

**REDESCRIPTION OF FIVE SPECIES OF THE GENUS *LYCODON* (BOIE, 1826)
(SERPENTS, COLUBRIDAE) ON THE BASIS OF MORPHOLOGICAL VARIATION
COLLECTED FROM BIRBHUM, WEST BENGAL, INDIA**

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ABSTRACT

A comparative morphometric study was done on five species of *Lycodon*, *L. aulicus*, *L. capucinus*, *L. travancoricus*, *L. fasciatus* and *L. striatus*. All the species differ from each other on several aspects like number of supralabials, infralabials, ventrals, dorsals, distances between eye to nostril, eye diameter, number and shape of the banding pattern. A key is framed on the basis of presence or absence of band in between head and neck and number of supra- and infra-labials.

KEYWORDS: *Banding Pattern, Infralabials, Lycodon, Morphometry, Supralabials*

Article History

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INTRODUCTION

One of the largest snake genera in the oriental region, *Lycodon* (Boie, 1826) (Uetz, 2011) has been a subject of study by numerous renowned workers (Vogel et al, 2012; Siler et al, 2012; Zhang et al, 2011; Vogel and Luo, 2011; Vogel and David 2010; Gaulke 2002; Lanza, 1999; Ota and Ross, 1994; Ota, 1988) at different corners like Laos, China, Thailand, Philippines, Taiwan etc. Consequently, it should be noted that a good number of new species has been described by recent workers (Vogel et al, 2012; Gaulke, 2002; Slowinski et al 2001; Lanza, 1999). Furthermore, it is surprising to note that no such detailed investigation has been undertaken over the decades in India though the genera *Lycodon* is widely distributed all over the India. An underestimation of the number of species included in this genera still prevails due to its nocturnal, secretive activity (Vogel et al. 2012) and the misleading characteristic of shape of cross bars like kraits (Deoras, 1992).

Out of 100 genera of sub family Colubridae the genus *Lycodon* is separated characteristically in having dorsoventrally depressed head, small eyes with vertically elliptical pupils, large nostril, strongly arched maxillary bone which is bent inwards anteriorly with fang like curved anterior teeth with a gap to the very large anterior teeth, smooth or feebly keeled dorsal scales in 17, 19 or 21 rows at mid body and ventrals. (Malkmus et al. 2002). As the genera still yet to be unexplored and the notable characteristic like colouration and banding patterns led the investigators to describe new species of the genera *Lycodon* in recent times (Vogel et al 2012; Gaulke, 2002; Lanza, 1999 etc). Taking all this account into consideration, the present review on the genera *Lycodon* has been undertaken.

The present study is based on the preserved specimens collected from different corners of Rampurhat, Birbhum district of West Bengal (24°10'52.96"N and 87°46'52.51"E). The investigation deals with the differences in morphology, some of which are species-specific. Variable characters are also incorporated in the present study to review and to give clarity of status of genera *Lycodon*.

MATERIALS AND METHODS

The study is based on comparison of 26 preserved specimens collected from different areas of Rampurhat, district Birbhum. The preserved specimens were examined for 18 morphological characters along with colouration, banding pattern, eye diameter and distance between centre of eye to nostril. All these except body and tail length were taken with the slide calipers to the nearest 0.1 mm. The measurements were taken in mm. Dorsal, ventral and subcaudal scales were counted. The banding pattern at different position of the body were recorded (distinct/ indistinct/ uncountable bands). Comparative statistical analysis on the morphological data were also evaluated.

Eighteen morphological characters were recorded for each specimen. The characters taken for study are listed in the table with their abbreviation (Table-1).

RESULTS

L. aulicus (Plate- 1)

Diagnosis

Head: Nine supra labials (3rd – 5th in continuation with eye), one preocular, one loreal (in good contact with nares), two postocular, two temporal (2+2 or 2+3), nine infralabials.

Dorsal: smooth scales with 17:17:15 rows, with single apical pit on each scale.

Ventral: 26-273, angulate laterally, anal entire.

Subcaudal: 43-54; paired.

Length: 600-700 mm, variable tail length.

Description

Dorsal: Body slender with smooth, shiny scale of brown or brown mixed with grayish or reddish. Yellow or yellowish white bands present on whole dorsal body starting from neck and become faint on tail region, rarely absent entirely. Bands are narrow on top of the dorsal and become wider on both the sides. Number of bands varies in between 10-25.

Ventral: Belly glossy white without any pattern. Sub caudal scales paired in zig zag fashion.

Head: Flattened, broader than neck and curved with smooth glossy scales. Whitish or yellow collar exist in widely distributed species. Eyes entirely black in appearance with vertically elliptical pupil.

Tongue: Pinkish red in colour.

Tail: Covered with smooth scales with faint bands. Pointed tip.

***L. striatus* (Plate-2)**

Diagnosis

Head: Eight supra labials (3rd to 5th entering the eye), one preocular does not reach the vertical, two postocular, temporal small, one loreal, six infra labial (two in contact with chin shields). Triangular in front and rectangular at base.

Dorsal: Smooth scales in 17 rows.

Ventral: 265-277, not angulate and entire.

Sub Caudal: 52-62, paired.

Length: 600-650 mm, tail 90-100 mm.

Description

Head: Head triangular, snout much depressed, slightly projected at the tip but posterior portion is rectangular in shape. Rostral much broader than deep, just visible from above. Angular whitish brown band in the head region. Eye rather small.

Dorsal: Body slender with smooth, shiny scales. The dorsal surface is chocolate in color. The anterior portion of dorsal side is much glossy while dull in the posterior. Bands are whitish with chocolate margin. Number of bands varies from 20-28. Later the bands become indistinguishable. Only chocolate brown spots are present instead of bands. True bands end before 1/3 rd of the body from posterior.

Ventral: Creamy white in color.

***L. travancoricus* (Plate-3)**

Diagnosis

Head: Rostral much broader, one loreal entering the eye not touching the internasal, one preocular in contact with frontal, two postoculars, temporal small (2+2 or 3+3). Eight supralabials, (3rd to 5th entering the eye), seven infralabials of which two are in contact with anterior chin shields.

Dorsal: Scales smooth, in 17 rows.

Ventral: 240-245, angulate laterally, anal entire.

Subcaudal: 50-60, paired.

Length: 450-504 mm, tail one-fifth of total length.

Description

Dorsal: Body slender with smooth scales. The dorsal side is deep brown in colour. Bands are white with dark brown spots from middle part of the body to tail end. In the dorsal side white bands are without spots but Y shaped cross bandings are observed in the lateral side. A band is observed in between head and neck. The tail bands are indistinct. There are more than 25 bands in between neck to vent.

Ventral: Whitish brown.

Head: Snout much depressed, eyes rather small. Rostral much broader, upper lip with white spot. Head is rather rhomboid in shape.

L. fasciatus (Plate4)

Diagnosis

Head: Head oval in shape. No band in head region. Broad rostral. Loreal long entering the eye. One preocular, two post ocular, temporal 2 + 2, eight supralabials (3rd to 5th entering the eye). Infralabials five to six (two in contact with anterior chin shield).

Dorsal: 17 rows of feebly keeled scales.

Ventral: 260-270, not angulate. Anal entire

Subcaudal: 49-51, paired.

Length: 680-695 mm, tail one seventh of total length.

Description

Head: Snout depressed, eye rather small. No band in head region.

Dorsal: Body covered with glossy scales. Well developed 3-4 whitish oval spots present in between neck and first band on the dorsal side. First spot always single and rests are single or double. Bands are light chocolate in colour separated by yellowish or reddish intervals. Number of true bands varies from 21-24 pairs. Tail bands are 17-18 singly arranged.

Ventral: Creamy white.

L. capucinus (Plate-5)

Diagnosis

Head: Head is triangular, no band in the head region. Rostral broad, one loreal extensive contact with internasal. Two preocular, 2 + 2 postocular, eight supralabials, six infralabials (two in contact with anterior chin shields).

Dorsal: 17 rows of smooth scales.

Ventral: 195-212, not angulate.

Subcaudal: 55-70, paired

Length: 652-720 mm, tail one fifth of total length.

Description

Head: The snout is duck billed shape. No band in head region. Eye is rather small.

Dorsal: Dorsal side is light chocolate. From neck to vent 28-32 white bands are present. All the bands including the band in between the head and neck are with deep brown margin. From vent to tip indistinct bands are present.

Ventral: Light brown to whitish in colour.

DISCUSSIONS

Statistical analysis was aimed to compare all the five species of *Lycodon*, *L. aulicus*, *L. striatus*, *L. travancoricus*, *L. fasciatus* and *L. capucinus* on the basis of snout vent length and tail length. The result shows that the snout-vent length (SVL) varies proportionately with the tail length (TL) in case of *L. aulicus* and *L. striatus* but tail length varies widely with the snout-vent length in other three species of *Lycodon*, *L. travancoricus*, *L. fasciatus* and *L. capucinus* (Figure 1, 2, 3, 4 & 5). Regression equation and P- values are presented in Table-2. But no significant variation is observed in least square method when all the five species of *Lycodon* sp. were considered as a whole (Figure 6). Distance between eye to nostril (EYEN) and diameter of eye (EYED) in percentage of snout -vent length was calculated for five species of *Lycodon* sp. and no significant variation is observed in least square method (Figure 7) and two-way ANOVA (Table-3). It's noteworthy that when all the five species are taken as a whole there is no significant variation because all the species belong to the same genus *Lycodon*.

It has been noted that 9 supralabials are present in case of *L. aulicus*, whereas, the other three species, *L. travancoricus*, *L. capucinus* and *L. striatus* possess 8 supralabials, while the other species *L. fasciatus* bears 6-8 supralabials in our present study. Number of infralabials varies within the five species, in *L. aulicus* and *L. striatus* both have 9 infralabials while the number of infralabials are 7, 6, and 5-6 in *L. travancoricus*, *L. capucinus* and *L. fasciatus* respectively in our study. Boulenger(1893) reported 8 supralabials each in *L. striatus* and *L. fasciatus* but 9 supralabials in both *L. aulicus* and *L. travancoricus*. Daltry and Wuster(2002) reported more in number of supralabials in *L. capucinus* than *L. fasciatus* (9-10 vs 8).

Type of dorsal scales also differs in five species. Dorsal scales of *L. aulicus* bear a single apical pit and that of *L. fasciatus* is feebly keeled. But in other three species dorsal scales are smooth. Daltry and Wuster (2002) reported that dorsal scale pattern in *L. capucinus* is smooth though it feebly keeled in *L. fasciatus*. Boulenger (1893) reported smooth dorsal scale present in *L. fasciatus*, *L. aulicus*, *L. travancoricus* and *L. striatus*.

Number of ventral scales in five species of *Lycodon* also differs. It is minimum (195-212) in *L. capucinus*, while maximum in *L. aulicus*, *L. striatus* and *L. fasciatus*, but in *L. travancoricus* the number of ventral scales are intermediate (240-245). Daltry and Wuster (2002) reported ventral scales in *L. capucinus* 182-214 and in *L. fasciatus* 189-224. In the present study *L. capucinus* bears 195-212 ventral scales but more in number in *L. fasciatus* (260-270). Generally ventral scales are not angulate except in *L. aulicus* and *L. travancoricus* where these are angulate laterally. Boulenger (1893) reported similar observation in *L. aulicus*, *L. travancoricus* in having obtusely angulate ventral scales and in *L. striatus* the ventral scales not angulate, but he mentioned that ventral scales of *L. fasciatus* is obtusely angulate which differs from our study.

Number of subcaudal scales is maximum in *L. capucinus* (55-70), minimum in *L. aulicus* and *L. fasciatus* (ranges from 43-54), but in *L. travancoricus* and *L. striatus* the numbers of subcaudal scales are almost same (50-62) in the present study. Vogel et al (2002) reported that less than 58 subcaudal are present in *L. States*, while it is 64-76 in *L. travancoricus*. Boulenger (1893) reported that numbers of subcaudals are 42-66 in *L. striatus*, 56-80 in *L. aulicus*, 56-76 in *L. travancoricus* 77-90 in *L. fasciatus*. Daltry and Wuster(2002) reported that number of subcaudals are 59-74 in *L. capucinus* and 66-94 in *L. fasciatus*. In respect to subcaudal scales, the report given by Jennifer et al is more or less similar to our study in *L. capucinus*. In case of *L. striatus* and *L. aulicus* Boulenger's report (1893) is same against our study. In *L. striatus* Vogel's report (2012) is similar to our case study, but in case of *L. travancoricus* the minimum subcaudal is

64 which is nearer to our maximum numbers (60). But in *L. fasciatus* our study is far behind than the report of Boulenger (1893) and Daltry and Wuster (2002).

Distance between eye to nostril is maximum in *L. aulicus* (average 5.5 mm), minimum in *L. capucinus* and *L. travancoricus* (average 4 mm) in each species, but intermediate in *L. fasciatus* (4-4.8 mm) and in *L. striatus* (4.5-5mm).

All the five specimens can be distinguished by colouration also. *L. fasciatus* differs from all four species in respect to its glossiness of scales. The dorsal surface of *L. aulicus* is brown or brownish grey or reddish grey in colour, while it is deep brown in *L. travancoricus*, chocolate in *L. striatus* and light chocolate in *L. capucinus*. Ventral surface of both *L. striatus* and *L. fasciatus* is creamy white, it is white in *L. aulicus*, whitish brown in *L. travancoricus* and light brown to whitish in *L. capucinus*. According to Boulenger (1893) the colouration of *L. aulicus* is brown above with uniform white lower part, that of *L. striatus* is dark brown or black above with uniform white lower part, but that of *L. travancoricus* is dark brown or black above with white below. Observations made by Boulenger support our study.

In case of *L. capucinus* a white band is present in between head and neck (Figure 6), from neck to vent 30 white bands are present with deep brown margin, no banding is in between vent and tail. According to Daltry and Wuster (2002) reticulate banding is present in *L. capucinus*.

In *L. travancoricus* bands are white from neck to middle part of the body but with chocolate spots in the later part of the body. Y shaped banding is observed in the lateral side. Starting from dorsal to lateral side 28 bands are present in between neck to vent and tail bands are indistinct. A band is observed in between head to neck (Figure 6). Boulenger (1893) reported white cross bands and white lineolations on side.

In *L. fasciatus* bands are light chocolate in colour separated by yellowish or reddish intervals (numbers of true bands vary from 21 to 24 pairs). Tail bands are 17-18 singly arranged. No band in between head and neck (Figure 6). According to Boulenger (1893) the body of *L. fasciatus* is encircled by broad purplish-black bands separated by yellowish or reddish intervals. Daltry and Wuster (2002) reported that *L. fasciatus* possess 24-49 bands. The observations of both the authors support our study.

In *L. aulicus* yellow or yellowish white bands are present on whole dorsal body starting from neck (including a distinct band in between head and neck, Figure 6) and become faint on tail region. Number of bands varies from 10-24. Boulenger (1893) reported uniform banding with white markings in *L. aulicus*.

In *L. striatus* an angular whitish brown band is present in between head and neck (Figure 6), from neck to vent 20-28 bands are present, later the bands become indistinguishable and chocolate brown spots are present instead of bands. True band ends before one third of the body from posterior. According to Boulenger (1893) transverse spots or cross bands are widely separated anteriorly in *L. striatus*; sides lineolated with white or with a black spot corresponds to each white cross band.

On the basis of our study considering the number of supralabials, infralabials and the presence of band in between head and neck (Figure 6) in five species *Lycodon* sp. is framed and presented as follows:

1. 9 supralabials.....*L. aulicus*
 Less than 9 supralabials.....2

2. 6 – 8 supralabials, no band in between head and neck.....*L. fasciatus*
8 supralabials, band in between head and neck.....3
3. 9 infralabials.....*L. striatus*
Less than 9 infralabials.....4
4. 6 infralabials.....*L. capucinus*
7 infralabials.....*L. travancoricus*

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APPENDICES

Table 1: Morphometric Characters of Five Species of *Lycodon* sp

Characters	<i>L. aulicus</i> (n=6)	<i>L. striatus</i> (n=6)	<i>L. travancoricus</i> (n=4)	<i>L. fasciatus</i> (n=3)	<i>L. capucinus</i> (n=5)
Snout vent length	525-600	507.5-545	365-420	590-604	533-590
Tail length (TaL)	86-100	92.5-105	75-85	90-92	119-135
Total length (TL)	611-700	600-650	440-504	680-695	652-720
Relative tail length (%)	0.159-0.170	0.182-0.193	0.200-0.216	0.151-0.153	0.220-0.233
Ventrals (VEN)	246-273	265-277	240-245	260-270	195-212
Type of ventrals	angulate not	angulate	angulate	not angulate not	angulate
Subcaudals (SC)	43-54	52-62	50-60	49-51	55-70
Type of subcaudals	paired	paired	paired	paired	paired
Loreals (Lor)	1+1	1+1	1+1	1+1	1+1
Supralabials (SL)	9+9	8+8	8+8	8+8	8+8
Infralabials (IL)	8+8	9+9	7+7	6+6	6+6
Preocular (Pre-Oc)	1+1	1+1	1+1	1+1	2+2
Postocular (Post-Oc)	2+2	2+2	2+2	2+2	2+2
Eye diameter (EYED)	2	2	2	1.6-2.0	2
Eye to nostril (EYEN)	5.5	4.5-5.0	4.0	4.0-4.8	4.0
No. of bands					
a) Head-Neck	1	1	1	0	1
b) Neck- Vent	10-24	20-28	25-28	21-24 pairs	28-32
c) Tail	faint	Indistinguishable with spot	indistinct	17-18 single	indistinct

Table 2: Statistical Data of Five Species of *Lycodon* sp.

Species	Regression	Equation P- Value	Significance
<i>L. aulicus</i>	Y= 0.9831X – 0.7355	0.0122	Significant
<i>L. striatus</i>	Y= 2.453X – 4.692	0.0298	Significant
<i>L. travancoricus</i>	Y= 0.07531X + 1.705	0.6336	Not significant
<i>L. fasciatus</i>	Y= 0.6444X + 0.1698	0.9607	Not significant
<i>L. capucinus</i>	Y= 1.024X – 0.7093	0.0691	Not significant

Table 3: Two Way ANOVA of Two Morphometric Characters (EYED and EYEN) Among Five Species

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.048469753	0.048469753	3.293062038	0.167206699
Residual	3	0.044156247	0.014718749		
Total	4	0.092626			

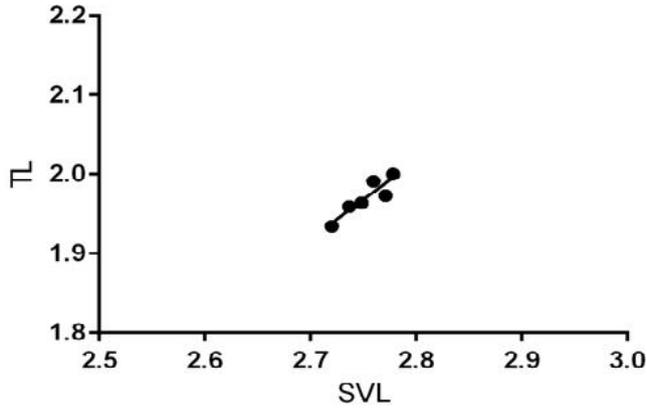


Figure 1: Regression of TL on SVL in *L. aulicus*

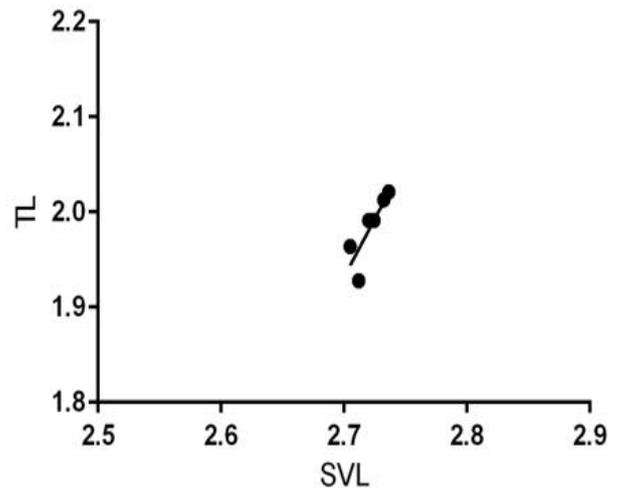


Figure 2: Regression of TL on SVL in *L. striatus*

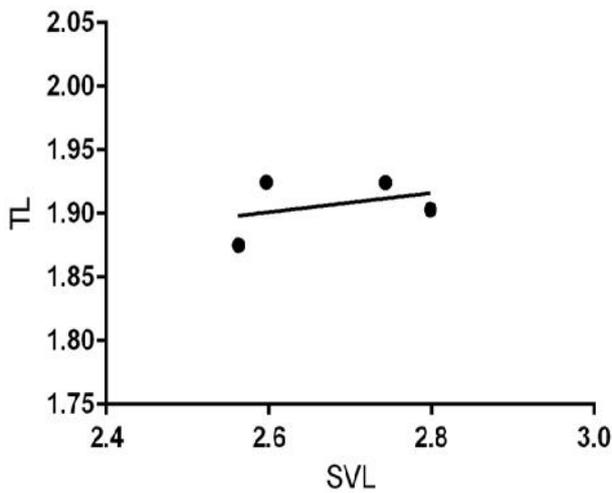


Figure 3: Regression of TL on SVL in *L. travancoricus*

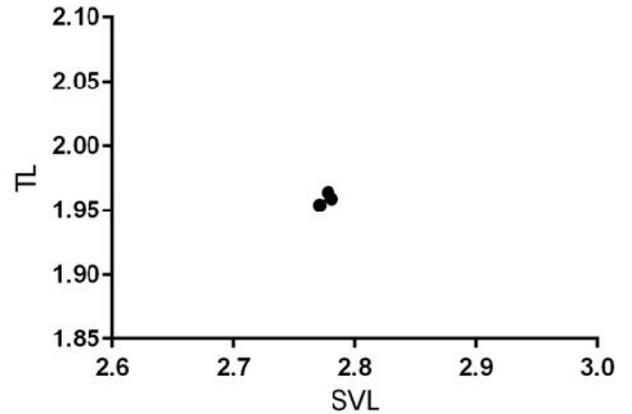


Figure 4: Regression of TL on SVL in *L. fasciatus*

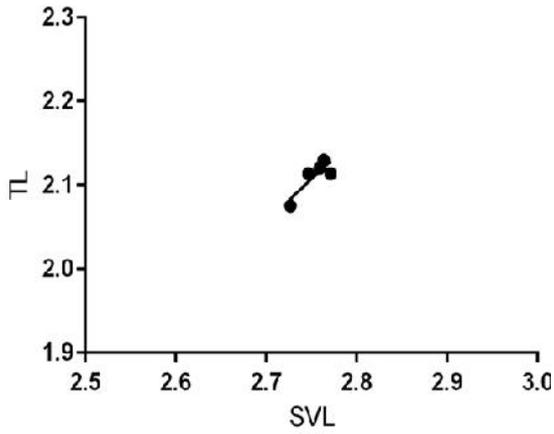


Figure 5: Regression of TL on SVL in *L. capucinus*

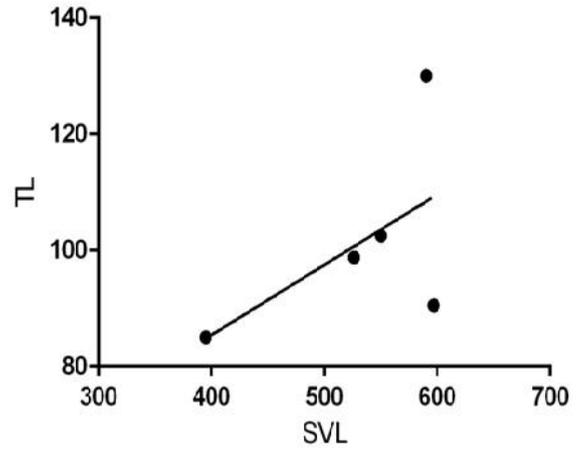


Figure 6: Regression of Tail Length (TL) on Snout-Vent Length (SVL) in Five Species of *Lycodon* sp. ($Y = 0.1210X + 37.03, P = 0.3183$, Not Significant)

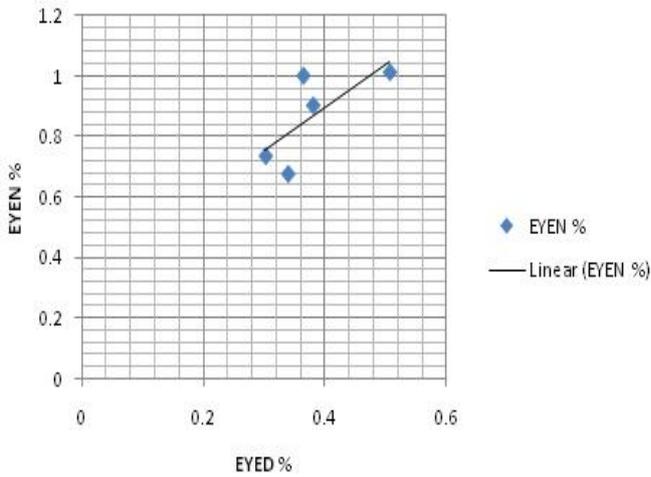


Figure 7: Regression of EYEN% on EYED% in Five Species of *Lycodon* sp. ($Y = 1.425X + 0.3272$)



Plate 1: *Lycodon aulicus*



Plate 2: *Lycodon striatus*



Plate 3: *Lycodon travancoricus*



Plate 4: *Lycodon fasciatus*



Plate 5: *Lycodon capucinus*

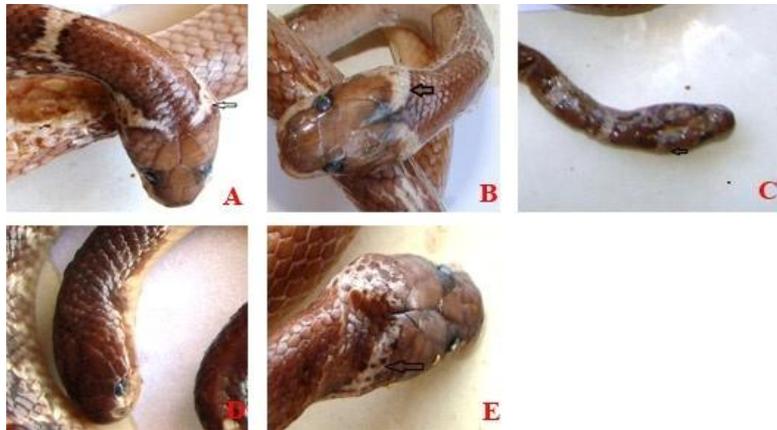


Plate 6: Heads of Five Species of *Lycodon* sp. Showing Band in between Head and Neck (A- *L. aulicus*, B- *L. striatus*, C- *L. travancoricus*, D- *L. fasciatus*, without Band and E- *L. capucinus*)

