

# Project Kodok

A research project aimed at investigating and monitoring Anuran populations in  
Tanjung Puting National Park,  
Central Kalimantan, Indonesia, South East Asia.

## Main Report



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## **1. Summary**

**A research project aimed at investigating and monitoring Anuran populations in Tanjung Puting National Park, Central Kalimantan, Indonesia, South East Asia.**

Amphibians worldwide are disappearing at an alarming rate, so much so that it made the front page of British newspapers last year (Connor S, The Independent 15/10/2005). Project Kodok was set up by undergraduates at the University of Edinburgh to contribute to the global understanding of Anura, so that steps can be taken towards their effective conservation and protection. Research was carried out in Tanjung Puting National Park, Central Kalimantan, Indonesia, in July and August 2005. Tanjung Puting is composed of a combination of peat swamp and dry ground forest at an elevation not exceeding 100m. The study began with the compilation of a species inventory, using general search methods. Each species found was photographed, and full descriptions made. Sound recordings were made for three species: *Occidozyga* sp, *Polypedates leucomystax* and *Rhacophorus appendiculatus*. In total 12 species were found, from five different families. Visual encounter surveys were conducted in two forms: firstly along 300m transects, primarily to encounter non-vocalising species, and secondly in 16m<sup>2</sup> quadrats around potential breeding sites, to encounter vocalising species. The surveys were conducted across a range of habitat types, representative of the study area. These included peat swamp; dry ground forest; rivers and streams; and seasonal flooded areas. The habitats that were most species rich were peat swamps, rivers and seasonal flooded areas. The highest abundance was seen at the post 17 stream transect, with 26 individuals recorded, all members of the species *Limnonectes paramacrodon*, which was the only species recorded at this site. Possible reasons for differences in abundance and species richness between habitats are discussed, as well as recommendations for future studies. Of particular interest is the occurrence of a species of *Occidozyga*, which could not be satisfactorily identified to species level, and also a possible new distributional record of *Leptobatrachium nigrops* for Indonesia.

## **2. INTRODUCTION**

It is universally acknowledged that global amphibian populations are declining, and since their populations have remained unchanged for millions of years (*Barinaga 1990*), the decline of an entire taxonomic group worldwide is both very serious and extremely puzzling.

Amphibians are considered an integral part of their ecosystem and an extensive food web that includes birds, reptiles, small mammals, insects and other amphibians. Continuing amphibian decline will have a direct effect on the survival of preying animals, to a greater or lesser degree depending on the particular predator. Amphibians are also predators themselves, to arthropod and invertebrate populations, and similarly these animals will be affected by the shift in ecosystem equilibrium.

As research continues, the reality becomes even more alarming since declining numbers have been detected in populations living in pristine, undisturbed environments and not just those, as once thought, in distressed or shrinking habitats. Many possible etiological agents have been highlighted as the cause of amphibian decline including climate change, habitat destruction, an increase in UV light, pollution, human disturbance and disease (notably a chytrid fungus, found to have had devastating effects on amphibian populations in both Australia and South America (*Berger et al. 1998*)). It seems apparent that there is no one single cause, but that a combination of factors is contributing to the acute loss of numbers.

In addition to animal conservation, scientists have been interested in amphibian populations for a second reason. Due to their highly permeable skin, amphibians are extremely sensitive to minute changes in their surroundings and hence can act as bio-indicators. Therefore by studying the variation, distribution and behaviour of these species, much can be gained about an ecosystem as a whole.

The aim of this project was to contribute to the understanding of global amphibian decline by studying Anuran populations in the tropical forests of Borneo, South East Asia. The study area chosen was that within Tanjung Puting National Park that represents various habitats; swamp, river, ponds, canopy, disused padi fields and human dwellings. The area also supports an extensive variety of fauna and flora.

Under the name of 'Project Kodok' a study was conducted in the first instance to produce a comprehensive inventory of Anuran species found in the study area. Secondly, using this list, monitoring surveys were carried out to assess abundance and distribution in specifically chosen habitats. By carrying out such field work, species richness and relative abundance of local Anuran populations were identified.

It is imperative for amphibian research to continue and for awareness of their situation to grow. A better understanding of their decline is needed so that effective conservation efforts can be made towards preserving this diverse and ecologically important group of organisms. Furthermore, additional study is vital to understand the wider implications of the declining numbers of this bio-indicating taxonomic group.

### **3. METHODOLOGY**

#### **3.1 Species Richness and Inventory**

Species lists are critical for conservation-related decisions. As the site had never been surveyed before, the first week(s) were primarily concerned with creating an inventory of species richness. We aimed to compile a species inventory of Anuran populations in the area, for both our own use, and further monitoring programmes. Time-constrained searches (yielding a number of species collected per sampling unit (days)) are a means of standardising effort between sites. A minimum of five sites representing all habitats was studied to form a collection of species that were photographed, their measurements taken and their calls recorded back at the laboratory. Four person-hours (one sampling day) were needed to collect samples at each of the sites. Each species was photographed and the call recorded where possible. Appropriate textbooks were used to identify species correctly. Taxonomy and nomenclature was checked using the most up-to-date taxonomic reference, Darrell Frosts' 'Amphibian Species of the World' website. Using time-constrained general collecting in this way allows for an evaluation of rate of species accumulation, with the asymptote approximating total species richness of the site (for the time of the year and methods used). All individuals were released.

#### **3.2 Vocalising Species**

After a reconnaissance and general time constrained collecting (above) in the first week(s) of arrival, we hoped to locate at least five breeding sites (forest pools, pig wallows, etc.). Surveys of these five sites would be undertaken over a course of weeks to monitor the vocalising species congregating there. It was anticipated that each night two team members would record vocalisation category (which species are present) and vocalisation intensity (intensity of calls of individual species) for 15 minutes of each hour from 19:00 to 01:00 or until vocalisation has ceased according to IUCN protocol. This methodology follows protocol used by MAYAMON and Project Anuran, a long term monitoring program in Central America. It was hoped that the use of the same methods and protocol under similar conditions in South East Asia would allow for comparisons of the status of anuran populations at different localities across the world.

However, due to a lack of calling behaviour (see discussion), an alternative method was required for targeting non-vocalising anurans at their breeding sites. Three sites were chosen (see map 1 in appendix) to set up quadrat type Visual Encounter Surveys (VES) that are appropriate for sampling a specific area thoroughly. These sites were: 'Umars Pond' (Pig wallow), 'Jalan 12', (both in Dry ground Dipterocarp Forest) and 'Jalan A1', (Peat Swamp Forest). The quadrats of 16m X 16m gave a total area searched of 256 sq m, where a 128m transect was split up into eight parallel transects and was walked by two persons searching 1m either side of the path. The survey time for each quadrat was 25 minutes 36 seconds, which gave a standardised walking speed of 0.3 km/h, the same rate as for standard transect VES (see below). A minimum of 3 repeats were taken for each site for both day (commencing 10AM) and night (commencing 10 PM).

**Table 1.1** GPS coordinates for VES quadrats

Site	Corner 1	Corner 2	Corner 3	Corner 4
Umar's Pond	49606623E	49604969E	49604973E,	49604982E,

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	9693080N	9694719N	9694706N	9694714N
Jalan 12	49606352E, 9695292N	4966350E, 9695277N	49606360E, 9695271N	-E (no signal) 49606369N
Jalan A1	49606886E, 9693418N	49606892E, 9693392N	4960613E, 9693415N	49606898E, 9693423N

### 3.3 Non-vocalising Species

To obtain measures of abundance of species away from breeding sites (also accounting for non-vocalising species) we used the transect design VES. For this type of sampling costs, personnel and time required are low, and are thus suitable for potentially complex faunas such as those found in Southeast Asian tropical forests. Five transect lines were cut (see map 1 in appendix), 300m in length and 2m in width, and were surveyed by two people walking carefully down the line searching the leaf litter and branches up to eye level. In order to standardise the search effort a time restraint of one hour is placed on each transect survey, producing an average search speed of 0.3 km per hour. A minimum of 3 repeats were conducted per transect, for both day (10AM-11AM) and night (10PM-11PM). The sites represented the following habitat types: 'Danau Buaya', and 'Jalan Sungai', both transected across rivers/seasonal flooded lake areas; 'Jalan Yusran' and 'Post 17 Stream' were leaf litter and stream transects in dry ground dipterocarp forest; and 'Jalan Satu' in peat swamp forest. Each survey was searched at a level of medium intensity, where animals active on the surface are counted along with those uncovered when leaf litter is raked and surface objects (e.g. rotting logs) are overturned. Where needed, animals were captured for identification. Assumptions of the VES are as follows: that each individual is equally conspicuous; that each species is equally likely to be encountered; that an observer can keep track of individuals so that they are not re-recorded; and results from two or more observers surveying the same area simultaneously are identical. Attempts were made to minimise any biases that were within our ability to control: having two observers keeping track of movements lessened the chance of re-recordings, and the initial phase of habitat reconnaissance and species richness inventory allowed workers to familiarise themselves with different habitats and species and form search images.

**Table 1.2** GPS coordinates for VES transects

Site	Start	Finish
Danau Buaya	49606062E, 9696442N	49606274E, 9696334N
Jalan Sungai	49604247E, 9694521N	49604511E, 9694583N
Jalan Yusran	49606358E, 9695289N	49606311E, 9695060N
Post 17 Stream	49610747E, 9693501N	49610659E, 9693317N
Jalan Satu	49606621E, 9693199N	- (no signal)

### 3.4 Habitat Types

The Camp Leakey Study Area is comprised of four main habitat types: dry ground tropical heath forest with dipterocarps, peat swamp forest, rivers with seasonally flooded lake areas and abandoned rice field secondary habitat. Dry ground dipterocarp is the most common forest type in the park, and is characterised by *Shorea*, *Lithocarpus*, *Koompassia* and *Sindora spp.*, as well as Ironwood (*Eusideroxylon wagleri*), many lianas, rattans and palms. Canopy height is 30-40m with emergents to 50m. Peat swamps harbour the richest number of species with Ramin (*Gonystylus bancanus*), *Tetramerista*, *Ganua*, *Palaquium*, *Dactylocladus*, and *Alstonia spp.* (the latter to 60m) and are characterised by stilt roots, adventitious roots, pneumatophores and epiphytes. Water in peat swamp is directly derived from rainfall (ombrogenous) and consists of pigments, organic acids, alkaloids and secondary compounds that leach from toxic leaf litter. This 'blackwater' drains into the rivers that denote the boundaries of Tanjung Puting National Park. In areas of abandoned dry rice fields ('ladang') *Imperata* grass has established. This fire resistant species out-competes and debilitates pioneering vegetation, deflecting natural secondary succession by tropical forest. Due to the time constraints of the project, our survey sites were selected in locations and habitats where amphibians were most likely to be encountered. No surveys were undertaken in 'ladang' areas. In addition to faunal data, temperature (degrees celcius at start and finish of survey), weather conditions and daily rainfall were recorded at each survey.

## 4. RESULTS

### 4.1 Species Accounts

A full list of all species encountered in the study area is given below. This includes all species found during the VES transects and quadrats and also during our extensive preliminary searches and any species encountered by camp assistants while working within the Camp Leakey study area. A complete set of photographs can be found in the appendix. The Project Kodok website ([www.projectkodok.org](http://www.projectkodok.org)) also contains extra photographs that may be used for identification purposes.

**Family: *Bufo* (True toads)**

**Genus: *Pseudobufo***

#### ***Pseudobufo subasper***

#### **Aquatic Swamp Toad**

##### *Description:*

A stout bodied toad, with heavy limbs and flat obtusely pointed nose with nostrils on dorsal surface of head (a feature of aquatic species). The tympanum is distinct.

The colour of the back and sides is dark brown to dark red with a yellow tint to the underside. A distinguishing feature of this species is a yellow to orange dorsal-lateral stripe which is not found in any other toad species. The body is covered in distinct round warts, both dorsally and laterally.

The fingers are long, slim and blunt at the tips with webbing at the base. The third and fourth fingers have two to three phalanges free of webbing. The toes are also blunt at the tips but are fully webbed.

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No distinct paratoid gland was observed.

### *Sexual dimorphism:*

In mature males the throat is black while in mature females it is yellow. The slits of the vocal sacs are visible on either side of mouth in males.

SVL Males: 77 - 94 mm Females: 92 - 155 mm

### *Habitat:*

Although not found during transects, many specimens of this toad was commonly found floating among the vegetation in water, in river margins and flood pools during reconnaissance visits to study areas, most notably the Sekonyer Kanan river.

### *Call:*

As yet unknown. Males have been observed calling whilst semi-submerged, but a sound recording is not yet available.

## **Family *Ranidae* (True frogs) Genus *Rana***

### ***Rana baramica***

#### **Brown Marsh Frog**

#### *Description:*

A slender, small to medium sized frog with an obtusely pointed snout with the nostril positioned closer to the snout tip rather than the eye. The eyes are large and prominent and the tympanum is also visible.

The skin is dark brown and mottled on the back with lighter brown patterning on the sides. Small bumps cover the posterior region of the back. The limbs show a dark crossbar patterning.

The fingers are long with slightly enlarged tips and little webbing at the base. Of the toes, the first, second, third and fifth, have two phalanges free of webbing. The fourth toes however have 3.5 – 3.66 phalanges free of webbing.

#### *Sexual dimorphism:*

Adult males have comparatively larger tympana and shorter tibia with a notable humeral gland in the under arm region.

SVL Males: 38 - 46 mm Females: 44 - 67 mm

#### *Habitat:*

Found in seasonally flooded areas, such as river margins and the Danau Buaya transect; in peat swamp forest pools such as that found at Jalan Satu and A1 sites; in leaf litter of dry ground forest for example as that seen at Umar's quadrat; an also around camp buildings. Also seen at the Jalan Dua stream.

#### *Call:*

Males call individually (as opposed to within a chorus) and the call has been previously recorded as a repetitive low chirp.



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### *Other Notes:*

This species is particularly similar to *Rana glandulosa* and may only be distinguished by its smaller size and comparably less foot webbing.

### ***Rana erythraea*** **Green Paddy Frog**

#### *Description:*

A slender, medium sized frog with a long, pointed snout and distinct tympanum, that is usually brown in colour. The back and sides are bright green, and a yellow-white anterior-posterior stripe runs from behind the eye to the end of the body. The upper lip is white, and connects to a second stripe, also white, that runs over the armpit and under the dorsal lateral fold. The upper legs are light brown to olive with darker stripes and rows of dots. The belly and underside of the legs are white with occasional mottling. The tips of the fingers are expanded discs with the first finger equal to or longer than the second. The toe discs are smaller than those of the fingers; the feet are extensively webbed apart from the top two phalanges of the fourth toe.

#### *Sexual dimorphism:*

Males have nuptial pads on the first fingers and have inconspicuous humeral glands under the arm.

SVL Males: 32-45mm Females: 48-75mm

#### *Habitat:*

This species is found in disturbed habitats such as man made ponds, flooded paddy fields and swamps. Males were found on submerged vegetation whereas females were found on grassy banks. Individuals were also found in flooded areas of river at the Danua Buaya transect (seasonal lake).

#### *Call:*

The call is known as a squeaky, wobbling sound but has yet to be recorded.

## **Genus *Occidozyga*** **(Puddle Frogs)**

### ***Occidozyga* sp.**

#### *Description:*

A particularly small and stout frog with a big, obtusely pointed head. The eyes are large, dark and prominent. The skin is tan-grey and mottled with dark marks/spots all over the upper side of the body. Most individuals show a single thin yellow stripe that continues down the center of the back starting between the shoulders. The underbelly is white.

The limbs are stout and the toes show full webbing.

#### *Sexual Dimorphism:*

SVL Males: 11-69 mm Female: 28-31mm

#### *Habitat:*

This species was found in abundance in shallow puddles and flooded banks at the Danau

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Buaya site. Most were floating in open water or under leaves. It was also found in forest pools in the Jalan A1 quadrat and Jalan satu transect, and additionally at the stream at Jalan Dua.

*Call:*

Male frogs call in chorus. The call is a 'wack wack wack' croak, and was recorded by Project Kodok.

**Genus *Limnonectes***

***Limnonectes malesianus***

**Peat Swamp Frog**

*Description:*

A medium to large sized frog with smooth red-brown skin. A creamy yellow dorsal stripe runs from snout to vent, and there is a thick white stripe between the eyes. The upper eyelids have a yellow coloured projection at the top and the tympanum is distinct. The belly is creamy white, with brown mottling on the throat and sides of the legs, although the undersides of the legs are plain. The tops of the legs have darker brown stripes; the lips are also striped with thick black bands. The toes are slender with full, black webbing.

*Sexual Dimorphism:*

SVL: Males: 70-150mm Females: 75-95mm

*Habitat:*

This species was not found during transects, but was seen on dry ground forest 0.5 km from post 17, in streams and pig wallows. It was also seen in peat swamp at Jalan A1 (Shonleben S, personal observation, 2004).

*Call:*

Known as several loud and sharp notes in quick succession.

***Limnonectes paramacrodon***

**Fanged frog**

*Description:*

A large frog, *Limnonectes paramacrodon* was found to be polymorphic, with different individuals displaying various colourings and markings. Characteristic to all individuals however, is a black, diamond shaped spot over the tympanum, a black stripe over the eye running from the tympanum to the nostril and a faint dark stripe between the eyes on the top of the head. The belly is white to yellowish, as are the undersides of the legs. The toes are completely webbed to the tips, with the exception of the fourth toe. The skin is smooth, and varies between grey-brown to a reddish brown. Some individuals had a yellow-orange dorsal stripe, which was completely absent on other individuals. Similarly, some individuals had darker stripes on the tarsal ridge and thigh, with different degrees of mottling along the flanks.

*Sexual dimorphism:*

Adult males have fangs on the lower gums, while females have only raised bumps. This species is unusual as the males are larger than the females, as they compete physically with

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each other by fighting for the females, rather than calling. Males do not have vocal sacs.

SVL Males: 60-75mm Females: 55-66mm

*Habitat:*

Found at the banks of the stream at Jalan Dua, and on the banks of steams and pig wallows on the path to Post 17 (0.5 km away from post 17 off from Jalan Toges). This species was found in abundance along the Post 17 transect. It was also encountered at the forest pools of Jalan Satu and peat swamps of Jalan A1.

**Family Megophryidae**

**Genus Leptobrachium (Large-Eyed Litter Frogs)**

***Leptobrachium nigrops***

**Leaf litter frog**

*Description:*

A small frog, this species is a member of a genus characterised by a large head in comparison to the smaller limbs and body. The skin on the back is dark charcoal to black, while the flanks have a reticulated dark patterning on a blue-white background. The belly is white with blue mottling. There is a distinct orange spot over the tympanum, and a black stripe over the eye, running down to the end of the snout. The eyes are large, slightly bulbous and black. The limbs are long and slim, with very little webbing on the feet, and none between the fingers.

The fingers are pointed and curved, as if in a grasping position. This is in contrast to other *Leptobrachium* species where the fingers and toes are rounded. This particular species is quite docile, and every individual we encountered, almost without exception, 'played dead' when handled.

*Sexual dimorphism:*

SVL Males: 35-40mm Females: 37-50mm

*Habitat:*

This species was encountered in leaf litter, dry ground forest at Danau Buaya transect, and also at Jalan RR-2.

*Call:*

Unknown

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Family *Rhacophoridae*

Genus *Polypedates*

***Polypedates colletti***  
**Hourglass Treefrog**

*Description:*

A medium sized but slender frog with a pointed snout, giving the head a triangular appearance. The tympanum is distinct. The skin is light tan to reddish brown with a dark hourglass shaped marking on the back, the distinguishing feature of this species (although this is absent on some individuals). The legs have a dark crossbar patterning with scattered dark spots on the sides. The underbelly is white. The fingertips are expanded into large discs; the toes are also expanded but to a lesser extent. Fingers lack webbing, but the toes are broadly webbed at the base.

*Sexual dimorphism:*

SVL Males: 44-52mm Females: 59-77mm.

*Habitat:*

This species was found in trees approximately 1m from the ground in dry ground forest such as Umar's pond and also Jalan RR-2 quadrats, but was not found during transects.

*Call:*

A series of harsh, crackling notes.

*Notes:*

Recent taxonomic changes have redefined the genus of this frog to *Polypedates* from the previous classification as *Rhacophorus colletti*.

***Polypedates macrotis***  
**Dark Eared Treefrog**

*Description:*

A medium sized to large frog with a triangular, obtusely pointed head and rounded snout. The eyes are prominent and the tympanum is distinct. The limbs are long, slender and slightly pointed. The skin is tan to brown on the back and legs, and some individuals have two dark stripes running down the back with dark patterning on the skin. A distinguishing feature (although not found universally) is a distinct dark brown marking covering the tympanum and tapering down each side of the body. The underside of the head has a dark brown irregular pattern, and the belly is white. The fingers have large discs but the webbing is less developed than on the toes. The toe discs are less expanded than those of the fingers.

*Sexual dimorphism:*

Males have yellow nuptial pads on the first finger; females have wider heads and fingertips. SVL Males: 45-57mm Females: 66-85mm

*Habitat:*

This species was found in trees approximately 1-1.5m from the ground in dry ground forest such as Umar's pond quadrat, but was not found during transects.

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### *Call:*

Males call in a chorus, a long, drawn out chuckle, with the first note being longer than the rest.

### ***Polypedates leucomystax***

#### **Four Lined Tree Frog**

##### Description:

A medium sized, slim tree frog with smooth mustard-brown coloured skin, it is characterised by four dark brown dorsal stripes down the length of its back. There is a fold of skin at the top of the tympanum; the top lip is dark in colour, while the belly is off-white. There are dark brown bands on all four legs, and the eyes are black with a gold stripe at the top. The ends of the fingers and toes extend into large pads, and the toes are fully webbed, with the exception of the fourth toe.

##### *Sexual Dimorphism:*

SVL Males: 37-50mm Females: 57-75mm

##### *Habitat:*

Found around human habitation, buildings and in trees around camp. Although not encountered during transects, this species was sited and heard calling from the roof of the dining room and a nearby tree.

##### *Call:*

A loud, clear croak repeated 3-4 times.

## **Genus *Rhacophorus***

### ***Rhacophorus appendiculatus***

#### **Friiled Tree Frog**

##### Description

A small tree frog with a triangular shaped head which is longer than broad, and is often described as having a conical tip to the snout. The body colour varies from grey-green to brown, with variable dark markings. The underside is white with a yellow tinge. The outer thighs show orange-pink flash markings. The most distinguishable feature of *Rhacophorus appendiculatus* is the frilled edge of the outer skin of the forearms and feet. Only the two outer fingers are webbed. The toes are expanded into large discs, and have three quarter webbing.

##### Sexual dimorphism

Males have yellow nuptial pads on the first fingers.

SVL Males: 30-37mm Females 42-50mm.

##### *Habitat*

This species was found in trees approximately 0.3-3m from the ground in dry ground forest such as Umar's pond, and also on Jalan 12 prior to the transect being established.

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### Call

A short to long series of soft clicking noises and a series of croaks.

### Family Microhylidae

### Genus Kalophrynus

#### *Kalophrynus plerostigma*

#### Rufous-sided Sticky Frog

##### Description:

A small frog with a distinct, acutely pointed nose and diamond shaped body. The skin is smooth with a defined ridge running dorso-laterally from the snout tip to the knee of the hind legs. The skin colour varies from green-grey to a deep rufous brown, and some individuals have a darker hourglass pattern on their back.

##### Sexual dimorphism:

Females appear to have small pebbling on their backs whereas males have small spines.

SVL: Males: 37-50mm Females: 35-57mm

##### Habitat:

Found in dry ground forest and in leaf litter of Jalan Toges and along the feeding trail. It was not however, found along transects.

##### Call:

Described as a sharp, repetitive chirp (Inger and Stuebing, 2005), but unrecorded by Project Kodok.

## 4.2 Visual Encounter Surveys

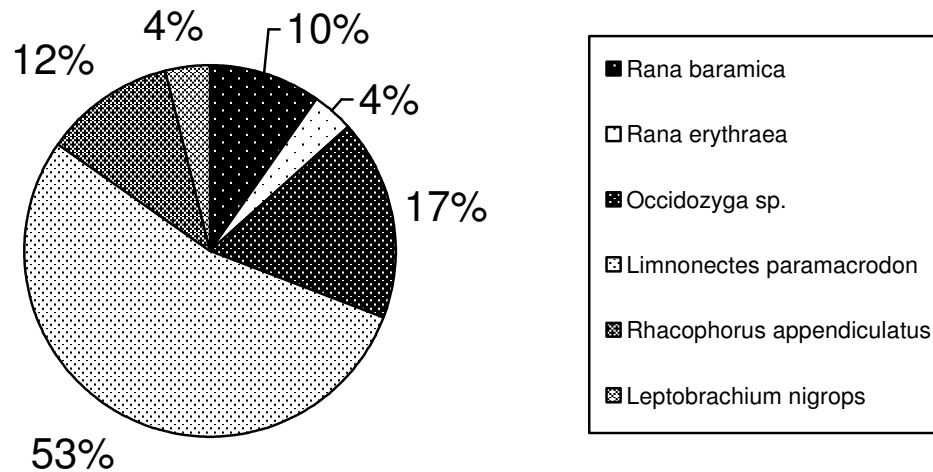
Although a total of twelve species were identified in the study area only six of these were encountered on the Visual Encounter Surveys (VES). Over three repeats for each of the eight VES sites a total of 52 individuals were found. The species abundances are shown in table 1. Of the 52 individuals *L. paramacrodon* accounted for 53.8% of the individuals found, this is over two fold higher than any of the other species. See Fig. 2.

**Table 1.3** A summary of the number of individuals found at each of the survey sites.

Species	Danua Buaya	Jalan Sungai	Jalan Yusran	Jalan Satu	Post 17 Stream	Umar's Pond	Jalan A1	Jalan 12	Total
<i>R. baramica</i>	0	0	1	1	0	1	2	0	5
<i>R. erythraea</i>	2	0	0	0	0	0	0	0	2
<i>Occidozyga sp.</i>	6	0	0	1	0	0	2	0	9
<i>L. paramacrodon</i>	1	0	0	0	26	0	1	0	28
<i>R. appendiculatus</i>	0	0	0	0	0	6	0	0	6

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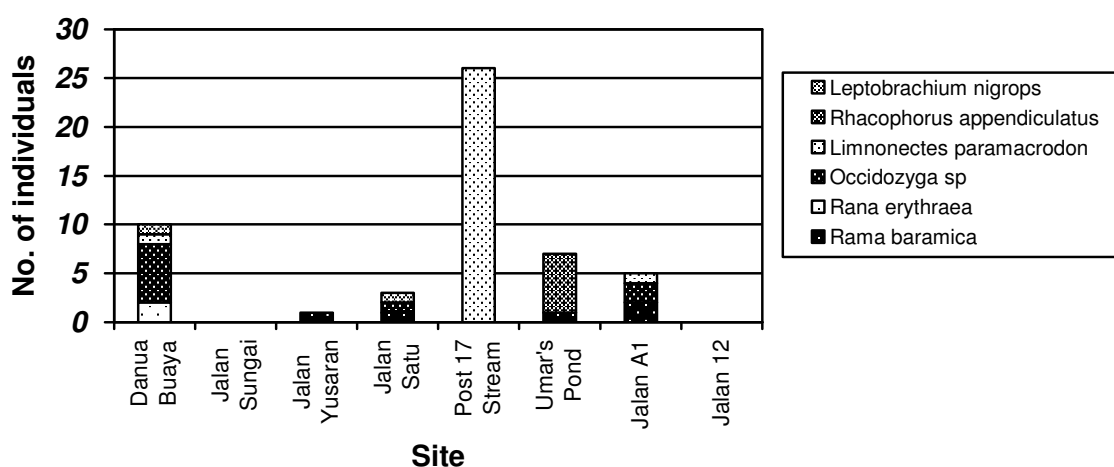
Species	Danua Buaya	Jalan Sungai	Jalan Yusran	Jalan Satu	Post 17 Stream	Umar's Pond	Jalan A1	Jalan 12	Total
<i>L. nigrops</i>	1	0	0	1	0	0	0	0	2



**Fig 1.** A piechart demonstrating the percentage of species recorded on all visual encounter surveys.

The species abundance and composition varies between all of the sites. On Jalan Sungai transect and Jalan 12 quadrat no individuals were encountered over the repeats. In contrast Post 17 Stream transect yielded 26 *L. paramacrodon* individuals over the same number of repeats, however no other species were observed at this site. Of the sites a which multiple species were found Danua Buaya had the highest species richness with four species of different Genus encountered, including; *R. erythraea*, *Occidozyga sp.*, *L. paramacrodon* and *L. nigrops*. On both Jalan Satu transect and Jalan A1 quadrat three species were found, *R. baramica* and *Occidozyga sp.* were common to both sites, whereas *L. nigrops* was found at Jalan Satu and *L. paramacrodon* at Jalan A1. Two species were encountered at Umar's pond quadrat; *R. appendiculatus* these and a single *R. baramica*.

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**Fig 2.** Species abundance at each of the eight survey sites.

The discrepancy in the number of surveys for each habitat type was due to time constraints and the logistics of setting up VES transects in suitable habitats. The highest number of species (four species) occurred in rivers / flooded areas and peat swamp forest habitats whereas only one species was found at the stream-dry ground forest habitat (see Fig. 3). However this species (*L. paramacrodon*) recorded the highest abundance. See Fig 2.

Habitat Type	No. Sites	No. Surveys	No. Individuals	No. Species
Rivers / Seasonal flooded areas	2	12	10	4
Peat swamp forest	2	12	8	4
Dry ground forest	3	18	8	2
Stream-dry ground forest	1	6	26	1

**Fig 3.** Summary data for each of the habitat types.

## 5. DISCUSSION

### 5.1 Species Accounts

The assemblage of 12 species recorded from the Camp Leakey Study Area is of typical peat swamp forest community type, characterised by such species as *Limnonectes malesianus* and *L. paramacrodon*. *L. paramacrodon* was the most common species, with 28 individuals recorded and the species itself recorded on seven separate occasions. Most individuals were found at the 'Post 17 Stream' transect. Indeed, this species is almost always found along the banks of small streams where it presumably also breeds (Inger and Stuebing, 1997). *L. malesianus* was only seen once ( $n = 1$ ), also at a small stream/pig wallow, but was not recorded at any of the survey sites. It is also known from the 'Jalan A1' swamp forest area (Shonleben, 2005). The toad *Pseudobufo subasper* was often seen in the margins of the Sekonyer kanan river at night, resting in the water amongst vegetation, but



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was not seen any of the river transects, perhaps because of the dryness of the habitat at that time of year. A possible method for further survey of this and other Riparian species (e.g. *Rana erythraea*) would be to survey from a canoe. In addition to these swamp species, hilly lowland forest taxa were also seen, individuals belonging to the species of *Rana*, *Kalophrynus*, *Polypedates* and *Rhacophorus* genus'. Another species recorded is a common, widespread commensal of man: *Polypedates leucomystax*. This taxon was expected to occur in the area. Some notable exceptions include swamp forest species such as *Bufo quadriporcatus* (rufous toads) and *Rana glandulosa* (rough-sided frogs) although a very closely related species of the latter, *Rana baramica*, was recorded and the two are known to occur in similar habitats. *B. quadriporcatus* is 'very abundant' in peat swamp forests near the coast (Inger and Stuebing, 1997) and its absence is curious - a repeat wet season study is needed to assess overall species composition of the site. Another very common species not seen (but known from almost every site ever studied in Borneo) is the Cinnamon Treefrog (*Nyctixalus pictus*). The most abundant Treefrog encountered was *Rhacophorus appendiculatus*, and this species may replace *N. pictus* in this area. Of particular interest is the occurrence of *Leptobrachium nigrops* and *Occidozyga* spp. *L. nigrops* is only previously known from flat and hilly forests and swampy terrain in coastal areas of Sabah, Malaysian Borneo (Inger and Stuebing, 1997). *Occidozyga* could not be identified satisfactorily to species level. The species known from Borneo (*O. sumatrana*) is larger (SVL up to 48mm) whereas no individuals were found larger than 28mm SVL (n = 16). It possessed a dorsal stripe, as in *O. sumatrana*, but the stripe was very thin and narrow, and not present in all individuals. There was no yellow tinge to the underside (instead uniform white) and the overall colour was grey-green with some black spots. The species most resembles *O. lima*, a species known from Java (Iskandar, 1998). The call of *Occidozyga* from the Study Area was recorded. The call of *O. sumatrana* is unknown. The call of *O. lima* is not described in Iskandar (1998). This species is being investigated further by Sam Shonleben.

## 5.2 Visual Encounter Surveys

Unfortunately, results are influenced by the different amount of survey effort at each habitat. The highest number of surveys were undertaken in dry-ground forest (eighteen surveys) followed by peat-swamp forest and river habitat (twelve surveys each) and stream habitat (six surveys). This discrepancy represents the fact that dry ground forest is the most common habitat type found within the study area. Due to the time available and logistics fewer surveys were done in the less common habitat types such as stream habitats. Obviously this source of bias will need to be reduced and the same number of surveys undertaken in each habitat type for any further study. However, even though the dry ground forests had the greatest survey effort this site had the second lowest species richness and only eight individuals were found. Peat-swamp forest and river habitats, both with a medium level of effort, had the highest species richness. This indicates that there is not a great bias from different levels of survey effort in different habitats.

Less than half of the total species found were encountered during actual visual encounter surveys. Seven other species were found in most cases by camp assistants who spent longer hours in the field over a wider area and thus had a greater chance of encountering species. The local camp assistants, many of whom were brought up in the forest have excellent search images for all wildlife including amphibians of which their knowledge was

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extensive (only Project Kodok members undertook VES's to standardise effort).

The highest species diversity observed in peat swamp and river habitats could be due to the fact that these habitat types retain the most rainfall for most of the year. Even though our survey took place during the dry season these habitats were consistently the wettest and thus would be most suitable for frog species that closely tied to wet habitats. Another reason for the high species richness is the greater availability of micro-habitats and niches in peat swamp habitats. This habitat also has the highest floral diversity.

The lowest species richness was observed along the stream habitat in dry ground forest. The single species found here, the Fanged Frog (*L. paramacrodon*) also had the highest abundance of any of the species encountered in our VES. The presence of a single species in high numbers indicates that this taxon could be out-competing other frog species and excluding them from the habitat. Males of the genus *Limnonectes*, of which *L. paramacrodon* is a member, are known to compete intraspecifically for nest areas along streams and rivers. Males compete directly utilising their enlarged mandibular processes (fangs) and also have enlarged heads and jaw and shoulder muscles. The only other species of this genus, *L. malesianus*, was encountered only once (one individual) at a similar stream site less than 0.5km away along with several *L. paramacrodon*. Another possible reason for the low species richness could be the uniform nature of the stream habitat with possibly less micro-habitats available.

### 5.3 Evaluation of Project Success

Project Kodok was set up as an undergraduate study to contribute to the understanding of populations of a vulnerable taxonomic group in Tanjung Puting National Park, namely Anura. It was carried out in the dry season, as this was the only time the members had a break in their studies and funding was available. Frogs and toads breed mainly in the wet season, when there is enough water to support the tadpoles until they undergo metamorphosis. This means that during this time adults of both sexes congregate at breeding sites, making them easier to locate. In the dry season however, frogs do not just 'disappear', but may hide themselves away to avoid prolonged exposure to the heat. This makes the task of finding them more difficult, but by no means renders search efforts as useless.

The lack of rain means that the methodology of assessing population abundance and species richness had to be adjusted to account for the change in the Anuran activities. The vocalisation surveys were not reliable to assess the populations, as only breeding males call, and it was not the breeding season for many species. The amount of calling males at this time would therefore not be an accurate representation of the actual number of individuals present. Therefore we decided to adapt the visual encounter surveys used along transects to assess non vocalising species, into a method that could be used to assess vocalising species as well. We therefore chose three breeding sites, where frogs had been heard to call during the rains early on in our study, and marked out quadrats in which to systematically search for frogs. In this way data was still generated for vocalising species, although not to the same extent as using vocalising surveys in the wet season (for example Project Anuran phase V- see main report).

There are around 140 Anura species on the island of Borneo, with most research having

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been done in the Northern Malaysian provinces of Sabah and Sarawak. In terms of complete biodiversity, montane areas have a much higher species-richness than lowland areas, like Tanjung Puting. A gradient exists traveling inland, and the encounter rate of different species would be expected to rise along this gradient, as the land elevation increases. Therefore, although 12 species is not a high percentage of the total species count of Borneo (which is rising every year), it represents an expected number for such a lowland, coastal area.

The results of our project represent a 'snapshot' of the species present and their abundance using our methods during the particular environmental conditions at that particular time of year. Camp Leakey study area is a very transient and dynamic habitat consisting of rain-fed peat swamp, which in turn feeds the rivers, which themselves expand and contract during the year. To obtain a true picture of overall species richness and abundance over several years, a long term survey taken at all habitat types at different times of the year would need to be implemented.

## **6. CONCLUSION**

The aims of Project Kodok were two-fold: firstly to record and catalogue the anura species in the study area around Camp Leakey, Tanjung Puting National Park; and secondly to assess the species richness and abundance of these anura in the study area. In addition to this, an assessment would be made to see if the season and site would be suitable for a long term study (five years). Nothing was previously known about the anura populations in Tanjung Puting, so all the findings made were completely novel for this area.

Thirteen species in all were encountered during the research period, and each one was recorded photographically, and a full description made. Acute efforts were made to record vocalisations of the individuals found. This proved difficult, as not many were calling in the natural habitats due to the dry weather, and none of the individuals retained in the laboratory vocalised there, despite being heard calling before capture. Therefore only three species' vocalisations were recorded: *Occidozyga* sp, *Polypedates leucomystax* and *Rhacophorus appendiculatus*. The call of *Occidozyga* has never previously been recorded. From these descriptions a concise booklet will now be produced, to be sent to Camp Leakey to describe the anura in the study area, and can also be a reference for anyone undertaking further studies there. This is in addition to the dissemination of our findings via this report, and will be designed to be accessible to tourists and students, and not just experts of the field.

The visual encounter surveys, both in the quadrats and along the transects did not generate significantly strong data. This was mostly due to the dryness of the season: notably more frogs were found after two nights of heavy rainfall (4-8 hours), which strongly supports this idea. The season grew continually drier during our research period as well, with the Sekonyer River dropping by around 2-3 feet over six weeks, and the majority of the swamp habitats becoming completely devoid of water. However, from the individuals we did find, and from anecdotal sightings by camp staff at different times of year, we feel that a similar type of survey during the wet season would produce highly representative data of the species richness and abundance in the area, and strongly recommend this site for further

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study. Unfortunately, an undergraduate team from Edinburgh would be unable to do this, due to logistical and financial practicalities, and so we are unable to make Project Kodok a long term study.

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