Aspects of the Ecology of Rodents in the Owabi Wildlife Sanctuary, Ghana: Sex-ratio, Age Structure and Reproductive Characteristics

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ABSTRACT— ***This study investigated aspects of the ecology (sex-ratio, age structure and reproductive characteristics) of four rodent species in the Owabi Wildlife Sanctuary (OWS). Collapsible Sherman live traps (22.5 x 8.8 x 7.5 cm) were used to capture the rodent species in 12 grids, measuring 20 × 20 m and covering different habitat types identified in the sanctuary from October, 2009 to April, 2010. Trapping effort covered 1,500 trap-nights and 119 individuals belonging to four species were captured. There were 77 individuals of Praomys tullbergi (Tullberg's soft-furred rat), 16 were Lophuromys sikapusi (Rusty-bellied brush-furred mouse) and 13 were Hybomys trivirgatus (Temminck's hump-nosed mouse) and Malacomys edwardsi (Edward's long-footed rat), with male-to-female ratios of 1.5:1, 1.7:1, 1:1.6 and 2.3:1 respectively. Adults dominated in the age structure of all the rodents captured. All the 50 adult males of the four rodents were in reproductive condition. Of the adult females, 5.6% of P. tullbergi, 33.3% of M. edwardsi and 25.0% of H. trivirgatus were pregnant while 22.2% of P. tullbergi and 50% of H. trivirgatus were lactating. The reproductive characteristics indicated a stable and thriving rodent community at the OWS. It is however recommended that a whole-year study be conducted to provide a sounder basis for the conclusions of this study.***

Keywords— Rodents, sex-ratio, age structure, reproductive characteristics, Owabi Wildlife Sanctuary, Ghana

1. INTRODUCTION

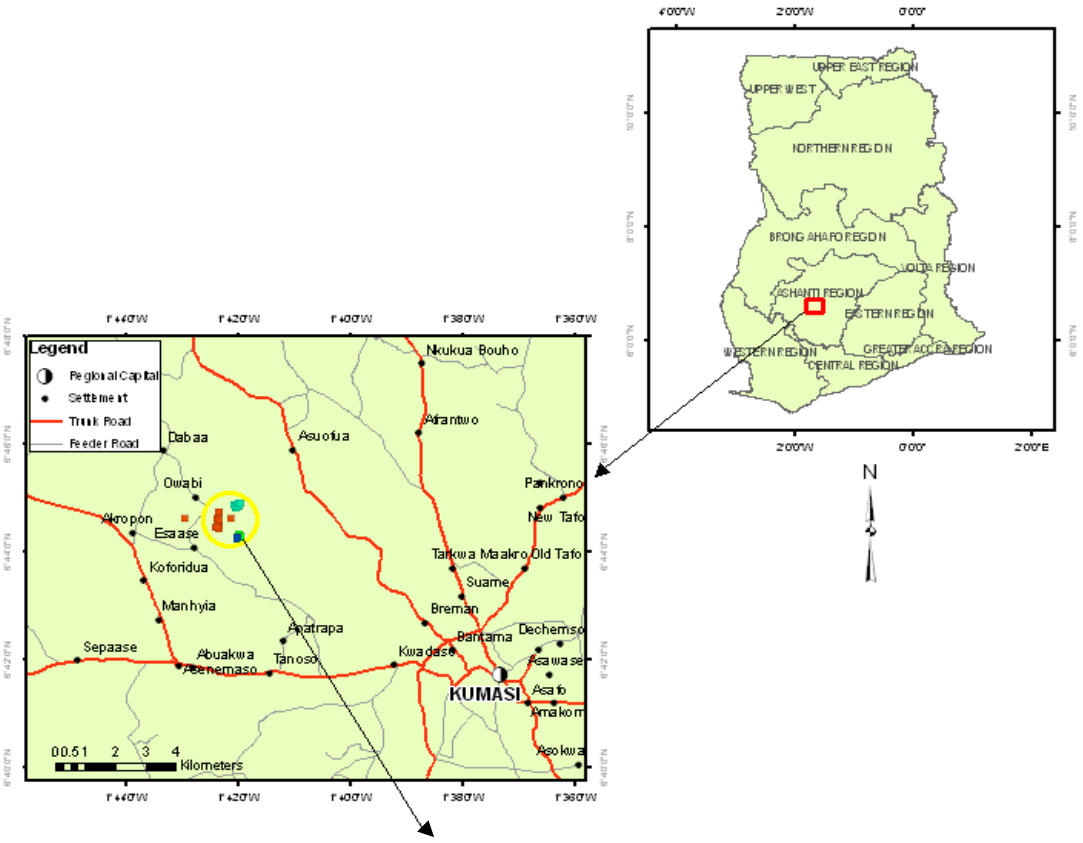
Even though efforts are being made to update species lists and to investigate the community ecology of small mammals in Ghana (e.g. Booth, 1959; Cole, 1975; Jeffrey, 1977; Decher, 1997; Yeboah, 1998; Decher & Bahian, 1999; Attuquayefio and Ryan, 2006; Garshong et al., 2013), it is equally essential to study aspects of their ecology relating to sex-ratio, age structure and reproductive characteristics. So importantly this is because there still remain a lot to be known about the small mammal species of Ghana. It is therefore pertinent to obtain information on small mammals, especially on their population structure, in areas where they are poorly documented such as the Owabi Wildlife Sanctuary (OWS), an important protected area in Ghana. Such information will provide a sound scientific basis for the development of species action plans and management strategies for the protected area to safeguard declining populations.

Aspects of rodent community structure such as sex-ratio, age structure and reproductive characteristics are essential components of population studies, which could provide the requisite information on the ecological status of the species as well as early warning of potential threats. The age structure, sex-ratio and reproductive characteristics of animals in ecological studies for example, is pivotal in making detailed analysis of population dynamics, calculate growth rate of individuals, fit growth curves, estimate maximum and average longevity, age of sexual maturity, or to determine age specific fertility, natality or mortality (Pucek & Lowe, 2009). In the applied sciences, to derive a sound ecologically-based rodent pest management strategy for example, it is important to obtain sufficient data on sex-ratio, age structure and reproductive characteristics to enable the development of effective management strategies to overcome rodent infestation in farms. This study is therefore expected to provide baseline data on the population structure of rodent species of the OWS. This would help inform management decisions and future small mammal research at the site.

2. METHODOLOGY

2.1 Study area

The Owabi Wildlife Sanctuary (OWS) (6º45'N, 1º43'W) is located in the Ashanti Region of Ghana. It has a mean annual rainfall of about 1,400 mm and a mean monthly temperature, ranging between 24.6 ºC and 27.8ºC, with a diurnal range of up to 9.1ºC. The general vegetation is a Moist Semi-deciduous Forest (north-west subtype) (Hall and Swaine, 1976). The study was conducted in the 13 km^2 inner sanctuary of the reserve, the core area, where park guards mount their regular surveillance.



Owabi Wildlife Sanctuary

Figure 1: Map of the Owabi Wildlife Sanctuary (Source: CERSGIS, University of Ghana)

2.2 Method

2.2.1 Small Mammal Live-trapping

Small mammals were live-trapped for five consecutive nights in a month from October, 2009 to April, 2010 using Sherman collapsible traps (22.5 cm × 8.8 cm × 7.5 cm). In each of the first three months of trapping, eight 20 m × 20 m grids were established to cover selected representative microhabitats (Table 1). The total number of grids was increased to 12 when more traps were obtained. Each square grid contained five traps, one at the center, and one at each corner, constituting a total of 1,500 trap-nights. The traps were baited with a mixture of groundnut paste and dried grated cassava, locally known as "Gari". Traps were set at 1600 hours GMT, and inspected daily from 0630 hours GMT. Captured animals were transferred into a mesh bag, anaesthetized with chloroform (to kill unidentified species humanely and daze aggressive species for ease of measurements), examined for reproductive condition (abdominal or scrotal testes in males and enlarged nipples, perforate vaginas, and pregnancy in females), identified on the spot (i.e. when possible) and released after toe-clipping.

The following standard measurements were taken:

- TOTL = Total Length (body and tail length, from nose-tip to end of tail)
- TL = Tail Length (from base of tail to the tip of tail)
- HBL = Head and Body Length (TOTL minus TL)
- HFL = Hind Foot Length (from heel to the tip of the longest toe)
- EL = Ear Length (from basal notch to the distal tip of pinna)
- WT = Weight (in grams).

The sex (using ano-genital distance which is longer in males) and age-class (assigned into three broad age-classes: juvenile, sub-adult and adult based on their weights) of the captured small mammal species were also determined.

Rosevear (1969) and Kingdon (1997) were the key references for rodent taxonomy and identification and small mammal field handling techniques followed Davies and Howell (2004).

Table 1: GPS Coordinates of Center Grids at the Owabi Wildlife Sanctuary

6º44.731'N; 1º42.324'W	6º44.864'N; 1º42.042'W	6º44.313'N; 1º41.947'W
6º44.613'N; 1º42.323'W	6º44.837'N; 1º42.016'W	6º44.294'N; 1º41.937'W
6º44.481'N; 1º42.333'W	6º44.862'N; 1º41.982'W	6º44.268'N; 1º42.003'W
6º44.474'N; 1º42.356'W	6º44.911'N; 1º41.938'W	6º44.284'N; 1º41.989'W

2.3 Analysis of Data

The Chi-square test was used to establish significant differences in sex-ratio (Ashcroft and Pereira, 2003). The categorization of the ages of the rodents was based on differences in weight for each rodent species as body weight in animals is known to be directly correlated with age (Okia, 1992; Pucek & Lowe, 2009).

3. RESULTS

Out of the 119 individuals of small mammal species that were captured in a total of 1,500 trap-nights, *Praomys tullbergi* (Tullberg's soft-furred rat) were dominant with 77 individuals, followed by *Lophuromys sikapusi* (Rusty-bellied brush-furred mouse) with 16 individuals. There were also 13 individuals each of *Hybomys trivirgatus* (Temminck's hump-nosed mouse) and *Malacomys edwardsi* (Edward's long-footed rat).

3.1 Sex-ratio

There were more males captured than females of all but one (*Hybomys trivirgatus*) of the rodent species captured, with the sex-ratios (male:female) varying from 1.5:1 in *P. tullbergi* to 2.3:1 in *M. edwardsi.* The ratios did not however vary significantly from the 1:1 ratio in any of the species caught in the Owabi Wildlife Sanctuary during the study period (*P. tullbergi*: $\chi^2_{(1;\,0.05)} = 2.922$, *L. sikapusi:* $\chi^2_{(1;\,0.05)} = 1.000$, *H. trivirgatus:* $\chi^2_{(1;\,0.05)} = 0.692$, and *M. edwardsi:* $\chi^2_{(1;\,0.05)} = 1.923$; $p > 0.05$) (Fig. 1).

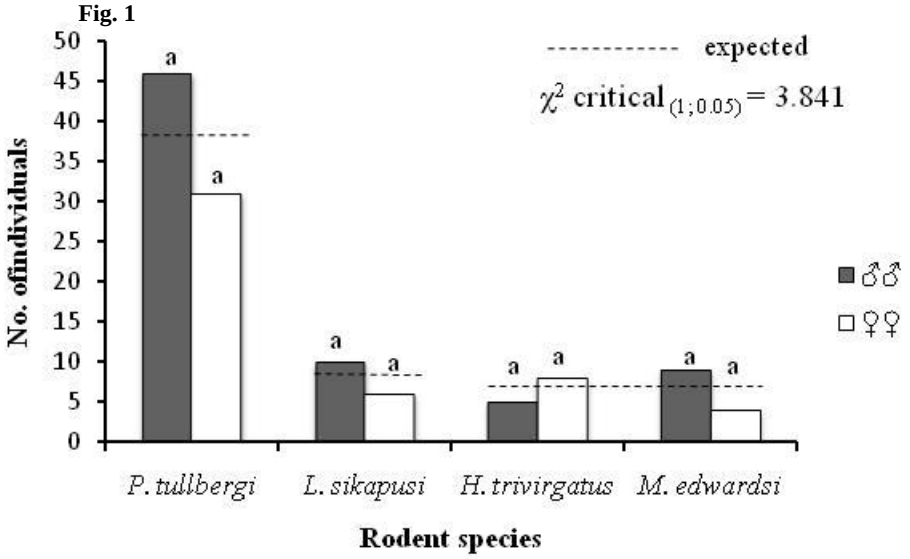


Figure 1: Sex-ratios of Rodent Species in the Owabi Wildlife Sanctuary, Ghana (The same variable by each species bar indicate non-significance; dashes indicate the expected number of individuals of males and females of each species)

3.2 Temporal variations in age structure

The age structure of the rodent species was determined by categorizing them into their respective weight limits. Animals were considered juvenile if they weighed less than 20 g for *Praomys tullbergi* and *Hybomys trivirgatus*, and less than 30 g for *Lophuromys sikapusi* and *Malacomys edwardsi*. They were considered subadult if they weighed between 20 and 30 g for *Praomys tullbergi* and *Hybomys trivirgatus*, and between 30 and 40 g for *Lophuromys sikapusi* and *Malacomys edwardsi*. Any animal that weighed beyond these specific weights was considered an adult (Table 2). Of all the rodent species captured throughout the study, the adults were the most numerous with juveniles being the least. Subadults and juveniles rarely occurred in all the captures throughout the study, except for *P. tullbergi* (Fig. 2), which, unlike the other species had all the three age groups occurring in the same month. The highest number of juveniles of *P. tullbergi* was recorded in April. No individual of *L. sikapusi* was caught in December (Fig. 3), *M. edwardsi* in November (Fig. 4) and *H. trivirgatus* in October and November (Fig. 5).

Table 2: Comparison Body Weights (in grams) among Rodent Species Captured in the Owabi Wildlife Sanctuary during the Study Period [actual numbers captured in parenthesis]

Species	**Weight (g)**		
	Adult	Subadult	Juvenile
P. tullbergi	> 30 (47)	20-30 (24)	< 20 (6)
L. sikapusi	> 40 (14)	30-40 (2)	< 30 (0)
H. trivirgatus	> 30 (11)	20-30 (2)	< 20 (0)
M. edwarsi	> 40 (12)	30-40 (1)	< 30 (0)

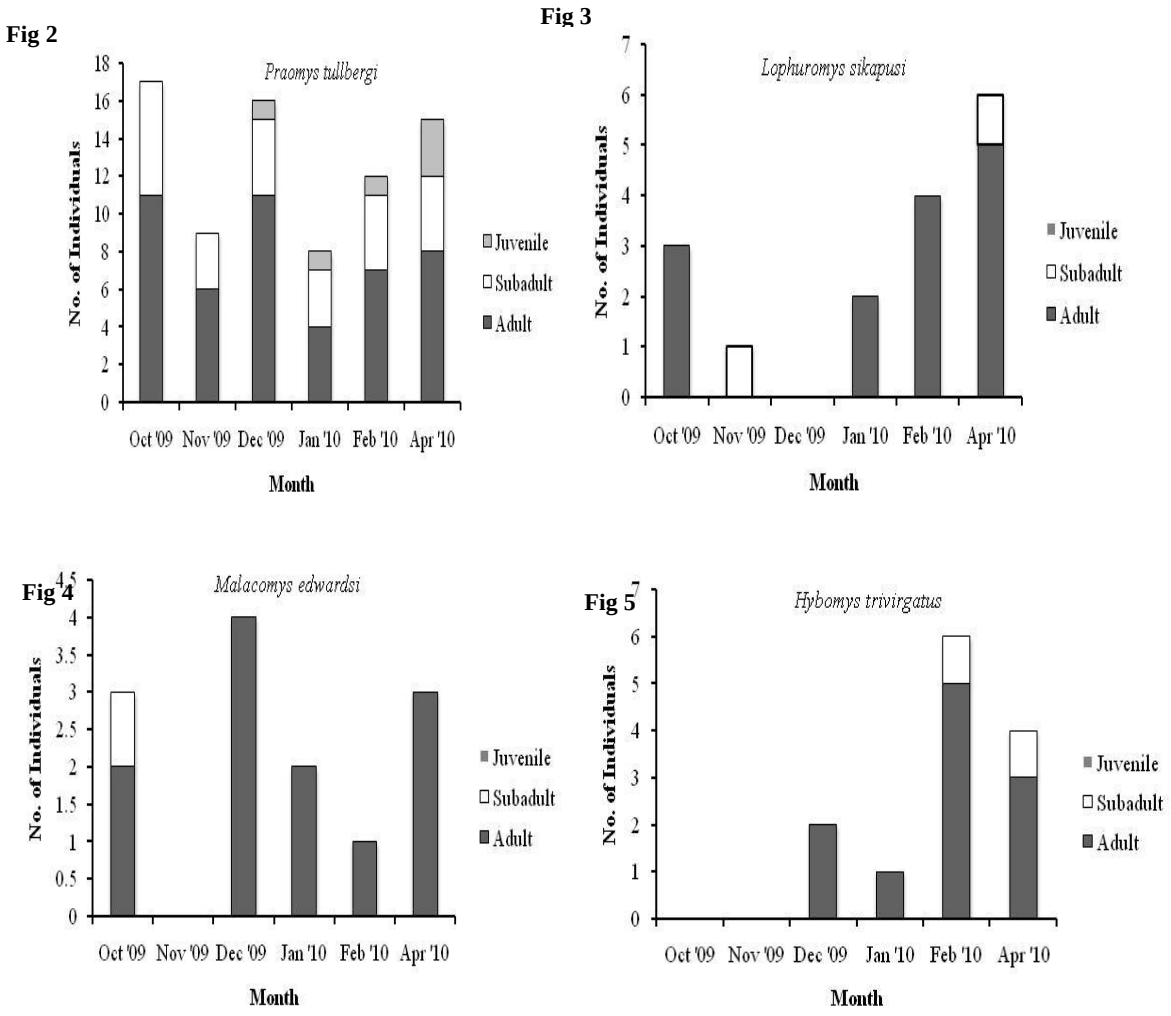


Fig. 2-5: Population Structure of Rodent Species Captured in the Owabi Wildlife Sanctuary, Ghana

3.3 Reproductive characteristics

All the adult male rodent species in the Owabi Wildlife Sanctuary were in reproductive condition with prominent scrotal testes during the study period. Some of the adult females were either pregnant or lactating, while some others were not in reproductive condition. None of the adult females of *L. sikapusi* was in reproductive condition. Whereas 25% of the adult females of *H. trivirgatus* were pregnant, 50% of them were lactating. *Praomys tullbergi* recorded 27.78% of its females in reproductive condition (22.2% lactating and 5.6% pregnant) in comparison to *M. edwardsi*, which had 33.3% of its adult females being pregnant (Table 3).

Table 3: Reproductive Characteristics of Adult Rodent Species in the Owabi Wildlife Sanctuary

Species	Males		Females		
	% Scrotal testes	Total	% Pregnant	% Lactating	Total
P. tullbergi	100.00	30	5.6	22.2	18
L. sikapusi	100.00	8	0.0	0.0	6
M. edwardsi	100.00	9	33.3	0.0	3
H. trivirgatus	100.00	3	25.0	50.0	8
Total		**50**			**35**

4. DISCUSSION

4.1 Sex-ratio

Although the male-to-female ratio did not differ significantly from 1:1, there were more males than females in three of the species. Only *Hybomys trivirgatus* had more females than males. According to Brown (1969) and Lidicker (2009), males tend to disperse more often or to greater distances than do females, resulting in a greater likelihood of more males encountering traps, hence their higher numbers caught in traps. This hypothesis is supported by Goundie and Vessey (1986) who reported that male White-footed mice dispersed about 75 meters from their nests while females only dispersed about half that distance (39 meters). Most of the female *H. trivirgatus* that were captured were in reproductive condition (75%), probably because the capture rate tends to be higher for reproductive females during the breeding season (Gliwicz, 1970). This might have accounted for the higher numbers of female *H. trivirgatus* than males.

4.2 Temporal Variations in Age Structure and Reproductive Characteristics

Body size in animals is directly correlated with age, and is therefore normally used as an index of age since it is considered the most appropriate non-destructive procedure to employ in age determination (Pucek and Lowe, 2009). Age is a factor that affects the behavioral response of small mammals to traps. Higher numbers of adults are often caught more than juveniles because age tends to affect trappability due to the animal's prior experience and social rank (Golley et al., 2009). According to Summerlin and Wolfe (1973), older individuals of a species rank higher in social structure and may be the first to be captured by traps. Happold (1979) reported on a similar phenomenon for *P. tullbergi* in a Nigerian forest and attributed it to the higher mortality rate in or lower trappability of juveniles compared to the other age groups. Also, the capture of fewer number of juveniles may be due to (i) juveniles not venturing far from their nests, hence decreasing their probability of encountering traps, (ii) the type of trap used in the study and/or (iii) the time of year the study was conducted.

Praomys tullbergi was the only species that had a good representation of all three age categories in most of the study months. This supports the hypothesis that *P. tullbergi* is polyestrous and breeds continuously all year round (Happold, 1978), and also that *P. tullbergi* dominates most forests of West Africa (hence the name "West African forest mouse"). The presence of juveniles and subadults may indicate breeding periods while their absence may indicate non-breeding periods. The breeding seasons of the rodent species involved in this study have not been properly determined in Ghana. The presence of subadults and juveniles among the rodent species captured for the sanctuary indicates a stable and thriving rodent population.

The presence of males and females in reproductive condition may also indicate a thriving rodent community at the Owabi Wildlife Sanctuary.

5. CONCLUSION AND RECOMMENDATIONS

It can be concluded that the four rodent species investigated at the Owabi Wildlife Sanctuary have a stable and thriving community as indicated by their respective sex-ratios and reproductive conditions.

It is however recommended that at least a whole-year study be conducted to provide a substantial basis on the conclusions of this study.

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