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POPULATION SIZE OF RED JUNGLEFOWL (*GALLUS GALLUS SPADICEUS*) IN AGRICULTURE AREAS

Mohamed Zakaria*, Muhammad I Arshad and Ahmad S Sajap

Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

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A two-year study was conducted on the population size of Red Junglefowl (*Gallus gallus spadiceus*) in five agricultural areas in the state of Selangor, Peninsular Malaysia. In the first year (from August 1995 to July 1996) the study was conducted in three habitats viz. rubber plantation, 22-year old oil palm plantation and orchard area at Universitiy Putra, Malaysia. In the second year (from August 1996 to July 1997) two additional habitats viz. 4 and 8 years old oil palm plantation at Sungai, Sedu Estate were selected. Red Junglefowl density was estimated by Distance Sampling Method. Habitat condition was also assessed to determine factors that affected the population size. The densities in 4 years, 8 years and 22 years old oil palm, rubber plantations and orchard were 84.22 km^{-2}, 27.80 km^{-2}, 21.43 km^{-2}, 15.66 km^{-2} and 6.06 km^{-2} respectively. The average group size was two birds per group. The largest group comprised of 10 birds was observed in an 8 years old palm oil plantation. The height of the canopy cover was found to have a significant effect on the density of Red Junglefowl. Low canopy cover provides the Red Junglefowl protection against predators and suitable roosting sites.

Key words: Agriculture, Red Junglefowl, Density, Habitat, Canopy cover.

Introduction

After the Second World War, the agriculture became one of the most important economic sectors in Malaysia. Large areas of virgin forest were converted into rubber estates to meet the overseas demand for rubber. A lean time in the early 1980's resulted in a decline in demand for rubber. As a result most rubber plantations were then converted into oil palm estates. Development of monoculture plantations in place of natural forests resulted in the disappearance of most forest-dependent wildlife, but some species have managed to colonize the new environment. The Red Junglefowl (*Gallus gallus spadiceus*) clearly took advantage of the disturbance or replacement of forest by tree crops and continue expanding into the available habitats. The spread of agriculture, shifting cultivation and the creation of clearings for crops helped increase the extent of habitat for Red Junglefowl Davison, (1982).

The Red Junglefowl is one of the important species belonging to the order Galliformes and is the chief progenitor of modern poultry, Darwin (1887). This species is widely distributed in southern and eastern India, Burma, Southeastern China (Yunnan, Kuanghsi, and the island of Hainan), Indo-China and the Malay Peninsula to Sumatra, the Philippine islands, Fiji and New Guinea, (Delacour 1977). The sub-species *Gallus gallus spadiceus* Bonnaterre, one of the five species distributed worldwide, is found in Peninsular Malaysia. The species is wide spread over all the country up to 1676 m high above sea level (Siti Hawa Yatim 1992).

It is an important gamebird in Peninsular Malaysia and the flesh is highly edible, Bump and Bohl (1961). The hunting season is from 1st May to 31st August and the hunting licence fee is RM 50 under Protection of Wildlife Act (1972). Red Junglefowl provides sport recreation, animal protein to the people, and revenue to the government. It is a popular bird to have in rural areas especially for cock fighting. The aboriginal people in Malaya often keep Red Junglefowl as pets (Beebe 1918-22).

The precise population status of Red Junglefowl has not been documented in the past. To understand the importance of agricultural areas to the future survival of the species or to develop a management plan requires advanced knowledge and understanding of the species distribution and population size. The present ecological study on this species is an attempt togather in-depth information with regard to population size in agricultural areas (i.e. rubber and palm oil plantations and orchard area). This information is pertinent for the development of a sound strategy for the survival of this important indigenous species.

* Author for correspodence

The data obtained from present study will allow us to know the density of Red Junglefowl and its impact on agricultural ecosystems. It will also enable the relevant agencies (i.e. government and private) to formulate proper strategies for the management of the species in the future.

Experimental

Study areas. Two study areas were selected for the investigation. The first part of the study was conducted from August 1995 to July 1996 at the main campus of Universitiy Putra Malaysia (UPM). It is located about 23 km from Kuala Lumpur (Longitude 102^0 42' E and Latitude 1^0 24' N). At UPM three study sites were selected, 22 years old palm oil plantation, rubber plantation and orchard area (planted with Rambutan, *Nephelium lappaceum* and Cempedak, *Artocarpus integer)*. The area of these sites was 60, 54 and 17.5 ha respectively. The second part of the study was conducted from August 1996 to July 1997 in Sungai Sedu Estate, Banting, Selangor. It is located about 60 km south-west of Kuala Lumpur (Longitude 101^0 35' E and Latitude 2^0 50' N). Two study sites were selected i.e. 4 years and 8 years old palm oil plantations. The size of these areas was 115.5 and 90.5 ha respectively.

Method. The density of the Red Junglefowl was estimated by the Distance Sampling Method, Buckland *et al* (1993). In UPM, two transect lines each in 22 years old palm oil plantation and in rubber plantation and one transect line in orchard area were established for the survey. The length of each transect line was 1.22 and 1.60 km in 22 years old palm oil plantations, 1.2 and 1 km in rubber plantations and 1.9 km in the orchard area. In the month of April 1996, due to disturbance by construction of hostels in the orchard area, a new transect line 1.1 km in length was established. In Sungai Sedu Estate a two-kilometer transect line was selected in each study area i.e. 4 years and 8 years old palm oil plantation.

Transect lines were selected according to the topography of the area, so as to cover maximum area for obtaining reliable data on the abundance of Red Junglefowl at each study site. Each line was walked twice monthly in the morning and in the evening on the presumption that the Red Junglefowl is more active during these times of the day (Kalsi 1992; Sathyakumar *et al.* 1992). Transects were walked slowly about one k_m hr^{-1} and when a Red Junglefowl was encountered, its sex, perpendicular distance from the line and its activities were recorded. The data on natural mortality were collected when a Red Junglefowl was found dead. The local hunters nearby were also interviewed to obtain information on the hunting activities.

To obtain information on whether habitat condition affects population size, the habitat characteristics were analyzed in each study area by quadrat method and by vegetation layers. Two vegetation layers were recognized following (Kayani 1984) i.e. trees, herbs and grasses. Thirty quadrats were randomly selected along the same transect line used for population survey, Walpole and Myers (1993). Different sizes of the quadrats were used for the analysis of different vegetation layers i.e. for tree layer, a 200 m long and 10 m wide belt was selected (Zakaria 1994) and for herbs and grasses, 1x1 m quadrats were used. The percent vertical cover of each species of plants in a quadrat was estimated visually. The crown cover was recorded separately by 'crown diameter method' of Muller-Dombois and Ellenberg (1974). The quadrat data was used to calculate the percent absolute cover of each species, total cover, and herb and grass cover of each of the study area. The data on height of the trees were obtained using a measuring rod and for trees above 8 m with a clinometer.

Red Junglefowl density in all study areas was analysed by using the program DISTANCE (Laake *et al*. 1993). Analysis of variance and Duncan's Multiple Range was used to compare flock size between the study sites. Pearson correlation analysis was used to examine the relationship of Red Junglefowl density with vegetation variables, area covered with litter, and bare area. Linear regression was used to examine the relationship of density with canopy cover. One-year data on sightings of Red Junglefowl in each study site was pooled to examine the sex ratios. To examine the overall sex ratio, Red Junglefowl sightings in all study sites were pooled.

Results and Discussion

Red Junglefowl were widely distributed and found in a wide variety of habitats. The individual density and group density of Red Junglefowl was highest in the 4 years old palm oil plantation and lowest in rubber plantation (Table 1). The average group size among study sites was significantly different ($F = 6.77$, $P < 0.001$). The analysis showed that the average group size of Red Junglefowl in the 22 years old palm oil plantation was significantly different with other habitats (Duncan Multiple Range Test, Table 1). The group size was highest in this plantation compared to others.

The frequency of group sizes in all the study areas is given in Fig 1. Red Junglefowl are often solitary in all study sites. Generally the solitary birds were males and rarely females. The largest group size was in the 8 years old palm oil plantation and was 10 birds. The most frequently observed group size was that of solitary, which was 54.88% (Fig 2). Pairs

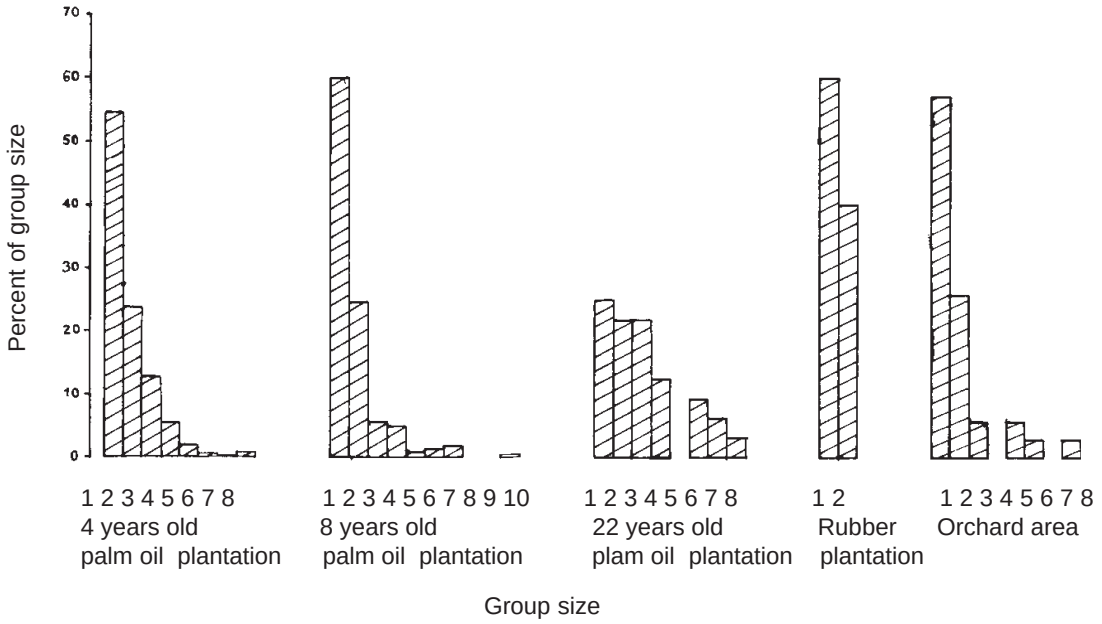

Fig 1. Frequency of group size of Red Junglefowl observed in different study areas

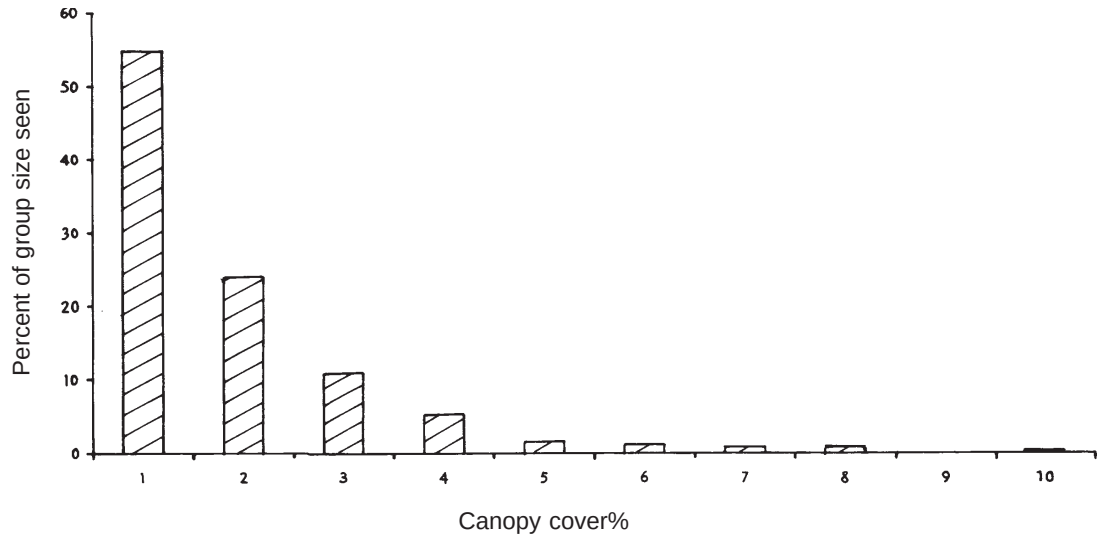

Fig 2. The percentage of Red Junglefowl group size seen of in all study areas

accounted for 24.06% while a group size of three comprised 10.92%.

Results on sex ratio show that in the 4 years and 8 years old oil palm, orchard and rubber plantations, the number of males were higher than the females (Table 1). Only in the 22 year old palm oil plantation the number of females were more than the males. The average sex ratio of male to female was 53:47.

The relationship of Red Junglefowl density with habitat variables was examined. The analyses showed that there was no correlation between the density of Red Junglefowl with grass and herb cover, grass and herb height, number of grass and herb species, bole height, tree height, bare area and area covered with litter Table 2. However, there was a significant negative relationship between canopy cover and density of Red Junglefowl ($r = -0.87$, $P < 0.05$). This suggested that as the canopy cover increases, the density decreases.

The regression analysis was performed to examine the effect of independent variables on dependent variables. The R^2 value in the analysis was 0.72. The regression model describes

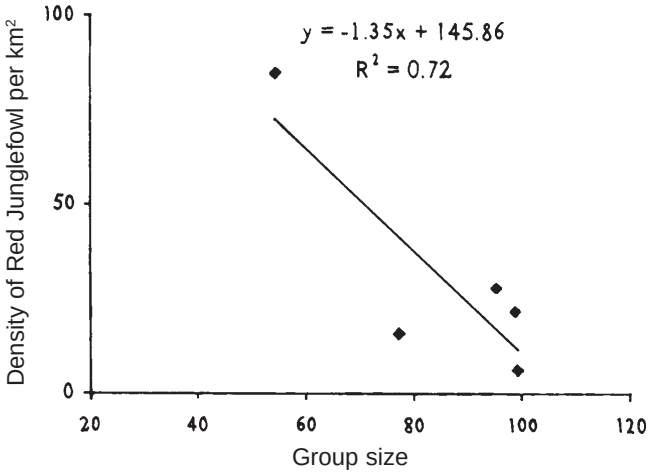

Fig 3. Density of Red Junglefowl in relation to canopy cover

population of Red Junglefowl can be iterated at the following Population = -1.36 canopy +145.86.

Thus the regression model of density of Red Junglefowl on canopy cover accounted for 72% of the variation Fig 3.

The main mortality was observed due to hunting activities (shooting and trapping) in the study areas. The main hunting activities by humans were concentrated in 4 years old palm oil plantation and were done mostly by shooting.

The Red Junglefowl sometimes were organised into groups of different sizes. A group may consist of a single male and female, several males, several females and a mixed group (male, female and chicks). Bigger congregations of Red Junglefowl were observed during the post-fledging period when the hens and chicks fed together. Single birds, either male or female, was most often sighted, over 55% of the total observations. This suggests that Red Junglefowl often occur singly. Similar findings were observed by Collias and Saichuae (1967) who reported 50% of Junglefowls were lone males in Thailand. Silva *et al*. (1992-93) reported that 88.1% of the Ceylon Junglefowl were solitary.

The group size ranged from 2 to 10 individuals in all study sites (orchard area, rubber plantation, 4 years, 8 years and 22 years old palm oil plantations). Bump and Bohl (1961) reported *Gallus gallus murghi* flock sizes comprised of 5 to 10 individuals in India while Nishida *et al*. (1990) observed 5 to 15 individuals of the same species in Nepal natural forest. This shows that the species *Gallus gallus spadiceus* occurs in smaller groups.

It is evident from the results that a higher number of males were seen than the females (male:female = 1.2:1). Contrary to these findings reported, (Collias and Saichuae 1967) a higher number of females compared to males in Thailand. The variation in these two studies might be due to smaller sample size in the earlier study. In addition both studies were conducted under different ecological conditions. It is well known that different habitats have different climatic and habitat conditions which might affect the population size.

Table 1
Individual density, group density, average group size, male:female sex ratio and mortality of Red Junglefowl in different study areas

Study areas	Individual km^{-2} (mean ± SE)	Group density/ (mean ± SE)	Average group (mean ± SE)	Sex -ratio (Male: Female)	Mortaity (No)
4 years old palm oil plantation	84.22 ± 5.45	44.93 ± 2.55	1.88 ± 0.06 b	52:48	16
8 years old palm oil plantation	27.80 ± 3.57	15.65 ± 1.84	1.78 ± 0.09 b	56.44	1
22 years old palm oil plantation	21.43 ± 6.84	4.89 ± 0.94	3.06 ± 0.35 a	45:55	-
Rubber plantation	6.06 ± 8.73	4.32 ± 6.19	1.40 ± 0.24 b	57:43	-
Orchard area	15.66 ± 3.64	8.27 ± 1.53	1.89 ± 0.26 b	60:40	1

Note: Means with same letters are not significantly different by using Duncan Multiple Range Test (DMRT) SE= Standard error

Table 2
Correlation coefficients (r) and significant level (p) of Red Junglefowl density with habitat variables (These are combine results for all study areas)

	Grass & herb cover	Grass & herb height	Tree bole height	Tree canopy cover	Tree height	No. of species	Bare area	Litter area
r	-0.51	-0.10	-0.54	-0.88	-0.42	-0.61	0.38	0.11
p	(0.37)	(0.87)	(0.34)	(0.05)	(0.48)	(0.28)	(0.62)	(0.86)

In this study the estimated density of Red Junglefowl in palm oil plantation viz. 4 years, 8 years and 22 years were 84 birds km^{-2}, 27 birds km^{-2} and 21 birds km^{-2} respectively. In orchard areas the density was 15 birds km^{-2} and in the rubber plantation 6 birds km^{-2}. In natural habitats, Collias and Collias (1967) estimated the population density of Red Junglefowl on the basis of average flock size. The estimated population density was 100 birds/km^2 near Doholkhand Forest Reserve in India. Bump and Bohl (1961) estimated 25 to 50 birds km^{-2} in Siwalik foothill area in India. However, they considered their estimates to be conservative. Furthermore, both studies were conducted in natural habitat but in different study areas of the country.

Therefore, it seems that the variation in study sites mark its impact on density of the birds. This statement is further substantiated in density of different plantations viz. 4 years old palm oil plantation has a higher density compared to 8 years old and 22 years old palm oil plantation. It is clear from the present study that not only the different palm oil plantations have different population size but different habitats (palm, oil rubber plantation and orchard area) also affect the population size.

The major population of Red Junglefowl was found in the young palm oil plantation. These plantations have less canopy cover and more areas of open space. This condition is preferred because the Red Junglefowl could easily fly away if attacked by predators. In addition, the lower height of palm oil trees provided better sites for roosting in relation to those at old oil palm trees. Similarly-, the canopy of young maturing palm reported (Abdullah and Babjee 1982) within easy reach for roosting. The young plant fronds often bent and touched the ground. These provided good protection of Red Junglefowl against its enemies. Tall palm oil plantations were less preferred by Red Junglefowl because the palm oil fronds were too high to be a roosting site at night. In addition the floor of old palm oil plantations was too open and enhanced predation by predators and poaching by humans.

In the rubber plantation the density of Red Junglefowl was low as compared with palm oil plantations and orchard. This might be due to the disturbance by rubber tappers. Generally, the rubber was tapped every day while palm oil was harvested every two weeks. Furthermore the thick ferns on the floor hindered the movement of Red Junglefowl. Similarly, Abdullah and Babjee (1982) reported that rubber plantation was not preferred because it was too open for predators to detect the fowl. Furthermore, the ripe palm oil fruit is soft and easy to eat whereas the rubber seed is hard and might be difficult to break. This could be another reason why palmoil plantations were preferred.

In the orchard area the density of Red Junglefowl was also low. It might be due to its floor which is wide open especially under Rambutan and Cempedak trees. The regular management practices such as fruit collection, use of herbicides and cutting of grass with a tractor also caused disturbance that might affect the density of Red Junglefowl in the orchard.

Conclusion

In conclusion, the density of Red Junglefowl depends mainly on the height of the canopy cover. The low canopy seems to play an important role in providing protection, especially from predators such as humans which were found as the main predator. These factors might be responsible for the attraction of the Red Junglefowl population into the young palm oil plantation.

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