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Science Focus

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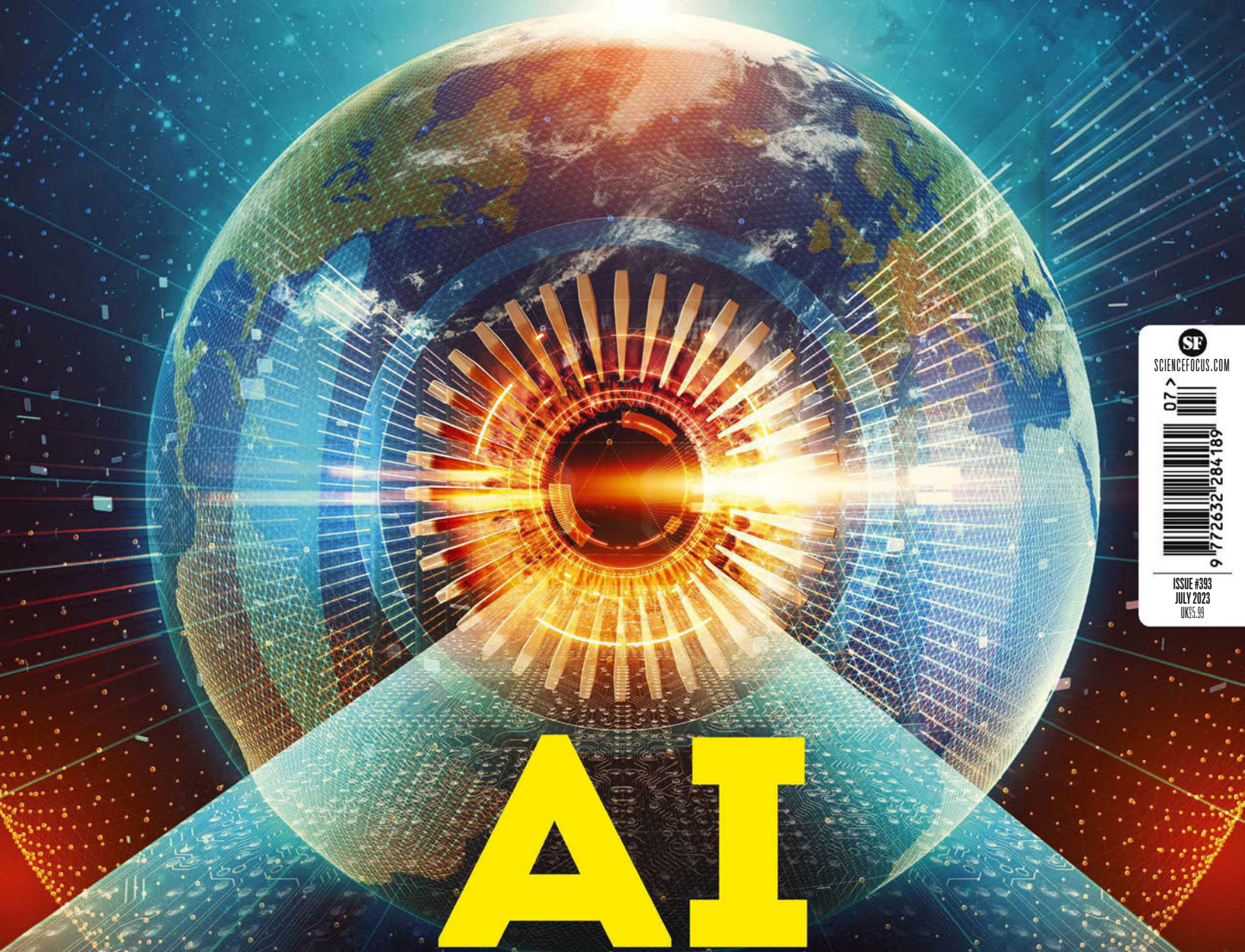
The hunt for
TINY KILLER ASTEROIDS

Could the
UK'S TAP WATER RUN OUT?



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AI

WHAT OUR FUTURE WITH ARTIFICIAL INTELLIGENCE REALLY LOOKS LIKE, ACCORDING TO THE EXPERTS

How to take control before it's too late *Can computer code soothe loneliness?*
Why we can't let machines think for us *Will an AI's creation ever move us to tears?*
How post-human intellects will save us

IN THIS ISSUE

Health
Has Ozempic accidentally become a game-changing drug?

Wildlife
Inside the secret lives of bees

Physics
What jazz musicians can teach quantum physicists

→ a subtle scent that actually deterred domesticated bees. But climate change or not, be in no doubt that whatever the causes of the decline, we're to blame.

WHY IS INSECT LIFE SO IMPORTANT?

Insects are like ecological glue, binding the natural world together. They're found in almost all terrestrial ecosystems and are involved in virtually every important ecological interaction. They're predators and prey, parasites, decomposers, nutrient cyclers, pollinators, seed dispersers, soil aerators and more.

When we start picking away at this ecological glue we risk damaging, or even destroying, the whole structure. In some cases, as with pollinators in some studies, we're seeing other species picking up the slack.

So, while we see a reduction in biodiversity, we don't always see a reduction in function. Just how long a system can tolerate this kind of pressure is unclear.

The notion that all insects will disappear is far-fetched. But the idea that we may end up with hugely depleted ecosystems that can't provide the 'services' we need – like pollination and nutrient cycling – seems far less far-fetched now than it did 20 years ago.

Over the coming years, it seems likely that we'll see many more negative effects. We'll be getting better at detecting them and we might, hopefully, also get better at combatting them.

IS THERE ANY WAY TO REVERSE THE DECLINE?

We can do things to slow down and even reverse the degradation of the natural world that we've caused. But it requires us to think in more mature ways than we're used to.

We often talk about 'saving' a species, or being concerned about a particular group (like insects). Such an approach is great for awareness and fundraising, but it doesn't fix the fundamental problem.

The reality is that we need to save their habitats – the places where nature can thrive. We also have to start thinking about the whole world as a habitat, not just the 'wild places' we see on nature documentaries.

Our towns and cities should be shared with biodiverse green spaces, interconnected with 'nature corridors' and dotted with ponds, tree stands and other features that support nature. Our agricultural practices need to change, allowing food production and nature to co-exist. We also need to make use of technological advances that allow us to produce more food from less land, giving more space for nature.

We can do these things, but we have to decide that we want to do them at a societal level. Up until now, we've been children in a sweetshop when it comes to using the planet. The declines we're seeing in the natural world are a sign that it's time to grow up.

by **PROF ADAM HART**
Adam is an entomologist at the University of Gloucestershire and presents shows on BBC Radio 4 and the BBC World Service.

ANALYSIS

KILLER ASTEROIDS: HOW SAFE ARE WE, REALLY?

A new study suggests we're safe from big impacts, but it's the small ones we have to worry about

It's the ultimate cosmic catastrophe. A killer space rock is locked on a collision course with Earth. When it hits, the curtain comes down on humanity as we fade into the shadows of history, just like the dinosaurs before us.

Despite being the subject of a string of apocalyptic Hollywood blockbusters, there is some good news. A recent study found that we're unlikely to be hit by any of the nearly 1,000 known near-Earth asteroids above a kilometre in diameter within the next millennium (the asteroid that unleashed hell upon Tyrannosaurus rex and co 66 million years ago is thought to have been between 10-15km – 6-9 miles – wide).

The study, led by Oscar Fuentes-Muñoz from the University of Colorado Boulder, is a marked improvement on previous work, which could only forecast a century ahead.

Although, according to Prof Phil Bland, an asteroid expert at Curtin University in Australia, the '1,000 impact-free years' claim comes with some important caveats. Most notably, it only applies to the big asteroids we already know about.

"It doesn't speak to the five per cent that are still out there waiting to be discovered," he says. "It doesn't include comets either, which we'll never be able to constrain."

This could be important, as many comets, which can be as big as asteroids, fly in from the outer Solar System having never entered the inner Solar System before. We have no way of tracking them until they're already very close to us.

Then there are all the asteroids smaller than a kilometre (just over half a mile) across. "We're not good at all at tracking smaller stuff," Bland says.

After all, the sky is an incredibly big place and these objects are relatively small. It's like looking for a tiny, dim needle in an unimaginably large, even darker haystack. For example, some asteroids reflect just five per cent of the sunlight that hits them.

To underscore the potential for a surprise impact, consider the 70m-wide asteroid 2023 DZ2 that passed between Earth and the Moon back in March. Astronomers only spotted it a month beforehand.

Had it hit Earth, it could have levelled a city. This

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"The '1,000 impact-free years' claim comes with some important caveats. Most notably, it only applies to the big asteroids we already know about"

close call came just two months after a truck-sized asteroid dubbed 2023 BU came within 3,600km (2,230 miles) of the southern tip of South America. That's 10 times closer than some of our communications satellites. It was discovered less than a week before it narrowly missed by us.

Such asteroids don't even have to strike the planet's surface to inflict significant harm. "Objects as small as 50m can cause an airburst [mid-air explosion] that's really devastating over a local area," Bland says.

In February 2013 a 15-20m object exploded in the atmosphere above Chelyabinsk in Russia. Almost 1,500 people were injured and more than 7,000 buildings damaged. The total cost of repairs came to around £26 million.

ABOVE Although no bigger than 20m, the meteorite that exploded over Chelyabinsk, Russia, in 2013 caused widespread injury and damage

Since then, astronomers have been ramping up their search efforts accordingly. Last year the NASA-funded Asteroid Terrestrial-impact Last Alert System (ATLAS) project became the first survey capable of searching the entire dark sky every 24 hours for near-Earth objects (NEOs) that could pose a future impact hazard to Earth. The Vera C Rubin Observatory in Chile →

ABOVE A fragment of the approximately 20m-wide meteorite that exploded above the Russian city of Chelyabinsk in 2013

→ also reached a significant construction milestone in May this year with the completion of the telescope structure. It's now ready to be integrated with the telescope's 3,200-megapixel camera, the largest digital camera ever built, and eventually form the LSST (Large Synoptic Survey Telescope).

Astronomers hope to start using the LSST to survey the sky in October 2024. "It'll give us a really interesting new look at this population of small asteroids," Bland says

Slightly further down the line, NASA hopes to launch its NEO Surveyor satellite in 2028. It should discover tens of thousands of new NEOs with diameters as small as 30m.

So, what happens if one of these projects detects an asteroid on course for a direct hit? "Asteroid impacts are one of the few natural disasters that can be prevented through human action," note Fuentes-Muñoz and his colleagues in their study.

NASA registered a significant breakthrough in 2022 when its Double Asteroid Redirection Test (DART) mission slammed a fridge-sized impactor into the asteroid Dimorphos.

The collision successfully altered Dimorphos's orbit around a second asteroid called Didymos by 32 minutes. A triumph given that NASA's threshold for success was set at just 73 seconds. Perhaps in future we could knock a threatening asteroid off course in a similar manner.

At the time, NASA's Administrator Bill Nelson said that the success of DART "shows that NASA is trying to be ready for whatever the Universe throws at us." Completing a catalogue of smaller potential threats would be an equally big step in the right direction.

by **COLIN STUART** *(@skyponderer)*

Colin is an award-winning astronomy writer and speaker.

COMMENT

OZEMPIC: IS IT MORE THAN JUST A WEIGHT-LOSS PILL?

The diabetes drug is useful in treating obesity, but could also help with a range of other conditions

Semaglutide – most often known by the brand name Ozempic, but also sold as Wegovy and Rybelsus – was developed to treat type 2 diabetes, but has been making headlines as a weight-loss drug. Now, with prescriptions for ozempic increasing, reports of other potential benefits are emerging, from reducing addictive behaviours to improving mood and brain function. Are there more uses for Ozempic?

Ozempic mimics the biological actions of a naturally produced hormone called GLP-1 (glucagon-like peptide-1). GLP-1 is one of the major hormones secreted by the gut after eating. It forms part of the complex pathways that signal to the rest of the body that food has been eaten. These pathways prevent over-consumption by signalling satiety – the feeling of satisfaction that comes after eating – and trigger the biological pathways that allow the body to use the nutrients that come from food. This includes increasing the production of insulin, which is important in moving sugar (glucose) from the blood into cells so that it can be used as energy.

By enhancing the promotion of insulin secretion, Ozempic and other GLP-1-mimicking drugs can help treat type 2 diabetes and suppress appetite, which can support the treatment of obesity. Ozempic is about 95 per cent similar to natural GLP-1, but the small differences make it easier for it to bind to carriers in the blood and harder for it to be broken down. So instead of peaking then rapidly dipping after a meal, as natural GLP-1 does, it can stay in the system longer, have larger impacts and reach other organs more readily.

Recently, reports have emerged of other potential off-target, but positive effects. Examples include reported reductions in alcohol consumption, smoking and nail-biting, as well as improvements in anxiety, stress and depression. A Danish study following users of semaglutide or liraglutide (another similar drug) for five years found that users had a lower incidence of dementia. These anecdotes and observations raise the possibility that Ozempic could be repurposed to fight other difficult-to-treat conditions.

This isn't a new concept – drugs are often repurposed, or repositioned, from their original uses. A well-

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