



Species Spotlight

Water Striders

Family: Gerridae

What it must be like to walk on water? Though some may act like they can, few life forms have actually achieved this feat of the feet. But it may not be as rare in the natural world as one may think. Over the long history of life on Earth, at least 1200 species (not including waterfowl) have evolved a water-walking ability. Of all these creatures, the water strider must be near the top of the list of those that do it with such an air of ease and grace. Also known as pond skaters or water skippers, striders populate the *Gerridae* family of insects, of which there are about 1700 species worldwide (30+ in North America) with new species still being found. The largest strider species in the world, *Gigantometra gigas* (found in Asia), can weigh up to 10 times more than small species. Its legs span about 300 mm (~1ft) to support its body weight on the water's surface.

They've Got Legs, and Know How to Use Them

All water strider species can stand, skate, and even jump while atop the surface of water. This is made possible by their six legs which are covered with thousands of microscopic hair-like structures called *microsetae* that measure about 50 micrometers long (less than two-thousandths of an inch) and number more than a thousand per square millimeter. They are etched with grooves which trap air and take advantage of the natural membrane-like quality of water surface-tension. Many insects immediately sink under their own body weight, but water strider legs can support up to 15X their weight, and are even more hydrophobic than duck feathers. That said, if the surface tension of water is broken by detergents or other surfactants (chemical compounds that reduce surface tension), water striders sink just like the rest of us. Each pair of legs perform their own specialized function. The two front, shortest legs act as grabbers to quickly snatch prey. The middle are longest and used as paddles and for propulsion. The back two legs add extra thrust and can be used to steer and brake. Each leg is jointed in such a way that a long section (tarsal segment) makes contact with the water surface and acts much like a snowshoe

**Water striders have
3 pairs of legs**

does, distributing weight over a larger surface area. Under each leg, the water surface bends inward, creating a dimple (meniscus). To propel itself forward, a strider shifts weight to the middle legs and pushes against the back wall of these dimples. The ultra-water repellent quality of strider legs has caught the

attention of researchers. In 2015, a team based in China used electron microscopes to observe how striders effortlessly repel water from their legs. The hope is that this research will lead to the development of novel, "super-hydrophobic" materials for use in self-cleaning surfaces and anti-dew materials, among other uses.

Hitting their Stride.

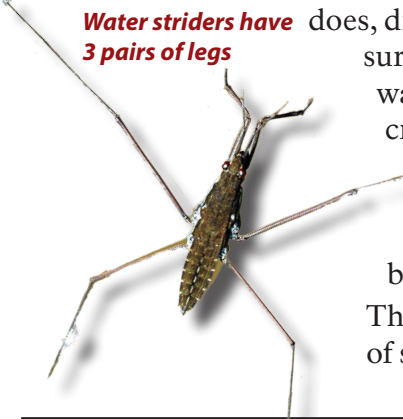
Striders can move very quickly on the water's surface, reaching speeds up to an incredible 100 body lengths per second - the equivalent of a 6-ft tall human hitting 400 mph. That speed is usually only utilized in short bursts, and it's often to catch a meal before it can get away. If a land-based or flying insect is unlucky enough to find itself in the water somehow, the ripples it makes as it struggles is like ringing the dinner bell for striders, who can sense the varied light reflections caused by the wavy surface film around a moving object. Once within its grasp, the strider will use its powerful penetrating proboscis to pierce the exoskeleton, then needle-like stylets inject proteolytic enzymes which simultaneously subdues the prey as it dissolves its innards. Once just the right consistency has been reached, a pump in the head of the strider sucks up the nutrient-rich liquid.

One of their favorite meals is mosquito larvae. As the larvae poke their breathing tubes through the surface of the water, striders grab hold of it, and that's one less mosquito to ruin your summer evening. North American species of striders are not known to bite humans, but that is not the case in Asia. As some new species were being documented in Thailand in 2007, one of the larger ones gave a painful bite to a researcher who was handling it (see inset).

Striders can escape their own predators by quickly jumping away. To do so, they push their middle legs downwards against the water surface, but not enough to break surface tension. The dimples will rebound and help trampoline the strider upwards.

If it Keeps on Raining, Legs ain't Gonna Break.

Researchers, up until just the past few years, had never explored how striders can survive heavy rainstorms, which due to climate change, are occurring more often each summer. Raindrops can be many times larger and weigh 0.035 grams while hitting speeds of 6 meters a second or more. If you are a young water strider weighing around .01 or so grams, how would you survive such an impact? Surprisingly, this research is helping shed light on the ways microplastics travel through aquatic ecosystems.





Arend photo

Brad Smith photo

Dr E. Santos and Dr A. Khila photos

From left to right: water striders use the dimples in the water created by their feet to push off from. Male water striders will tap at the water's surface to encourage females to allow quick copulation. Variations in strider legs allow different species to inhabit specific habitats. The extendable fans on the legs of *Rhagovelia* species allow them to live in fast moving water that species without the fan appendage cannot.

A team from the University of Tennessee used high speed cameras and a rain simulator to observe what happens to striders during a downpour. A direct impact from a large raindrop can indeed sink a strider, and a nearby hit can launch it feet into the air. It is their strong exoskeleton which allows them to survive by absorbing the impact. If submerged they'll 'power stroke' their way to the surface again, but if needs be they can stay submerged for several minutes by utilizing the small bubble of air they carry, called a plastron, to breath.

Though at first appearing completely unrelated, water strider legs and microplastics (particles <5mm) do share some key traits: both are extremely light and water repellent. Microplastics, when submerged by raindrops, are harder to remove and are therefore more likely to contaminate marine life. Extrapolating and building upon their water strider research, the University of Tennessee is conducting experiments to study the impact of rainfall on the underwater transport of microplastic particles, highlighting the role of factors like density, size, or the presence of polluting surfactants in their movements.

Stride (In the Name of Love).

Antagonistic coevolution. Not the most romantic term ever coined by biologists, and for good reason. It is used to describe the process by which, over thousands of generations, creatures evolve together to find ways to successfully breed, even if the other side is not necessarily a willing participant: a sort-of mating ritual arms race. As of now, the male water strider has come up with a winning strategy. At some point in their evolution, female water striders developed a physical shield that can block unwanted males from mating with them. Since then, males have come upon a behavioral counter-measure to overcome the female's physical one.

When water is your primary medium, you use it as a tool for just about everything. Water striders have an intricate language produced solely by variations in the way they make vibration ripples on the water surface. Using their legs to create species-specific surface waves, striders can

attract mates, establish/defend territories, ID other strider species, and - wait for it - facilitate quick mating. Once a male has mounted a female in the water, he will repeatedly tap the surface with his legs in such a way that is likely to attract aquatic predators. It's a risky gamble for sure, but since the female is below him, she is at greater risk of being the first to be nabbed by a fish or other predator. Rather than risking death, the female less inclined to deploy her shield for threat of being eaten. Romeo and Juliet this is not.

When her eggs are ready, the female water strider can penetrate the surface of the water with her rear end while still staying afloat, and deposit her eggs on submerged rocks, vegetation, or floating objects. The eggs will hatch in a couple weeks or less. Striders are

members of the "true bug" club. Unlike the young of other insects like beetles, butterflies and dragonflies which must pupate from larva (caterpillars, maggots, grubs, etc.), true bug offspring look and behave like their parents from birth, just in miniature form. Strider nymphs go through 5 molts, shedding their exoskeleton to grow a new one. Development from egg to adult takes about 2 months or more, depending on species and temperature of the water.

Winging It

Some species of striders possess wings of varying lengths. Species living primarily on calm water (ponds and slow moving sections of streams and rivers) have larger wings than those inhabiting swiftly moving water, as longer wings are more susceptible to damage. Wing sizes change from brood to brood through the phenomenon of polymorphism. This built-in randomness helps assure that they can better adapt to habitat and environmental water changes, allowing the next generation to move to a more suitable habitat if needs be. Wingless species can also move across land by jumping about, but it's a lot less efficient and more dangerous journey than it is for their winged cousins.

For more information

[Watch a short PBS video](#) about striders with great close up views of their legs and feeding behavior.

"It's much, much worse than a bee or wasp sting. It's actually not a sting; it's a bite. You'll be thinking about it a half hour or an hour. I was bitten in the pad of my little finger, and I felt intense pain all the way to my elbow for a good 30 minutes."

- Robert Sites, entomologist, Univ. of Missouri-Columbia