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The emergence of a robust and inclusive framework for a nationwide assessment of African lions

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Wildlife managers and policymakers rely on regular and reliable population estimates of large carnivores to guide their conservation decisions and interventions. Although species such as tigers, snow leopards, and jaguars are routinely monitored using advanced approaches, African lions have typically been monitored with unreliable techniques. As a result, our understanding of lion population dynamics is limited, hindering strategic planning and adaptive management. To remedy this, Kenya aimed to identify a robust monitoring framework and implement a national census of lions (Kenya Large Carnivore Taskforce 2009).

In Kenya's Maasai Mara, Elliot and Gopalaswamy (2017) demonstrated how to apply a search-encounter-based spatially explicit capture–recapture (SE-SECR) framework to reliably estimate lion density. Heeding their call for a unified framework to assess lion numbers in key populations, a multi-agency team applied this method in Lake Nakuru National Park (LNNP), and published their findings in *Conservation Science and Practice* (Elliot et al. 2020). This work had important conservation impacts: (1) it altered the management of lions in LNNP, since previous perceptions of "too many lions" were replaced with scientific evidence of a small population, (2) it catalyzed the Kenya Wildlife Service (KWS) to adopt SE-SECR to estimate lion density across potential source populations, (3) it prompted the formation of a multi-agency technical team to guide the national census and (4) it led to training of personnel in robust monitoring techniques. Having resolved to rigorously estimate lion density within source populations, the technical team adopted the recommendations emanating from Gopalaswamy et al. (2019), also published in *Conservation Science and Practice*, by switching focus to habitat occupancy at larger scales.

Between 2018 and 2020, SE-SECR surveys were conducted within ten of Kenya's most important source populations of lions. At a national scale, detection-nondetection data were collected and analyzed using occupancy models to predict the distribution of lions and

five other large carnivore species. Over 400 people from more than 40 organizations participated variably in all aspects of Africa's first science-based, countrywide large carnivore census. A bottom-up approach was adopted, where key local stakeholders were identified and subsequently involved at every step of the scientific process. This helped ensure local uptake of the methods, results and participation in the resulting conservation recommendations and actions. Kenya now has robust baseline figures for most key source populations, and the ongoing trainings, together with the techniques used, will allow repeat censuses to estimate vital rates and population trends and aid in improved assessments of conservation interventions. Nationally, the knowledge of large carnivore hotspots is being used by the KWS to identify new priority conservation regions (e.g., northern Kenya) for enhancing the security and co-existence of carnivores, livestock, and humans. This information is detailed and discussed in a comprehensive report and publication (Elliot et al. 2021, Broekhuis et al. 2022) and has been incorporated into two national conservation documents (Kenya Wildlife Service 2020, Waweru et al. 2021). More generally, it serves as a model of transparent and "inclusive monitoring" where multi-agency teams from Government and Non-Governmental Organizations collect and process data for improved conservation outcomes.

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