ON INDIAN TADPOLES WITH A SUCTORIAL DISC.

By MIRA KRIPALANI, *M.Sc., Zoological Survey of India, Calcutta.*
(With One Plate.)

While working on the distribution and evolution of the species of frogs with tadpoles having a ventral suctorial disc, a specialised structure for life in torrential streams, it was found necessary to study in detail the Indian forms. For this purpose, both named and unnamed materials in the collection of the Zoological Survey of India were examined. As a result of this study, three species of tadpoles of this group have been established from India, *viz.*, *Staurois*[1] *afghana* (Günther), *S. himalayana* (Boulenger) and a new form. The range of the well known *S. afghana* has been extended from the Eastern to the Western Himalayas. *S. himalayana* tadpoles have now been definitely characterized. The new form is described here. A key to all the known species of tadpoles with suctorial discs has been given to distinguish the new tadpole.

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Staurois afghana (Günther).

(Plate, Fig. 1.)

1920. *Rana latopalmata*, Boulenger, *Rec. Ind. Mus.*, **20**, p. 217 (see this work for earlier references).
1930. *Rana latopalmata*, Cochran, *Proc. U. S. Nat. Mus. Washington*, **77**, p. 5.
1940. *Staurois afghanus*, Pope & Boring, *Peking Nat. Hist. Bull.*, **15**, p. 47.
1950. *Staurois afghanus*, Liu, *Fieldiana Zoology Memoirs*, **2**, p. 358.

Material Examined

Reg. No.	Locality.	Date and Donor/ Collector.	Number of specimens.
19752	Charan Khad below Dharamsala, Kangra dist., Punjab.	22-26. V. 1926. S. L. Hora.	11
20574	Kokla nalla, about ½ mile above its junction with Kosi River, Nepal.	29. I. 48. Kosi Survey.	7
19166	Manjhitar, Sikkim (The Great Rangit River).	VI. 1913. B. L. Chowdhury.	3
17768, 18448, 18453, 18456, 18457, 18458.	Darjiling dist., alt. 1000-3000 ft.	V-VI. 1912. Lord Charmichael.	17

[1]The generic name *Staurois* is used here as defined by Noble (*Ann. N. Y. Acad. Sci.* **30**, p. 107, 1927), without prejudice to the propriety or otherwise of its nomenclatorial usuage.

Material Examined—contd.

Reg. No.	Locality.	Date and Donor/ Collector.	Number of specimens.
17796	Kalimpong, Darjiling district, alt. 600-4, 500 ft.	IV-V 1915. F. H. Gravely.	67
19341	Pashok, Darjiling dist., E. Himalayas, alt. 3000 ft.	25. V. 1914. F. H. Gravely.	53
20576	Rilli River, below Kalimpong, Darjiling district.	29. I. 1931 S. L. Hora.	1
20572	A stream midway between Gille Khola Station and Tista bridge, Darjiling district.	3. II. 1931. S. L. Hora.	3
20573	A stream midway between Gille Khola Station and Tista bridge, Darjiling district.	1-14. VI. 1934. S. L. Hora.	22
18983[1], 19340.	Hill stream, above Tura, Garo Hills, Assam.	VI. 1917. S. W. Kemp.	15
16360, 16332	Cherrapunji, Khasi Hills, Assam.	B. Warren	2
10096, 10106, 10119.	Cherrapunji, Khasi Hills, Assam.	.. J. B. Bourne.	3
19935.	Non-priang stream below Cherrapunji, Khasi hills, alt. 1200 ft. Assam.	20-24. II. 1923. S. L. Hora.	3
20571.	Dumpep, Khasi Hills, Assam	IV. 1930. J. L. Bhadhuri.	Many
16966, 16967.	Yembung, Eastern side of Dihang River, Assam.	.. Abor Exped.; (Kemp.).	4
10205	Pegu, Burma	.. Major Berdmore.	1

Remarks.—The tadpoles of *S. afghana* can be readily distinguished from the other two Indian species by (i) the dental formula being $5^{3}5/1_{2}1$ and (ii) the margin of the posterior lip being, as a rule, slightly wavy and sometimes fimbriate.

A short but good description of the tadpole of *Staurois* (=*Rana*) *afghana* was given by Boulenger[2] in 1887, but in view of the large number of specimens examined it would not seem out of place to offer some further remarks on the tadpoles of this species.

There is always a row of papillae on the margin of the lip folds round the corners of the mouth, rarely extending to the margins of the posterior lip. Sometimes an extra row is present inside the postero-lateral margins of the anterior lip and beneath the outermost row of the labial teeth (Fig. 1).

[1]Registered numbers 18983 and 19340 previously determined as *R. livida* are now referred to *S. afghana* =*R. afghana*).

[2]Boulenger, G. A., *Am. Mus. Genova*, (2) 5, p. 420 (1887).

Most of the tadpoles have the colour of their jaws and labial teeth very dark but the lighter shade is not uncommon. This is well indicated, though was probably not noticed, by Dr. Hora[1] in the plate showing the development of the tadpole.

Sometimes there is a white marking on the upper jaw varying from the size of a dot to a V-shaped patch and sometimes even extending round its whole margin. It was due to this variable nature of the white marking that Smith was led to repudiate in 1929[2] his earlier identification of similar tadpoles as *Rana livida.*[3]

A few specimens (9 out of a lot of 250 tadpoles)[4] have jaws as well as labial teeth absolutely or nearly white. All these tadpoles have fore limbs fairly well developed and ventral sucking discs rather less prominently demarkated. Rest of the tadpoles, with black jaws and labial teeth, are without any trace of fore limbs, which, when present, are very minute. It is thus evident that the whiteness of the jaws and labial teeth indicates an advanced stage in the metamorphosis of the tadpole towards adulthood.

Colour of body olive above, with dark markings, if present. The specimens from Nepal are nearly black in colour with irregular ashy markings. The ventral surface is lighter and without markings. The tail portion is, as a rule, of the same colour as the body.

Measurement of a specimen with hind legs half developed: total length, 52 mm.; length of head and body, 17 mm.; body width, 11 mm.; tail length, 35 mm.; tail height, 8 mm.

Geographical distribution.—So far it has been recorded from the Eastern Himalayas (Sikkim & Darjiling), Khasi hills in Assam, Southern Yunnan, hills of Burma as far south as Tenasserim and Siam. Its range is here extended to Western Himalayas in Nepal and Kangra district of the Punjab.

Staurois himalayana (Boulenger).

(Plate, Fig. 2).

1920. *Rana himalayana*, Boulenger, *Rec. Ind. Mus.*, **20**, p. 219 (see for earlier references).

1951. *Rana himalayana*, Acharji, & Kripalani *Rec. Ind. Mus.*, **49**, p. 183.

Material Examined.

Reg. No.	Locality.	Date and Donor/ Collector.	Numbers of specimens.
17879[5]	Darjiling district. . .	III. 1914. Lord Charmichael.	2
20575	Rilli River below Kalimpong, Darjiling district.	29. I. 1931. S. L. Hora.	14

[1]Hora, S. L., *Trans. Roy. Soc. Edin.*, 57, pp. 469-472, (1932).

[2]Smith, M. A., *Rec. Ind. Mus.*, **31**, p. 78 (1929).

[3]Smith, M. A., *Rec. Ind. Mus.*, **26**, p. 139 (1924).

[4]These 9 specimens have Z. S. I. Nos. 10096, 10106, 10119, 18448, 18456-18458 and two specimens out of 53 registered under No. 19341.

[5]The two specimens under No. 17879 bear the label *R. formosa* determined by Boulenger. They are now referred to *S. himalayana.* The tadpoles of *R. formosa* have not yet been described.

Material Examined—contd.

Reg. No.	Locality.	Date and Doner/ Collector.	Number of specimens.
20577	A stream midway between Tista Bridge and Gille-Khola station, Darjiling district.	1-14. VI. 1934. S. L. Hora.	33
20579	Sikkim, alt. 2000 ft.	25. I. 1922. Major F. M. Bailey.	1

Remarks.—Annandale collected a tadpole with a suctorial disc from a stream at Kurseong situated at a height of 5,000 ft. in the Darjiling district during May 21st to May 29th, 1906. He described it as *Rana sp*[1]. Boulenger in his monograph on *Rana*, in 1920 doubtfully referred it to *Staurois* (=*Rana*) *himalayana*. He differentiated it from the tadpoles of *afghana*, then known as *latopalmata*, by its fringed lip, the dental formula $4^{3}4/1_{2}1$ and uniform colouration. There are 20 tadpoles in the Z. S. I[1]. Collection as listed above which agree with Annandale's description and are almost identical with those of *Staurois lifanensis* Liu of Szechwan in Western China. Liu[2], while discussing the relationships of *Staurois lifanensis*, remarked on the very close relationship between the adults of *S. lifanensis* and *S. himalayana*.

The tadpoles of *S. himalayana* are distinguished from the other two Indian species by (i) the dental formula being 4^{3}-$4/1_{2}1$ and (ii) the margin of the posterior lip being distinctly fimbriate and notched in the middle. The tadpole of *S. lifanensis* is almost indentical with that of *S. himalayana* except that the margin of the posterior lip, though fimbriate, is not notched in the middle. Thus, the *himalayana* tadpole is more closely related to that of *Staurois lifanensis*[3] Liu of Szechwan in Western China than to the other forms in Darjiling.

There is a row of marginal papillae round the postero-lateral margin of the upper lip ; these are continued on the margin of the folds round the corners of the mouth and finally extend round the margin of the lower lip. An extra row is present inside the postero-lateral margins of the upper lip. There are some papillae present beneath the outermost row of the labial teeth (Fig. 2).

Colour of the body is olive above with markings, if present, dark. Under surface is lighter and without markings. The tail muscle is of the same colour as the body.

Measurement of a specimen with hind legs about half developed.—Total length 37 mm. ; length of head and body 13 mm. ; body width 9 mm. ; tail length 24 mm. ; tail height 8 mm.

Geographical distribution.—It has been recorded from Western Himalayas in Kangra district of the Punjab (only 2 young frogs known) and

[1]Annandale, *Journ. As. Soc. Bengal*, (2) **2**, p. 290 (1906).
[2]Liu, C. H., *Fieldiana, Zoology Memoirs*, **2**, p. 345 (1950).
[3]Liu, C. H., *Fieldiana, Zoology Memoirs*, **2**, p. 347 (1950).

Eastern Himalayas in Darjiling district of North Bengal. This is the first record from Sikkim. If future researches show that *S. lifanensis* is identical with this species then the range of *S. himalayana* will more or less be co-extensive with that of *S. afghana.*

A NEW TADPOLE.

(Plate, Figs. 3-9.)

A tadpole with a suctorial disc registered under number 20578, Zoological Survey of India, was collected by Dr. S. L. Hora, from a stream between Gille-khola Station and Tista bridge in the Darjiling district of N. Bengal, during the first fifteen days of June 1934. A short description is being given as it happens to be a hitherto unknown tadpole.

The tadpole seems to live in much stronger mountain streams than *Staurois afghana* and *S. himalayana.* Obviously due to that reason it has not been collected in larger numbers along with them. It seems to have been accidently collected along with others but its precise habitat remains to be determined.

It differs from *Staurois afghana* (Gunther) and *S. himalayana* (Boulenger) in being better equipped for fixing itself by having (i) the dental formula $5\frac{3}{3}5/1\frac{1}{1}1$, thus more rows of series of teeth on the posterior lip, (ii) spinous processes on its dorsal and ventral surfaces and (iii) suctorial disc with numerous patches of cornified tissue on the friction area.

The tadpole is of quite a large size, the length of the specimen, with hind legs about half developed, is 73 mm. The body is dorso-ventrally flattened with the snout region depressed. The snout is broadly rounded. The nostrils are much nearer to the eyes than to the tip of the snout, the distance between them being less than the interorbital width. The eyes are more dorsal than lateral, a little nearer to the spiracle than to the tip of the snout. The Pupils are round. The spiracle, which is sinistral, is placed very low down on the side of the body, directed upwards and backwards, ending in a short tube. It is nearer the base of the tail than to the tip of the snout. The vent is median and tubular. The tail which is more than twice as long as head and body, is gradually pointed at the tip. The tail fin is deeper dorsally than ventrally, decreasing in height towards the base of the tail. There is no fin dorsally or ventrally for a short distance from the base of the tail. The muscular portion is strongly developed.

A large suctorial disc is present ventrally (Fig. 7). It has a free border all round except at the anterior end where it is replaced by the posterior lip of the mouth. The central portion of the disc is depressed in the form of a saucer. The skin of this region is thin and through it prominences of muscles and tendons are seen clearly. On the sloping postero-lateral sides surrounding the central portion is the friction area, the skin of which is hardened due to the presence of cornified and tuberculated tissue slightly similar to that of *S. afghana*[1] and *S. himalayana* but arranged here in the form of numerous and irregular patches with microscopic spines (Fig. 8). which undoubtedly help in the adhesion

[1]Bhadhuri, J. L., *Trans. Roy. Soc. Edin.*, **58**, p. 346, pl. figs. 6 & 8 (1934).

of the disc. Surrounding the friction area is the friction rim, the margin of which forms the free border of the suctorial disc. The mouth (Fig. 6) is surrounded by anterior and posterior lips which are continuous and are slightly folded at the corners of the mouth. The anterior lip is horseshoe shaped, posterior lip is thick, straight with fimbriated margin and notched in the middle. There are only 3 papillae on the lips at the corners of the mouth. Labial teeth well developed. There are eight rows on the anterior lip, first 3 continuous and remaining 5 interrupted with the innermost row shortest. There are 5 rows on the posterior lip, the innermost interrupted and outer 4 continuous. Jaws well developed, and moderately serrated.

Two pairs of glandular patches of granules are present. One pair placed behind and below each eye, another quite large and irregular placed laterally at the extreme end of the body (Fig. 3).

Spinous processes are present. These are abundant and rather regularly arranged on the dorsal surface of head (Figs. 4 & 5) while ventrally on each of the postero-lateral side of the disc, are 3 spinous processes directed posteriorly. These may be assisting in the fixation of the disc by hooking in co-ordination with the movements of the disc and lips. Few spinous processes are present on the under surface of toes (Fig. 9).

Colour of the body and muscular portion of the tail is dark brown with irregular darker markings. The under surface is brown without any markings.

Measurement of the specimen with hind legs half developed. Tail length 73 mm.; length of head and body 22 mm.; body width 15·5 mm.; tail length 51 mm.; tail height 11 mm.

Key for the identification of Tadpoles with suctorial Disc.

1.	More than 3 series of teeth on posterior lip .	**2**
	3 Series of teeth on posterior lip . .	**7**
2.	More than 6 series of teeth on posterior lip Dental formula $4\frac{4}{4}4/5\frac{5}{5}5$ Burma, Siam, Malayasia & Philippines) .	*S. jerboa* (Günther).
	Less than 6 series of teeth on posterior lip .	**3**
3.	8-11 series of teeth on anterior lip . . .	**4**
	4-5 series of teeth on anterior lip . .	**6**
4.	11 series of teeth on anterior lip . . . Dental formula $8^{2}8/1\frac{1}{1}1$ (Borneo)	*S. cavitympanum* (Blgr.).
	Less than 11 series of teeth on anterior lip . .	**5**
5.	Dental formula $5\frac{4}{4}5/1\frac{1}{1}1$ (Malay P. & Borneo) . .	*S. larutensis* (Blgr.).
	Dental formula $5^{2}5/1\frac{1}{1}1$ (N. Bengal) . .	*Tadpole nov.*
6.	Dental formula $3^{1}3/1\frac{1}{3}1$ (Malayasia)	*S. hosii* (Blgr.).
	Dental formula $3^{2}3/1\frac{1}{1}1$ (Borneo & Java)	*S. whiteheadi* (Blgr.).
	Dental formula $3^{1}3/1\frac{1}{1}1$ (Borneo) . . .	*S. guttatus* (Günther).
7.	4-5 Series of teeth on anterior lip .	**8**
	6-8 Series of teeth on anterior lip .	**9**
8.	Dental formula $2^{2}2/1\frac{1}{2}1$ (Hainan)	*S. hainanensis* (Blgr.).
	Dental formula $4/1\frac{1}{2}1$ (N. W., E. China and Tonking)	*S. ricketti* (Blgr.)

9.	8 Series of teeth on anterior lip .	
	Dental formula $5^{3}5/1_{\frac{1}{2}}1$ (Himalayas, Burma, Siam & S. W. China).	*S. afghana* (Günther).
	Less than 8 series of teeth on anterior lip	**10**
10.	Without extra papillae inside of marginal papillae of latero-posterior region of anterior lip.	
	Dental formula $3^{3}3/1_{\frac{1}{2}}1$ (N. W. & E. China)	*S. chunganensis* (Pope).
	With extra papillae inside of marginal papillae of latero-posterior region of anterior lip.	
	Dental formula $4^{3}4/1_{\frac{1}{2}}1$ . .	**11**
11.	Without some papillae beneath outermost row of labial teeth of posterior lip (N. W. China).	*S. mantzorum* (David).
	With some papillae beneath outermost row of labial teeth of posterior lip.	**12**
12.	Posterior lip notched in the middle (N. Punjab, Sikkim, N. Bengal).	*S. himalayana* (Blgr.).
	Posterior lip not notched in the middle . .	**13**
13.	2 Sub-branchial muscles round, parallel and not meeting diaphragmatoprecardialis (N. W. China).	*S. kangtingensis Liu.*
	2 Sub-branchial muscles oval, converging and in contract with diaphragmatocardialis (N. W. China).	*S lifanensis* Liu.