



## RESEARCH ARTICLE

## Morphometric studies on *Sphaerotheca breviceps* (Schneider, 1799) from Western Himalaya, Srinagar Garhwal region of Uttarakhand.

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### Abstract

Statistical analysis with traditional morphometry was performed to analyze the intra population variation in *Sphaerotheca breviceps* (Anura: Dicroglossidae) from Western Himalaya, Srinagar Garhwal region of Uttarakhand. Random samples (N=24) of individuals were collected from different sites to measure 30 morphometric parameters. Maximum SVL of the sample measured was found to be 42.31mm. A significant positive correlation was obtained between the parameters considered at the 1 % level of significance. Regression analysis was performed for three morphometric variables viz., Head length (HL) with Snout vent length (SVL) and Hind limb length (HLL) with Snout vent length (SVL) and fitted regression equation  $y = 0.358x - 0.347$  ( $R^2 = 0.844$ ) and  $y = 1.725x - 8.038$  ( $R^2 = 0.984$ ) respectively were obtained for the species.

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### Introduction:

Amphibians of the Himalayas (high altitude) are vividly different from those of the plains of India and have adapted to this environment. The study of high altitude amphibian is, therefore, of much scientific importance (Ray, 1999). Although Western Himalayan ecosystem, embraces all types of amphibians on account of its varied climate, topography, altitudinal and vegetation conditions, the amphibian fauna of this area has not been adequately studied. *Sphaerotheca breviceps* (Fig. 2) is a forked tongue frog of family Dicroglossidae, capable of burrowing (Pillai, 1976). Burrowing frogs are known to wriggle backwards into the soft squelchy earth, to hide completely and fall torpid. They have a small digging apparatus on their hind limbs. The species descriptions of frogs of this genus are very important for the conservation and preservation of these burrowing frogs. *Sphaerotheca* is a tricky genus since many of the different species within the genus share many morphological similarities. It has been reported from many habitats, including seasonal, deciduous forest, arid plains and scrubland, grassland, areas of human habitation, plantations, and temporary stagnant wetlands in the breeding season (ponds). Adults are often found under ground cover. Perusal of literature revealed scanty data available pertaining to its ecology and species diversity from Western Himalaya. Further, any data on this species is lacking. Hence, an attempt to fill this lacuna through a short term study encompassing diversity and morphometry of anurans was undertaken. The present study analyzes the morphometric sampling of *S. breviceps* population in Garhwal region of Western Himalaya. Data obtained on the morphometry of the species during the present study would contribute to the knowledge of the bio-ecological perspectives of the species.

### Material and Methods:

The present study was undertaken around Srinagar Garhwal region of Uttarakhand, Western Himalaya (Fig. 1). The sites are located at 30.13°N 78.48°E at the left bank of River Alaknanda. Sampling was done at a height of 1806feet to 2034feet. The field work was carried out around the study sites during the months of August to November, 2013 at evening time (7PM to 11 PM). Method of sampling is based on the methodology given by Pichandi et al. (2013). Four visits were made to the selected study site. A survey was carried out near water bodies and micro-habitats such as on the floor, rocks, leaves, under leaf litter, under logs, under the soil, among dried leaves, among weeds, near

termite mounds etc., based on standard procedures (Daniel, 2005, Pichandi et al., 2013). Live frogs were caught and 29 characters (Islam et. al., 2008) were measured with digital Vernier caliper (Aerospace) to the nearest 0.1 mm accuracy (Table 1). Morphometric measurements of the samples (N=24) randomly collected during the survey were taken in the field conditions and animals were released after recording the observations. Care was taken to ensure no stress on the animals during the course of the measurements. Along with the quantitative morphological measurements, some qualitative characters, including body color, dermal ridge, median stripe, snout shape, body shape, and thigh region coloration were also observed. Correlation analysis was done on only 16 important morphometric parameters. Regression analysis was performed for three morphometric variables viz., Head length (HL) with Snout vent length (SVL) and Hind limb length (HLL) with Snout vent length (SVL) only.

### Results and Discussion:

The descriptive statistics data along with the correlation analysis are tabulated sequentially (Table 1 and 2). Regression plots for morphometric parameters viz., SVL and HL; SVL and HLL of *Sphaerotheca breviceps* with fitted regression equation are also depicted (Fig. 3). Average SVL of the sample measured was found to be 29.11 mm. A significant positive correlation was obtained between the 16 important morphometric parameters considered at the 1 % level of significance (Table 3). Regression analysis was performed for three morphometric variables viz., Head length (HL) with Snout vent length(SVL) and Hind limb length (HLL) with Snout vent length(SVL) and fitted regression equation  $y = 0.358x - 0.347$  ( $R^2 = 0.844$ ) and  $y = 1.725x - 8.038$  ( $R^2 = 0.984$ ) respectively were obtained for the species. Along with the quantitative morphological measurements, some qualitative characters, including body color, dermal ridge, median stripe, snout shape, body shape, and thigh region coloration were also observed.

**Table 1. Morphological parameters used in this study.**

Abbreviation	Character
SVL	Snout-vent length
HL	Head length (from back of mandible to tip of snout).
HW	Head width (left side back of mandible to right side back of mandible)
STL	Snout-tympanum length (Tip of snout to front of tympanum)
MSL	Mouth angle-snout length (Tip of snout to end of mouth opening)
NS	Nostril- snout length (Distance from nostril to tip of snout)
SL	Snout length
NTL	NTL Nostril tympanum length (Distance between nostril and front of tympanum)
EN	Distance from front of eyes to nostril
TEL	Tympanum eye length (distance between end of eye to front of tympanum)
TD	Tympanum diameter (Maximum diameter)
MN	Distance from back of mandible to nostril
MFE	Distance from back of mandible to front of eye
MBE	Distance from back of mandible to back of eye
IN	Internarial space (Distance between 2 nostrils)
EL	Eye length (greatest diameter of the eye including upper eyelids)
IOD	Interorbital distance
UEW	Maximum width of upper eyelid
HAL	Hand length (from base of outer palmer tubercle to tip of third finger)
FAL	Fore arm length (from elbow to base of outer palmer tubercle)
LAL	Lower arm length
HLL	Hind limb length
THIGHL	Thigh length
TL	Tibia length
FOL	Foot length (from base of inner metatarsal tubercle to tip of fourth toe)
TFOL	Length of tarsus and foot (from base of tarsus to tip of fourth toe)
ThreeFL	Third finger length
OneFL	First finger length
FourTL	Fourth toe length
ITL	Inner toe length

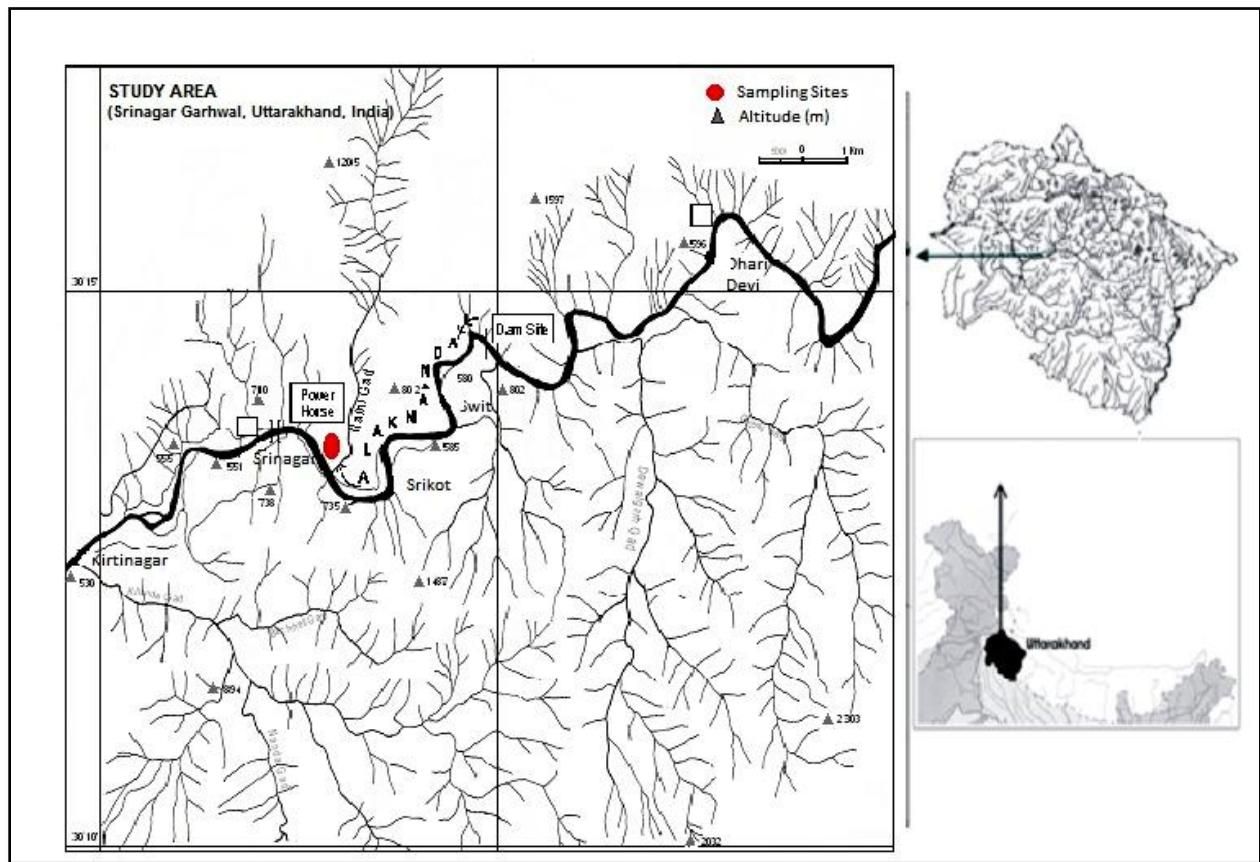
**Table 2. Descriptive statistics of morphometric parameters of *Sphaerotheca breviceps* (N=24) from Srinagar Garhwal region, Uttarakhand, India.**

Parameters	Minimum (mm)	Maximum (mm)	Mean (mm)	Standard Deviation (mm)
SVL	17.01	42.31	29.10875	7.31868
HL	6.01	19.51	10.09375	2.856137
HW	6.01	15.51	11.14625	3.124717
STL	6	13.03	8.599167	1.987902
MSL	6.08	9.72	8.105	1.390324
NS	0.62	3.24	1.94375	0.894013
SL	1.81	5.4	3.686667	1.074303
NTL	4.22	10.02	7.1725	1.528396
EN	0.91	2.93	1.96625	0.566483
TEL	0.43	2.21	1.039167	0.527471
TD	0.9	3.58	1.960417	0.91601
MN	6.01	13.52	9.445417	2.023604
MFE	4.23	10.07	7.242083	2.033611
MBE	1.12	5.82	3.384167	1.743554
IN	1.11	4.09	2.341667	1.025177
EL	2.54	5.94	4.525417	1.145809
IOD	1.08	3.53	2.23375	0.807965
UEW	1.26	4.31	2.97625	0.891988
HAL	2.72	9.51	5.352917	2.255402
FAL	4.21	10.56	7.312083	2.189074
LAL	4.42	10.15	7.434167	2.220891
HLL	24.5	64.9	42.18833	12.726019
THIGHL	6.02	18.92	11.51125	3.94187
TL	7.41	18.09	12.79875	3.554719
FOL	7.12	19.56	13.8675	4.708291
TFOL	11.07	27.89	17.87833	5.278425
3FL	3.21	5.52	4.229167	0.660974
1FL	1.82	3.29	2.334583	0.533365
4TL	3.03	7.42	5.230833	1.258353
ITL	1.42	6.81	3.985417	1.526149

**Table 3. Correlation coefficient (r) values for parameters of *Sphaerotheca breviceps* (N=24) from Srinagar Garhwal region, Uttarakhand, India.**

	SVL	HL	HW	NS	SL	EN	TD	EL	IOD	HLL	THL	FOL	3FL	1FL	4TL	ITL
SVL	1	0.919	0.983	0.974	0.896	0.987	0.939	0.959	0.966	0.979	0.986	0.958	0.987	0.937	0.987	0.991
HL		1	0.885	0.879	0.673	0.906	0.872	0.852	0.893	0.897	0.926	0.856	0.923	0.877	0.917	0.924
HW			1	0.983	0.923	0.983	0.942	0.975	0.986	0.990	0.985	0.979	0.968	0.946	0.986	0.987
NS				1	0.921	0.979	0.935	0.959	0.981	0.984	0.976	0.977	0.953	0.929	0.978	0.981
SL					1	0.910	0.837	0.924	0.881	0.897	0.870	0.910	0.874	0.819	0.887	0.887
EN						1	0.956	0.952	0.966	0.971	0.978	0.947	0.971	0.942	0.982	0.990
TD							1	0.878	0.939	0.939	0.960	0.896	0.918	0.991	0.945	0.953
EL								1	0.961	0.968	0.947	0.974	0.969	0.884	0.958	0.951
IOD									1	0.992	0.982	0.984	0.953	0.953	0.981	0.976
HLL										1	0.992	0.991	0.968	0.950	0.991	0.984
THL											1	0.966	0.974	0.966	0.991	0.994
FOL												1	0.947	0.912	0.976	0.958
3FL													1	0.919	0.973	0.975
1FL														1	0.949	0.949
4TL															1	0.988
ITL																1

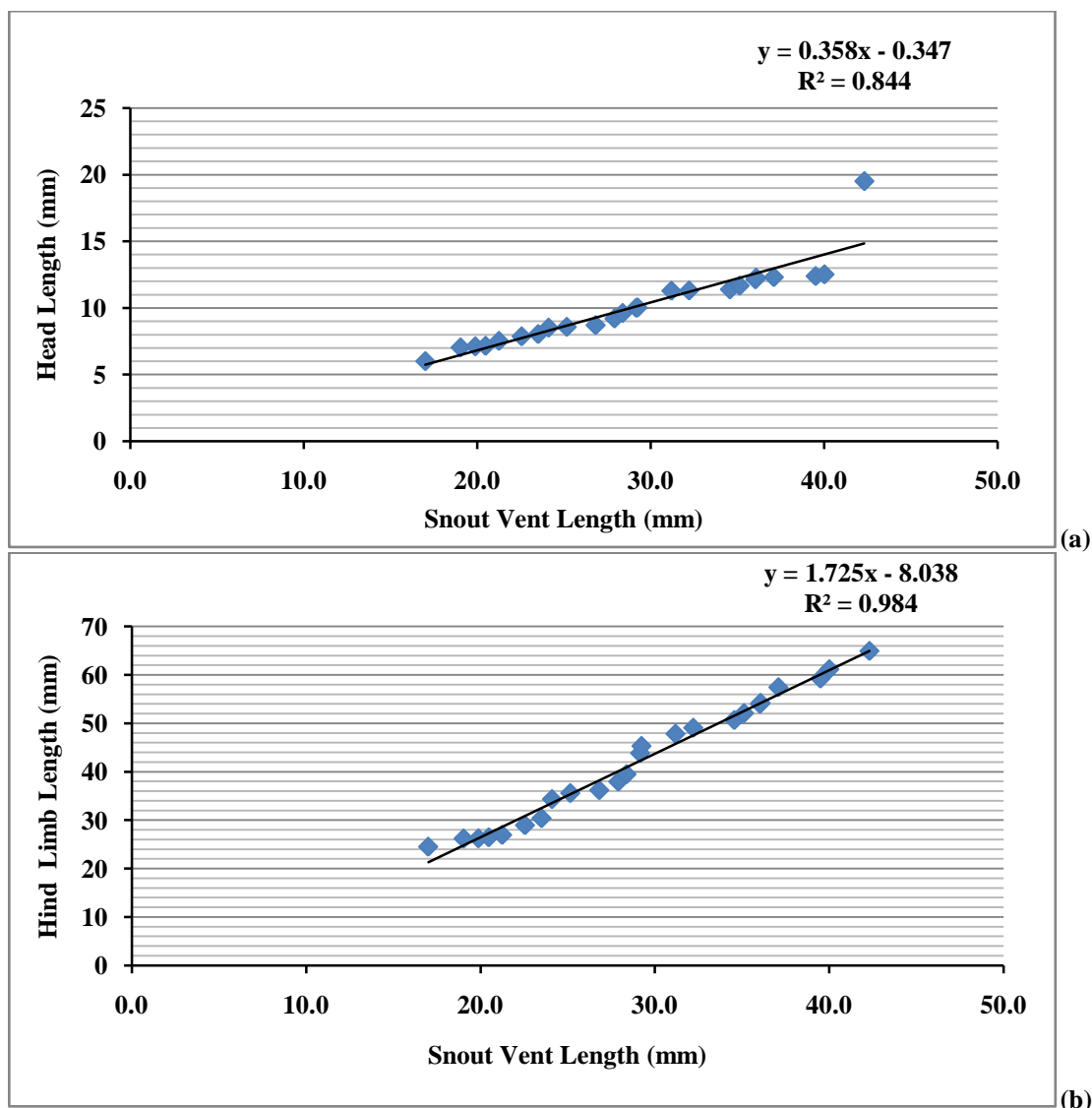
\*Correlation Coefficient (r) is significant at the 0.01 level (2-tailed).



**Fig. 1** Location map of study area



**Fig. 2** *Sphaerotheca breviceps* (Study Specimen)



**Fig. 3(a & b) Regression analysis plots for morphometric parameters of *Sphaerotheca breviceps* with fitted regression equation**

### **Morphological Characteristics:**

The body rather short and stout. The skin of upper parts smooth with some scattered elongated tubercles. Belly and lower surface of the thigh near anal region glandular. Fingers are completely free; toes incompletely webbed, metatarsals bounded by muscles. Vomerine teeth in two oblique series. Inner metatarsal tubercle shovel-shaped with sharp margins. Tongue large, free and notched behind. There is a supratympanic fold commencing from posterior corner of eye upto shoulder. Vomerine teeth in tow oblique groups, extending a little beyond hinder edges of choanae. Tongue free and deeply notched behind. Fingers free, first longer than second. First finger 1.33-1.65 times length of second finger. Third finger as long as first or slightly longer. Fourth finger shortest. First finger with a large, round subarticular tubercles on second, third and fourth almost equal in dimension and quite prominent. Palmer tubercle elongated. Forelimb stout and closer to body and head. Hind limbs robust and toes moderate. Subarticular tubercles prominent but smaller in dimension than those of fingers. Tips of toes obtuse and with half webs. Inner metatarsal tubercles shovel-shaped, compressed, placed obliquely at base of first toe.

**Coloration:** There is a considerable color variation within the same population. A vertebral streak of cream color is present. In color, it is light brown or olive above, with darker spots or marblings, Dorsum olive golden,

with a light yellow median line; a well marked large golden ocellus on shoulder on each side, continuing obliquely along flanks. Indistinct yellowish bars on limbs and jaws. The posterior aspect of the limbs marbled with cream color, ventrally immaculate. Some individuals yellowish brown bold patches. Crown with two oblique brown streaks separated by a yellow band beginning from the upper eyelid and converging on posterior region. Males with a dark brown vocal sac.

The morphological data is unique being a rare data to be produced in terms of the species morphometry in the region and future studies in this regard would facilitate further understanding of the impact of immediate ecological conditions on the anuran morphology. Snout vent length (SVL) and head length (HL) were the two variables that mostly contributed for significant differences related to morphometric traits, as observed for other groups (Castellano and Giacoma, 1998; Castellano et al., 1999; Babik & Rafinski, 2000; Castellano et al., 2000; Méndez et al., 2004, Rosso et al., 2004, Silva et al., 2008, Bahuguna and Bhutia, 2010, Pichandi et al., 2013). According to our results, the variation in morphological traits did not present a spatial pattern, showing a substantial overlap in overall morphometric variables of the studied population. In anuran amphibians, adult body sizes depend on many factors, including time of metamorphosis, growth rate before and after maturity, age of maturity, and longevity (Rosso et al., 2004). Although, the present findings contribute to the morphometric data for the population of the species from the region, the variation is attributed to the regional differences compared to the available literature. However, it is worth considering the data owing to its uniqueness viz., first time reporting from the study region contributing to the understanding of the ecological impacts on morphometry in future.

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