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Fireflies' Rhythmic Lighting Patterns: Analysis of the IMRAD format

The research article “Self-organization in natural swarms of *Photinus carolinus* synchronous fireflies” was published in the journal *Science Advances* on July 07, 2021, by Sarfati et al. (2021). The study, conducted by a group of scientists and biophysicists from the University of Chicago, focuses on the behavior of various groups of fireflies and how they perform several synchronized lighting patterns. This research article is specific in demonstrating the scientific results and incorporates different visual representations, hedging verbs, fluctuating tenses and voice, and the IMRAD format.

Sarfati et al. (2021) begin with an informative and unstructured abstract that briefly states the methods, the results, and the conclusions of the study. The abstract is written in the present tense and maintains an active voice throughout. They write the rest of the paper in the IMRAD format, and each part has a corresponding IMRAD heading. The first part is the introduction. The introduction is very short, with only two paragraphs, but it provides a clear explanation of the research objectives and includes a solid background on the bioluminescent features of fireflies. Furthermore, Sarfati et al. (2021) write this section in the present tense and active voice. This paper incorporates a formal hypothesis. It also focuses on previous research, which serves as inspiration for the research study. At the same time, Sarfati et al. (2021) reveal that the current technology used to research the natural patterns of fireflies is not enough to explain other features of firefly organizational behavior.

The next part, and the longest of this paper, is the results section. Although Sarfati et al. (2021) do not subdivide this section nor include subheadings, they add different charts, graphs, and images to visually represent the data collected. One of the graphs, for instance, represents the number of times fireflies flashed in a given frame by analyzing the image intensity threshold. They reference the data in the text and generalize the most important trends of these results to guide the reader. This part is written in present tense and active voice. For example, the authors use phrases like, “We video-recorded” and “We investigate.”

The discussion section summarizes the main findings and explains some of the major implications of the research. It is written in the present tense and upholds an active voice. For example, Sarfati et al. (2021) often state phrases like, “We demonstrate that firefly density” and “We consider the line-of-sight.” The authors also use Hedging verbs like “demonstrate” and “suggest” frequently. Moreover, they consider both the benefits and the limitations of the research. They suggest that although they were able to find evidence that fireflies light up in synchrony, further analysis is required to comprehend why and how flash bursts occur at different locations. Previous research studies are cited in the discussion section.

To conclude, the materials and methods section includes subheadings like “Experimental sites” and “3D reconstruction using 360 cameras” to provide structure. The information is presented in simple past tense and passive voice. For example, it states, “The cameras were positioned.” Additionally, they provide a comprehensible description of the criteria used for reconstructing the three-dimensional view of a natural swarm. This detailed explanation allows others to follow the procedure and replicate the experiment.

References

- Sarfati R, Hayes JC, Peleg O. 2021. Self-organization in natural swarms of *Photinus carolinus* synchronous fireflies. *Science Advances*. 7(28):eabg9259. doi:10.1126/sciadv.abg9259.
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