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SAMPLING METHODS FOR PHLEBOTOMINE SAND FLIES: A CRITICAL ANALYSIS OF THEIR EFFICIENCY AND USAGE- MINI REVIEW

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Abstract: *Phlebotomine sand flies (Diptera: Psychodidae, Phlebotominae) are hematophagous insects of medical importance, involved in the transmission of various pathogens such as Leishmania spp., Bartonella bacilliformis, and several phleboviruses. Monitoring these vectors is essential for epidemiological surveillance and the development of control strategies. Given their cryptic behavior and nocturnal activity, the use of sampling methods adapted to specific ecological contexts is necessary. This review provides a comparative analysis of the main techniques used for sand fly collection, divided into two main groups: traps without attractants (e.g., sticky traps, interception traps) and traps with attractants, which rely on chemical, visual, thermal, or biological stimuli (e.g., traps using CO_2, light, heat, or live hosts). The advantages, limitations, and applicability of these methods are evaluated based on habitat specificity and research objectives. Moreover, the review highlights the benefits of combining multiple trapping methods to improve the accuracy of ecological and epidemiological assessments, thus contributing to the optimization of vector surveillance and control programs.*
Keywords: Phlebotominae, trapping methods, vector surveillance, leishmaniasis

• Introduction

Phlebotomine sand flies (Diptera: Psychodidae: Phlebotominae) are blood-feeding insects of major public health importance, acting as vectors for *Leishmania* spp., *Bartonella bacilliformis*, and various phleboviruses. With over 800 species, they are primarily found in tropical and subtropical regions. These nocturnal dipterans thrive in warm, humid environments, which complicates monitoring. Their 30–60 day life cycle is highly sensitive to environmental conditions. Effective surveillance is essential for vector-borne disease control, but their cryptic behavior and small size hinder field sampling.

• Material and method

This review was based on a systematic analysis of peer-reviewed literature from major databases (PubMed, Web of Science, Scopus, ScienceDirect), using keyword combinations such as “phlebotomine sand flies collection techniques,” “methods for trapping sand flies,” and “phlebotomine surveillance tools.” Only English-language studies describing both passive and active methods in diverse ecological contexts were included, covering original research, reviews, and comparative studies.

• Results and discussions

Phlebotomine sand fly collection methods are classified into passive (non-attractant-based) and active (stimulus-based) techniques. Passive traps—such as sticky, Malaise, and windowpane traps—intercept flies without using attractants, while active traps rely on visual, thermal, or chemical cues like light, CO_2, or heat.

No.	Trap type	Category	Attractant	Targeted species	Notes
1.	Sticky trap	Passive	None (interception)	Various, including species not attracted to light	Easy to use, low cost
2.	Malaise trap	Passive	None (interception)	Species flying upward	Effective in forested areas
3.	Windowpane Trap	Passive	None (visual, transparent)	Species flying along open routes	Sensitive to flight direction
4.	Tube/ Tunnel trap	Passive	None	Synanthropic or cryptic species	Good for burrows, rock crevices
5.	CDC Light trap	Active	Light	Light-attracted species	Simple to implement
6.	CDC Light + CO_2 Trap	Active	Light + CO_2	Blood-feeding females	High efficiency, more complex logistics
7.	Thermal Attraction Trap	Active	Heat	Blood-feeding females	More efficient when combined with other stimuli
8.	Shannon Trap	Active	Light and human presence	Nocturnal, light-oriented species	Requires operator, allows behavioral observation
9.	Animal-Baited Trap (Disney type)	Active	CO_2+odor+heat	Zoophilic species (e.g., *Ph. papatasi*)	Ideal for host-preference studies

Field studies indicate that CO_2-baited CDC light traps are highly effective for capturing blood-feeding sand flies, whereas adhesive traps help reveal species diversity in low-density settings. Trap efficiency is influenced by environmental factors, placement, and airflow. Some passive traps may also exploit behavioral or visual cues. Combining multiple, context-adapted methods improves the accuracy of surveillance and supports early detection of emerging vector species.

• Conclusions

- Trap selection should align with study goals and field context: passive traps are preferable for biodiversity surveys in remote areas, while active traps with chemical or visual attractants are more effective for monitoring blood-feeding vectors.
- Combining multiple attractants (CO_2, light, heat) increases trap efficiency but requires greater logistical effort and is best suited for endemic or high-risk zones.
- No single method is universally effective; integrated, context-adapted strategies ensure optimal outcomes in sand fly surveillance.