How highly social mammals optimize group size

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Credit: Karen Arnold/public domain

(Phys.org)—The sizes of social groups among mammals are driven by dynamics from within the group and a combination of pressures and incentives from outside. While aggregation and cooperation are often beneficial for species survival, group size influences the allocation of time and the use of space, and has strong implications for individual health and fitness. Over the years, studies have largely suggested a linear

relationship between group size, home range area and daily travel distance, with disadvantages only for the largest groups.

However, a new study reported in the *Proceedings of the National Academy of Sciences* produced unexpected results, surprising even the team of researchers who published it. The study, which tracked a population of wild baboons in the Amboseli-Longido ecosystem straddling the border of Kenya and Tanzania, demonstrates a U-shaped relationship between group size and home range area, average daily distance traveled, evenness of use within the home range and glucocorticoid concentrations in individuals that were used as a measure of stress.

Strikingly, the researchers found that intermediate-sized groups of baboons had optimal space-use strategies compared with small- and large-sized populations, a result not previously revealed in group size studies. This led the authors to ask what dynamics were driving this disparity.

They propose that large, socially dominant groups are constrained by intragroup competition, while small-sized groups are subjected to intergroup competition and predation. Additionally, living in larger groups can lead to longer intervals between births, delayed sexual maturity, decreased fertility, and more exposure to circulating pathogens. Previously, it was unknown how group size affects physiology; as a step toward understanding this dynamic, the researchers checked the levels of glucocorticoid stress hormones present in the blood of members of the studied groups.

These hormones are secreted in response to stressors, and while they provide a short-term benefit, chronically raised levels are detrimental to individual health. The researchers found that females in both the smaller and larger groups had higher concentrations of stress hormones than females in the intermediate-sized groups.

Another unexpected result: Both large and small groups had larger annual and monthly home ranges, longer daily travel, and more even patterns of space use than intermediate groups. The intermediate groups had smaller home ranges, and their use of space was more temporally and spatially skewed.

The authors suggest two reasons that their study presents results unobserved in previous studies: First, group size predicts group dominance, and smaller groups have a competitive disadvantage by contrast with larger groups; additionally, they may be subject to more predation than larger groups. Previous studies dealt with arboreal primates that may have a lower risk of such predation.

Second, previous studies demonstrated a bias toward the examination of intermediate and large groups. This is likely due to the overall lack of availability of smaller groups for study, without which the U-shaped pattern observed in the present study would not appear. Among the implications of the study, the authors note that the group sizes of baboons quite often correspond to the predicted optimum sizes.

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Abstract
Group size is an important trait of social animals, affecting how individuals allocate time and use space, and influencing both an individual's fitness and the collective, cooperative behaviors of the group as a whole. Here we tested predictions motivated by the ecological constraints model of group size, examining the effects of group size on ranging patterns and adult female glucocorticoid (stress hormone) concentrations in five social groups of wild baboons (Papio cynocephalus) over an 11-y period. Strikingly, we found evidence that

intermediate-sized groups have energetically optimal space-use strategies; both large and small groups experience ranging disadvantages, in contrast to the commonly reported positive linear relationship between group size and home range area and daily travel distance, which depict a disadvantage only in large groups. Specifically, we observed a U-shaped relationship between group size and home range area, average daily distance traveled, evenness of space use within the home range, and glucocorticoid concentrations. We propose that a likely explanation for these U-shaped patterns is that large, socially dominant groups are constrained by within-group competition, whereas small, socially subordinate groups are constrained by between-group competition and predation pressures. Overall, our results provide testable hypotheses for evaluating group-size constraints in other group-living species, in which the costs of intra- and intergroup competition vary as a function of group size.