

N O T E

Instability of Dominance Hierarchies Among Male Madagascar Hissing Cockroaches, *Gromphadorhina portentosa* (Dictyoptera: Blaberidae)¹

Floyd W. Shockley

Department of Entomology, University of Missouri-Columbia, Columbia, MO 65211 USA

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In insect social groups with a more or less stable social system, dominance hierarchies depend on the constant submission of subordinate individuals (Huntingford and Turner 1987, *Animal Conflict*; Dugatkin et al. 1994, *Ethology* 97: 94-102). It is, therefore, important for members of a social group to have the ability to distinguish between dominant and subordinate individuals during social interactions to avoid escalation and injury. Within social groups of the Madagascar hissing cockroach, *Gromphadorhina portentosa*, dominance hierarchies are established through complex displays of one or more agonistic behaviors (Breed et al. 1981, *J. Kansas Entomol. Soc.* 54: 197-208; Clark and Moore 1994, *J. Insect Behav.* 7: 199-215). The objective of this study was to indirectly test to see if an individual's behavioral characteristics, those behaviors that enhance an individual's ability to maintain its position within a social group, play a more significant role than previous social experience in determining social rank in *G. portentosa*.

Males were raised within a social group comprised of both males and females. Three replicate groups of 10 adult males were isolated from the colony and moved into glass terrariums (51 × 26.5 × 31.5 cm) with a rocky substratum and fresh food and water. Individuals were marked on the dorsal side of the abdomen with letters using Testors® acrylic paint. The insects were maintained at 28°C in an environmentally-controlled room with a 12:12 light:dark photoperiod. After transfer to the terrarium, each group of males was given 4 d to set up a stable dominance hierarchy. The ranks in the hierarchy were determined using 15-min long, paired encounters conducted in circular plastic arenas (15 cm diam × 8 cm deep) under a 25-watt red light in an otherwise dark room.

Of 10 behaviors involved in the agonistic interactions between male *G. portentosa*, Abdomen Push, Abdomen Flick, Butt, and Lunge were used to establish dominance, while Retreat and Crouch were used to signify subordination among competing individuals (Bell et al. 1979, *Insectes Soc.* 26: 252-263; Breed et al. 1981; Clark and Moore 1994). The two most dominant males were identified by constructing a table of ranks based on the total number of dominant behaviors expressed per insect

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summed for all encounters (Moore et al. 1988, J. Insect Behav. 1: 157-168; Dugatkin et al. 1994). In all three replicates, the two dominant males were then removed in order to alter the social group makeup and test whether their removal affects the hierarchy of the remaining individuals. The hierarchy was again determined using paired encounters. In one group, the dominant insects that were removed initially were replaced and the hierarchy determined again to compare insect rank before and after removal of the dominant individuals with the insect rank after the return of the dominant individuals to the social group. The correlation between insect ranks before and after removal of the dominant individuals was determined using Spearman's ρ .

In all three replicate groups, there was a significant change in the individual ranks (Rep. 1: Spearman's $\rho = -0.286$, $p > 0.1$; Rep. 2: Spearman's $\rho = -0.119$, $p > 0.1$; Rep. 3: Spearman's $\rho = 0.119$, $p > 0.1$) such that there was no correlation between insect rank before and after removal of the dominant males. When the dominant individuals were reintroduced in the third replicate group, the insect ranks returned to the ranking displayed before the dominant individuals were removed.

There was complete reorganization of the dominance hierarchy in all three groups tested. This reorganization indicates that in *G. portentosa* there is not a linear shift in dominance when the dominant individuals are removed from the population as would be expected if the individual's dominance level was merely based on the insect's role as defined by the structure of the social group. The results of this study suggest that it is the constituency of the social or familial group which affects the level of expression of individual dominant characteristics in a given population subgroup of male *G. portentosa*. However, this condition may be an artifact of no-choice, forced aggregation that creates additional selective pressures influencing the expression of behaviors by all individuals involved and creating an unnatural pre-social condition.

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