Science AMA Series: I'm Brian Fisher, ant specialist and Curator of Entomology at the California Academy of Sciences, aka "the real Ant Man." My research focuses on new technology to discover and docum

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[1]Affiliation not available

April 17, 2023

Abstract

Hi Reddit! Okay, let's start with the ants. Shakespeare once wrote, "Though she be but little, she is fierce." What they lack in size, ants more than make up for in numbers, and they offer countless behaviors to explore. Ants are Earth's first farmers and shepherds, they engineer floating pontoons and enslave other ants, and their combined weight actually equals humanity's. Yet despite all these intriguing facts, we mostly ignore this global community of ants beneath our feet ... except when they enter our kitchens uninvited. When I'm not describing new at species at the California Academy of Science's laboratory of ant evolution I'm often found hip-deep in Madagascar mud and searching remote river valleys and precious virgin forests for new ants. I love documenting the species diversity and distribution of this "invisible majority," and I use that data to establish conservation priorities. I also champion the vital importance of specimen collection and taxonomy every chance I get — critical work that supports new research, but that many consider unglamorous in this age of sexy scientific sound bites. Understanding ant diversity and distribution helps determine areas that must be preserved to protect the highest number of all living things. Map an ant, save a plant! (And everything else.) I've discovered more than 1,000 new species (including the vampire, trap jaw, and "cliff-jumping" ant) and created Ant Course — a sort of professional "ant camp" for collection and taxonomy. You may find me on BBC http://www.bbc.co.uk/nature/18368213, National Geographic http://news.nationalgeographic.com/news/2006/08/060821-ants.html, and Discovery News http://news.discovery.com/animals/6-new-dracula-ant-species-discovered-in-madagascar-140331.htm as cameras follow me into the field or ask me to discuss films like "Ant Man" https://www.youtube.com/watch?v=-nUpY4M1dWA, and you can always find me on Twitter at @ant_explorer. Ask me anything! Thanks for all the questions. I'll sign in tomorrow to answer a few more. May the ants be with you! More links: Telling Story Collider about living with (and almost dying with) pygmies: http://storycollider.org/podcast/2014-11-16 Fisher lab: http://www.fisherlab.org/

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BRIAN_FISHER R/SCIENCE

ABSTRACT

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Thanks for all the questions. I'll sign in tomorrow to answer a few more. May the ants be with you!
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CORRESPONDENCE:

DATE RECEIVED:
August 22, 2015

DOI:
10.15200/winn.144015.59995

ARCHIVED:
August 21, 2015

Hi Dr. Fisher and thanks for visiting today.

I'm making an assumption that different species have different levels of cooperation amongst themselves and symbiotically with other species. Is there a genetic and/or neural foundation for this behavior?

Thanks again for answering our questions.

CompMolNeuro
Great Question. I'll start with "cooperation" which from a human's perspective quite interesting as we

CITATION:
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struggle to live in a crowded world. First some basics. Ants are of course social, and that has huge implications on their evolutionary story - compared to other individual animals, it is like ants (and other social hym.) it is like they are evolving on a different dimension. The worker ants you see running around are all sisters. These workers are usually sterile. This means that they can not reproduce because they lack a spermatheca and often ovaries, while the queen has both of these. [by the way, the spermatheca is quite a nifty invention: after a queen mates once, it will keep the sperm alive for years, usually for the life of the queen, and the queen will dish out the sperm as needed]. Workers can come in a huge variety from small minor workers to large Majors (soldiers) and then there is the queen. What determines this variation - it was thought to be controlled by what was given the larvae - but we are learning now, thanks to the genomic revolution, that genetics can have a complex role (see the papers cited below). One last point, I must mention that the individual ant is not the organisms, ants are superorganisms and the only way to understand ants is to look at the entire colony as a whole.

Welcome Brian,

I have long wondered what I am seeing when 10s of thousands of ants pour out onto the sidewalk in chaos. I've read about the long, violent wars that ants will wage, but is that what is happening? Or is it probably something else?

Thank you!

adenovato
Ants, like humans, have many strategies for defending their territory. One interesting example is the Pavement ant, Tetramorium sp. E. (why sp. E, well that is another story). This species is native to Eurasia but was introduced to North America about 100 years ago (note ants, like humans, are quick to colonize new words: Argentine ant, Fire ants .....) but what is cool is that it does a "play" war, right in front of your house, in almost every urban setting across North America. Two colonies will meet on a front, each colony trying to push and shove the other back, demonstrating, with little casualties, that they are superior and not to be messed with. From a standing position, it may just look like a black mat, but up close, it is a full on drama, with ants pushing and shoving. It is like that scene in Ant Man, where the toy train falls over - we have no idea what is happening in the secret world of the small.

A long time ago, I saw a show about how ants seem to have few communicable diseases, despite providing excellent conditions for their spread in their societies. It was postulated that the ants must have natural antiseptics or antibiotics that keep then healthy. Has much research been done on that idea recently?

tforkner
How long could we last living in damp, dark, crowded rooms without getting sick. But when you find an ant nest, it is amazing how clean and happy they look. How do they keep disease at bay. We are just learning about the pathogen load on ants. If you sequence the DNA of an ant, there is more virus DNA than ant DNA. And the same for bacteria. In the news today is an article about ants that self medicate. But I think we have a lot more to learn about how ants use glandular secretions to protect themselves from the bad bacteria and viruses and promote the good ones. There is some evidence that the metapleural gland is key to producing these chemicals. Ants are 140 millions years old, they have a long history of fighting pathogens, and with 30,000 species, they have come up with diverse strategies and solutions. Pharmaceutical companies might one day use ants to help us learn how to fight our own pathogens.

What is the best resource to find comprehensive information on different ant species? I live in the upper Midwest, outside on my driveway I can find 5 or 6 different species without even looking that hard, They all can't eat the same things, they have to occupy different niches

right? They are hard enough to ID, where can I learn natural history of individual species? Or, is this information even known?

x24co
When I first went to the tropics in 1986, I saw ants everywhere, but I had a hard time learning about ants. That is why in 2002, I started AntWeb.org which is like a virtural musuem. It shows you the ants that are found nearby (by State or country) and it shows a picture of an ant - not just any picture, these pictures are composites, we take images through a microscope and then combine all the 20 - 100 images into a single all in focus image. I've been on a quest to image every ant species - I've had teams traveling to museums around the world, imaging ants. We are about 75% finished. The next phase, after we have all the species imaged, will be to develop keys to every species. If you are interested in ant literature, you can find pdf for every taxonomic paper on AntCat.org. There is also another site, antwiki that harvests publication data and data from AntWeb.org and combines that with additional information on the biology of ants.

Dr FIsher, Ants are one of my favorite animals. Can you discuss a little bit about the cognitive science behind the 'hive mind'? How does a colony of ant sync itself and operate so efficiently like a borg collective?

Also: can the Academy please have a bigger exhibit for ants. Let's hang out and talk ants next time I visit.

deadfermata
Ants are great problem solvers. We are only just now decoding how ants, after over 100 millions of evolution, work together to solve problems through collective intelligence. In an above question I referenced many works related to this topic. You may think that ant societies function with an all knowing queen telling all the worker ants what to do - but this is NOT what happens. We are learning that small network of individuals work together, using simple pathways (algorithms), much the same way our own neurons function. To me, what is fascinating is that this works on ant colonies of 20 individuals to massive colonies of 1/2 million. How ants forage and make decisions has already help build better algorithms to push bytes through the internet or organise the delivery of Fedex trucks. Now we are learning how to make small robots work together, which seems like an impossible task for robots, and also difficult for humans. We have all tried to move a couch with a roommate. Add four people and it becomes harder not easier. How do ants move such large items together back to the nest? Studies are now showing how robots can work together to move an manipulate objects like ants.

Thank you for doing this AMA!

I was wondering if you could talk a little bit more about what it's like to work at an institution like the California Academy of Sciences, vs. a university setting. Does it allow you to focus a lot more on public outreach activities? Do you have more freedom, or different types of freedom, to pursue the research questions you are interested in? Did you come to it more by chance, or more deliberately?

neurobeegirl
Great question!! Over the last few years, I've noticed a big change in the importance of science in the public's eye. It seems that the place of discourse of science moved to the background - to privileged groups at universities. Being at a public institution like the Academy of Sciences, where my audience is as diverse as the public, I can help bring the conversation back to the public [Reddit too of course is going a great job in this regard). So the museum provides a platform for reaching out to engage the public in different ways than if I was just at a university. But at the same time, the museum, like at a university, requires me to be an entrepreneur in science, to develop my own questions, find my own funding. But because I am dealing with the public, I also think this position has shaped the questions I

address as a scientists. I feel an obligation to ensure my research makes a difference, I can't help but want to save the places on earth that are home to these wonderful animals, ants. Save an ant - Save a Planet. We want to do both good science and have science be good to society.

An article was posted recently on reddit about ants consuming hydrogen peroxide to fend off fugal infections. Here's the link:

https://www.newscientist.com/article/dn28077-ant-knows-how-to-self-medicate-to-fight-off-fungal-infection/

This is fascinating. How do we explain this behaviour?

sproket888
This is a fascinating discovery: that sick ants are can seek out medicine to treat their illness, in this case seeking H2O2 to treat a fungus infection. I wish they had actually replicated the study in the wild to show that in natural conditions, ants infected with fungus would seek out food high in H2O2. Without this test, we really don't know the implication for their findings. Also, what if the fungus was driving this behavior, turning the ants to zombies, keeping the ants alive longer so that the fungus could grow bigger and infect more ants in the colony. If this was the case, this would not be an example of self medication but another example of ants being turned into zombies.

Given they can cause a right old mess of my garden paths and have recently managed to dig their way into my living room, I have tended to smother ant nests with poison.

I understand ants tend to be quite useful for moving and aerating soil, but are there any other benefits to letting them do their thing? Are they akin to bees in the sense that they are fundamental to the continuation of life as we know it?

TheDrCK
How lucky you are!! To have ants visit you, right in your home. Nature not at your doorstep but in your own living room. I can understand how at first this may feel like an invasion. But stop, don't reach for the poison. Take a moment and learn from her ways. Watch how they communication and self organize. Realize you are dealing with an organisms that has collective intelligence that is teaching us how to develop algorithms for AI, how to develop better business structure, how to build better roads and functioning cities. Stop and realize that it is these ants that are responsible for soil in your garden - they turn over more soil than earthworms; they are the vacuum cleaners that keep the "brown cycle" humming along so that the cycle of ecosystems keep working. But you say, OK, OK, but not in my kitchen or living room. What should I do. So if giving a cookie crumb and watching them forage and mass recruit is not for you, then what ever you do, not spray chemicals. In many areas, ants drive home owners to spray chemicals around their homes - which do little to keep ants at bay, but all those chemicals wash into our local streams - a big problem in the Bay Area. You can fight ants with hot water but inside your home, you can seal their entrance with calk or if you must, you can use the baits (yes, they have chemicals, but it the chemicals are more directed to just the target).

I'm really interested in getting a job in the field of conservation (I also happen to be particularly fond of insects). Any advice to an aspiring conservation biologist in terms of experiences, graduate schools, or jobs to look for?

wittja01
The field of conservation is a diverse field that ranges from science, policy, health, and society. As a scientist, I feel a special obligation to contribute. In fact that when I was a PhD student, like 1,000's of others, I set off to save the rainforest. Others set off to save coral reefs, the elephants, lions etc. And look where we are 30 years later - all those PhD students have done little to slow the tide of change.

Thus **science innovation alone can not save the rainforest** or ensure functioning planet for our children. So if you are wanting to be a scientist and do good to society, you are going to have to learn or join forces with a greater community of conservationists.

Im frim vietnam, whats our cooleat ant? And can you talk about that colony of ants that has taken over the globe. Believe its a south american variety.

chasingsnow
Vietnam! Can't wait to go - as it turns out, one of the most interesting and rarest ant in the world is found in Northern Vietnam: Opamyrma!

I've read that humans spreading non-native ants has wiped out insect populations globally and has caused irreparable harm to the ecology. This started mass die offs of things further up the food chain too. Any truth to that?

Also, what are your thoughts on entomophagy? Do you think it would be beneficial (health and ecology wise) to start mixing beef with bugs for things like hamburger patties at fast food restaurants?

_My_Angry_Account_
Many of you have asked about introduced ants (exotic ants, invasive ants). A few ants have given all ants a bad name, these are the invasive ants like Argentine ants, Bigheaded ant, fire ants). Records over the last 500 years have shown that soon after humans reached new worlds, ants followed. Ants are transported by boats, by almost any means around the world. And a few ants, have become part of the human landscape. Every single dinning room across the tropics has the ghost ant (Tapinoma melanocephalum). Now this species is just an addition to our sugar bowls but others like the argentine ant, crazy ant or bigheaded ant, have had a huge impact on our ecosystems. When these introduced ants team up with another plant (phloem) feeding mutualists, like a mealy bug (which is often also an introduced species), these ants can tap into an endless flow of sugar from plants to fuel their invasion. High on sugar, these ants have lead to "ecological meltdown" on Christmas island. Insular system are more susceptible because they lack diverse native ant communities. With deforestation, we are making many new islands of habitat on continents that are also now susceptible to invasion and meltdown.

This is pretty cool, thanks for being here. One of the things I find fascinating about ants is the range of chemicals they utilize on a daily basis! I'm sure it gets very complex, but two areas I am interested in are the venoms and chemical defense mechanisms that ants employ as well as the chemical signaling that ants utilize for communication.

Can you go into these a little? What are some of the more unusual aspects of ants in this regard? What exactly is known about the chemicals used for ant communication/signaling? Highly volatile pheromones, or something else?

Thanks!

glr123
Ants are chemical factories. As you noted, they use chemicals for both defense and communication. An individual ant may have 30 or so glands that produce chemicals in addition to the ones used in defense. Ants "hear" the chemical words with their antennae. With time, we will learn more about the evolution of the genes used in olfactory and chemical production. I am sure we will also discover ways to break the chemical code of the invasive ants and use these chemical cues to control ants.

Why'd they call the ants in Ant-Man male pronouns. Aren't most ants female?

Protectpoultry
You are right, the Ant-Man film got it wrong. The ants in the film are all female and thus Anthony should have been Antoinette. They got so many aspects of ant society right, it is amazing they missed this obvious point - There is an important movement in Science to promote and encourage women in science, but seeing this obvious blind spot in this film makes me wonder if there is equal need for a Women in Film movement.

Has there been any experimentation/investigation into the possibility of controlling ants by mimicking pheromones and directing them towards basic/utilitarian tasks that could be useful to humans? If so, has it yielded any results?

burrabantha
This is an interesting question that has been "asked" by many other insects. There are many beetles for example that have evolved ways to break the code to enter safely inside an ant colony where they get to live in the colony and spend the rest of their lives living under the protection of their ants hosts. They then eat the food the ants bring to the nest or even eat the ant babies. There are also fly larvae that turn ants into zombies and the ant serves the baby fly larvae instead of the colony.

So could we also manipulate ants. For example, could you manipulate ants to help create better soil, or train ants to apply antifungal or antibacterial cream on our wounds or even in our homes! I think we will be driving driverless cars before that happens.

What species of ants are in need of conservation?

thegauntlet
Very rarely does a single ant species get "upvoted" for a conservation action. Though many plant species, ecological interactions, and even whole ecosystems depend on ants, they are invisible to most conservation planners. My work focuses on getting the public and conservation planners to see that functioning ecosystems are more than just a few large mammals or plant species and that a holistic approach is needed. I work in insular systems like the Seychelles or Mauritius, where conservation planning focused on plants and birds have ignored in the past the role of ants, and as a result, their efforts have promoted the invasion of invasive ants - leading to major setbacks in protecting native species.

That said, there are a few amazing ants that need conservation: for example the genus Eciton, army ants, is like the jaguar of the ant world. Like the Monarch butterfly, has a complex life history including stages of migration, high food consumption, that make it susceptible to survive in small forest patches. This ant, which makes its own home each night by creating a fabric out of its own of workers, is has created a specialized micro-ecosystem of life: there are also over 1,000 species of other arthropods that are symbionts with this genus.

Hey Dr. Fisher, thanks for being here. Ants have long been an interest of mine, although i don't pretend to be any great authority. To that, my first question: what books would you recommend a layman to read on the subject, if any?

I heard recently about huge "supercolonies" found that span huge swathes and sometimes entire countries. If you're up to date on the topic (and if i'm not totally imagining this) what are the mechanics of that? Are they truly single entities, or just appear and interact in certain ways that they're classified as such?

Someone else in this thread mentioned the "hive mind." While i'm given to understand it's mostly a result of pheromones and automatic responses, it's still often amazing and surprising the things that an ant colony accomplishes. What's your favorite example of ant colony

cooperation, or at least the one you find most unique and interesting?

Bringing it more local, i've been reading about the increasing Argentine ant population in California and other places. Besides being invasive, how disruptive are they to local ant populations? Can (should) anything be done about them?

Saintbaba
Many of your questions relate to how ants work together as a society. Here are are few books/articles for you to look over, they include a few on bees where this subject has also been of great interest:

Wisdom of the Hive by Tom Seeley Honeybee Democracy by Tom Seeley Self-organization in Biological Systems by Scott Camazine et al. Ant Encounters by Deborah Gordon Collective Animal Behavior by David Sumpter Collective Intelligence by Stephen C. Pratt, The Ecology of Collective Behavior by Deborah M. Gordon

Hello, my 8 year old daughter has wanted to be a entomologist since she was 5. Her question for you is "how do you become a entomologist". "will I have to work at a school, or can I find a job traveling" and "I hate spiders and roaches. Is there any bugs that you hate?" Thank you in advance for your answers. She is obsessed with studding bugs. Her room resembles a mini lab.

codycloudz
8 years old is a perfect age to begin a life long career as an entomologist. As your daughter knowns, one advantage of a career as an entomologist, you get to pursue your childhood dreams as a job - I feel lucky and privileged everyday that I actually get paid for doing something I love. How do you become an entomologist? She's got the first step - love insects (well you don't have to love them all, fine to ignore the roaches). The next step, is to start asking questions, and with time, start finding ways to answer questions.

Dear mr Fisher, how does the agricultural industry look at ants and did the view of the agricultural industry on ants change over the last 20 years?

Another question I have: can/do ants cooperate with *other species of insects* of similar or greater cellular plurality?

IwoJimaGER
Ants were the first farmers - they evolved farming about 60 million years ago. Leaf cutter ants are one of 200 species of ants that farm - they gather plant matter, like leaves, and feed the cellulose to a specific fungus. Underground, they grow massive colonies, all living off their fungus gardens. Humans have struggled a lot with how to grow a monoculture - how do ants do this and is there something we can learn about how they farm. Human do this: they plan like a bunch of corn and then pick the seeds from the corn that grows the highest or the largest ears. Ants, would not pick the seeds. They would take the entire plan, with the soil. Ants aren't planting "seeds", they are creating an entire ecosystem to promote the growth of their fungus.
Each new queen that leaves the parent nest to start a colony, is given a starter kit, in a special pouch under the chin, a ball of fungus that includes the fungus they need to eat, but also all the supporting fungus to promote the protection and grown of the fungus.

I take photographs of insects in my garden. I am trying to classify them by order, probably failing miserably, but where could I send information in case I found something new?

hateme2
If you want to ID your bugs and also help map the world's biodiversity, submit your images to iNaturalist (web or app) - where users will help ID your images. You can also submit images to

bugguide.