

Scientists build tiny 'diving suit' for cockroaches, turning them into search-and-rescue cyborgs

LIVESCIENCE **Live Science** · [Follow](#)
Sascha Pare

Fri, July 10, 2026 at 12:33 AM GMT+8

 Add us on Google  

When you buy through links on our articles, Future and its syndication partners may earn a commission.



Engineers at NTU Singapore and Waseda University in Japan have developed a diving suit for cyborg cockroaches. | Credit: Nanyang Technological University (NTU)

Engineers have designed a waterproof "diving suit" for cyborg cockroaches that enables the hybrid insects to survive and roam underwater for up to three hours. This function expands the capabilities of cyborg insects and could one day be deployed in disaster zones, according to the team.

A built-in oxygen generator and silicone tubes deliver the gas directly to a cockroach's breathing holes, known as spiracles. The design is adapted for use in low-oxygen conditions as well as submerged environments, the researchers said in a new study published June 29 in the journal [Nature Communications](#).

"Our approach combines a soft waterproof shell with a simple yet reliable chemical oxygen generator," study co-author [Shinjiro Umezu](#), a professor in the School of Creative Science and Engineering at Waseda University in Japan, said in a [statement](#). "This allows the insect to retain its natural mobility while being protected from an environment that it cannot normally survive in."

Cyborg insects are living insects that have been fitted with electronic controllers that guide their movements. Researchers have previously used them in search-and-rescue operations to access and investigate hard-to-reach areas; for example, they were used in rescue efforts after the devastating magnitude 7.7 earthquake in Myanmar in March 2025 that [killed at least 3,700 people](#) and injured 4,800 more. The advantage of cyborg insects over tiny robots is that the former employ insects' muscles to move, whereas the latter rely on high-power batteries that consume energy and can run out of steam.

The cyborg insects deployed in Myanmar were developed in the laboratory of [Hirotaka Sato](#), senior author of the new study and a professor in the School of Mechanical and Aerospace Engineering at Singapore's Nanyang Technological University.

Sato has spent more than a decade pioneering cyborg insect technology. He and colleagues hope the new diving suit will extend cyborg insects' operational range to include flooded and partially submerged areas in disaster zones.

The suit consists of a flexible shell, four silicone tubes that attach to the spiracles and a transparent, 3D-printed oxygen tank.

"The key engineering challenge was to build a system that was small, light and flexible enough for the insect to wear, while still producing enough oxygen for long-duration underwater movement," Umezu said.

The silicone tubes send oxygen straight into the thoracic spiracles, while the abdominal spiracles, which are lower down the insects' bodies, take in the oxygen contained in the suit.

"Our new insect diving suit works like the oxygen tank used by human divers," Sato said in the statement. The silicone tubes can be attached and removed without pain or harm to the insect, the researchers added.