The model of two-level intergroup competition

Аннотация

At the middle of the 2000-th, scientists studying the functioning of insect communities identified four basic patterns of the organizational structure of such communities: (i) Cooperation is more developed in groups with strong kinship. (ii) Cooperation in species with large colony sizes is often more developed than in species with small colony sizes. And small-sized colonies often exhibit greater internal reproductive conflict and less morphological and behavioral specialization (iii) Within a single species, brood size (i.e., in a sense, efficiency) per capita usually decreases as colony size increases. (iv). Advanced cooperation tends to occur when resources are limited and intergroup competition is fierce. Thinking of the functioning of a group of organisms as a two-level competitive market in which individuals face the problem of allocating their energy between investment in intergroup competition and investment in intragroup competition, i.e., an internal struggle for the share of resources obtained through intergroup competition, we can compare such a biological situation with the economic phenomenon of "coopetition" — the cooperation of competing agents with the goal of later competitively dividing the resources won in consequence In the framework of economic researches the effects similar to (ii) — in the framework of large and small group competition the optimal strategy of large group would be complete squeezing out of the second group and monopolization of the market (i.e. large groups tend to act cooperatively) and (iii) - there are conditions, in which the size of the group has a negative impact on productivity of each of its individuals (this effect is called the paradox of group size or Ringelman effect). The general idea of modeling such effects is the idea of proportionality - each individual (an individual/rational agent) decides what share of his forces to invest in intergroup competition and what share to invest in intragroup competition. The group's gain must be proportional to its total investment in competition, while the individual's gain is proportional to its contribution to intra-group competition. Despite the prevalence of empirical observations, no game-theoretic model has yet been introduced in which the empirically observed effects can be confirmed. This paper proposes a model that eliminates the problems of previously existing ones and the simulation of Nash equilibrium states within the proposed model allows the above effects to be observed in numerical experiments.

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