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Estimating Interdependence of Social Statuses in a Cooperative Breeding Birds through Mathematical Modelling

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Abstract : The cooperatively breeding birds have two major ranks for the sexually mature birds. The breeders mate and produce offspring while the non-breeding helpers increase the chick production rate through help in mate-finding and allo-parenting. However, the chicks also cooperate to raise their younger siblings through warming, defending and food sharing. Although, the existing literatures describes the evolution of allo-parenting in birds but do not differentiate the significance of allo-parenting in sexually immature and mature helpers separately. This study addresses the significance of both immature and mature helpers' contribution to the total sustainable bird population in a breeding site using Blue-tailed bee-eater as a test-bed species. To serve this purpose, a mathematical model has been built considering each social status and chicks as separate but interactive compartments. Also, to observe the dynamics of each social status with changing prey abundance, a prey population has been introduced as an additional compartment. The model was analyzed for stability condition and was validated using field-data. A simulation experiment was then performed to observe the change in equilibria with a varying helping rate from both the helpers. The result from the simulation experiment suggest that the cooperative breeding population changes its population sizes significantly with a change in helping rate from the sexually immature helpers. On the other hand, the mature helpers do not contribute to the stability of the population equilibrium as much as the immature helpers.

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