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# PELLET-CASTING BY NON-RAPTORIAL BIRDS OF SINGAPORE

**L. K. Wang**, **M. Chan**, **Y. M. Chan**, **G. C. Tan** and **Y. C. Wee***
*Bird Ecology Study Group, Nature Society (Singapore)*
*39 Sian Tuan Avenue, Singapore 588313, Republic of Singapore*
(**Corresponding author: wee37@starhub.net.sg*)

## INTRODUCTION

Pellet-casting is well known in raptors and owls. These carnivorous birds consume the flesh together with bones, teeth, fur, feathers, and other indigestible parts of their prey. The flesh is easily digested but the harder parts are compacted in the gizzard into a pellet. After a short period of time when the flesh is digested, the pellet is regurgitated. The shape of the pellet may reflect the inner shape of the bird's gizzard (Below, 1979). The composition of the pellet depends entirely on the diet of the bird.

Local birdwatchers are well-acquainted with pellet-casting by raptors and owls. However, until a few years ago, few were aware that many other birds also cast pellets. Then, one of us (YCW) noticed a bee-eater perching on a television antenna atop a house retching. Later, a small, dry pellet was found on the ground some distance away (Figs. 1, 2). The composition of this pellet did not point to a bee-eater, being mostly fibres, and devoid of insect exoskeletons. However, the possibility of the bee-eater casting a pellet was raised in a weblog (YC, 2006).

Pellet-casting of non-raptorial birds was, until recently, not reported by local birdwatchers. The probable reasons for this are discussed in Wee (2006), and Wee & Tsang (2008). Stalking a bird after it has eaten and waiting for it to regurgitate a pellet takes time and patience. Many birdwatchers seem satisfied merely in the identification of birds.

This article compiles observations of pellet-casting in various groups of non-raptorial birds in Singapore. Hopefully, this will raise awareness among local naturalists of this interesting, yet little-known behaviour, and urge them to report such observations in the future.

## OBSERVATIONS

***Strigidae (Typical Owls).*** **–** Owls feed on a wide variety of vertebrates and invertebrates and much of the information of their food habits has come from examination of their pellets (Marks et al., 1999). These birds have no crop to hold food

Fig. 1. A dry pellet ejected by an unknown bird. Scale is in 1 mm intervals. (Photograph by: Y. C. Wee).

Fig. 2. The pellet soaked and dissected, showing the dominance of plant fibres. (Photograph by: Y. C. Wee).

Fig. 3. A spotted wood owl (*Strix seloputo*) resting during the day. (Photograph by: Chan Yoke Meng).

for later consumption. When a prey is caught, it is swallowed whole and channeled directly to the gizzard where the digestive fluids act on the soft tissues (Long, 1998). The hard, undigested materials, often more or less intact, are compacted into a pellet. This pellet varies in size and shape, depending of the species of owl and the animals they eat. Normally, a pellet forms a few hours after a meal. It then travels from the gizzard into a space above known as the proventriculus, where it is stored for a few hours. However, the pellet has to be ejected before the owl can swallow new food.

A number of pellets were collected below the roost of a juvenile spotted wood owl (*Strix seloputo*) in Aug.2007 at Sentosa (Fig. 3). These pellets were light brown when fresh, consisting of fur mainly. Dark beetle elytra can be clearly seen in Fig. 4 while in Fig. 5, pieces of white bones are prominent. The pellets measure 4–5 by 3–4 mm and had a distinct odour, probably an indication that decomposition had set in. Figure 6 is a collection of small mammalian bones from a number of pellets.

Fig. 4. A pellet of the spotted wood owl below the roost. (Photograph by: Chan Yoke Meng).

Fig. 5. Compacted pellet with white mammalian bones. Scale in 1 mm intervals. (Photograph by: Y. C. Wee).

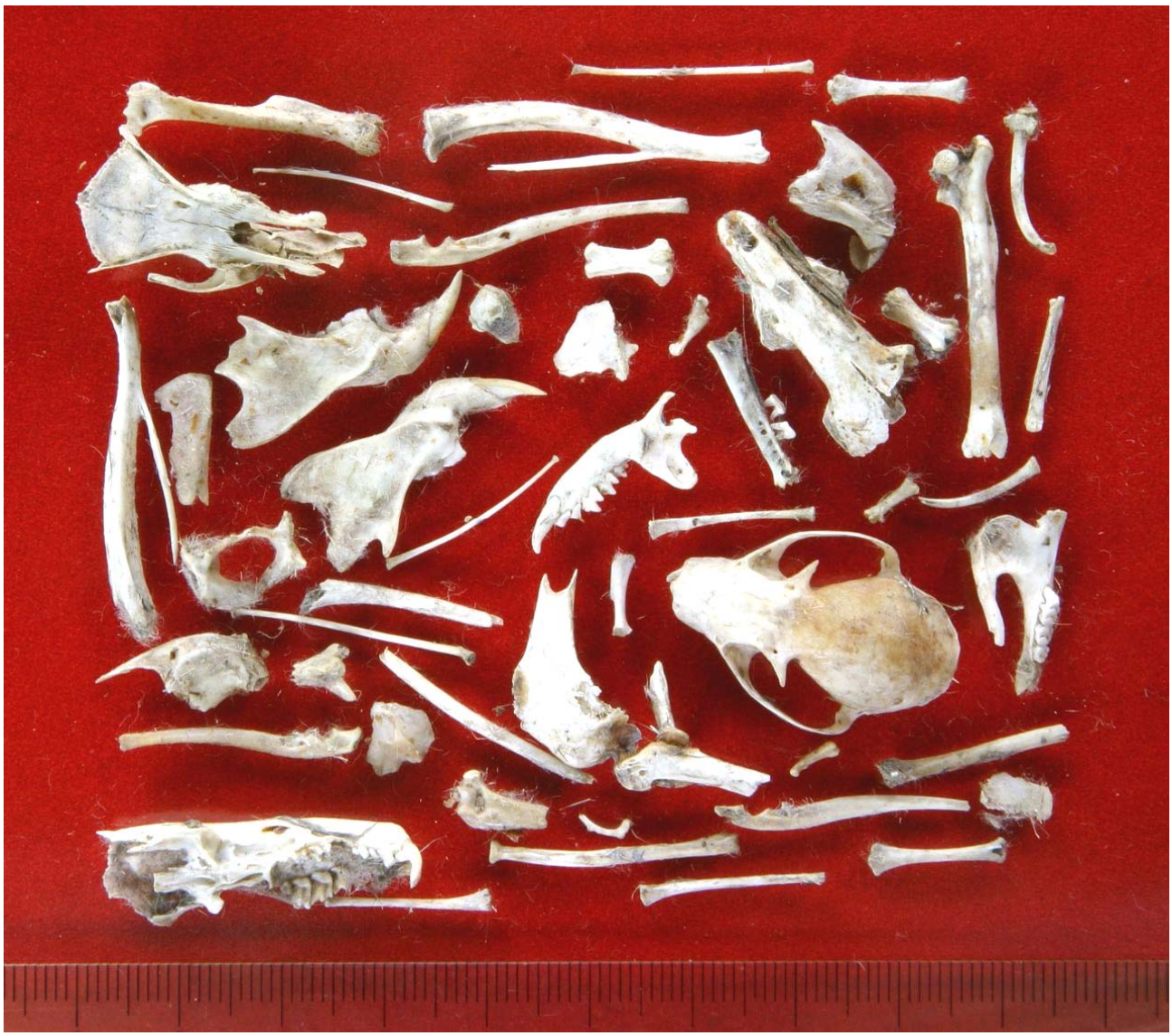

Fig. 6. Bones from a number of pellets collected below the roost of a spotted wood owl on display. Scale in 1 mm intervals. (Photograph by: Y. C. Wee).

***Alcedinidae (Kingfishers).*** **–** Kingfishers do not eat fish exclusively. In fact, many species take other small animals such as insects, molluscs, crustaceans, and amphibians, even an occasional bird or reptile (Woodall, 2001). These birds regularly cast pellets of compacted bones and insect exoskeletons. However, young fledglings when fed whole fish, digest the bones and scales (Evans & Heiser, 2004). As the fledgling grows and the flight feathers are fully formed, there is less demand for extra calcium and other related minerals. It is only then that the young bird starts casting pellets.

Two species have been recorded casting pellets. The first is the common kingfisher (*Alcedo atthis*), observed around urban gardens, parks and open areas (Fig. 7). The rather large pellet ejected is white, indicating the fish bones the bird ate earlier. Closer examination of the image shows small pieces of white debris at the back of the bird's head, pieces that were not totally compacted to the main pellet.

The second example is the ruddy kingfisher (*Halcyon coromanda*), an uncommon passage migrant and winter visitor. Towards the end of Oct.2006, this bird made a brief appearance of a few days at Jurong, near the Chinese Garden. Photographers and birders alike flocked to get a glimpse and/or to take pictures of this rare bird. The bird had just taken a terrestrial snail and was perching with the prey in its bill. It smashed the snail against the perch to break the shell before swallowing the soft body (Fig. 8). About an hour later, after most of the crowd had moved away, the ruddy kingfisher made a retching action. Then the bill widened substantially to show the large gape and equally large opening into the throat (Fig. 9). At the same time the body bent forward and a pellet was expelled. The pellet ended in the undergrowth below the tree and could not be found. Closer examination of Fig. 9 shows a dark object in the throat that was about to be ejected. The darkness of the pellet is probably owed to pieces of shell that were swallowed.

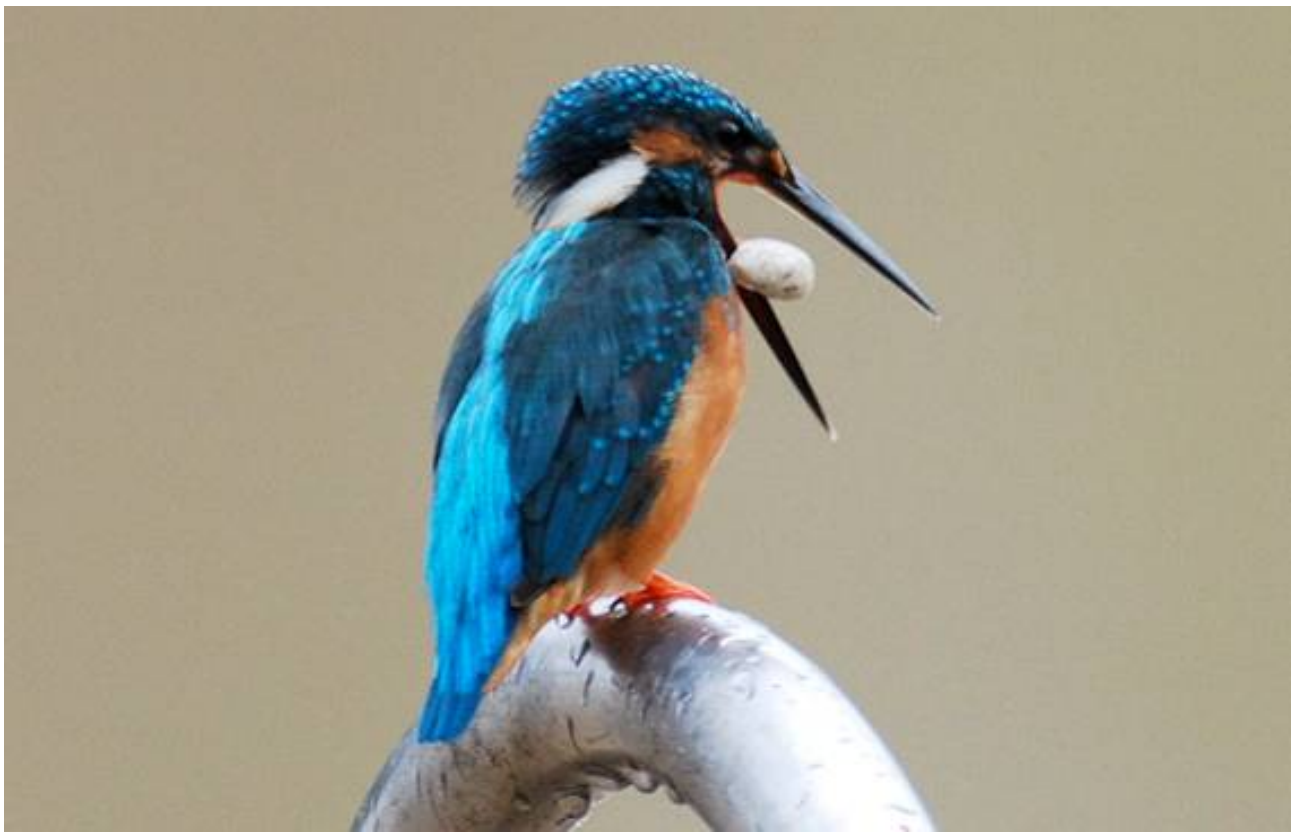

Fig. 7. A common kingfisher (*Alcedo atthis*) casting a large white pellet. (Photograph by: Tan Gim Cheong).

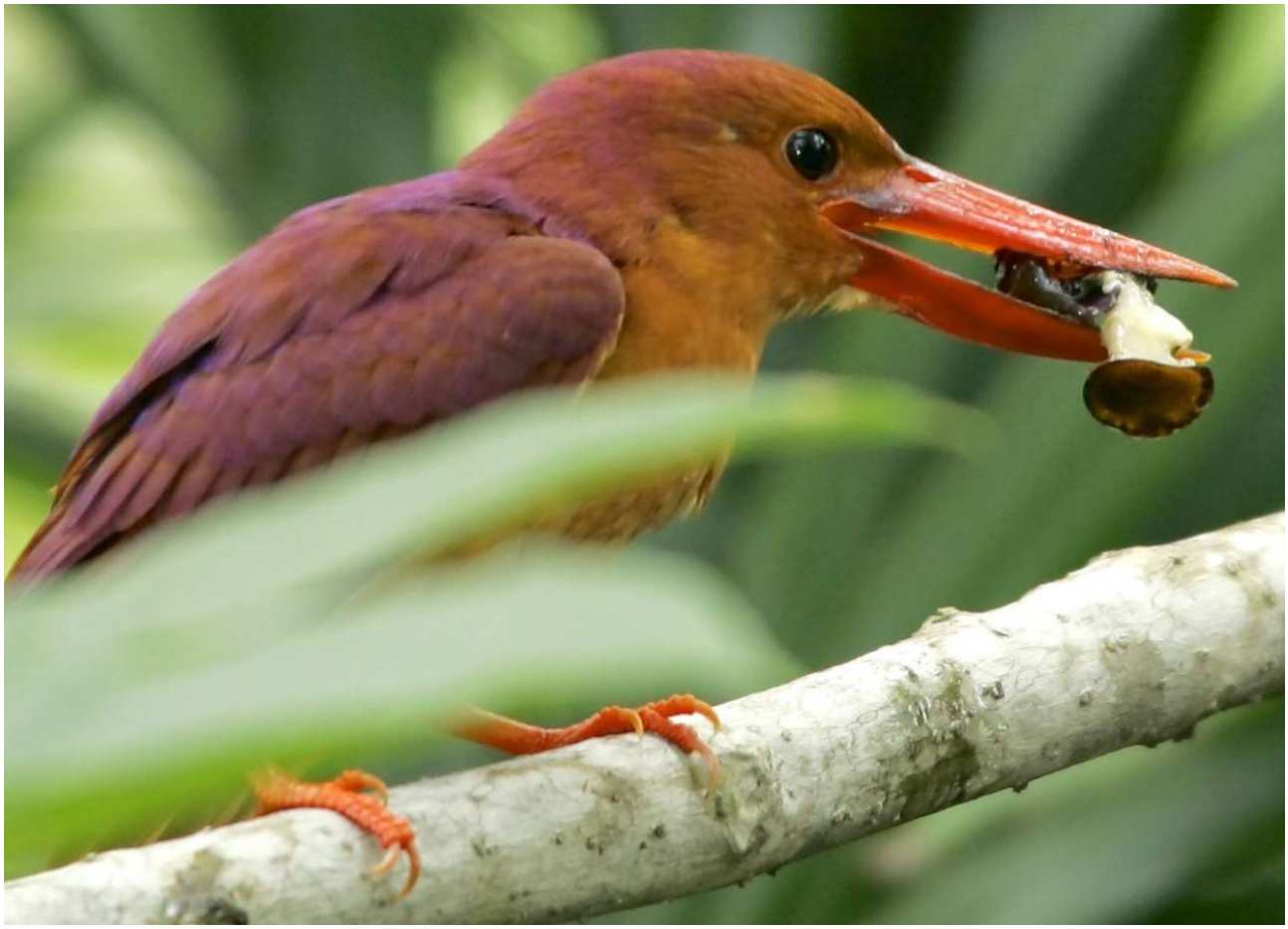

Fig. 8. A ruddy kingfisher (*Halcyon coromanda*) about to swallow a snail after smashing the shell against the perch. (Photograph by: Chan Yoke Meng).

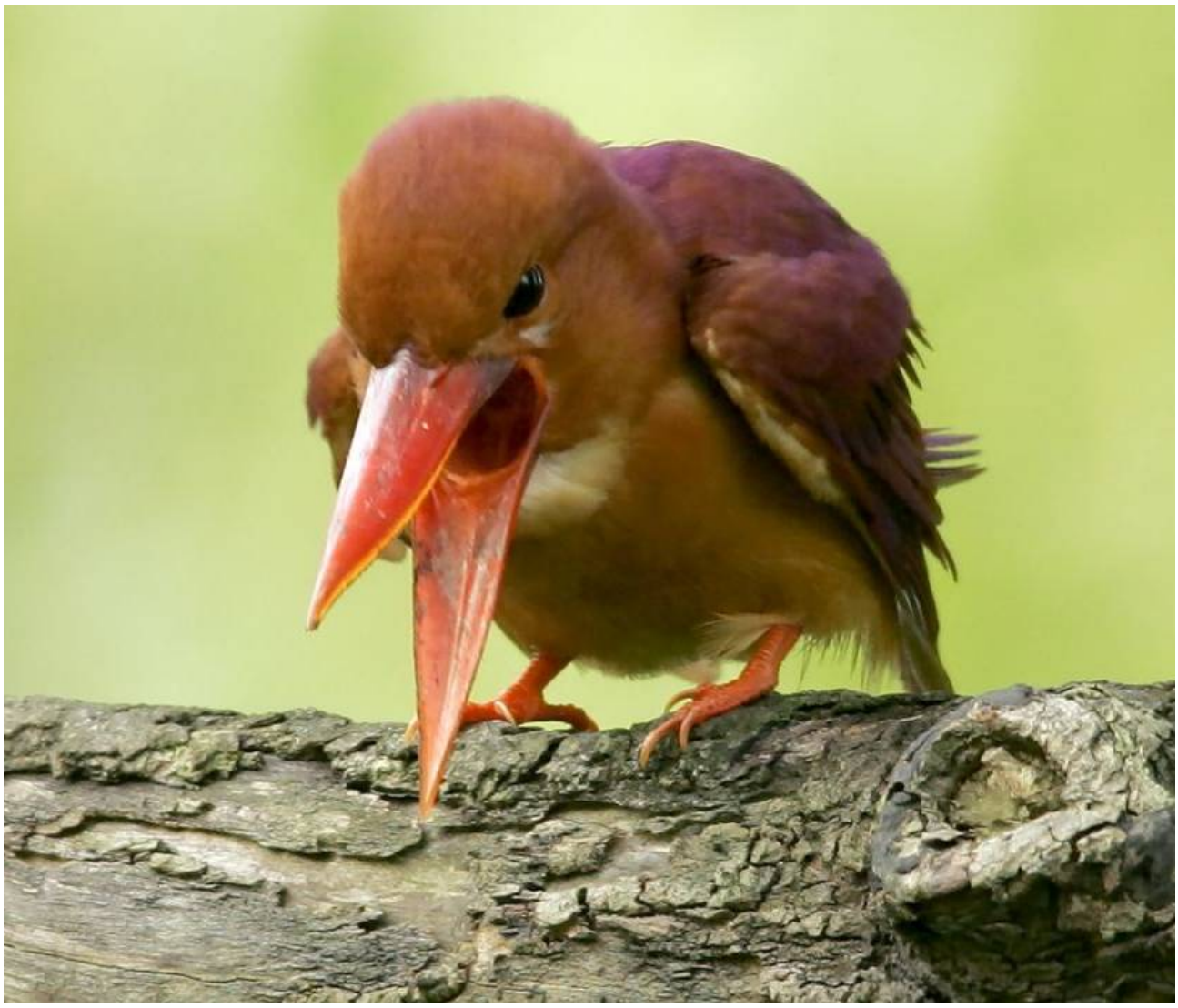

Fig. 9. The ruddy kingfisher in the act of casting a pellet. (Photograph by: Chan Yoke Meng).

***Meropidae (Bee-eaters).*** **–** Singapore has two species of bee-eater—the blue-tailed bee-eater (*Merops philippinus*) and blue-throated bee-eater (*Merops viridis*). The former is a very common winter visitor while the latter is a common resident as well as a rather uncommon winter visitor. These birds, as their names imply, specialise on bees, often caught on the wing (Fig. 10). They also eat dragonflies as well as other insects, althouth they seldom eat ground insects.

The bird normally perches on a high vantage point where it can keep a lookout for flying insects. Once it spots an insect, it sallies forth, catching and bringing it back to its perch to be processed. This involves striking it against the branch to stun it and rubbing it against a hard surface to remove the sting and venom sac. Once the insect has been properly processed, it is tossed in the air and immediately swallowed. Pellets have been found inside a nest chamber of the blue-throated bee-eater (Wells, 1999) and under a winter roost of blue-tailed bee-eater (Medway & Wells, 1976).

The blue-tailed bee-eater was caught on camera regurgitating a pellet containing the indigestible remains of the insects it ate (Fig. 11). The fresh pellet is blackish and about 1–3 cm long.

***Ardeidae (Herons).*** **–** This family is represented by egrets, herons and bitterns. These birds are carnivorous, feeding on live prey such as fish, amphibians, reptiles, birds and small mammals. They also take aquatic invertebrates like insects, molluscs, and crustaceans. Generally they swallow their prey whole. Their digestive system is extremely efficient and the only materials that they cannot digest are the chitinous exoskeletons of insects and the keratin of mammal fur and bird feathers (Martinez-Vilalta & Motis, 1992). So these are usually regurgitated as pellets. Marquiss & Leitch (2008) reported a grey heron (*Ardea cinerea*) nestling casting pellets of bones and other undigested matter from the fish it was fed with, and these included artifacts like nylon and fish hooks.

Local photographers have yet to document a heron casting a pellet. However, the striated heron (*Butorides striatus*) that one of us reared (YCW) after the chick was picked up by a concerned member of the public, initially cast out pellets,

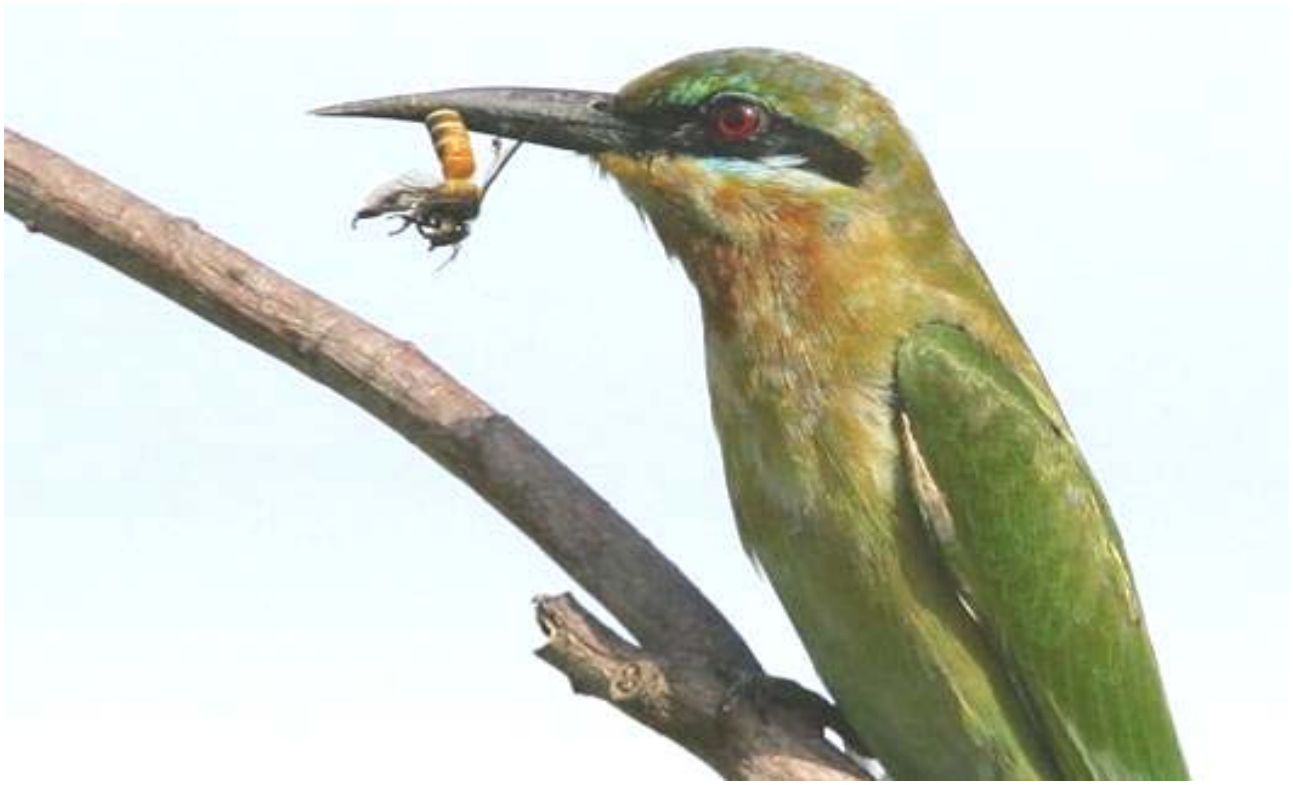

Fig. 10. Blue-tailed bee-eater (*Merops philippinus*) about to eat a bee. (Photograph by: Chan Yoke Meng).

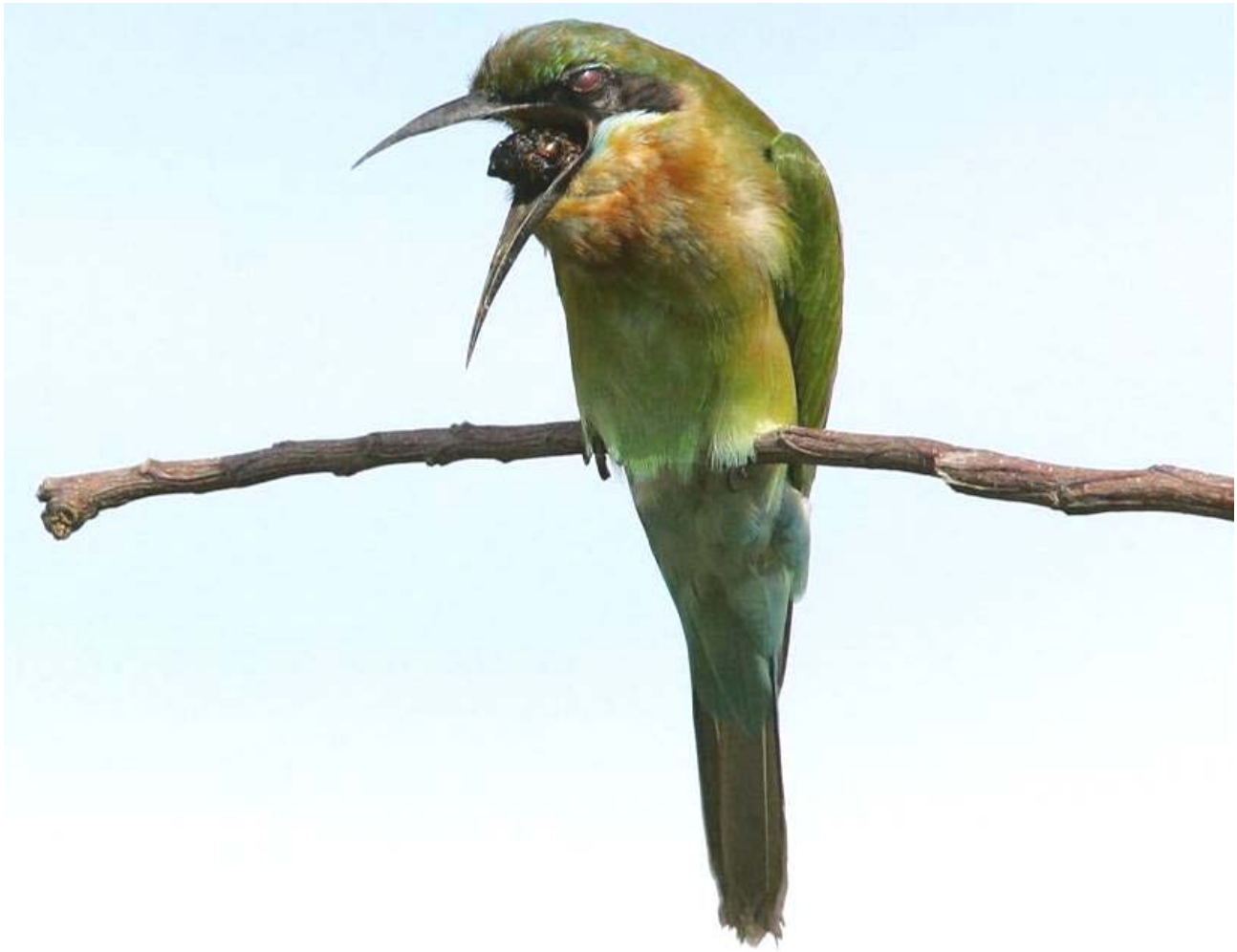

Fig. 11. Blue-tailed bee-eater casting a pellet. (Photograph by: Chan Yoke Meng).

although the act was not actually seen (YC et al., 2007). Small white pieces of pellets were found after it was fed pieces of fish with bones and scales (Figs. 12, 13). As the chick grew older, no such pellets were ever seen again, probably because its digestive juices dissolved the hard substances in the food.

***Laniidae (Shrikes).*** – Shrikes are aggressive and predatory passerine birds that behave like small raptors when hunting. Their diet includes large insects, small rodents, reptiles and mammals (Smythies, 1999; Wells, 2007). They also eat small birds. Their upper mandible ends in a strong, hooked bill that they use with great efficiency to kill and dismember prey.

The tiger shrike (*Lanius tigrinus*) is a common winter visitor and passage migrant (Wang & Hails, 2007). A juvenile bird was observed in mid-Sep.2006, manipulating a large scarab beetle (Fig. 14). The bird was on its perch when it suddenly dived towards the ground and caught the beetle by one of its legs. Returning to its perch and with one of its feet holding down the beetle, it started to stab the wriggling insect with its sharp bill. Then, holding on to the head, it thrashed it against the branch until it managed to tear away the upper portions from the body and ate its meal.

The shrike was observed casting a pellet some time later. The pellet shows the presence of pieces of black beetle elytra, besides various exoskeleton portions (Fig. 15).

## DISCUSSION

Below (1979) reported that the International Bird Pellet Study Group listed 18 orders comprising 67 families and 316 species of birds that cast pellets. Of these, 129 (41%) species were Falconiformes (vultures, hawks, eagles, buzzards and falcons) and Strigiformes (typical owls). This does not include 11 species, including a skimmer (Rynchops), thus adding the Rynchopidae to the total number of families.

Raptors and owls that regularly eat other animals are well known for casting pellets. So do other carnivorous birds such as shrikes. Fish eaters such as kingfishers, herons, grebes and crakes similarly cast pellets. Gulls (Marks et al., 1999) and possibly terns are also reported to cast pellets. In grebes most of the fish bones as well as various insects and their larvae, especially aquatic insects, molluscs, crustaceans and small amphibians, are totally dissolved by the strong acid in

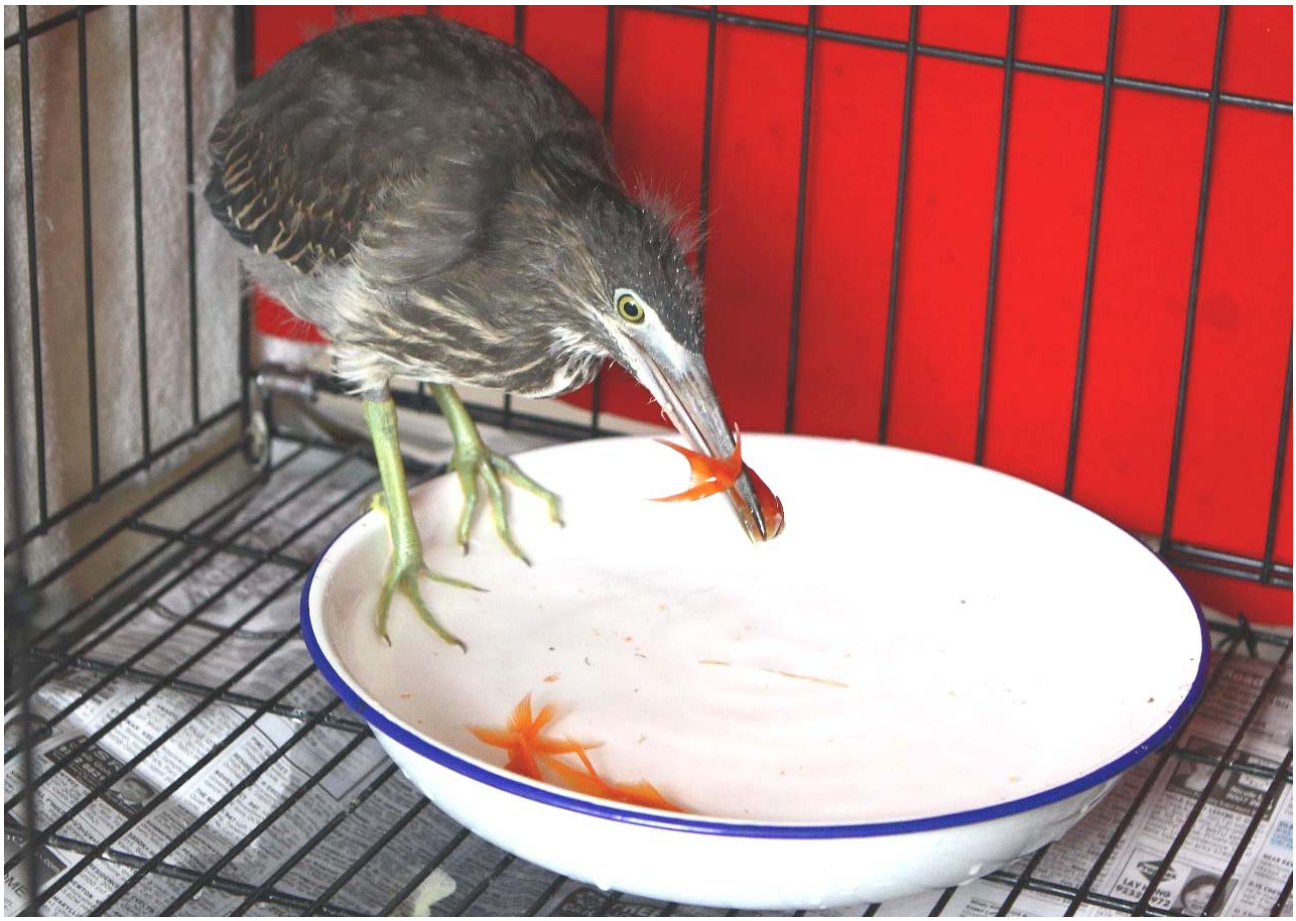

Fig. 12. A striated heron (*Butorides striatus*) chick feeding on goldfish. (Photograph by: Y. C. Wee).

Fig. 13. Pellets collected from the cage where the striated heron chick was kept. Scale in mm. (Photograph by: Y. C. Wee).

the bird's stomach (Limona & Hoyo, 1992; Evans & Heiser, 2004). Grebes eat their own feathers and plant matter, believed to act as retainers, keeping the fish bones in the stomach long enough for the acid to dissolve them (Piersma & van Eerden, 2008). So instead of casting normal pellets, grebe cast pellets consisting mainly of water weeds and feathers, together with some fish bones that have yet to be dissolved.

Many insectivorous birds, in addition to bee-eaters, have to deal with the indigestible exoskeleton and the hairs of caterpillars they consume (Evans & Heiser, 2004). One example is the nightjars that take night-flying insects on the wing, flying with their mouth open (Cleere, 1999). Other possibilities include thrushes and swallows.

Many shore birds such as sanderling (*Calidris alba*), turnstones, curlews, plovers and rails, are also pellet casters because of their diet, which consists of mainly invertebrate prey such as crustaceans, worms and molluscs. In fact, pellet-analysis has been conducted on the common redshank (*Tringa totanus*), giving details on mudflat prey that are consumed by these sandpipers (Sanchez et al., 2005). Such analyses have also been conducted on curlew sandpipers (*Calidris ferruginea*), grey plovers (*Pluvialis squatarola*) and common greenshank (*Tringa nebularia*) (Kalejtab, 1993).

Other birds that certainly cast pellets include crows (Marks et al., 1999) and ravens (Laudet & Selva, 2005). We suspect frugivorous birds also cast pellets. Many fruigivorous birds swallow fruits whole and regurgitate the seeds. But we are not certain if they cast pellets as well. The example shown in Figs. 1 and 2 could be a pellet from a fruit-eating bird. However, this has not been proven.

## CONCLUSIONS

This paper highlights the importance of documenting bird behaviour, which has added tremendous amount of knowledge to ornithology. Obviously bird photographers and birdwatchers need to be vigilant and keep an eye on these birds to enrich our knowledge of pellet-casting species.

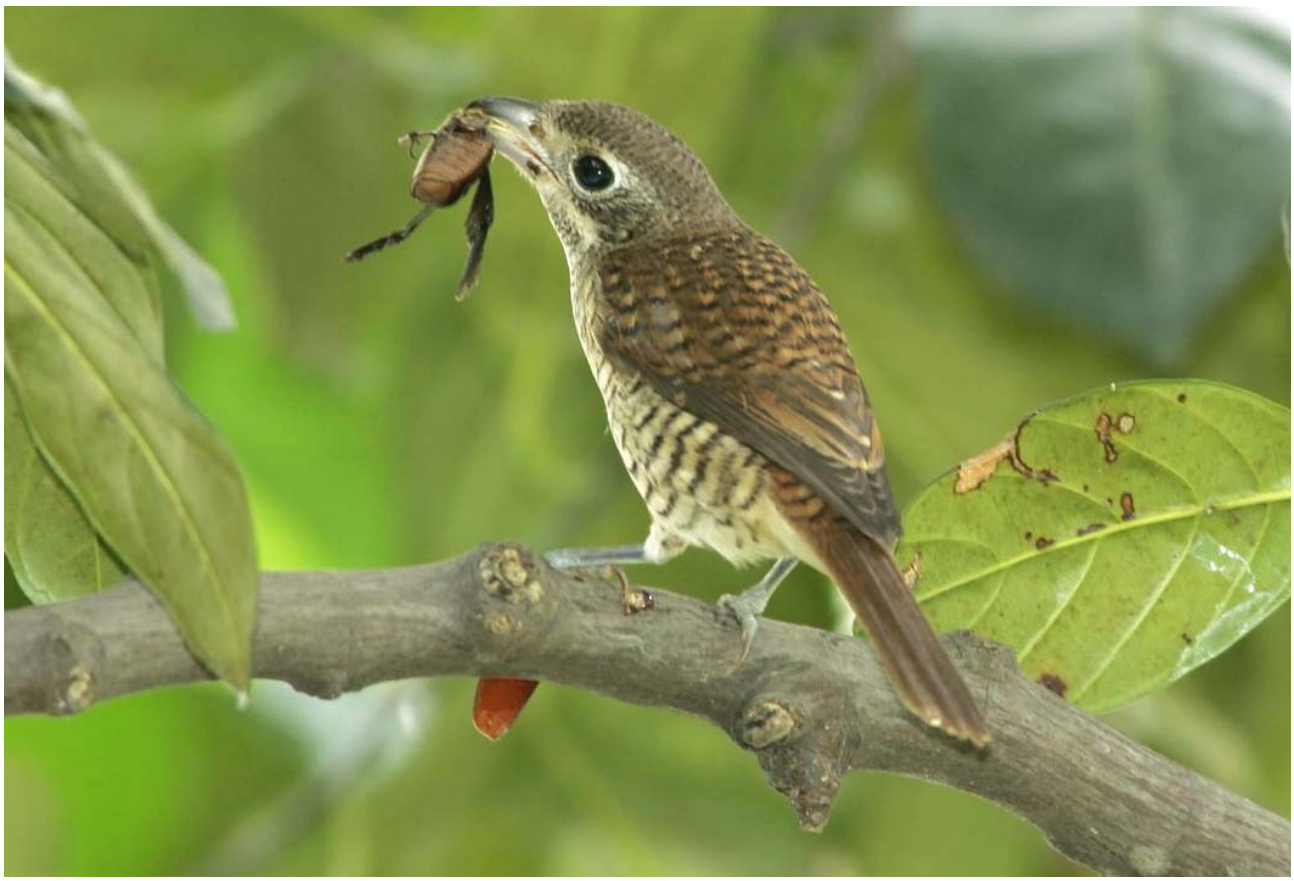

Fig. 14. A juvenile tiger shrike (*Lanius tigrinus*) manipulating a scarab beetle. (Photograph by: Chan Yoke Meng).

Fig. 15. A pellet cast by a tiger shrike after its meal of a beetle, identified from the presence of black elytra. (Photograph by: Chan Yoke Meng).

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