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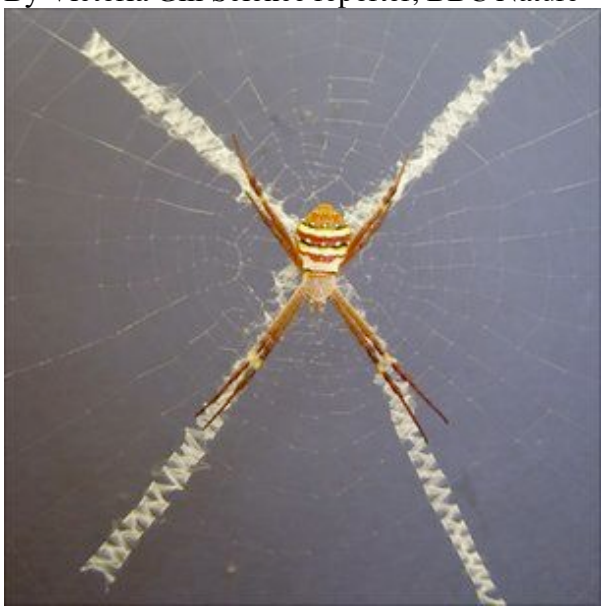
Spiders protect webs with decorations

By Victoria Gill Science reporter, BBC Nature



Previous research has shown that decorated webs tend to last longer

The delicate web decorations spun by some orb-weaving spiders are a strange but well-known phenomena, but exactly why the spiders adorn their webs is unclear.

Now a study by researchers in Australia suggests that the creatures use decorations to protect their webs from damage.

A team has made a discovery in one spider species that suggests the spiders use adornments "tactically" to make their webs more visible to animals that might accidentally damage them.

The findings are published in the journal Behavioural Ecology and Sociobiology.

"When I started studying this behaviour I had no idea that it was such a tricky area," said lead researcher Dr Andre Walter from the University of Melbourne in Australia.

"The debate about [its] function has lasted for over 100 years and is still highly controversial."

Previous research has shown that decorated webs tend to last longer than undecorated ones. But Dr Walter wanted to find out if this protective function was what motivated the spiders to spin their decorations.

He set up plastic frames in his lab, and left a group of orb-weaving *Argiope keyserlingi* spiders to build their webs in the frames. Once they were finished, the team carried out some controlled damage.

Dr Walter divided the spiders into three groups, left one group's webs alone, "lightly damaged" another group's and carried out heavy damage on another.

- Studies have suggested that web decorations attract prey
- Decorations make spiders more visible to predators, so scientists think the local environment - and what types of predators are around - influences how much a spider decorates its web

When they repaired or rebuilt their webs, the spiders increased their decorating activity following heavy damage but not mild damage, he reported.

So he thinks the spiders deliberately make their webs more visible to passing animals that might unintentionally walk into them.

"The spiders tactically use the decorations," he said, "distinguishing between normal web damage that happens every day (when the prey insects hit the web) and unusual damage by unwanted visitors."

Invisible obstacle
"Have you ever seen those cross-shaped tapes on brand-new windows?" Dr Walter asked.

"They're to warn us that there's something we might not see.

"The cross shaped decorations in *Argiope keyserlingi* may work in a very similar manner."

The decorations may draw in prey by reflecting UV light
The species his team studied belongs to a group of orb-weaving spiders that permanently live in their webs, sitting in the centre.

"Other orb-weavers build protective retreats where they can hide," explained Dr Walter.

"So damaging or destroying the web for [this species] means costly web repairs or even the risk of losing their home completely."

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Gigantic spider's web discovered in Madagascar

By Matt Walker
Editor, Earth News

Darwin's bark spider web, in close up

A newly discovered species of spider living in Madagascar makes the world's longest known web, spanning 25m.

The spider also makes the largest orb web yet found for any spider, and constructs it out of the most tough biomaterial yet known, say scientists.

Darwin's bark spider, a species new to science, weaves its huge web over flowing rivers, stretching from bank to bank.

It is so big that it can catch 30 or more prey insects at any one time.

Darwin's bark spider weaves what experts call an orb web, the most familiar spider web design.

> **Some of the webs qualify, to the best of our knowledge, as the largest spider webs ever documented**
>
> Professor Ingi Agnarsson

But this web is unusual as it is the largest orb web yet known to be made by any living spider, with the largest web measuring 2.8m^2.

The previous largest webs are spun by orb spiders belonging to the genus *Nephila*. Last year a new species of giant orb weaving spider (*Nephila komaci*) was discovered in Africa and Madagascar that can spin webs up to 1m across.

But even that web is dwarfed by those spun by Darwin's bark spider.

"They build their web with the orb suspended directly above a river or the water body of a lake, a habitat that no other spider can use," says Professor Ingi Agnarsson, the director of the Museum of Zoology at the University of Puerto Rico, in San Juan who made the discovery with colleagues.

The spider's web dwarfs scientists

That allows the spiders to catch insects flying over water, and explains why the web is so long.

To reach from one bank to the other, the spider must weave anchoring lines of up to 25m.

It also helps explain why the spider must weave it from such tough material, as the huge web must support its own weight and that of any prey it captures.

Prof Agnarsson and colleague Matjaz Kuntner, who also both work at the Smithsonian Institution in Washington DC, US, discovered the new spider species, which has the scientific name of *Caerostris darwini*, around the Namorona river in the Ranomafana NP and Fianarantsoa Province in eastern Madagascar.

Details of the spider and its behaviour are published in the Journal of Arachnology.

As in other related species, females dwarf the males.

The researchers found many webs spun by the spider, with most hanging vertically above the river, with some at an angles of up to 50º.

"Some of the webs qualify, to the best of our knowledge, as the largest spider webs ever documented," say the researchers in the journal.

Up to 32 unwrapped prey items, mainly mayflies, were found in a single web.

How the spiders spin such a huge web above water, and how they anchor their drag lines on either side of a river, is currently being researched.

Many of the webs showed obvious signs of damage and repair, while others had large open holes, suggesting that the spider maintains each web for several days.

Most orb weaving spiders take down and reconstruct their webs each day.

Monitoring a giant web

The spiders are able to weave such large webs, held up by such long drag lines, by using the toughest, most energy-absorbing silk ever discovered, tougher than any other known biological, and most man-made, materials.

Spider silks combine high strength with elasticity and are therefore already exceptionally tough, being able to absorb three times more energy before breaking than Kevlar, a material often used in bulletproof vests, say the researchers.

However, Darwin's bark spider weaves silk that is about 100% tougher than any other known silk, making it the toughest biological material known, say the researchers.

The have published details of the web's toughness in another scientific journal PLoS One.

Other spiders are capable of weaving giant webs.

For example, one huge web complex was found in 2007 in Texas.

But this web complex was not the work of one large spider.

Rather, millions of small ones weaved a series of interlaced webs that ended up covering an area twice the size of a football field.

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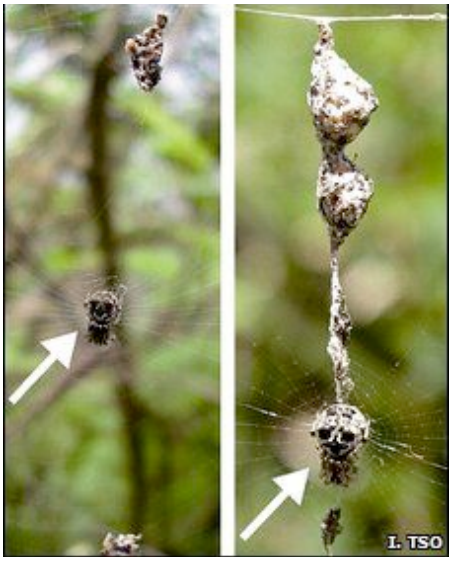
Spider builds life-sized decoys

Matt Walker
Editor, Earth News



An adult *C. mulmeinensis* alongside decoy prey pellets (L) and decoy egg sacs (R)

There is a species of spider that builds models of itself, which it uses as decoys to distract predators.

The spider may be the first example of an animal building a life-size replica of its own body.

So believe the scientists who made the discovery, which is published in the journal Animal Behaviour.

The arachnid's behaviour also offers one explanation for why many spiders like to decorate their webs with strange-looking ornaments.

Many animals try to divert the attentions of predators by becoming masters of disguise.

Some try to avoid being seen altogether by using camouflage to blend in against a background, such as the peppered moth evolving motley wings that blend into tree bark, or stick insects that look like sticks.

Others evolve more conspicuous ornaments designed to distract a predator, such as butterflies that grow large eyespots or lizards that quickly move colourful tails, which they detach from their bodies if grabbed.

This latter strategy has puzzled biologists, because attracting predators in the first place is usually a bad idea.

One hypothesis is that animals which grow conspicuous ornaments benefit overall, because directing a predator to attack an expendable part of the body, such as the lizard's tail, outweighs the costs of attracting the attention of the predator in the first place.

Under attack

But animals do not tend to actually build life-like replica models of themselves to act as decoys.

However, that is exactly what a species of orb spider called *Cyclosa mulmeinensis* does,

biologists Ling Tseng and I-Min Tso of Tunghai University in Taichung, Taiwan, have discovered.

This and other related spiders in the same genus decorate their webs with material such as detritus, plant parts, prey remains or egg sacs.

Because such detritus is often of a similar colour to the spider, researchers suspected it might help camouflage the arachnid.

> **Our study seems to be the first to empirically demonstrate the function of animal-made decoys**
>
> Spider specialist I-Min Tso

Initially Tseng and Tso decided to test the idea by videoing another related species called *Cyclosa confusa* living in the wild. They measured how often predatory wasps attacked the spiders in webs decorated with detritus compared with those in undecorated webs.

"We predicted that spiders with prey carcass decorations on webs should receive fewer wasp attacks because spiders should be well camouflaged by such objects," says Tso. "To our surprise, spiders on decorated webs received far more attacks than those on undecorated webs."

That confirmed that the decorations attracted predators rather than acting as camouflage.

However, Tseng and Tso suspected that these decorations might also redirect enough attacks to make them worthwhile.

Life-like decoys

So they tested the idea on another species *Cyclosa mulmeinensis* living on Orchid Island off the southeast coast of Taiwan. This species decorates its web with both the remains of dead insect prey and egg sacs.

Intriguingly, the spiders made prey pellets and egg sacs that were the same size as its own body.

The researchers also found that these decorations appeared to wasps to be the same colour, and reflect light in the same way, as the spider's body.

In short, the spider made decorations that were of the same size, shape and appearance as itself.

"Our results show that this vulnerable spider protects itself from predator attacks by constructing decoys that increase the conspicuousness of the web, and resemble its own appearance in size and colour," the researchers write in Animal Behaviour.

A female *C. mulmeinensis*

"When both spiders and web decorations are present on the same web, they look like a string of nearly identical oval objects to the predators."

"I don't know of any animal that actively builds a decoy of itself. Our study seems to be the first to empirically demonstrate the function of animal-made decoys," says Tso.

The decoys worked, too. More often than not, a wasp would attack a decoy rather than the spider, thinking it to be a tasty meal.

But all wasp strikes on spiders living on undecorated webs were directed straight at the spider.

"Decorations built by *Cyclosa* spiders function as a conspicuous anti-predator device instead of a camouflaging device. The benefit of successful escape from predator attack seems to outweigh the cost of increased detection," says Tso.

Web decorations

Scientists have been trying to answer the question of why many species decorate their webs for more than 100 years.

Tso suspects that there is no single answer.

"I think that the functions of web decorations might be very diverse and differ from taxa to taxa. Different spiders seem to decorate their webs for different reasons," he says.

For example, spiders often decorate their webs with silk ornaments, which might strengthen the web, act as a warning signal to predators, to deter large animals from accidentally walking into the web, destroying it, or to act as a visual signal to attract prey.

Others, including *Cyclosa* species, may use non-silk decorations primarily as anti-predator devices.

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Baby cannibal spider gang makes web vibrate in time

BY Matt Walker
Editor, Earth News

Good vibrations (courtesy of Dr K W Kim)

It is like something out of a horror movie: baby spiders devour their own mother, then climb aboard her web, and make it throb in a series of pulsating vibrations.

But that is exactly what black-lace weaver spiderlings do, a biologist in South Korea has discovered.

After cannibalizing their mother, up to 160 spiderlings gather and contract their bodies in synchrony, collectively pulling at the web to make it vibrate.

The behaviour may deter predators.

Details are published in the journal Insects Sociaux.

Ultimate sacrifice

Most spiders are solitary animals.

But some are social animals, living in communal webs throughout their lives, cooperating in nest construction, brood caring and prey hunting.

Other species are subsocial, where individual spiders come together and cooperate at certain stages of their lives.

Black-lace weaver spiders (*Amaurobius ferox*) can be found under stones and logs in the woodlands and gardens of Europe and North America.

They belong to the subsocial spiders, with the young baby spiders displaying a range of intriguing behaviours.

For example, female *A. ferox* spiders produce a single clutch of 60-130 spiderlings, which she feeds by laying eggs for her offspring to eat.

But then she makes the ultimate sacrifice: she encourages her spiderlings onto her body, and allows them to devour her alive (see video below).

After she has died, the spiderlings then form a social group for 3-4 weeks until they disperse from the social nest.

During this time, the spiderlings are known to cooperate by going hunting together.

By cooperating on a hunt, the spiderlings are capable of attacking and subduing prey up to 20 times bigger than themselves.

Web shake

But Dr Kil Won Kim of the University of Incheon of the Republic of Korea, who has researched this cooperative hunting behaviour, has discovered that the spiderlings gang together in another bizarre, and previously unknown way.

"After matriphagy [the eating of the mother], *A. ferox* spiderlings show synchronous movement, contracting their bodies simultaneously," Dr Kim told the BBC.

This behaviour emerged the day after the death of the mother, and was triggered by intruding insects, mites or worms approaching the web.

Eating mother alive (courtesy of Dr K W Kim)

An individual spiderling contracted its body, pulling at the web as it did so.

Almost immediately, other spiderlings joined in, also contracting their bodies.

That created a bigger effect, which was to make the whole web throb in a series of rhythmic vibrations.

At its peak, up to 60 per cent of the spiderlings engaged in this behaviour at any one time.

The denser the group of spiderlings, the stronger the vibrations of the web, and the presence of other spiderlings nearby encouraged others to also contract their bodies.

The spiderlings also performed contractions at the highest frequency four days after eating their mother, with the behaviour declining as they aged.

It also occured during the period before the baby spiderlings were old enough to go hunting.

Scary tactic

It is unclear why the baby spiders make their web throb in this way.

"Contractions may function as antipredatory behaviour," says Dr Kim.

A few lines of evidence point to this.

The baby spiders do not do it in the presence of the mother, which likely protects them before sacrificing herself.

They also vibrate only when a large intruder is nearby, suggesting it is a defence mechanism, as the vibrations would be transmitted to any intruder touching the web.

The visible movements of the web may also give an intruder the impression that there is a much larger organism nearby, again deterring them from approaching the vulnerable baby spiders.

Few other collective defence responses have been recorded in spiders.

One other example is in the territorial social spider *Cyrtophora moluccencis*. When a bee or wasp flies over a female's cocoon, she will shake it vigorously, an action that prompts other females nearby to also shake their cocoons, perhaps to deter the invader.

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'Giant' orb web spider discovered

Orb-weaving spiders can spin webs of up to 1m (3ft 3in) in diameter

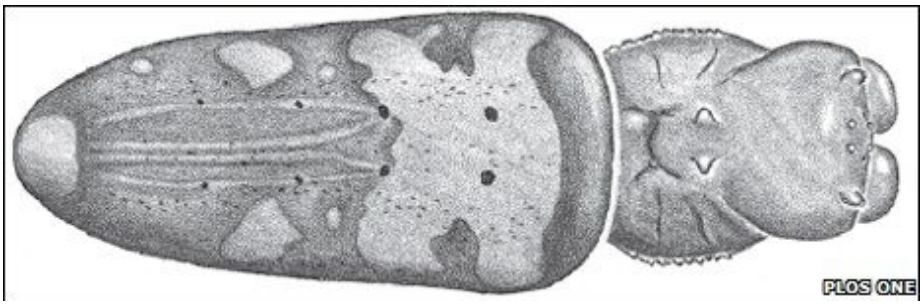
A new and rare species of "giant" orb web spider has been discovered in Africa and Madagascar.

In the journal Plos One, researchers describe *Nephila komaci* as the largest web spinning spider known to science.

Only the females of this groups of species are giants, with a leg span of up to 12cm (4.7in); the male spiders are tiny by comparison.

Scientists say the female spiders are capable of spinning webs that reach up to 1m (3ft 3in) in diameter.

Orb-weaving spiders are a widespread group which take their name from the round webs they typically spin.



The few preserved female specimens had bodies almost 4cm (1.5in) long

The new spider was identified by Matjaz Kuntner, a biologist from the Slovenian Academy of Sciences and Arts, and his colleague Jonathan Coddington, from the Smithsonian Institution's National Museum of Natural History in Washington DC.

Dr Kuntner told BBC News that the discovery was "very unusual"

because *Nephila* spiders were so well-studied and so large.

But this species is so elusive that even Dr Kuntner has not seen one live. He was able to identify the species from a specimen he first examined in 2000.

The giant female was in a collection belonging to the Plant Protection Research Institute in Pretoria, South Africa.

"It did not match any described species," said Dr Kuntner.

In his search through more than 2,500 samples from 37 museums, no further specimens turned up and he assumed the spider must be extinct.

But when a colleague in South Africa found three more of the spiders, it became apparent that they belonged to this same new species.

Male Nephila spiders look tiny in comparison to "giant" females

The discovery will enable scientists to study the evolution of the dramatic size difference between male and female *Nephila* spiders.

Dr Kuntner explained that the widely accepted theory was that evolutionary pressure was causing female "gigantism", with the females increasing in size in order to produce larger numbers of offspring.

He and his colleague, Jonathan Coddington, from the Smithsonian Institution's National Museum of Natural History in Washington DC, fear the rare spider might be endangered.

"Its range is restricted and all known localities lie within two endangered biodiversity hotspots: Maputaland and Madagascar," said Dr Coddington.

Dr Kuntner named the species in honour of his best friend and fellow scientist Andrej Komac, who recently died in an accident.

'Giant' orb web spider compared to human hand

'Giant' orb web spider
Nephila komaci

12cm

Legs are approximately to scale