Collective behaviour

Why polarized motion

Polarized motion

Demšar J, *etal*, 2016
doi: 10.1038/srep39428

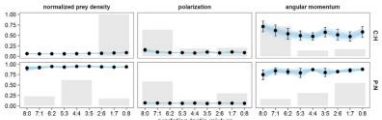

Figure 1. Normalized prey density, polarization, and angular momentum for conforming predation pressure mixtures: P – attack prey individuals located at the periphery of prey groups, N – attack the nearest prey individual, C – attack the most central prey individual in a prey group, and H – high density area attacks. The predation pressure mixture ratio *a*:*b* denotes the number of predators using a specific predation tactic, e.g. in the case of C:H, 0:8 (top row, right side of the plot) all predators (eight) use high density area attacks. Points and whiskers represent the estimated posterior means and 95% posterior confidence intervals. Individual draws from the posterior distributions are connected with lines to visualize posterior uncertainty and aid in the interpretation of how the means vary across the predation pressure mixtures. To summarize the results, the predation mixtures were grouped into groups of three: predation pressure predominantly from centre (C:H) or periphery (P:N) attacking predators (8:0, 7:1, 2:6), balanced pressure (5:3, 4:4, 3:5), and predation pressure predominantly from high density area (C:H) or nearest prey individual (P:N) attacking predators (6:2, 7:1, 0:8). The shaded bars show, for each group, the probability that that group has the highest mean. These probabilities were estimated with draws from the posterior distributions in which each group member had an equal probability of being selected. That is, each predation mixture was weighted equally.

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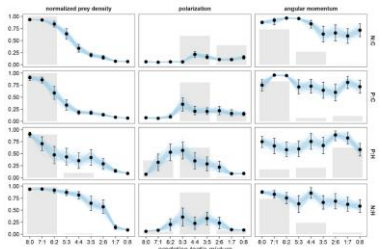

Figure 2. Normalized prey density, polarization, and angular momentum for antagonistic predation pressure mixtures: P – attack prey individuals located at the periphery of prey groups, N – attack the nearest prey individual, C – attack the most central prey individual in a prey group, and H – high density area attacks. The predation pressure mixture ratio *a*:*b* denotes the proportion of predators using a specific predation tactic, e.g. in the case of N:C, 0:8 (top row, right side of the plot) all predators (eight) attack the most central prey individual in a prey group. Points and whiskers represent the estimated posterior means and 95% posterior confidence intervals. Individual draws from the posterior distributions are connected with lines to visualize posterior uncertainty and aid in the interpretation of how the means vary across the predation pressure mixtures. To summarize the results, the predation mixtures were grouped into groups of three: low degree of antagonism in predation pressures with predominant pressure from predators that force prey into grouping (8:0, 1:7, 2:6), high degree of antagonism in predation pressures (5:3, 4:4, 3:5), and low degree of antagonism in predation pressures with predominant pressure from predators that force prey into dispersion (6:2, 7:1, 0:8). The shaded bars show, for each group, the probability that that group has the highest mean. These probabilities were estimated with draws from the posterior distributions in which each group member had an equal probability of being selected. That is, each predation mixture was weighted equally.

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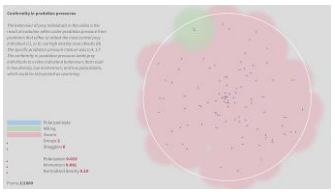

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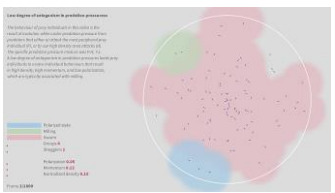

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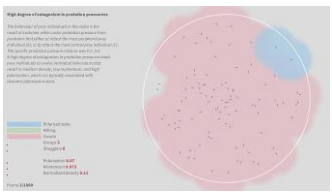

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Our results suggest that a mixture of antagonistic external pressures that simultaneously steer prey towards grouping and dispersing might be required for prey individuals to evolve dynamic parallel movement.

In summary, while the dilution of risk might be sufficient for prey individuals to evolve grouping, and predator confusion might lead prey individuals to evolve swarming, our results suggest that exposure to antagonistic predation pressures might be a necessary requirement for prey individuals to evolve parallel movement. This could indicate that the direction of evolution (grouping or dispersing) is not A versus B, but a labile result—whether grouping or dispersing evolves depends on a) the nature of the group, and b) the pressures that the group finds itself facing.