THE ANTS OF MASSACHUSETTS:

Biodiversity Under our Feet

by Aaron M. Ellison and Elizabeth J. Farnsworth

The email came in mid-summer of 2011: Daniella Prince, a junior at Brown University, had found a new species of ant on the beach at Falmouth (below). The species was certainly a new discovery for Massachusetts, and perhaps even new to science. Four months later, before giving a seminar at the University of Massachusetts in Boston, one of us (Aaron) was being shown around the facilities at the Science Building. "Do you ever have any ants in the greenhouse?" he asked off-handedly.

"Of course," came the answer. "In fact, there's this colony over here that we've been trying to get rid of for months." The ant in question turned out to be *Cardiocondyla obscurior*, a well-known tropical "tramp" that, like Daniella's discovery, had never before been recorded in Massachusetts. The more we look for ants, the more new discoveries we make – and you can help!

Our book, **A Field Guide to the Ants of New England**, was nearly completed in the spring of 2011. We had already spent

Photo © Gary Alpert / MCZ

A dark Fuzzy Ant (an unknown species of Lasius*) collected in Falmouth in July 2011 by Daniella Prince. This ant is similar to the European* Lasius niger*, but more specimens need to be collected before we can make a definitive identification.*

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Cardiocondyla obscurior, a tropical tramp collected in the Biology Department greenhouse at UMass-Boston in November 2011 by Aaron Ellison. Previously unknown from Massachusetts or anywhere else in New England, this ant could turn up anywhere it stays warm the year round.

4 years collecting ants in the field, scouring museum collections and data-basing fragile specimens, reading the historical literature, and picking the brains of many colleagues. In total, we had looked at more than 13,000 collection records, and we were pretty confident we had finally assembled a complete list of the ants of Massachusetts.

But the discovery of both of these previously unrecorded species gave us a reality check just as our field guide was going to press. It required the rapid production of new illustrations, the rewriting of keys, and the repagination of the already surprisingly lengthy manuscript. "Enough already," said Jean Thomson Black, our patient editor at Yale University Press. "Any new species will have to wait until the second edition."

So how many ant species do we have in Massachusetts, and how many more new species are probably out there waiting to be found? The short answers are: as of May, 2013, 111 species have been collected in the Commonwealth (more than from any other New England state) and at least two more species are likely to be collected in the future. (The latter figure is statistically most probable, but the most probable range is 1-13 more species.) But why should we care?

We are all awash in ants and at any time no one is likely to be more than a few feet from an ant nest. But don't worry – most won't eat your house or raid your kitchen. Rather, ants spend most of their time outdoors providing crucial ecosystem services that we take completely for granted. Those services include creating and aerating soil; breaking down dead carcasses; dispersing the seeds of our beautiful woodland herbs; and providing an important seasonal food source for birds, bears, and other wildlife. And ants, with their elaborate, sculptured body armor and intense colors, are as beautiful to look at as some of the finest bronzes. After this short introduction to the ants of Massachusetts, we hope you will never deliberately step on an ant again.

Ant Societies

Many of us may fondly recall our first ant farm: a "sand"-wich between two slices of clear Plexiglas invented in the late 1950s by "Uncle" Milton Levine. Ant farms introduced millions of children and their parents to many of the intricacies of ant societies, many of which are shared with other Hymenoptera (the order of insects that includes not only the ants, but also the bees, wasps, and sawflies).

We call them ant societies, not simply colonies or nests (many of which together make up a society), to emphasize some of their most conspicuous and intriguing aspects. For example, virtually all of the ants we ever see walking out and about are workers: sterile females. In most single colonies, all of these workers are produced by one reproductive female (a "queen") who mated one or more times shortly after she emerged from her natal nest. A queen ant produces egg after egg fertilized from the sperm she stored from her single mating flight. Queens of short-lived species, like those of acorn-nesting ants in the genus *Temnothorax*, may lay only 50-100 eggs. But queens of long-lived species, including the Eastern Carpenter Ant (*Camponotus pennsylvanicus*) or the Allegheny Mound Ant (*Formica exsectoides*) can live for decades and produce hundreds of thousands of workers.

Unlike the long-lived queen-mother, individual workers live only for a short time – from a couple of weeks to a few months. But during her short life, a worker may tend eggs and larvae, keep the nest clean, take out the trash, guard the nest from invaders or raiders from other, unrelated colonies or different species,

Photo © Aaron Ellison/Harvard Forest

Temnothorax curvispinosus *is a tiny, short-lived species. A single acorn, hollowed out by weevil and moth larvae, may house an entire colony of 50-100 individuals.*

or forage tens of yards away from the nest for a meal for the colony. Lest this seem like a pathetically short distance, a ¼-inch-long worker ant walking 30 feet carrying a caterpillar weighing five times her own weight would be roughly equivalent to a 6-foot-tall, 200-pound person carrying half a ton of hors d'oeuvres *in his teeth* from Faneuil Hall back to his office at Government Center. And an individual worker might make this same trip dozens of times every day.

What each worker does on any given day is determined by the needs of her colony. Different species "decide" on these needs in different ways, but all communicate the decisions to each other with chemical signals, and the queen coordinates the overall activities. If the queen dies, the nest no longer functions as an integrated unit, dead workers are not replaced, and the colony eventually dies out altogether. Because Uncle Milton only supplied workers (no queens) with his ant farms, he guaranteed himself and his family a steady income because we ant farmers continually had to reorder batches of new workers.

We see a lot of similarities between our own societies and the societies of ants. Humans care for their infants, small children, and teenagers; ants tend their eggs, larvae, and pupae. Like ant societies, many human societies have (or had until recently) castes of workers defined by birth. Both societies have workers and management, but unlike in human societies, all of the worker ants in a single colony are sisters and all have the same mother. Thus, conflicts between management and workers are rare *within* an ant colony. But when unrelated colonies of the same species intersect, conflict can erupt; among ants, these fights usually end in the death of one of the colonies.

Interactions between different ant species are much more variable. Sometimes, workers from different species walking the same path ignore each other completely. At the opposite extreme are the so-called Amazon ants in the genus *Polyergus*, which, like other slave-making species, send armies of workers to raid colonies of other species. The Amazons remove larvae and pupae from the raided (host) colonies and bring them back to their own nests, where adult host workers rear the host brood to carry out all of the essential housekeeping tasks of the slave-maker's nest. In between are many species of social parasites, including the Allegheny Mound Ant, that take over host colonies by killing the host queen. When the parasite queen lays eggs, the host workers rear them. Eventually, as the host workers die off, they are replaced by the parasite's workers. Of course, every ant species has its own unique life history. But the details of the life histories of the more than 100 species of ants in Massachusetts still remain to be studied.

Diverse Habitats = Diverse Ants

Why are there so many species of ants in Massachusetts? It's mostly due to the diversity of habitat types found in the state. Many ants are picky environmental specialists, tied closely to their specific habitat types. Since Massachusetts straddles the boundary between the boreal North Woods and the temperate

Photo © Gary Alpert/MCZ

The black Eastern Carpenter Ant, Camponotus pennsylvanicus, *is readily recognized by its large size and the long golden hairs on its gaster (abdomen). The queen shown here is carrying one of her pupae. She may live for 10 years and produce hundreds of thousands of eggs during her lifetime.*

Photo © Aaron Ellison/Harvard Forest

An Amazon ant, Polyergus lucidus, *leaves its nest to raid a nearby colony of* Formica incerta *of larvae and pupae for slaves. The large sickle-shaped mandibles distinguish this genus from all others in New England.*

Mid-Atlantic environmental zones, it naturally offers a wide range of habitats. Indeed, the landscape of Massachusetts is a study in contrasts, from the upland forests of the Worcester Plateau and the Berkshires, bisected by the fertile Connecticut River Valley, to the urban core of Boston sprawling to I-495 and beyond, and the pine barrens, sandplain grasslands, and heathlands of Montague, Plymouth, Cape Cod, and the Islands. The diversity and distribution of ants in Massachusetts reflect these different ecoregions and the substantial variation in the types of vegetation they support.

Forest Ants: The Common and The Rare

As the numerous stone walls threading through our forests attest, European colonists had clear-cut most of Massachusetts for lumber, tanbark, pasture, and row crops by the mid-1800s. But then bigger trees, and even more importantly, more fertile, easily tillable soils, were found further afield, and agriculture moved to the Midwest. The forests returned as farms were abandoned, and even today more than 60% of Massachusetts is covered in woodland. It is therefore not surprising that our most common ants are forest-dwellers such as the Eastern Carpenter Ant (*Camponotus pennsylvanicus*), the Punctured Ant (*Myrmica punctiventris*), the Rough Aphaenogaster (*Aphaenogaster rudis*), and the rather inaptly named Cornfield Ant (*Lasius alienus*).

The Eastern Carpenter Ant, one of our largest and – with its lustrous black body and golden hairs – most handsome species, is familiar to virtually all homeowners. It, like the seven other carpenter ant species that are found in Massachusetts, lives inside of rotting stumps and forms enormous colonies. A single queen will often produce more than 10,000 short-lived workers during a lifetime that may last 10 years or longer. As these ants forage for food, they may stumble upon an entrance into your house – often by following an electrical conduit or pipe – and set up a satellite nest in a rotten beam or rafter. These satellite nests are used by the workforce of the ever-growing colony for additional living space, food storage, and to rear yet more larvae, but the queen stays in the main nest in the nearby forest. Unlike termites, carpenter ants do not actually eat sound, dry wood; they simply hollow out moist, decayed wood. If you have carpenter ants living in your home, hiring a human carpenter to replace rotten wood and seal up cracks, crevices, and conduits will encourage the ants to look elsewhere for overflow housing and will take care of them better than an exterminator.

Both the Punctured Ant and the Rough Aphaenogaster, along with other forest species in the genera *Myrmica* and *Aphaenogaster*, make small nests of fewer than 100 workers in any available small, protected space in the forest. But their small size belies their outsized

Photo © Aaron Ellison/Harvard Forest: red ants, top.

Photo © Gary Alpert/MCZ: Mounds and black ant, bottom

The Allegheny Mound Ant, Formica exsectoides, *makes large mounds of mineral soil. This species is distinguished by its concave head, nearly hairless body, and its coloration – red head and mesosoma, black gaster (top inset). The founding queen of this social parasite kills the queen of its host, the silvery-black* Formica subsericea *(bottom inset).*

Common forest ants of Massachusetts include (top to bottom) the Punctured Ant, Myrmica punctiventris*; the Rough Aphaenogaster,* Aphaenogaster rudis*; and the Cornfield Ant,* Lasius alienus.

importance. These ants collect and disperse the seeds of plants like *Trillium*, gaywings, bloodroot, and *Hepatica*. These, and many other forest herbs, endow their seeds with an *elaiosome* – a packet of fat and protein that is to an ant what a chocolate éclair is to us. The ants grab the seed, take it back to the nest, eat the elaiosome, and leave the seed to germinate in the rich soil the ants have moved up from below. Indeed, without these ants, our forests would have far fewer of the beautiful understory flowers we enjoy every spring.

Many other forest-dwelling ants make their nests under small rocks and large stones, and the glaciers left plenty for

them here in Massachusetts. The soil under rocks is pleasingly moist, and as the rocks warm up in the sun, they radiate heat into the nest. (Ants are "cold-blooded" and need an external heat source to kick-start them into action.) Rocks also afford protection from numerous predators ranging from spiders to voles to bears. Some of our most uncommon forest ants lurk in the crevices of old stone walls or will turn up under boulders – if you can lift them! These rarer species include the centipede-eating Vampire Ant (*Stigmatomma pallipes*), which uses its large, fearsomely-toothed mandibles and powerful stinger to capture its prey; lemony-yellow, lemon-scented citronella ants (some *Lasius* species); and three species of springtail-hunting Angular Ants (*Pyramica* species), which, with their triangular heads and lacy, membranous "skirts" hugging their abdomens, would be better called Lady Gaga Ants.

The Cornfield Ant (*Lasius alienus*) is a geographical enigma that lives throughout temperate Asia, Europe, and North America. In Eurasia, it nests in agricultural fields, but here in North America it is a forest-nesting species. Despite its abundance, we know very little about its natural history, and here in New England it appears to be in the process of evolving into a new species, or is in fact another species altogether. Another species of *Lasius* that actually does live in Massachusetts' cornfields is the Labor Day Ant (*Lasius neoniger*); its common name refers to the predictable time of its annual mating swarms. Both *L. alienus* and *L. neoniger* are small, brown, fuzzy

Top, the Vampire Ant, Stigmatomma pallipes*, is a rare species that makes its nest under large stones and should be looked for within old stone walls meandering through New England's forests. Middle, Citronella Ants, such as this* Lasius claviger*, live deep in the soil where they tend aphids that feed on plant roots. The three species of the uncommon "Lady Gaga" Ants (a* Pyramica pergandei *worker is shown at bottom) reach the northern limit of their range in Massachusetts. Look for their tiny nests under small rocks in undisturbed forests and old woodlands.*

Photo © Aaron Ellison/Harvard Forest

The Pavement Ant, Tetramorium caespitum, *makes enormous nests with more than 10,000 workers, often constructing them beneath driveways and sidewalks. In the spring, colonies in close proximity to each other can often be observed engaged in fierce battles.*

ants, but they occupy different habitats: *L. alienus* in the woods, *L. neoniger* in fields. In Massachusetts, we have many such species-pairs, in which individual species within a genus are segregated by habitat. So, notice the habitat you are in; it is often an important clue to identifying which ant species you have.

Aliens Among Us: Ants In The City

Other ant species are urban-dwellers; interestingly, all nine of the nonnative ants of Massachusetts are found most commonly in cities and towns. Where concrete abounds, look for the (European, originally) Pavement Ant (*Tetramorium caespitum*), which makes its nests in the cracks of driveways, roadways, and sidewalks. In the early spring, it is not uncommon to see neighboring, but unrelated, large colonies of Pavement Ants engaging in territorial battles.

Photo © Gary Alpert/MCZ

The Ruby Ant (*Myrmica rubra*) also turns up in cities, but because it prefers wetter habitats, it has also spread along the coast and the Housatonic River valley. In North America, unlike in most of its native range in Europe, *M. rubra* makes polydomous ("many nests") and polygynous ("many queens") colonies in lawns and gardens, and can drive our native ants from the immediate area. It is one of the very few ants in Massachusetts that will sting a person. Luckily, its sting is very mild in comparison to those of bees and wasps, but it can certainly annoy picnickers in city parks or near the beach. Our remaining nonnative ants are, like the aforementioned *Cardiocondyla*, tropical tramps that can live only in our warm, damp basements, greenhouses, and other heated buildings.

The most common native ant in the city is the tiny Odorous House Ant (*Tapinoma sessile*). We often call it the Sugar Ant because of its tendency to emerge from our sugar bowls and stroll across the kitchen counter in search of more food. But to appreciate its official common name (approved by the Entomological Society of America), pick one up, squeeze it gently, and smell your fingers. The odor of overripe bananas is unmistakable! The easiest way to discourage these tiny opportunists is to put your sugar away in a tight container, rather than littering your counter with poisonous ant traps.

Head for the Beach

The sandplains of Plymouth, Cape Cod, and the Islands are home to more species of ants than any other habitat in Massachusetts. These warm, open areas, with

Inset Photo © Gary Alpert/MCZ

The Ruby Ant, Myrmica rubra, *also known as the European Fire Ant, was first collected in the United States in 1908 at Harvard's Arnold Arboretum in Jamaica Plain. It is now established in coastal New England from Newport, Rhode Island, north and east to Maine's Acadia National Park. In Massachusetts, it has been collected from Worcester to Boston, on Cape Cod, and along the Housatonic River in Berkshire County.*

Photo © Gary Alpert / MCZ

One of our most familiar native ants is the Odorous House Ant, Tapinoma sessile, *also known as the Sugar Ant thanks to its sweet tooth. When handled, it produces a distinctive smell similar to that of overripe bananas.*

vegetation ranging from mature Pitch Pine forests to oak shrublands, open grasslands, and heathlands, provide a diverse range of nesting grounds for a wide variety of ants. More than 70 species have been recorded from the pine barrens in Myles Standish State Forest alone; its county, Plymouth, with 77 known ant species, supports the richest ant fauna of any county in all of New England.

Many ants found in the sandplains of Massachusetts are specialists that live only in particular types of soil. Species such as Knight's Ant (*Formica knighti*), the metallic-green *Monomorium viridum*, the Texas Temnothorax (*Temnothorax texanus*), and an undescribed species of Thief Ant (in the genus *Solenopsis*) nest only in pure sand. Add a little – but not too much – clay to the sand, and these species are replaced as primary residents by, among others, a big-headed harvester ant, *Pheidole pilifera*, the American Ant (*Myrmica americana*), and Nylander's Ant (*Nylanderia parvula*).

Many of the pure-sand species are quite rare. Knight's Ant, originally described from a specimen collected in an Iowa prairie, has only ever been collected five times, including once in Myles Standish State Forest. The Green Monomorium is similarly secretive, having been collected (but not photographed) in Myles Standish and on Cape Cod. Both the Texas Temnothorax and the undescribed Thief Ant are found regularly on the Cape and Islands, but their biology and natural history have not been studied in detail.

In contrast, the clay-tolerant species, *Pheidole pilifera*, *Myrmica americana*, and *Nylanderia parvula* are much more common, abundant, and better known, although their nests can be challenging to spot. The visible part of a *Pheidole* nest is quite small: a volcano-like crater, only a few inches in diameter, in a sandy field. But digging down reveals a nest that can extend 3-5 feet below the surface, with side chambers in which seeds are stored, brood is reared, and, at the bottom, lies the queen's chamber. In contrast, you might never see the nest of *Myrmica americana* or *Nylanderia parvula*, both of which have small colonies of fewer than 100–500 workers and construct diffuse nests with chambers scattered around

Photo © Aaron Ellison / Harvard Forest

Photo © Gary Alpert / MCZ

Sandplain specialists include (top left): Knight's Ant, Formica knighti, *here shown tending aphids on a pitch-pine seedling; (top right) the Texas Temnothorax,* Temnothorax texanus, *foraging at Wellfleet Bay; and (lower left) a tiny, undescribed Thief Ant (*Solenopsis *species).*

under clumps of grass, small pebbles, or in and around tiny twigs. These ants are omnivorous scavengers and opportunistic predators; workers, led by chemical trails laid down by advance scouts, will appear seemingly out of nowhere to capture and haul in caterpillars or small beetles, clean up decomposing insects, or lick sugary secretions off of plants or aphids.

The warm coastal plain of Massachusetts with its unique habitats and its proximity to airports and docks provides one of the best locations to look for new species of ants. Although more time has been spent looking for ants on Cape Cod and the offshore islands than any other parts of the state, careful searching there continues to turn up new species: Daniella Prince's new *Lasius* from Falmouth is only the most recent example. Even a few new observations of these ants would be substantial contributions to myrmecology (literally, "ant science").

Look Around: Ants Are Everywhere!

So, next time you find yourself waiting to cross a street, or ambling along a path, eating lunch outdoors, or just daydreaming, take a few minutes to look at the ants around you. We know surprisingly little about even the basic natural history of most of the 111 species of ants already collected in Massachusetts, and there could be at least 13 more species waiting to be found.

It's easy to find and watch ants – settle down for a picnic and you'll soon have plenty of ants for company. Gently pick

This big-headed Harvester Ant, Pheidole pilifera, *is most commonly found in sandplain habitats.*

Photo © Gary Alpert / MCZ

one up, look at its profile with a 10× hand-lens, and, following the illustrated key in ***A Field Guide to the Ants of New England***, you'll be able to identify which one of the 30 genera of ants in Massachusetts it is. Although a few species can be identified using only a hand-lens, keying the ant out using a dissecting microscope is necessary to go from genus to species identification for most of our local ants. Viewed through a microscope, the diagnostic–and beautiful–characters, including elaborate body sculpturing, compound eyes with different numbers of facets, sharp spines, and differently-shaped hairs can be seen much more easily.

Ants haven't even been formally collected in 187 of the 351 cities and towns across the Commonwealth (see map, facing page), and you can help increase our knowledge about the distribution and diversity of ants in Massachusetts. Although new discoveries may bedevil the publishers of field guides, they delight scientists. To be scientifically useful, specimen data should include where the ant was collected (as precisely as possible, including a description or photograph of the habitat and its geographic coordinates), when it was collected, and who collected it. It is usually okay to collect and pin a few workers, but there is rarely good reason to collect a queen, as collecting the queen will doom the colony. Nicely pinned specimens can be vouchered in university collections and museums, but always ask the curators if the specimen can be accommodated before sending it in. As you find and identify ants, send us your collection data (via *http://NEants.net*) so we can update our range maps and build an atlas of the ants of Massachusetts. With so many ants, the world needs more myrmecologists.

Aaron Ellison is Senior Research Fellow in Ecology at the Harvard Forest, where he studies the ecology of ants, carnivorous plants, and the environments in which they live. Elizabeth Farnsworth is Senior Research Ecologist at New England Wild Flower Society, and has illustrated and written books and articles on ants, plants, and many other critters. Aaron and Elizabeth are co-authors, along with Nicholas Gotelli (University of Vermont) and Gary Alpert (Harvard University) of **A Field Guide to the Ants of New England** *(Yale University Press, 2012).*

ADDITIONAL READING ABOUT ANTS

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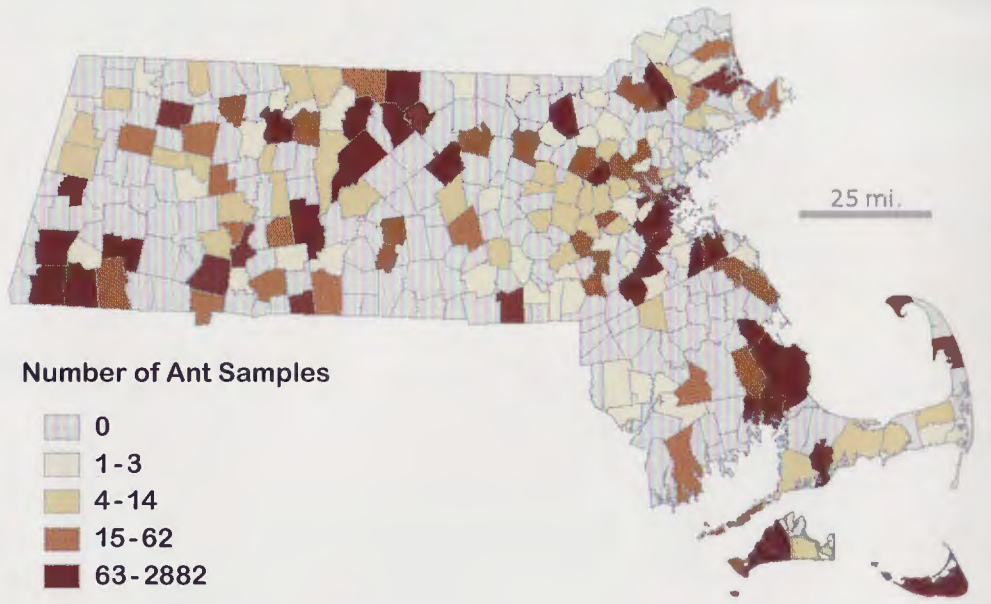

Map © Brian Hall / Harvard Forest

Massachusetts towns in which ants have (colors represent quintiles of specimens) or have not (gray) been collected. Spending time collecting ants in towns in which ants have not been previously collected may yield new species records for Massachusetts. Send your finds to the authors at ***http://NEants.net****.*

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Ants as Prey

Due to their great abundance, wide distribution, and high nutritional value (more than 50% protein by weight) ants are an important element in the diet of many insects and other invertebrates, amphibians, reptiles, birds, and even many mammals. Perhaps the most famous insect predator of ants is the ant lion. Its larvae dig conical pit traps (above) in fine sand and wait at the bottom for hapless ants to stumble in and be devoured. Most woodpeckers, like the Piliated Woodpecker pictured (top, left) feeding its young Carpenter Ant pupae, remove ants and their eggs or pupae from decaying trees and logs. Swallows and kingbirds (Eastern Kingbird, top, right) pick flying ants right out of the air. And while there are exotic mammals specialized to consume ants (e.g., anteaters and echidnas), our own native black bear depends on ants as an important, perhaps crucial (at least in some years) food source, especially in summer. Carpenter ants are frequent targets, especially of the woodpeckers and bears, but bears consume many species of ants, large and small, and appear to hunt them primarily by smell. This one (left) is using its powerful claws to turn and open an ant-infested log.

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