

Key demographic processes and population dynamics of cooperative breeders: *Lycaon pictus* as case study

David S. Boukal¹ and L. Berec² .

Cooperative breeding is a frequently cited cause of the Allee effect but its population-dynamical consequences have been little studied [1,5]. Here we examine the role of demographic processes and organizational scales in population dynamics of obligate cooperators by developing an individual-based, metapopulation-like model. As a case study, we follow the life history of the African wild dog (*Lycaon pictus*), which is one of the most endangered carnivores today [4]. The model extends previous approaches [2,3,6]; it assumes a sexually reproducing age-structured metapopulation with finite number of territories and centres on the following demographic processes: alloparental care within packs leading to group-size-dependent mortality of pups, dispersal of individuals between packs, and occasional environmental catastrophes. We vary the level of pup dependence on alloparental care and environmental catastrophes and also distinguish two types of alloparental care that approximately correspond to pup guarding (with pup mortality corresponding to threshold pack size) and food provisioning (with pup mortality corresponding to helper-to-pup ratio).

The Allee effect at the individual level (increased pup mortality due to insufficient alloparental care) carries over both to the pack level (critical pack size) and to the metapopulation level (critical number of packs

¹Department of Theoretical Biology, Institute of Entomology, Academy of Sciences of the Czech Republic, and Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, 370 05 České Budějovice, Czech Republic (e-mail: boukal@entu.cas.cz).

²Department of Theoretical Biology, Institute of Entomology, Academy of Sciences of the Czech Republic, and Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, 370 05 České Budějovice, Czech Republic (e-mail: berec@entu.cas.cz).

needed for metapopulation survival). The metapopulation shows bistable pattern, i.e. extinction or saturation, under all parameter combinations. Pup survival at low pack sizes is one of the key factors for metapopulation survival. We show that with increasing dependence of pups on alloparental care, metapopulation survival is increasingly positively correlated with average pack size and pack size after invasion of large same-sex dispersing group, and negatively correlated with percentage of small packs. Among the studied cases, all these demographic characteristics vary most widely for intermediate food provisioning levels.

References

- [1] Boukal, D. S. and L. Berec, 2002. Single-species models of the Allee effect: extinction boundaries, sex ratios and mate encounters. *Journal of Theoretical Biology*, 218, 375-394.
- [2] Courchamp, F., B. T. Grenfell and T. H. Clutton-Brock, 1999. Population dynamics of obligate cooperators. *Proceedings of the Royal Society of London B*, 266, 557-563.
- [3] Courchamp, F., T. Clutton-Brock and B. Grenfell, 2000. Multipack dynamics and the Allee effect in the African wild dog, *Lycaon pictus*. *Animal Conservation*, 3, 277-285.
- [4] R. Woodroffe, J. R. Ginsberg and D. W. Macdonald, eds. The African wild dog: status survey and conservation action plan, IUCN, Gland, Switzerland.
- [5] Stephens, P. A., W. J. Sutherland and R. P. Freckleton, 1999. What is the Allee effect? *Oikos*, 87, 185-190.
- [6] Vucetich, J. A. and S. Creel, 1999. Ecological interactions, social organization, and extinction risk in African wild dogs. *Biological Conservation*, 13, 1172-1182.