

# Field guide to the amphibians and turtles of the Deramakot and Tangkulap Pinangah Forest Reserves



Created by:  
Sami Asad, Victor Vitalis and Adi Shabrani



## INTRODUCTION

The island of Borneo possesses a diverse array of amphibian species with more than 180 species currently described. Despite the high diversity of Bornean amphibians, data on their ecology, behaviour, life history and responses to disturbance are poorly understood. Amphibians play important roles within tropical ecosystems, providing prey for many species and predating invertebrates. This group is particularly sensitive to changes in habitat (particularly changes in temperature, water quality and micro-habitat availability). As such, the presence of a diverse amphibian community is a good indicator of a healthy forest ecosystem.

The Deramakot (DFR) and Tangkulap Pinangah Forest Reserves (TPFR) are located in Sabah's north Kinabatangan region (Figure. 1). The DFR is certified by the Forest Stewardship Council (FSC) and utilizes Reduced Impact Logging (RIL) techniques. The neighbouring TPFR has utilized Conventional Logging (CL) techniques. Conventional logging ceased in the TPFR in 2001, and the area's forests are now at varying stages of regeneration. Previous research by the Leibniz Institute for Zoo and Wildlife Research (IZW), shows that these concessions support very high mammalian diversity.

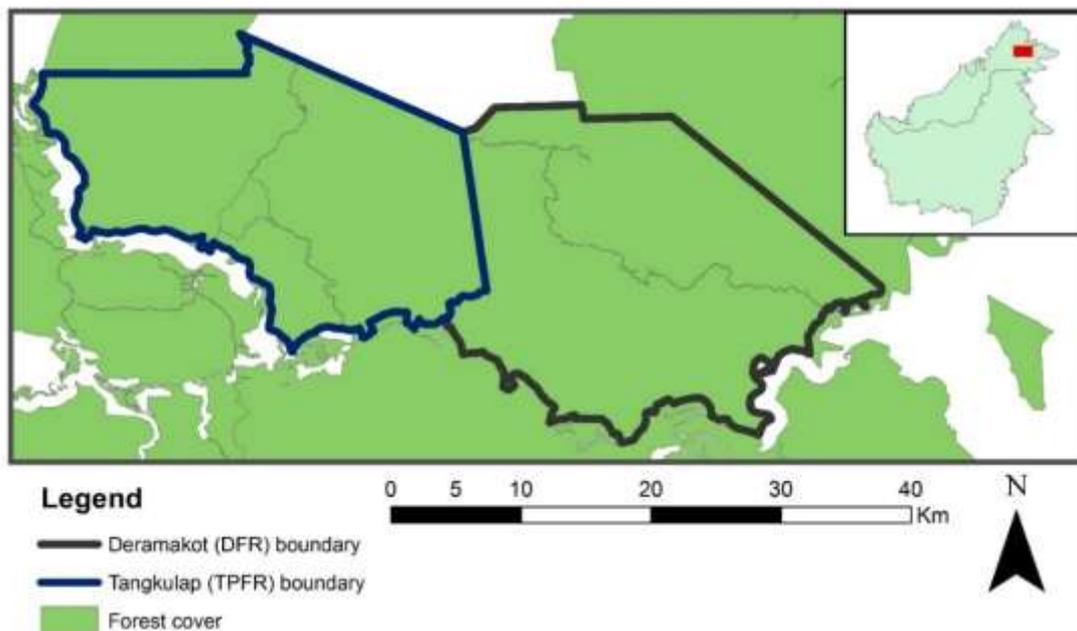


Figure. 1: Location of the Deramakot (DFR) and Tangkulap Pinangah Forest Reserves (TPFR) in Sabah, Malaysian Borneo.

Between the years 2017 – 2019, an amphibian and reptile research project conducted in collaboration between the Museum für Naturkunde Berlin (MfN), IZW and the Sabah Forestry Department (SFD) identified high amphibian diversity within the reserves. In total 52 amphibian species have been recorded (including one caecilian), constituting 27% of Borneo's total amphibian diversity, comparable to two neighbouring unlogged sites (Maliau basin: 59 sp, Danum Valley: 55 sp). As such, these reserves serve as important sites of amphibian diversity in Sabah, and throughout Borneo. Here, we provide a list of the amphibians found within the reserves, and an identification guide for identifying the majority of these species in the field.

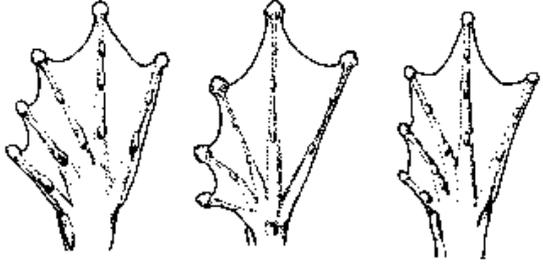
## DERAMAKOT AND TANGKULAP AMPHIBIAN SPECIES LIST

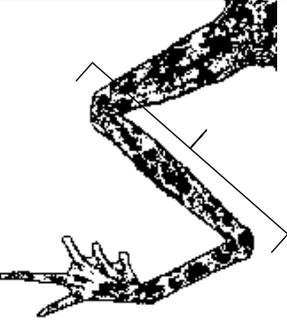
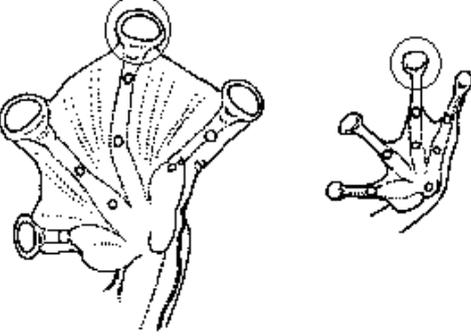
Check list of the 52 amphibian species found within the DFR and TPF, including their endemic (18) and IUCN status; LC = Least concern, NT = Near Threatened (9).

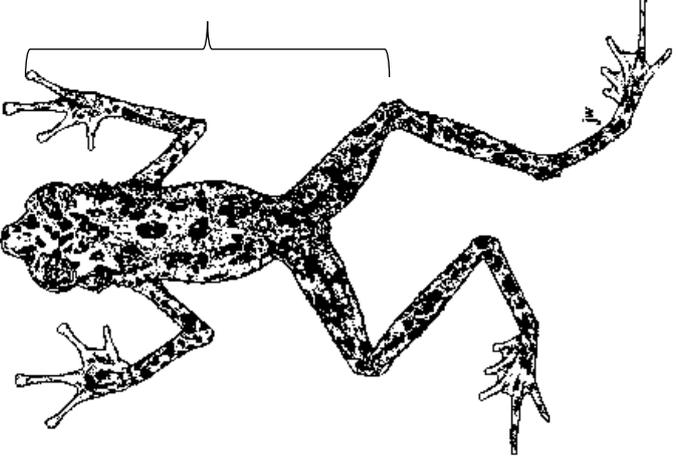
Amphibian Family	Amphibian Species	Endemic	IUCN status
Bufoinidae	<i>Rentapia hosii</i>	N	LC
	<i>Ingerophrynus divergens</i>	N	LC
	<i>Phrynomantis juxtasper</i>	N	LC
Ceratobatrachidae	<i>Alcalus baluensis</i>	Y	LC
Dicroglossidae	<i>Fejervarya limnocharis</i>	N	LC
	<i>Limnonectes finchi</i>	N	LC
	<i>Limnonectes ingeri</i>	Y	LC
	<i>Limnonectes kuhlii</i>	N	LC
	<i>Limnonectes leporinus</i>	Y	LC
	<i>Limnonectes palavanensis</i>	N	LC
	<i>Limnonectes paramacrodon</i>	N	NT
	<i>Occidozyga baluensis</i>	Y	NT
Megophryidae	<i>Leptobrachella parva</i>	Y	LC
	<i>Leptobrachium abbotti</i>	N	LC
	<i>Leptolalax fritinniensis</i>	Y	NT
	<i>Megophrys nasuta</i>	N	LC
Microhylidae	<i>Chaperina fusca</i>	N	LC
	<i>Glyphoglossus smithi</i>	Y	NT
	<i>Kalophrynus heterochirus</i>	Y	LC
	<i>Kalophrynus intermedius</i>	Y	LC
	<i>Kalophrynus pleurostigma</i>	N	LC
	<i>Kaloula baleata</i>	N	LC
	<i>Metaphrynella sundana</i>	N	LC
	<i>Microhyla borneensis</i>	Y	LC
<i>Microhyla petrigena</i>	N	NT	
Ranidae	<i>Abavorana luctuosa</i>	N	LC
	<i>Amnirana nicobariensis</i>	N	LC
	<i>Chalcorana raniceps</i>	N	LC
	<i>Chalcorana megalonesa</i>	Y	LC
	<i>Hylarana erythraea</i>	N	LC
	<i>Meristogenys orphnocnemis</i>	Y	LC
	<i>Pulchrana glandulosa</i>	N	LC
	<i>Pulchrana picturata</i>	N	LC
	<i>Pulchrana signata</i>	N	LC
	<i>Staurois guttatus</i>	N	LC
Rhacophoridae	<i>Feihyla kajau</i>	Y	LC
	<i>Kurixalus appendiculatus</i>	N	LC
	<i>Philautus hosii</i>	Y	LC
	<i>Philautus tectus</i>	Y	LC
	<i>Polypedates leucomystax</i>	N	LC

Rhacophoridae	<i>Polypedates macrotis</i>	N	LC
	<i>Polypedates otlophus</i>	N	LC
	<i>Rhacophorus borneensis</i>	Y	NT
	<i>Rhacophorus dulitensis</i>	N	NT
	<i>Rhacophorus gauni</i>	Y	NT
	<i>Rhacophorus harrissoni</i>	N	LC
	<i>Rhacophorus nigropalmatus</i>	N	LC
	<i>Rhacophorus pardalis</i>	N	LC
	<i>Rhacophorus rufipes</i>	Y	LC
	<i>Nyctixalus pictus</i>	N	NT
Ichthyophiidae	<i>Caudacaecila</i> or <i>Ichthyophis</i> sp	-	-
<b>Total</b>		<b>52</b>	<b>18</b>

**SOME IMPORTANT MORPHOLOGY IN SPECIES IDENTIFICATION**

			
<p>Non webbed feet/finger</p> <p>- webbing is absent in between fingers</p>	<p>Half webbing</p> <p>- Webbing present; but to at least half of the 4<sup>th</sup> digit</p>	<p>3/4 webbing</p> <p>- webbing present to at least 3/4 of the 4<sup>th</sup> digit</p>	<p>Full webbed feet/finger</p> <p>- Webbing present all the way to fingertips. Indicates strong association to aquatic lifestyles</p>

		
<p>Tibia</p> <p>- Longer tibia allow further jumps</p>	<p>Toe/Finger pad</p> <p>- Extension on finger/toe to allow better attachment on rocks/branches</p>	<p>Paratoid gland</p> <p>- Poison producing gland on top of neck, prominent especially in Bufonids (toads).</p>

	
<p>Tympanum</p> <p>- Hearing apparatus of frogs. Usually round in shape, size might differ in between species.</p>	<p>Snout-vent length (SVL)</p> <p>- Standard measurement of size in frogs. Measured from end of snout to end of body (tail part).</p>

## AMPHIBIAN IDENTIFICATION GUIDE

### FAMILY: BUFONIDAE

Family of frogs commonly known as toads. Usually characterized by a large paratoid gland behind the ear and dry warty skin.

#### ***Ingerophrynus divergens* (INDI)**

Small-medium sized toad (40-55 mm SVL) found near primary and secondary forests streams. The species has very warty skin and is well camouflaged.

Habitat requirements:

- Primary and secondary forest streams

Key features:

- Warty skin
- Black band on back of head connecting eyes
- Two black, diamond like markings on back



#### ***Phrynoidis juxtasper* (PHJU)**

A very large robust toad (120-215 mm SVL) found along large rivers in primary and secondary forests. Warts end in small spines. Paratoid gland in this species secretes toxic substance.

Habitat requirements:

- Primary and secondary forest large streams

Key features:

- Large size
- Large, long paratoid glands
- Warts end in small spines



***Rentapia hosii* (REHO)**

A large, slender yet robust toad (50-105 mm SVL). Arboreal but comes down to large rivers in primary and secondary forests for breeding.

Habitat requirements:

- Primary and secondary forest large streams

Key features:

- Thick warty body
- Slender limbs
- Paratoid gland appears as large thick ridge behind eye



**FAMILY: CERATOBATRACHIDAE**

Family of frogs which are currently under taxonomic evaluation. In Borneo, this family is represented by a single genus, *Alacalus*.

***Alacalus baluensis* (ALBA)**

Small sized frog (20-36 mm SVL), with large head, that looks disproportionate to the short body. Usually found in abundance along small sloped streams.

Habitat requirements:

- Small sloped streams
- Rocky bottom
- Closed canopy

Key features:

- Large head
- Short body, with dark marking on its dorsum
- Have finger and toe pad, usually white in colour



**FAMILY: DICROGLOSSIDAE**

Typically large stout bodied, stream and swamp dwelling frogs with a classical “frog” build: Large eyes and pointed snouts, large well developed hind legs, with joints visible along the back. Very widely distributed across different habitats, from human modified to pristine forest. Male members of the genus *Limnonectes* are especially interesting for their aggressive defence of breeding territory.

***Fejervarya limnocharis* (FELI)**

Small-medium sized frog (40-60 mm SVL) commonly associated with human habitats (drainage pools, ponds, ditches). Calls loudly in congregations.

Habitat requirements:

- Permanent or temporary small, stagnant pools
- Open canopy

Key features:

- Cream, dorsal strip, widens at tip nose
- Dorsal ridges
- Flat head with wide, pointy snout

Similar species:

*Limnonectes ingeri* sometimes exhibits a dorsal stripe similar to FELI. However, *L. ingeri* has a larger, more stout appearance, and the dorsal stripe (when present) is narrower and doesn't widen at tip of nose



***Limnonectes finchi* (LIFI)**

Small frog (30-40 mm SVL) found on the old secondary and primary forest floor. Lays eggs under leaf litter. Male frogs guard the eggs and transport hatched tadpoles on back to nearby pool.

Habitat requirements:

- Permanent shallow pool
- Closed canopy
- Thick leaf litter

Key features

- Inverted V shaped skin fold between shoulders
- Tip of nose/head colour different from back, separated by sharp, dark line between eyes
- Vertical skin fold, with bumpy dorsum.

Similar species:

*L. palavanensis*: smooth skin (lacks dorsal ridges). *L. ingeri*: juvenile might look like *L. finchi*, but can be distinguished by head shape (wider and bigger), and lacks "V".



***Limnectes ingeri* (LIIN)**

Large bodied frog (100-130 mm SVL) of large, rocky and muddy rivers. Usually found in disturbed, secondary habitats.

Habitat requirements:

- Slow flowing, medium streams with silted bottom
- Open canopy/disturbed habitats

Key features:

- Large size, very stocky hind legs in adults
- Lack of dark stripe between eye nostril
- Fully webbed feet

Similar species:

*Limnectes leporinus*; has dark strip between eye and nostril. Snout forms distinct angled ridges when viewed from the front.



***Limnectes kuhlii* (LIKU)**

Medium sized, stocky frog (50-70 mm SVL) of small, streams. Found in good secondary forest and primary forest. Forms large species complex.

Habitat requirements:

- Moderately-fast flowing, small streams with sandy or rocky bottom
- Closed canopy

Key features:

- Network of intricate skin ridges
- Male larger than female; has larger jaw with “fangs”.
- Large abductor muscles and broad head
- Eyes face almost upward

Similar species:

*Occidozyga* sp. However these are smaller and eyes are more upward, skin network absent



***Limnonectes leporinus* (LILE)**

Large bodied frog (100-175 mm SVL) of large flat rivers. Males build deep circular depression by kicking sands round for breeding at sides of slow flowing streams.

Habitat requirements:

- Slow flowing, large streams with silty or rocky bottom
- Closed canopy

Key features:

- Large body size with strong hind legs
- Dark stripe between eye and nostril, all the way to tympanum
- Skin bumpy in juveniles, smooth in adults
- Fully webbed feet

Similar species:

*Limnonectes ingeri*: lacks eye to nostril stripe.



***Limnonectes palavanensis* (LIPAL)**

Small frog (30-40 mm SVL) found on the old secondary and primary forest floor, where it lays eggs under leaf litter. Male frog will guard the eggs and transport hatched tadpoles on back to nearby pool.

Habitat requirements:

- Permanent shallow pool
- Closed canopy
- Thick leaf litter

Key features

- V shaped skin fold between shoulders
- Tip of nose/head colour different from back, separated by sharp, dark line between eyes
- Two dark ridges along back
- Yellowish underside

Similar species:

*L. finchi*: bumpy skin



***Occidozyga baluensis* (OCBA)**

Very small frog (25-35 mm SVL), inhabits seepage areas, pools and quiet shallow areas of forest streams.

Habitat requirements:

- Permanent shallow seepage/pool
- Closed canopy

Key features:

- Wrinkly sand coloured skin
- Some have black hourglass on dorsum
- Speckled throat

Similar species:

*Occidozyga laevis*: larger, flatter yellow underside



***Occidozyga laevis* (OCLA)**

Medium sized frog (30-50 mm SVL), inhabits swampy areas, ponds and puddles. Mostly aquatic, only eyes and nostrils above water.

Habitat requirements:

- Permanent shallow seepage/pool
- Closed canopy

Key features:

- Eyes toward front of head
- Greyish brown
- Belly often yellowish
- Some individuals vertebral stripe

Similar species:

*O.baulensis*: smaller and more stocky, dark back pattern.



## **FAMILY: MEGOPHRYIDAE**

A group of frogs with diverse sizes; from as small as 15 mm to as large as 120 mm. These frogs are usually associated with leaf litter habitat, and most of them are found breeding in small flowing streams. Body shape and colouration are typically similar to leaf litter shapes and colour to aid in camouflage. Toes are typically non-webbed, indicating more terrestrial lifestyles.

### ***Leptobrachella parva (LEPA)***

Very small frog (16-18 mm) that is usually found perching on vegetation near small streams. Emit high pitch “buzz” call that can be heard in congregations at sloped streams.

Habitat requirements:

- Small, sloped flowing streams
- Leaf litter at banks
- Closed canopy

Key features:

- Brown-reddish body
- Very small size
- Loud high pitch call that resemble insect buzzing



### ***Leptolalax fritinniens (LEFR)***

Small frog (30-48 mm SVL), dorsal colouration darker than ventral, typically greyish. Arms lighter in colouration with some orange, eyes look disproportionally big compared to body.

Habitat requirements:

- Moderately fast flowing streams
- Leaf litter at banks
- Closed canopy

Key features:

- Big eyes
- Spotted body, but very vague
- Slender arms and hind limbs

Similar species:

*Leptolalax abbotti* – *L. fritinniens* has more slender body compared to this species.



***Leptobrachium abbotti* (LEAB)**

Medium-large sized frog (50-70 mm SVL) with large head and eyes. Throat sometimes speckled with dark markings. Makes very loud calls of deep “quak”

Habitat requirements:

- Moderately sloped, medium sized streams
- Leaf litter at banks
- Closed canopy

Key features:

- Large, flattened head
- Large eyes
- Blunt snout
- Slender arms and hind limbs

Similar species:

*L. fritinniens* - *Leptolalax abbotti* has a much large stockier body



***Megophrys nasuta* (MENA)**

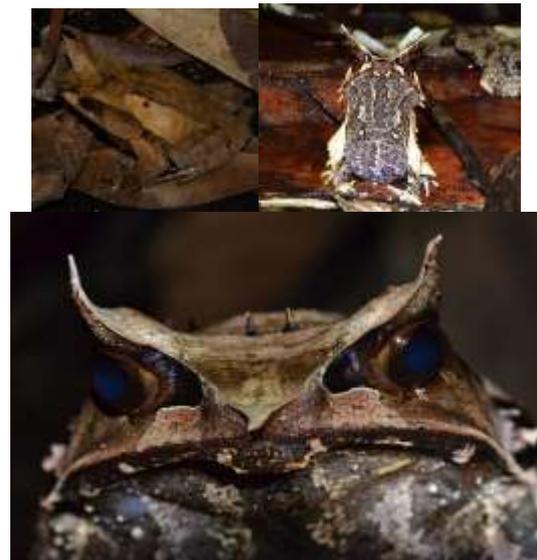
Large, charismatic frog of Borneo (up to 120mm). Has a distinct shape with projection on its eyes and snout (hence the name horned frog), which blend completely within thick leaf litter. Breeding call is described as single loud “honk”.

Habitat requirements:

- Moderately fast flowing streams
- Leaf litter at banks
- Closed canopy

Key features:

- Projection on eyes and snout
- Throat mottled
- Two horizontal skin fold on its dorsum
- Brown colouration.
- Large mouth



**FAMILY: MICROHYLIDAE**

Small frogs, characterized by their narrow mouth. Usually found on the forest floor or low vegetation along flowing streams. Typically triangle shaped with small heads/mouths. Prefer pools for breeding but some use small water bodies in bamboo, tree holes and any stagnant water.

***Chaperina fusca* (CHFU)**

Very small colourful frog (15-20 mm SVL) of the forest floor and streams. Prefer small side pool at streams but will breed in any water filled area (inc tree roots and roadside ditches).

Habitat requirements:

- Permanent/ temporary sidepool
- Water filled logs/buttreass roots
- Closed canopy

Key features:

- Blueish/greyish dorsum, with lateral white spots.
- Yellow spots on belly
- Spines on hind and forelimbs



***Metaphrynella sundana***

Small tree-hole frog (20-30 mm SVL) that rarely strays from water-filled holes on trees. Has a distinct call of a single “hoot”, which is repeated in an interval, especially in forest with old growth trees.

Habitat requirements:

- Water filled tree holes
- Closed canopy

Key features:

- Finger and toe pads, with light colouration
- Fingers almost forms a webbing
- Soft but warty skin



***Microhyla borneensis* (MIBO)**

Very small frog (20-25 mm SVL) of the forest floor usually under leaf litter. Congregates at pools where it breeds. Calls described as a series of loud crackles.

Habitat requirements:

- Permanent/ temporary pool
- Closed canopy with thick leaf litter

Key features:

- Lightly speckled body
- Black spots on its lips and along body side
- Marking on its back (similar to a shape of Christmas tree)



***Microhyla petrigena* (MIPE)**

Very small frog (15-20 mm SVL) found in undisturbed forest streams. Usually found in congregations on overhanging vegetation above small water-filled holes.

Habitat requirements:

- Permanent sidepool/stagnant pools
- Closed canopy

Key features:

- Dark marking on its back and dorsal part of legs that resemble boomerang when viewed from top
- White stripe that runs from side of eyes to top of forelimbs



***Kalophrynus heterochirus***

Small frog (30-40 mm SVL) with variable colouration. Have coarsely granular dorsum with light line in between back and underside.

Habitat requirements:

- Closed canopy with thick leaf litter

Key features

- Lightly spotted underside with few white-on-black blotches in between thigh
- Granular greyish dorsum

Similar species:

*Kalophrynus intermedius* – red/orange throat with two longitudinal lines, unspotted underside.



***Kalophrynus intermedius***

Small sticky frog (30-40 mm SVL) with granular dorsum. Greyish coloured body, fingers are reduced.

Habitat requirements:

- Permanent/temporary pool
- Closed canopy
- Thick leaf litter

Key features

- Reddish-orange throat with two longitudinal line
- Granular greyish dorsum



<ul style="list-style-type: none"> <li>- Small size</li> </ul> <p>Similar species:  <i>Kalophrynus heterochirus</i> – spotted underside, blotches in between thigh and belly, black spot on groin.</p>	
<p><b><i>Kalophrynus pleurostigma</i> (KAPE)</b></p> <p>Medium sized frog (35-50 mm SVL), triangular in shape. Has an orange throat, with black spot present in groin area. Secretes sticky mucus if threatened.</p> <p>Habitat requirements:</p> <ul style="list-style-type: none"> <li>- Permanent/temporary pool</li> <li>- Closed canopy</li> <li>- Thick leaf litter</li> </ul> <p>Key features</p> <ul style="list-style-type: none"> <li>- Has light dorso-lateral lines that separate its back and sides</li> <li>- Dark spot between thigh and body</li> <li>- Pointed snout</li> </ul>	 

**FAMILY: RANIDAE**

Typical body shape frogs. Body more streamlined as compared to large stocky Dicroglossid body. Most species inhabit streams with low vegetation, with some preferring slow flowing water or ponds.

<p><b><i>Abavorana luctuosa</i> (ABLU)</b></p> <p>Medium sized frog (40-60 mm SVL) of primary forest habitats. Usually found near small pools.</p> <p>Habitat requirements:</p> <ul style="list-style-type: none"> <li>- Lowed primary forest</li> <li>- Shallow forest pools</li> </ul> <p>Key Features</p> <ul style="list-style-type: none"> <li>- Mahogany-brown back</li> <li>- White line running along sides</li> <li>- White banded thighs</li> </ul>	
---	--

***Amnirana nicobariensis* (AMNI)**

Medium sized (40-50 mm SVL) frog of open/human disturbed areas. Unusually found in roadside ditches

Habitat requirements:

- Permanent pool/ditches
- Open canopy

Key features:

- Smooth, pointed snout
- White lip
- Dark inconspicuous eardrum
- Black mark from starting from ear

Similar sp:

*Chalcorana raniceps*, but AMNI is smaller, and has dark marking at the side of its head.



***Chalcorana megalonesa* (CHME)**

Medium (male >35mm, female >50mm SVL) sized frog of primary and secondary habitats.

Habitat requirement.

- Side pools of medium, slow flowing streams and ponds.

Key features:

- Green, sometimes with brown back
- Reddish inner thighs
- White lip
- Many dark spots on back

Similar species:

*C.raniceps*: Fewer dark spots on back and smaller (30-28mm)



***Chalcorana raniceps* (CHRA)**

Small-medium frog (30-50 mm SVL) found in mixed secondary/primary habitats.

Habitat requirement.

- Side pools of medium, slow flowing streams and ponds.

Key features:

- Green, sometimes with brown back
- Reddish inner thighs
- White lip



Similar species:

*C. megalonesa*: Has more dark spots on back and is larger (35-50mm).

***Hylarana erytharea* (HYER)**

Medium sized frog (40-75 mm SVL) strongly associated with human habitats, often breeds in pools/ditches

Habitat requirement:

- Permanent or temporary small, stagnant pools
- Open canopy

Key features:

- White bands running along the dorsal and ventral edges
- Bright green back
- White belly



***Meristogenys orphnocnemis* (MEOR)**

Medium sized (50-70 mm SVL) frog of rocky streams from lowland forests. Very long tibia (hind legs) to allow jumps across boulders, without the need to swim in very fast torrent.

Habitat requirement:

- Large, fast flowing streams with semi submerged large rocks.
- Closed canopy

Key features:

- Pointed snout
- Iris: upper bronze, middle copper
- Raised dorsal ridges
- Dorsum greenish brown
- Very long hind legs



***Pulchrana glandulosa (PUGU)***

Medium-large sized frog (60-90 mm SVL) of swampy primary and secondary habitats. Call similar to quiet dog bark

Habitat requirements:

- Large flat waterways, typical of swampy/flooded forest

Key features:

- Large head
- Black, grey and white marbled skin



***Pulchrana picturata (PUPI)***

Medium sized (40-70 mm SVL) frog of small, large flat, often silted lowland streams. Found in secondary, but mostly primary habitats

Habitat requirement:

- Large, flat streams, with vegetation on banks.
- Silted streams with closed canopy

Key features:

- Black with orange spots

Similar species:

*P.signata*: Striped, PUPI spotted



***Pulchrana signata (PUSI)***

Medium sized (40-70 mm SVL) frog of small, large flat, often silted lowland streams. Found in secondary, but mostly primary habitats

Habitat requirement:

- Small, moderately fast flowing streams
- Silted streams with closed canopy

Key features:

- Black with orange stripe

Similar species:

*P.picturata*: Spotted instead of two stripes.



***Staurois guttatus (STGU)***

Medium sized frog (30-55 mm SVL) inhabits large rocky streams. One of the frog species with diurnal activity. Exhibits toe-waving as a form of communication.



Habitat requirements:

- Medium, fast flowing streams with semi-submerged boulders
- Closed canopy

Key features:

- Greenish body, with darker dorsum that resembles moss colouration.
- Protruding snout
- Presence of finger and toe pad.
- Fully webbed toes with dark blue topside



### **FAMILY: RHACOPHORIDAE**

Tree frogs of medium to large size. Usually found perching on leaf or branch above streams and pools. This group is especially associated with good, high quality habitat because of their dependence on trees and dense canopy to provide suitable temperature and moisture for refuge and breeding sites.

***Feihyla kajau (FEKA)***

Small, (20 mm SVL) delicate tree frog usually found near small, slow flowing streams in undisturbed forests. Usually perched 1-2m high on streams. Eggs are laid on overhanging leaf, protected by jelly-like membrane.

Habitat requirement:

- Small, clear flowing streams with overhanging vegetation on banks.
- Closed canopy

Key features:

- Green dorsum with white spots
- White belly
- Fringes on hind limbs
- Translucent belly (internal organs visible!)



***Kurixalus appendiculatus (KUAP)***

Small-medium (30-40 mm SVL) sized, greenish brown common tree frog. Found at pools/ponds calling in numbers. Account of territoriality aggressiveness was recorded for the species.

Habitat requirement:

- Permanent shallow pools/marshy area
- Overhanging vegetation
- Closed canopy

Key features:

- Brown body with greenish tint.
- Flat head with long snout
- Fringes along the limbs

Similar species:

*Philautus hosii* – green iris, larger, skin granular



***Philautus hosii (PHHO)***

Medium sized frog (45-65 mm SVL) that perches over large flat rocky clear streams.

Habitat requirement:

- Dense canopy cover
- Large, moderately fast flowing stream

Key features:

- White, grey, sometimes brownish dorsum. Occasionally with conspicuous dark X between the shoulders
- Dark round dots on the flanks of most specimens.
- Yellow to greenish iris.

Similar species:

*Kurixalus appendiculatus* – smaller size, iris yellow to brown colour, fringes on tibia and forearms.



***Philautus tectus (PHTE)***

Small frogs (20-27 mm SVL) with direct development. Colour is variable. Usually found at forest edges (with bushy ferns) or vegetation at damp parts of the vertical rocks in forest streams. Produce up to 5 large eggs which develop directly into froglets.

Habitat requirement:



- Overhanging vegetation
- Closed canopy
- High air moisture

Key features:

- Yellowish, brownish, greenish or reddish body
- Conspicuous toe and finger pad
- Small size
- Pointy snout



***Polypedates leucomystax (POLE)***

Medium sized (50-70 mm SVL) tree frog commonly associated with human areas. Found in large numbers around ditches and pools.

Habitat requirement:

- Permanent deep pond
- Open canopy

Key features:

- Four dark lines along back
- Long fingers with large pad
- Yellow/brownish in colour

Similar species:

*P. macrotis*: Larger and black face band covering eardrum, shorter snout.



***Polypedates macrotis (POMA)***

Large (60-80 mm SVL), brownish yellow tree frog. Found by forest pools and those adjacent to forests. Disturbance tolerant.

Habitat requirement:

- Permanent deep pond with Overhanging vegetation

Key features:

- Dark mask/line over nose, eardrum, usually to mid body
- Barred legs

Similar species:

*P. leucomystax*: Has four dark lines along back, and face band covering eardrum absent.



***Polypedates ottilophus (POOT)***

Large brownish yellow tree frog (80-100 mm SVL). Found by forest pools and those adjacent to forests. Disturbance tolerant.

Habitat requirement:

- Permanent deep pond with overhanging vegetation

Key features:

- Bony ridge on the back of its ear

Similar species:

*P. macrotis*: Has dark lines covering eardrum.



***Rhacophorus borneensis (RHBO)***

Medium sized (40-50 mm SVL) brilliant green and blue flying frog. Rarely encountered but often heard in primary, but sometimes secondary forests

Habitat requirement:

- Stagnant pond
- Overhanging vegetation
- Closed canopy

Key features:

- Bright green body, blue/black flanks with yellow fingers
- Slight Flaps on side of arms and legs
- Blue and black between toe webbing
- Full webbing on both fingers and toe

Similar species

*R. nigropalmatus* – This species is larger, and lacks the blue colouration on the sides.



***Rhacophorus harisoni* (RHHA)**

A medium sizes (female up to 70mm, male > 50mm) frog species. Brown frog with white/blue speckled sides. The snout is angular and pointed and the hands are fully webbed.

Habitat requirement:

- Dense canopy cover
- Tree holes/butresses for breeding

Key features:

- Colouration varies from brown to greyish
- Full webbing on fingers
- Sometimes with white spot under eyes
- Underside white
- White/Blue ish spots between thigh and belly



***Rhacophorus gauni* (RHGA)**

A small tree (30-38 mm SVL) frog of lowland/hilly forest. Often found overhanging wide rocky streams.

Habitat requirements

- Wide, clear, rocky streams
- Overhanging vegetation
- Primary forest

Key features

- Prominent spines on eyelid and hind leg
- White spot beneath eye
- Distinct yellow patches between groin and thigh and back of thigh



***Rhacophorus nigropalmatus* (RHNI)**

Large (90-100 mm SVL) brilliant green flying frog, famously mentioned by Alfred Wallace. Found perching on high vegetation by breeding pools in primary and secondary forests.

Habitat requirement:

- Permanent deep stagnant pond
- Overhanging vegetation

Key features:

- Bright green body, with yellow fingers
- Flaps on side of arms and legs
- Black between toe webbing
- Full webbing on both fingers and toe



***Rhacophorus pardalis* (RHPA)**

Medium sized frog (60-70 mm SVL) with red coloured body. Disturbance tolerant, found in secondary, primary forest and roadside ditches. Lays eggs in foam nest attached on overhanging vegetation above stagnant pond.

**Habitat requirement:**

- Permanent deep stagnant pond
- Overhanging vegetation and Closed canopy

**Key features:**

- Reddish-orange body, dorsum sometimes speckled with dark marking and stripes
- Yellow body side with black spots
- Full webbing on both fingers and toes



***Nyctixalus pictus* (NYPI)**

Medium sized tree frog. Distinct orange and white spotted colouration breeds in tree holes. Found predominately primary but also secondary forest.

**Habitat requirement:**

- Permanent/temporary water-filled tree hole.
- Closed canopy.

**Key features**

- Bright orange body with white spots
- See above!



# Turtles and tortoises of Deramakot and Tangkulap

Turtles and tortoises are widespread throughout Deramakot (and to a lesser extent, Tangkulap). Of the 6 species known to occur here, 3 are listed as vulnerable and 2 endangered by the IUCN red list. These species are divided between hard-shelled turtles (Geoemydidae), soft-shelled turtles (Trionychidae) and tortoises (Testudinidae). All except the tortoises are associated with water bodies and can be identified to species by features on the shell.

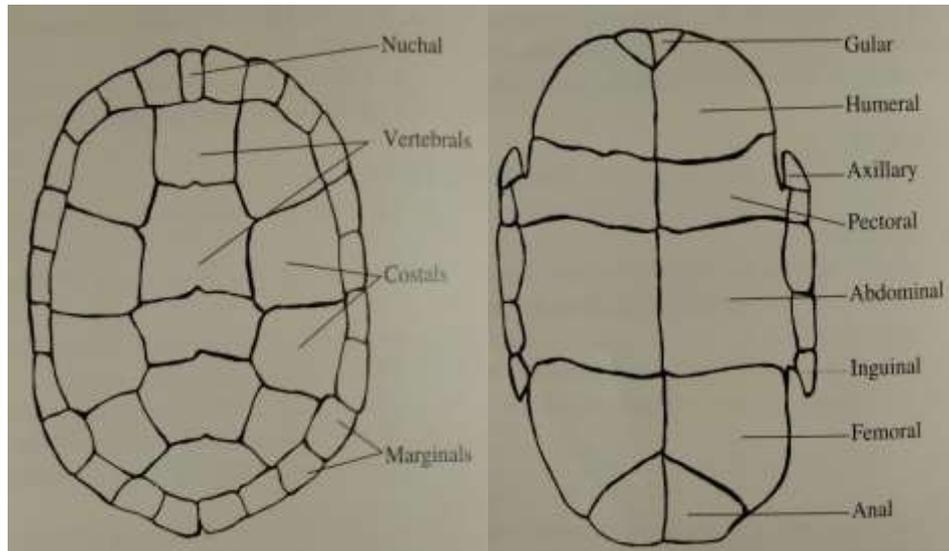


Figure 1: Guide to scales (scutes) of turtle shells: Left – Carapace (top), right – plastron (bottom)

Check list of turtles and tortoises found in the Deramakot and Tangkulap forest reserves.

## **Geoemydidae**

- Malayan box turtle (*Cuora amboinensis*)
- Spiny hill turtle (*Heosemys spinosa*)
- Malayan Flat-shell turtle (*Notochelys platynota*)
- Black marsh turtle (*Siebenrockiella crassicollis*)

## **Trionychidae**

- Malayan Softshell turtle (*Dogania subplana*)

## **Testudinidae**

- Asian forest tortoise (*Manouria emys*)

## **Geoemydidae**

Geoemydidae are hard-shelled river turtles of medium to large size. All Deramakot/Tangkulap species are aquatic and semi aquatic and most often found in larger, slow flowing rivers, but may also inhabit smaller forest streams. They can be found in the morning and late afternoon, but are most often found at night.

**Malayan box turtle - *Cuora amboinensis* (CUAM)**

A medium sized turtle (250mm), with a domed, smooth edged shell. Plastron olive brown-black, carapace yellow with black blotch on each scute. Face slightly yellow. Crepuscular/nocturnal. Males concave plastron, females flat. Often found crossing roads near swampy areas.

**Habitat requirements**

- Hill, lowland and disturbed forests
- Highly adaptive, ponds, swamps, rivers and rice fields

**Key Features:**

- Dark, domed shell
- Yellow lines beginning at nose running to back of head
- Carapace yellow with dark blotches on each scute (scale)



**Spiny hill turtle - *Heosemys spinosa* (HESP)**

A medium sized turtle (225mm), with serrated edges (more pronounced in juveniles). Plastron reddish brown in adults, carapace yellowish brown. Crepuscular /nocturnal. Males longer thicker tails than females.

**Habitat requirements**

- Hill and lowland forests
- Small shallow streams

**Key Features:**

- 5 vertebral scutes(scales)
- Serrated edges (confined to front and back in adults)
- Pronounced vertebral keel
- Carapace dark radiating lines



**Malayan flat-shelled turtle - *Notochelys platynota* (NOPL)**

A medium/large turtle (360mm), with flat topped shell. Plastron brown with fine black pattern, hatchlings bright yellow!  
Diurnal/Crepuscular/nocturnal, Males longer thicker tails and concave plastra.

**Habitat requirements**

- Hill and lowland forests
- Marshes, swamps, streams

**Key Features:**

- 6-7 vertebral scutes (unique to this species)
- Plastron with flat top
- Front and back serrated in juveniles, only back in adults.
- Head brown with yellow or cream patches
- Carapace dark patches (no lines)



**Black marsh turtle - *Siebenrockiella crassicollis* (SICR)**

A small-medium turtle (200mm), with black domed shell. Plastron hinged, yellow with black blotches. Found in marshy swamps and slow flowing rivers

**Habitat requirements**

- Secondary and primary forest
- Marshes, swamps

**Key Features:**

- Black domed shell
- Hinged plastron
- Ridge along carapace



## Trionychidae

Asian soft-shelled turtles are easily recognizable by their smooth, flattened shells and pig-like noses. They have no visible scales on their shells. They are aquatic and never found far from water. Usually found in muddy rivers where they shelter in mud but can also be found in forest streams. Almost exclusively nocturnal or crepuscular.

### Malayan softshell turtle – *Dogania subplana* (DOSU)

A medium/large turtle (up to 310 mm). Dorsum olive brown and mottled, olive-yellowish below. Juveniles have red markings at side of head. Mostly nocturnal.

#### Habitat requirements

- Hill and foothill forests
- Fast and slow silted/rocky streams

#### Key Features:

- Flat sided shell
- Short, pig like nose
- Juveniles (below) have 4 black eye spots on back and reddish throat
- Large head
- Back vertebral stripe



## Testudinidae

The true tortoises are entirely terrestrial and usually large.

### Asian forest tortoise - *Manouria emys* (MAEM)

A large turtle (up to 560mm). Large flattened carapace slightly oval in shape. Back dark brown, bottom yellowish brown. Active by day. Males may or may not have depressed plastron.

#### Habitat requirements

- Hill and lowland forests

#### Key Features:

- Large, oval, domed shell
- Slightly hooked upper jaw



## DERAMAKOT AND TANGKULAP REPTILE SPECIES LIST

Check list of the 6 turtle/tortoise, 17 lizard and 40 snake species found within the DFR and TPFR, including their endemic (12) and IUCN status; LC = Least concern, NT = Near Threatened, V = Vulnerable (4), EN = Endangered (2).

Reptile type	Reptile family	Reptile species	Endemic	IUCN status	
Turtles/ tortoises	Geoemydidae	<i>Cuora amboinensis</i>	N	V	
		<i>Heosemys spinosa</i>	N	EN	
		<i>Notochelys platynota</i>	N	V	
		<i>Siebenrockiella crassicollis</i>	N	V	
	Testudinidae	<i>Manouria emys</i>	N	EN	
	Trionychidae	<i>Dogania subplana</i>	N	LC	
Lizards	Agamidae	<i>Aphaniotis ornata</i>	Y	NA	
		<i>Draco quinquefasciatus</i>	N	NA	
		<i>Gonocephalus bornensis</i>	Y	NA	
		<i>Gonocephalus grandis</i>	N	LC	
	Eublepharidae	<i>Aeluroscalabotes felinus</i>	N	NA	
	Geckonidae	<i>Cyrtodactylus consobrinus</i>	N	NA	
		<i>Cyrtodactylus pubisulcus</i>	Y	NA	
		<i>Cyrtodactylus yoshii</i>	Y	NA	
		<i>Gekko smithii</i>	N	LC	
	Scincidae	<i>Eutropis rudis</i>	N	NA	
		<i>Eutropis rugifera</i>	N	NA	
		<i>Eutropis multifasciata</i>	N	NA	
		<i>Lygosoma bowringii</i>	N	NA	
		<i>Tropidophorus beccarii</i>	N	NA	
		<i>Tropidophorus brookei</i>	Y	NA	
	Varanidae	<i>Varanus rudicollis</i>	N	NA	
		<i>Varanus salvator</i>	N	LC	
	Snakes	Colubridae	<i>Ahaetulla prasina</i>	N	LC
			<i>Aplopeltura boa</i>	N	LC
			<i>Asthenodipsas laevis</i>	N	LC
<i>Boiga cynodon</i>			N	LC	
<i>Boiga dendrophilia</i>			N	NA	
<i>Boiga drapiezii</i>			N	LC	
<i>Boiga jaspidea</i>			N	LC	
<i>Calamaria schmidtii</i>			Y	LC	
<i>Chrysopelia ornata</i>			N	LC	
<i>Chrysopelia pelias</i>			N	LC	
<i>Coelognathus flavolineatus</i>			N	LC	
<i>Dendrelaphis caudolineatus</i>			N	NA	
<i>Dendrelaphis formosus</i>			N	LC	
<i>Dryocalamus subannulatus</i>			N	LC	
<i>Dryocalamus tristrigatus</i>			N	LC	
<i>Gonyosoma oxycephalum</i>			N	LC	

Snakes	Colubridae	<i>Hebius flavifrons</i>	Y	LC	
		<i>Lycodon subcinctus</i>	N	NA	
		<i>Oligodon annulifer</i>	Y	NA	
		<i>Oligodon everetti</i>	Y	LC	
		<i>Oligodon octolineatus</i>	N	LC	
		<i>Opisthotropis typica</i>	N	LC	
		<i>Pareas nuchalis</i>	Y	LC	
		<i>Psammodynastes pictus</i>	N	NA	
		<i>Psammodynastes pulverulentus</i>	N	NA	
		<i>Ptyas fusca</i>	N	LC	
		<i>Sibynophis melanocephalus</i>	N	LC	
		<i>Stegonotus borneensis</i>	Y	LC	
		<i>Xenochrophis trianguligerus</i>	N	LC	
		<i>Xenodermus javanicus</i>	N	LC	
		Elapidae	<i>Calliophis intestinalis</i>	N	LC
			<i>Naja sumatrana</i>	N	LC
<i>Ophiophagus hannah</i>	N		V		
Pythonidae	<i>Malayopython reticulatus</i>	N	NA		
	<i>Python breitensteini</i>	Y	LC		
Typhlopidae	<i>Ramphotyphlops braminus</i>	N	NA		
Viperidae	<i>Trimeresurus borneensis</i>	N	LC		
	<i>Tropidolaemus subannulatus</i>	N	LC		
Xenodermatidae	<i>Xenodermus javanicus</i>	N	LC		
Xenopeltidae	<i>Xenopeltis unicolor</i>	N	LC		
<b>Total</b>		<b>63</b>	<b>12</b>		

## AKNOLEDGEMENTS

The authors would like to thank the Sabah Forestry Department, who facilitated access to the study site, accommodation and a wealth of data. In particular we would like to thank Peter Lagan and Johnny Kissing who provided invaluable assistance during the course our research and completing this guide. For funding assistance, we would like to thank Auckland Zoo, Columbus Zoo, the German herpetological society (DGHT) and the Museum für Naturkunde, Berlin.

## OTHER AMPHIBIAN AND REPTILE IDENTIFICATION RESOURCES

Das, I., and Has, A., Accessed 18 May 2019. Available at: <http://frogsborneo.org/>

Inger, R. F., Stuebing. 2017. A Field Guide to the Frogs of Borneo. Natural History Publications, Kota Kinabalu, Malaysia. 228 pp.

Inger, R.F., 1966. The systematics and zoogeography of the Amphibia of Borneo. *Fieldiana Zoology*, 52, 1-402.

Lim, B. L. & Das, I. 1999. *Turtles of Borneo and peninsular Malaysia*. – Natural History Publications (Borneo), Kota Kinabalu, Malaysia.

Stuebing, R.B., Inger, R.F. & Lardner, B. 2014. *A field guide to the snakes of Borneo*. Natural History Publications (Borneo), Kota Kinabalu, Malaysia.

