LANGKILDE LAB/PENN STATE

*An eastern fence lizard (*Sceloporus undulatus*) eating fire ants (*Solenopsis invicta*)*

Eating for Immunity

Eastern fence lizards live in dry pine forests, around houses and barns, and, as their name implies, along fences in most of the eastern states south of the Ohio River Valley. Their colors and patterning mimic wood and bark, enabling them to hide from birds, their primary predators. But fire ants from South America are slowly moving northward in the United States and posing a new threat to the lizards.

Ecologist Tracy Langkilde and colleagues in her laboratory at Pennsylvania State University have long studied fence lizard ecosystems and have found that the way fence lizards—individuals and populations—are responding to this new threat offers a fascinating look into a species' response to rapid environmental change.

"The fire ants attack the lizards," said Catherine Tylan, the study's lead author. "Where the fire ants live, fence lizards have shorter lifespans, and rougher lives. They have had to change how they react behaviorally to [this new] predator . . . their limbs have even changed to be longer so they can run faster."

The research shows that, in areas rife with fire ants, lizards have changed other defensive strategies. Rather than freezing to camouflage, they now thrash their bodies and twitch their limbs before fleeing, much like a human would when attacked by a fire ant. And the lizards have started eating the ants.

Consuming fire ants, of course, eliminates those individuals from threatening again. But the research also indicates that eating fire ants stimulates lizard immune systems, making them more resistant to bites in the future. Tylan explained, "We see very clear differences in immune profiles between communities where the fire ants are present and where they're absent. By eating the fire ants, the lizards may be helping themselves immunologically defend against stings."

The team found significant variation in three immune factors between lizard populations with fire ants and those without. Each of those factors are key in defending lizards' bodies from the fire ant venom. "This phenomenon helps explains a pattern we typically see in lizard populations," said Tylan. "Population levels decrease when the fire ants first arrive, but then they rebound." (*Biological Invasions*) *—Brittany Steff*

A Rude Awakening

No matter how exhausted we feel, if an emergency breaks out, humans—along with other animals—can forestall the urge to sleep. A new study has provided key insights into the neurological basis for this ability in fruit flies. Because fruit flies serve as a model organism for some physiological processes in humans, the study's results could point to new therapeutic approaches for treating insomnia and other sleep disorders.

"Falling asleep at the wrong time can be dangerous," said Paul Shaw, a professor of neuroscience at Washington University in Missouri and the study's co-corresponding author. "In this [study], we identify a potential mechanism that allows animals to stay awake when they are in life-threatening situations."

In their sleep patterns, fruit flies (*Drosophila*) are remarkably like *Homo sapiens*: active during the daytime, at rest during the night, and fond of afternoon naps. Many human sleeping drugs, such as antihistamines, also work on flies. *Drosophila* have accordingly emerged as a useful sleep-study surrogate and, with a brain a million times smaller than the human brain, they are far more amenable to targeted investigations.

Shaw and colleagues focused on a special set of two-dozen neurons in fruit flies concerned with wakefulness and sleeping. The researchers examined how these neurons responded when the flies were exposed to experiences that modified their sleep behavior.

Challenging the flies intellectually, for instance, by teaching them a new behavior or placing them in crowded social settings, tired the insects. The twenty-four sleep neurons became less sensitive to the neurotransmitter dopamine, that ordinarily promotes wakefulness.

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Fruit flies and humans show similar sleep patterns.

In contrast, startling the flies awake by shaking their containers boosted production of two other neurotransmitters, glutamate and allatostatin A. The latter of these chemicals promotes wakefulness and is likely what keeps the flies alert to respond to threatening situations.

Other experiments showed that the sleep-promoting neurons can stay modified for many days following an environmental stimulus. For instance, introducing time-restricted feeding, where the flies can only eat during certain hours, rendered the sleep neurons more sensitive to dopamine. As a result, the flies slept less, yet did not display evident tiredness, suggesting that time-restricted feeding had increased sleep quality.

Overall, the study showed that the responsiveness of neurons critically important to sleeping and waking varies with environment, suggesting new ways we might regulate sleep. "Together," said Shaw, "these data indicate that sleep-promoting neurons are not simply passive components of a hardwired circuit but, rather, change their physiological properties to match sleep need with environmental demands." (*PLoS Biology*) *—Adam Hadhazy*