The feeding preference of sunda scops-owl (*Otus lempiji horsfield*) to bait

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**Abstract.** Oil palm is the most important plantation commodities in Indonesia due to planting area and productivity. There are some constrains faced by oil palm management, one of them is plant pest including insects and rats. Insects and rats have a high reproduction capability and severely damage to oil palm plantation. An effective and environmentally control of these pests using natural enemies, one of them owl. The sunda scops-owl (*Otus lempiji* Horsfield) was tested in the Laboratory of Vertebrate Pest, IPB University using different types of feed, to calculate the level of bait preference. Method used was bi-choice test, comparing the feeding of preference bait between: (a) rat and larvae of beetle, (b) rat and lizard, (c) rat and fish, (d) rat and cricket. Before and after treatment, all baits were weighed to determine the amount consumption and preference to feed. The data showed that the sunda scops-owl consumed rat higher than larvae of beetle, lizard, fish, and cricket, and significantly different.

**Keywords:** bait preference, oil palm, rat, sunda scops-owl.

1. **Introduction**

Indonesia is a country that has abundant natural resources, include the water resource, agriculture, and plantations. At present time, agricultural sector has declined slightly due to the conversion in land functions from agriculture to non-agriculture. Meanwhile, the plantation sector is still developing, one of this is oil palm plantations. Palm oil production is the raw material for making CPO (crude palm oil) which is very much needed in international trade. Indonesian palm oil production has been recognized by several countries in the world. Until 2012, Indonesia was able to become the largest CPO supplier, which was around 14 million tons [3].

The average of CPO production in Indonesia which is 2.99 tons/ha, is still lower than Malaysia. The low of oil palm production is influenced by several factors, one of which is the presence of rat pests (*Rattus tiomanicus* Miller) on the plantation. In oil palm plants that have already been produced, rats eat both young and old palm fruit. In young fruit, the whole part (core and flesh of the fruit) can be eaten by rats [6]. An adult rat is able to consume oil palm fruit between 5.94 g to 13.7 g per day [9]. Based on these data, the total loss of CPO production per year can reach 10% of total production [1].

Appropriate technology is needed to control rats in oil palm plantations. Several methods have been developed to control rats, including sanitation, culture technical (agronomy), physical, mechanical, biological, and chemical cultures. In facts, people prefer the chemical method to kill rats, because the poisons show effective killing power by giving a real rat death [6]. The use of rodenticides to control
rats, sometime not environmentally friendly. One of the control method currently being developed is the use of natural enemies in the form of rat predators, barn/white owl (Tyto alba).

The use of barn owls as natural enemies of rats is highly recommended for controlling rats on plantations. [2] states that the price of cultivated barn owls is relatively expensive, at around three to four hundred thousand rupiah per head. In reality, not all farmers have enough capital to implement this method. Thus, another alternative natural enemy is needed that can be used to control rats. There were several owl species with different families to T. alba (Family Tytonidae), one of them is sunda scops-owl (Otus lempiji), from the Family Strigidae.

Economically, sunda scops-owl (O. lempiji) is cheaper than T. alba because of its smaller body size. Sunda scops-owl is used because of its high population abundance in field/nature [4]. Research on the biology and ecology of sunda scops-owl has not been widely reported, so research on bait preferences of this animal needs to be done.

2. Materials and methods

2.1. Place of research
The research was conducted at the Vertebrate Pest Laboratory, Department of Plant Protection. Faculty of Agriculture, IPB University. Identification of owl species was carried out at the Ornithology (Zoology) Laboratory of the Indonesian Institute of Sciences (LIPI) Bogor.

2.2. Materials and tools
The materials used in this study were sunda scops-owl, white rat, beetle larvae, lizard, fish (tilapia and mas), cricket, grain, and chloroform. The tools used were rat cages, sunda scops-owl cages, bait containers, glasses, spoons, pinset, scales, and iron with hook ends.

2.3. Research methods
Feeding preference test method used bi-choice test, which was testing rats with beetle larvae, rats with lizards, rats with fish, and rats with crickets. The feed was given in abundant quantities (ad libitum). The rats used were white rats (R. norvegicus) instead of tree/wood rats (R. tiomanicus). The white rats used were pre-adult rats with 25-50 g of body weights. The use of beetle larvae and cricket was based on the study of [4] which states that in the field O. lempiji commonly preys on insects such as beetles, cockroaches, grasshoppers, crickets, and also small birds. The use of lizards as one of the bait in this test refers to the research of [5] that states in the field/nature O. lempiji preys on geckos and rats. Availability of geckos in nature is very rare, so the bait used in testing is replaced by lizards. The used of fish in testing was based on water ecosystems that exist in oil palm plantations. The difference in fish species is caused by the availability of tilapia in the market that is less, so the use of carp as a substitute is considered the same as tilapia.

Each treatment was given for seven consecutive days. Before each treatment, sunda scops-owl was adapted in the laboratory for three-days period. During the adaptation period, sunda scops-owl only given rats as a feed standard for owls. In this test a different type of sunda scops-owl was used between the first treatment and the next three treatments. The first treatment used 14 owls while the next three treatments used as much as 12 owls.

2.3.1. Variables observed. The variables observed in this test were the consumption of sunda scops-owl on the feed given during treatment, consumption of sunda scops-owl on rats during the adaptation period, and weight body of sunda scops-owl before and after treatment.

2.3.2. Feed conversion. All data obtained from the test were then converted into 100 g sunda scops-owl body weight, with the following formula:

- Feed conversion = \{(average feed consumed (g) x 100)/average body weight of sunda scops-owl (g)\}
2.3.3. Data analysis. The experimental design used was a completely randomized design with 14 and 12 replications. The test data was processed using the Statistical Analysis System (SAS) program for Windows version 9.0. The further test used Duncan's Multiple Range Test at the level of $\alpha = 5\%$ and $1\%$.

2.3.4. Identification. The process of identifying owls to species level is carried out after all tests are completed and the bird is dead. The four owls identified differ in morphology such as feather color and body length. Identification of owl used [4].

3. Result and discussion

3.1. Owl identification result

The results of the identification showed that the owl was included in the species O. lempiji, which was sunda scops-owl in the Indonesian language. The long of sunda scops-owl about 20 cm, brownish to grey colour. The earpiece is long and clear, it has a collar behind the pale neck. The lower body is brighter (brown or light gray), there are dark spots in the form of arrows or parallelogram. According to [4] sunda scops-owl is an owl that has very varied feathers and may also vary individually in the population.

3.2. Testing on the feeding preference of sunda scops-owl

The average consumption of sunda scops-owl on rats and comparative baits could be seen in Table 1. There were four treatments with different baits. At the first treatment, the sunda scops-owl fed rat with beetle larvae. The ability of owl to consume rat (29.68 g) was higher and significantly different to the consumption of beetle larvae (0.84 g) ($\alpha = 5\%$ and $1\%$). This was because the sunda scops-owl is a type of meat-eating bird, while the beetle larvae are small and generally live on the ground, although sometimes they lived in the surface of the ground. In addition, the sunda scops-owl used more sharp vision in capturing prey. The beetle larvae are smaller than rats, so the sunda scops-owl is more interested in consuming rats than beetle larvae.

| Table 1. Average consumption (g/100 g body weight) sunda scops-owl on rat and comparative bait* |
|---------------------------------------------------------------|
| Comparative bait                                             | Consumption of baits |
|                                                               | Beetle larvae | Lizard | Fish  | Cricket |
| Rat                                                           | 29.68 aA      | 23.51 aA | 31.34 aA | 20.21 aA |

Notes: *the number in the same column followed by different letters showed significantly different at the level of $\alpha = 5\%$ (lowercase) and $1\%$ (uppercase) based on Duncan's Multiple Range Test (DMRT).

Initially 20 heads of sunda scops-owl were used, but at the beginning of the treatment of rat with lizard, eight sunda scops-owls dead. Thus, only 12 owls were used in the second, third, and fourth treatments. Because of the proper data, among 20 owls at the first treatment, only 14 owls continued to be analyzed. The second treatment was giving rat feed with lizard. The data showed that the average consumption of sunda scops-owl to rat (23.51 g) was higher and differed significantly compared to its consumption to lizard (2.98 g). When this treatment was running, eight sunda scops-owl was dead, possibly consuming the poison inside the body of lizard. Lizard poison’s cause consumption of sunda scops-owl on this bait was very small. Consumption of sunda scops-owl on lizard was relatively small (1,405 g) and significantly different compared to the consumption of rat (16,749 g) ($\alpha = 5\%$ and $1\%$). Sunda scops-owls that survive consumed more lizard (2.98 g), but have not dead. This is due to the
different conditions of each sunda scops-owl. The dead of sunda scops-owl could not adapt well to the new condition at cages in the laboratory. Sunda scops-owl that survived have a good adaptability.

The third treatment was giving rat with fish as a sunda scops-owl bait. Data analysis showed that the average consumption of sunda scops-owl on rat (31.34 g). It was higher and significantly different to the consumption of fish (9.80 g) (α = 5% and 1%). Based on [4] the sunda scops-owl used to live in the forest, plantations, and even in the large cities that have trees. Some of these places have water ecosystems such as rivers, lakes, ponds, and so on. Therefore, in nature sunda scops-owl recognized fish as its prey. Owls can also catch fish on the surface of the water. This was supported by the sensation of sunda scops-owl vision which can see prey from a great distance and strong grip on both feet.

Data analysis for the fourth treatment showed that consumption of the sunda scops-owl on rats was significantly different from crickets (α = 5% and 1%). The sunda scops-owl consumed large amounts of rat (20.21 g) compared to cricket (6.24 g). In nature, crickets are insect that are included in the type of feed eaten by sunda scops-owl [4].

In general, all of the bi-choice test treatments showed that the sunda scops-owl consumed rat higher and significantly different with other baits. Average consumption of baits at treatment and adaptation period showed in Table 2. Comparison of the consumption of rat with other baits and rat during adaptation in the three treatments showed significantly different results (α = 5% and 1%). Consumption of rats during the adaptation period after lizard treatment (33.05 g) was higher than the combined rats and lizards during treatment (26.49 g). The consumption of rat during adaptation after the treatment of fish (27.61 g) was lower than the combined rat with fish (41.13 g). The consumption of rat during the adaptation period after cricket treatment (20.33 g) was lower than the combined rat with cricket (26.45 g).

Table 2. Average consumption (g/100 g of body weight) of sunda scops-owl to baits at treatment and adaptation period

| Treatment | Comparative Baits |  |  |
| --- | --- | --- | --- |
|  | Lizard | Fish | Cricket |
| Rat plus comparative baits (treatment) | 26.49 bB | 41.13 aA | 26.45 aA |
| Rat (adaptation period) | 33.05 aA | 27.61 bB | 20.33 bB |

Notes: *the number in the same column followed by different letters showed significantly different at the level of α = 5% (lowercase) and 1% (uppercase) based on Duncan's Multiple Range Test (DMRT).

The lower consumption of sunda scops-owls to rat plus lizard was due to the toxic effects possessed by lizard, so their appetite decreased. In contrast with the consumption of sunda scops-owls to rat plus fish and rat plus cricket. Both treatments showed no toxic effect of fish and cricket, then the consumption of sunda scops-owls higher than rat during adaptation period.

Results of study from [8] showed that fish and cricket were among the eight flavored animals that could improve the ability of rat to consume bait in the laboratory. Based on this research, the possibility of sunda scops-owl was tested. The consumption of owl to bait is higher because of the presence of fish or cricket that act as flavoring agent. Another factor that affects was the fishy aroma, so the consumption of sunda scops-owl to rat and fish is higher than other bait.

The high level of preference to rat in sunda scops-owl is expected to control rat in the field/nature (oil palm plantations), especially subadult rat. [5] states that O. lempiji likes geckos, insects, and rat as prey. In addition, there is still a large population of owl, including on Java island. According to the Attachment of Republik Indonesia Government Regulation No. 7 year 1999, the family of the sunda scops-owl (Family Strigidae) was not included in the type of owl protected by the government. Therefore, the use of sunda scops-owl as natural enemies in the field needs to be further studied on their
effectiveness as barn owl (T. alba). If the use in the field is effective and the breeding can be running well, then the sunda scops-owl can be used as an alternative biological control.

3.3. Changing the body weight of sunda scops-owl
The mean body weight changes in sunda scops-owl, before and after treatment showed in Table 3. The data showed that there was an increased in the weight of the sunda scops-owl due to consuming of the feed. The treatment of rat and beetle larvae showed a low increased (4.57 g), whereas in the treatment of rat with lizard, fish, and cricket showed a high increased (18.92 g). This was because in the first body weight change only one treatment, while the second there were three treatments in a row.

| Treatment                  | Body weight of sunda scops-owl (g) | Differences |
|----------------------------|-----------------------------------|-------------|
| Rat with beetle larvae     | 95.04                             | + 4.57      |
| Rat with lizard, fish, and cricket | 90.54                             | + 18.92     |

The increased of body weight in sunda scops-owl occured when giving rat feed with fish, because the consumption at that treatment was the highest. The lowest change occurred after the treatment of rat with lizard, because the influence of poison which were eaten by sunda scops-owl resulted the decreasing in the consumption of rats.

4. Conclusion
The sunda scops-owl (O. lempiji) which was tested with several bait choices, compared with rat showed significantly different results. The sunda scops-owl preferred rat as a bait/prey compare to another bait/prey (beetle larvae, lizard, fish, and cricket). Feeds other than rat that contain poison could reduce the appetite of sunda scops-owl to rat. The amount of bait consumption by the sunda scops-owl was directly linear to the body weight.

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