High altitude multi-taskers: Bumble bee food plant use broadens along an altitudinal productivity gradient

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Online Resource 1. Results of non-parametric tests.

Data on foraging niche overlap between queens and workers did not meet the assumption of normality, but a non-parametric test conducted via permutation ANOVA agree with the finding from the parametric analysis that overlap in foraging niche between queens and workers was greater at high altitude than lower altitudes ($DF = 2$, Number of Iterations $= 4560$, $P = 0.037$; Fig. 2).

Even after square root transformation, niche breadth data were not normally distributed. However, results of non-parametric tests conducted via permutation ANOVA ($DF = 2$, Number of Iterations $= 779$, $P = 0.37$) agree with the parametric statistics, which indicate no difference in niche breadth with altitude (Fig. 1a).

The error structure of the foraging overlap data did not meet the assumption of normality; however, non-parametric tests ($\chi^2 = 16.84$, $P < 0.0001$) agreed with results of the parametric analysis. Foraging niche overlap was significantly greater in the alpine than at lower altitudes (Fig. 1c).
Online Resource 2. Niche breadth (a; $F_{2,26} = 2.49, P = 0.10$) and discrimination (b; $F_{2,26} = 6.24, P = 0.0061$) among flower visiting bumble bees in the Colorado Rocky Mountains from 1966-1969. Means of groups denoted by different letters differ significantly at $P < 0.05$ and error bars denote standard errors.
Online Resource 3. Weighted bipartite graphs for pollen foraging bumble bees and their host plants in the Colorado Rocky Mountains at three altitudinal ranges: (a) montane, (b) subalpine, and (c) alpine. Widths of connecting lines reflect the proportional frequency of a given plant-bumble bee interaction in the interaction web. Asterisks denote significance levels for statistical tests of nestedness (i.e., the weighted interaction nestedness (WIN) value is statistically different from random (* denotes $P > 0.05$, ** denotes $P > 0.001$, *** denotes $P > 0.0001$)) for montane (WINE = 0.371; WIN = 0.481, $z = 3.14$, $P = 0.00085$), subalpine (WINE = 0.477; WIN = 0.486, $z = 4.45$, $P < 0.0001$), and alpine networks (WINE = 0.478; WIN = 0.289, $z = 3.79$, $P < 0.0001$)
Online Resource 4. Weighted bipartite graphs for nectar foraging bumble bees and their host plants in the Colorado Rocky Mountains at three altitudinal ranges: (a) montane, (b) subalpine, and (c) alpine. Widths of connecting lines reflect the proportional frequency of a given plant-bumblebee interaction in the interaction web. Asterisks denote significance levels for statistical tests of nestedness (i.e., the weighted interaction nestedness (WIN) value is statistically different from random (* denotes $P > 0.05$, ** denotes $P > 0.001$, *** denotes $P > 0.0001$)) for montane (WINE = 0.392; WIN = 0.381, $z = 3.52, P = 0.00022$), subalpine (WINE = 0.263; WIN = 0.334, $z = 2.63, P = 0.0042$), and alpine networks (WINE = 0.679; WIN = 0.360, $z = 6.71, < 0.0001$).
Online Resource 5. The relationship of altitude to network specialization for pollen-forager (solid squares) and nectar forage (open squares) webs. Altitude had a significantly negative affect on network specialization for pollen-forager webs (\(y = 0.968 - 0.226x; r^2 = 0.999, t = -25.41, P = 0.025; \) solid line), but nectar-forager webs had no significant relationship (\(r^2 = 0.521, t = -1.04, P = 0.487; \) no line shown).