SOCIAL DETERMINANTS OF MOVEMENTS AND AGGREGATION AMONG FREE RANGING ELEPHANTS (*Loxodonta africana*, Blumenbach) IN AMBOSELI, KENYA.

BY

HAMISI SEIF MUTINDA (Ph.D)
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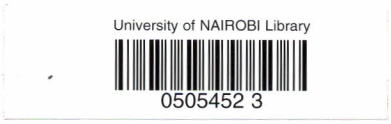

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SUMMARY

It is now widely accepted that elephant female groups live in complex social units, family that are led by a matriarchs, who is the oldest female in the group. It is also established that the matriarch, through complex acoustic and probably, olfactory signalling, exert tremendous influence over the group on where to go, when to leave a habitat patch, and when to attack during group defence and what species of animal to attack and in what set of circumstances. It is also reported that matriarchs play a leadership role in movements of female groups to distant habitats along certain used routes. If the behaviour by the oldest female is to make any sense, it needs to be viewed in evolutionary terms. Family groups are constituted of closely related individuals and by living and moving as a group, females are likely to increase their fitness value compared to if they were to live and move singly or with their young calves. However, group living creates a challenging environment to elephants because of their enormous forage (average, 170kg fresh plant mass/day/adult animal) and water (on average, 150lts/day/adult animal) requirements and increased competition for these resource as group size increase. Despite these challenges, large aggregations, some containing as many as 500 individuals are common in savannah subs-species of the African elephant (*Loxodonta africana africana*) during the wet season. It is clear that family units prefer to assemble and form large aggregation when conditions are favourable following onset of rains, and disband into individual units or sections of family units when conditions are severe such as during dry season or droughts.

It is obvious that movement of female groups depends not only habitat conditions arising from extrinsic ecological variables but also intrinsic social variables arising from the influence exerted by matriarchs and the size of the family they are leading. Ecological factors such as rainfall and water distribution affect movements and aggregation as they affect the supply of forage and water, creating surplus and deficit amounts of both resources during wet and dry periods respectively. However, studies to show how matriarchs and family size affect movements and aggregations of family units are deficient. In this study it was hypothesised that aggregation sizes in which families are found correlate negatively with family size and positively with age of matriarch and that family size expansion increases probability of fragmentation. It was also hypothesised that in elephant aggregations, the number of individuals following a movement initiation increased with age of the movement initiator, and that family units with a young matriarch and those that have few members seek out and follow those with old matriarchs. Additionally, dominance is determined by the age of the individual

and the size of family from which they came, with females that are young and from small family units being subordinate to those that are older or from large families. Further, trail use is structured along the social organisation of the population with dominance rank determining the position on the trail.

The hypotheses were tested through observation of elephant aggregations encountered during daily opportunistic searching conducted for two years. When an aggregation was found, the size, number of families they contained, identities of those family units and whether they were fragmented or not were recorded. Continuous focal sampling lasting 30-minutes was used to monitor family-family associations, movement initiation, and approach-avoid events by family units in aggregations. Scan sampling lasting 2 minutes, taken at 15 minutes intervals, was used to record aggregation size and size of subgroups including identities of constituent family units. In order to determine the effects of dominance rank, all dyadic contests were recorded against individuals and families performing them. Winners and losers and family units from which they came were identified. In order to determine how female groups use trails, family units were observed when using marked trails. Group size, identities of family units, their position along the procession and individuals leading and those coming last as they approach water were recorded. In order to determine how far elephants went in Amboseli, ground surveys were conducted and location of elephants, dung and footprints in eight localities surrounding the Amboseli National Park were conducted. An aerial survey was conducted to further confirm the location of elephants within and outside the park

Data collected showed that mean aggregation size declined significantly with increase in family size ($p<0.05$) but not with increase in age of matriarch ($p>0.05$). Polynomial regression analysis showed that mean aggregation size decreased significantly with age of matriarch for families with matriarchs that were less than 46 years and increased with age of matriarch for family units that have matriarch whose age was 46 years and over ($p<0.05$). The frequency with which families were found fragmented increased with family size while, with large family units being found split by 1/3 more often than small family units ($p<0.05$). The frequency with which families were found unfragmented increased with increasing age of matriarch. The same trends were observed for frequencies with which families were found split by half or a third. Further, in large aggregations grouping patterns changed throughout the days with peaks at 0900hrs and 1500hrs. The mean size of subgroups decreased significantly with increase in family size ($p<0.05$). The average size of families being approached

decreased significantly with increase in size of approaching family units ($p<0.05$). Family units that were large or were led with an old matriarch (>55 years) avoided each other and very rarely occurred in the same subgroup. Individuals that won in agonistic dominance contest were older than those that lost. When winning individuals were young, they came from family units that were larger than those from which losers came.

Movements on trail procession was orderly; family units that have young matriarchs and non-matriarchal sections of split families frequently led on trail processions while families with the oldest matriarch came last ($p<0.05$). Within family units, few individuals, two to four at most either led or came last within a family procession. Matriarchs frequently came last compared to other adult females, while adult female of age between 13 and 30 years led the procession, with daughters of matriarch leading in many instances compared to other adult females ($p<0.05$). Additionally, trail use changed seasonally, dry season trails were re-used by same groups when they moved back to their dry season range. There were several trail types in elephants range areas. Trunk trails were used by all family units, both resident and migrant herds, while the adjacent diffuse trails were used by specific resident family units. Elephant trails extended beyond the park boundary. Elephants, their footprints or dung were found in most of sampled location outside the park.

It was concluded that the effect of matriarch on aggregation and movements of family units is determined by age. Families with young, in experienced matriarch follow and associate with those that have old, experienced matriarch, forming large aggregations around these two categories. However, family size variable tended confound the effect of age of matriarch even though family size increased generally with age of matriarch, suggesting that experienced matriarch could be having a positive effect on fitness of its members. It was recommended that killing of old females through poaching, problem animal control or hunting would have the effect of creating large aggregations which would then have immidiate impact on habitats in which the elephant population are found.