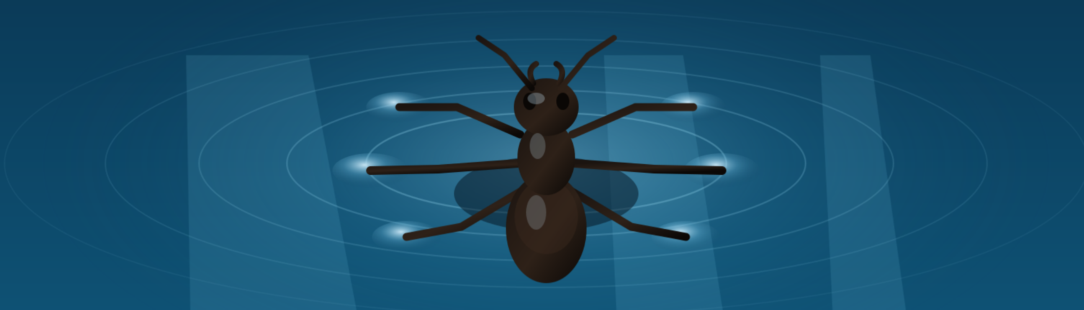
ANTS AND WATER

The Complete Manual

How ants drink, drown, dive, raft,
and survive the wettest place on earth



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Published by antaddict.com

The information in this book is provided for educational purposes. Pest control products are regulated differently in different countries and must be used according to their labels. Nothing in Part V constitutes professional pest control advice. Readers dealing with structural damage, stinging species, or any situation involving allergy risk should consult a licensed professional.

First edition, 2026.

About the author

I have kept ants for six years and I write everything on antaddict.com myself.

That is a modest credential and I would rather state it plainly than dress it up. I am not a myrmecologist. What I have is a lot of hours watching colonies, a habit of reading the primary literature rather than summaries of it, and a low tolerance for confident claims that turn out to have no source.

This book reflects all three. Where research exists, I cite it. Where it does not, I say that the recommendation comes from my own colonies or from what the hobby has converged on, and I do not let those two categories blur together.

Every citation in the reference list is real and checkable. If you find one that is not, tell me and I will correct it.

More at antaddict.com/sabri-hayouni

How to use this manual

There are three ways into this book and they enter at different doors.

If you keep ants, start at Part IV. It is the practical section and it is the reason most readers download this. Come back to Part I afterward for the physiology that explains why the recommendations are what they are.

If you found this because something in your house has ants, go to Part V. It is short and it is written for you. Chapter 21 is the part that matters.

If you are here because the biology is interesting, read straight through. Parts I to III are a continuous argument, and Part II contains the best material in the book.

Every part opens with a note about the quality of the evidence behind it. Those notes are not filler. Part III rests on fifteen years of published measurement. Part IV rests substantially on my own experience. Knowing which is which is the point.

Ten things this book will change

The one-page summary, for readers who want to know what they are getting.

1. **"Water ants" is not a species.** It is three unrelated questions wearing one label, and separating them is the first job of the book.
2. **No ant is aquatic.** Several are amphibious. None has gills, none forages underwater, none completes its life cycle in water.
3. **Waterproofing is a property of arrangement, not just of animals.** A fire ant raft is more water-repellent than any ant in it, because the weave does what the individual cannot.
4. **Ants have solved flooding at least six separate times.** Rafts, levees, head-plugs, bailing, drainage architecture, and simple tolerance are independent answers to one problem.
5. **One mangrove ant seals its nest with collapsing mud.** The tide closes the door by arriving. No worker has to do anything.
6. **Another runs anaerobic.** *Colobopsis anderseni* appears to be the first social insect documented to switch to metabolism without oxygen when its sealed nest runs out.
7. **A third bails out its home by drinking.** Eight hundred ants, three thousand trips, half a teaspoon of water, two days.
8. **Colonies do not want a humidity. They want a choice.** Uniform conditions in a formicarium remove behaviors the ants would otherwise use to manage themselves.

9. **Brood position is your best instrument.** Better than a hygrometer in a small nest, and free.
10. **Most captive colonies die of mold, not thirst.** And founding queens die of it most, because social immunity is a function of having workers to spare.

PART I

The Physiology of Water

CHAPTER 1

What People Mean by "Water Ants"

Let me start by dismantling the title of the book you are holding.

1.1 There is no such thing

"Water ant" is not a taxonomic name. There is no genus, no species, no group of related ants that scientists call water ants. If you searched an entomological database for the term you would find nothing, because the term belongs to ordinary speech rather than to biology.

I am telling you this on page one rather than burying it, because a book that let you believe otherwise for a hundred pages would not be worth your time.

What the phrase does have is a set of real meanings, and they are unrelated to each other.

1.2 The three things people mean

Meaning one: ants near water in my house. Someone finds ants around a bathroom sink, a shower drain, a kitchen tap, a pet water bowl, or a pool deck. They search for what they are looking at. This is the most common intent and it is the subject of Part V.

Meaning two: the ants I saw floating after the flood. Someone in the US Gulf states, or Australia, or South America, sees a mat of ants riding floodwater after a storm.

These are almost always fire ants, *Solenopsis invicta*, and what they are seeing is one of the more remarkable structures in the animal kingdom. Part III.

Meaning three: are there ants that actually live in water? Someone has read about mangrove ants or diving ants and wants to know how far it goes. This is the most interesting question and the answer is more restrained than the internet suggests. Part II.

One phrase, three questions, three different halves of biology. That is why this book has the structure it has.

1.3 The species most often mislabeled

When somebody says water ants and means a specific animal, these are usually the animals.

What they say	What it usually is	Why the confusion
Water ants in my bathroom	*Tapinoma sessile* (odorous house ant)	Strongly associated with moisture, common indoors
Tiny water ants in the kitchen	*Monomorium pharaonis* (pharaoh ant)	Small, indoor, drawn to moisture and food
Floating water ants	*Solenopsis invicta* (red imported fire ant)	Rafting after floods, widely filmed
Ants that live in water	*Polyrhachis sokolova*	Genuine intertidal mangrove nester
Swimming ants	*Polyrhachis sokolova*, some *Formica*	Surface locomotion, not swimming as usually meant
Diving ants	Usually a misreading of the mangrove literature	No ant dives to forage

Note that no row in that table is wrong to be curious about. Every one of them is a real animal doing something real. The label is what fails, not the observation.

1.4 Why the confusion persists

Three reinforcing causes, and it is worth understanding them because they shape every source you will find.

Pest control copy. Commercial pest pages are written for search traffic, and they will build a page around whatever phrase people type. A page titled "How to get rid of water ants" implies water ants exist. Enough such pages and the term acquires apparent legitimacy.

Viral flood footage. Fire ant rafts are genuinely arresting to watch and the footage circulates every hurricane season, usually captioned in ways that suggest a special kind of ant rather than an ordinary fire ant doing something extraordinary.

Compression of real science. The mangrove ant research is fascinating and it gets retold. Each retelling loses a qualifier. "Retreats to trapped air pockets during tidal inundation" becomes "survives underwater" becomes "breathes underwater" in about three hops.

1.5 What is actually true

The honest summary, which the rest of the book supports in detail.

No ant is fully aquatic. None has gills, none completes its life cycle in water, none forages by swimming underwater.

Several ant species are genuinely amphibious in the sense that they live in habitats that are underwater for part of every day, and they have real adaptations for it. Those adaptations are architectural, behavioral, and metabolic rather than anatomical. Ants did not evolve into water animals. They evolved ways of staying dry, or of enduring not being.

That distinction is the intellectual spine of this book.

CHAPTER 2

How an Ant Drinks

Every colony is a water distribution network. Understanding how the plumbing works explains a surprising amount of what you see in a formicarium.

2.1 The crop, or social stomach

An ant that drinks does not simply fill its stomach.

Liquid taken in is stored in the crop, an expandable organ in the gaster that sits ahead of the digestive tract proper. The crop is separated from the midgut by the proventriculus, a valve whose structure varies considerably across ant groups. Liquid-feeding ants tend to have a more elaborate proventriculus, which allows the crop to store a large volume without that volume passing on to be digested.[27]

The consequence is that the crop functions as a container rather than as a stomach. Its contents belong to the colony, not to the individual carrying them. This is why it is called the social stomach.

The extreme version of this is the honeypot ants, *Myrmecocystus*, where replete workers hang from the ceiling with gasters distended into near-spherical storage vessels, so full that they can barely move, and the colony draws on them later.[27]

2.2 Trophallaxis

Liquid moves between individuals by trophallaxis: mouth-to-mouth transfer, in which a donor regurgitates crop contents to a receiver.

The transferred fluid is not only food. Work on *Camponotus floridanus* found trophallactic fluid containing hydrocarbons, cholesterol, microRNA, and juvenile hormone, which is a master developmental regulator. Formicine ants have strikingly acidic trophallactic fluid, at pH 2 to 4, because they acidify their crop contents by ingesting their own formic acid.[27]

So the fluid passing between two ants carries nutrition, chemical identity, developmental signals, and antimicrobial acidity, all at once. Calling it feeding undersells it considerably.

2.3 The social bucket

Not all ants have the crop machinery for this.

Several groups, including *Ectatomma*, *Diacamma*, *Neoponera*, *Odontomachus*, *Paraponera*, *Pachycondyla*, and *Rhytidoponera*, lack the morphological specialization for crop storage but still consume liquid. They use mandibular pseudotrophallaxis instead: the forager holds a droplet of liquid between her mandibles, where surface tension keeps it in a round shape, carries it home, and passes it to nestmates without ever ingesting or regurgitating it.[27]

This is sometimes called the social bucket method, and it is a lovely piece of biology. The ant is not a container. She is a porter carrying a droplet in her jaws, held together by nothing but the physics from Chapter 9.

Ants use this to collect and transport water specifically, as well as honeydew, nectar, and haemolymph.[27]

2.4 What this means for the colony's water budget

Two practical implications.

A colony's water reserve is distributed, not stored centrally. There is no reservoir. There are hundreds of small ones walking around, and the colony equalizes them by continuous exchange.

Water reaches the brood indirectly. Larvae do not go to the water source. Nurses bring it to them. In a formicarium this means that a colony can have perfectly adequate drinking water in the outworld and still have brood suffering in a nest chamber that is too dry, because ambient humidity and delivered water are two separate supply lines.

That second point is the single most useful thing in this chapter and it is why Part IV insists on treating drinking water and nest humidity as different problems.

I have not found a reliable published figure for total daily water throughput in a colony, and I am not going to estimate one. Order-of-magnitude claims about how much water a colony moves are common online and I could not trace them to measurement.

CHAPTER 3

Desiccation and the Cuticle

An insect is a small, warm, wet thing in a large dry world. Everything about its outer surface is a response to that.

3.1 The lipid layer

The ant cuticle is coated in a thin layer of epicuticular lipids, principally hydrocarbons. This layer does two jobs that would seem unrelated: it carries the chemical signature by which nestmates recognize each other, and it waterproofs the animal.

The waterproofing role is demonstrable by removing it. Hood and Tschinkel extracted the epicuticular lipids from arboreal and terrestrial ants using chloroform and methanol, and found that once stripped, both groups lost water at the same high rate at 0 percent relative humidity. Unextracted arboreal ants lost water at half the rate of unextracted terrestrial ants.[6]

The waterproofing therefore sits in the lipid chemistry, not in the anatomy underneath.

There is a wrinkle worth knowing. Cuticular hydrocarbon profiles are not uniform across the body. Body parts differ in their mix of late-melting, more solid compounds and early-melting, more liquid ones.[28] An ant is not evenly waterproofed. Some parts of it leak faster than others.

3.2 Size and survival

Desiccation resistance scales with body size, but not as steeply as simple geometry predicts.

Hood and Tschinkel found resistance increasing with dry weight to the power of about 0.55, whereas the surface-area-to-volume relationship would predict an exponent nearer 0.67. Arboreal ants survived roughly eight times longer than terrestrial ants of comparable size, and after size effects were removed, desiccation resistance still differed between terrestrial species in a way that correlated with foraging patterns.[6]

Three things follow.

Small ants dry out faster. This is why *Temnothorax* and small *Monomorium* have less margin than a *Camponotus* major.

Habitat beats size. An arboreal ant of the same mass as a ground ant survives dramatically longer, because of the lipid layer, not the geometry.

Behavior is part of the answer. Species that forage differently have different resistance even at the same size. Physiology and behavior are tuned together.

3.3 Spiracles and the closed system

Insects exchange gas through spiracles, valved openings feeding a branching network of tracheal tubes. Because the openings are valved, they can be closed.

Closing them reduces water loss, at the cost of reducing gas exchange. Many insects use discontinuous or cyclic patterns of spiracular opening, and reducing respiratory water loss is one long-standing hypothesis for why. I want to flag that the function of discontinuous gas exchange has been actively debated in the physiology literature and the water-saving explanation is one candidate among several rather than a settled conclusion.

For our purposes the practical point stands regardless of which hypothesis wins. A closable respiratory system is why ants survive submersion, and it is why a drowned-looking ant is often recoverable.

3.4 Rectal water recovery

One more mechanism, less discussed and quite elegant.

Arboreal ants in the Hood and Tschinkel study had greater total rectal pad area than terrestrial ants, which suggests a greater capacity to reclaim water from the faeces before excretion.[6]

An animal that cannot easily find water reabsorbs what it was about to throw away. This is the same solution deserts drive in vertebrates.

3.5 What this means for keeping

A short translation of the whole chapter.

Wood-nesting and arboreal genera tolerate dry nests better than soil-nesting genera of the same size, and the reason is a measurable property of the cuticle rather than a preference. Small species have less buffer than large ones in the same conditions. Brood, with less developed cuticle, has less buffer than adults.

That is the physiological basis of the gradient tables in Chapter 18, and it is why those tables are organized by natural habitat rather than by anything else.

CHAPTER 4

Humidity Preference and Brood Placement

Ants do not tolerate their microclimate. They choose it, continuously, and move their brood around inside it.

4.1 Different stages, different needs

A colony contains eggs, larvae at several instars, pupae, callows, workers, and a queen. There is no reason these should share an optimum and good reason to think they do not.

Eggs and early larvae are the most desiccation-vulnerable. They are small, they have the least developed cuticle, and they cannot move themselves. Pupae, particularly naked pupae in species that do not spin cocoons, are vulnerable at both extremes, drying out in low humidity and susceptible to fungal problems in high.

Adult workers are the most robust and the most mobile, which is precisely why they are the ones doing the carrying.

4.2 Brood shuttling, demonstrated

The clearest experimental demonstrations come from thermal rather than humidity gradients, but the behavior is the same behavior.

Camponotus mus nurse workers in a laboratory thermal gradient of 20 to 40 °C showed a circadian rhythm of brood placement, moving brood to about 30.8 °C (87.4 °F) in the middle of the light phase and back to about 27.5 °C (81.5 °F) eight hours later. The high-temperature translocation was entrained by photophase length, and the low-temperature one depended on the preceding move.[1]

Two temperatures, deliberately alternated, on a clock. That is not tolerance. That is management.

On the humidity side, gardening workers of *Atta sexdens rubropilosa* offered chambers at 33, 75, 84, and 98 percent relative humidity distributed themselves randomly across the chambers but placed the fungus garden in the wettest one.[2]

That result has a detail worth pausing on. The workers themselves did not prefer the wet chamber. What they were protecting did. The ants were making a decision about the fungus, not about their own comfort.

The same logic almost certainly applies to brood in non-fungus-growing species, and it is the reason brood position is a usable diagnostic in a formicarium.

4.3 Building against the gradient

Ants do not only move things. They modify the environment.

Acromyrmex heyeri workers respond to simulated water loss through the nest thatch by depositing building material at the loss points.[3] The same species trades thermoregulation against humidity control rather than optimizing either alone.[4] And in *Acromyrmex ambiguus*, circulating dry air through the nest triggered workers to plug tunnels with leaf fragments, with plugs concentrated at the dry-air inflows rather than the outflows, meaning the ants were reading the direction of airflow and building against it.[5]

That last result is the one to remember. The ants detected a local moisture deficit, identified its direction, and built a structure to stop it.

4.4 The keeper's translation

Everything in Part IV descends from this chapter.

If ants actively place brood by microclimate, then brood position is a readout of microclimate. If they build against gradients, then a nest with no gradient has disabled a behavior they would otherwise use. And if what they protect is not the same as where they sit, then watching where the workers are tells you less than watching where the eggs are.

Give them a gradient. Then read it.

PART II

Ants That Live On and In Water

A note before this section

These are the species people mean when they use the phrase "water ants" and mean something real by it.

They are also the species most misrepresented online. Search for the mangrove ants and you will find claims of ants surviving days underwater, ants that breathe through gills, ants that have colonized the sea. The truth is stranger than most of it and better documented than any of it, and it comes largely from one research group working in Darwin Harbour in northern Australia.

Where the real numbers are less dramatic than the popular ones, I give the real numbers.

CHAPTER 5

Polyrhachis sokolova, the Mangrove Mud-Nester

No ant is aquatic. This one comes closest.

5.1 Where it lives

Polyrhachis sokolova nests in marine and estuarine mud in the intertidal zone. It is the only *Polyrhachis* known to do so. Its range runs along the Australian coastline and extends beyond the mainland, with records from New Guinea and New Caledonia.

The detail that makes it remarkable is not the mud. It is the tide.

Nests studied in Darwin Harbour were found from the *Ceriops tagal* zone through to the *Rhizophora stylosa* zone, at elevations between 5.99 and 7.22 m above the lowest astronomical tide. At those elevations the nests were inundated in 13 to 61 percent of all high tides, for durations of up to 3.5 hours.[20]

Read that as a lifestyle rather than a statistic. A substantial fraction of this ant's existence is spent with the sea over the top of its home, for hours at a stretch, on a schedule set by the moon.

5.2 The nest

Nielsen excavated nests and cast the galleries in polyurethane foam, which is the only way to see the shape of something built in mud.

The nests are extensive. A single nest can exceed 100 by 50 cm in extent, roughly 39 by 20 in, with galleries running down to depths of about 18 in (45 cm). There are normally two entrances, and the entrances are elevated above the surrounding mud surface, usually between the mangrove trees and close to the roots. Most entrances are surrounded by a crater of soil particles that the ants have excavated from below.[20]

That crater is not decoration. It is the mechanism.

5.3 The collapsing stopper

Here is the finding that makes this species worth a chapter.

When the rising tide reaches the nest entrance, the loose soil particles of the crater collapse inward. The collapse forms a stopper in the entrance that prevents water from intruding into the nest. The galleries stay dry through the high tide.[20]

Stop and consider what that means. The ants have not built a door. They have built a structure that fails in a useful way. The material is deliberately loose, so that water arriving from above causes it to slump and seal the opening it was surrounding.

It is passive. It requires no worker present, no decision, no coordination. The tide closes the nest by arriving.

This is a genuinely elegant piece of engineering and it is almost never the thing people cite about this species.

5.4 What the trapped air is like

The galleries staying dry is not the same as the galleries being comfortable.

Air trapped in a sealed nest becomes stale. Nests of *P. sokolova* have been sampled for carbon dioxide during and following inundation, and the ants retreat to air pockets in which carbon dioxide reaches concentrations reported as high as 11 percent.[21][22]

For comparison, ordinary air is about 0.04 percent carbon dioxide. Eleven percent is a level that would render a human unconscious.

Nest architecture matters to how this plays out. Narrow tunnels connecting the main cavities can maintain separate air pockets even at high tide, meaning that flooding in one part of the nest does not flood the whole nest.[20] The nest is compartmented, and the compartments fail independently.

5.5 Swimming

P. sokolova workers show a clear swimming or surface-walking behavior. It was observed in returning foragers as they came back to the nest just before the entrance collapsed, and again during the ebb.[20]

I want to be precise about the claim, because this is where the internet version departs from the paper. The ants move across the water surface. They are not swimming underwater in the sense of a diving beetle. The behavior is described as swimming or walking on the surface, and it is a way of crossing water, not living in it.

What it demonstrates is that surface water is passable terrain for this species rather than a barrier. For an ant on a mudflat with a rising tide, that is the difference between making it home and not.

5.6 The tide as a clock

Everything this species does runs on a schedule that has nothing to do with day or night.

Foraging happens on the low tide. Return happens before the entrance seals. The colony's active period is set by a cycle of roughly 12.4 hours that drifts against the solar day, so the ants are foraging at a different clock time every day and at the same tidal time every day.

I find this the most interesting thing about the species and it is the least discussed. Most ants live by the sun. This one lives by the moon.

5.7 What it is not

Three corrections, because they circulate.

It does not breathe underwater. It retreats into trapped air. The distinction is total.

It is not the only ant in tidal habitats. Subterranean nests of several species in the Gulf of California flood regularly, ant communities have been studied in seasonally inundated Amazonian forest, and in northern Europe *Lasius flavus* in tidal meadows is submerged along with its larvae and its aphids during winter inundations that can last several days. [20] *P. sokolova* is the best studied, not the only case.

Its nests are not "completely submerged at each high tide" in the sense usually implied. Some sources say this. What the excavation data show is inundation in 13 to 61 percent of high tides depending on nest elevation, which is a range, not a constant, and the galleries within stay dry.

CHAPTER 6

The Sealed Nest: *Colobopsis anderseni*

If *Polyrhachis sokolova* solves flooding with architecture, this species solves it with a worker's face.

6.1 A name note first

You will find this ant in the literature as *Camponotus anderseni* McArthur & Shattuck, 2001. It has since been placed in *Colobopsis*, and recent papers use *Colobopsis anderseni*.

Both names refer to the same animal. I mention it because if you go looking for the primary sources, you need both spellings to find them all.

6.2 Where it lives

C. anderseni lives exclusively in the twigs of the mangrove tree *Sonneratia alba*. That tree forms the fringe at the wettest part of the mangrove zone.

So the ant is not in the mud like *P. sokolova*. It is above the mud, inside a plant, at the seaward edge of the forest. And the twigs it occupies go under at high tide.

6.3 The head as a door

Phragmosis is the use of a modified body part as a physical plug. Several unrelated ant groups have evolved it, usually against intruders.

In *C. anderseni*, soldiers block the nest entrance hole with their heads to prevent water influx during inundation.[23]

The word "block" is doing a lot of work there. This is a living gasket. One individual, positioned in the entrance, is the only thing between the colony and the sea.

6.4 The cost of a perfect seal

Excluding water also excludes gas exchange. That is the trap.

A sealed twig nest with a colony inside will run down its oxygen and accumulate carbon dioxide, and there is no way to seal against one and not the other. The ants have chosen suffocation over drowning, and they have to survive the choice for the duration of the tide.

What the research found is that *C. anderseni* is, as far as is currently known, the first social insect documented to engage in anaerobic respiration when oxygen becomes limiting.[23]

That is the headline finding of this chapter and it deserves plain restatement. When the oxygen runs out, this ant switches to metabolism that does not require it. Anaerobic metabolism is inefficient and produces waste products that have to be dealt with afterward, which is why it is normally a short-term emergency measure in animals. Here it is a routine tidal adaptation.

6.5 What I will not claim

The popular version of this species says it survives for days underwater.

The published work concerns nest submersion associated with tidal inundation, and tidal inundation is measured in hours. In the sister species *P. sokolova*, documented inundation durations reach 3.5 hours.[20] I have found no support for multi-day submersion in either species and I am not going to repeat it.

Hours of sealed anaerobic survival in a twig full of seawater is already an extraordinary thing for an insect to do. It does not need inflating.

6.6 Why this matters beyond mangroves

Two general lessons come out of this species.

Ant respiratory limits are wider than the textbook version. If a *Colobopsis* soldier can run anaerobic, the standard picture of insect tracheal respiration as an obligate aerobic system needs an asterisk.

Extreme habitats reveal capacity, not exception. The mangrove work is valuable precisely because the conditions are extreme enough to expose what ants can do. The capacities were presumably there in the lineage before the habitat demanded them.

CHAPTER 7

Cataulacus muticus and Communal Bailing

This one is the strangest thing in the book, and the title of the paper that described it is "Communal peeing: a new mode of flood control in ants."[24]

7.1 The problem

Cataulacus muticus nests exclusively in the hollow internodes of giant bamboo. In west Malaysia it occupies two bamboo species, *Gigantochloa scortechinii* and *Dendrocalamus asper*, forming large monogynous, polydomous colonies that can exceed 2,000 workers spread across the internodes of several neighboring culms.

A bamboo internode is a sealed cylinder with a small entrance hole the ants have made. In a perhumid tropical rainforest, that cylinder fills with rainwater.

There is no drainage. Water that gets in stays in, unless something removes it.

7.2 The two-graded response

Maschwitz and Moog studied the response in the Gombak Valley in Malaysia and in the laboratory. The ants respond in two stages.[24]

Stage one, during heavy rain: block the entrance. Workers plug the nest entrance with their heads to reduce water influx. Same solution as the mangrove twig ants, arrived at independently, against rain instead of tide.

Stage two, when water gets in anyway: drink it and carry it out. Workers imbibe the water inside the nest, walk out, and excrete it as droplets on the outer surface of the bamboo stem.

The colony bails out its home using its own digestive tract as the bucket.

7.3 The numbers

The laboratory experiment is worth describing because it makes the scale concrete.

Three colonies were housed in transparent plastic tubes shaped like the hollow internodes of their natural bamboo. Two milliliters of colored water, roughly half a teaspoon, was introduced into the nests. Over the following two days, about 800 ants made more than 3,000 trips to drink and deposit the water outside.

Half a teaspoon. Three thousand trips. Two days.

7.4 Is it really peeing?

The paper's title is memorable but the mechanism deserves a sentence of care.

The behavior involves imbibing water and excreting it. Whether it passes through the digestive tract as true excretion, or is regurgitated, is a distinction that matters biologically. The published description is drinking followed by excretion of water droplets, and I will leave the precise route to the primary source rather than overstating what I know.

There is a related behavior in another bamboo-nesting ant that is described as spitting rather than excreting, reported in *Tetraponera binghami*. Different genus, different subfamily, same problem, similar solution.[24]

7.5 The control that makes it a finding

This is the part I appreciate most as a piece of science.

The same laboratory tests were run on two other *Cataulacus* species: *C. catuvolcus*, which colonizes small dead twigs, and *C. horridus*, which lives in rotten wood. Neither showed any form of water-bailing behavior.[24]

That control is what turns an anecdote into a result. The behavior is not a generic *Cataulacus* trait. It belongs to the species with the flooding problem.

Ecology first, behavior second. That principle runs through this entire part of the book.

CHAPTER 8

Bog, Marsh, and Seasonal Flood Specialists

The mangrove species are the spectacular cases. They are not the common ones. Far more ants deal with water as a seasonal or occasional problem than as a twice-daily one.

8.1 The seasonally flooded forest

Ant communities have been studied in annually inundated forest in the Brazilian Amazon, and flooding measurably restructures litter-nesting ant communities, affecting species richness, density, and composition.[25]

The general pattern is what you would expect. Flooding acts as a filter. Species that cannot cope are absent or reduced; species with a response persist.

What is worth noting is that this is a community-level effect, not just a mortality effect. The flood does not simply kill ants. It determines which ants are there at all.

8.2 Tidal meadows in northern Europe

The case I find most instructive is the least exotic.

In northern Europe, tidal meadows are often inundated for up to several days during the winter season. The dominant ant there, *Lasius flavus*, lives in plant-covered sand nests that give no protection against seawater infiltration. The ants, their larvae, and their aphids are all submerged during these inundations.[20]

No stopper. No head-blocking. No bailing. They go under and they come back.

That is a fourth strategy and it is the most widespread one: simple tolerance. Ants have a low metabolic rate, a closed tracheal system that resists water entry, and a considerable capacity to survive periods without gas exchange. A great many species survive submersion not by preventing it but by outlasting it.

Lasius flavus is a common garden ant across much of Europe. It is not a specialist. It is just quietly good at this.

8.3 Documented flood strategies, collected

Reviews of ant flood responses list a range of behaviors across unrelated groups.[26] Assembled:

Strategy	Description	Example group
Raft formation	Self-assembled floating structure	*Solenopsis*
Levee construction	Earthen banks built around the entrance after heavy rain	*Solenopsis*
Entrance sealing	Physical plugging, active or passive	*Colobopsis*, *Polyrhachis*, *Cataulacus*
Water bailing	Removing water from the nest by carrying it	*Cataulacus*, *Tetraponera*
Drainage architecture	Nest design that sheds seeping water	Various
Nest relocation	Moving out ahead of or during flooding	Widespread
Passive tolerance	Surviving submersion without a specific response	*Lasius flavus* and many others
Air-pocket retreat	Withdrawing to trapped air within the nest	*Polyrhachis sokolova*

Eight strategies. At least six independent evolutionary origins among them. Flooding is a problem ants have solved repeatedly and separately, which is usually a sign that the selective pressure is both strong and ancient.

8.4 What this predicts for temperate keepers

If your species comes from a habitat with a seasonal water table, it probably has more tolerance than you expect and it may relocate rather than resist.

If your species comes from dry, well-drained ground, it has no such history and a flooded nest is a genuine emergency. Chapter 17 is the relevant chapter.

CHAPTER 9

Walking on Water

A short chapter about a short distance: the few micrometers between an ant standing on water and an ant in it.

9.1 The physics

Water molecules cohere. At the surface, that cohesion produces a film under tension, which can support a load if the load does not break through.

Whether an object floats on surface tension depends on its weight, the length of its contact line with the water, and whether its surface is wetted by water or repels it. Small and water-repellent wins. Large and wettable loses.

An ant is small. Most ant cuticle is at least moderately hydrophobic, a property that comes from the epicuticular lipid layer covered in Chapter 3. Between the two, a lot of ants can rest on a water surface without sinking, and some can move across it.

9.2 Which is which

Genuine surface locomotion, as opposed to being stuck, is documented in the mangrove specialists. *P. sokolova* workers show clear swimming or surface-walking behavior when crossing water on the incoming and outgoing tide.[20]

Most ants can float. Fewer can steer. The difference between a floating ant and a water-walking ant is propulsion, and propulsion on a surface film requires either specific leg movements that push against the film or enough body length to get purchase.

I want to be honest that I am reasoning from general arthropod biomechanics here rather than from ant-specific measurement, because ant surface locomotion is not a well-studied subject compared to water striders.

9.3 The sink trap

Practical consequence, and the thing most readers actually came for.

An ant found in a sink or bathtub is usually not drowning. It is trapped by geometry. The sides are smooth and steeply curved, and an ant that has fallen in cannot get purchase to climb out. If there is water in the basin, the ant is likely resting on the surface film or clinging to the side, and it may have been doing so for a long time.

This is also why ants appear in bathrooms in numbers that seem alarming. They are not swarming the sink. They are falling into it and not getting out, and the ones you see accumulate.

Detergent changes this immediately. Surfactant lowers surface tension, and an ant that was resting on the film sinks through it. This is the same mechanism behind the soapy-water advice for fire ant rafts in Section 10.7, operating at a scale of one.

9.4 Why an ant pulled from water often revives

Worth stating here because it surprises people and it matters practically.

Insects do not breathe through their mouths. Gas exchange happens through spiracles, small valved openings along the body, feeding into a system of tracheal tubes. Spiracles can close.

An ant that goes under does not immediately flood its respiratory system. It closes up and waits. Metabolic rate is low, oxygen demand is low, and the closed system resists water entry. This is a large part of why *Lasius flavus* survives days under a tidal meadow and why an ant fished out of a water dish will frequently walk away after a few hours on a dry towel.

So: do not throw away drowned-looking ants. Section 17.2 says the same thing from the other direction.

PART III

Surviving Flood

A note before this section

This is the best-evidenced part of the book. The fire ant raft has been studied by biologists, physicists, and materials engineers for fifteen years, and there is a genuine body of measurement behind almost everything in Chapter 10.

That creates the opposite problem from Part IV. Here the risk is not thin evidence. It is that the popular retelling of this research has drifted a long way from what the papers actually say. Roughly half of what circulates online about fire ant rafts is embellishment layered onto a real and already remarkable finding.

Where I correct a widespread claim, I say which claim and why. That is most of Section 10.6.

CHAPTER 10

The Fire Ant Raft

Drop one fire ant into water and it struggles. Drop eight thousand in and they float.

That gap is the whole subject of this chapter, and the fact that it is a gap rather than a difference of degree is what makes it interesting. The raft is not many ants floating. It is a structure with properties none of its members possess.

10.1 What a raft actually is

In 2011 a team at Georgia Institute of Technology published the study that opened this field. Mlot, Tovey, and Hu used time-lapse photography to document how *Solenopsis invicta* workers link their bodies when their habitat floods. Their framing is worth quoting in substance rather than paraphrase, because it is the conceptual move that made everything after it possible: water repellency in nature had been treated as a static material property of things like plant leaves and insect cuticles, and what the fire ants demonstrate is a self-assembled hydrophobic surface.[10]

Read that again. The waterproofing is not a property of the ants. It is a property of the arrangement.

Their comparison is to weaving. Individual fibers are not waterproof. Woven tightly enough into a fabric, they become so, because the geometry of the weave prevents water from passing between them. The ants do the same thing with their bodies, and they assemble the fabric themselves, in minutes, without a plan.

This is why a raft belongs in a category with materials rather than with behaviors. It is closer to a fabric or a foam than to a swarm.

10.2 How they link

The connections are of two kinds: mandible to tarsus, and tarsus to tarsus. In plain terms, jaws gripping legs and legs gripping legs.

The grip is not a permanent weld. Bonds form and break continuously as the structure is loaded and unloaded, and that reversibility is central to how the raft behaves. A rigid structure of the same shape would tear. A raft redistributes.

Two features follow from the linking geometry.

Air is trapped. The bodies do not pack solid. The spaces between linked ants hold air, and the trapped air is what provides the buoyancy. An air bubble clings to a submerged individual strongly enough that holding a single ant underwater requires physically tethering it.[10]

Water repellency increases. An individual fire ant's cuticle is moderately hydrophobic. The raft surface is considerably more so, measured as an increase in the contact angle of a water droplet resting on it.[10]

That second point is the self-assembly claim made concrete. The ants did not become more waterproof. The surface did.

10.3 The raft as a material

Once you accept that the raft is a material, the obvious next question is what kind. Physicists have answered that in some detail.

Fire ant aggregations are viscoelastic. Tested with oscillatory rheology, they behave partly like an elastic solid and partly like a viscous fluid. At the lowest ant densities tested and within the linear regime, the elastic and viscous moduli were essentially identical across the frequency range examined, which the authors read as the absence of any dominant mode of structural relaxation. Pushed beyond the linear regime, the aggregations shear-thin.[11]

Shear-thinning means the material gets easier to deform the faster you deform it. Ketchup does this. So does blood. So, apparently, does a pile of living ants.

The raft is also not static in shape. Work on rafts docked against vertical rods documented a treadmilling process: ants in the structural network transition into a free layer walking on top, the raft contracts, and free ants deposit back into the network at the edges, so the structure continuously turns itself over while maintaining its form.[12]

A raft is therefore doing three things at once. Floating, flowing, and rebuilding itself. Any one of those would be notable.

10.4 Towers

When a floating raft meets emergent vegetation, the ants can climb it and build upward. This has been studied experimentally by having colonies construct towers around a vertical rod standing in for a plant stem.

The finding that matters is that the towers sink and are perpetually rebuilt.[13] The structure is not a completed object. It is a steady state maintained by continuous replacement, in the same way a fountain has a shape without any water staying in it.

This connects directly to Section 10.3. A viscoelastic material under its own weight will creep. A tower of viscoelastic living material will sag and must be rebuilt from below, forever, or it collapses.

10.5 Where the queen and brood go

Here I have to slow down, because this is where the popular account outruns the evidence.

The widely repeated claim is that the colony places the queen and brood in the protected center or on top of the raft, deliberately, as a prioritization decision. You will find this stated flatly on hundreds of pages.

What the research reliably supports is narrower. Brood are present in natural rafts, brood are buoyant, and the raft as a whole is a layered structure with a distinct top and bottom rather than a homogeneous mass. Descriptions of the queen occupying a sheltered position are common in field observation.

What I am not comfortable asserting is the intentional-prioritization framing, because the alternative explanation is hard to rule out and rarely gets mentioned. Buoyant items in a self-assembling structure end up in particular positions for physical reasons. A brood pile at the top of a raft may be a decision, or it may be what happens to buoyant objects in a bilayer that is continuously turning itself over.

I am not saying the prioritization account is wrong. I am saying that when you read a confident version of it, check whether it is sourced to a measurement or to an assumption that sounds right.

10.6 Four claims to be careful with

These circulate widely. Each contains something true.

"Rafts survive for weeks." The 2011 paper describes groups floating effortlessly for days.[10] Days is already remarkable. Weeks, months, and crossing open ocean are extensions I have not found support for.

"Floating fire ants are more venomous." A specific figure, 165 percent of normal venom content, gets repeated constantly. I have not been able to trace it to a primary source I can verify, and I am not going to reproduce a number I cannot stand behind. What is well supported and sufficient for public-safety purposes: rafted colonies are stressed, aggressive, and in direct contact with anyone who touches them. That is reason enough to leave them alone.

"The bottom layer of ants drowns for the colony." A sacrifice framing. Ants on the underside are not submerged in the way this implies, because the trapped air layer is what keeps the raft up in the first place. If the bottom layer were drowning, the raft would be sinking.

"Fire ants invented this to invade new places." Rafting is an adaptation to periodic flooding in the South American floodplains where *S. invicta* evolved. That it also happens to assist dispersal in invaded regions is a consequence, not a purpose.

10.7 What this means after a hurricane

The practical version, because in the US Gulf states this is a real seasonal hazard rather than a curiosity.

Floodwater carries rafts. They look like floating debris, clumps of reddish material, or an oil-slick sheen on the surface. They are mobile, they adhere to anything they contact, and contact with a person or a boat triggers immediate dispersal onto that surface.

The rules are short. Do not touch floating debris in floodwater in fire ant country. Do not attempt to break up a raft with a hand or a paddle. Do not spray water at one, which disperses it into smaller rafts rather than destroying it. Wear boots and gloves in standing water. If a raft is against a structure, a surfactant such as dish soap in water reduces the surface tension that keeps it afloat, which is the mechanism behind the standard advice.

For anyone with a known fire ant sting allergy, floodwater in an infested region is not an environment to enter on foot at all.

CHAPTER 11

Rafting and Bridging Beyond *Solenopsis*

Fire ants dominate this literature to a degree that distorts the picture. It is worth being explicit about what we do and do not know outside that one species.

11.1 The honest state of the evidence

Solenopsis invicta rafting is exceptionally well studied. Rafting in other genera is reported, sometimes photographed, and rarely measured.

That asymmetry has a mundane cause. *S. invicta* is a major invasive pest in a wealthy country with a large research community, it is easy to collect in enormous numbers, and its rafts are large and photogenic. None of that makes it unique in nature. It makes it convenient.

So when this chapter says a behavior is documented in one genus and not others, read that as a statement about where researchers have looked, not as a statement about what ants can do.

11.2 Living bridges: the same trick, a different problem

The clearest evidence that self-assembly is a general ant capability rather than a fire ant peculiarity comes from a completely different context.

Army ants of the genus *Eciton* build bridges out of their own bodies to span gaps in foraging trails. Field experiments with *Eciton hamatum* showed that these bridges are not fixed once built. They lengthen, widen, and migrate in response to traffic levels and the geometry of the gap. Bridges start where the trail deviates from the ants' incoming direction, then move over time to create shortcuts across larger gaps. They stop moving at the point where the cost of locking more workers into the structure outweighs the benefit of a shorter trail, and they dismantle when traffic across them drops below a threshold.[14]

Structurally this is the same phenomenon as a raft. Individuals link into a load-bearing assembly, the assembly has properties no individual has, it continuously reconfigures, and it dissolves when no longer needed.

The problems being solved are different. A raft solves buoyancy. A bridge solves a gap. The mechanism underneath is one mechanism.

11.3 Genera reported to raft or float

Presented with the appropriate caution. Reported means observed and described. It does not mean measured.

Group	Reported behavior	Evidence quality
Solenopsis (fire ants)	Full raft formation, towers, treadmilling	Extensively measured
Eciton (army ants)	Bridges, bivouacs, scaffolds; some flood response	Well studied, mostly not on water
Formica	Clumping and floating reported	Anecdotal
Camponotus	Some species tolerate submersion; see Part II	Species-specific research exists
Polyrhachis	Mangrove species swim and run on water; see Part II	Species-specific research exists
Anoplolepis	Rafting reported in invasion contexts	Anecdotal
Linepithema	Colony relocation ahead of flooding reported	Anecdotal

Two rows there point forward rather than sideways. *Camponotus anderseni* and *Polyrhachis sokolova* are covered properly in Part II, because what they do is not rafting. Rafting is floating on top of water. Those two live in it.

11.4 The species that simply drown

It needs saying, because a book about ants and water can easily leave the impression that ants are universally good at this.

They are not. Most ant species have no flood strategy beyond moving upward and hoping. A colony in a temperate woodland that has never experienced seasonal inundation has no selective history that would produce a raft, and there is no reason to expect one.

Flood tolerance clusters in lineages with flood-prone ancestry. *S. invicta* comes from South American floodplains. The mangrove specialists come from a habitat that is submerged twice daily. The capability tracks the history.

This is the single most useful generalization in this part of the book, and it is also the one that transfers directly to your formicarium. A species from a habitat that floods will tolerate a wet accident. A species from dry ground will not.

CHAPTER 12

Nest Architecture as Flood Defense

A raft is the emergency response. The nest is the standing defense, and it is working every day whether or not the water arrives.

I want to flag the evidential status of this chapter up front. Ant nest architecture has been mapped in real detail for a handful of species, largely through the cast-and-excavate work of Walter Tschinkel and others. The link from that architecture to flood performance specifically is more often inferred than tested. I will mark where I am inferring.

12.1 Chambers hold air

The basic physics is not complicated. A horizontal chamber connected to a vertical shaft, in soil that is being flooded from above, does not fill completely. Water entering the shaft compresses the air already in the chamber, and the compressed air resists further entry.

The result is an air pocket. How large depends on chamber geometry, how fast the water rises, and how permeable the surrounding soil is.

This is the same principle as a diving bell. It is also the principle behind the sealed-nest strategy covered in Part II, where *Camponotus anderseni* plugs its nest entrance with a worker's head and the colony survives on the enclosed air.

Inference flag: that chambers hold air under flooding is physics and is not in doubt. That chamber shape in specific species has been selected *for* this function is a hypothesis, not a demonstrated result, for most species.

12.2 Turrets, craters, and the raised entrance

Many ants build the nest entrance above the surrounding ground level. Craters of excavated soil, thatch mounds, and constructed turrets all raise the opening.

These structures have several documented functions, and ventilation is a well-supported one. In grass-cutting ants, turrets are not simply heaps of dumped spoil. Workers import building materials and arrange them with spatial selectivity into the turret walls, which indicates a built structure rather than a byproduct.[15]

Flood exclusion is an obvious additional benefit of a raised entrance and it is frequently stated as a function. I would treat it as plausible and undertested. A structure can be built for ventilation and still keep water out.

12.3 Depth as a tradeoff

Nest depth is where flood risk collides with everything else the colony needs.

Deep nests buffer temperature, stay closer to stable humidity, and put brood beyond the reach of most surface predators and most surface disturbance. Deep nests also fill first and drain last.

Shallow nests warm faster in spring, which matters enormously for brood development, and they drain quickly.

They also expose the colony to temperature extremes and to anything that disturbs the top few inches of soil.

Soil conditions demonstrably shape digging decisions. In South American *Acromyrmex*, soil temperature influences digging behavior and the resulting adaptive value of nest depth differs between species.[16] The mechanism is local and immediate: workers respond to what they encounter as they dig, and architecture emerges from that.

Inference flag: extending this from soil temperature to soil water as a depth-determining cue is reasonable and, as far as I have found, not directly demonstrated in the same way.

12.4 Relocation as the real strategy

Here is the part that gets underweighted. For most species facing rising water, the nest is not the defense. Leaving is.

Colonies relocate. They do it more readily and more often than most people assume, and a colony that abandons a flooding nest and reassembles fifteen feet (about 4.5 m) uphill has solved the problem more completely than any architectural feature could.

This reframes the whole chapter. Nest architecture buys time. Time is what relocation needs.

CHAPTER 13

Rain, Foraging, and Colony Timing

Water shapes ant behavior long before it becomes a flood. This chapter is about the ordinary case.

13.1 Rain suppresses foraging

Ants forage less in rain. This is uncontroversial and the mechanisms are partly worked out.

Direct effects are the obvious ones. Rain physically dislodges small insects, floods trails, disrupts pheromone trails by washing them away or diluting them, and makes surfaces treacherous.

There are also load effects. In experiments with leaf-cutting ants, ants carrying wetted leaf fragments frequently dropped their loads even when the ants themselves were not wet, and wetted ants also dropped loads that were not wet. Watered leaf fragments gained 143 percent in weight. Ants increased their speed by about 30 percent after experimental increases in relative humidity and after exposure to the sound of raindrops striking leaves near the trail.[17]

That last detail deserves attention. The ants sped up in response to the sound of rain, before the rain reached them. Whatever else is going on, they are using an advance cue.

13.2 The "ants get busy before rain" claim, examined

This is folk weather lore in dozens of cultures and it is one of the questions that brings people to a site like this.

The honest answer has three parts.

There is a real observable phenomenon. People do see increased ant activity ahead of weather. That is not imagined.

There are plausible mechanisms. Falling barometric pressure, rising humidity, temperature changes, and, per the study above, acoustic cues from approaching rain are all detectable by insects and all precede rain reliably enough to be useful. Increasing foraging speed or urgency ahead of a period when foraging will be impossible is a sensible strategy.

The specific folk claim is not well established. "Ants marching in a line means rain is coming" is a different and much stronger claim than "ants respond to pre-rain cues," and it is the strong version that circulates. Ants march in lines constantly. Rain follows sometimes. That is not evidence, it is the base rate.

My position: the underlying biology is real and partially demonstrated, the folk forecasting method is not reliable, and anyone telling you they predict weather by watching their garden ants is describing confirmation bias with a pleasant story attached.

13.3 Rain and nuptial flights

The connection here is stronger and more interesting, and it also comes with a useful counterexample.

Rain is among the most common triggering stimuli for nuptial flights, particularly in species from dry habitats such as deserts, grassland, and forest clearings.[18] The functional explanation is straightforward: rainfall softens soil, and a newly mated queen has to excavate a founding chamber immediately, alone, with no workers and a fixed energy budget. Soft ground is the difference between success and failure.

The synchronization this produces can be regional in scale. Observations of the seed-harvesting ant *Messor barbarus* across the Iberian Peninsula identified clusters of nuptial flights triggered by the same weather fronts, with flights associated with a single front spanning a mean maximum distance of roughly 638 km and a maximum of 1,075 km.[19] Colonies more than a thousand kilometers apart flying on the same cue, because the same weather system passed over all of them.

Now the counterexample, which is the part usually left out. In *Manica rubida* in Poland, no rainfall was observed in the 24 hours preceding flights, with rain arriving only afterward.[19] In a climate that is already moist, digging is not the constraint, so rain is not the cue.

That is the correct shape of the generalization. Rain triggers flights where soil hardness is the limiting factor. Where it is not, it does not.

13.4 What this means for keepers

Two practical consequences.

For catching queens: in dry climates, the day or two after significant rainfall during flight season is the highest-yield window, and the effect is regional rather than local. If a front has passed over your area, it has passed over a large number of colonies simultaneously. In wetter temperate climates, rain is a weaker predictor and temperature and humidity thresholds matter more.

For understanding your colony: a captive colony has no weather. Every barometric, acoustic, and humidity cue that would normally structure its foraging is absent, replaced by whatever your room does. Some of the behavioral flatness keepers notice in long-established captive colonies may trace back to this, though I want to be clear that I am speculating and I know of no research testing it.

PART IV

Water in the Formicarium

A note before this section

Everything in Parts I through III came out of published research. This part is different, and you deserve to know that up front.

There is a large scientific literature on how ants manage water in natural nests. There is almost no scientific literature on how ants manage water in a plastic box on your desk. Where I can point to a study, I do. Where I am reporting six years of my own colonies and what the wider hobby has converged on, I say so plainly.

That distinction matters more here than anywhere else in the book. A hobby recommendation repeated for fifteen years across forums is not evidence. It is a hypothesis with a lot of anecdotal support, which is a real thing but not the same thing.

CHAPTER 14

The Test Tube Setup

The test tube is the single most important piece of equipment in this hobby, and it is the one most keepers get wrong. Not badly wrong. Slightly wrong, repeatedly, in ways that kill founding queens without ever announcing themselves.

A test tube setup is a water reservoir held behind a cotton plug, with the colony living in the dry air space in front of it. The reservoir does two jobs at once. It supplies drinking water, and it holds the humidity of the chamber at a level the brood can survive.

Those two jobs have different failure modes. Understanding that is most of the chapter.

14.1 Why the cotton plug fails

The plug is a wick. Water moves through it by capillary action, evaporates off the colony-facing surface, and saturates the air in the tube. That is the whole mechanism.

It fails in three ways.

Packed too tight. Compressed cotton has smaller pores. Smaller pores hold water more strongly and release it more slowly. A tube plugged hard enough that the cotton looks dense will run dry in the front while the reservoir is still visibly full. The ants can see water they cannot reach.

Packed too loose. The plug leaks. Water seeps forward into the chamber, pools under the brood, and drowns eggs and small larvae. This is the more common beginner failure because a loose plug feels safer than a tight one.

Contaminated. Cotton that has been touched with bare hands, stored in a dusty drawer, or reused from a previous colony carries fungal spores and skin oils. The oils change the wicking rate. The spores do what spores do, which is Chapter 16.

The target is a plug you can push into the tube with steady thumb pressure and no tool. If you need a pen or a rod to seat it, it is too tight. If it slides in freely, it is too loose.

I aim for a plug about twice as long as the tube diameter. In a 16 mm tube that is roughly 1.25 in (32 mm) of cotton. That length gives enough wicking path to slow the transfer without choking it.

14.2 Choosing tube diameter

Tube diameter is a humidity decision disguised as a space decision.

A wider tube has a larger air volume per unit of evaporating surface. That means lower equilibrium humidity for the same reservoir. A narrow tube runs wetter. This is worth knowing because it means the same species can be too dry in one tube and too wet in another with identical technique.

The practical sizes:

Tube diameter	Air chamber volume	Best for	Typical failure
12 mm	Very small	Claustral queens, tiny species (*Temnothorax*, small *Monomorium*)	Overheating, condensation drowning
16 mm	Small	Most founding queens, colonies to roughly 50 workers	The default. Few problems.
20 mm	Moderate	Colonies of 50 to 200 workers, larger *Camponotus*	Drying out faster than expected
25 mm	Large	Large colonies pre-nest, polygynous groups	Poor humidity retention, needs monitoring

A founding queen in a 25 mm tube is not in danger, but she is in a chamber where the humidity gradient is shallow and the reservoir depletes across a larger evaporating front. She will be fine. She will also be harder to read, because a large tube shows fewer visible cues before it goes wrong.

Start at 16 mm. Move up only when the colony physically needs the floor space.

14.3 Reading a tube before the brood dies

A drying tube gives warnings. Most keepers learn to recognize them after losing a colony. You can learn them now instead.

The meniscus recedes and stops moving. The reservoir is still there but the plug has lost its capillary connection to the tube wall. Air has broken the water column. From this point the chamber is drying and the reservoir is decorative.

The cotton face turns matte. A wicking plug has a faint sheen on the colony-facing surface under angled light. When that sheen disappears, evaporation is outpacing supply.

Condensation vanishes overnight. In a functioning tube you will usually see fine condensation somewhere on the glass during the cooler part of the day cycle. When it stops appearing entirely, chamber humidity has dropped.

Brood moves toward the plug. Workers relocating eggs and small larvae up against the cotton is the colony telling you the rest of the tube is too dry for them. This is not subtle once you know to look. It is also the last comfortable warning you get.

Pupae develop dark or shriveled patches. By this stage you have already lost some of the brood. Move immediately.

The brood-position signal is worth trusting, because there is good evidence that ants actively relocate brood along microclimate gradients rather than tolerating whatever conditions they find. Nurse workers of *Camponotus mus* shift brood between two distinct temperatures on a daily rhythm in a laboratory thermal gradient, moving it to about 30.8 °C (87.4 °F) during the light phase and back to about 27.5 °C (81.5 °F) eight hours later.[1] Gardening workers of *Atta sexdens rubropilosa* offered chambers at 33, 75, 84 and 98 percent relative humidity distributed themselves randomly but consistently placed the fungus garden in the wettest chamber.[2]

Those studies are about temperature and about fungus, not about your *Lasius* brood. But the principle they establish is solid: when ants have a gradient, they use it, and where they put the thing they are protecting tells you what that thing needs.

14.4 The tube swap, step by step

Every keeper eventually has to move a colony from a failing tube to a fresh one. Done badly this is the single most destructive routine operation in the hobby.

The method that has cost me the fewest workers:

1. **Prepare the new tube at least a day early.** Fill roughly one third with water, seat the plug, and let it sit. A tube plugged five minutes ago has not equilibrated and will weep.
2. **Chill nothing.** Refrigerating a colony to slow them down is common advice and I have stopped doing it. It stresses the colony to solve a problem that patience solves for free.
3. **Connect, do not transfer.** Join the old and new tubes with a short length of vinyl tubing, or seat both openings into a small container. Do not tip, shake, or pour.
4. **Darken the new tube, light the old one.** Foil or dark paper on the fresh tube, ambient light on the old one. Ants move toward dark and away from light. Let the preference do the work.
5. **Wait.** Small colonies often move within hours. Founding queens can take a week or more. A queen who has not moved after two weeks is telling you she does not consider the new tube better, which usually means it is too wet.
6. **Confirm the brood moved.** Workers relocate before brood. A colony that has moved but left eggs behind is not finished.
7. **Do not discard the old tube for 48 hours.** Stragglers are common and a lone worker left in a bin is a worker you have killed.

The whole operation is a patience test. Nearly every disaster I have had came from deciding I was in a hurry.

14.5 Reservoir failures, named

Learning the failure by name makes it faster to spot.

Weeping. Water visibly wetting the chamber-side cotton face and pooling on the glass. Plug too loose or tube handled roughly. Fix by re-seating with slightly more cotton.

Column break. Air bubble separating the reservoir from the plug. Reservoir looks full, chamber is drying. Not fixable in place. Swap the tube.

Green plug. Algae in the reservoir, usually from a tube stored in daylight. Cosmetic at first, but it indicates a nutrient source in your water. Swap and store tubes dark.

Black plug. Mold at the cotton face. This is a colony emergency, covered in Chapter 16.

Salt ring. A white deposit at the cotton face from hard tap water. Harmless in itself, but it slowly clogs the wicking pores and shortens tube life. This is the strongest practical argument for not using hard tap water, and it is a physical argument rather than a toxicological one.

Excavated plug. Some species, notably *Camponotus* and various *Messor*, will dig into the cotton. A partially excavated plug wicks unpredictably and can collapse. Not usually harmful, but it puts the tube on a clock.

CHAPTER 15

Building a Humidity Gradient

Most nest care advice tells you to keep a species at a particular humidity. That framing is wrong, and it is wrong in a way that causes real losses.

Ants do not want a humidity. They want a choice.

15.1 Why a single target humidity is the wrong goal

A colony is not one organism with one requirement. It is eggs, larvae of several instars, pupae, callows, workers, and a queen, and there is no reason to expect those to share an optimum. Eggs and small larvae are the most vulnerable to desiccation because they have the least favorable surface-area-to-volume ratio and the least developed cuticle. Adult workers are the most resistant.

The evidence for stage-specific placement in ants is strongest in the fungus-growing species, where the cultivar adds a fourth requirement on top of the ants themselves. *Acromyrmex heyeri* workers were shown to modify their thatched nest structure in response to simulated water loss, depositing building material at the points where humid air was escaping.[3] The same species trades off thermoregulation against humidity control rather than optimizing either alone.[4] In *Acromyrmex ambiguus*, circulating dry air through nest chambers triggered workers to plug tunnels with leaf fragments, and the plugs went specifically to the inflow points, meaning the ants were reading the direction of the dry airflow and building against it.[5]

Read that last one again, because it is the cleanest demonstration of the principle in the literature. The ants were not maintaining a set point. They were detecting a local deficit and closing it.

A formicarium with one uniform humidity removes every one of those behaviors. The colony cannot shuttle brood, cannot build against a gradient, and cannot separate the wet zone from the dry zone. You have taken away their instruments and left them with your judgment instead.

15.2 Hydration ports, sponges, and passive wicking

Three delivery methods, three sets of tradeoffs.

Hydration port with reservoir. A sealed chamber behind a porous barrier, filled through an external tube. The standard for grout, ytong, and hydrostone nests. Most controllable, slowest to respond to correction, and the most likely to overshoot if you refill on a schedule instead of on observation.

Sponge or foam block. A wet block in a separate chamber or the outworld. Cheap and forgiving. Also a mold farm if left more than a few days, because it holds organic debris and stays saturated.

Passive wicking from a test tube. A water tube connected to the nest, letting the tube supply both drinking water and ambient moisture. Genuinely underrated for small and mid-size colonies. The failure modes are the ones you already learned in Chapter 14.

The hobby has converged on a fourth approach that I now use for most species: multiple test tubes at different states connected to one outworld. One with a full reservoir, one with a double cotton plug running drier, one dry. The colony sorts itself. This is not a novel idea and I did not invent it, but it is the closest a simple setup gets to what the ants actually do in the ground.

15.3 Substrate choice

The substrate is the mechanism. Choose it for its water behavior, not its appearance.

Substrate	Wicking speed	Gradient quality	Notes
Aerated concrete (ytong)	Moderate	Good	Easy to carve, forgiving, mildly alkaline when new. Soak and rinse before use.
Grout	Slow	Very good	Holds a gradient well. Dense mixes can wick almost nothing, so test before committing a colony.
Hydrostone / dental plaster	Fast	Moderate	Wets and dries quickly. Responsive, but less stable if you are inattentive.
Sand-clay	Variable	Good	Naturalistic and diggable. Collapse risk and hard to inspect.
Acrylic with hydration chamber	None (barrier only)	Depends on barrier	Zero substrate buffering, so humidity swings track your refills directly.
Bare glass or plastic	None	None	No gradient at all. Fine as outworld, poor as nest.

The alkalinity note on fresh ytong is worth taking seriously. New aerated concrete leaches alkaline compounds. Soaking and rinsing repeatedly over several days before use is standard hobby practice and costs you nothing but time.

15.4 Measuring humidity inside a small nest

Here is an uncomfortable truth. Most humidity readings keepers take are close to meaningless.

A cheap hygrometer probe placed in an outworld measures the outworld. The nest chamber behind a grout wall can differ from it by a wide margin. A probe pressed against a wet substrate reads the substrate surface, not the air the brood is sitting in. And the sensor itself, in a chamber a few cubic centimeters in volume, changes the thing it is measuring by occupying part of it.

What actually works:

- **Small-diameter probes** inserted through a dedicated port, not through the entrance
- **Long equilibration times.** Give a reading twenty minutes before you believe it
- **Comparative rather than absolute readings.** Whether the wet end reads higher than the dry end is a useful and reliable fact. Whether the wet end reads exactly 78 percent is not
- **Calibration with a saturated salt solution** if you are going to make decisions on the numbers

I have largely stopped chasing absolute numbers in small nests. The colony is a better instrument than my hygrometer, and Section 14.3 is how you read it.

15.5 Gradient targets by group

The table below is hobby consensus, not published research. I want to be exact about what that means: these ranges come from keeper reports and supplier care sheets, cross-checked against the natural habitat moisture of each genus. They are a reasonable starting point and they are not measurements.

Genus	Natural habitat	Wet end	Dry end	Priority
Lasius	Soil, moderate moisture	High	Moderate	Keep a genuinely wet corner. Founding queens are sensitive.
Camponotus	Wood, often drier	Moderate	Low	Tolerates dry nests well if drinking water is available. Do not oversaturate.
Messor	Arid to semi-arid	Moderate	Low	Seed stores mold in damp nests. Dry bias.
Myrmica	Damp soil, meadow	High	Moderate	Genuinely moisture-dependent.
Pheidole	Highly variable by species	Moderate	Low	Check the specific species. The genus spans deserts and rainforests.
Temnothorax	Acorns, twigs, crevices	Moderate	Low	Small colonies, small margins. Watch closely.
Solenopsis	Soil, flood-prone	High	Moderate	Naturally adapted to saturated soil.
Crematogaster	Arboreal and terrestrial	Moderate	Low	Arboreal species are notably desiccation-resistant.

That last row connects to real evidence. Hood and Tschinkel exposed arboreal and terrestrial ants to 0, 25, 50, 75 and 100 percent relative humidity at 30 °C (86 °F) and found arboreal species survived roughly eight times longer than terrestrial species of comparable size. When the waterproofing epicuticular lipids were stripped with a chloroform and methanol extraction, both groups lost water at the same high rate, which locates the difference in the cuticular lipid layer rather than in behavior or anatomy.[6]

The practical translation: an arboreal or wood-nesting genus can be kept drier than a soil-nesting genus of the same size, and the reason is a physical property of the cuticle rather than a preference you could train out of them.

CHAPTER 16

Mold, Bacteria, and Water Quality

More captive colonies die of mold than of dehydration. That is my read after six years, and I think most experienced keepers would agree with it.

16.1 The moisture, mold, death chain

The sequence is consistent enough to be worth writing as a chain.

Excess moisture with no drying zone. Then organic debris that does not get removed, usually uneaten insect prey or a dead worker in a corner the colony has stopped visiting. Then fungal growth on that substrate. Then spore load rising in a sealed chamber. Then either direct infection of workers, or colony stress and abandonment of part of the nest, which concentrates them further and accelerates everything.

Each link is breakable. The easiest to break is the second.

16.2 What mold in a formicarium actually is

Most of what keepers call mold is saprophytic fungus growing on dead organic matter. It is not attacking the ants. It is eating the cricket you left in there.

The genuinely dangerous fungi are the entomopathogens, principally *Metarhizium* and *Beauveria* species, which infect insects directly. These are not exotic. *Metarhizium* is the standard experimental organism in ant social immunity research precisely because it infects and kills ants reliably, and it has been used that way on genera as ordinary as *Lasius* and *Myrmica*.[8][9]

The distinction matters practically. White fuzz on a dead mealworm is a housekeeping problem. Workers dying in ones and twos with no other explanation, in a nest that has been damp for weeks, is a different problem.

16.3 What the colony does about it

Ants are not passive here, and the research on this is genuinely striking.

Colonies mount coordinated hygienic responses to fungal contamination. In *Atta sexdens*, fungus grooming behavior was upregulated specifically against entomopathogenic fungi rather than against harmless mycoantagonistic ones, the enhanced response persisted for up to 30 days but not beyond 60, and colonies responded more strongly to a repeat of the same pathogen than to a different one.[7] In *Lasius*, contact between healthy workers and fungus-exposed nestmates transferred small numbers of conidia to the healthy ants, and those low-level exposures produced pathogen-specific immune gene expression and protective immunization rather than an epidemic.[8] Conidia were found on the cuticle of all directly exposed individuals in high numbers and on 37 percent of their nestmates, usually at counts between one and ten.[8]

Colony size matters to the outcome. *Myrmica rubra* colonies of different sizes were exposed to waste contaminated with *Metarhizium brunneum* at loads scaled proportionally to colony size, and the largest colonies had the lowest mortality.[9]

That last finding is the one to hold onto, because it explains something every keeper notices. A founding queen with ten workers is not a small colony with the same defenses. She is a colony with almost no social immunity at all. The grooming, the waste management, the redundancy that protects a mature nest are all functions of having workers to spare. She has none.

Founding stage is when mold kills. Treat it accordingly.

16.4 Water quality

Here I have to be honest about the state of the evidence, because the hobby is more confident on this than the facts support.

Tap water. Chlorinated municipal water is the default for most keepers and most colonies do fine on it. The real cost is mineral deposition, which clogs cotton plugs and leaves scale on hydration ports. In hard-water regions this genuinely shortens tube life.

Boiled and cooled tap water. Drives off chlorine, does not remove minerals, and does not sterilize in any meaningful sense at a rolling boil for a minute. Modest benefit.

Distilled or deionized water. No minerals, no scale, no chlorine. This is what I use, mostly for the plug-clogging reason rather than any health claim. The occasional argument that ants need dissolved minerals from their water does not have evidence behind it either way that I have found, and ants in nature drink from sources ranging from dew to standing puddles.

Bottled mineral water. No advantage I can identify and it reintroduces the scale problem.

Water left standing in an open container. Avoid. It grows things.

My recommendation is distilled, and my reason is mechanical rather than biological. Anyone telling you tap water poisons colonies is overstating what is known. Anyone telling you water source does not matter at all has not scraped a hard-water salt ring out of a hydration port.

16.5 Springtails and cleanup crews

Springtails (Collembola, typically *Folsomia candida* or similar) are widely used in the hobby as a cleanup crew in outworlds. They consume mold and organic debris.

An honest assessment: this works, in the sense that keepers who use them report less visible mold, and there is no mechanism by which it should not work. There is essentially no peer-reviewed research on springtail cleanup crews in formicaria specifically. The practice is imported from the reptile and dart frog hobby where it is long established.

Two caveats worth stating. First, springtails need moisture themselves, so a population large enough to control mold implies conditions damp enough to grow it. They are a treatment for a symptom. Second, in a small outworld a large springtail population becomes a food competitor and a visual nuisance, and some keepers report colonies harassing them.

Use them in outworlds. Do not use them as a substitute for removing food waste.

16.6 When mold has already started

Triage, in order.

1. **Remove the source.** Uneaten prey, dead workers, spilled sugar. This is 80 percent of the fix and most people skip straight to step 4.
2. **Increase the dry zone.** Stop refilling the wet end. Let the gradient shift dry. Do not dry the whole nest, which just trades one emergency for another.
3. **Improve airflow if the design allows it.** Sealed nests concentrate spores. A mesh-vented outworld helps.
4. **Move the colony** if the growth is in the nest chamber itself rather than the outworld, or if you are seeing worker deaths. A move is stressful. A colony sitting in an active fungal bloom is worse.
5. **Do not use antifungal chemicals.** Household fungicides and disinfectants are insecticidal at the concentrations that kill mold. There is no safe dose that solves your problem.

For a founding queen in a moldy tube, move immediately and do not wait for her to relocate voluntarily. She has no worker buffer and no time.

CHAPTER 17

Flooding Your Own Colony

Every keeper does this at least once. The goal of this chapter is to make sure you do it once.

17.1 The three ways it happens

Overfilling a hydration port. The reservoir backfills into the nest chambers. Usually happens when refilling on a fixed schedule rather than on inspection, or when the port geometry lets water pass a barrier that was only ever meant to hold a saturated substrate.

A failed test tube plug. Covered in 14.5. A loose or excavated plug releases the reservoir into the chamber. This is the most common cause of drowned founding queens.

Condensation collapse. Slower and sneakier. A nest running very wet accumulates condensation on a cool surface, usually a glass or acrylic lid. The droplets coalesce and run down onto the brood pile. The nest was never flooded from the reservoir. It rained indoors.

Condensation collapse tends to hit in autumn and spring in temperate homes, when room temperature swings across the day. If you find water on a brood pile with a reservoir that has not moved, look up.

17.2 The first hour

Response order matters. Ants recover from a lot. Brood recovers from much less.

1. **Tilt, do not tip.** Angle the nest so free water runs to a corner away from the colony. Sudden reorientation causes workers to scatter and drop brood.
2. **Wick, do not blot.** Touch the corner of a folded paper towel to the pooled water and let capillary action pull it out. Pressing a towel into the chamber crushes ants.
3. **Open the nest to air.** Remove the lid or open the vents. Evaporation is the only tool that works fast enough and does not require you to reach inside.
4. **Do not apply heat yet.** A heat mat on a flooded chamber cooks the brood in humid air. Heat comes after the free water is gone, not before.
5. **Leave the ants alone.** They will move brood themselves and they are better at it than you are. Your job is removing water, not rescuing individuals.
6. **Do not discard drowned-looking workers.** Ants pulled from water often recover after hours on a dry surface. Set them aside somewhere they cannot escape and check the next day before you write them off.

That last point surprises people. An ant that appears dead after submersion is frequently in a recoverable state, which makes sense given how many ant species deal with periodic flooding in the wild. Parts II and III of this book cover why that tolerance exists.

17.3 Drying without cooking

After the standing water is out, the substrate is still saturated. This is where second losses happen.

The instinct is to dry it fast. Resist it. A grout or ytong nest that goes from saturated to bone dry in a day puts the colony through a second shock in the opposite direction, and pupae are vulnerable at both ends.

What works:

- Open venting, room temperature, patience. Most small nests shed excess moisture in one to three days
- If you must use heat, use it on the far end of the nest from the colony and keep the surface below roughly 86 °F (30 °C)
- Let the colony choose. If a dry connected tube or chamber is available they will often relocate on their own within hours, which solves the problem better than any drying schedule
- Do not refill the hydration port until the substrate has visibly lightened in color. In ytong and grout this is a reliable visual cue

17.4 Preventing the next one

Three habits, in order of how much grief they save.

Refill on inspection, never on schedule. Look at the substrate, then decide. A calendar reminder to water every Sunday is how ports get overfilled.

Underfill deliberately. Fill hydration reservoirs to roughly two thirds. The buffer costs you a few days of interval and removes the overfill failure mode entirely.

Build in an escape. Every nest should connect to at least one chamber the colony can retreat to if the main nest goes wrong. A dry test tube attached to the outworld costs nothing and has saved two of my colonies.

CHAPTER 18

Species Reference Chart

Read the header note before you read the tables.

These values are hobby consensus, not measurements. They are assembled from keeper reports, supplier care sheets, and the natural habitat moisture of each genus. Where published research exists it is cited in the text of Chapters 14 through 16, and it covers almost none of these genera directly. Treat this chart as a starting hypothesis to test against your colony's behavior, using the brood-position signal from Section 14.3 as the real instrument.

Species with a wide geographic range vary internally. *Pheidole* in particular spans deserts and rainforests, and the genus row below is close to useless for any specific species.

18.1 Moisture requirements by genus

Genus	Natural nest site	Nest moisture bias	Test tube tolerance	Flood sensitivity
Lasius	Soil, under stones	Wet to moderate	Excellent	Moderate
Camponotus	Dead wood, cavities	Moderate to dry	Excellent	Low
Messor	Soil, arid to semi-arid	Dry	Good	High (seed stores)
Myrmica	Damp soil, moss	Wet	Good	Moderate
Formica	Soil, thatch mounds	Moderate	Good	Low
Tetramorium	Soil, pavement cracks	Moderate	Excellent	Moderate
Pheidole	Highly variable	Check species	Excellent	Variable
Solenopsis	Soil, often flood-prone	Wet to moderate	Excellent	Very low
Crematogaster	Wood, arboreal soil cavities	Moderate to dry	Good	Low
Temnothorax	Acorns, twigs, rock crevices	Moderate	Good	High (small colonies)
Aphaenogaster	Soil, leaf litter	Moderate to wet	Good	Moderate
Polyrhachis	Variable, some mangrove	Moderate to wet	Good	Very low in some species

18.2 Founding stage adjustments

Founding queens are not small colonies. Adjust as follows.

Founding type	Water access	Notes
Fully claustral	Sealed tube, no external water	She metabolizes wing muscle and fat reserves. Do not open the tube. Do not feed.
Semi-claustral	Tube plus outworld access	Needs drinking water and food throughout founding.
Parasitic / social parasite	Sealed tube with host workers	Same as fully claustral once host workers are present.
Polygynous group	Sealed tube, larger diameter	Watch for aggression, not moisture.

The single most common founding-stage killing mistake is opening a fully claustral queen's tube to check on her, feed her, or improve her humidity. She does not need any of it and the disturbance costs more than it gains.

18.3 Quick diagnostic table

What you see	Most likely cause	First action
Brood pushed against cotton plug	Chamber drying	Prepare a fresh tube
Brood moved to driest chamber	Nest too wet	Stop refilling, increase venting
Water pooled under brood	Plug failure or overfill	Wick out immediately, see 17.2
White fuzz on prey remains	Saprophytic mold	Remove food, no other action needed
Black or dark growth on cotton	Fungal growth at the wick	Swap tube now
Workers dying singly, nest damp for weeks	Possible entomopathogen	Move colony, dry the gradient
Shriveled or darkened pupae	Sustained low humidity	Move to wetter setup, expect losses
Reservoir full, cotton dry and matte	Column break	Swap tube
White scale at hydration port	Hard water minerals	Switch to distilled
Condensation on brood, reservoir unchanged	Condensation collapse	Vent, check room temperature swing

PART V

Water Ants Around the Home

A note before this section

Most people who arrive at the phrase "water ants" arrive here, at this part of the book. They have ants around a sink and they want them gone.

I am an ant keeper, not a pest control operator. I have written this section on the principle that understanding why the ants are there does more good than a product recommendation, and I have kept the control advice conservative and mechanism-based. Where a situation needs a professional, I say so.

CHAPTER 19

Why Ants Appear at Your Sink

19.1 Water is a resource, and sometimes the scarce one

Ants need water. Chapter 2 covered the machinery: foragers collect liquid, carry it in the crop or between the mandibles, and distribute it through the colony.

Most of the year, in most places, water is not the limiting resource. Dew, rain, plant fluids, and prey body fluids supply enough. Two situations change that.

Summer drought. Outdoor water sources dry up. Your kitchen has water every single day regardless of weather. A colony that finds it has found a reliable supply in an unreliable season.

Heated indoor winter. This one is less obvious and it catches people out. A heated house in winter can run at very low relative humidity, sometimes drier than the outdoor air. A colony nesting in a wall void or under a slab in that environment is in a genuinely arid microclimate, and the bathroom is the wettest place in the building.

The pattern most people report, ants appearing suddenly in the bathroom in midsummer or midwinter and not in spring, is exactly what this predicts.

19.2 It is usually not a nest

An important reframing.

Ants at a sink are usually foragers from a colony living somewhere else, often outdoors, often some distance away. The trail you see is a supply line, not a residence.

There are exceptions. Some species will nest in damp wall voids, under sinks, behind tile, or in decayed wood around a leak. Persistent activity in one spot, activity that continues through the night and in cold weather, and winged ants appearing indoors are all signs pointing toward an indoor nest rather than an indoor trail.

The distinction matters because the responses are different. A trail is a resource problem. A nest is a structural one.

19.3 Which species you probably have

In North American homes, three species account for most moisture-associated indoor ant reports.

Species	Common name	Size	Where you see it	Tell
Tapinoma sessile	Odorous house ant	Small, about 1/8 in (3 mm)	Kitchens, bathrooms, near moisture	Crushed workers smell strongly, often described as rotten coconut or blue cheese
Monomorium pharaonis	Pharaoh ant	Very small, about 1/16 in (2 mm)	Kitchens, bathrooms, hospitals	Yellowish to light brown, multiple queens, colonies split when disturbed
Tetramorium immigrans	Pavement ant	Small, about 1/8 in (3 mm)	Around slabs, patios, entry points	Dark, grooved head and thorax, classic sidewalk-crack ant

Two further possibilities worth knowing.

Carpenter ants (*Camponotus* species) are large, often black, and their presence indoors is a different kind of signal. They excavate galleries in wood that is already softened by moisture. Carpenter ants in a bathroom or around a window frame frequently mean there is a water leak in the structure. The ants are a symptom.

Moisture ants is a loose term applied to several genera, often *Lasius*, associated with damp decayed wood. Same principle as carpenter ants: the ants followed the water damage.

19.4 Identifying by location

A rough guide, because where you see them narrows it faster than what they look like.

Where	Likely	What it suggests
Bathroom sink, shower base	Odorous house ant, pharaoh ant	Water seeking, usually a trail
Kitchen counter, near sugar	Odorous house ant, pavement ant	Food seeking, water incidental
Along baseboards in one room	Possible indoor nest	Investigate for a leak
Around window frames, large black ants	Carpenter ants	Check for water damage in the frame
Under sink, in a damp cabinet	Various, possible nest	Check plumbing
Emerging from a slab crack	Pavement ant	Outdoor colony, indoor foraging

19.5 A note on pharaoh ants

If you have identified pharaoh ants, stop and read this.

Monomorium pharaonis colonies have many queens and respond to disturbance by budding, splitting into multiple satellite colonies. Spraying them makes the problem larger and more distributed rather than smaller.

This is the clearest case in this book where the correct advice is to stop and call a licensed professional. Pharaoh ant control is a baiting problem requiring the right bait and patience, and getting it wrong makes it worse.

CHAPTER 20

Pools, Ponds, and Irrigation

20.1 Standing water is an attractant and a hazard

Any reliable outdoor water source concentrates ant activity around it. Pool edges, condensate lines, leaking irrigation fittings, birdbaths, and pet bowls all do this.

What people usually notice is not the ants drinking. It is the ants drowning.

20.2 What drowned ants in a pool tell you

A pool skimmer full of ants is a data point about proximity, not about a pool problem.

Ants arriving at a pool edge in numbers sufficient to accumulate in the skimmer means a colony within normal foraging range, which for most household species is tens of feet rather than hundreds. The ants are not attracted to the pool chemistry. They are attracted to water and to whatever organic material collects around a pool deck.

If the accumulation is sudden and large, it is worth checking whether a nearby colony has been disturbed or flooded, since both cause mass movement.

20.3 Irrigation as an indoor entry route

A pattern worth knowing because it is easy to miss.

Irrigation lines, condensate drains, and hose bibs create permanently damp soil against a foundation. Permanently damp soil against a foundation is good nesting habitat, and a colony nesting there is inches from every crack, pipe penetration, and expansion joint in the structure.

A great many persistent indoor ant problems trace back to an outdoor moisture condition against the building. Fixing the moisture does more than any indoor treatment.

20.4 Fire ants and standing water

In the US Gulf states, Australia, and other invaded regions, standing water and fire ants combine into a genuine hazard rather than a nuisance.

Section 10.7 covers this properly. The short version: do not touch floating debris in floodwater, do not break up rafts by hand or with a paddle, wear boots and gloves in standing water, and if you have a known sting allergy, do not enter floodwater on foot in an infested area at all.

CHAPTER 21

What Works, and What Does Not

21.1 Moisture removal is the primary control

If you take one thing from this part of the book, take this.

The single most effective long-term action against moisture-associated ants is removing the moisture. Fix the dripping tap. Repair the leaking trap under the sink. Clear the gutter that is dumping water against the foundation. Improve ventilation in the bathroom. Move the irrigation head away from the wall.

This is unglamorous and it is slower than a spray can and it is what actually works, because it removes the reason the ants came rather than the ants that came.

It also handles the carpenter ant and moisture ant cases at the root, since those species are responding to water-damaged wood specifically.

21.2 Why spraying visible ants fails

Two reasons, and they are worth understanding rather than just being told.

The ants you see are a small minority. Foragers are a fraction of a colony, and the colony is elsewhere. Killing every ant on the counter changes nothing about the colony's size or its motivation to send more.

Repellent sprays can fragment colonies. In species that bud, and pharaoh ants are the extreme case, disturbance triggers splitting. You can convert one colony into several and spread the problem across a larger area.

Contact killing has a place for immediate hygiene on a food surface. It is not a control strategy.

21.3 Baits, honestly

Baiting works on the opposite principle. A slow-acting toxicant in an attractive carrier is carried back to the nest and distributed, and Chapter 2 explains exactly why that works: trophallaxis is a colony-wide distribution network, and a bait exploits it.

Practical points that determine whether baiting succeeds:

- **Slow is the point.** A bait that kills the forager before she gets home has failed. Do not supplement with a spray on the same trail.
- **Match the carrier to the season.** Colonies shift between sugar and protein demand depending on brood stage. A bait that is ignored may be the wrong type rather than a bad product.
- **Patience.** Results take days to weeks, not hours.
- **Remove competing food.** A bait competes with everything else available.
- **Follow the label.** This is a legal instruction, not a suggestion, and label requirements differ by country.

21.4 What I would not bother with

Stated plainly, because these circulate widely.

Barrier substances such as chalk, cinnamon, and coffee grounds. These may deter briefly. They do not affect the colony and the ants route around them.

Ultrasonic repellers. I am not aware of credible evidence that these work on ants and I would not spend money on one.

Boiling water poured into a nest. Injures the top of the nest, rarely reaches the queen, and in a lawn or garden bed it damages plant roots. It also does nothing about the reason the colony is there.

Vinegar as a control. Wiping a trail with vinegar disrupts the pheromone path and can interrupt foraging temporarily. It is a cleaning step, not a control method, and it should be described as such.

21.5 When to call a professional

I would call, without hesitating, in these cases.

- Pharaoh ants, confirmed or suspected, for the budding reason in Section 19.5
- Carpenter ants indoors, because the structural moisture issue behind them needs assessment
- Fire ants around a home with children, pets, or anyone with a sting allergy
- Any infestation that persists after moisture sources have genuinely been fixed
- Any situation where you are considering applying something you do not fully understand

There is no failure in this. Identification and product selection are the whole skill, and a good operator has both.

21.6 The keeper's aside

I will end this part with the obvious conflict of interest declared.

I keep ants. I find them extraordinary. I have also lived with an odorous house ant trail across a kitchen counter, and I did not enjoy it any more than you are enjoying yours.

The two positions are compatible. An ant colony in a mangrove doing anaerobic respiration under a rising tide is a marvel. The same biology, running in the wall behind your shower, is a maintenance problem. Fix the leak.

Glossary

Alate. A winged reproductive ant, male or female, before the nuptial flight.

Callow. A newly emerged adult worker, pale and soft-cuticled, before darkening.

Claustral founding. A founding strategy in which the queen seals herself in and raises the first workers entirely on her own body reserves, without foraging.

Crop. The expandable storage organ in the gaster where liquid is held before digestion. Often called the social stomach, because its contents are shared.

Cuticular hydrocarbon (CHC). The waxy lipid compounds coating the insect cuticle. Serve both as a waterproof barrier and as the chemical signature for nestmate recognition.

Desiccation. Death or damage by water loss.

Discontinuous gas exchange. A pattern in which spiracles open and close in cycles rather than remaining open. One proposed function is reducing respiratory water loss, though this remains debated.

Eclosion. Emergence of the adult from the pupa.

Entomopathogen. An organism that causes disease in insects. In this book, principally the fungi *Metarhizium* and *Beauveria*.

Formicarium. A container designed for housing an ant colony.

Gaster. The bulbous rear section of an ant's body, behind the waist.

Hypercapnia. Elevated carbon dioxide concentration.

Hypoxia. Depleted oxygen concentration.

Instar. A developmental stage between molts, used mainly of larvae.

LAT (lowest astronomical tide). The lowest tide level predictable under average meteorological conditions. Used as a reference elevation in the mangrove chapters.

Perhumid. A climate classification for consistently very wet conditions with no significant dry season.

Phragmosis. The use of a modified body part, usually the head, as a physical plug for a nest entrance.

Polydomous. A colony occupying multiple separate nest sites.

Polygynous. A colony with more than one egg-laying queen.

Proventriculus. The valve separating the crop from the midgut, controlling what passes from social storage into individual digestion.

Pseudotrophallaxis. Liquid transport and sharing without ingestion, typically as a droplet held between the mandibles. Also called the social bucket method.

Relative humidity (RH). Water vapor content of air as a percentage of the maximum that air could hold at that temperature.

Replete. A worker whose gaster is distended with stored liquid, serving as a living container for the colony.

Saprophyte. An organism feeding on dead organic matter. Most formicarium mold is saprophytic rather than pathogenic.

Spiracle. A valved opening in the insect body wall through which gas exchange occurs.

Trachea. The branching tubes carrying gas from the spiracles into the insect body.

Trophallaxis. Direct transfer of fluid between individuals, usually mouth to mouth.

Viscoelastic. Having both solid-like elastic and fluid-like viscous mechanical behavior. Fire ant aggregations are viscoelastic.

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A closing note

I said in the front matter that I would tell you which parts of this book are research and which are experience. I want to close by saying why that mattered enough to structure the whole thing around it.

There is a large amount of confident writing about ants online, and a lot of it is confident about things nobody has measured. The 165 percent venom figure in Chapter 10. The queen protected in the center of the raft. The mangrove ant surviving days underwater. Every one of those is repeated in hundreds of places, and I could not trace a single one to a primary source.

None of them needed to be exaggerated. The real findings are better. An ant that seals its nest by building a structure designed to collapse. A colony that becomes waterproof by weaving itself. Eight hundred ants carrying half a teaspoon of water out of a bamboo stem, three thousand trips over two days.

You do not have to embellish that. You just have to check it.

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