Biologically relevant scales in large mammal management policies

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Highlights

- We assess elephant home-range and movement against KNP's historic management zones.

- KNP's principle of exclusive zoning at this management scale is irrelevant.

- The consequential area of influence, as opposed to the zone of management, is key.

- Management must be at relevant scales for ecological effects and elephant behavior.

- Our results provide quantitative scale mismatch thresholds and inform the KNP Plan.

Abstract

The African elephant is an important keystone species that may have significant effects on ecosystem structure and eco-tourism revenues. In Kruger National Park (KNP), South Africa, where elephant populations have been increasing, management have adopted a zonation approach, with zones identified for specific and measurable management interventions to control

elephant populations, or to reduce conflict with humans. Localised culling is one proposed management intervention. The zones, partly derived from static annual elephant distribution surveys, are intended to encompass only localised effects on elephant within that zone, assuming no effect into adjacent undisturbed zones, or into contiguous neighbouring landholdings outside KNP. We deployed 17 GPS/GSM collars on free-roaming elephant herds within KNP to assess their seasonal home-range use and size and daily movement paths. These temporally robust movement metrics were analyzed against the Park's elephant management zones, partly derived from sporadic telemetry fixes and static distribution counts. Multiple daily and seasonal spatial shifts by elephant across neighbouring zones, including into adjacent reserves, rendered the principle of exclusive zoning at this management scale incorrect. The KNP management zones and proposed management actions are not biologically relevant to elephant, or appropriate for managing the ecological or human-wildlife impact of elephant, resulting in spatial and temporal scale mismatches. We predict that the intended management actions, specifically culling, and its resultant intended consequences (immigration, reduced vegetation impact and reduced growth due to disturbance) is not localised to the target zone, and, because it is season specific, is at risk of targeting transient non-resident elephant whilst missing resident elephant that have crossed into other zones. This scale mismatch may have a ripple effect outside the target zone, causing serious ecological risks, especially given the documented long-term negative effects of management disturbance on elephant. We further quantify this scale mismatch into four categories based on percentages of the following factors: the proportion of sampled population affected, the seasonal zone occupancy (the proportion of locations per zone per season) and number of zone crossings, and the governance of management units (consistency of management interventions imposed across zones). This generates a prediction of the risk of this exclusive zoning and its consequences. We suggest a new approach, whereby, known elephant intensity of use at local scales is adaptively managed for specific management objectives. However, management must occur within a known and contained zone of influence defined by elephant behaviour derived from resident movement studies, as opposed to broad scale zonation at the population or park level.

Keywords

Elephant; Kruger National Park; Management effects; Ranging behaviour; Scale mismatch

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