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NOTE

War prompts distress symptoms in Israeli Blind Snake

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Case study

The effects of armed conflict on wildlife are an often sidelined consequence of war. The rare studies on this subject mainly deal with population declines caused by bombs & chemicals, habitat alteration (both collateral & strategic), increase in exploitation by displaced people, and decrease in enforcement (reviewed in Gaynor et al. 2016). Behavioral reactions to sudden noises of military origin were studied in endotherms (Weisenberger et al. 1996; Krausman et al. 1998; Maier et al. 1998, Conomy et al. 1998; Goudie & Jones 2004), but all focused on aircraft engines, not blasts, only two studies included physiological indices of stress, such as heart rate (Weisenberger et al. 1996) and more recently, in a lizard, blood corticosterones (Kepas et al. 2023). Study of reptiles' reaction to anthropogenic noise in general is minimal (Shannon et al. 2016).

On 11 May 2021, following recent tensions and violent events in Jerusalem, hundreds of rockets were fired into Israel, including Tel Aviv, where our laboratory is located. Most rockets were intercepted, some hit their targets, in both cases producing thunderous explosions. Six hours later, another bombardment was fired. Throughout that time, we were conducting unrelated measurements of the metabolic rate of a Syrian Blind Snake *Xerotyphlops syriacus*, which resulted in a coincidental documentation of its physiological response to the rocket barrages.

Xerotyphlops syriacus (Jan, 1864) is a nocturnal and fossorial blind snake of the family Typhlopidae inhabiting Lebanon, Syria, Jordan, Israel, the Palestinian Territories, and Egypt (Bar et al. 2021). The individual we investigated was caught in Tel Aviv University (under permit #2021/42720 from the Nature and Parks Authority). It was kept in a terrarium with moist earth but no food to ensure a post-absorptive state during the study. After a week it was placed in a 50 ml metabolic chamber connected to a LICOR LI-7000 CO2/H2O analyzer (LICOR, Lincoln, NE, USA) which was kept dark and at a stable 20°C. Dry air flowed through the chamber at 50 ml/min, whereupon exiting CO_2 was measured. An empty identical chamber was used to calibrate baseline gas levels, to which measurement automatically switched for 15 minutes at pre-programmed intervals, without affecting the airflow or any other aspect of the chamber housing the snake. An hour after the first measurement, a second was made using the same protocol except for temperature, which

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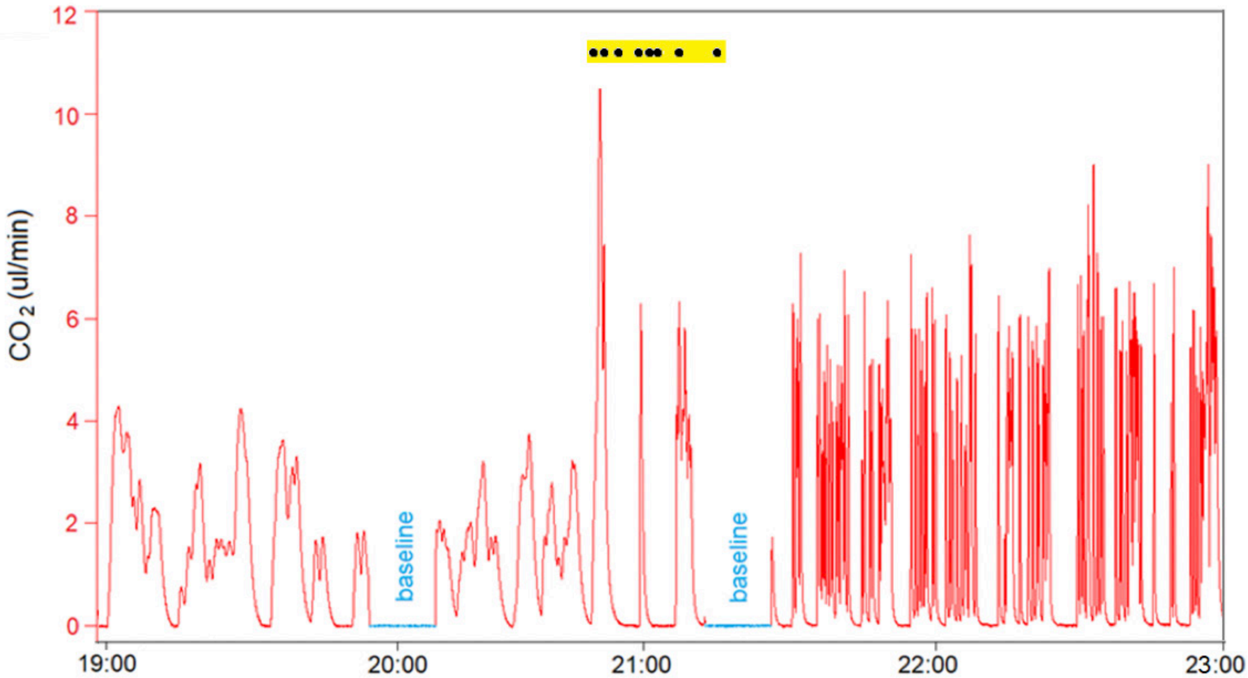

Figure 1. Carbon dioxide production of *Xerotyphlops syriacus* before, during, and after the first barrage (in yellow). Inset is a detail of the barrage itself, each black dot indicates a round of several rockets that hit or were intercepted in North Tel Aviv. Blue lines denote the pre-set baseline intervals, which come from a different channel. Chamber temperature is 20°C.

was cooled down to 12°C. The snake was rehydrated when the experiment ended, and released the following day back where it was found. We analyzed the data with Expedata 1.9.20, using the baseline to correct drift and shift. Measurements were conducted under ethics permit #18616 from the TAU Ethics Committee. Sunset was at 1929 h, and the room and surrounding floor were empty of people by the beginning of this recording. Everything was pre-programmed to run automatically so we could see real-time results from afar.

At 2047 h, concurrently with the explosion of the first round of rockets, we witnessed a sharp change in the gas exchange pattern (Figure 1), from the usual smooth pattern to a series of rapid peaks. The amplitude of the peak at the first explosion was 2.8 times the maximum pre-explosion peak. Eleven sharp CO_2 peaks in the span of 200 seconds (5.88-fold the prior frequency) instantly followed the penultimate rocket round, which hit nearest to the laboratory. In the last round we measured only the first seconds, because of the automatic switch to the baseline channel, but the start of a rise in CO_2 is detectable. Between the end of the rocket barrage (2116 h) and the predetermined end of the measurement (2300 h), O_2 uptake returned to basal levels but respiration rates stayed high. During the second measurement that night, with colder temperature, we witnessed two respiration peaks of starting at 0251 h and 0301 h (Figure 2). Each of these peaks, concurrent with the two new rounds of explosions, had an amplitude three times higher and a total area tenfold above the average for peaks in the hour before.

We interpret the change in gas exchange patterns of *X. syriacus* as a response to the explosions outside. While the physiological symptoms of fear and distress in reptiles are difficult to confirm (Lambert et al. 2019), relaxed breathing is usually taken as an indicator of well-being in reptiles (Warwick et al. 2013) and other animals (Carstens & Mober 2000). Nearly every round of rockets was followed by a sharp peak in gas exchange, too closely matched to be dismissed as a coincidence. The overall metabolic rate was not higher after the explosions ended but breathing changed to high frequency bouts of unusually high, interspaced peaks, which persisted for hours. This response was exhibited by a blind snake with no external ears, inside a sealed, padded chamber, within an incubator located in a closed, windowless second-floor room of a concrete building. Animals in nature are much less shielded from the sound of explosions and the ensuing destruction. Wildlife is understandably not the focus when politics descend into violence, but is doubtlessly also grievously affected.

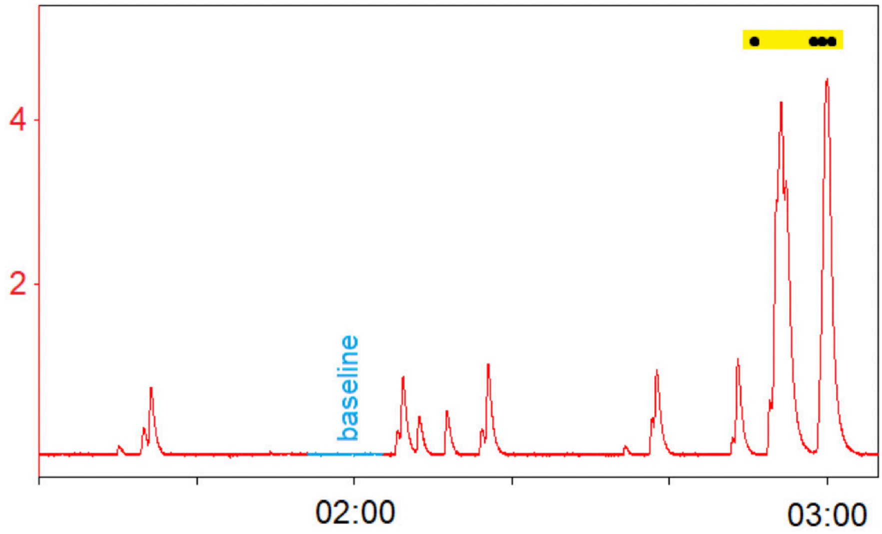

Figure 2. Carbon dioxide production (y-axis units are ul/min CO_2) of *Xerotyphlops syriacus* before and during the second barrage (in yellow). Each black dot indicates a round of several rockets that hit or were intercepted in North Tel Aviv. Blue lines denote the pre-set baseline intervals, which come from a different channel. Chamber temperature is 12°C.

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