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Assessing bat (Chiroptera) diversity: determinants of assemblage and ensemble structure at Kwalata Game Ranch, Gauteng South Africa

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Abstract

In this study I assessed bat (Chiroptera) diversity on Kwalata Game Ranch (KGR) in Gauteng, South Africa. I investigated the influence of habitat heterogeneity, specifically vegetation type and level of cover, on the local bat assemblage structure. I sampled bats within three vegetation types (savanna-woodland, riparian and ecotone) on KGR and estimated percentage vegetation cover at sample sites as a proxy for vegetation structural complexity. I used passive sampling with bat detectors and active trapping with mistnets, harp-traps and roost searches to ensure as thorough an inventory as possible. Sample-based rarefaction revealed that the KGR bat assemblage is relatively species-poor and bat diversity is equivalent among the different vegetation types (confirmed with Whittaker's β diversity index). A total of only eight insectivorous species was recorded and pteropodids appear to be absent from KGR. Moreover, species richness estimators indicated sampling was exhaustive. I attributed the low bat diversity to the impacts of known land use, particularly historical grazing by cattle (during 1980's) and land clearing by humans that have resulted in a relatively fragmented savannah-woodland . In addition to the diversity assessment I evaluated effects of the deterministic processes of interspecific competition and prey defences on the ensemble structure of insectivorous bats . I measured the parameters of size, wing morphology and echolocation call structure for each species. These are the primary traits governing the habitat in which insectivorous bats can forage and the types of prey they can handle. Competition should result in size assortment of species that minimizes their similarity while defences of insect prey should result in a narrow range of effective echolocation parameters. Taking size into account is important as size can govern the type of prey able to be handled thus differently sized sympatric bat species may

have similar echolocation characteristics but do not compete for prey. I used null models to test for the effects of competition and prey defences. I compared the insectivorous bat ensemble of KGR with random ensembles constructed from regional species pools of insectivorous bats. My results suggest evidence for competition – minimum size differences were larger and more evenly distributed than expected from chance. Moreover, my results are unlikely to be reflecting the “ghost of competition past” as the majority of insectivorous bat species at KGR are generalists thus making resource overlap more likely. Prey defences, on the other hand, appear to have no influence on the KGR ensemble structure – echolocation call parameters were clumped rather than more similar than chance would expect. Evidence for competition was surprising given the species-poor nature of the ensemble. Thus alternative factors potentially contributing to assortment of size and wing morphology parameters are discussed. KGR is bordered by large peri-urban settlements with numerous street lamps and large spotlights that produce substantial light pollution. High-duty cycle bats are often the main contributors to the prey defence hypothesis as they usually echolocate outside of the hearing range of tympanate insects. However, they may actively avoid artificially lit areas as a result of the slow flight making them more susceptible to predation. Also, artificial lights can interfere with the defence mechanisms of many tympanate insects thus allowing low-duty cycle echolocating bats to take advantage of a usually unavailable resource. The lack of evidence for the influence of prey defences was thus attributed to impacts of ecological light pollution.