Emerging patterns from urban ecological field studies

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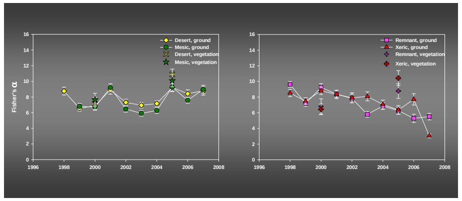
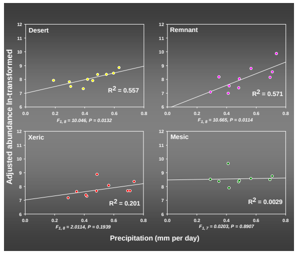
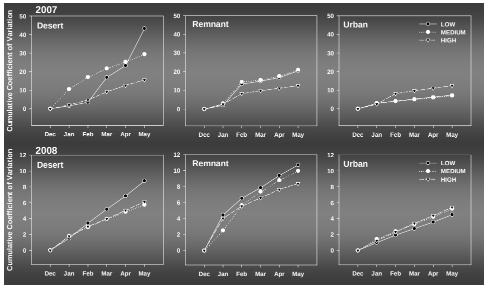
The growing metropolitan Phoenix area sets the stage for observing rapid changes to plant and arthropod communities. Results from ten years of monitoring arthropods, and three years of manipulation of plant productivity and arthropod communities in urban and desert areas, condensed to eight major points reveal patterns and processes typical for complex ecosystems. Urban areas are extremely heterogeneous combining different types of ground surface and vertical structures. Our research shows that (1) proximity to built structures affects plant productivity due to reduced wind speed, and (2) variation in plant growth decreases in urban residential areas. This may create a beneficial environment for arthropods, which is reflected by (3) higher abundance among ground dwelling arthropods in urban mesic habitats. Vegetation living arthropods however (4), are much less abundant than expected from a bottom up perspective. We tested effects of bird predation (5), but did not find a significant impact. We believe that the high number of exotic plant species, due to loss of native host plants (6) contribute to this altered state of arthropod communities. Arthropod diversity (7) is highly variable depending on spatial association and habitat type. Desert remnant areas (8) embedded in the urban matrix function as control sites for monitoring plant and arthropod communities, but experience isolation effects as they increasingly become islands in the urban landscape. Our novel results may help us understand the consequences of current changes to human ecosystems.



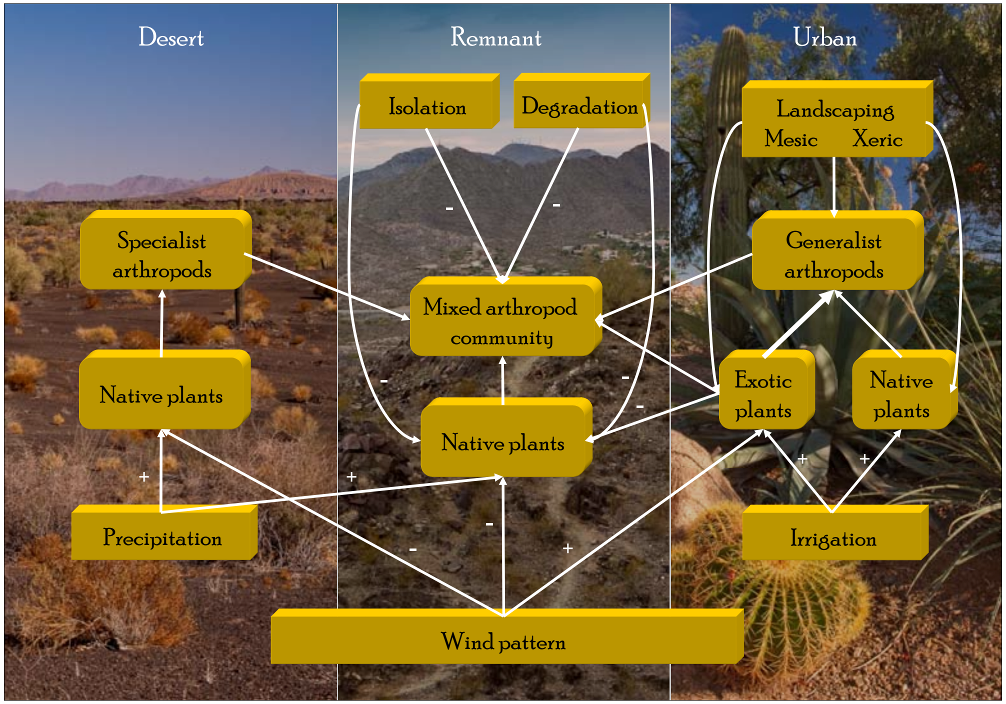
Arthropod family diversity in desert, desert remnants and two urban residential habitats, 1998 – 2008. Mesic and desert habitats (left) surprisingly experience the same fluctuations and relatively high diversities, while diversity in remnants and xeric habitats (right) are declining (Bang and Faeth, *in review*).

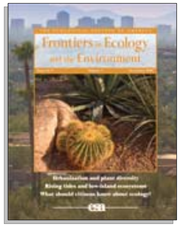
Variation in abundance of ground dwelling arthropods collected annually with pitfall trapping in response to annual daily precipitation in four habitat types. The pattern confirms that arthropods respond to bottom-up effects in desert and remnant areas, while arthropods in urban residential areas are decoupled from fluctuations in precipitation (Bang and Faeth, *in review*).



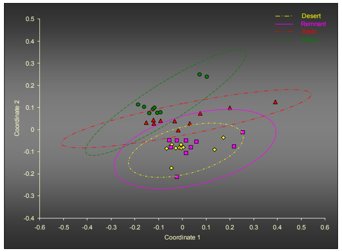


Cumulative coefficient of variation in brittlebush growth in 2007 and 2008 in three habitat types, at three levels of water availability. 2007 experienced one night below freezing which caused considerable variation in desert plant growth. Urban plants were less affected and recovered faster. 2008 was a normal year in terms of low temperatures, reflected by lower overall variation, but again, urban plants were less variable than desert and remnant plants. Desert and remnant plants displayed less variation with high water availability, while urban plants seemed unaffected. This suggests that other factors than water are important for plant growth in the city (Bang et al., *in prep*).

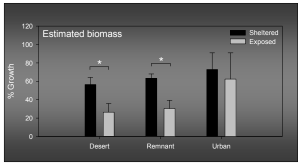




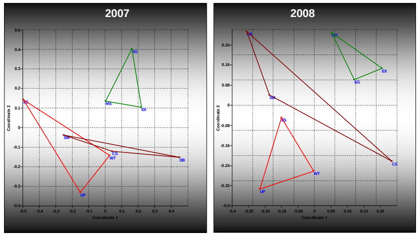
Walker et al. (2009) found that the total plant species pool in the urban ecosystem is higher than in the desert as a result of increased importation of introduced species. This may explain the high diversity of arthropods found in mesic habitats with pitfall sampling (Bang and Faeth, *in review*).



Non-metric multi-dimensional scaling of annual pitfall samples reveals that ground-dwelling arthropod family composition in urban mesic habitats is significantly different from desert habitats (Bang and Faeth, *in review*).



Brittlebush plants protected against wind increased significantly more in biomass than unsheltered plants in desert and desert remnant areas, while there was no effect of wind protection in urban areas where all plants increased significantly. Since all the experimental plants had the same adequate water and nutrient availability, this suggests that reduced wind speed is a primary contributing factor to observed increased plant growth in cities (Bang et al., *in prep*).



Non-metric multidimensional scaling of vegetation living arthropod families in three habitat types, three locations of each. Red = desert, brown = desert remnants, green = urban habitats. The results indicate clear differences in community composition along an indirect rural-urban gradient (Bang et al., *in prep*).

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