FIELD ASSESSMENT OF ABUNDANCE, HOST PLANT UTILIZATION AND BEHAVIOR OF THE INVASIVE PHYTOPOLYPHAGOUS GIANT AFRICAN SNAIL, *ACHATINA* FROM SELECTED SITES IN MINDANAO, PHILIPPINES

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ABSTRACT: *We conducted an assessment of abundance, host plant utilization and behavior of the invasive Phytopolyphagous giant African snail, Achatina from selected sites in Mindanao, Philippines in situ. The study was carried out in protected montane areas (Pasonanca Natural Park, Zamboanga City and Initao-Libertad Protected Landscape and Seascape, Misamis Oriental) and suburban ecosystems (Pagadian City and Cagayan de Oro City) in Mindanao, Philippines. Results of the assessment show that out of the twenty-five (25) identified plants, they preferred succulent food plants such as Carica papaya, Colocasia esculenta and Operculina turphetum. They were also found aggregating in plant litters which maybe a source of providing moisture to the organism. Results show that the feeding of A. fulica is dependent on plant community composition and varies according to quality and quantity. Absence of native gastropod fauna could be related to its difficulty to compete with A. fulica. Results reveal that the phytopolyphagous nature of A. fulica facilitates the establishment of their population.*

KEYWORDS: Phytopolyphagous, abundance, invasiveness, biodiversity

1.0 INTRODUCTION

An invasive species such as *Achatina fulica* (Fig. 1) is considered as one of the greatest threat to native biodiversity next to habitat destruction. This snail known as the giant African snail is a fast-growing invasive phytopolyphagous pest considered as the most ecologically damaging land snail and ranks second among the "100 Worst Alien Invasive Species" [1]. This pest caused crop yield losses by herbivory, transmits plant pathogens and higher costs of pest control including adverse effects on indigenous gastropods that may arise through competition [1, 2, 3]. It also has invaded many suburban habitats including protected areas [4]. Considering that the data on the impact of this invasive species on native biota in the Philippines are scarce [4,5,6,7], information about *A. fulica*'s feeding preferences and behavior is important to be able to assess the extent of invasiveness of the pest by looking at its distribution and field behavior. Thus this field observation study was conducted.

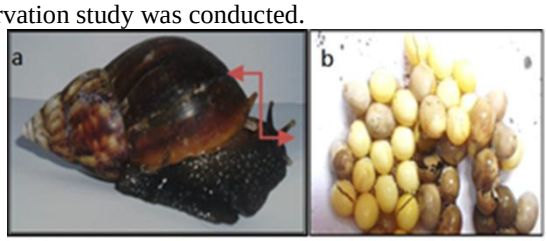

Figure 1. Adult *A. fulica* (a) and the eggs (b)

2.0 METHODOLOGY

Opportunistic sampling of *Achatina fulica* was done from August to November 2015 during different periods, including rainy days, in four areas of Mindanao, Philippines: Pasonanca Natural Park in Zamboanga City, suburban areas in Pagadian City, Initao-Libertad Protected Landscape and Seascape area and the urban area of Cagayan de Oro City. A corresponding gratuitous permit was obtained from the Department of Environment and Natural Resources (DENR) for the protected areas. Purposive sampling of *A. fulica* was employed to maximize its occurrence in the area. Reconnaissance and prior interview were also conducted in communities to determine if there were occurrences of the snail in the area.

Food preferences of the snail were done by actual observation of the behavior of the snail in the field. Vegetation were assessed for each of the sampling sites using the random meander method [8] rather than quadrats, to maximize the opportunity of detecting significant or sparsely distributed flora species utilized by *A. fulica*. Observation was also done on the presence of native snail fauna in the area. Abundance was determined for each of the selected sampling areas.

3.0 RESULTS AND DISCUSSION

Field counts of *A. fulica* in selected sampling sites of the four areas in Mindanao, Philippines are shown in Table 1.

Table 1. Species abundance of A. fulica in four sampling sites in Mindanao, Philippines.

Sampling Sites	Abundance
Pasonanca Natural Park, Zamboanga City (protected area)	201
Pagadian City	137
Initao-Libertad Protected Landscape	350
Cagayan de Oro City	90

A. fulica was more abundantly found in protected areas where entrance of people is limited than suburban ecosystems. This is contrary to the works of Albuquerque et al. [9] where the snail was most abundant in sites with high human density which was argued to be responsible for its establishment and dispersion. USDA [2] reported that A. Fulica is currently confined to mostly residential settings where plant loss would be confined to landscaping and garden plants. Our results were in contrast to these studies since the Initao-Libertad Protected Landscape has the highest number of individuals seen (N=350). This could be due to the growth of young seedlings, more decaying plant litter and

trees that provides a suitable resting place for the snail. Studies have shown that the ecological conditions are stable in lower montane forest areas [10] thus may explain abundance of this snail.

Looking at the food plants of the snail, a total of 25 plants (both native and horticultural) were being fed by A. fulica (Table 2). Preferred were vascular plants such as Carica papaya and Colocasia esculenta, both present in the three sites except in Initao-Libertad Protected Landscape (Fig. 2). These were preferred herbaceous succulent agricultural crops associated with species abundance with vegetation abundance [11]. Also preferred were young tree seedlings (Steganotaenia asaliacea, Terminalia margarapali, Couroupita guianensis, Swetenia macrophylla and Broussonetia luzonica) recorded in Initao-Libertad Protected Landscape. Operculina turphethum, a flowering plant under Convulvulaceae and common in grasslands are most preferred by A. fulica in Cagayan de Oro suburban ecosystem (Table 2).

Table 2. Host plants (native and horticultural) associated with A. fulica as recorded in terms of its abundance in the four sampling sites.

Native & Horticultural Flora	Family	Sampling Sites				Total
		a	*b*	*c*	*d*	
Colocasia esculenta	Araceae	67	38	-	3	108
Carica papaya	Caricaceae	26	10	-	5	41
Musa paradisiaca	Musaceae	18	6	-	13	37
Abelmoschus manihot	Euphorbiaceae	3	-	-	-	3
Manihot esculenta	Euphorbiaceae	-	-	-	5	5
Citrus lima	Rutaceae	-	-	-	1	1
Livistona rotundifolia	Palmae	1	-	-	-	1
Cynodon sp.	Poaceae	-	-	-	*	1
Operculina turphetum	Convulvulaceae	-	-	-	65	65
Saccharum oficianarum	Poaceae	-	-	-	1	1
Eugenia sp.	Myrtaceae	-	-	-	1	1
Moringa oleifera	Moringaceae	4	2	-	5	11
Anona muricata	Anonaceae	1	1	-	2	4
Oreganum vulgare	Verbenaceae	2	1	-	-	3
Ipomea alba	Convulvulaceae	-	2	-	5	7
Ipomea batatas	Convulvulaceae	1	-	-	-	1
Twigs	Unidentified	-	-	-	3	3
Plant Litters	Miscellaneous	**	**	**	**	**
Psidium guajava	Myrtaceae	-	-	1	-	1
Strilitzia sp.	Strilitziaceae			1	-	1
Steganotaenia asaliacea	Apiaceae	-	-	6	-	6
Terminalia margarapali	Combretaceae	-	-	1	-	1
Couroupita guianensis	Lecythidaceae	-	-	1	-	1
Swetenia macrophylla	Meliaceae	-	-	1	-	1
Broussonetia luzonica	Moraceae	-	-	1	-	1

Legend: (*) In cluster, (**) Too Numerous to Count; (-) absent; (a) Pasonanca Natural Park, Zamboanga City; (b) Pagadian City (c) Initao-Libertad Protected Landscape; (d) Cagayan de Oro City.

Figure 2. Three topmost abundant host plant of *A. fulica* being fed by most of the species (a-b) *Colocasia esculenta*; (c-d) *Carica papaya*; (e-f) *Operculina turphetum*.

Field observation of the preferred food plants of *A. fulica* was dependent on plant community composition and varies according to quality and quantity. The results are supported by the works of Raut & Barker [3] and Albuquerque et al. [9] which argue that the location of food by *A. fulica* is powered by its sense of smell, being mainly attracted to garden crops that are in abundance thus allows their survival and multiplication.

Based from the observations on their habits in the field, this species was observed to have a remarkable broad range of host plants as reported in other studies [12] although younger snails prefer the soft textured plants such as banana (*Musa* sp.) and the older snails prefer herbaceous vascular plants such as *Carica papaya.* Those with shell lengths of 5 to 30 mm selectively feed on living vegetation [13]. Most of the intermediate-aged individuals scavenge on detritus such as leaf litter and decomposing plant material. Plant litters were observed to have populations "too numerous to count (TNTC)" indicating that decaying plant matter (detritus) and suitable living plants are the main food source of *A. fulica* [11]. These plant litters increase soil moisture which is very important during extreme, dry weather when they aestivate. This snail species seeks moist soil as an aestivation site to aid

in maintaining body moisture because they do not feed while aestivating [14].

The list of "*Economically important plants recorded as being subject to losses through damage by Achatina fulica Bowdich (Achatinidae) in regions outside of Africa*" is significantly long and includes the following groups of plants as recorded in this study: banana (Musaceae), cassava (Euphorbiaceae), citrus (Rutaceae), malunggay (Moringaceae), mahogany (Meliaceae), papaya (Caricaceae), sweet potato (Convolvulaceae) and taro (Araceae). Economic crop that generally suffer little damage as perceived in this study and also supported by the works of Raut and Barker [4] include sugar cane (*Saccharum officinarum*) since these types of plants are particularly resistant to damage from *A. fulica*.

Another issue associated with this invasive species is their tendency to compete with native gastropod fauna. Absence of native snail fauna was noted during the three visits in the four sampling sites. In a study by Sosa *et al.* [15] which focused on terrestrial snail survey in Marinduque, Philippines, two previously recorded species, *Helicostyla bicolorata* and *Ryssota sagittifera*, were not detected in their recent survey. Accordingly, the presence of *A. fulica* raises some concern as they may compete with the native fauna [16]. In our evaluation of its invasive impact, assessments of its ecological behavior were observed in different sampling areas (Fig. 3).

Figure 3. Noted ecological behavior of *A. fulica* during the study.

Field observations of the snail show it prefers succulent plants as food (a), rarely lay eggs in an empty shell (b) and can regenerate injured shell (c). Invading snails are commonly observed during night time where they are on the feeding mode (ENVIROKEY, 14; Capinera, 11). They normally seek shaded, sheltered resting locations with high humidity, but can climb trees and walls to rest (e & f). This behavior will enable them to store energy needed to feed at night and also prevents from being preyed upon. All these observed behavioural activity of the snail may explain its invasiveness enabling it to survive in a wide variety of environmental conditions. Their phytopolyphagous diet, perfect adaptability to extreme cold and hot environments by way of aestivation (h) coupled with high reproductive efficiency make this species cosmopolitan in distribution [3]. Being herbivorous and phytopolyphagous, severe damage to susceptible native vegetation can be expected when populations become sufficiently high from an ecological perspective [12,17].

4.0 CONCLUSION

Results showing the phytopolyphagous behavior of *A. fulica* supports the species are well adapted depending on the available vegetation. Their food preference is one important factor that may condition *A. fulica*'s population dynamics, growth rate, survival and fecundity. Native gastropod fauna could face competition for resources from invasive species leading to the non-existence of native snail fauna as evident in this study. The findings on their population abundance in protected areas could provide an early warning signal for an immediate and pragmatic management decision.

ACKNOWLEDGEMENT

The senior author would like to acknowledge the Department of Science and Technology-Accelerated Science and Technology Human Resources Development Program (DOST-ASTHRDP) and Western Mindanao State University (WMSU) for the scholarship grant, and the Department of Environment and Natural Resources - Protected Area Office (DENR-PAO) for the gratuitous permit.

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