Daytime predation by a nocturnal scorpion on marching desert locust nymphs during an outbreak

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Abstract

During a desert locust (*Schistocerca gregaria*) outbreak in Mauritania in 2025, we observed a typically nocturnal fattail scorpion (*Androctonus amoreuxi*) emerge from its burrow and capture a marching last-instar locust nymph during the hottest part of the day. After repeatedly stinging the nymph, the scorpion attempted to carry it back to its burrow but abandoned the prey after briefly crossing sun-exposed ground where the surface temperature reached 48 °C. Excavation of the burrow revealed another paralyzed locust nymph stored underground, suggesting possible prey storage. In subsequent experiments in bright conditions, this scorpion readily attacked, captured and envenomated eight active locust nymphs in succession. During more than 15 years of fieldwork in the Sahara Desert, we have never observed daytime surface activity by this scorpion species except during desert locust outbreaks. These observations suggest that unusually high prey availability may promote opportunistic daytime foraging by this nocturnal predator, suggesting adaptive predatory flexibility.

Keywords

Behavioral plasticity, desert, locust, niche boundaries, predation, scorpion

Introduction

Desert locust *Schistocerca gregaria* (Forskål, 1775) outbreaks are among the most spectacular biological phenomena in terrestrial ecosystems (Cullen et al. 2017). During outbreaks, gregarious nymphs form dense marching bands, with local densities exceeding 5,000 individuals/100 m² (Maeno et al. 2021). Local diurnal generalist predators can respond to the temporarily abundant locusts by shifting their diet toward them (Sánchez-Zapata et al. 2007, Cullen et al. 2017). In comparison, little is known about how nocturnal arthropod predators respond to the temporary superabundance of locusts or whether they exhibit functional responses to such resource pulses. Interestingly, despite such high prey availability, few predators are known to collect and store locusts for later consumption.

Desert scorpions are predominantly nocturnal predators that spend the daytime inside burrows or other sheltered microhabitats to avoid lethal temperatures in arid environments (Cloudsley-Thompson 1981, Polis 1981, Adams et al. 2016). Among them, the fattail scorpion *Androctonus amoreuxi* (Audouin, 1826) is a widespread Saharan species that emerges after sunset to capture arthropod prey (Polis and Farley 1980, Shachak and Brand 1983). To our knowledge, daytime activity has not been reported for *A. amoreuxi*. During more than 15 years of fieldwork in the Sahara Desert, we have frequently observed this species foraging at night but have not observed daytime surface activity except during desert locust outbreaks.

Here we report an *A. amoreuxi* emerging from its burrow and capturing a marching desert locust nymph during the hottest part of the day. Subsequent laboratory observations showed that the scorpion retained the capacity to attack and envenomate multiple locust nymphs in succession under bright daytime conditions. The discovery of a paralyzed locust nymph inside the scorpion burrow also suggests possible prey storage. We present this unusual predator–prey interaction as a natural history observation and discuss its possible ecological significance during desert locust outbreaks.

Materials and Methods

Field observation.—Field observations were conducted in Mauritania, West Africa, during a desert locust (*Schistocerca gregaria*) outbreak in November 2025. The study site (19°25.207'N, 14°52.389'W; WGS 84) was located near Akjoujt. The habitat consisted of sandy desert with sparse vegetation dominated by the perennial grass *Panicum turgidum* (0.5–1.3 m tall) (Maeno et al. 2024). At the time of the observation, gregarious last-instar nymphs of *S. gregaria* were actively marching in a band through the study site (Maeno et al. 2021). At approximately 15:00, a daytime predation event by a scorpion was observed. Air temperature and relative humidity were recorded in the shade at 50 cm above

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the ground using a thermo-hygro recorder (TR-72wf, ONDOTORI, Tokyo, Japan). The surface temperature of sun-exposed sandy ground was recorded using a thermo-recorder equipped with a temperature probe (TR-71nw, ONDOTORI). Following the predation event, the burrow was carefully excavated to capture the scorpion. During excavation, a paralyzed but still-living locust nymph was found in the same burrow, approximately 50 cm from the burrow entrance.

Laboratory assay.—We tested whether the scorpion would attack prey under daytime-like conditions, at the Centre National de Lutte Antiacridienne (CNLA) in Mauritania. After capture, the scorpion was maintained individually for 4 days under semi-field conditions in a sand-filled white plastic container (40 L) in the shade. During this period, the lid was kept slightly open and no food was provided. On the evening before the laboratory assay, the container was completely covered with the lid to provide a dark, sheltered environment. At approximately 14:00 the following day, the lid was removed and the scorpion was exposed to bright light conditions (>20,000 lux; measured using a digital lux meter, VL-U7100X, LPL Co., Ltd., Japan). Over a 2 h period, eight live gregarious last-instar desert locust nymphs were introduced one at a time into the scorpion's white plastic container and removed immediately after being stung, with approximately 5 min between successive prey presentations. Predatory responses, including prey capture and stinging behavior, were recorded. For each trial, the occurrence of prey capture and stinging was noted. Ambient temperature during the assay was 28–30°C. The condition of envenomated prey was monitored for up to 5 days. During the field survey, a second scorpion was captured at night and brought to the laboratory. To determine whether this individual could also immobilize multiple locust nymphs, it was tested using the same procedure. Because of logistical constraints, only three last-instar locust nymphs were presented to this individual.

Results

Field observations.—In November 2022, we observed an *A. amoreuxi* scorpion capture and envenomate a fifth-instar desert locust nymph at dusk and drag it into its burrow. In 2025, we again observed an *A. amoreuxi* capture and envenomate a fifth-instar nymph but this time during the hottest part of the day (TAir = 33.5°C; TSoil surface = 48.1°C) (Fig. 1, Movie 1). Multiple gregarious locust nymphs were marching through the shrub containing the scorpion burrow (Fig. 1A). As an observer approached, a gregarious locust nymph jumped to escape and was subsequently captured by a scorpion that had emerged from its burrow at the base of vegetation (Fig. 1B). The interaction was recorded on video. The scorpion grasped the locust nymph with its pedipalps and repeatedly stung it with its stinger, then began to carry the immobilized prey, apparently attempting to return to its burrow. However, it briefly entered sun-exposed ground, after which it rapidly dropped the prey and retreated. The scorpion moved around the area, repeatedly contacting the dropped nymph and attempting to retrieve it; however, when the nymph became entangled in vegetation and could not be removed, the scorpion quickly abandoned the prey and instead entered its burrow. The envenomated locust lay on its side and showed leg movements but was unable to walk (Fig. 1C).

Following the 2025 observation, we carefully excavated the burrow to collect the scorpion. During excavation, a paralyzed but still-living locust nymph was found in the same burrow, approximately 50 cm from the burrow entrance (Movie 2, Fig. 1D). The scorpion was subsequently collected and transported to the laboratory.

Laboratory assay.—In laboratory tests under bright light conditions, a scorpion presented with live fifth-instar locust nymphs readily attacked and stung eight nymphs in succession (Fig. 1E). All eight introduced nymphs were rapidly immobilized following envenomation and initially remained alive. By the following day, all nymphs still appeared alive, and three showed slight leg movements. On Day 2, all individuals were completely immobile, with no visible signs of movement; however, three individuals retained a fresh and intact appearance even after 5 days. A similar observation was subsequently made with a second scorpion, which attacked and envenomated three locust nymphs, all of which became immobilized.

Discussion

Our study documents a rare predator–prey interaction during a desert locust outbreak, in which a typically nocturnal scorpion captured a marching desert locust nymph in the hottest part of the day. During 15 years of fieldwork in the Sahara Desert, we regularly observed *A. amoreuxi* foraging at night but never encountered this species on the surface during the daytime, except when locusts were present during outbreaks. Although based on limited observations, this finding suggests that the exceptionally high prey densities associated with locust outbreaks may occasionally promote opportunistic daytime foraging by an otherwise nocturnal predator.

Hot desert scorpions generally remain inside burrows during daylight to avoid lethal temperatures and desiccation (Cloudsley-Thompson 1981, Adams et al. 2016). In the 2025 field observation, the scorpion emerged in a shaded area beneath vegetation and captured a locust but rapidly retreated after briefly entering sun-exposed ground where the surface temperature approached 50°C. Rather than indicating a relaxation of thermal constraints, this behavior suggests that daytime foraging remains strongly restricted to thermally buffered microhabitats. During outbreaks, gregarious desert locust nymphs have been recorded actively marching at air temperatures of 34.8°C and ground surface temperature of 54.1°C (Maeno et al. 2021). Under extremely hot conditions, however, they frequently seek shade beneath vegetation or climb onto plants to reduce thermal stress (Maeno et al. 2013, 2021). These thermoregulatory behaviors may increase the frequency with which locust nymphs pass close to scorpion burrows beneath vegetation, creating opportunities for scorpions to encounter abundant prey during otherwise restrictive midday conditions.

The present observations also suggest that scorpion venom may facilitate temporary prey storage during periods of exceptionally high prey availability. A paralyzed but still-living locust nymph was recovered from the burrow, and laboratory observations showed that envenomated nymphs remained immobilized for more than 24 h, with some retaining a fresh and intact appearance for several days. A single scorpion successfully immobilized at least eight locust nymphs in succession, and a second scorpion similarly immobilized three nymphs, indicating that *A. amoreuxi* can envenomate multiple locust nymphs over a short period. Although prey storage has received little attention in scorpions, the ability to immobilize multiple prey could potentially allow scorpions to exploit transient pulses of abundant food more efficiently. Scorpion venoms contain diverse insecticidal peptides

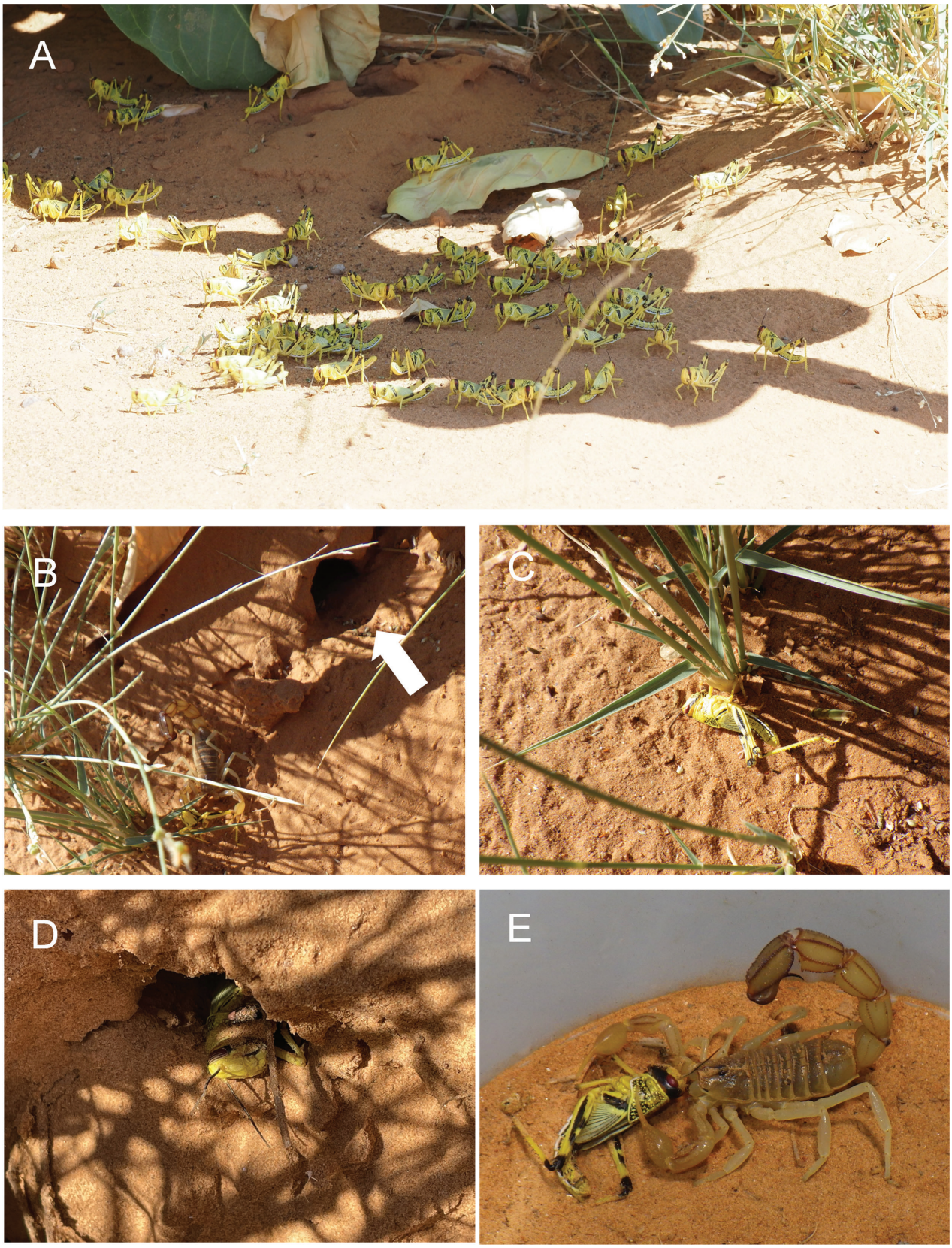

Fig. 1. A. Gregarious locust nymphs, *Schistocerca gregaria*, sheltering in the shade beneath vegetation at the study site; **B.** A scorpion, *Androctonus amoreuxi*, emerging from its burrow (arrow) during the hottest part of the day and capturing a last-instar desert locust nymph; **C.** A locust nymph that was captured but dropped by the scorpion; the nymph is paralyzed and shows slight leg movements; **D.** A paralyzed desert locust nymph found inside the scorpion burrow; **E.** An *A. amoreuxi* scorpion feeding on a last-instar desert locust nymph after envenomation under laboratory conditions.

and have attracted considerable interest as potential sources of bioinsecticides (Gurevitz et al. 2007, Dal Belo et al. 2025). Our observations further show that *A. amoreuxi* venom can rapidly immobilize desert locust nymphs, providing an ecological basis for future studies investigating scorpion venom as a potential source of bioinsecticidal compounds for locust management.

Rare behavioral interactions such as the one reported here are unlikely to be documented through short-term ecological studies because they depend on the rare coincidence of exceptionally high prey abundance, suitable microhabitats, and the presence of an observer at precisely the right time. Long-term field observations therefore remain indispensable for documenting infrequent ecological and behavioral events under natural conditions. Beyond describing a previously undocumented predator–prey interaction, this study illustrates how natural history observations can generate new ecological hypotheses. Future laboratory experiments under more naturalistic conditions could test these hypotheses by manipulating prey density, light intensity, and microhabitat temperature to determine whether these factors influence daytime emergence and predatory activity in *A. amoreuxi*. Such studies may contribute to a better understanding of predator–prey interactions in desert food webs and, potentially, to the development of ecologically based locust management strategies. More broadly, our observations highlight the potential for adaptive predatory flexibility in response to temporary pulses of abundant prey.

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Additional information

Conflict of interest
The authors have declared that no competing interests exist.

Ethical statement
No ethical statement was reported.

Artificial Intelligence (AI) use
The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.
Regarding the use of AI in the preparation of this manuscript, the authors declare the following: GPT
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K.O.M. designed and performed the research, analyzed the data, and wrote the paper. A.S.B. and M.E.H.J. reviewed the final manuscript and organized field surveys.

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Data availability
All of the data that support the findings of this study are available in the main text. The video file is available here: https://figshare.com/s/f03e772f395468de877b.