

## Social Structure of Giraffe

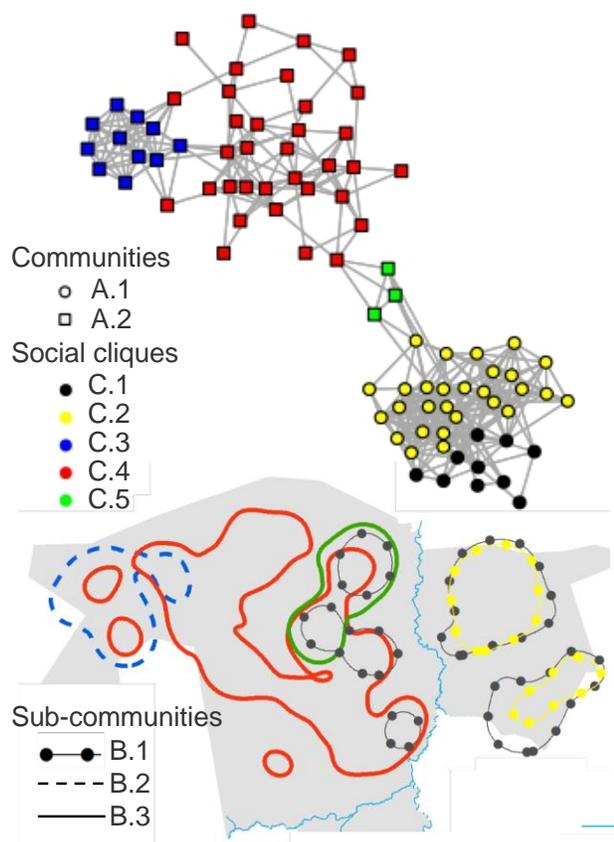
We explored the social networks of giraffe at Ol Pejeta Conservancy (OPC) to assess the long-standing belief that giraffe have limited social organization. We show that individual giraffe are members of social cliques, which are groups of giraffe that associate more frequently with one another than with giraffe outside of their clique. For example, clique C.3 (shown in blue in Figure 1) is relatively socially exclusive, even though females of this clique could easily travel from their home range in the west part of OPC to the central part of OPC. Cliques C.1 and C.2 (yellow and black) both live on the eastern side of OPC and overlap in space.

Multiple cliques make up a community of individuals that interact more frequently with each other than with individuals from different communities. The two main female communities are divided by the Ewaso Nyiro River (Figure 1).

Females of all ages seem to be members of cliques. Among males, however, male cliques seem to consist primarily of younger animals that know one another. Being a member of a clique does not mean that a giraffe is always with its fellow clique members and never interacts with others, but it does mean that a giraffe maintains preferential relationships with members of its own clique.

Such social divisions have never before been quantified in giraffe and indicate that giraffe may have more complex social organization than previously thought.

Figure 1. Social network and map of social clique home ranges for females.



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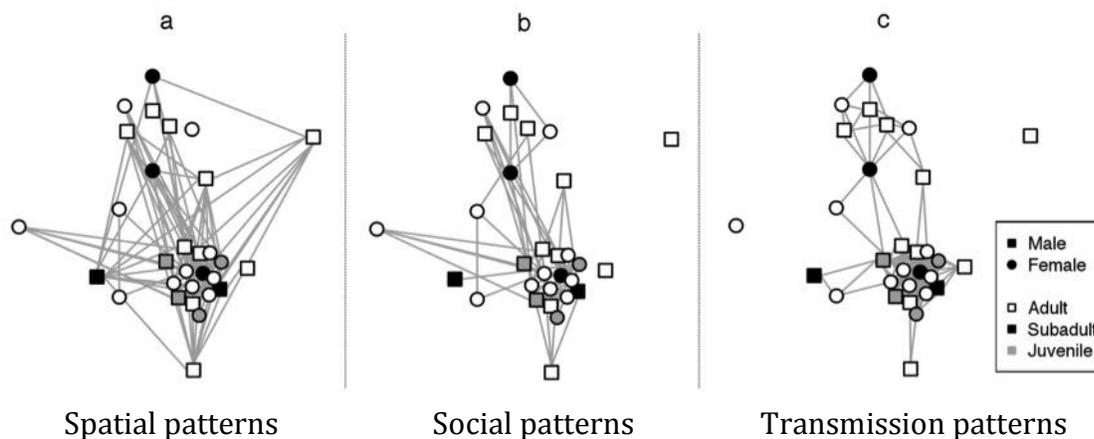
## Pathogen transmission patterns and giraffe social networks

We developed a novel approach to quantify pathogen transmission patterns in wild giraffe. A transmission network of “who transmitted an infection to whom” was constructed by interlinking individuals if they shared genotype a common gut bacteria, *Escherichia coli*.

By using microbial genetics to quantify who transmits to whom, we investigated how the structure of giraffe social and spatial networks influenced the structure of the transmission network (Figure 2). We found that transmission was more likely to occur between individuals that were strongly linked in the social network, but sharing space did not affect the probability of transmission occurring.

This one-of-a-kind study emphasizes the importance of social patterns in understanding the spread of infectious diseases, and has important implications for understanding what factors create “super-spreader” individuals who are especially critical for population-wide spread of diseases.

Fig. 2. Comparison of the (a) spatial, (b) social, and (c) transmission networks. The spatial network was based on patterns of home-range overlap among individuals, the social network was based on association patterns, and the transmission network was based on who transmitted *E. coli* to whom.



*Published in:*

VanderWaal, K. L., Atwill, E. R., Isbell, L. A. & McCowan, B. 2014. Linking social and pathogen transmission networks using microbial genetics in giraffe (*Giraffa camelopardalis*). *Journal of Animal Ecology*.

## Multi-species transmission networks: Implications for pathogen management and control

We constructed a “who transmits infections to whom” network showing patterns of pathogen transmission among wildlife and cattle. Animals were linked in the network if they shared genotypes of a common gut bacteria, *Escherichia coli*.

We found that some species may function as “super-spreaders” in the transmission network. Individual Grant’s gazelles, for example, were connected to a large number of other animals in the network, which means that they are highly involved in spreading *E. coli* in OPC.

Individual zebra, in contrast, tended to bridge regions of the transmission network that would otherwise be poorly connected. These long-distance connections occurred because zebra range more widely than other species, which allows them to move pathogens from one area to another.

Control strategies targeted at super-spreader species, such as zebra and Grant’s gazelle, are crucial for slowing disease spread. More research is needed on other pathogens before targeted disease control strategies are attempted.

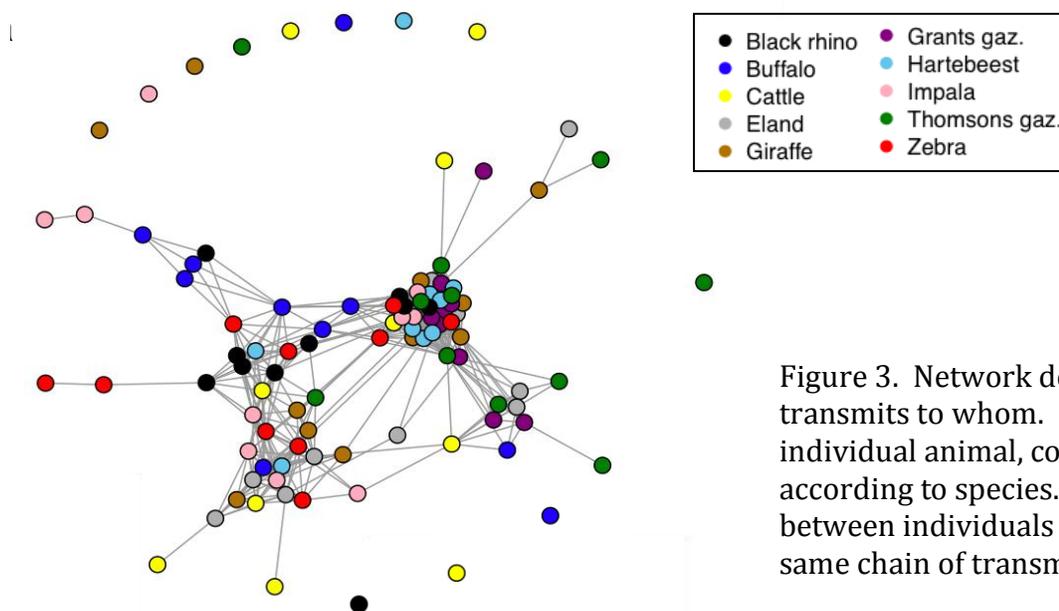


Figure 3. Network depicting who transmits to whom. Each dot is an individual animal, color-coded according to species. Lines are drawn between individuals that are part of the same chain of transmission.

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