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Research Note

RICE HAY AS BAIT FOR GUANO ARTHROPODS IN MAPANGHI AND BULALON CAVES, POLILLO ISLAND, PHILIPPINES

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ABSTRACT

The inclusion of terrestrial arthropods in cave biodiversity assessments is now better appreciated and studies on sampling and collection methods are ongoing toward continuous improvement. Litter baiting using dried narra and bamboo leaves, both dry and wet, was a method formally evaluated for efficiency (number of individuals collected) and effectiveness (number of species collected) in sampling or collecting cave arthropods. Here, an earlier version of the litter baits using rice hay is reviewed in answer to queries on the possibility of using the substrate and the technique in collecting cave arthropods. The baiting experiments were set up in Mapanghi and Bulalon Caves in Barangay Poblacion, Burdeos, Quezon on eastern side of the island of Polillo, in the Philippines. Both wet and dry rice hay baits attracted arthropods commonly encountered in cave guano. However, microarthropods commonly associated with rice hay or stubble were also collected, which may have persisted in the rice hay despite drying and subsequent soaking in water for the wet bait. Other advantages and disadvantages of rice hay as bait are briefly discussed. Overall, rice hay may be used as litter bait, in protocols that combine other methods, but with proper preparation to drive away non-cave or non-guano arthropods.

Key words: cave arthropods, cave litter-baiting, fruit bat guano, insect bat guano, techniques

INTRODUCTION

The inclusion of terrestrial arthropods in broader biodiversity research, documentation and conservation has gained support (e.g., Gonzalez et al. 2018) after decades since earlier efforts (e.g. Lit, 2003) for better appreciation as the most diverse group, including studies of cave biodiversity (e.g. Böhm et al. 2022). In caves, current protocols for collecting guanophilous and other terrestrial arthropods include several sampling methods, namely: pitfall trapping, modified

light trapping, guano sampling, and opportunistic sampling (Lit et al., 2022). The protocol emphasizes the need to use multiple sampling methods, each targeting different sets of guilds or taxa, to properly survey cave arthropods. Earlier, Encinares & Lit (2014) evaluated the use of dry and wet leaf litter baits in terms of efficiency (number of individuals collected) and effectiveness (number of species collected). These features of baits or methods follow the definitions by Weinstein & Slaney (1995) and Slaney & Weinstein (1996). While litter baiting is not part of the set of methods followed in ongoing studies, a few inquiries on the possibility of using this method for rapid biodiversity assessment of certain caves prompted a review of possible material or substrate that may be used as bait. Inquiries cited the cave invertebrate collecting guide by Hunt & Millar (2001) which included terrestrial leaf litter packs. Notably, Encinares & Lit (2014) suggested that leaf litter baiting, whether dry or wet, should be used in combination with other methods to obtain a collection that is representative of the entire cave arthropod community. Along the same line of thought, this paper presents a brief review of the use of rice hay as litter bait for cave arthropods.

MATERIALS AND METHODS

Source and preparation of rice hay

Rice hay was obtained from Mang Enong Gonzales' farm within which the two caves, Bulalon and Mapanghi Caves, are located. These two caves are coded as C18 and C19, respectively, in the map included in the paper of Alviola et al. (2023). The location is on the eastern side of Polillo Island and politically a part of Barangay Poblacion, Burdeos, Quezon Province. Dried leaves from a pile accumulated near a rice thresher preferring those at or near the top of the pile, which have less moisture compared to those at the inner and bottom portions of the haystack.

Description of the set up

The setup is very similar to those evaluated by Encinares & Lit (2014), except that the experiments in this study were conducted only in the dark zones of both caves. Whereas Hunt & Millar (2001) listed this technique as litter bait, it is essentially a baited wide-mouthed, relatively shallow, rectangular pitfall trap (Figure 1). Disposable plastic (polypropylene, approximately 750 ml volume) lunch boxes, each 5.0 cm high and measuring 11.5 x 17.2 cm at the top or rim and 8.0 x 13.6 cm at the bottom, were cleaned and rinsed with distilled water and air-dried. Three lunch boxes were filled with wet rice hay and another three with dry. They were laid out randomly and placed into the surface layer of guano gathered beneath the roost of bats, by carefully digging and taking away portions of the guano and laying down the lunch boxes such that their rims were on the same level as the guano surface. To prevent accumulation of water dripping from

stalactites or of urine from bats, the lids or covers of the lunch boxes were placed on top of the box, supported, or propped at the four corners with cut pieces of coconut midrib. They were left overnight, and samples were retrieved together with the lunch boxes, covered with their respective lids, and secured with rubber bands.

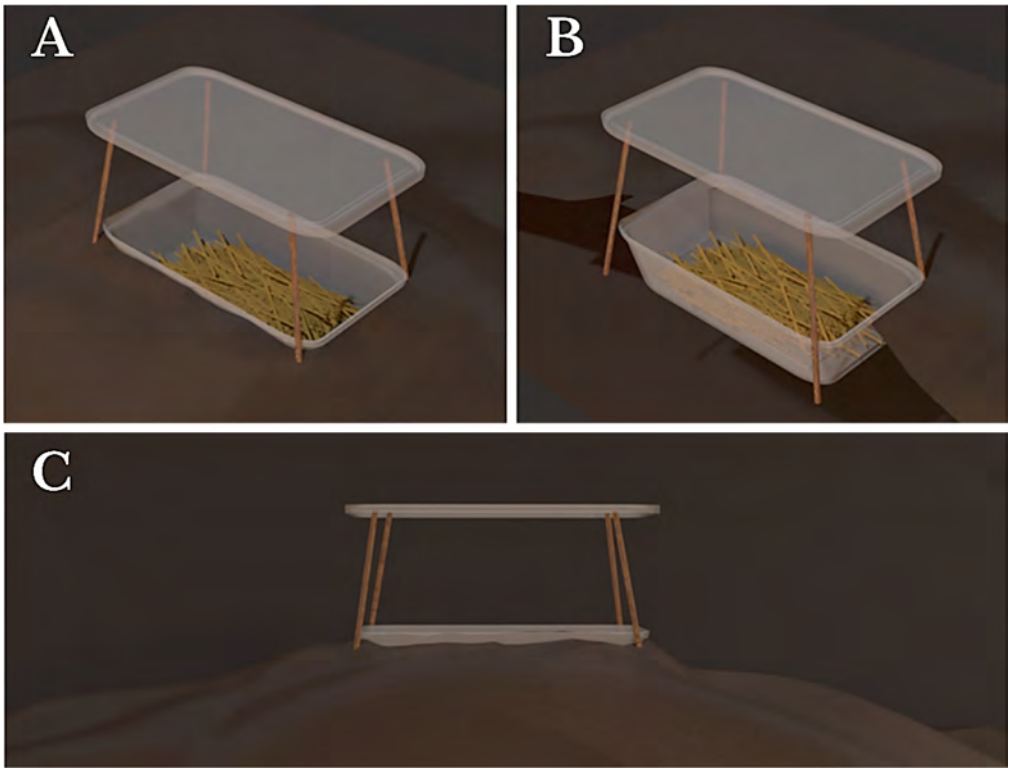

Figure 1. Setup for baiting cave guano arthropods with rice hay. a. perspective view with the lid of the plastic box (polypropylene, approximate volume capacity: 750 ml, 5.0 cm high; 11.5 x 17.2 cm at the top or rim and 8.0 x 13.6 cm at the bottom) at the same level with the surface of the guano pile and with the cover propped by bamboo skewers or coconut midribs. b. same but with the surrounding guano substrate removed. c. same but lateral view. (3D illustration by R.C. Larona).

Collection/extraction of baited arthropods

All samples were examined at the base camp to collect and preserve the larger specimens. Upon reaching the laboratory, the remaining contents of each lunch box were emptied into separate Berlese-Tullgren funnels to extract and collect the micro-arthropods into receptacles containing 95% ethanol.

Sorting, identification and counting

Each species was separated and placed in vials with ethanol. It was assumed that every morphologically distinct group of individuals constitute a separate species, i.e., morphospecies (sensu Duelli et al. 2005, but see Biological Survey of Canada 1994). Each morphospecies was identified to at least the order level, but preferably up to family level. The number of individuals of each morphospecies was counted, and a tally counter was used for whenever necessary.

Statistical analysis

The experiment was considered two-factorial, and data were subjected to the Shapiro-Wilk test for normality, and analysis of variance. The total numbers of individuals and of taxon or species attracted to the wet and dry versions of the rice hay bait were interpreted as bait efficiency and effectiveness, respectively.

RESULTS AND DISCUSSION

In terms of the number of individuals, there were statistically, significantly more individuals attracted to the wet rice hay bait than to the dry (Table 1). This was true for both caves. However, between the two caves, there were significantly more individuals baited in Bulalon Cave than in Mapanghi Cave. As mentioned, this study conducted the experiment only in the dark zones of the two caves. In contrast, Encinares & Lit (2014) conducted the evaluation only in Bulalon Cave but set up wet and dry baits in all three zones, i.e., the entrance, twilight and dark zones but no significant differences were detected. The values obtained by their (Encinares & Lit 2014: 475 for dry and 469 for wet) and this study in the dark zone of Bulalon Cave were close. Also, in this study, there is no significant interaction of the location (either cave) and the type of hay (wet or dry) for this parameter.

In terms of the number of species that were captured, only the dry bait in Mapanghi Cave yielded significantly fewer morphospecies compared to the wet bait. The number of species obtained in Bulalon Cave for both dry and wet baits were equal. There was also no variation and hence, no significant differences, in the number of orders/classes of the arthropods collected using either dry or wet baits for both caves.

Both wet and dry rice hay baits attracted arthropods commonly encountered in cave guano. These included cockroaches, ground beetles, springtails, millipedes, centipedes, mites (oribatids, cheyletids, macrochelids, ascids, etc.), spiderlings, guano moth larvae, nematoceran larvae, phorid larvae, wingless dipterans, psocodeans, etc. Notably there were also fig wasps

(Hymenoptera: Agaonidae). Alviola et al. (2023) tabulated various attributes of Bulalon and Mapanghi Caves as part of their study of bat communities in caves of Polillo island, including among others, the types of disturbance and the estimated bat population. They estimated local bat populations for each of these two caves as more than 1000 individuals. The abundance of guano arthropods baited in these two caves may be attributed to the relatively great amounts of piled guano, which in turn, is directly related to the numerous bats that roost in those caves. The greater number of individuals in Bulalon than in Mapanghi Cave may have been affected by various factors (microenvironmental) inherent or ambient to those caves at the time of the baiting experiments. This could include the relatively higher degree of (tourist) disturbance in Mapanghi and/or even the higher relative humidity and more constant stream flow in Bulalon.

Table 1. Total number of individuals and taxa of guanophilous arthropods (excluding mites) collected using dry and wet rice hay baits in the dark zones of Bulalon and Mapanghi Caves, Burdeos, Polillo Island, Quezon Province, Philippines, 2007.

Parameters*	**Mapanghi Cave**		**Bulalon Cave**	
	Dry	Wet	Dry	Wet
Total No. of Individuals	424.00a	466.00b	456.67a	511.00b
Total No. of Species	19.00a	28.00b	28.00	28.00
Total No. of Orders/Classes	16.00	16.00	16.00	16.00

*Means followed by the same letter within a row under a cave column are not significantly different at a = 0.05

Although there was no attempt to identify the collected specimens to genus or species, there were, however, morphospecies that appeared similar to species, especially acarines, that have been reported as associated with rice hay or rice stubble (Sayaboc et al. 1975, Corpuz-Raros & Raros, 1999). Both Sayaboc et al. (1975) and Corpuz-Raros & Raros (1999) listed numerous mites that were either saprophagous or predatory. Among saprophages, their lists included members of the families Pyemotidae, Suidasiidae (e.g., *Suidasia pontifica* Oudemans) and Scheloribatidae (*Scheloribates* spp.). For predators, the families Rhodacaridae, Eupodidae and the likes of *Cheyletus malaccensis* Oudemans (Cheyletidae). Interestingly, among the samples obtained by rice hay baiting, there are morpho-species that appear to be similar, if not exactly the same species as the aforementioned. If indeed they are the same species as those identified by

Corpuz-Raros & Raros (1999) from rice litter, they may have probably persisted in the rice hay despite drying and subsequent soaking in water for the wet bait. Nevertheless, the location of the caves in a farm mainly planted to rice, and the time of conduct of the experiment being during the rice harvesting season, and in particular, at Bulalon Cave where a stream passing through the rice field enters the cave, there is always the possibility of natural occurrence of those species as trogloxenes (or plain vagrants/accidentals). Incidentally, some mite species collected from these caves obtained in subsequent expeditions have been included in the checklist of cave mites by Corpuz-Raros & Lit (2015).

The greater number of morpho-species on wet rice hay bait is probably due to the greater attractiveness of an available wet or moist food source or substrate inside the cave. Both the Biological Survey of Canada (1994) and Duelli (2005) emphasized the great value of using morpho-species when comparing and monitoring species richness of a locality, ecosystem or set of habitats, as well as in rapid biodiversity assessments. However, morpho-species as a concept and as a technique or method is quite limited when comparative qualitative assessments of species composition over time and/or space is desired. Nevertheless, these shortcomings can be minimized if not entirely solved when more taxonomists or trained specialists participate actively as co-investigators.

There are various advantages and disadvantages of using rice hay as bait for collecting cave arthropods. During the harvest season, and at certain times of the year when the incorporation or plowing in of rice litter is not practiced in a farm, rice may be readily available, compared to what have been used in other litter baits e.g. dried narra and bamboo leaves (Encinares & Lit, 2014). However, the same may not be true in farms where rice hay by itself or in combination with other soil fertility enhancers are plowed in. Proper preparation is also needed to cleanse the rice hay of resident microarthropods like detritivorous mites and their associates. Overall, rice hay may be used as litter bait, in protocols that combine other methods, toward a broader representation of the diverse community of cave-dwelling, guanophilous arthropods. This also generally complies with other collection methods as discussed in general reviews like those of Wynne et al. (2018 & 2019).

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