Pertanika J. Trop. Agric. Sci. 30(1): 45 - 50 (2007)

ISSN: 1511-3701

Influence of Wet and Dry Seasons on the Breeding of Barn Owl and Its Relation to Rat Damage

HAFIDZI M. N.[1], M. NA'IM[1] AND AKBAR, Z.[2]

[1]*Department of Plant Protection, Faculty of Agriculture, 43400 UPM, Serdang, Selangor, Malaysia*

[2]*School of Environmental and Natural Resource Sciences, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia*

Keywords: ***Tyto alba*, *Rattus argentiventer*, biological control, seasonal, crop damage**

ABSTRACT

*The effects of wet and dry season paddy crops on the breeding of barn owl (*Tyto alba*) and its relation to rat damage was studied in the district of Tanjung Karang, Selangor, Malaysia. The first site was at Sungai Burung where the nest box density was one box per 45 hectares of rice field. The second study site was in Sawah Sempadan which involved three experimental plots designed to investigate the effects of nest box density on rat damage, with densities of 1 box per 5, 10 and 20 hectares. The nest box occupancy rates for both seasons were 72.2% but can increase to 83.3% during the wet season crop. Mean clutch size during the dry and wet season crops were 5.38 and 4.07 respectively. Hatching success was 85.7% during the dry season and 79.2% during the wet season. Fledging success for both seasons were greater than 93%. Higher occupancy and hatching success during the dry season crop suggests that* T. alba *responded in a functional way in dealing with increasing rat numbers. Lower rates during the wet season crop serve to limit population growth of T. alba. Damage levels to paddy crop at Sungai Burung, during the tillering stage for both seasons were less than 2%. Damage levels during the booting and harvesting stages were also < 2% but increased to 3.22% and 3.39% respectively for the dry season crop. Higher crop damage level during the dry season can be associated with limited alternative food sources and the rats rely on paddy as their main food source. Damage levels at Sawah Sempadan were low throughout both crop seasons with mean crop damage levels of 0.65 + 0.10% for the 5 ha/box plot, 0.78 ± 0.28% for the 10 ha./box and 1.57 ± 0.15% for the 20 ha./box plot. This indicates that higher density of* T. alba *at Sawah Sempadan can control rats better throughout paddy crop seasons.*

INTRODUCTION

Natural breeding of the barn owl *(Tyto alba)* for the purpose of rat control in rice fields in Malaysia was started in 1989 when the Malaysia Department of Agriculture established the first project in Tanjung Karang, Selangor, by providing artificial nest boxes (Shamsiah and Goh, 1991). *Tyto alba* tend to confine its feeding activities within a designated area around the nest box. By investigating the dietary remains, presented in the form of a pellet (Glue, 1974), the diet of *T. alba* can be determined, which also reflects the prey composition of the area (Webster, 1974).

A long-term study undertaken by Marti (1988) showed that food habits of *T. alba* shows a similar pattern in the same region, where it continuously preys on small mammals but rarely take other birds as food. Champbell *et al.* (1987) noted that in areas with similar climate and range of habitat, the prey species of *T. alba* remains consistent. They also noted that food habits of *T. alba* in British Columbia varied among different geographical areas, but *Microtus townsendii* remain the primary prey in all seasons, with the highest proportion recorded during the autumn season. In ricefield areas in Malaysia, *T. alba* mainly feeds on rats, especially the

ricefield rat *Rattus argentiventer* with occasional shrews and birds (Hafidzi and Naim, 2003).

Normally there are two rice planting seasons in a year in Malaysia. The first is the main season which coincides with the wetter months of the year and a second off-season which coincides with the dryer months. The objective of this study was to investigate the effect of wet and dry seasons on the breeding and feeding behaviour of barn owl.

MATERIALS AND METHODS

The study was conducted in Sungai Burung and Sawah Sempadan, Tanjung Karang Selangor Malaysia from January to December 2002. Rice is planted in these areas by direct seeding. There are two planting seasons per year: the dry season which lasts from April to August and, the wet season, from November to March. Rice varieties planted in the area are the MR 102, MR 129 and MR 185. In the Sungai Burung area, the time of planting is later than in Sawah Sempadan. For instance, in the dry season, planting in Sawah Sempadan started in February and in March for Sungai Burung. Eighteen artificial nest boxes set up by the Department of Agriculture in November, 2001 were chosen for this study. The nest boxes were modeled against the original design by Duckett (1976). The nest box density at Sungai Burung was 45 ha/box, although density may vary as these boxes were erected according to suitability of sites and ease of inspection. Nest occupancy rates were determined by the proportion of nest box with eggs, owlets and fledgling adults. Owlets were considered fledgling adults at 8 – 9 weeks from hatching (Smal, 1990). These parameters were used to compare the effects of wet and dry seasons on *T. alba* breeding.

Rat damage assessment was divided into three rice crop growth stages: tillering (4 weeks after seeding), booting (8-9 weeks after seeding) and harvesting (two weeks before harvesting) and divided into wet and dry seasons. The methods involved sampling along ten parallel linear rows of rice crop chosen at random in each plot. Ten quadrats of 0.25 X 0.25m for tillering stage and 0.5 X 0.5m, 5 meters apart were sampled along each row for 100 quadrats. The method of Buckle (1994) was used to assess rice crop damage.

$$\% \text{ Damage} = \frac{a \times c}{b + c}$$

Where : a = number of damaged hills out of 100 samples
b = number of undamaged tillers in the hills with damage
c = number of damaged tillers in the hills with damage

The rat damage levels at Sungai Burung were then compared with damage levels at Sawah Sempadan from three predetermined experimental plots with nest box densities of 5 ha, 10 ha and 20 ha/box. Fifteen artificial nest boxes were set up in August 30, 2001 in a designated area at Sawah Sempadan, where none has previously been established. The nearest nest box was more than one kilometer away to reduce impact on owl movement from neighbouring nest boxes. The boxes were arranged in three clusters consisting of five boxes covering an area of 5 (Plot A), 10 (Plot B) and 20 (Plot C) hectares as shown in *Fig. 1*. Analysis of variance (ANOVA) was used to statistically analyze damage levels between wet and dry seasons at each of the three planting stages; tillering, booting and harvesting. Correlation was used to compare nest box density and mean damage levels for both wet and dry seasons in combination.

RESULTS AND DISCUSSIONS

Breeding of Barn Owl in the Wet and Dry Seasons

The census showed there were two breeding seasons: during the wet season from January to April and during the dry season from June to September. Occupancy rates throughout the dry and wet seasons were consistent i.e. 72.2% (*Fig. 2*). However, November and December census showed that occupancy during the wet season can be as high as 83.3%. This indicates that occupancy rates may vary between planting season. Based on a yearly census carried out from 1993 – 1997, Hafidzi *et al.* (1999) showed that in the same area, the proportion of boxes with eggs were consistently higher during the first planting season (December to January) than the second planting season (July to August). They also found that the proportions of boxes with owlets were generally twice in February and

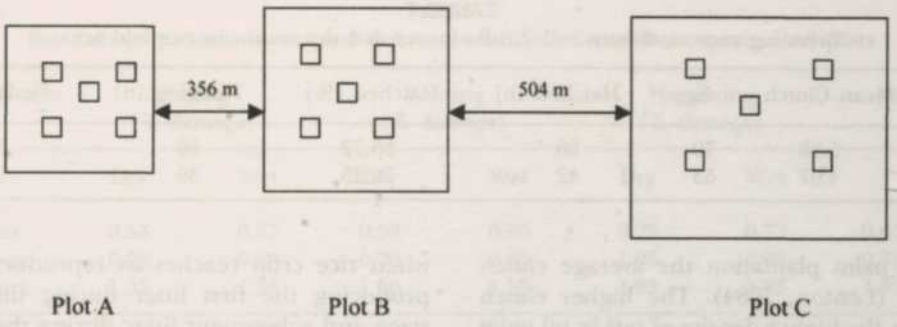

Fig. 1: Experimental plots representing three nest box densities. Plot A(5ha/box), Plot B (10 ha/box) and Plot C (20 ha/box). ☐ *represents nest box*

March compared to September. Therefore it can be deduced that wet and dry seasons may influence nest box occupancy rates, but these require a wider census over a number of years.

Smal (1988) showed that nest box occupancy of *T. alba* in an oil palm plantation varied from month to month. He also found there was a marked seasonal variation, with relatively few boxes being occupied in April and May and that peak occupancy, as high as 80 – 90%, were recorded from October to January (Smal, 1990). Lee and Ho (1999) found that nest occupancy rate in cocoa reached 70% at peak breeding season.

Table 1 shows that *T. alba* produce more eggs during the dry season i.e. mean clutch size of 5.38 compared to 4.07 during the wet season. Percent hatching was also higher in the dry season compared to wet season i.e 85.7% and 79.2% respectively. This suggest that although there were indications that the proportion of nest boxes occupied were higher during the wet season, egg production per breeding pair may be higher during the dry season. This suggests that *T. alba* may respond in a functional way towards prey availability (Erlinge *et al.*, 1984). In the dry season, food resources may be limited and therefore rats may rely heavily on the rice crop, increasing its density in the ricefield. This in turn may increase the hunting success of *T. alba*. Higher food intake leads to a higher clutch size and hatching success. However, the rate of fledging between dry and wet season was similar i.e. highs of 93%. This suggest that the lower clutch size and hatching success during the wet season is compensated for by correspondingly high fledging rates.

The high recruitment of *T. alba* in the preceeding dry season leads to a higher nest box occupancy in the wet season. Lower prey availability, as a greater range of food resource may lead to a dispersal of the rat population, which in turn cause lower egg production and hatching success. This compensatory mechanism leads to a stable *T. alba* population and keeps their numbers within the carrying capacity of the rice field habitat to prevent over predation on rats.

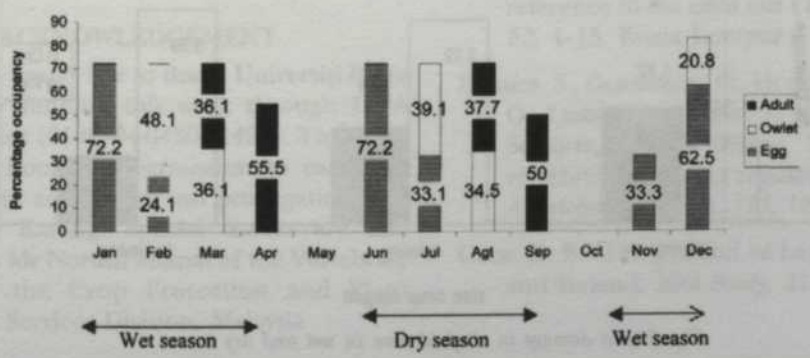

Fig. 2: Mean occupancy of barn owl T. alba *in wet and dry season in ricefield area*

TABLE 1
Breeding success of barn owl *T. alba* in wet and dry season in ricefield area

Season	Mean Clutch	Egg	Hatched (n)	Hatched (%)	Fledging (n)	Fledging (%)
Dry	5.38	70	60	85.72	56	93.3
Wet	4.07	53	42	79.25	39	93.8

In oil palm plantation the average clutch size is 6.6 (Lenton, 1984). The higher clutch size reflects the higher density of rats in oil palm plantations, which may reach 300 – 400 per hectare (Wood, 1969). In contrast, density estimates of rats in rice field ranged from 120 – 240 rats/ha. (Leung *et al.*, 1999). Oil palm plantations can sustain higher rat populations as food is almost available throughout the year, in the form of oil palm fruits, as opposed to paddy fields which are seasonal. The continuous breeding season from June/July to September/ October and followed by a second clutch from October to January (Smal, 1990), supports this observation.

Rat Damage Analysis in the Wet and Dry Seasons

Incidence of rat damage in both wet and dry seasons at the tillering stage were less than 2% (*Fig. 2*). In all three development stages, damage to crop in the dry season were significantly higher than in the wet season (ANOVA; Tillering, $F = 4.41$, $P < 0.05$; Booting, $F = 4.56$, $P < 0.0001$; Harvesting, $F = 5.02$, $P < 0.001$). In the wet season, damage levels did not exceed 2% for all stages of growth. However, damage recorded in the dry season crop showed a marked increase from 1.34% to 3.22% and 3.39% at the booting and harvesting stages. Rats only start to breed when rice crop reaches its reproductive stage, producing the first litter during the booting stage and subsequent litter during the ripening stage and shortly after harvest (Lam, 1983; Leung *et al.*, 1999). This partly explains the higher damage during ripening and harvesting. Also, during dry season, there is limited alternative food available. To maintain their sustenance, the rat population will converge on the paddy fields, leading to higher damage.

However, damage census in Sawah Sempadan showed that damage levels were low and stable for both the wet and dry season crops (Table 2). This can be attributed to the higher density of nest boxes in the area i.e. 20 ha, 10 ha and 5 ha per nest box. At such high density, *T. alba* has much better control of rats. Even, when comparing the three experimental plots in Sawah Sempadan, damage levels in the 20 ha. per nest box recorded a consistently higher damage levels than the other two plots i.e. 1.57 ± 0.15 % compared to 0.65 ± 0.10% for the 5 ha/box plot and 0.78 ± 0.28% for the 10 ha/box plot. *Fig. 3* shows the extent of crop damage in Sawah Sempadan was highly correlated to nest box density ($R^2 = 0.96$).

Difference in % damage for all three crop stages between dry and wet seasons were significant.

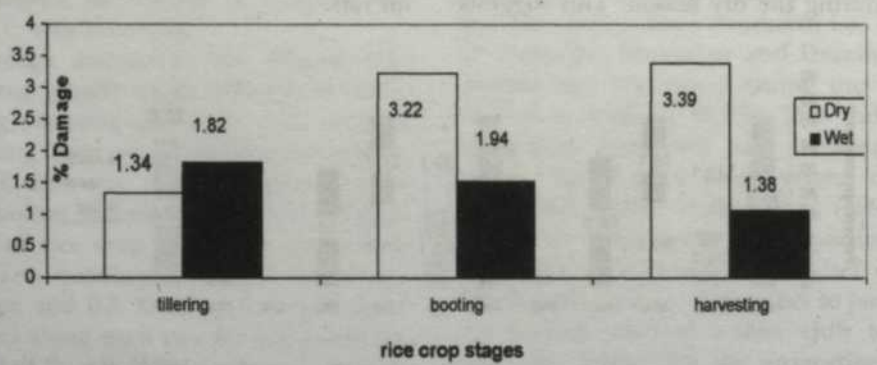

Fig. 2: Rat damage in ricefield area in wet and dry season

TABLE 2
Rat damage patterns in wet and dry seasonat Sawah Sempadan experimental plots

Nest box density	Tillering (% damage)		Booting (% damage)		Harvesting (% damage)		Average
	Dry	Wet	Dry	Wet	Dry	Wet	
5 ha/box	0.53	0.57	0.58	0.66	0.79	0.77	0.65 + 0.10
10 ha/box	0.23	0.89	0.79	0.85	1.03	0.93	0.78 + 0.28
20 ha/box	1.57	1.54	1.36	1.53	1.83	1.62	1.57 + 0.15

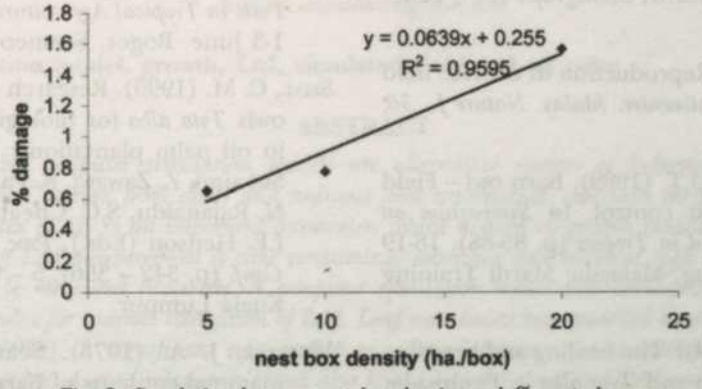

Fig. 3: Correlation between nest box density and % crop damage

CONCLUSION

Nest box occupany by the barn owl, *Tyto alba,* varies between the dry and wet season crops, with possibly higher occupancy rates during the latter. Clutch size and hatching success is higher during the dry season crop but compensated for by the high fledging rates during the wet season crop. Damage levels were higher at the booting and tillering stages of paddy crop during the dry season. However, with high *T. alba* density, damage throughout crop stages in both seasons remain low and stable.

ACKNOWLEDGEMENT

The authors would like to thank Universiti Putra Malaysia for funding this work through IRPA research grant (01-02-04-0430-51490). Thanks to Mrs Asnah Booty for permission to carry out research work at the barn owl propagation area in Tanjung Karang. Special thanks are also extended to Mr Nordin Mamat of the Vertebrate Section of the Crop Protection and Plant Quarantine Services Division, Malaysia

REFERENCES

CHAMPBELL, R. W., MANUWAL, D. A. and HARRESTED, A. S. (1987). Food habits of the common barn owl in British Columbia. *Can. J. Zool., 65,* 578 – 586.

BUCKLE, A. P. (1994). Damage assessment and damage surveys. In A.P. Buckle and R.H. Smith (Eds.), *Rodent pests and their control* (p. 197-218). CAB International.

DUCKETT, J. E. (1976). Owls as major predators of rats in oil palm estates with particular reference to the barn owl (*Tyto alba*). *Planter, 52,* 4–15. Kuala Lumpur

ERLINGE, S., GORANSSON, G., HOGSTEDT, G., JANSSON, G., LIBERG, O., LOMAN, J., NILSON, I. N., VON SCHANTZ, T. and SYLVEN, M. (1984). Can vertebrate predators regulate their prey? *The American Naturalist, 123,* 125 – 133.

GLUE, D. E. (1974). Food of barn owl in Britain and Ireland. *Bird Study, 21,* 200–210.

HAFIDZI, M..N, ZULKIFLI, A and KAMARUDDIN, A. A. (1999). Barn owl as a biological control agent of rats in paddy fields. In *Symposium on Biological Control in Tropics* (p. 85-88), 18-19 March. Serdang, Malaysia: Mardi Training Centre.

HAFIDZI, M.N. and MOHD. NA'IM. (2003). Prey selection by barn owls in rice fields in Malaysia. In G.R. Singleton, L.A. Hinds, C.J. Krebs and D.M. Spratt (Eds.), Rats, mice and people: rodent biology and management (p. 220-223). *ACIAR Monograph* (96), 220 – 223.

LAM, Y. M. (1983). Reproduction in the rice field rat *Rattus argentiventer. Malay. Nature J., 36,* 249–282.

LEE, C.H. and HO, D.T. (1999). Barn owl – Field biology and rat control. In *Symposium on Biological Control in Tropics* (p. 85-88), 18-19 March. Serdang, Malaysia: Mardi Training Centre.

LENTON, G. M. (1984). The feeding and breeding ecology of barn owl *Tyto alba* in Peninsular Malaysia. *IBIS, 126,* 551-575.

LEUNG, L.K.P., SINGLETON, G.R., SUDARMAJI and RAHMINI. (1999). Ecologically-based population management of rice field-rat in Indonesia. In *Ecologically based rodent management* (p. 305-318).

MARTI, D. E. (1988). A long term study of food niche dynamics in the common barn owl: Comparison within and between population. *Can. J. Zool., 66,* 1803 – 1812.

SHAMSIAH, M. and GOH, N. S. (1991). The use of barn owl *(Tyto alba*) to control rice field-rat. An experience in Seberang Perak. *MAPPS Newsletter, 15(2),* 20.

SMAL, C. M. (1988). Barn owl (*Tyto alba*) for the control of rats in agricultural crops in the tropics. In *Symposium on Biological Control of Pests in Tropical Agricultural Ecosystem* (21 p.), 1-3 June. Bogor. Seameo- Biotrop.

SMAL, C. M. (1990). Research on the use of barn owls *Tyto alba* for biological control of rats in oil palm plantations: 1986 – 1989. In J. Sukaimi, Z. Zawawi, K. Paranjothy, A. Darus, N. Rajanaidu, S.C. Cheah, M.B. Wahid and I.E. Henson (Eds.), *Proc. Intl. Palm Oil Dev. Conf.* (p. 342 – 356), 5 – 9 September 1989. Kuala Lumpur.

WEBSTER, J. A. (1973). Seasonal variation in mammal contents of Barn owl castings. *Bird Study, 20,* 185 – 196.

WOOD, B. J. (1969). Population studies on the Malaysian wood rat *Rattus tiomanicus* in oil palms, demonstrating an effective new control method and assessing some older ones. *Planter, 45,* 510 – 526. Kuala Lumpur.