"Jills of all Trades: Ant Diversity and Versatility in the Cross Timbers Ecoregion"

Ann B. Mayo, PhD candidate, University of Texas-Arlington

State of the Prairie Conference, Fort Worth Botanical Garden, Fort Worth, Texas
May 29 – 31, 2014

Slide 1: Title

"Jills" -- Most ants are female. All the workers and the queen are females. The male ants die soon after mating.

Slide 2: Ants as Bioindicators

Can ants – the ant assemblage – be used to assess and monitor ecosystem health and change?

- ant species are easy to collect, identify, and handle
  - can collect many workers without harming the colony
  - no restrictions or problems as may be encountered with vertebrate species – endangered species; large animals; difficult to capture; etc.
  - umbrella species: ants may be sensitive to similar changes as endangered species or sensitive to changes in these other species (see below)
  - individual ant species and/or the ant assemblage (all the ant species in an area)
- ants are diverse: biology and ecological relationships
  - potential to detect/respond to invasive species, especially ants
  - land use changes
  - Climate Change
    - ant species found in old packrat middens indicate/confirm past climate changes such as when the Big Bend area became hotter and drier
  - potential as an assessment tool for land management

Slide 3: Ant Diversity and Ecology

- In this talk, I will cover
  - Ant Diversity
  - Ant Ecology
  - Cross Timbers Ecology
  - Ants in the Prairie
  - Conservation

Slide 4: Ant Diversity

- Ant species are ubiquitous – they are important members of all terrestrial ecosystems except Antarctica.
- Ants have lots of diversity in size, shape, and life history. Life history traits include: how many queens in a colony; how large is a colony; how many eggs are produced; etc.

Slide 5: Ant Ecology

Topics

- Food webs
- Relationships
- Ecosystem Engineers

- Recyclers – the ants claim to fame (important in gardens for this as well)

Slide 6: Food Webs

Ants are significant members of food webs as both prey and predators.

To the extent that other species specialize on ants (ant eaters, ant lions, horned lizard) and the extent to which ants have specialized diets, these webs may have tight relationships which can be sensitive to changes in these species presence and abundance. Ants with specialized diets have the capacity to greatly effect those populations of plants, insects, and fungi. Seed harvesting ants may impact plants and plant communities by limiting the seeds available for the generation.

Slide 7: Mutualisms

with plants, other insects, and fungi

Ants are poor pollinators since they do not eat pollen and lack the hairs of bees for pollen collection. Ants are also not likely to be loyal to a particular plant.

Some species of ants disperse seeds. These plants produce a carbohydrate packet, called an eliasome which is attached to the seed. The ants collect these seeds and eat the eliasome but do not eat the seeds. The seeds are left in the ant nest where the seeds are protected and hidden and then can germinate.

Some ants will protect plants by removing vines and other competing plants and attach animals that try to feed on the plants (grasshoppers). These plants make hollow stems. thorns, and other structures to house the ant colonies.

Some ants raise aphids on plants. The ants move the aphids around on the plant as the aphids drink the plant sap. The ants drink the excess plant sap from the anus of the aphids.

Some ants collect leaves on which to grow fungi which the ants then eat. (fungus gardens)

Slide 8: Competition

Nest site competition as an example.

Digger bees dig nests into the soil. In these photos, digger bees make nests in sandy soil where Comanche harvester ants also nest. One bee build her nest too close to an ant nest. The ants filled in the bee nest and by the next day, the bee nest was gone.

Here is a link to a 10 minute recording with commentary of how the harvester ants dealt with another bee nest. – This was done by the same ant colony.
(https://www.youtube.com/watch?v=xYNqb7Dp1Fo)

Slide 9: Ant relationships

- Ants typically do not tolerate direct interactions with other colonies or other ant species at their nests. Some ant species prey on other ants (army ants) or lay their eggs in other colonies (inquiline queens) or make slaves of some species.
- However, in these first photos, a native fire ant appears to have a benign relationship with a fungus ant.
- The second photo, shows several *Forelius* ants harassing a Comanche harvester ant who came too close to the *Forelius* ant nest.

Slide 10: Ecosystem Engineers

Ants may change their physical habitat in significant ways which in turn affect other species.

Slide 11: Recyclers

Most ants are ground nesting and ground active. They move materials from their foraging ranges (which can include trees, understory, within the ground) into their nests and out again ("trash") which may be located in a special chamber in the nest or taken to a middens pile outside the nest.

Slide 12: Soil Dynamics

The internal nest structure is made up of chambers connected by tunnels. Different ant species have different forms. But this general structure facilitates water and gas movement into the soil.

If the ants are ground nesting, they also extend their nests by digging and removing soil. All these activities mix soil layers and change the soil chemistry. They also enhance water and gas movement within soil. Ant activities in the nest also impact soil chemistry.

Many organisms take over and benefit from abandoned ant nests. Some animals will use these nests as dens or places to hide. Seeds already within the nest as well as ones that disperse in benefit from the increased nutrition/minerals and other changes in the soil related to the nest. Plant roots may quickly penetrate into abandoned nests as well.

Slide 13: The Cross Timbers Ecoregion

Tony Burgess described this area as a region of "biological confusion" in his opening remarks – because this is a diverse region ecologically with dynamic mosaic of habitats and microhabitats. This is a system of constant change across multiple and connected habitats.

Slide 14: Where is the Cross Timbers?

Kansas, Oklahoma, and Texas. Some people also included portions of Arkansas and Missouri.

Slide 15: The Mosaic: the "Confusion"

The habitats are in a constant, low perhaps slow, transition. The habitats include:

- Oak Woodland – very shady; cooler temperatures. These are large expanses of trees which surround the prairie.
- Oak Motts – a few trees or shrubs which develop within the prairie and begin the accumulation of humus.
- Light Gaps – areas where a tree has come down and opening up the understory and ground to sunlight changing the light and temperature.
- Prairie – open areas dominated by herbaceous plants and grasses.

Slide 16: Prairie in the Cross Timbers

Some photos of different prairies in the Fort Worth Nature Center.

The three on the upper left are from Todd Island and on the Aquila formation which is a very sandy soil. This is where the Comanche harvester ant nests. The bottom left is part of Canyon Ridge Truck Road which is a limestone soil and very rocky. There was a Barbatus harvester ant nest in the canyon wall to the right in this photo. Top right is the prairie at Alice Ashley. There was a Barbatus harvester ant nest in this prairie but it is gone now. The bottom right is a prairie near the Bison Range. This is a rocky, limestone soil with lots of *Yucca*. It seems to me that the Aquila prairies have the most species diversity of herbaceous plants and grasses.

Slide 17: Ants in the Prairie

How are the ants part of the prairie?

Slide 18: Ecological Roles

The ants in prairies play the same kinds of roles we have just seen generally for ants.

As ecosystem engineers – several of these species make conspicuous structures as they excavate their nests. The Comanche and Barbatus harvester ants make the largest external structures and probably have the largest internal structure of chambers and tunnels that extend broadly (Barbatus external nest yards can be 2 m across and the nest underneath probably extends beyond that distance) and deeply as well.

Other ant species also contribute to soil dynamics through their nesting and foraging activities. Though some of these structures may be small to us, they do affect microclimates/habitats and have small scale effects important to many organisms that are at the base of ecosystem health and function.

Aphaenogaster sp. are dispersing seeds and tending aphids. Fungus ants (*Trachymyrmex* sp.) are tending fungus gardens.

The harvester ants forage primarily on seeds and thereby impact plant populations.

The three mini trap draw ant species, *Strumigenys* sp., are specialists on springtails (Collembola), a small insect with a springing defense.

Ants are also moving materials not only below and above ground but between the various habitats and microhabitats – between the forest, woodlands, light gaps, prairie and motts. Some of these species may be moving material from distances of more than 200 – 300 m. The acrobatic ants commonly nest in one area and forage in nearby trees and harvester ants collect seeds from any habitat. The ants, therefore, are important transporters of material and energy among or within this "biological confusion." (Not much is known about this – I would like to look into it.)

Slide 19,20, and 21: Ant Diversity in the Fort Worth Nature Center

I have used pitfall traps to collect ants several times and recently did this from May – September in 17 sites in the Nature Center. These sites included 14 prairies and 3 woodlands. Two of the prairies sites are also mowed because they are right of ways and two of these sites were burned as part of the Nature Center's burning program. I have found 37 species of ground active ants – that is, I did not sample for all ants but by using pitfall traps, focused on the ants that would be caught from the ground. Interestingly, I did capture one army ant which was unusual to catch since these ants forage through the ground and are very difficult to capture. I suspect there are other army ant species.

Despite the vegetation heterogeneity, these 37 species of ants were found in nearly all sites. The exceptions were the Comanche harvester ant which was only found in the deep sands of the Aquila formation and the carpenter ant *Camponotus*. This homogeneity of species found across sites probably reflects 1) the broader niche – more generalized – of most of these species which supports flexibility in the face of small scale local heterogeneity and 2) the foraging range needed to support colonies.

Slide 19: Mini trap jaw ants: 3 species; these ants specialize on springtails, a small insect especially common in the cooler part of spring and summer

Pyramid or cone ant (*Dorymyrmex*): perhaps 2 species; these were particularly abundant. They are easily distinguished by a cone shaped structure on their dorsum (backside). The shape of the cone varies with species. I have no idea what the cone is for.

Aphaenogaster: 3 species; mostly woodland ants; they disperse seeds and tend aphids.

Slide 20: Big headed ants (*Pheidole* sp.): 4 species; these are seed eaters; the majors have large heads and can look very different from the minors.

Forelius mccooki: a small and very common ant in most areas

Brachymyrmex depilis: a tiny ant.

Fungus ant and Turret ant (*Trachymyrmex* sp.): 2 species: *T. septentrionalis* (this one has some relationship with our native fire ant, *Solenopsis xyloni*) and *T. turrifex* (this one makes the turrets).

Slide 21: The Comanche harvester ant (*Pogonomyrmex comanche*): this is my focal ant; I have found 900 colonies of this ant at the Nature Center on Todd Island. Their diet is about 80% seeds and they are generalists – they take just about any seed. They also scavenge insects, grasshopper frass, and vegetative parts of plants.

The Barbatus harvester ant (*Pogonomyrmex barbatus*): the most common harvester ant in this area; known as the big read ant; makes large cleared external nest yards which can be 2 m in diameter with definite trunk trails.

Harvester ants in the genus *Pogonomyrmex* are the preferred food of the Texas horned lizard. Other horned lizards also favor these ants. Other birds, mammal, lizards, insects (a bee assassin) and spiders (black widows) also eat these ants.

Slide 22: How do the ants deal with this mosaic?

I believe these particular species are here because they have a broader niche and are able to cope with changes in weather, etc. on a regular basis – they are used to flux. Some of these species are often described as species of disturbance. A few of the species are more specialized: Comanche nests only in deep sand but otherwise is a generalist predator and will forage great distances from her nest. The winter ant, *Prenolepis imparis*, is active only in cooler parts of the year. I usually don't catch the winter ant from June through September.

Also, since most ants build a nest within another structure – often the ground but also in acorns and woody twigs/branches, they are protected from the elements.

Though I had thought there would be more ant species specific to prairies with different vegetation and soil types, given the attributes of ants, it is not so surprising that there is such homogeneity of species presence across these local habitats.

Slide 23: Ants and Conservation

Although ants are easy to assess and present few problems in handling, etc., the studies using them as bioindicators are mixed. If the ant species are particularly specialized, they probably have a better change of being a good assessment tool. But their adaptability and flexibility which has insured their survival and proliferation, may mean that they can adjust to environmental changes without leaving clues (like changes in presence and abundance) which we can readily measure.

However, they do respond quickly to invasive species, especially invasive ants. This is undoubtedly because the invasive ant species compete on the same scale with native ants for nesting sites and food resources.

In thinking about conservation measures more generally, it is important to remember groups of organisms such as ants. Although they are small and we often think of them as pests, they are critical parts of food webs and other structuring in ecosystems. Everything is connected.

Slide 24: Acknowledgements

3 Cheers for the Nature Center Staff who have been helpful beyond the call of duty.

Slide 25: Contact Information

My email address: amayo@uta.edu

I have an open notebook on-line, which is a kind of blog. It features my research but also has some natural history information, commentary on books on ants, etc. The site is called "Ant Ecology and Other Adventures (http://onsnetwork.org/mayonotebook).

I am also part of a research group: Ants of Texas and we have a blog (texasants.blogspot.com). We are a group of myrmecologists (ant biologists) with the goal of producing a complete list of ant species in Texas with distribution and ecological information.

I have an ant project on iNaturalist for sightings of Texas ants – so if you get some good photos with location information and other observations, I invite your sharing these. (http://www.inaturalist.org/projects/texas-ants)

If you have ants you would like identified, you may contact me.

Slide 26: Questions?

You can email me questions at amayo@uta.edu