



E-ISSN: 2320-7078

P-ISSN: 2349-6800

[www.entomoljournal.com](http://www.entomoljournal.com)

JEZS 2024; 12(2): 40-44

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Received: 06-01-2024

Accepted: 08-03-2024

**John Megre Shields**

BSc. (Hons), Independent

Researcher, Unaffiliated, Spain

## Colour preference and antipotentiation to physical perturbation stimulus in *Euscorpium balearicus*

**John Megre Shields**DOI: <https://doi.org/10.22271/j.ento.2024.v12.i2a.9296>**Abstract**

In this study, I explored whether the Balearic scorpion, *Euscorpium balearicus*, shows a preference for resting in particular coloured zones following a perturbing stimulus, and whether this behaviour changes over time, in a manner phenomenologically mentioned here as antipotentiation. The scorpion subject was placed in a glass cup split into four colour zones, and was gently provoked into movement by pushes from a wooden stick. The colour quadrant they initially rested in, and the one they chose after provocation were noted for 75 instances. It was found that over time, the number of provocations required to trigger movement increased, and the distance that the scorpion absconded from the stimulus decreased per stimulation; even considering the possible effects of fatigue, this potentially indicates antipotentiation, as is discussed. Analysis of colour preferences leans towards no significant preference for a particular colour zone.

**Keywords:** *Euscorpium balearicus*, colour preference, antipotentiation, perturbation stimulus**Introduction**

The Balearic scorpion, *Euscorpium balearicus*, is a nocturnal species native to the Gymnesian Isles of the Mediterranean region<sup>[3, 4]</sup>. Being that the geology there is colourfully diverse, and *Euscorpium* are said to not just be lapidicolous but also live in woods and other areas<sup>[1, 2, 5]</sup>; as such I wondered whether they may lean towards one colour over another as being a 'safer colour' for respite following provocation, despite their questionable eyesight. Thus was established this trial. Throughout the experiment, I observed that the intensity and type of their response appeared to reduce over time, whilst the quantity of nudges required to initiate provocation increased; a process termed 'antipotentiation' in this study. This exploratory research was conducted single-handedly in Mallorca, Spain where the scorpion subject was obtained from its natural habitat, at around 5:30pm on Friday the 10th of March, 2024, from underneath a rock by a small cutting by the side of the path on the Puig de Maria mountainside, in Pollença, and the experiment carried out starting at 10:21pm of the same day. The experimental apparatuses were devised from household objects. The provoking stimuli used in this research were nothing more than gentle pushes via a wooden stick, delivered in a controlled environment whose temperature and humidity were equivalent to those of its natural habitat, being that the experiment was conducted within roughly a kilometre of the collection site of the sample.

It was hypothesized that the subjects tested may exhibit a preference for a specific colour zone, in which to rest after experiencing a perturbing stimulus. The intent was initially to observe and record data for these potential behavioural patterns and understand more about the behaviours and preferences of *Euscorpium balearicus*.

**Materials and Methods**

A single scorpion, *Euscorpium balearicus*, was obtained from its natural habitat in Mallorca, Spain, and introduced into an experimental setup which constituted of a glass cup of 8 cm diameter.

**Corresponding Author:****John Megre Shields**

BSc. (Hons), Independent

Researcher, Unaffiliated, Spain

The bottom of the cup was separated into four quadrants using a sheet of paper, coloured using Faber-Castell Oil Pastel crayons-Emerald Green (n.163), Phthalo Blue (n.110), and Pink Carmine (n.127), with the fourth quadrant left white which was positioned under the cup.

The experiment was conducted in a house located approximately 1 km from the specimen collection spot, matching the climatic conditions of the scorpion's natural habitat as closely as possible. The house, devoid of artificial heating, and being well naturally ventilated, maintained an essentially equivalent range of temperature and humidity as the scorpion's natural environment.

During the experimental process, artificial lighting conditions were created using a single 25W bulb (approximating 675 lumens) in a lamp positioned overhead the cup, a little towards the side of the green quadrant due to recording requirements; the entire experiment over 75 stimulations was recorded using a phone positioned on a stack of books for optimal viewing and accuracy of data collection. The wooden stick used was the back end of a Vernissage paintbrush (n.16). The method of provocation involved gently nudging the scorpion with a clean wooden stick. At the outset of each trial, the scorpion was allowed to choose a quadrant for resting. Once settled, physical stimulus was applied to provoke the scorpion into movement (defining 'adequate provocation' as the scorpion moving at least one quadrant away from its initial position). The starting and resting quadrant colours post-provocation were noted for all 75 trials. In addition, other data points meticulously recorded included the number of quadrants passed by the scorpion following provocation before deciding to rest again, and number of prods required to induce the adequate provocation.

Owing to the manner of the apparatus being a standard-sized glass cup, the surface material and size was such that for the scorpion, when provoked into running, it would essentially always run in circles along the edge of the glass in the

opposite direction from which it had been provoked (which was kept consistent throughout). This ensured that the scorpion would be almost guaranteed to cycle through all possible colour zones in the same anticlockwise manner before settling down to rest, if it ran for long enough after being provoked.

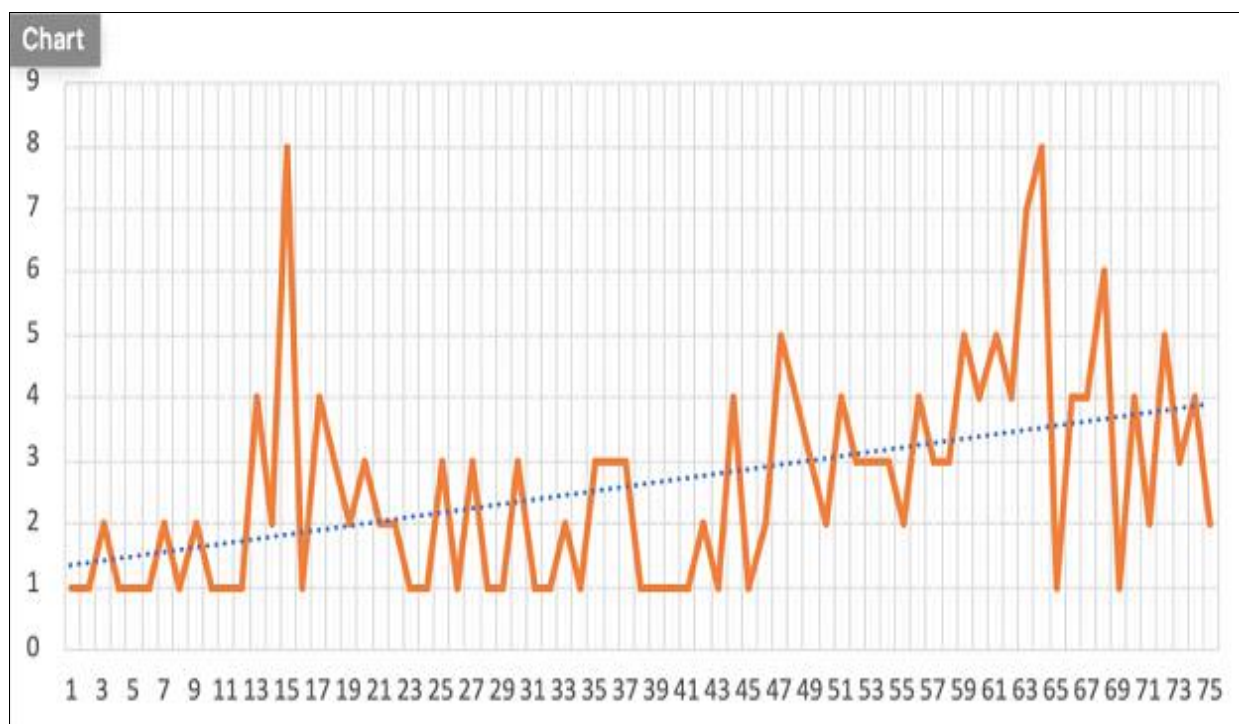
The entire experiment of 75 provocations was performed on the same scorpion in a span of approximately 13 minutes.

## Results

The resting colour preferences of the *Euscorpius balearicus* were recorded over 75 provocation trials. The results illustrated no significant preference for any particular colour quadrant ( $\chi^2=4.526$ ,  $DF=3$ ,  $p=0.2100$ ); however, the observed resting distribution was 22.5 counts in the Red quadrant, 15.5 in Blue, 13 in Green, and 24 in White respectively, with 18.75 as the expected value for each. 22.5, 15.5 and 18.75 were rounded up to 23, 16 and 19 to permit the use of the chi-squared test. Half values were given in recording results when the scorpion settled halfway between two colour zones.

A trend was observed in the number of prods required to induce the scorpion's movement. There appeared to be an escalation in the number needed over the course of the trial sessions, with averages rising from 2.36 in the first 25 trials, to 2.56 in the next 25, and finally to 3.6 in the last 25 trials, indicating a clear trend towards an antipotentiation effect over time (Figure 1).

Concurrently, the behaviour of the scorpion adapted to the consistent disturbance - from initially traversing an average 3.81 quadrants on stimulation to 2.03 and finally to about 1.3 over the course of 75 trials, showing a tendency to explore fewer quadrant spaces as the experiment progressed. As such, the tested hypothesis of antipotentiation, wherein the scorpions exhibit a decreasing intensity of reaction to repeated non-harmful stimuli, appeared well-supported by the experimental observables (Figure 2).



**Fig 1:** Number of prods required for provocation over 75 Trials

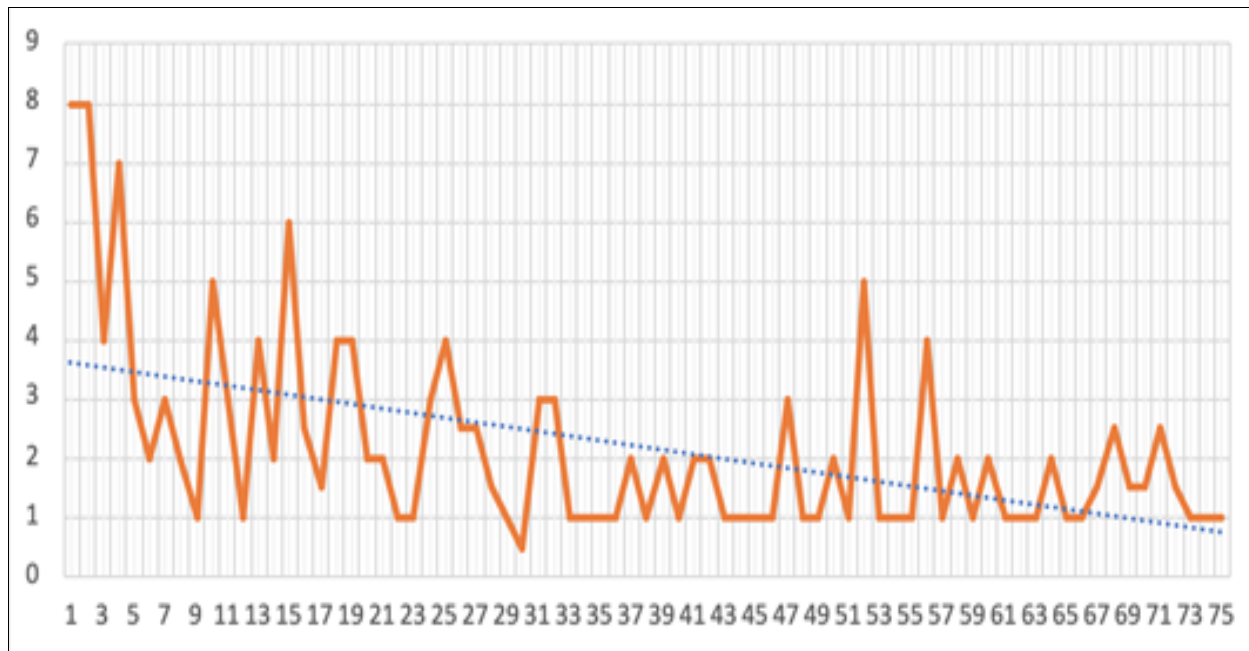


Fig 2: Number of quadrants passed per provocation

Table 1: The Data

Provocation Number	Start Colour	End Colour	Number of Quadrants Passed	Number of Prods to Proveke
1	R	R	8	1
2	R	R	8	1
3	R	R	4	2
4	R	W	7	1
5	W	G	3	1
6	G	R	2	1
7	R	W	3	2
8	W	B	2	1
9	B	G	1	2
10	G	W	5	1
11	W	G	3	1
12	G	W	1	1
13	W	W	4	4
14	W	B	2	2
15	B	W	6	8
16	W	B/G	2.5	1
17	B/G	W	1.5	4
18	W	W	4	3
19	W	W	4	2
20	W	B	2	3
21	B	W	2	2
22	W	R	1	2
23	R	B	1	1
24	B	R	3	1
25	R	R	4	3
26	R	W/G	2.5	1
27	W/G	B	2.5	3
28	B	W/G	1.5	1
29	W/G	W/R	1	1
30	W/R	R	0.5	3
31	R	W	3	1
32	W	G	3	1
33	G	W	1	2
34	W	R	1	1
35	R	B	1	3
36	B	G	1	3
37	G	R	2	3
38	R	B	1	1
39	B	W	2	1
40	W	R	1	1
41	R	G	2	1

42	G	R	2	2
43	R	B	1	1
44	B	G	1	4
45	G	W	1	1
46	W	R	1	2
47	R	W	3	5
48	W	R	1	4
49	R	B	1	3
50	B	W	2	2
51	W	R	1	4
52	R	B	5	3
53	B	G	1	3
54	G	W	1	3
55	W	R	1	2
56	R	R	4	4
57	R	B	1	3
58	B	W	2	3
59	W	R	1	5
60	R	G	2	4
61	G	W	1	5
62	W	R	1	4
63	R	B	1	7
64	B	W	2	8
65	W	R	1	1
66	R	B	1	4
67	B	W/G	1.5	4
68	W/G	B	2.5	6
69	B	W/G	1.5	1
70	W/G	R	1.5	4
71	R	W/G	2.5	2
72	W/G	R	1.5	5
73	R	B	1	3
74	B	G	1	4
75	G	W	1	2

## Discussions

The results of this experiment reveal two intriguing aspects of *Euscorpis balearicus* behaviour. Firstly, the scorpion showed no clear preference between resting in the Red, Blue, Green, or White quadrant of the test arena ( $\chi^2=4.526$ ,  $DF=3$ ,  $P=0.2100$ ), and each colour hosted the post-perturbation resting scorpion a fairly even number of times. This informs us about the potential lack of inherent colour preference in this species, however, more research involving a larger sample is necessary to draw a decisive conclusion.

The second significant aspect of their behaviour was the decreasing strength of reaction in response to repeated provocation—a phenomenon here termed as 'antipotentiation'. Indeed, the number of prods required to provoke movement grew, and the scorpion opted to traverse fewer quadrants after a stimulus, over time.

To offer a more precise observation, after around 17 consecutive adequate provocations, the body language of the scorpion following the provocation became for a while less strongly 'fleeing', as like a headless chicken, instead becoming more so defensive, with the scorpion turning and baring its claws in a sort of aggressive seeming defiance, perhaps feeling that the perturbation has been consistent and annoying but not harmful, and that thus perhaps the scorpion's perturber could be itself intimidated away.

Shortly after this short period around 17 provocations in, the scorpion seemed to give up trying to be 'aggressively defensive' by turning towards the stimulus and baring its claws and raising its stinger, and instead seemed to recognise perhaps that the stimulus was more worthy of being ignored than engaged with, owing to its impotency besides being able

to enact a mild 'shove'.

Around 35 provocations in came the point where the scorpion seemed hardly to wish to move out of its zone, seeming to have been antipotentiated to the stimulus, now deeming it perhaps unworthy of considerably fleeing from. It seemed at this point to cease regarding the stick as a survival threat.

It seems plausible that the decreasing strength of response was a result of an energy conservation strategy, whereby the scorpion decided to preserve energy after gauging the non-harmful nature of an initially startling disruption. Or perhaps it was merely fatigue that caused the scorpion to act anew in this less responsive manner. This last potentiality I think somewhat less likely, seeing as though every now and then (see provocations 47, 52, 56) later on into the experiment the scorpion demonstrated the still extant capability to move far in response to a stimulus, though the frequency of such movements was greatly reduced<sup>[6]</sup>.

These interpretations are conjectures, derived from a single specimen's observational data; thus they warrant further exploration with larger sample sizes under varied environmental conditions to corroborate these findings.

This exploratory study can serve as a foundation for further investigations, to validate the observed antipotentiation effect and to unravel the impact of various environmental parameters on the behavioural responses of *Euscorpis balearicus*. By replicating this experiment with a larger sample size, over an extended time, employing a variety of sophisticated stimuli, and under a broader spectrum of environmental conditions, colours, and shades of colours more closely mimicking the habitats the scorpions were found in, by doing this we could gain a more comprehensive

understanding of the behavioural capabilities and adaptability of this fascinating scorpion species.

### Conclusion

In conclusion, this exploratory study revealed intriguing aspects of *Euscorpium balearicum* behaviour with no apparent resting colour preference and an increasing antipotentiation effect to a non-harmful, repeating stimulus indicating potential adaptabilities and energy conservation strategies inherent to the species. These observations provide a useful stepping stone into further examinations of this fascinating species' preferences and coping mechanisms. Research employing a larger sample size, an array of environmental parameters, diverse perturbation stimuli, and colour variations mimicking the natural habitat of the scorpion would augment the validity and applicability of these findings. Such studies would contribute significantly to our understanding of scorpion behaviour, potentially offering broader insights into survival strategies and behaviors among arthropods.

### Acknowledgements

I'd like to thank my wonderful partner Leah Maddalena Singer-Pennell, who is at present also one of my chief benefactors enabling this study, along with the inimitable Serge Obolensky Beddington-Behrens, Martina Singer, and Timothy Pennell, whose support in this moment I greatly recognise.

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