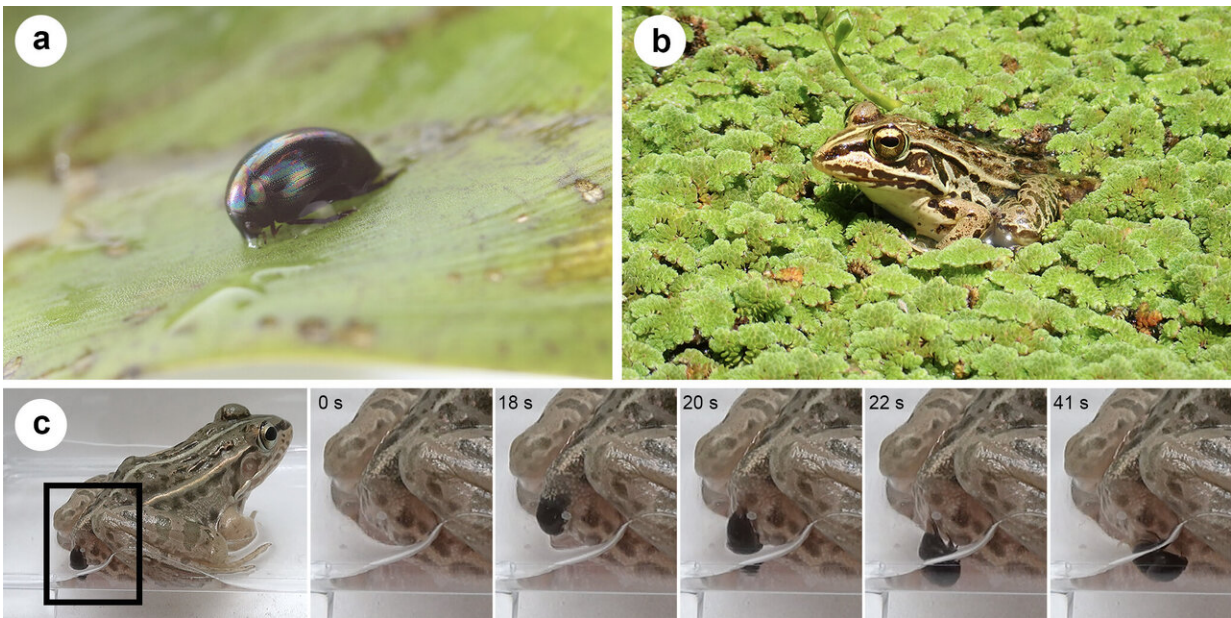


An insect species can actively escape from the vents of predators via the digestive system

August 3 2020



(a) An adult of the aquatic beetle *Regimbartia attenuata*. (b) The potential predator *Pelophylax nigromaculatus*. (c) *R. attenuata* escaping from the vent of *P. nigromaculatus*. Credit: Kobe University

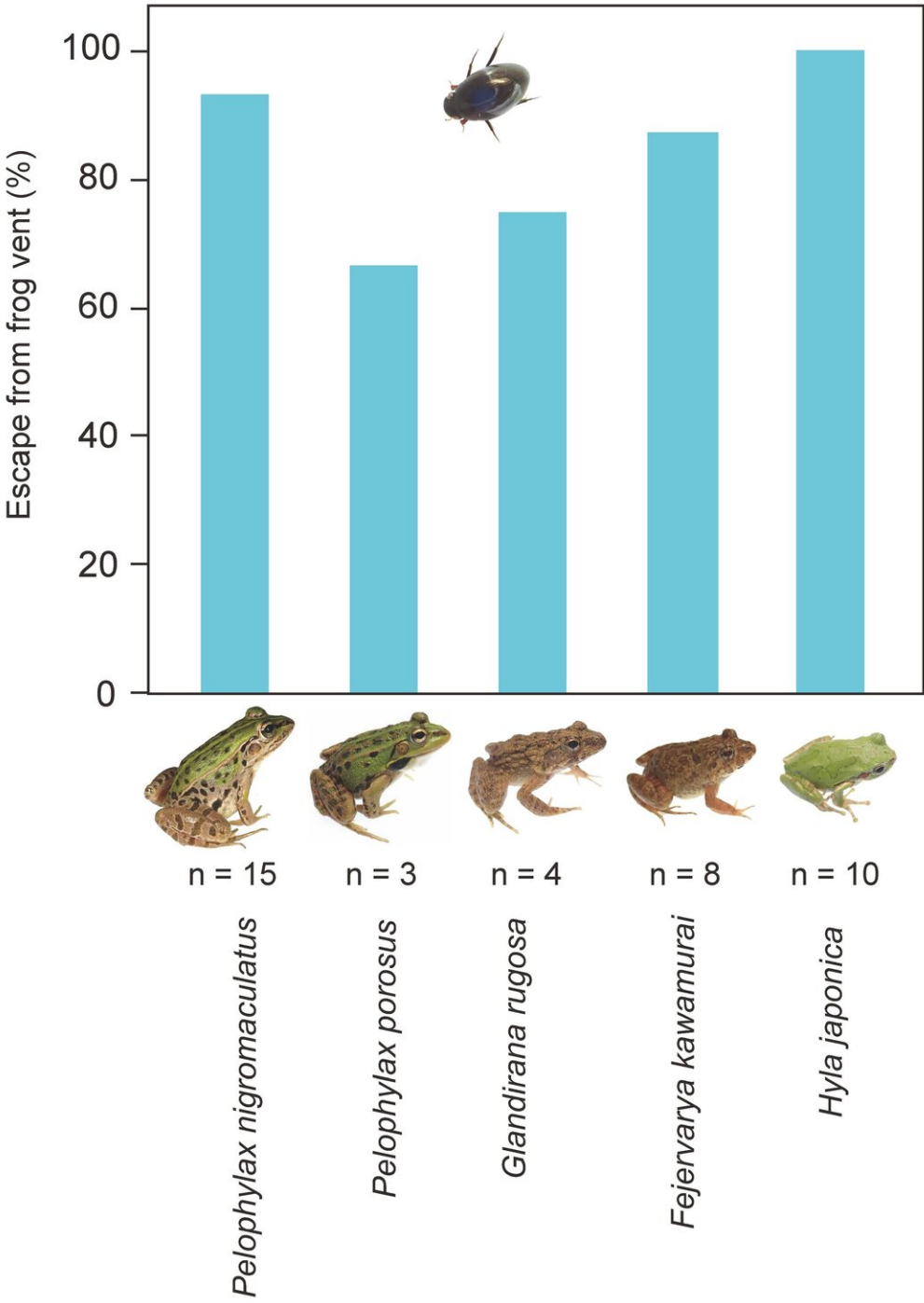
Prey can evade predators and also avoid attacks. However, some can escape from inside a predator after being swallowed. For example, some animals that can survive predators' digestive systems are excreted in feces and thereby escape, albeit in a passive manner. Now, for the first time, research has documented the quick, active escape of prey from the

body of a predator after being eaten.

Kobe University ecologist SUGIURA Shinji found that the aquatic beetle *Regimbartia attenuata* can actively escape from the [vent](#) of the [frog](#) *Pelophylax nigromaculatus* via the digestive system. Furthermore, his laboratory experiments suggest that the beetle can promote frog excretion to facilitate its escape. His research appears in the 3 August 2020 issue of *Current Biology*.

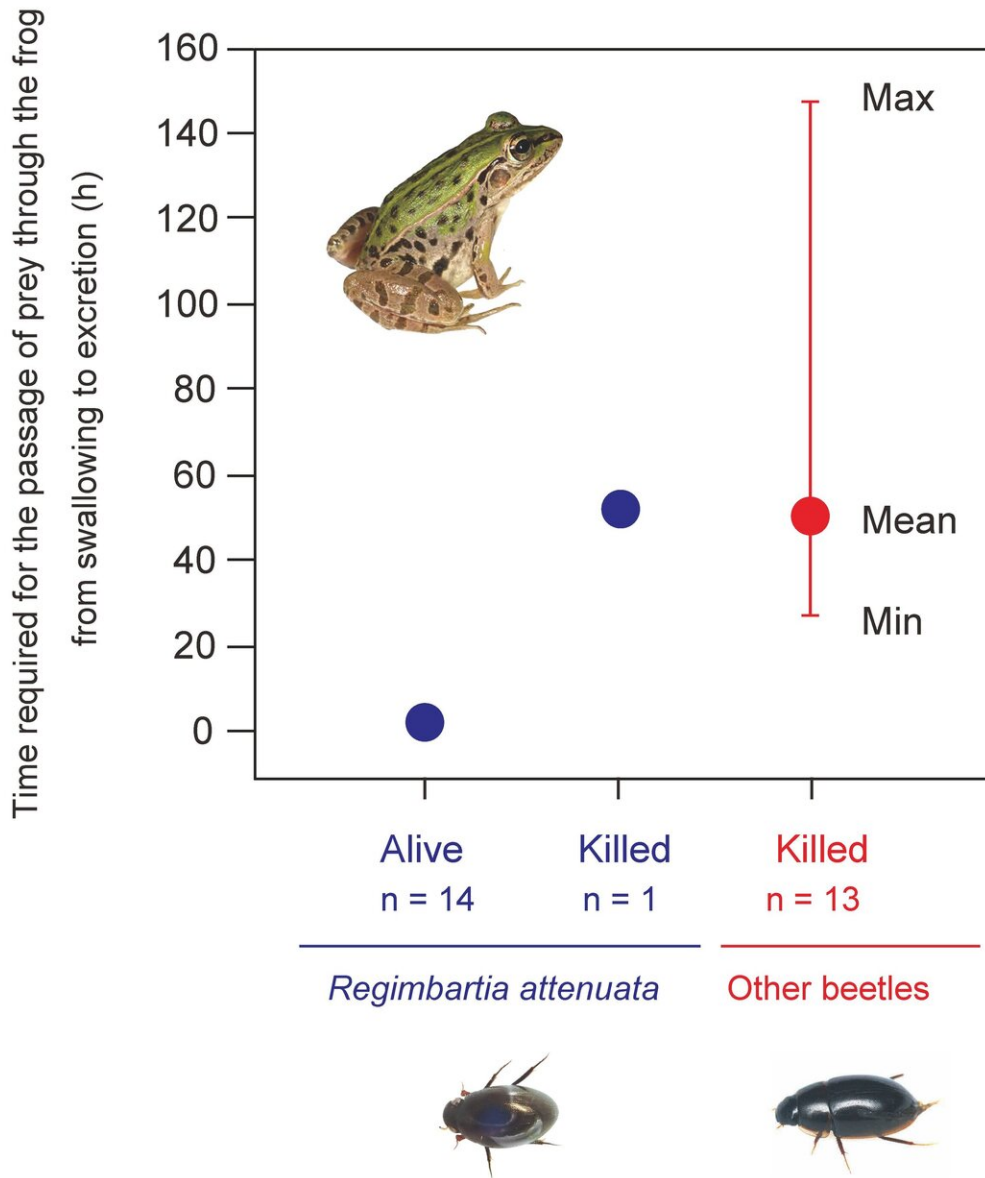
Many [frog species](#) lack teeth and are unable to kill [prey](#) before swallowing it. Therefore, frogs' digestive systems play an important role in killing prey. To investigate the defenses of insects against frogs, Sugiura provided frogs with various insect [species](#).

The aquatic beetle species *R. attenuata* and frog species *P. nigromaculatus* are frequently found in the same paddy fields in Japan. Because *P. nigromaculatus* preys on terrestrial and aquatic insects, this frog species can attack *R. attenuata* under field conditions. To investigate the responses of *R. attenuata* to *P. nigromaculatus*, Sugiura provided *R. attenuata* adults ([body length](#) 3.8-5.0 mm) to juvenile and adult *P. nigromaculatus* (snout-vent length 22.5-74.2 mm) under laboratory conditions. All adults were easily swallowed by the frogs. However, 93.3% of the swallowed beetles were excreted within six hours after being swallowed (Figs. 1-3). Surprisingly, all excreted beetles were alive and active.



Success rates of the escape of *Regimbartia attenuata* from five frog species.

Credit: Kobe University



Time required for the passage of *Regimbartia attenuata* and other beetles through the frog *Pelophylax nigromaculatus* from swallowing to excretion.

Credit: Kobe University

These observations indicate that swallowed *R. attenuata* move toward the frog vent through the digestive system. *P. nigromaculatus* always excreted the undigested parts of prey (except live *R. attenuata*) > 24 h after swallowing them (Fig. 3). Because the frog's sphincter muscle pressure keeps the vent closed, the tiny beetles are unable to exit through the vent without inducing the frog to open it. Therefore, *R. attenuata* may stimulate the frog's gut to promote excretion. The same behavior was observed when *R. attenuata* was swallowed by four other frog species: *Pelophylax porosus*, *Glandirana rugosa*, *Fejervarya kawamurai*, and *Hyla japonica*.

This study is the first to report the successful escape of prey insects from the vent of a predator and to suggest that the prey promotes predator excretion to escape from inside the [predator's](#) body.

More information: *Current Biology* (2020). [DOI: 10.1016/j.cub.2020.06.026](#)

Provided by Kobe University

Citation: An insect species can actively escape from the vents of predators via the digestive system (2020, August 3) retrieved 27 April 2024 from <https://phys.org/news/2020-08-insect-species-vents-predators-digestive.html>

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