The porcupines, the common bamboo rat, squirrels and the tree-shrew as secondary pests of agriculture in Malaysia

The secondary pests of agriculture are components of our wildlife heritage that feed on crop plants intermittently and rarely cause serious damage.

By B.L. Lim

The secondary pests of agriculture are intermittent or temporary visitors to crop fields from which they obtain food opportunistically. Unlike the primary pests that are well-adapted permanent residents of crop habitats, the secondary pests cause relatively little damage and deserve to be protected as part of our natural heritage.

The secondary mammalian pests in Malaysia include porcupines (Family *Hystricidae*), squirrels (Fam. *Sciuridae*), and the common bamboo rat (Fam. *Spalacidae*), all belonging to the Order Rodentia, and the common tree-shrew (Fam. *Tupaiidae*) belonging to the Order Scandentia.

In this account, the following abbreviations are used: HB = head plus body; HF = hind foot; T = tail; Wt = weight; DWNP = Department of Wildlife and National Parks, Malaysia; IMR = Institute for Medical Research, Malaysia.

Common porcupine *(Hystrix brachyura)*

The common porcupine is the largest and commonest porcupine, with HB 550–750 mm, T 60–110 mm, HF 80–100 mm, Wt 5–8 kg. Generally dark brown, covered with banded black and white stiff short and long spines. Those at the back are long (about 150–200 mm). The tail is short and bears short goblet-shaped spines

Common porcupine (*Hystrix brachyura*).

that rattle when the tail is shaken. The tail is usually carried almost upright, so that the animal appears to have no tail. The popular belief that the quills can be discharged like arrows can be disregarded. Quills damaged in action or other causes are regrown. Mammae 4.

Distribution and conservation status: This species occurs from NE India through Myanmar, Thailand, Vietnam, Laos and Cambodia to South and Central China. It occurs throughout the Malay Peninsula to Singapore, and also in Borneo, Sumatra and Java. The species is not currently at risk (DWNP 2000.

Ecology: Nocturnal and terrestrial. Natural diet of fallen fruits, especially durians, pineapples, roots and tubers. A lowland and hill resident and

non-habitat-specific, ranging from cultivated areas and forest fringes to secondary and primary forests, where it makes extensive burrows. It also nests in crevices of large boulders, and in small caves in forested areas. The large incisor teeth and powerful jaw muscles need something to gnaw at. Bones of dead animals and even tusks of dead elephants are known to be destroyed by this porcupine to get at the marrow and at the pulp of the tusk. When confronted, it rattles its tail, raises its quills and charges backwards towards its predator's sensitive nose. The bunch of approaching sharp quills is enough to deter predators.

In the early 1950's, our IMR field team in Sungei Buloh Forest reserve that was collecting small animals for bio-medical study found a freshly dead python (*Python reticulatus*). During post-mortem, a common porcupine of 320 grams was recovered in the treachea organ of the snake. The organ was badly damaged by the quills of the porcupine that it had swallowed. In India, R. C. Morris has recorded a panther slain by the porcupine *Hystrix indica*, (which is about two times larger than *H. brachyura*), its head pierced by the porcupine quills. There is also a record of a young adult tiger found dead with its lung and liver riddled with porcupine quills.

The common porcupine is a minor pest of oil palm, rubber, and pineapple plantations, and also of fruit orchards and a range of other crops like tapioca, melon, sweet potatoes and vegetables.

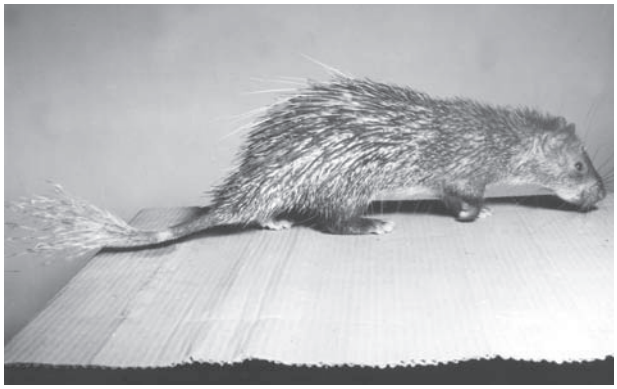
Reproduction capacity: The normal litter is one (seven instances), but twins (two instances) have been recorded in mainland Peninsular Malaysia. In the islands of Pulau Tioman and Pulau Langkawi, a single young (three instances) and twins (four instances) have been recorded.

Brush-tailed porcupine *(Atherurus macrourus)*

The brush-tailed porcupine is about half the size of the common porcupine, with measurements of HB 360–550 mm, T 130–240 mm, HF 60–75 MM, Wt 2–3.5 kg. The quills of this species are flattened and very much shorter than those of the common porcupine. The tail is long and conspicuous and ends in a tuft of hairs shaped like a string of beads, not globular like the common porcupine. The general colour is grayish brown on the back with the belly whitish. Mammae 4.

Distribution and status: East India to South China, including Myanmar, Thailand, Laos, Vietnam, Cambodia, Peninsular Malaysia and Indonesia (Sumatra), Not currently at risk (DWNP 2010).

Ecology and habitat: This species is common, nocturnal and terrestrial, occurring in forests and plantations. The emergence of this animal, originally a forest inhabitant, into plantation habitats coincided with deforestation during the 1960's. Individuals occasionally intrude into



Brush-tailed porcupine (*Atherurus macrourus*).

orchards and vegetable farms adjacent to human dwellings resulting in some being caught inside farm houses. Its nesting habit, though not as extensive, is similar to the common porcupine. In the forest, its burrows are made in the stumps of large trees and crevices of rocky boulders. In oil palm plantations, it burrows under the heaps of cut palm leaves placed on the ground. It eats roots, tubers, fruits and cultivated crops. Like all rodent species it has the habit of gnawing on tree barks and fallen tree stumps.

Reproduction capacity: The normal litter is of two young (eleven instances) recorded in the mainland of Peninsular Malaysia, while one to three young (mean of two) have been recorded from specimens examined in Pulau Tioman.

Long-tailed porcupine (*Trichys fasciculata*)

This animal will at first be mistaken for a giant rat. It differs from the previous two species of porcupines by having a long and scaly tail with a tuft of flattened hairs at the tip. The quills on the body are short, about 5 cm, and flat. The general colour is brown with a paler belly. It is the smallest porcupine, with HB 325– 450 mm, T 150–250 mm, HF 55–65 mm, Wt 1–2.5 kg. Mammae 4.

Distribution and conservation status: Malaysia and Indonesia. The type specimen is from Malacca. Vulnerable (DWNP 2010).

Ecology and habitat: Nocturnal, terrestrial. This species was once thought to be rare in the Malay Peninsula, with only a few individuals caught in primary and hill forests. With deforestation during the 1960's onwards, the animals have become fairly common in secondary forests, forest fringes, peat swamp forests and cultivated areas, particularly oil palm plantations adjacent to forests. Unlike the common and brush-tailed porcupines, which make extensive burrows, this animal has been more commonly found in hollows of large stumps of fallen trees, crevices in rock boulders and in termite hills. It feeds on large seeds and fruits of trees, and oil palm seeds dropped on the ground. Also on bamboos and fallen tree shoots. It also has a habit of gnawing on tree stumps. Farmers claim to have trapped this animal in rice fields, based on which its local name *landak padi* (paddy porcupine) is derived, but we have yet to trap one in rice fields to date.

Common bamboo rat (*Rhizomys sumatrensis*)

A very large rat with HB 270–480 mm, T 85–100 mm, HF 50–60 mm, Wt up to 2 kg. This rat is easily recognized by its thick heavy body, short naked tail, stout digging claws on short legs and a large head with huge incisor teeth. The fur on the upper part of the body is grayish white, dark on top of the head, with contrasting buff patches on the cheek and throat. Belly is whitish. Mammae 10.

Common bamboo rat *(Rhizomys sumatrensis)*.

Distribution and conservation status: Myanmar, Thailand, Laos, Vietnam, Cambodia, S. China, Peninsular Malaysia and Indonesia (Sumatra) and. Totally protected (DWNP 2010).

Ecology and habits: Nocturnal and terrestrial. In Peninsular Malaysia, the habitat of this animal is associated with bamboos, usually in disturbed or secondary forests. It digs extensive burrows with several outlets under large clumps of forest bamboos. These outlet holes serve as escape routes whenever the main burrow is disturbed. It remains underground by day, but comes out at night and roams widely in the forest and adjacent rubber and oil palm estates and cultivated fields of tapioca, maize, and sweet-potato. Bamboo roots are its natural diet in the forest, but wandering individuals can cause serious damage to tapioca plants, sweet potatoes and seedlings of oil palm and rubber. A few individuals can damage a few hundred newly planted oil palm or rubber trees in one night. Captive individuals can thrive for years on mixed starchy roots (sweet potatoes, tapioca, sugar cane, bamboo shoots etc.), supplemented with fruits (apples, oranges etc.), and large bones of cattle for grinding down its incisors.

The common bamboo rat is by nature a docile animal, easily tamed in captivity despite its threatening attitude. When confronted, its raises its head with mouth agape, and makes a kind of barking grunt. Such display is only momentary and the animal will quickly tone down. Tamed individuals can be docile, friendly and will accept food out of one's hand. The bamboo rat is hunted for food by humans as well as by wild cats and other forest predators. The animal is only an incidental agricultural pest.

Reproduction capacity: During the period 1950–1970, three out of 10 animals from forest reserves (Ulu Langat, Ulu Gombak, and Kepong) were trapped pregnant. The litter size was 2–4, mean of 2. A Mr. C. S. Ogilvie, sometime Superintendant of the King George V National park (now Taman Negara) kept one female that gave birth to five young. Gestation period estimated at not less than 22 days. The young are born hairless with eyes closed. At 12 –13 days, hair grew, and the incisor teeth were already noticeable; at 24 days, eyes opened; at 29 days they first attempted solid food. But at three months they were still suckling occasionally, and by the fourth month they were completely weaned. In the IMR, one specimen lived up to 4 years 8 months in captivity.

Common plantain squirrel (*Callosciurus notatus*)

A medium-sized squirrel with Hb 150 - 200 mm, T. 160–210 mm, HF 40–53 mm, Wt. 150–250 gms. Body reddish brown. Tail brown with the tip pale red or chesnut red. The belly is red, with a prominent black stripe on each side. Mammae 6.

Distribution and status: Thailand, Malaysia and other SE Asian countries including Singapore and Indonesia (Sumatra, Java). Not at risk (DWNP 2010).

Ecology and habitat: Diurnal. The species is non-habitat-specific. It is not only common in forests at all elevations, but is also well-adapted to cultivated vegetation, gardens and towns. It is an under-storey dweller in forested areas, and is semi-arboreal in habit. In plantations and in towns, it is strictly arboreal, descending to the

Common plantain squirrel (*Callosciurus notatus*).

ground to cross gaps in the tree canopy. The nest is usually built with twigs and leaves, spherical in shape and placed in the upper branches of large bushes or small trees. It makes a shrill whistling chirp, followed by loud startling chatter in the presence of humans or predators. Its natural diet consists of fruits and insects with the latter constituting nearly half the stomach contents. In oil palm plantations, it can be a rather severe pest, next to rats.

Reproductive capacity: During the period 1950–1955, 108 pregnant females were recorded throughout the year in various forest reserves in Selangor, most frequently during April-June (60.2%), least in October-December (39.8%). New born are hairless, and their eyes are closed. Maximum recorded life span in captivity at the IMR was 4 years 6 months.

Grey-bellied squirrel (*Callosciurus caniceps*)
This squirrel is slightly larger and more stoutly built than the common plantain squirrel. Measurements HB 160–230 mm, T 150–230 mm, HF 45–50 mm, Wt 160-300 gm. The upper part of the body and tail are uniform speckled olive brown. Belly grey without stripes on the flanks. Mammae 6.

Distribution and status: Myanmar, Thailand, Laos and Peninsular Malaysia. It does not occur in the south of Johor or in Singapore. Currently not at risk (DWNP 2010).

Ecology and habitat: Diurnal and arboreal. This species was primarily a lowland and hill forest

Grey-bellied squirrel (*Callosciurus caniceps*).

resident at elevations up to 1500 m. Deforestation was the main factor driving its emergence into more open habitats, resulting in the animal getting adapted to cultivated land (rubber, oil palm, coconut plantations), also occasionally to gardens around human habitations. The most conspicuous characteristic feature is its alarm note, a loud harsh staccato *tak, tak tak,* quick at first and then slower by the increase in the pause-period between each *tak*. The nest is built at fork-branches of tall trees in the upper storey in the forest, on oil palm trees in oil palm plantations and in the forks of branches in rubber plantations. The nest is large and oval in shape. Though said to be primarily arboreal, trapping results have indicated otherwise; the animal is mostly trapped on the forest floor. The natural diet is similar to that of the common plantain squirrel. In captivity, it survives on all kinds of fruits, local and foreign, supplemented by grasshoppers, and may live for 2–3 years.

Reproductive capacity: In forest reserves in Selangor and Pahang, pregnant females have been caught in most months of the year through 1950–1970. Litter size 1–5, mean 2.4 (48 instances). The young are born hairless and blind. Lifespan in captivity at the IMR was 4 years 6 months.

Slender squirrel (*Sundasciurus tenuis*)

A slender small-sized squirrel with HB 90–130 mm, T 80–120 mm, HF 28–35 mm, Wt 50–100 gm. Back olive brown, eyelids with a crescentic buff ring round the eye. Belly brown grey, not clearly demarcated. Face profile slightly turned up. Tail thin covered with short hairs. Mammae 6.

Slender squirrel (*Sundasciurus tenuis*).

Distribution and status: Throughout Southeast Asia, including Thailand, Malaysia, Singapore, Indonesia (Sumatra). Currently not at risk (DWNP 2010).

Ecology and habitat: Diurnal and arboreal. This squirrel occurs in the middle and upper storeys of primary and secondary forests, from lowlands up to about 1500 m elevation; also in forest fringes, scrub and plantations. It usually moves in pairs or in groups of 4–5 individuals and the movements are generally very quick and darting. Its presence in the vicinity is indicated by its alarm call, a bird-like chirp. Though primarily arboreal by nature it also descends to the ground in search of food. Its natural diet consists of fruits and other vegetable material, and insects. Insects constitute one-quarter to half of its stomach contents.

Reproductive capacity: Normal litter size of 2 embryos (12 instances) were recorded in the mainland and 2 - 4, mean 2.3 (5 instances at Pulau Tioman).

Common tree-shrew (*Tupaia glis*)

The common tree-shrew (*Tupaia glis*), a medium-sized animal with HB 125–200 mm, T 115–195 mm, HF 38–45 mm, Wt. 80–180 g, has a characteristic longish snout in contrast to the short muzzle of the squirrels. The hairs of the upper part of the body, short and smooth, are reddish to grizzled brown, and with a buffy belly. The yellowish stripe on each side of the shoulder and the brownish hairy tail distinguish it from other tree-shrew species. Mammae 6.

Distribution and status: Burma to Sumatra, Java and Palawan. It is widely distributed throughout Malaysia with the exception of Sabah. It is currently listed as totally protected although it is quite common and adaptable.

Ecology and habitat: Diurnal, semi-arboreal. Non-habitat-specific, found in all kinds of forests, lowland to sub-montane up to 1100 m. Due to deforestation since the 1950, the species is now found in bush and woodlands as well as urban and suburban areas. Usually solitary, but at times two to three are observed running about in gardens with occasional visits into houses.

Its natural diet is very mixed, including ants and other arthropods, and fruits, seeds and buds. It has the habit of stripping the bark of seeding plants in search of insects. Stomach contents (45 instances) revealed plenty of insect particles, greenish matter and remains of snail shells, tiny vertebrate animals such as small lizards, and

Common tree-shrew (*Tupaia glis*).

sucklings of rats. Captive individuals thrive well on grass-hoppers, mealworm and fruit, supplemented with occasional sucklings of laboratory rats or mice.

The nest is built in holes of fallen logs and tree trunks, and in rocky boulders. It is very active, noisy and aggressive, spending most of its time on the ground among roots of trees, and in brushwood or low bushes in the under-storey of the forest. It is also able to climb freely up large trunks. It makes a variety of short squeaks, including a single high pitched 'cherr' as an alarm note. A continuous chattering 'cherr' is a territorial warning call against intruders, and a soft and cooing note is to attract its mate nearby.

The species is a pest in orchard and cocoa plantations. In cocoa plantations, it makes a small hole on the fruit which attracts insects. A day later, on its revisit, besides searching for insects in the fruit, it also drinks the fermented juice. The cocoa fruit is totally damaged by this and by follow-up pests such as the common plantain squirrel and rats.

Reproductive capacity: In Selangor, in a marked-capture-release study (1953–1955) of this species, pregnant females were trapped at all months of the year. Higher frequencies (48 instances) were found during April-June with a lower one (17 instances) in October-December. A breeding study by J. R. Hendrickson revealed a gestation period of 46–50 days. Litter size 1 - 3, mean 2.0 (16 instances). The young are born hairless and with eyes closed. One captured female gave birth to 3 young in the trap, and was successfully reared in captivity with the mother. Hairs began to grow on the sixth day and the young left the nest at 33 days. The mother died after two months, but the young were raised up to 3 and a half months. I was not able to tame them and released them to the forest.

Uses in food and folk medicine: All the rodent species in the families Hystricidae, Sciuridae and Rhizomidae have been used as food. Some people believe that wild animal meat contains aphrodisiac properties for men. The penis of the tree squirrels, after preparation by aboriginal *orang asli* medicinal elders, is sought by those who claim that when embedded into the thigh skin, it is more effective than viagra for strengthening the sexual urge.

Tumor growth among animals is common. In rats, such growths in the walls of intestines are small and soft, but larger harder structures are also present. In humans such growths are known as "polyps" and are found in the intestines; the larger ones might be cancerous.

In the case of the porcupines, very rare calcified stones may occur in the large intestines. The calcified stone probably incorporates hair particles and food material (bones, tree bark, roots of plants etc.). It is believed, particularly by the Chinese, that these stones have highly potent medicinal properties, for curing terminal cancer and other illnesses. Because of its rarity, this stone is worth a fortune. Just a gram in powder form can fetch up to a thousand or more Malaysian ringgit in the market. According to the orang asli and other collectors of this stone, it is only found in the common porcupine (*Hystrix brachyura*).

Parasites of medical importance: Unlike the house and field rats which are reservoirs and carrier hosts of zoonotic diseases, none of the six species of rodents (porcupines, squirrels, bamboo rat) nor the treeshrew have been implicated. However, most of the specimens examined were found to carry ectoparasites. The ectoparasites were ticks, fleas, chigger mites and nematodes. Ticks (*Dermancentor atrosignatus, D. auratus, D. limbooliati, Amblyomma testudinarium* and *Dermancentor* sp.) were common on the two species of porcupines. Fleas (*Stivalius cognatus, Xenopsylla choepis*) were found on the common plantain and grey-bellied squirrels and the tick (*Hoemaphysalis nadchatram*) on the slender squirrel. Ticks (*Dermacentor* sp., *Amblyomma* sp., *Ixodes granulatus* and chigger mites *Leptotro.mbidum delience*) were recovered from tree-shrews. The few common bamboo rats examined were all free of ectoparasites.

The helminth parasites recovered from some of the squirrels and the tree-shrew were nematodes (*Nippostrongylus braziliensis*, *Trichuris ratti*), trematodes (*Lipertrema vitellariolateraliss*, *Achillurbaianus ratti*) and cestodes (*Hymenolepis diminuta, Taenia taeniaformis*).

None of these helminth parasites are of public health importance. However, most ectoparasites are potential carries of diseases. Ticks have been associated with viral diseases, fleas with plague and chiggers with rickettsial diseases.

The common plantain squirrel and the grey-bellied squirrel are presently very common in plantations of rubber, coconut, oil palms, durian and other fruits. The common and brush-tailed porcupines are more conservative and intrude only into plantations adjacent to forest areas. The species that is most adaptable is the tree-shrew in Peninsular Malaysia. This species, though common in forest areas has now established in towns and cities.

The secondary pests in this account are good examples of how small vertebrate species are being forced to migrate into man-made environments. The damage done to crops by these secondary pests, is not as great as the damage caused by primary pests such as house and field rats. The lower rate of destruction by the secondary pest species may be due to their low reproductive rates compared to primary pests. However, the situation may change as the animals continue to evolve in response to changes in the environment. Continued research is needed to monitor such changes.

Key to the identification of secondary pest mammals

1. Body hairs modified into spines or quills ……2
   Body hairs normal, soft and smooth ……4

2. Large animals with HB>500mm, the quills on the body banded black and white ……..…….. common porcupine, *Hystrix brachyura*.
   Smaller animals, with HB < 500mm. The quills on the body flattened and short ……..… 3

3. Tail about one-third of HB length, bearing a cluster of modified quills along the tip of the tail ……..brush-tailed porcupine, *Atherurus macrourus*.
   Tail half of HB length or longer, terminating in a tuft of long stiff hairs at the tip of the tail ……..…… long-tailed porcupine, *Trychys fasciculata*.

4. Tail short and naked, head large with huge incisors, general colour grayish white ……..…… ..... common bamboo rat, *Rhizomys sumatrensis*.
   Tail long and hairy, general colour brownish ...……...……...5

5. Nostril elongated; general colour reddish to grizzled brown ……..……..... ..... common tree-shrew, *Tupaia glis*.
   Nostril not elongated ……..…….....……6

6. Small-sized, with HB < 130mm, HF > 35mm. General colour olive brown; tail thin, covered with short hairs .....…..……. slender tree-squirrel, *Sundasciurus tenuis*.
   Larger sized, with HB > 140mm, HF > 40mm …….....……..……..7

7. Belly reddish with a prominent black stripe on each side. Tip of tail pale red or chesnut red …… common plantain tree-squirrel, *Callosciurus notatus*.
   Belly, body and tail uniformly grayish…….....…….
   …….....…….. grey-bellied tree squirrel, *Callosciurus caniceps*.

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