Antipredator behaviour of *Leptobrachium hendricksoni* Taylor, 1962 (Anura: Megophryidae) from Peninsular Malaysia

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On 10 May 2014, eight adults of *Leptobrachium hendricksoni* were captured from Ulu Paip Recreational Forest, Kedah, Peninsular Malaysia. When handled and manipulated for photography, several defensive behaviours were exhibited by these individuals, including crouching down, puffing up the body, body-raising and death feigning. The first three strategies were recorded for the first time, and thus increased the range of antipredator behaviours in *L. hendricksoni*. These defensive strategies have been described as important for the survivorship of the individuals when being attacked by a potential predator.

Three species of frogs from genus *Leptobrachium* Tschudi, 1838, namely *Leptobrachium hendricksoni* Taylor, 1962, *L. nigrops* Berry & Hendrickson, 1963, and *L. smithi* Matsui, Nabhitabhata & Panha, 1999 inhabit the forest of Peninsular Malaysia (Amphibia Web, 2015). *Leptobrachium hendricksoni* (spotted litter frog) is known in Thailand, Malaysia and Indonesia but is absent from Singapore. It is generally recorded at low altitudes but sometimes can be found up to 1000 m a.s.l. (IUCN, 2014). In Peninsular Malaysia, this species is encountered both in primary and secondary forests. They dwell in forest floor litter, near stream banks and in flat swampy areas (Berry, 1975; Ibrahim *et al.*, 2008) and hiding under leaf litter and logs on the forest floor (Berry, 1975). Many forested areas in Peninsular Malaysia including Penang National Park (Ibrahim *et al.*, 2008), Templer Park Selangor (Berry, 1975), Bukit Hijau Kedah (Shahriza *et al.*, 2011) and Bukit Jana Perak (Shahriza *et al.*, 2012) are known localities for this species. This species can be recognized by its broader head, rounded snout, distinct tympanum, red iris, rounded finger tips and ventral surface with large or small black spots. The snout-vent length (SVL) of this species is between 46 and 63 mm (Berry, 1975).

A wide range of predators, including snakes, consume frogs as their main dietary component. Frog species have developed various defensive mechanisms which protect them from predators, such as remaining motionless, crouching down, body contracting, body-raising, unken reflex, stiff-legged posture, mouth gaping and death feigning (Duellman & Trueb, 1986; Toledo *et al.*, 2010; Toledo *et al.*, 2011). Various antipredator behaviours have been reported from South American frog species (Borteiro *et al.*, 2014; Ferrante *et al.*, 2014; Gally *et al.*, 2014; Mangia & Garda, 2015) but are poorly known for southeast Asian frogs. A report on death feigning or thanatosis behaviour has been documented in *L. hendricksoni* from Peninsular Malaysia (Shahriza, 2014). During a thanatosis display, a frog assumes a death-like posture which will help divert an attack from a potential predator (Toledo *et al.*, 2010). To provide more information on behavioural ecology, herein I documented three additional antipredator behaviours of crouching down, puffing up the body and body-raising in *L. hendricksoni*.

On 10 May 2014, between 21:00 and 22:30 hours, eight adults of *L. hendricksoni* (fig.1.A) were captured at Ulu Paip Recreational Forest, Kedah, Malaysia (05°23’N, 100°39’E; 440 m a.s.l.). Four individuals of *L.
*L. hendricksoni* were caught on leaf litter, near a swampy area (muddy water with slit bottom), two specimens under leaf litter, at the edge of a small ditch (approx. 1-2 m width) and another two specimens on the wet forest trail. Other frog species such as *Limnonectes blythii* (Boulenger, 1920), *Chalcorana labialis* (Boulenger, 1887) and *Occidozyga laevis* ( Günther, 1858) were also observed at the sampling sites. All the captured specimens were brought back to laboratory, where SVL and weight (W) were measured using a digital calliper and electronic balance. Subsequently, all the specimens (14USM-UP-LH01, 02, 03, 04, 05, 06, 07, 08) were euthanized, tagged, fixed with 10% formalin, transferred to 70% ethanol and deposited at School of Pharmacy, Universiti Sains Malaysia (USM) as a reference collection for the species.

When manipulated for photography, several defensive behaviours were shown (three individuals showed crouching down, three exhibited death feigning, one displayed by puffing up, one raising its body and one did not displayed any behaviour). The SVL, W and behaviour type of each individual is shown in table 1.

Table 1. Snout-vent length (SVL), weight (W) and types of defensive behaviour of *L. hendricksoni* from Peninsular Malaysia. Abbreviations as follows: CD, Crouching down; DF, Death feigning; PU, Puffing up the body; BR, Body-raising; X, Presence; -, Absence.

<table>
<thead>
<tr>
<th>Specimens</th>
<th>SVL (mm)</th>
<th>W (g)</th>
<th>CD</th>
<th>DF</th>
<th>PU</th>
<th>BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>14USM-UP-LH01</td>
<td>51</td>
<td>10</td>
<td>X</td>
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<td>14USM-UP-LH02</td>
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<td>10</td>
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<td>9</td>
<td></td>
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<tr>
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<td>9</td>
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<td>47</td>
<td>8</td>
<td>-</td>
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<td>47</td>
<td>9</td>
<td>-</td>
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<td>X</td>
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<td>46</td>
<td>8</td>
<td>X</td>
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</tbody>
</table>

Crouching down behaviour (CD) was viewed by specimens 1, 2 and 8 (14USM-UP-LH01, 02, 08) (fig. 1.B) and was observed at the field. The frogs were detected hiding under leaf litter, near a swampy area. We slowly removed the leaves in order to capture the frogs. As a reaction, the frogs did not hop away, but remained motionless on the substrates. Their bodies were flattened and ventral surface touched the substrates. Its limbs and head flexed tightly onto the body, assuming a crouching posture. The frogs assumed this position for approximately 2-3 minutes with their snouts facing down and both eyes open. When we touched the frogs with hand or stick, it still remained in this motionless posture. Additionally, in this posture the frogs exposed their dorsal region (dark brown) that is very similar to their environment (leaf litter and twigs). This camouflage strategy may allow the frogs to avoid predation.

Death feigning behaviour (DF) was exhibited by specimens 2, 3 and 4 (14USM-UP-LH02, 03, 04) (fig. 1.C). During handling for photography, the frogs started to crawl and hide beneath leaves. When recaptured and placed on leaves, the frogs suddenly inflated their bodies and exposed their ventral region (whitish with small black dots). Their forelimbs were raised upward and rear limbs were held close to their bodies. The frogs remained in this position, motionless, with their eyes open for approximately 1.5-2 minutes, before resuming their normal posture and hoping away. Since many predators do not feed on dead organisms (Toledo et al., 2011) death feigning may provide these frogs with some form of protection.

Puffing up the body (PU) was displayed by specimen 5 (14USM-UP-LH05) (fig. 1.D). During the photography session, we touched the individual with a stick. Surprisingly, the frog did not hop away but elevated its body. Later the frog inflated its body, stretched out its fore and hind limbs, raised its head and exposed their ventral surface pattern. With both of its large eyes open (orange in colour), the frog assumed this motionless position for about 1.5 minutes. The inflated body posture would also have discouraged a potential predator, as it has to swallow a larger prey. Later, the individual returned to a normal posture and hopped away.

Body-raising behaviour (BR) was showed by specimen 7 (14USM-UP-LH07) (fig. 1.E). This posture was detected on the forest floor at the sampling site. When we were trying to capture the frog, it suddenly elevated
its body and head. Their forelimbs were erected while the rear limbs were stretched. Both limbs did not touch the substrates except for the palmar and plantar surfaces. Additionally, the inguinal area was also raised from the substrate. The frog stayed in this posture for about one minute with both eyes open and did not inflate its body.

These observations suggest that this slow-moving frog, *L. hendriksoni*, has developed various defensive mechanisms including crouching down, death feigning, puffing up the body and body-raising which assist them in defence from predators. Further study is required in order to explore other antipredator behaviours of this species.

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LITERATURE CITED


