Advancing science by leaps and bounds

by Gregory D. Larsen

SCIENTIFIC NAME
Onychomys spp.

TAXONOMY
PHYLUM: Chordata
CLASS: Mammalia
ORDER: Rodentia
FAMILY: Cricetidae

General description

All three species of the genus *Onychomys* are called grasshopper mice, although chiefly northern grasshopper mice (*O. leucogaster*) and southern grasshopper mice (*O. torridus*) are used in laboratory research. Mature grasshopper mice span about 120–190 mm from head to tail and weigh 30–60 g. The dorsal fur is brown on *O. leucogaster* but gray on *O. torridus*, and both have white ventral fur and white tail tips[1].

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Grasshopper mice are nocturnal, carnivorous predators. In the wild they feed primarily on arthropods and small vertebrates, including other rodents, but researchers have maintained captive colonies using combinations of commercially available diets for rodents and carnivorous or insectivorous mammals[1,2]. These mice communicate through scent marking and a distinctive 'howl' that is audible to humans, but it remains unknown precisely what information is conveyed in these social messages. Grasshopper mice are very aggressive, and when housed together in captivity, two individuals of the same sex will often fight to the death. When housed in breeding pairs, however, grasshopper mice can be successfully bred and reared in captivity[1].

Research résumé

Predatory aggression in grasshopper mice is easily characterized and can be dependably elicited by presenting the mice with potential prey. For this reason, some of the first experiments with this species used grasshopper mice as a model of aggressive behavior, testing how drugs[3,4], sleep deprivation[5] or conditioned learning[6] differentially affected the predatory aggression of grasshopper mice when presented with prey. Such experiments helped reveal the cognitive mechanisms and neurophysiology that underlie and mediate aggressive behavior in predatory mammals.

Other studies have made use of grasshopper mice as a convenient rodent model of diseases transmitted through carnivory. Researchers in Japan have used a captive colony of *O. leucogaster* to model echinococcosis, a disease that occurs when an animal consumes organs with cysts of *Echinococcus* tapeworms[2], and US laboratories have studied transmission of plague (*Yersinia pestis*) when *O. leucogaster* are fed infected prey[7]. This latter study is of particular importance to researchers studying plague in the southwestern United States because grasshopper mice are an alternate host of plague, contributing to periodic outbreaks among denser populations of prairie dogs. Grasshopper mice have also been used to study several other diseases, often alongside more conventional small mammal models[1].

Most recently, researchers have gained new insights into the mechanisms of pain and pain suppression by studying the unique natural history of grasshopper mice[8]. *O. torridus* are sympatric with bark scorpions (*Centruroides sculpturatus*) in the Sonoran Desert, where the mice voraciously predate upon the scorpions. When they attack scorpions, grasshopper mice usually sustain multiple stings that normally cause severe pain, but this scarcely deters them (a supplementary movie accompanies ref. 8). The venom of bark scorpions typically induces pain by activating specific sodium channels ($Na_v1.7$) that are expressed in peripheral sensory neurons. In southern grasshopper mice, however, a different sodium channel ($Na_v1.8$) in the same neurons binds the toxins from scorpion venom, causing the channels to become inhibited. This prevents pain signaling from sensory neurons, inducing analgesia whenever a grasshopper mouse is stung by scorpions. Since few toxins are known to bind to $Na_v1.8$, this biochemical response in grasshopper mice could provide the basis for future analgesic therapies.

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