THE SHADE TREE

A BI-MONTHLY BULLETIN DEVOTED TO NEW JERSEY'S SHADE TREES

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This Issue Presents…

DIRECTOR'S DISCOURSE

By Richard Wolowicz

As I was driving home from the Federation's 97th Annual Conference, I couldn't help but be in awe of the impressive display of fall foliage. Despite the drought, the colors did not fail to amaze me. This started me thinking about the meeting and I realized that over the previous two days, I had seen a glimpse of the future.

The glimpse consisted of the fellow professionals and volunteers who attended the conference. The glimpse of the future – promoted by our talented speakers - taught us about tree preservation, planting, and ecology and challenged our ways of thinking. This great slate of speakers also inspired the attendees to use what was learned and do our part to keep our shade tree population healthy and robust.

It is not an easy feat to put together and implement the Annual Meeting. I would like to thank the Executive Board of the NJ Shade Tree Federation for all of the hours spent on phone calls and zoom meetings where they provided their valuable time. There were many people in the background who provided many hours of labor. This includes the Board Members of the Federation, the volunteers who manned the tables and answered questions and also managed the set-up and take-down details. The extra effort of the of the up and coming stars in this field, the Rutgers Forestry Club students, participated in a more hands on approach than ever before. Yes, indeed the future care of trees is in good hands.

I would like to publicly thank our new Member Outreach Coordinator, Emily Farschon, and to officially welcome her aboard. Her energy and ability to absorb the new scanner software was unbelievable. Last but not least, special thanks to our President Pam Zipse for all of the extra hands-on work she has done to make this meeting a success.

Yes, I have seen the future of tree care…and in my opinion…it is in good hands.

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WHAT WE'RE STILL LEARNING ABOUT HOW TREES GROW

by University of Utah

A study led by University of Utah researchers, with an international team of collaborators, finds that tree growth does not seem to be generally limited by photosynthesis but rather by cell growth. This suggests that we need to rethink the way we forecast forest growth in a changing climate, and that forests in the future may not be able to absorb as much carbon from the atmosphere as we thought.

"A tree growing is like a horse and cart system moving forward down the road," says William Anderegg,
an associate professor in the U's School of Biological Sciences and principal investigator of the study. "But we basically don't know if photosynthesis is the horse most often or if it's cell expansion and division. This has been a longstanding and difficult question in the field. And it matters immensely for understanding how trees will respond to climate change."

The study is published in Science.

Source vs. sink

We learned the basics in elementary school—trees produce their own food through photosynthesis, taking sunlight, carbon dioxide and water and turning it into leaves and wood.

There's more to the story, though. To convert carbon gained from photosynthesis into wood requires wood cells to expand and divide.

So trees get carbon from the atmosphere through photosynthesis. This is the trees' carbon source. They then spend that carbon to build new wood cells—the tree's carbon sink.

But if instead the trees' growth is sink-limited, then the tree can only grow as fast as its cells can divide. Lots of factors can directly affect both photosynthesis and cell growth rate, including temperature and the availability of water or nutrients. So if trees are sink-limited, simulating their growth has to include the sink response to these factors.

The researchers tested that question by comparing the trees' source and sink rates at sites in North America, Europe, Japan and Australia. Measuring carbon sink rates was relatively easy—the researchers just collected samples from trees that contained records of growth. "Extracting wood cores from tree stems and measuring the width of each ring on these cores essentially lets us reconstruct past tree growth," says Antoine Cabon, a postdoctoral scholar in the School of Biological Sciences and lead author of the study.

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Measuring carbon sources is tougher, but doable. Source data was measured with 78 eddy covariance towers, 30 feet tall or more, that measure carbon dioxide concentrations and wind speeds in three dimensions at the top of forest canopies, Cabon says. "Based on these measurements and some other calculations," he says, "we can estimate the total forest photosynthesis of a forest stand."

Decoupled

The researchers analyzed the data they collected, looking for evidence that tree growth and photosynthesis were processes that are linked, or coupled. They didn't find it. When photosynthesis increased or decreased, there was not a parallel increase or decrease in tree growth.

"Strong coupling between photosynthesis and tree growth would be expected in the case where tree growth is source limited," Cabon says. "The fact that we mostly observe a decoupling is our principal argument to conclude that tree growth is not source-limited."

Surprisingly, the decoupling was seen in environments across the globe. Cabon says they did expect to see some decoupling in some places, but "we did not expect to see such a widespread pattern."

The strength of coupling or decoupling between two processes can lie on a spectrum, so the researchers were interested in what conditions led to stronger or weaker decoupling. Fruit-bearing and flowering trees, for example, exhibited different source-sink relationships than conifers. More diversity in a forest increased coupling. Dense, covered leaf canopies decreased it.

Finally, coupling between photosynthesis and growth increased in warm and wet conditions, with the opposite also true: that in cold and dry conditions, trees are more limited by cell growth.

Cabon says that this last finding suggests that the source vs. sink issue depends on the tree's environment and climate. "This means that climate change may reshape the distribution of source and sink limitations of the world forests," he says.

A new way to look forward

The key takeaway is that vegetation models, which use mathematical equations and plant characteristics to estimate future forest growth, may need to be updated. "Virtually all these models assume that tree growth is source limited," Cabon says.

For example, he says, current vegetation models predict that forests will thrive with higher atmospheric carbon dioxide. "The fact that tree growth is often sink limited means that for many forests this may not actually happen."

That has additional implications: forests currently absorb and store about a quarter of our current carbon dioxide emissions. If forest growth slows down, so do forests' ability to take in carbon, and their ability to slow climate change.

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THE LONELIEST TREES: CAN SCIENCE SAVE THESE THREATENED SPECIES FROM EXTINCTION?

By Aisling Irwin

News Feature, 31 August 2022, Correction 16 September 2022

There are trees so rare that only a single specimen remains. Some conservationists want to save them all — but others question this lofty goal.

Perched among the fronds of the world's loneliest tree, Viswambharan Sarasan had an important decision to make. Sarasan had worked for years to get access to this palm — the last living member of the species Hyophorbe amaricaulis, which grows in Curepipe Botanic Gardens, Mauritius.

He reached up towards a cluster of its walnut-sized, olive-green fruit. Sarasan, a botanist at the Royal Botanic Gardens at Kew, near London, had been through sensitive negotiations for permission to take the fruit, each with one crucial seed inside. He then had to wait for the tree, nicknamed the lonesome palm, to produce them. Nine metres up, 50 fruit dangling within his grasp, he had to decide how many to take: enough to give himself a chance of culturing them back at Kew, while leaving enough for local scientists to work with.

"It was the only shot I could get," he says of his visit in June 2006. "But I didn't want to take all the seeds and then it turns out badly."

He picked ten fruit. It was not his lucky number.

When the plight of trees gets publicity, deforestation is generally the reason, but it is not the only crisis they face. Nearly one-third of trees — more than 17,500 species — are threatened with extinction. This is more than twice the number of threatened mammals, birds, amphibians and reptiles combined. Mass plantings of trees, paradoxically, often add to the problem by using single species. Now, hundreds of plant conservationists globally are fighting to save the trees speeding towards extinction.

"We shouldn't be giving up on any tree species," says Paul Smith, head of Botanic Gardens Conservation International (BGCI), a London-based charity that co-leads the campaign to secure the future of the world's threatened tree species.

But time is short, the obstacles are formidable and both climate change and fashions in ecology are moving against them.

Peter Bridgewater, a specialist in biodiversity governance at the University of Canberra, Australia, says that finding a natural home for every tree species is impossible because climate change is altering ecosystems so fundamentally. Scientists who think this goal is realistic are "living in their own cloud cuckoo land," he says.

Neglected trees Inextricably linked with the problem of climate change, and equally as damaging, is the disappearance of species from Earth. The rate of extinction is at historic levels and accelerating, with around one million animals and plants under threat.

The plight of trees can get lost among the tales of endangered mammals or birds. To get trees more visibility, in 2016 the BGCI, working with the International Union

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for Conservation of Nature (IUCN), organized the largest conservation assessment in the IUCN's history: the Global Tree Assessment. Hundreds of plant conservationists searched rainforests, mountains and strife-torn regions, sometimes with no more than a crinkly herbarium specimen or the testimony of a long-dead explorer to guide them.

In a 2021 report, they announced that they had found 58,497 tree species, of which 17,510 were threatened. Since then, almost 2,800 of those have been labelled as critically endangered. Some 142 species are thought to be extinct in the wild (see 'Trees under threat'). This year, a separate group of modellers estimated that a further 9,000 tree species are undiscovered.

It is not just the number of trees, but also their diversity that matters. A single species can be the foundation of an entire ecological network, and its disappearance could cause a cascade of extinctions that might lead to an ecosystem collapse.

How much can forests fight climate change?

Strong, diverse ecosystems are also better at sequestering carbon, says Jean-Christophe Vié, directorgeneral of the Franklinia Foundation, a private organization in Geneva, Switzerland, that funds tree conservation and supports the Global Tree Assessment. No tree species should be viewed as dispensable, says Vié, because it would set a precedent for every developer, farmer or logger to justify removing any threatened tree.

But tree conservation has become lost in international biodiversity targets — partly because trees get subsumed into general plant-conservation goals, and because plants are generally less showy than birds and animals. Trees need to be assessed for ecologists to champion them, says Malin Rivers, head of conservation prioritization at the BGCI.

"If you look at mammals, birds, reptiles, they have data to bring to the table when there is a policy discussion," she says. "Taxonomy gives the species a name; conservation assessment gives it a voice."

Protect and propagate

Armed with the Global Tree Assessment's catalogue of threatened species, conservationists have begunprioritizing species and taxonomic groups. The best approach, says Smith, is to protect vulnerable trees in their natural habitats. If that's not possible, researchers try growing them from seed in a laboratory, greenhouse or botanic garden.

The Global Tree Assessment revealed that nearly two-thirds of threatened trees are found in areas that are already protected, and stressed that one important task is to strengthen or expand these havens. That might mean controlling grazing, implementing a national logging ban for a particular species or establishing plots on which the tree can be cultivated for fruit or flowers without harming the larger population. On the eastern Caribbean island of Dominica, for instance, where harvesting resin for incense was killing lansan trees (Protium attenuatum), a tweak to the tapping method has halted the damage.

Sometimes, however, so few trees are left that protecting an area isn't enough.

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DOGGETT . . . Liquid asset for trees and tree care companies.

The fastest growing segment of the tree care industry is liquid tree fertilization and Doggett is leading the way. The spectacular growth in this field has come from the fact that the fertilizing method that helps trees the most also helps tree care companies the most.

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THE LONELIEST TREES: CAN SCIENCE SAVE THESE THREATENED SPECIES FROM EXTINCTION?

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In Tanzania, seed-biology specialist Fandey Mashimba works with a tiny population of a towering species called Karomia gigas. These trees, with their large oval leaves and distinctive, papery fruit, were thought to have gone extinct in the 1980s, but around six of them were discovered in 2011 by botanists from the University of Dar es Salaam. Protecting the habitat isn't enough, because a fungus destroys their immature fruit. Mashimba, who oversees seed production for Tanzania's Forest Service Agency, tries to whisk the fruit away before the fungus infects them, to sterilize and multiply the seeds for planting.

Mashimba and his colleagues tried germinating hundreds of K. gigas seeds. The result: just three treasured plants, which Mashimba monitors through his office window as their giant leaves wave in the breeze. In 2018, the forestry service also dispatched 6,000 fruit to the Missouri Botanical Garden in St Louis. There, botanist Roy Gereau oversaw the extraction and cultivation of 24,000 seeds. The seeds produced only 30 plants. Last year, one sapling unfurled a small, pale purple flower, which perished within a day. When two trees flower simultaneously, botanists will attempt cross-pollination.

Mashimba is lucky in one respect: at least K. gigas produces seeds. Some trees produce none because their pollinators are gone; sometimes only one sex of a tree remains. For instance, most of the surviving specimens of the catkin yew (Amentotaxus argotaenia) in Hong Kong are male. After a global search for a close genetic relative, a single suitable female was discovered in the Royal Botanic Garden Edinburgh, UK; scientists there dispatched cuttings for planting near the surviving males. When they flower, reproduction can begin, says Gunter Fischer, a restoration ecologist at Missouri Botanical Garden. But this could take 30 years.

Even if scientists do manage to acquire seeds from trees that are near extinction, germinating them can be tricky. Some go into dormancy, a protective state that, depending on the species, might be broken only through heating, cooling or scarring. Natural dormancy can last for years. Scientists try to circumvent it by culturing the embryo — the small section of a plant seed that will become the roots and stems — in a process known as embryo rescue.

Every trick in the book

The lonesome palm in the Curepipe Botanic Gardens — elderly, damaged and spindly — has seed problems, germination problems and more. It has resisted multiple rescuers since the 1980s. One obstacle is that the palm produces male and female flowers at different times, to avoid self-fertilization.

Using a ladder and a brush, scientists override this process to collect, store and transfer pollen. It was the fruit of one such assisted-pollination project, each containing a single seed, that Sarasan carried back to Kew in 2006. He knew that lonesome palm seeds don't grow if they are planted, so he used embryo rescue. With so few seeds, he felt there was no scope for experimenting with different culture media, so he made his best guess as to which blend to use.

"I was so protective," he says. "It was the responsibility, the excitement and also the fear of losing it." The plantlets grew to 25 centimetres long. Then, one day, their fine white roots turned brown and they died, doubtless because of some nuance of the culture medium, he says.

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Other efforts have been derailed by mishap. In 2010, Kew horticultural scientist Carlos Magdalena negotiated to collect some freshly picked palm fruit while he was visiting Mauritius. Owing to a misunderstanding, two of the five fruit stored in a nearby fridge were eaten by a garden labourer who did not know their significance. Back at Kew, the seeds from the others failed to germinate. The failure rankles with Magdalena, who has a string of plant rescues to his name. As he roves the Kew greenhouses, steamy sanctuaries for plants that are bereft of a place in the wild, he sometimes feels he is all that stands between a species and its permanent loss.

José Luis Marcelo Peña knows how he feels. In 2018, Marcelo Peña, a taxonomist at the National University of Jaén in Peru, was trekking through a steep, parched forest in Peru's Marañón valley when he discovered a tree with light green flowers: Pradosia argentea, thought to be extinct.

"It was a unique happiness that cannot be described," says Marcelo Peña. Surveys yielded 200 more trees in the area, all of which were imminently threatened by agriculture.

COVID-19 lockdowns began just as he attempted to save them. Without university facilities, but with remote help from the BGCI, he extracted 400 seeds from the purple fruit at home. More than 60 germinated: 20 survived. The following year, he tried again using fresh seeds, but a fungus got them all. As he finishes his story, he removes his glasses to wipe tears away. "It's a big responsibility," he says. And even with 20 little successes in the nursery, Marcelo Peña is concerned about the next step — reintroduction to the wild. Local people were unaware of P. argentea until recently, he says. They now support protecting the remaining trees — but they also need space to farm, which could put those survivors at risk.

Back to the wild

Thriving in the wild is a distant dream for K. gigas, too. Tanzania's forest agency and its partners are developing seed-propagation sites and nurseries for the species. But its future is uncertain, mostly because new trees could succumb to the same mysterious fungus.

"We might have to content ourselves with saying, well, we have these lovely creatures in the zoo," says Gereau.

Reintroductions can be spectacularly successful, however. The BGCI highlights a project on Malawi's Mount Mulanje, the only natural home of the cypress Widdringtonia whytei. In 2019, just seven mature trees remained, the others victims of illegal felling. By 2022, thanks to a collaboration with Malawi's Forestry Research Institute and local people, the slopes are alive again with 500,000 seedlings, and many locals now make a living through this endeavour.

Propagation itself turned out to be fairly simple, says Smith. In Mauritius, by contrast, ecologists have a tougher task. The Mauritian Wildlife Foundation, with help from botanists elsewhere, is attempting to save multiple critically endangered species at once, but success at propagation varies widely. There have been some dramatic

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restorations, including of some species from which only a single tree remained. But the lonesome palm, now part of this project, continues to resist.

A fourth attempt has begun. Nets hang around the tree to catch the male flowers and store their pollen for hand fertilization when the female flowers appear. In France, botanist Stéphane Buord at the National Botanical Conservatory of Brest hopes to overcome the problem that faced Sarasan — too few seeds — by tapping into the large quantities of seeds produced by Hyophorbe vaughanii, a close Mauritian relative of the lonesome palm. He and his team have spent years working out a complex technical protocol that coaxes its embryos into rooted seedlings that survive outside a test tube. Now he is waiting to try this approach on the seeds of the lonesome palm.

If he succeeds, the palm might eventually be reintroduced into a national park or into the wild. Kersley Pynee, a conservation scientist at the Mauritius National Parks and Conservation Service, has reintroduced other trees and shrubs and says it is an uphill struggle. Plants can fall victim to fungi, pests and other assailants. After one recent planting of 1,000 seedlings of the flowering shrub Nesocodon mauritianus, just 5 now remain, he says.

This is to be expected, says Smith. In nature, trees produce vast quantities of seeds, of which only a fraction germinate and survive because of natural dangers such as infestations, fire or competition for light or nutrients.

Tree museum

The Global Trees Campaign has so far planted out hundreds of thousands of seedlings from 300 threatened tree species. But for trees that can no longer survive in the wild, the only other options are to keep a specimen in a living collection, or to store its seeds in a bank.

One target of the 2011 Global Strategy for Plant Conservation, part of the Convention on Biological Diversity, was to conserve at least 75% of threatened plants in living collections or seed banks by 2020 — a goal that has not been met. What's more, simply drying and freezing seeds doesn't always work. Technologies such as cryopreservation — fast freezing at ultra-low temperatures — could offer an alternative, although it is expensive and impractical for many countries. And in 2018, conservationists warned that the seeds of one-third of tree species cannot be banked, largely because they don't survive drying.

Smith rejects this bleak diagnosis. Between seed banks, cryopreservation, nurseries, botanic gardens and arboreta, there are plenty of options to "buy us time," he says.

One trend that could help is mass tree-planting, in which governments and corporations plant trees to sequester carbon to meet emissions targets. Done badly, as many of these projects are, mass plantings can destroy biodiversity. Done well, they could rescue many species, says Smith. "This is a bandwagon we really need to jump on."

BIRDS ARE ONE LINE OF DEFENSE AGAINST DREADED SPOTTED LANTERNFLIES

But to harness their full bug-eating potential, it'll likely help to remove the invasive tree-of-heaven.

By Carlyn Kranking Reporter, Audubon Magazine

September 17, 2021

It's not a fly (despite its name), and it's not a moth (though some call it that). Others have simply dubbed it a "bad bug," and, well, that's pretty much spot-on.

The invasive spotted lanternfly, native to Asia, is a plant-eating threat to the U.S. environment and economy. First detected in Pennsylvania in 2014, it has now spread to at least 14 states in the Northeast, Mid-Atlantic and Midwest, damaging crops and native plants in the process.

Early on, people generally thought the bug lacked natural predators here, meaning it could reproduce with virtually no limits, says Robin Irizarry, program associate for Audubon Mid-Atlantic. But birders, who spend plenty of time observing wildlife, soon noticed that wasn't the case. In Philadelphia-area birding group chats, Irizarry saw others send photos of birds eating the invasive bugs. That got people excited.

"Then, as we all started thinking about it, more and more incidents started coming up," Irizarry says. In August 2020, he started a page on iNaturalist where community scientists could post photos of birds, other insects, and spiders eating the spotted lanternfly. The page currently has 78 observations of 33 different species chowing down.

Soon, these observations had a greater purpose: They contributed to a broader research initiative to examine if and how spotted lanternflies could be controlled by predation. Early results suggest there may even be a way to encourage wildlife to eat more bad bugs. This study, led by Ph.D. candidate Anne Johnson at Pennsylvania State University, examined hundreds of predation events. She created an email address and a Facebook page, called Birds Biting Bad Bugs, and asked people to send in observations. Combined with data from Irizarry's iNaturalist page, she has compiled 660 predation events to date. So far, birds are the most-reported predator, though insects also frequently preyed on these bugs. The most common avian predator? Chickens.

"That's potentially an observer bias," Johnson says, since people who keep chickens can see them so easily. Following that, Northern Cardinals, Gray Catbirds, Blue Jays, and Tufted Titmice were some of the other most-seen eaters. Among insects, the praying mantis took the lead.

Spotted lanternflies are such a concern because they eat through woody plants, especially in vineyards. The bug could potentially cause $325 million in annual losses in Pennsylvania alone, according to a 2019 report. Plus, they excrete a sugary substance called honeydew, which attracts sooty mold. When this mold covers leaves, it can inhibit photosynthesis. As spotted lanternflies congregate on trees and drink their sap, they leave the plants more susceptible to disease and death.

Though the lanternflies suck sap from over 70 kinds of trees, it appears they prefer to eat tree-ofheaven, another non-native species from China. This prolific tree is fast-growing and quick-spreading— groups of tree-of-heaven clump together, and they produce chemicals in their leaves, roots, and bark that can prevent other plants from growing. Johnson wondered if, by feeding on tree-of-heaven, spotted lanternflies stored these chemicals in their bodies to deter predators, just like monarch caterpillars feeding

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on milkweed.

"Animals that are defended in some way often have these bright colors with contrasting black patterns," Johnson says. And spotted lanternflies have red wings with black spots. "That led us to think that spotted lanternfly probably had some sort of defense against predators that was helping it be so
pervasive in its new, introduced environment here."

To test this hunch, she created two batches of suet—one made with spotted lanternflies that fed on the tree-of-heaven, and the other made with spotted lanternflies that couldn't access the invasive tree. So far, birds have shown a preference for the bugs that didn't eat tree-of-heaven, she says. This could mean that the presence of this non-native tree and its toxins is discouraging some potential predators from eating spotted lanternflies.

The toxins aren't dangerous to birds, but they're enough to make the bugs taste bitter, Johnson says. State officials have recommended that people remove the tree-of-heaven to help curb the spread of the spotted lanternfly. But Johnson's research suggests an added benefit: "If you get rid of the tree-ofheaven, then the birds can eat them no problem, it seems," she says.

Predation, however, is just one line of defense out of many that will be needed to control this invasive pest, and states where the bug is now spreading believe it will take an all-hands-on-deck response. "I don't think there's any silver bullet," says Julie Urban, research associate professor in entomology at Penn State, who's studying how to keep female spotted lanternflies from reproducing. "It's going to take a lot of different tools put together to really prevent them from further spreading."

They're not great fliers, but the bugs or egg masses can hitch a ride on vehicles or shipments and expand their range. Some counties in Pennsylvania, New Jersey, Delaware, Maryland, and Virginia have issued quarantines, and others are asking for reports of sightings to help track the bug's spread. Spotted lanternflies are so destructive that agricultural officials across multiple states have asked residents to kill the bugs on sight ("Stomp it Out," as the New Jersey Department of Agriculture says), or scrape egg masses off trees, eliminating 30 to 50 eggs at once.

Penn State Extension recommends that homeowners use traps, especially if they have high populations on their property. But certain ones are better than others: Some birds have gotten caught in sticky traps, adhesive surfaces on trees that can snare anything they touch. Experts caution against using these.

"If you have to do anything, make sure that it's not something that's going to have unintended consequences like that," Irizarry says. "You might be accidentally trapping a bird that would have been out there eating spotted lanternflies and doing something good."

Instead, try circle traps, the most effective kind according to Penn State. Circle traps, which wrap around a tree and funnel spotted lanternflies through mesh into a container, can be bought online or made at home, using these instructions from Penn State. Plus, Johnson says, "encouraging birds and beneficial insects into your yard is a great way to provide some more natural control."

Ultimately, the United States might already be past the point of being able to eradicate the spotted lanternfly, Johnson says. But something can still be done. Birds and insects remind us, as Irizarry says, "we have some natural allies in this."

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