

Reading True/False/Not Given OR Yes/No/Not Given

The secret of staying young

Pheidole dentata, a native ant of the south-eastern U.S., isn't immortal. But scientists have found that it doesn't seem to show any signs of aging. Old workers ants can do everything just as well as the youngsters, and their brains appear just as sharp. 'We get a picture that these ants really don't decline,' says Ysabel Giraldo, who studies the ants for her doctoral thesis at Boston University.

Such age-defying feats are rare in the animal kingdom. Naked mole rats can live for almost 30 years and stay fit for nearly their entire lives. They can still reproduce even when old, and they never get cancer. But the vast majority of animals deteriorate with age just like people do. Like the naked mole rat, ants are social creatures that usually live in highly organised colonies. 'It's this social complexity that makes *P. dentata* useful for studying aging in people,' says Giraldo, now at the California Institute of Technology. Humans are also highly social, a trait that has been connected to healthier aging. By contrast, most animal studies of aging use mice, worms, or fruit flies, which all lead much more isolated lives.

In the lab, *P. dentata* worker ants typically live for around 140 days. Giraldo focused on ants at four age ranges: 20 to 22 days, 45 to 47 days, 95 to 97 days and 120 to 122 days. Unlike all previous studies, which only estimated how old the ants were, her work tracked the ants from the time the pupae became adults, so she knew their exact ages. Then she put them through a range of tests.

Giraldo watched how well the ants took care of the young of the colony, recording how often each ant attended to, carried and fed them. She compared how well 20-day-old and 95-day-old ants followed the telltale scent that the insects usually leave to mark a trail to food. She tested how ants responded to light and also measured how active they were by counting how often ants in a small dish walked across a line. And she experimented with how ants react to live prey: a tethered fruit fly. Giraldo expected the older ants to perform poorly in all these tasks. But the elderly insects were all good caretakers and trail-followers – the 95-day-old ants could track the scent even longer than their younger counterparts. They all responded to light well, and the older ants were more active. And when it came to reacting to prey, the older ants attacked the poor fruit fly just as aggressively as the young ones did, flaring their mandibles or pulling at the fly's legs.

Then Giraldo compared the brains of 20-day-old and 95-day-old ants, identifying any cells that were close to death. She saw no major differences with age, nor was there any difference in the location of the dying cells, showing that age didn't seem to affect specific brain functions. Ants and other insects have structures in their brains called mushroom bodies, which are important for processing information, learning and memory. She also wanted to see if aging affects the density of synaptic complexes within these structures – regions where neurons come together. Again, the answer was no. What was more, the old ants didn't experience any drop in the levels of either serotonin or dopamine – brain chemicals whose decline often coincides with aging. In humans, for example, a decrease in serotonin has been linked to Alzheimer's disease.

'This is the first time anyone has looked at both behavioral and neural changes in these ants so thoroughly,' says Giraldo, who recently published the findings in the Proceedings of the Royal Society B. Scientists have looked at some similar aspects in bees, but the results of recent bee studies were mixed – some studies showed age-related declines, which biologists call senescence, and others didn't. 'For now, the study raises more questions than it answers,' Giraldo says, 'including how *P. dentata* stays in such good shape.'

Also, if the ants don't deteriorate with age, why do they die at all? Out in the wild, the ants probably don't live for a full 140 days thanks to predators, disease and just being in an environment that's much harsher than the comforts of the lab. 'The lucky ants that do live into old age may suffer a steep decline just before dying,' Giraldo says, but she can't say for sure because her study wasn't designed to follow an ant's final moments.

'It will be important to extend these findings to other species of social insects,' says Gene E. Robinson, an entomologist at the University of Illinois at Urbana-Champaign. This ant might be unique, or it might represent a broader pattern among other social bugs with possible clues to the science of aging in larger animals. Either way, it seems that for these ants, age really doesn't matter.

Questions 9-13

Do the following statements agree with the information given in Reading Passage 1?

In boxes 9-13 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

9 Pheidole dentata ants are the only known animals which remain active for almost their whole lives.

10 Ysabel Giraldo was the first person to study Pheidole dentata ants using precise data about the insects' ages.

11 The ants in Giraldo's experiments behaved as she had predicted that they would.

12 The recent studies of bees used different methods of measuring age-related decline.

13 Pheidole dentata ants kept in laboratory conditions tend to live longer lives.

Is everything terrible, or are things just very, very bad?

Chelsea Rochman, an ecologist at the University of California, Davis, has been trying to answer a dismal question: Is everything terrible, or are things just very, very bad?

Rochman is a member of the National Center for Ecological Analysis and Synthesis's marine-debris working group, a collection of scientists who study, among other things, the growing problem of marine debris, also known as ocean trash. Plenty of studies have sounded alarm bells about the state of marine debris; in a recent paper published in the journal Ecology, Rochman and her colleagues set out to determine how many of those perceived risks are real.

Often, Rochman says, scientists will end a paper by speculating about the broader impacts of what they've found. For example, a study could show that certain seabirds eat plastic bags, and go on to warn that whole bird populations are at risk of dying out. 'But the truth was that nobody had yet tested those perceived threats,' Rochman says. 'There wasn't a lot of information.'

Rochman and her colleagues examined more than a hundred papers on the impacts of marine debris that were published through 2013. Within each paper, they asked what threats scientists had studied – 366 perceived threats in all – and what they'd actually found.

In 83 percent of cases, the perceived dangers of ocean trash were proven true. In the remaining cases, the working group found the studies had weaknesses in design and content which affected the validity of their conclusions – they lacked a control group, for example, or used faulty statistics.

Strikingly, Rochman says, only one well-designed study failed to find the effect it was looking for, an investigation of mussels ingesting microscopic bits. The plastic moved from the mussels' stomachs to their bloodstreams, scientists found, and stayed there for weeks – but didn't seem to stress out the shellfish.

While mussels may be fine eating trash, though, the analysis also gave a clearer picture of the many ways that ocean debris is bothersome.

Within the studies they looked at, most of the proven threats came from plastic debris, rather than other materials like metal or wood. Most of the dangers also involved large pieces of debris – animals getting entangled in trash, for example, or eating it and severely injuring themselves.

But a lot of ocean debris is 'microplastic,' or pieces smaller than five millimeters. These may be ingredients used in cosmetics and toiletries, fibers shed by synthetic clothing in the wash, or eroded remnants of larger debris. Compared to the number of studies investigating large-scale debris, Rochman's group found little research on the effects of these tiny bits. 'There are a lot of open questions still for microplastic,' Rochman says, though she notes that more papers on the subject have been published since 2013, the cutoff point for the group's analysis.

There are also, she adds, a lot of open questions about the ways that ocean debris can lead to sea-creature death. Many studies have looked at how plastic affects an individual animal, or that animal's tissues or cells, rather than whole populations. And in the lab, scientists often use higher concentrations of plastic than what's really in the ocean. None of that tells us how many birds or fish or sea turtles could die from plastic pollution – or how deaths in one species could affect that animal's predators, or the rest of the ecosystem.

'We need to be asking more ecologically relevant questions,' Rochman says. Usually, scientists don't know exactly how disasters such as a tanker accidentally spilling its whole cargo of oil and polluting huge areas of the ocean will affect the environment until after they've happened. 'We don't ask the right questions early enough,' she says. But if ecologists can understand how the

slow-moving effect of ocean trash is damaging ecosystems, they might be able to prevent things from getting worse.

Asking the right questions can help policy makers, and the public, figure out where to focus their attention. The problems that look or sound most dramatic may not be the best places to start. For example, the name of the 'Great Pacific Garbage Patch' – a collection of marine debris in the northern Pacific Ocean – might conjure up a vast, floating trash island. In reality though, much of the debris is tiny or below the surface; a person could sail through the area without seeing any trash at all. A Dutch group called 'The Ocean Cleanup' is currently working on plans to put mechanical devices in the Pacific Garbage Patch and similar areas to suck up plastic. But a recent paper used simulations to show that strategically positioning the cleanup devices closer to shore would more effectively reduce pollution over the long term.

'I think clearing up some of these misperceptions is really important,' Rochman says. Among scientists as well as in the media, she says, 'A lot of the images about strandings and entanglement and all of that cause the perception that plastic debris is killing everything in the ocean.' Interrogating the existing scientific literature can help ecologists figure out which problems really need addressing, and which ones they'd be better off – like the mussels – absorbing and ignoring.

Questions 27-33

Do the following statements agree with the information given in Reading Passage 3?

In boxes 27-33 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

27. Rochman and her colleagues were the first people to research the problem of marine debris.

28. The creatures most in danger from ocean trash are certain seabirds.

29. The studies Rochman has reviewed have already proved that populations of some birds will soon become extinct.

30. Rochman analysed papers on the different kinds of danger caused by ocean trash.
31. Most of the research analysed by Rochman and her colleagues was badly designed.
32. One study examined by Rochman was expecting to find that mussels were harmed by eating plastic.
33. Some mussels choose to eat plastic in preference to their natural diet.

