at the appropriate scale. Understanding the population ecology of a target species at a landscape scale, in the face of conservation interventions, will entail conducting surveys to appropriately estimate parameters relating to metapopulation, source-sink, or population dynamics in heterogeneous landscapes (21). While large scale surveys can also be important for other reasons (e.g., to mobilize funds, motivate politicians, and foster public support for conservation efforts), we maintain that their implementation must be guided by clearly defined scientific questions and confronted with rigor and transparency to ensure reproducibility and knowledge accrual to justify investments (22).

For the monitoring of large carnivores, we propose a two-scaled approach that uses a multi-agency team of stakeholders and does not compromise the strength of inference for scale. This is achievable by conducting

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frequent (at least once per year), intensive surveys to estimate population trends, critical vital rates, and other informative parameters at key source populations and changing focus from population to habitat occupancy dynamics at large (metapopulation or landscape) scales (23, 24). At large scales, we would prefer to assess habitat occupancy reliably and feasibly rather than to monitor abundance unreliably (e.g., without accounting for detection probability) over time. When new opportunities for targeted conservation arise across the larger landscape, we recommend rigorous monitoring at these sites, as demonstrated in determining tiger population dynamics in a neighboring population in Rajaji, India (25). We anticipate that such a science-based approach will define a sound basis for investment, involvement, and capacity building of all the relevant stakeholders, which is key to the long-term conservation of wildlife populations, and will help to ameliorate conflict-of-interest issues.

Policymakers and researchers must recognize the public interest in certain conservation issues, such as the status of charismatic large megafauna. However, science will fail to meaningfully contribute to this conversation when lacking transparency or using faulty questions, methods, or data. On the other hand, rigorous, well-communicated, science-based programs can encourage or energize conservation stakeholders. If science is to help solve the world's pressing and global problems, it must stay rigorous, appropriate to scale, and both relevant and active at a local level.

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