

A Meta-Analysis of Quantitative Collecting Techniques for Spiders

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ABSTRACT

Quantitative sampling of organisms is often used to provide information in ecological studies, monitor populations, and aid in biodiversity projects. Many studies involve the quantitative sampling of spiders. In this meta-analysis study, 207 peer-reviewed journal articles formed the basis of an initial data set for a quantitative analysis of spider collection techniques. Data collected included country of study, mode of study, trapping techniques used, spider diversity, and number of specimens collected. Our meta-analysis gathered research articles that included 33 different countries of study. Trapping techniques greatly vary depending on the habitat in which spiders dwell. These were divided into aerial, arboreal, terrestrial, and subterranean. From the gathered data, 5% of the articles included aerial trapping, 20% included arboreal trapping, 1% included subterranean trapping, and 80% included terrestrial trapping. 60% of the terrestrial studies utilized pitfall trapping, 20% used hand collecting, 15% used sweep netting, and 5% used branch-beating.

INTRODUCTION

The idea for this project arose when the efficiency of using pan traps to collect specimens was realized. Pan traps are this lab's preferred method for insect collection, but our lab also uses them as a primary method for collecting spiders. Upon searching through research papers regarding spider collection, it was found that a small number of papers mentioned the use of pan traps as a quantitative collection technique for spiders. This was a surprising discovery, so a meta-analysis of quantitative spider collection techniques began. A meta-analysis consists of a systematic review of a substantial data collection in order to draw conclusions from the quantitative data set as a whole.

Table 1. Identification and Frequency for Countries of Research

Country	Number of Studies	Country	Number of Studies
Ukraine	2	Ukraine	2
Borneo	1	Brazil	3
Bulgaria	1	Hungary	3
Greece	1	Israel	3
Latvia	1	Italy	3
Namibia	1	Norway	3
Netherlands	1	Spain	3
Panama	1	Australia	4
Portugal	1	Canada	4
Slovenia	1	Czech Republic	4
South Africa	1	Denmark	4
Columbia	2	India	4
France	2	Poland	5
Kazakhstan	2	Slovakia	5
Lithuania	2	Russia	6
Mexico	2	England	7
Scotland	2	Finland	10
Sweden	2	Belgium	13
Switzerland	2	Germany	13
Tanzania	2	United States	47

MATERIALS AND METHODS

Journal of Arachnology and *Proceedings of the European Colloquium of Arachnology* were originally consulted to find peer-reviewed journal articles that had utilized quantitative spider sampling techniques. The articles and sources listed as references within these journals became our initial data set of 207 articles. Some of the articles collected did not generate enough data or were not useful to our study, so the final data set of this study consisted of 186 articles. Certain data fields were collected from each of the assessed articles: country of study, mode of study, trapping methods, duration of study, dimensions of traps, and total number of specimens collected (divided into family, genera and species when applicable). Once these data were compiled, focus shifted to finding any research published that conducted a similar meta-analysis on quantitative spider collection techniques. After searching through the Camden-Carroll Library online database and other peer-reviewed online databases, no meta-analyses on quantitative spider collection techniques were found.

RESULTS

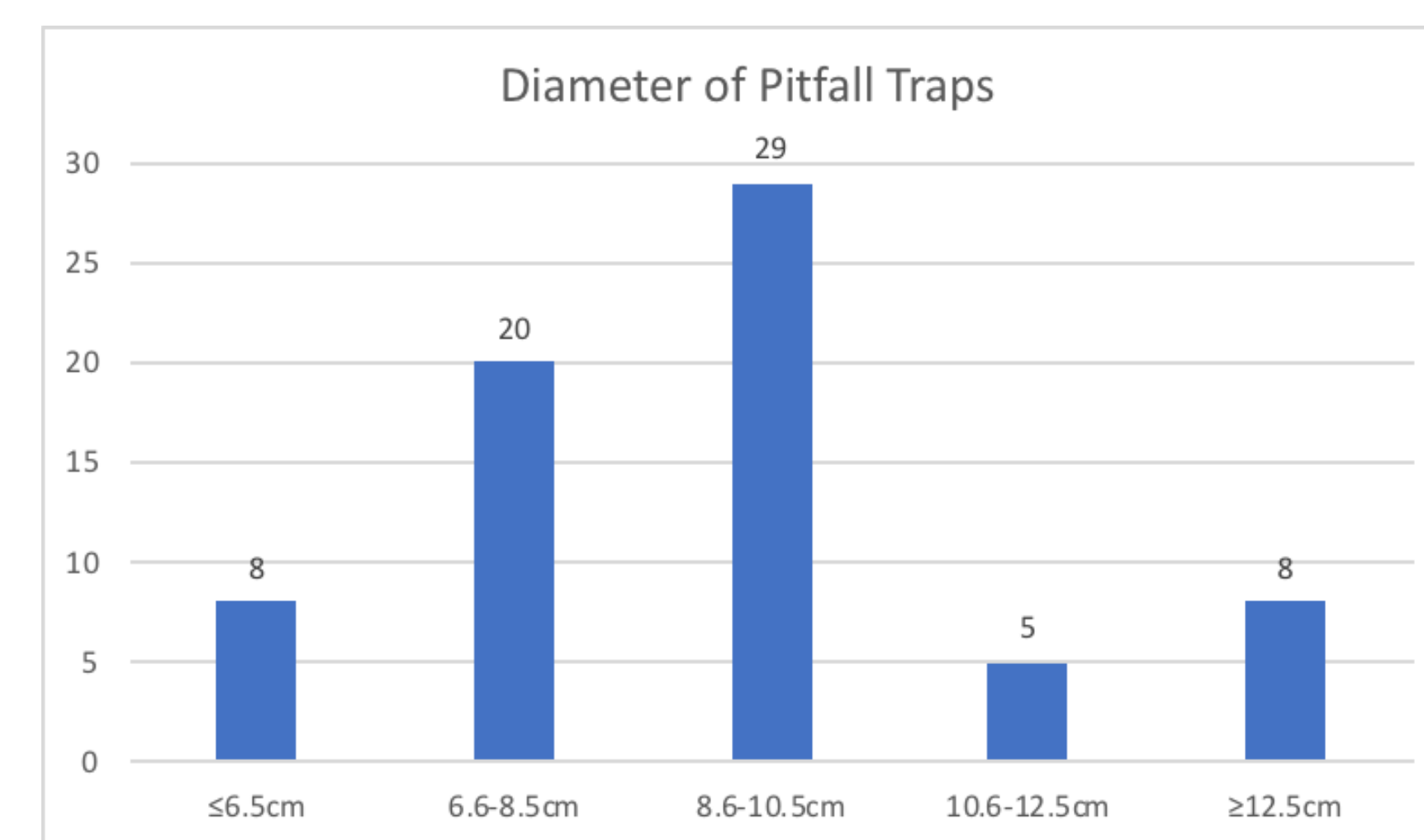


Figure 1. Depiction of pitfall trap dimensions.

Diameter for pitfall traps are highly variable in collection methodology, though some are more common than others. Of the 70 papers that mentioned diameter of the pitfall traps used, 49 (70%) used a diameter ranging from 6.6cm to 10.5cm.



Figures 2a and 2b. Field sampling with use of leaf litter collection (left, 2a) and pan trapping (right, 2b).

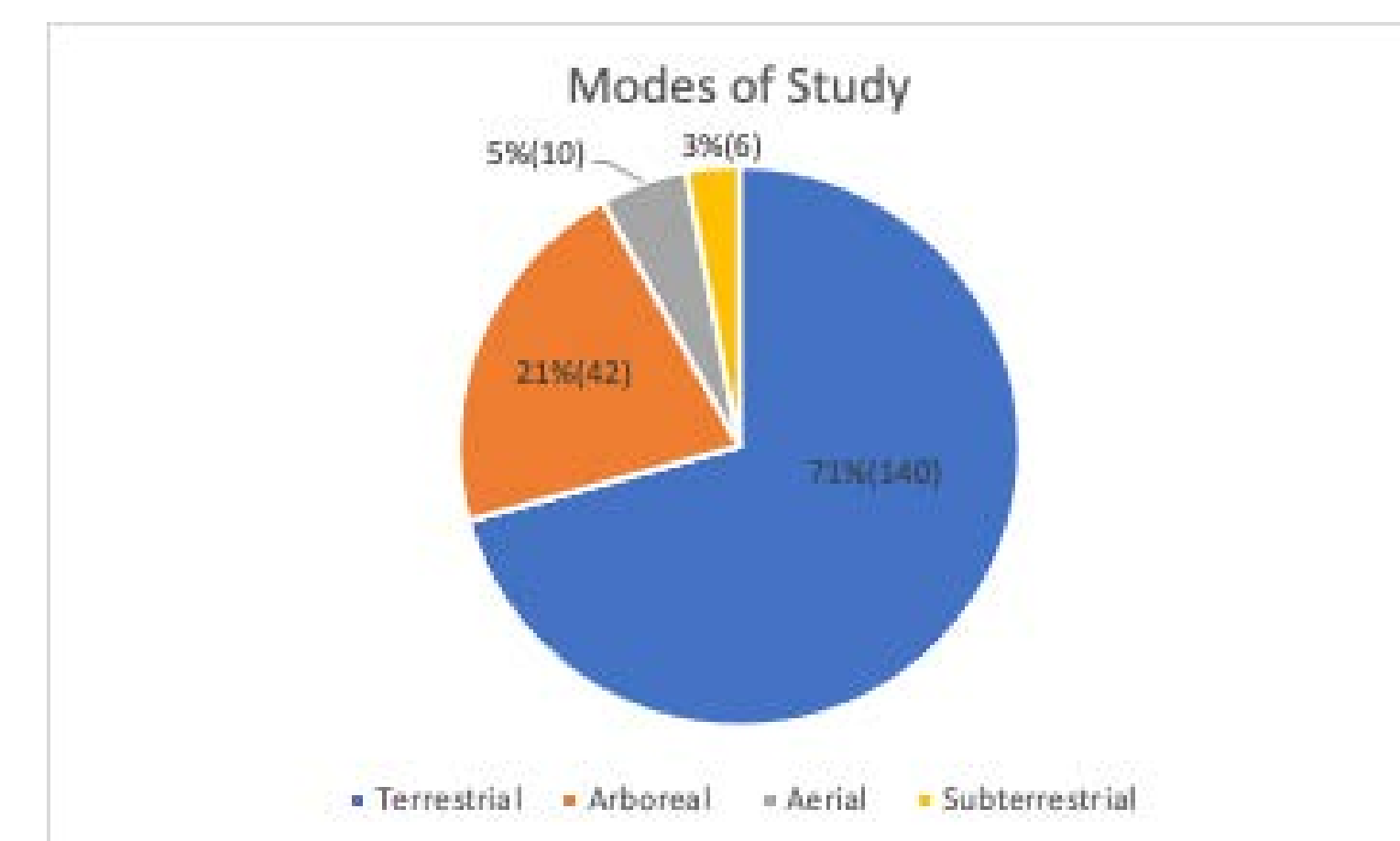
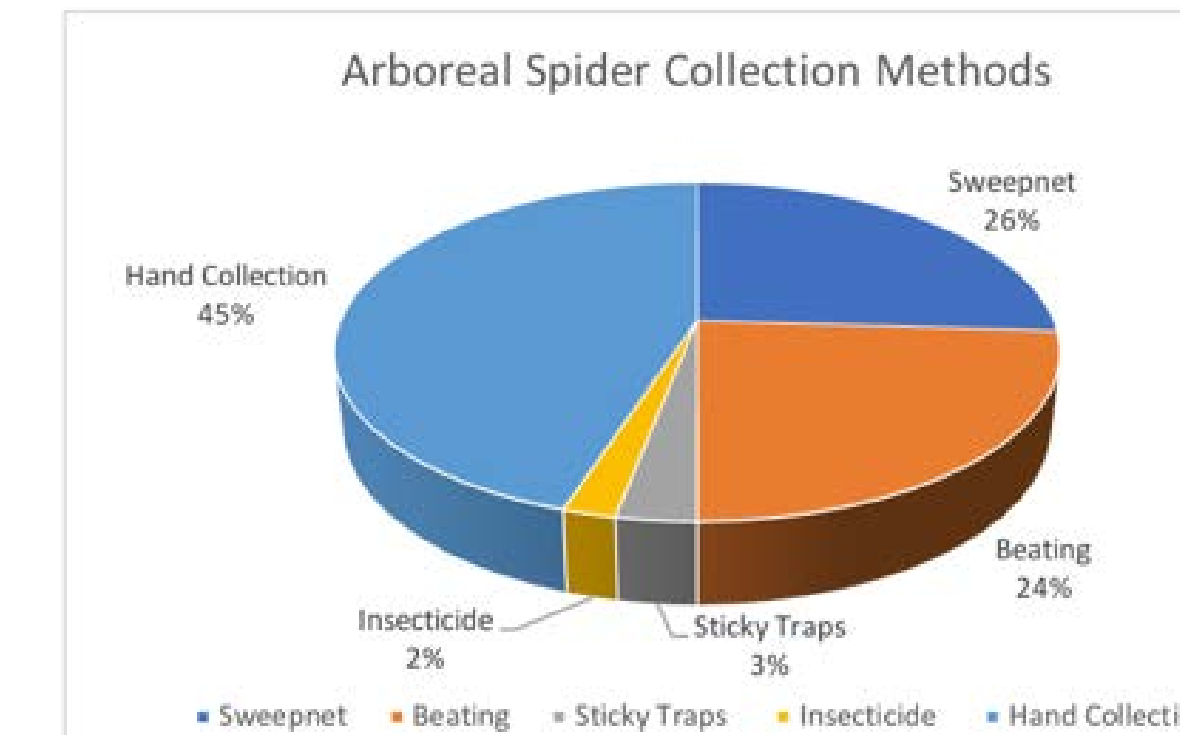


Figure 3. Article Count for Each Mode of Collection. Terrestrial are spiders that are ground-dwelling, arboreal are those found upon bushes, aerial are those that can move through the air, and subterranean are those that live underneath the ground.



Of the 42 papers that performed arboreal spider collection, five different methods of collection were used. Hand collection (45, 45%) was the most common collection method and insecticide (2, 2%) was the least common.

Figure 4a. Breakdown of Arboreal Spider Collection Methods.

Of the 140 papers that performed terrestrial spider collection, eleven different collection methods were used. Pitfall trapping (123, 62%) was the most common and head lighting (1, <1%) was the least common.

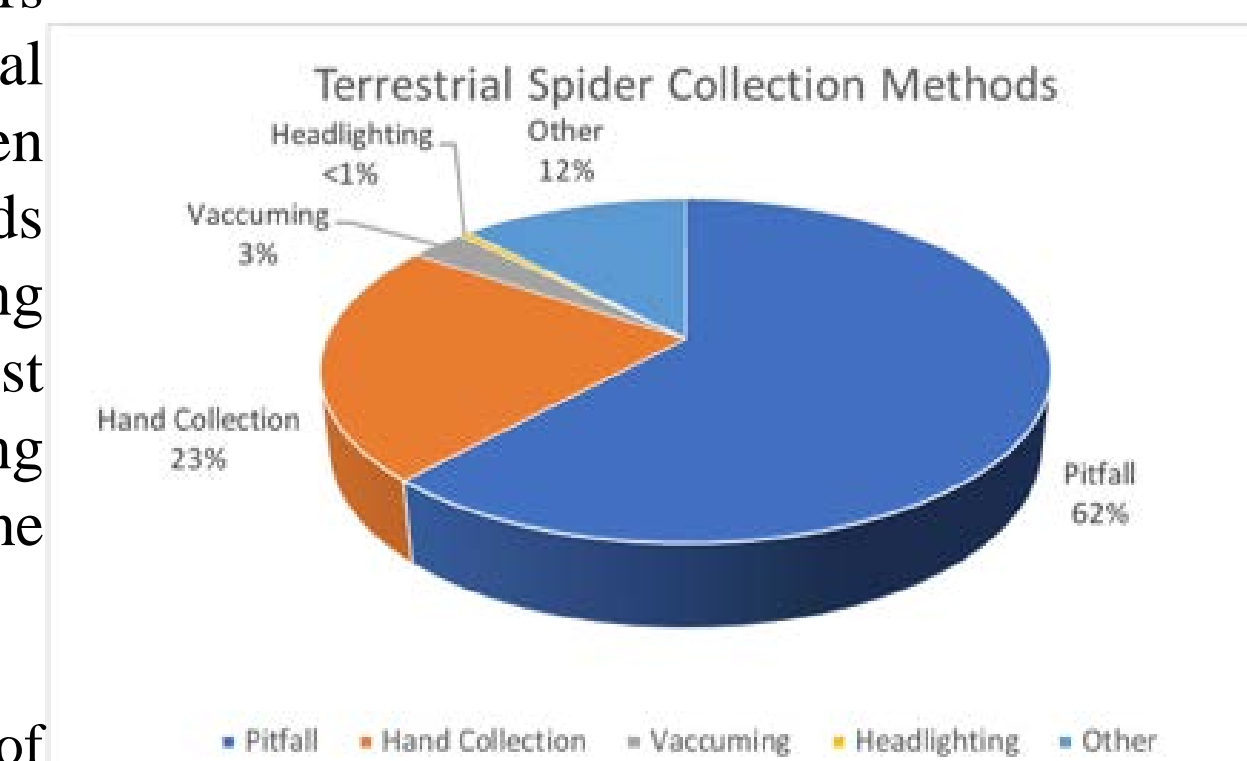


Figure 4b. Breakdown of Terrestrial Spider Collection Methods.

Pitfall traps are typically containers placed in the ground so that insects fall inside while crawling on the ground. Beating is done by agitating foliage of a bush, tree, or plant with a stick or a rod so that insects fall into a collecting sheet or pan placed below. Hand picking is a visual search where insects are collected by hand by overturning objects on the ground, or picking insects off trees, bushes, etc. Sweep netting is a method of collecting small specimens that are not easily seen by swiping a large net through vegetation. Sticky traps come in two forms, collar (placed on bark of trees) and hanging (left from a branch to move). Pheromone traps utilize chemicals secreted by spiders, most commonly sex pheromones, to attract specimen to a target area. Vacuum collection is the process of locating specimens and using a low-speed vacuum to collect them. Headlighting is a collection method that utilizes a headlamp to visualize nocturnal spiders and collect them by hand. Pan traps are placed on the ground and filled with preservatives (in our field collection, a salt/water/dish soap solution) so that insects can crawl inside.



Figure 5. Collection methods pictured from left to right; top: pitfall trap, beating, hand collection; middle: sweep net, sticky trap, pheromone trap; bottom: vacuuming, headlighting, pan trap.

DISCUSSION

The lack of pan trap usage within this study furthers our initial confusion. Pan traps have a similar collection to that of pitfall traps and are typically filled with a salt water and detergent solution. Preservatives used in the pitfall traps of this analysis tended to be harsh on the specimens, such as ethylene glycol and formalin. These preservatives were more commonly used in studies from the 1960s and 70s. More recently, researchers have been moving to the safer detergent/water/salt mixture to capture and preserve specimens with pitfall traps. Of the 71 articles that used pitfall traps, 22 (31%) used a mixture of detergent and water as the killing agent for collection. This works well because the detergent serves to break the surface tension of the water causing the specimens to sink to the bottom of the trap. The examined studies classified their habitat collection into four distinct types: terrestrial, subterranean, arboreal, and aerial collection. Terrestrial collection is collection of surface-dwelling spiders. This can be accomplished with many collection methods, but pitfall traps are the most common method (see Figure 4b). Subterranean collection is collection of specimens beneath ground level, such as burrowing spider species. Compared to the other three collection modes, research regarding subterranean spider collection is uncommon. Arboreal collection involves specimens inhabiting vegetation such as trees or bushes. The most common collection technique in these studies is sweep net collection or beating (see Figure 4a). Aerial collection is collecting specimens in the air, such as ballooning species of spiders. Like subterranean collection, research on aerial species are few in comparison to terrestrial and arboreal collection techniques. Due to the low frequency of articles mentioning these types of study, they are not illustrated with charts or graphs in the same manner as terrestrial and arboreal collection.

ACKNOWLEDGEMENTS

We would like to thank the Department of Biology and Chemistry for providing us the means to complete this research; the George M. Luckey Academic Honors Program for their continued support in our endeavors; and the Daniel Boone National Forest as it provided locations for our initial collections.

REFERENCES