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Breeding Activities of *Ingerophrynus parvus* (Anura: Bufonidae) in Kedah, Malaysia

(Aktiviti Pembiakan *Ingerophrynus parvus* (Anura: Bufonidae) di Kedah, Malaysia)

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ABSTRACT

The breeding activities of the Dwarf Toad, Ingerophrynus parvus *were observed under natural conditions at Sungai Junjong, Kulim, Kedah, Peninsular Malaysia for a period of 12 months. Breeding parameters, such as calling activities, amplecant pairs, eggs deposition and presence of tadpoles were examined every week in each month. Pearson correlation was used to analyse the relationship between rainfall and each breeding parameter. The results showed positive relationships between rainfall and calling activities (*r*=0.74), between rainfall and amplexus activities (*r*=0.52), and between rainfall and spawning activities (0.81).*

Keywords: Amphibian; frog; rainfall; reproductive cycle; tadpoles

ABSTRAK

Aktiviti pembiakan katak Puru Kerdil, Ingerophrynus parvus *telah dikaji secara semula jadi di Sungai Junjong, Kulim, Kedah, Semenanjung Malaysia selama 12 bulan. Parameter pembiakan, seperti aktiviti panggilan, pasangan mengawan, penghasilan telur dan kehadiran larva diperiksa pada setiap minggu. Ujian korelasi Pearson telah digunakan untuk menganalisis perhubungan antara jumlah hujan dan setiap parameter pembiakan. Hasil kajian menunjukkan terdapat perhubungan yang positif antara jumlah hujan dan aktiviti panggilan (*r*=0.74), antara jumlah hujan dan aktiviti mengawan (*r*=0.52) dan antara jumlah hujan dan aktiviti penghasilan telur (0.81).*

Kata kunci: Amfibia; berudu; jumlah hujan; katak; kitaran pembiakan

INTRODUCTION

In Peninsular Malaysia, 17 species of toad from 8 genera represent the family of Bufonidae. The eight genera include *Ansonia* (7 species), *Ingerophrynus* (4 species), *Phrynoidis* (1 species), *Duttaphrynus* (1 species), *Leptophryne* (1 species), *Pedostibes* (1 species), *Pelophryne* (1 species) and *Pseudobufo* (1 species) (Norhayati et al. 2009). *Ingerophrynus parvus* is a small stocky bufonid found on the forest floor, swampy area and near streams in the forest (Berry 1975). This species is widely distributed in Peninsular Malaysia, Thailand, South Burma and Sumatera (Taylor 1962) but is not found in Borneo (Kiew 1984).

There are a few amplectic positions in anuran, such as inguinal, axillary, cephalic, straddle, glued and independent (Duellman & Trueb 1986). In *I. parvus* the amplexus activities begin when the male frogs grasp the axillary of the females. Axillary amplexus normally involves the male grasping the female in the axilla and their nuptial pads pressed tightly into the axilla. The pairs will stay in this amplectic position for a few hours until the females spawn their eggs in the water and the males fertilize them.

Toads from the family Bufonidae usually produce a lot of eggs in string form and breed in stagnant or slow moving water (Inger 1966). *I. parvus* breeds in temporary pools that connect to streams, rainpool puddles (Taylor 1962) and in swampy areas (Arak 1984). It also breeds in pools alongside small streams and rocky pools beside small creeks (Inger et al. 1974). Other species of bufonids, such as *Duttaphrynus melanostictus* from India, breed in ditches and puddles (Saidapur & Girish 2001). In Thailand, *Bufo macrotis* breeds in temporary puddles near rivers and small streams in the forest (Taylor 1962), while in Sabah, *Bufo divergens* breeds in small and intermediate streams in the forest (Inger & Stuebing 1989).

In tropical Asia, scientists have done researches on breeding and development of tropical frogs. For examples, Church (1960a, 1960b) studied the sexual cycle of *Duttaphrynus melanostictus* and breeding pattern of *Fejervarya cancrivora*, Inger and Greenberg (1963) studied the reproductive pattern of *Hylarana erythraea*, Berry (1964) studied the breeding pattern of seven species of anurans, Inger and Bacon (1968) studied the reproduction and cluth size of several forest frogs, Kanamadi et al. (2002) studied the breeding period of *Kaloula pulchra*, Ibrahim et al. (1999) studied the reproductive pattern of *Fejervarya limnocharis* and *F. cancrivora*, Leong (2002) studied the status of larva identities, Biju (2003) studied the reproductive mode of *Philautus glandulosus*, Gururaja and Ramachandra

(2006) studied the developmental mode of *Philautus* cf. *leucorhinus* and Sheridan (2008) studied breeding behaviour of *Polypedates leucomystax*. The purpose of this study was to examine the breeding activities of Malaysian Dwarf Toad, *I. parvus* under natural conditions at Sungai Junjong, Kedah, Malaysia.

Materials and Methods

The breeding activities of *I. parvus* were conducted under natural conditions at Junjong River (5^0 17'N, 100^0 33'E) (< 300 m asl) in Kedah, Malaysia (Figure 1) for a period of 12 months. This area is located at Kulim Bandar Baru district, about 15 km from Kulim town and is surrounded by fruit orchards, rubber plantations and old secondary forests. Several tree species, such as *Hevea brasiliensis*, *Durio zibethinus*, *Garcinia mangostana*, *Nephelium lappaceum*, *Artocarpus elasticus*, *Ficus conglomerata* and *Pithecellobium jiringa* were found here. The understorey species were dominated by ferns, herbs, epiphytes and shrubs. The physical descriptions of Junjong River are shown in Table 1.

TABLE 1. The physical descriptions of Junjong River

Coordinate	5^0 17' N/100^0 33'E
Altitude	< 300 m asl
Width	2-5 m, with big rocks and boulders
Flow	Fast flowing with several cascade areas
Substrate	sand and pebble stones
Vegetation	fern, araceae, bamboo, herb, shrub

We visited the study sites one day every week (4 times per month) to observe and record all the breeding parameters, namely calling activities, amplexus activities, eggs deposition and the presence of larvae. The total number of field work observations was 48 times. All the activities were observed at night (1900h-0200h), except for the presence of larvae, which was done at day time (0900h-0000h). Examination of each parameter was done at a distance of 300 m along the stream. The calling activities were determined based on the number of calling males, while amplexus activities were based on the number of amplecant pairs that were found along the stream. The number of egg clutches produced by female frogs determined the spawning activities, while larvae were recorded based on their presence or absence.

Data on rainfall, relative humidity, minimum and maximum temperature of the study sites were obtained from the Meteorology Department, Petaling Jaya, Selangor. The relationships between rainfall and all

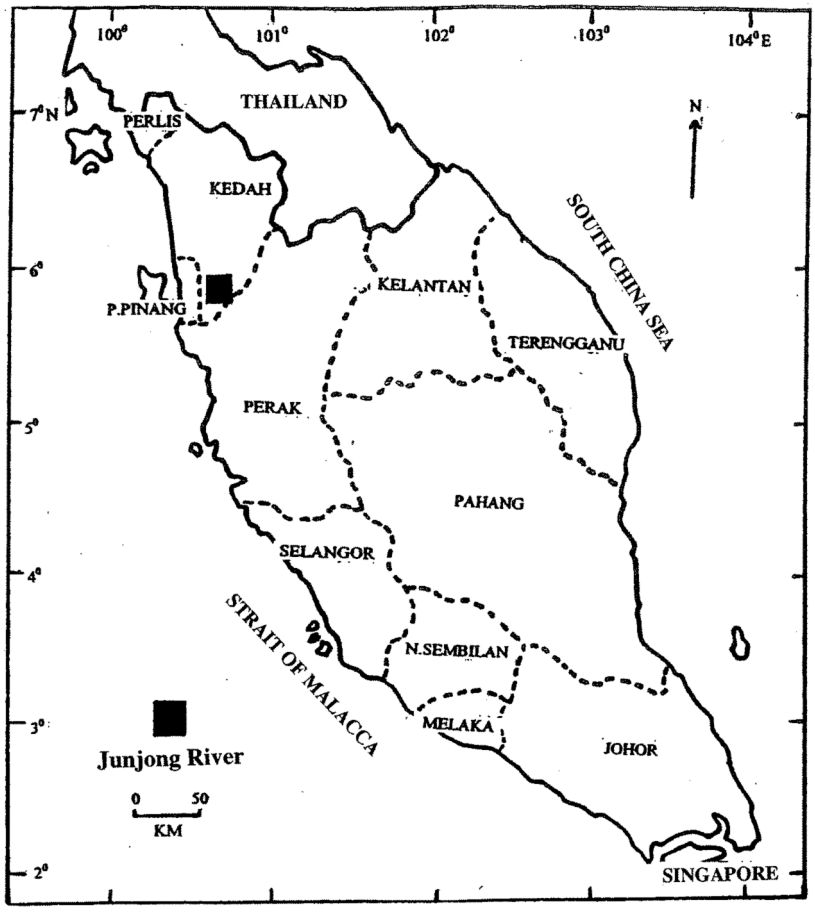

FIGURE 1. Location of Junjong River, Kedah

the breeding parameters were analysed using Pearson correlation (SPSS 13).

RESULTS

The males of *I. parvus* produced their calling activities actively every month, except in March 1998 and February 1999. These activities became more active in August 1998 (10 individuals) and October 1998 (9 individuals) when the rainfall was high at 413 mm and 553 mm, respectively. The monthly mean value of calling activities for *I. parvus* was 4.92 ± 3.30 individuals (0-13 individuals, 13).

The number of amplecant pairs found during the survey period was very low throughout the months, except in August 1998 (4 pairs) when the rainfall was 412.7 mm. The monthly mean value of amplecant pairs was 0.85 pairs (0-4 pairs, 13). Meanwhile, the highest number of egg clutches was also found in August 1998 (3 clutches) with the monthly mean value of 0.7 cluthes (0-3 clutches, 13). Although the number of amplecant pairs and egg clutches were low, the larvae at various stages of development were easily found every month, except November 1998, December 1998 and March 1999. All the data on breeding parameters are shown in Table 2, while the data on rainfall, relative humidity and temperature are shown in Table 3.

Pearson correlation was used to determine the relationship between the rainfall and all the breeding activities. From the results, there was a positive correlation between rainfall and calling activities (r=0.74, p<0.01) (Figure 2(a)), between rainfall and amplexus activities (r=0.52, p>0.01) (Figure 2(b)) and between rainfall and egg depositions (r=0.81, p<0.01) (Figure 2(c)).

DISCUSSION

Calling activities were the method used by male frogs to attract females during their breeding season (Toledo & Haddad 2005). In this study, the calling activities produced by *I. parvus* occurred almost every month. Although the rainfall was low in April 1998 (99.0 mm) and June 1998 (140.3 mm), two and seven calling activities were recorded, respectively. The high rainfall in August 1998 (412.7 mm), October 1998 (553.3 mm) and November 1998 (427.9 mm) made this activity more active with ten, nine and eight calling activities recorded, respectively. Positive correlation between these two parameters indicated the influence of rainfall on the calling activities. Girish and Kanamadi (2000) also reported the influence of rainfall on the calling activities of the Malabar gliding frog.

From our observations, only a few amplecant pairs were found in certain months, in which the highest was in August 1998 (4 pairs), when the rainfall was 412.7 mm. Pearson correlation between these two parameters shows a positive relationship. Several types of oviposition occurred in frog fauna, such as aquatic oviposition, arboreal oviposition, foam nest contruction and others (Duellman & Trueb 1986). For *I. parvus,* they spawn their eggs in the water (aquatic oviposition). The egg clutches of *I. parvus* were found in certain months at their breeding sites, in which the highest was also in August 1998 (three clutches). Pearson correlation shows a positive relationship between the rainfall and egg clutches, which indicates the influences of rainfall on the spawning activities. The tadpoles of *I. parvus* at various stages of development were easily detected in the puddles and temporary pools near the stream in almost every month.

TABLE 2. The breeding activities of *I. parvus* at Junjong River, Kulim, Kedah

Month	Rainfall (mm)	Calling (individuals)	Amplexus (pairs)	Egg clutches	Larvae
Mar 98	35.1	-	-	-	P
Apr 98	99.0	2	-	-	P
May 98	357.8	4	-	1	P
Jun 98	140.3	7	1	-	P
Jul 98	213.5	8	-	-	P
Aug 98	412.7	10	4	3	P
Sep 98	274.4	5	-	1	P
Oct 98	553.3	9	2	2	P
Nov 98	427.9	8	1	1	-
Des 98	224.9	4	-	-	-
Jan 99	227.9	6	3	1	P
Feb 99	124.9	-	-	-	P
Mac 99	182.1	1	-	-	-
Total	3273.8	64	11	9	
Mean	251.83	4.92	0.85	0.7	
SD	143.05	3.3	-	-	
Range	35-553	0-10	0-4	0-3	

Note: P = Present

TABLE 3. The monthly rainfall, relative humidity, minimum and maximum temperature

Month	Number if raining days	Rainfall (mm)	Humidity (%)	Min temperature (°C)	Max temperature (°C)
Mar 98	3	35.1	95	23.3	36.4
Apr 98	10	99.0	94	24.3	36.0
May 98	18	357.8	95	24.7	34.4
Jun 98	13	140.3	95	23.8	33.1
Jul 98	18	213.5	93	23.3	33.3
Aug 98	20	412.7	95	22.9	32.5
Sep 98	13	274.4	95	23.2	32.7
Oct 98	22	553.3	93	23.2	32.4
Nov 98	21	427.9	95	23.1	32.6
Des 98	16	224.9	96	22.8	32.3
Jan 99	12	227.9	95	22.4	33.3
Feb 99	14	124.9	93	22.8	33.7
Mac 99	13	182.1	94	23.0	33.6
Total	193	3273.8	1228	302.8	436.3
Mean	14.8	251.83	94.5	23.3	33.56
SD	4.96	143.05	0.93	0.61	1.27
Range	3.0-22	35.1-553.3	93-96	22.4-24.7	32.3-36.4

Note:
Min. = Minimum
Max. = Maximum
Elevation: 32 meters above sea level
Source: Meteorology Department, Petaling Jaya, Selangor

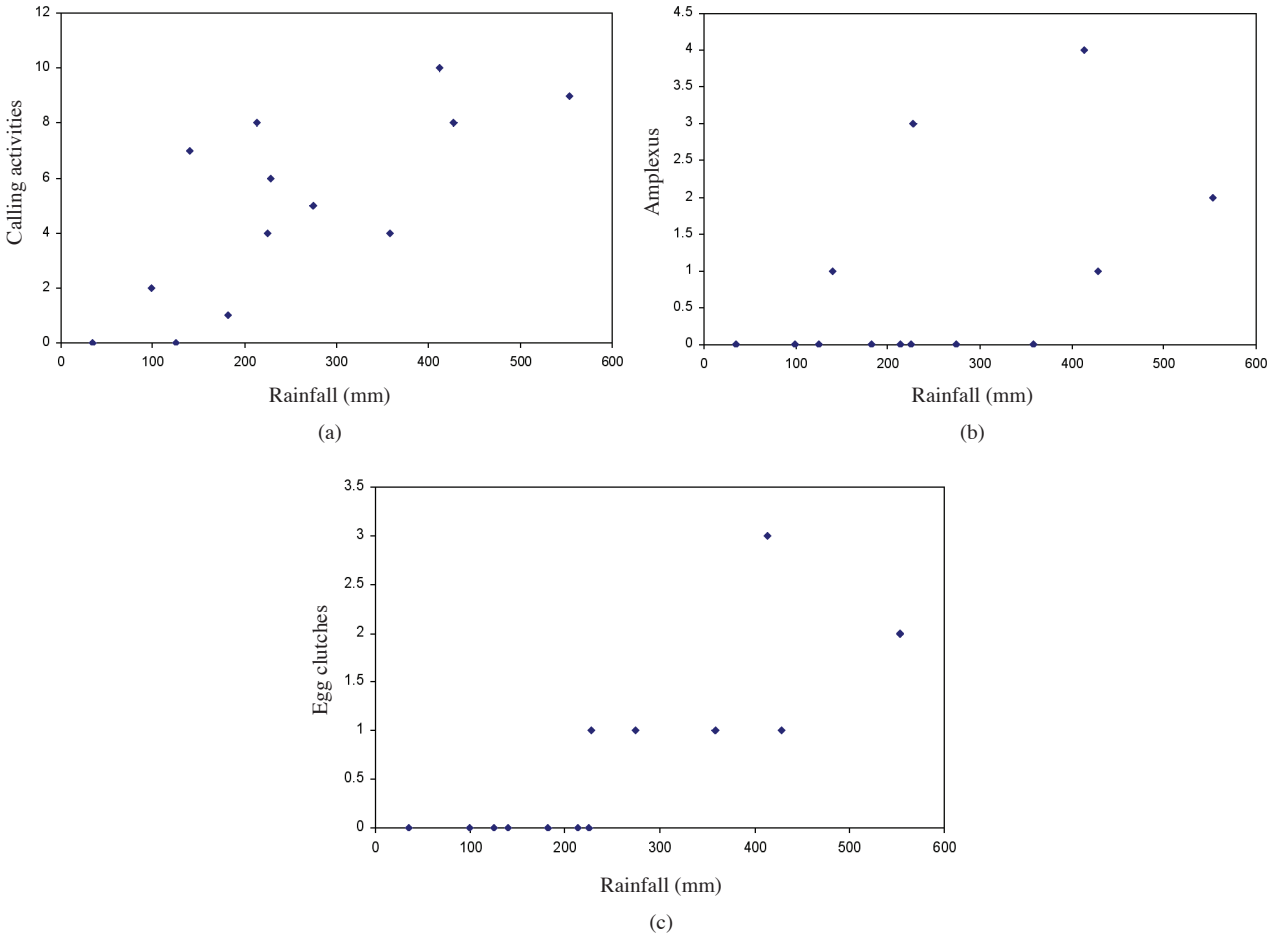

FIGURE 2. (a) The correlation between calling activities and rainfall for *I. parvus* (r=0.74), (b) The correlation between amplexus activities and rainfall for *I. parvus* (r=0.52) and (c) The correlation between egg clutches and rainfall for *I. parvus* (r=0.81)

The increasing rainfall seems to increase all the three breeding parameters as shown in Figure 2. This indicated that rainfall played an important role in activating and stimulating breeding activities of these frogs. Puddles, rainpools and temporary ponds emerge when there is rainfall and become the most important breeding sites for frogs (Gascon 1991; Prado et al. 2005; Zina & Haddad 2005). *I. parvus* uses ephemeral water bodies to breed and this type of water bodies fully depend on rainfall for the source of water. This species does not breed in the stream because rapid water flow can drift away all their eggs. Although there was a light or heavy rainfall, the calling activities of male frogs and larvae of *I. parvus* have been heard and seen in almost every month. These indicated that the breeding activities of this species occurred throughout the year without any specific season.

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REFERENCES

Arak, A. 1984. Sex and song in Malaysian frog and toads. *Malayan Naturalist* 1984: 20-24.

Berry, P.Y. 1964. The breeding patterns of seven species of Singapore Anura. *Journal of Animal Ecology* 13: 227-243.

Berry, P.Y. 1975. *The Amphibian Fauna of Peninsular Malaysia*. Kuala Lumpur: Tropical Press.

Biju, S.D. 2003. Reproductive mode in the Shrub Frog *Philautus glandulosus* (Jerdon, 1853) (Anura: Rhacophoridae). *Current Science* 84: 283-284.

Church, G. 1960a. Annual and lunar periodicity in the sexual cycle of the Javanese Toad, *Bufo melanostictus* Schneider. *Zoologica* 45: 181-188.

Church, G. 1960b. The effect of seasonal and Lunar changes on the breeding pattern of the edible Javanese Frog, *Rana cancrivora* Gravenhorst. *Truebia* 25: 215-233.

Duellman, W.E. & Trueb, L. 1986. *Biology of Amphibians*. New York: McGraw-Hill Book Company.

Gascon, C. 1991. Breeding of *Leptodactylus knudseni*: Responses to rainfall variation. *Copeia* 1991: 248-252.

Girish, G.K. & Kanamadi, R.D. 2000. Courtship and nesting behavior of the Malabar gliding frog, *Rhacophorus malabaricus* (Jerdon, 1870). *Current Science* 79: 377-380.

Ibrahim, H.J., Ahmad, I. & Rahman, K.A. 1999. Correlations of reproductive parameter of two tropical frogs from Malaysia. *Asiatic Herpetological Research* 8: 48-52.

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

Inger, R.F. & Bacon, J.P. 1968. Annual reproduction and clutch size in rain forest frogs from Sarawak. *Copeia* 1968: 602-606.

Inger, R.F. & Greenberg, B. 1963. The annual reproductive pattern of the frog *Rana erythraea* in Sarawak. *Physiology Zoology* 36: 21-33.

Inger, R.F. & Stuebing, R.B. 1989. *Frogs of Sabah*. Kota Kinabalu: Sabah Park Trustees.

Inger, R.F., Voris, H.K. & Voris, H.H. 1974. Genetic variation and population ecology of some Southeast Asian frogs of the Genera *Bufo* and *Rana*. *Biochemical Genetics* 12: 121-145.

Kanamadi, R.D., Kadadevaru, G.G. & Schneider, H. 2002. Advertisement call and breeding period of the frog, *Kaloula pulchra* (Microhylidae). *Herpetological Review* 33: 19-21.

Kiew, B.H. 1984. Conservation status of the Malaysian fauna (III Amphibians). *Malayan Naturalist* 37(4): 6-10.

Leong, T.M. 2002. Status of larval identities among the Peninsular Malaysian Anura. *Herpetological Review* 33(3): 171-174.

Norhayati, A., Belabut, D. & Chan, K.O. 2009. Amphibia My: Amphibians and reptiles of Peninsular Malaysia [Online], [Access on 20 December 2009]. http://amphibia.my.

Prado, C.P.A., Uetanabaro, M. & Haddad, C.F.B. 2005. Breeding activity patterns, reproductive modes and habitat use by Anurans (Amphibia) in a seasonal environment in the Pantanal, Brazil. *Amphibia-Reptilia* 26: 211-221.

Saidapur, S.K. & Girish, S. 2001. Growth and metamorphosis of *Bufo melanostictus* tadpoles: Effects of kinship and density. *Journal of Herpetology* 35: 249-254.

Sheridan, J.A. 2008. Ecology and behavior of *Polypedates leucomystax* (Anura: Rhacophoridae) in northest Thailand. *Herpetological Review* 39: 165-169.

Taylor, E.H. 1962. The amphibian fauna of Thailand. *University of Kansas Science Bulletin* 43: 265-599.

Toledo, L.F. & Haddad, C.F.B. 2005. Acoustic repertoire and calling behavior of *Scinax fuscomarginatus* (Anura, Hylidae). *Journal of Herpetology* 39: 455-464.

Zina, J. & Haddad, C.F.B. 2005. Reproductive activity and vocalizations of *Laptodactylus labyrinthicus* (Anura: Leptodactylidae) in southeastern Brazil. *Biota Neotropica* 5: 1-11.

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