Bull. zool. Surv. India, 4(1) : 85—93, 1981

A COMPARATIVE ANALYSIS OF THE WESTERN AND EASTERN HIMALAYAN POPULATIONS OF *LABEO DYOCHEILUS* (MCCLELLAND) (PISCES : CYPRINIFORMES) WITH A DISCUSSION OF ITS SPECIFIC COMPOSITION

MRINAL K. DAS AND K. C. JAYARAM

Zoological Survey of India, Calcutta

ABSTRACT

Labeo dyocheilus (McClelland) is widely distributed in the Himalayan range and its base and is found in the Indus, Ganga, Jamuna, Brahmaputra and Mahanadi river systems. The Western Himalayan population of the species was segregated as a separate group by Mukerji (1934). He did not give any name but indicated the composition of the species according to its geographical distribution. Mirza and Awan (1976) described the Western Himalayan population as a subspecies *L. dyocheilus pakistanicus*. In this paper the infra-structure of the Western and Eastern Himalayan populations is statistically analysed and the provision of a subspecies rank for the Western Himalayan population is justified.

INTRODUCTION

Among the fishes of the carp family Cyprinidae, many species of the genus *Labeo* occupy a prime place in view of their fast growth, rich flesh content and popular demand. The genus is distributed through Africa, Syria, Pakistan, India. Bangladesh, Sri Lanka, Burma, Nepal, Thailand, Malay Archipelago to China.

Labeo dyocheilus was first described by McClelland (1839) from Brahmaputra river. It is widely distributed in the Himalayan range and its base and is found in the Indus, Ganga, Jamuna, Brahmaputra and Mahanadi river systems. The systematic status of this species has been in confusion and many specimens have often been misidentified with its allied species *Labeo dero* (Hamilton). Mukerji (1934) reporting upon the fish collections made by Lt. Col. R. W. Burton from the tributary streams of the Mali Hka river, Myitkyina Dist., Burma stated that "*Labeo dyocheilus* is a very variable species and according to its geographical distribution the species may be divided into the following groups :

1. Western Himalayan form.
2. Eastern Himalayan and Assamese form, *i. e., forma typica.*
3. Burmese and Siamese form."

Hora (1936) showed the material from Burma (Burton's coll.), which were identified by Mukerji (1934) as *L. dyocheilus*, as representing *L. dero*. Later Hora (*op. cit.*) separated the Burmese and Siamese form, which differ from the typical *L. dero*, as a new species—*Labeo devdevi* (see Jayaram and Das, 1980). Recently Mirza and Awan (1976) described the Western Himalayan population of *L. dyocheilus* as a different subspecies and named it *L. dyocheilus pakistanicus*. In the present study the Western and Eastern Himalayan populations are statistically analysed

and compared to ascertain their exact specific status by computing the degree of diversity and interrelationship among them.

Material Examined

A. *Western Himalayan Population* : Total 82 examples (Range of SL-44.35-295.0 mm).

1. ZSI F 4587/2, 40 exs., A branch of Pulin nala and its union with Tawi river, nearly 1.6 km east of Nagrota, Jammu Dist., R. Tilak coll., 28.10.64.

2. ZSI F 4607/2, two exs., Choe nala, 16.8 km west of Jammu Dist., R. Tilak coll., 18.10.64.

3. ZSI F 4585/2, two exs., A branch of Tawi river, nearly 3.2 km down stream from Nagrota, Jammu Dist., R. Tilak coll., 30.1.64.

4. ZSI F 4609/2, three exs., A branch of Tawi River, 200 yds down stream from Bridge, Jammu Dist., R. Titak coll., 21.10.64.

5. ZSI F 4608/2, seven exs., A branch of Tawi river, 1.6 km up stream from Jammu, R. Tilak coll., 24.10.64.

6. ZSI F 4586/2, 26 exs., Tawi river, 3.2 km down stream from Nagrota, Jammu Dist., R. Tilak coll., 30.10.64.

7. ZSI. 1533, one ex., Simla, Purchased F. day.

8. ZSI 1522, one ex., Hardwar, Purchased F. Day.

B. *Eastern Himalayan Population* : Total 46 examples (Range of SL=66.2—266.0 mm).

1. ZSI F 25542 17 exs., Belsari river, a tributary of Brahmaputra river, about 32 km from Lokra (Balipara Frontier Tract), Assam, S. L. Hora coll. 12.11.39.

2. ZSI F 1673/2, one ex., A stream, 6.4 km west of Sambhunath, Kathmandu valley, Nepal, A. K. Dutta coll., 22.6.58.

3. ZSI F 12279/1, one ex., Tarai, Nepal, F. M. Bailey coll., Feb., 1936.

4. ZSI Cat 698, five exs., Mandalay, F. Day coll.

5. ZSI Cat 700, one ex., Mandalay, Major Sladen coll.

6. ZSI F 2456/2, three exs., Amatulla river, 3.2 km south of Amatulla village, Kameng Fron. Div., NEFA, K. C. Jayaram coll., 8.3.61.

7. ZSI FF 1584, four exs., Assam, H.A.H. coll.

8. ZSI FF 1585, two exs., Calcutta bazar.

9. ZSI FF 1586, three exs., Rangoli Dam, Barkot Dist., Sambalpur, Orissa, T. K. Sen coll., 16.4.73.

10. ZSI FF 1123, three exs., Streams flowing by Ganapati Hills, South Kamrup, Assam, A. K. Mukherjee coll., 11.9.75.

11. ZSI FF 1587, four exs., Tezpur, Assam, T. K. Sen coll., 1975.

12. ZSI FF 1588, one ex., Birtalla village near Brahmani river, Banki, Orissa, T. K. Sen coll., 30.3.73.

13. ZSI FF 1589, one ex., Received from Tech. Advisor to the Settlement Officer, Khulna, Bangladesh, 3.5.26.

Description

Western Himalayan Population

Head and body laterally flattened. Body deepest just in front of dorsal fin. Head relatively large and covered with integument. Snout prominent, muscular, more or blunt anteriorly. Front part of snout covered with spiny tubercles and/or pores. Lateral lobe distinct. Mouth inferior, fairly large, crescentic and extending up to level of nostrils. Lips thick, Fleshy, continuous at angle of mouth. Dorsal surface of free portion of lower lip covered with series of ridges. Labial fold interrupted. Eyes prominent, situated laterally in middle or posterior half of head. Interorbital space slightly convex. Nostrils wide,

TABLE I—Frequency distribution of meristic counts*

Fin rays

Population	DORSAL			PECTORAL				PELVIC		ANAL	CAUDAL	
	iv/9	iv/10	iv/11	i/13	i/14	i/15	i/16	i/8	i/9	iii/5	9+9	10+9
W. Himalayan	4	77	1	—	15	59	8	80	2	82	3	76
E. Himalayan	1	41	4	2	6	32	6	46	—	46	1	45

Scales

Population	No. of LL Scales								No. of pre-dorsal scales					Circumpeduncular scales					
	37	38	39	40	41	42	43	44	14	15	16	17	18	20	21	22	23	24	25
W. Himalayan	1	—	1	7	25	30	12	1	9	53	11	2	1	—	18	48	7	5	2
E. Himalayan	—	—	1	8	5	14	11	2	3	22	8	4	—	7	12	21	3	—	—

Population	No. of L. tr. Scales							
	$7\frac{1}{2}/5\frac{1}{2}$	$7\frac{1}{2}/6\frac{1}{2}$	$7\frac{1}{2}/7\frac{1}{2}$	$8\frac{1}{2}/5\frac{1}{2}$	$8\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/7\frac{1}{2}$
W. Himalayan	—	—	1	1	55	12	2	4
E. Himalayan	6	1	—	15	20	—	—	—

*Counts given only for undamaged specimens.

prominent, situated nearer eyes than tip of snout. One pair of small maxillary barbels at angle of mouth.

Dorsal fin inserted above tip of pectoral fin from 9th, 10th or 11th lateral line scale and almost equidistant between tip of snout and caudal fin base. Pectoral, pelvic and anal fins moderately long ; pectoral not reaching pelvic ; pelvic not reaching anal; in some specimens tip of anal just reaching caudal fin base. Caudal fiin deeply forked, upper lobe of caudal slightly longer than lower lobe in some. All rays of dorsal, pectoral, pelvic and anal fins with fleshy lateral lappets towards their base.

Lateral line complete.

Scales moderate sized, arranged in regular fashion on body, those on chest considerably reduced in size. Well developed scaly appendages at base of pelvic fins. The frequency distribution of certain scale and fin-ray counts are given in Table-I.

Colour :

In alcohol preserved specimens dark brown

on the dorsal and lateral sides and yellowish pink below.

*Body proportions** :

Length of head 3.13—4.29 (3.44), body depth 3.33—4.46 (3.94), pre-dorsal distance 1.95—2.41 (2.06), post-dorsal distance 1.66—1.9 (1.77), pre-pelvic distance 1.67—1.95 (1.82), pre-anal distance 1.22—1.34 (1.28), dorsal fin length 3.56—4.37 (3.97), pectoral fin length 4.24—5.38 (4.89), pelvic fin length 4.33—5.85 (5.36), anal fin length 4.69—5.95 (5.3) and caudal fin length 2.89—3.44 (3.12), all in standard length.

Head width 1.71—1.95 (1.81), snout length 1.97—2.77 (2.34), post-orbital length 2.06—2.74 (2.51), diameter of eye 3.83—7.17 (4.5), width of gape of mouth 2.5—3.91 (3.03), inter-orbital space width 2.16—3.36 (2.8), inter-nostrilar space width 2.99—4.8 (3.61), dorsal fin base width 1.26—1.94 (1.48), length of caudal peduncle 1.27—2.31 (1.81) and least height of caudal peduncle 1.87-3.0 (2.6), all in length of head,

Diameter of eye 1.45—3.57 (1.94) in snout length, 1.31—3.31 (1.61) in inter-orbital space width and 1.0—2.4 (1.25) in inter-nostrilar space width.

Least height of caudal peduncle 1.21—1.63 (1.44) in its length.

Pre-dorsal distance 1.51—1.99 (1.61) in pre-anal distance.

Eastern Himalayan Population :

Head and body laterally flattened. Body deepest in front of dorsal fin. Head relatively small, narrow and covered with a thick integument. Snout prominent, muscular, more or less pointed anteriorly. Front part of snout studded with spiny tubercles and/or pores all over. Lateral lobe distinct. Mouth inferior and crescentic. Lips thick, fleshy, continuous at angle of mouth. Dorsal surface of free portion of lower lip covered with series of ridges. Labial fold interrupted. Eye situated in posterior half of head. Inter-orbital space slightly convex. Nostrils wide, prominent, situated nearer eyes than tip of snout. One pair of maxillary barbels present at angle of mouth.

Dorsal fin inserted above tip of pectoral fin usually from 10th or 11th, rarely from 9th or 12th, lateral line scale and nearer tip of snout than caudal fin base. Pectoral, pelvic and anal fins long ; pectoral not reaching pelvic and pelvic not reaching anal ; in some cases tip of anal almost touching caudal fin base. Caudal deeply forked, long. All rays of dorsal, pectoral, pelvic and anal fins with thin fleshy lateral lappets towards their base.

Lateral line complete.

Scales moderate sized, arranged in regular fashion on body, those on chest considerably reduced in size. Well developed scaly appendages at base of pelvic fin. The frequency distribution of certain scale and fin-ray counts are given in Table—I.

Colour :

According to McClelland (1839) "the colours are bluish or brownish black above and on the extremities of the fins, but bluish white with various stains of red and yellow on the shoulders", while according to Day (1889) it is "of a dull green, darkest above ; fins darkest in the centre." In alcohol preserved specimens the colour is from a uniform reddish to greenish brown above and paler below.

Body proportions :

Length of head 3.38—4.33 (3.76), body

* Mean values are given in parentheses.

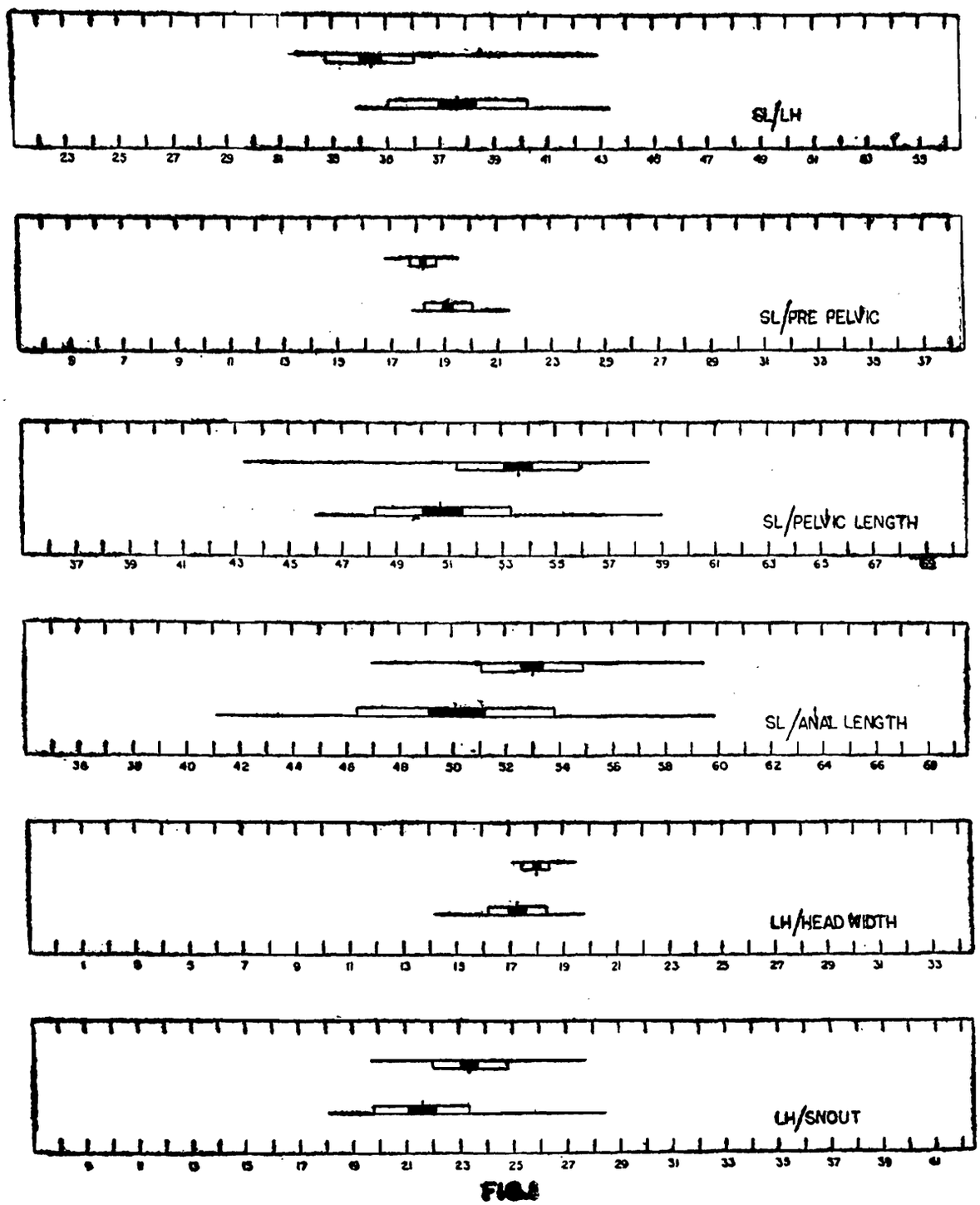

Fig. 1. Graphs showing the variation in some body proportions in the samples of two populations. Upper diagram and lower diagram in each graph represent *L. dyocheilus pakistanicus* and *L. dyocheilus dyocheilus* respectively.

depth 3.33—4.47 (3.88), pre-dorsal distance 1.93—2.28 (2.1), post-dorsal distance 1.59—1.91 (1.77), pre-pelvic distance 1.77—2.14 (1.91), pre-anal distance 1.25—1.45 (1.3), dorsal fin length 3.45—4.55 (3.98), pectoral fin length 4.38—5.51 (4.86), pelvic fin length 459—5.9. (5.07), anal fin length 4.11—5.99 (5.01) and caudal fin length 2.75—3.6 (3.09), all in standard length.

Head width 1.42—1.98 (1.73), snout length 1.81—2.85 (2.16), post-orbital length 2.33—3.04 (2.71), diameter of eye 3.87—7.01 (4.68), width of gape of mouth 1.96—4.29 (2.77), inter-orbital space width 2.0—2.96 (2.49), inter-nostrilar space width 2.65—3.67 (3.18), dorsal fin base width 1.12—1.71 (1.41), length of caudal peduncle 1.19—1.85 (1.55) and least height of caudal peduncle 1.87—2.68 (2.36), all in length of head.

Diameter of eye 1.67—3.73 (2.2) in snout length, 1.5—3.5 (1.92) in inter-orbital space width and 1.12—2.61 (1.49) in inter-nostrilar space width.

Least height of caudal peduncle 1.22—1.83 (1.53) in its length.

Pre-dorsal distance 1.44— 1.73 (1.61) in pre-anal distance.

Discussion

Taxonomic characters are generally found to intergrade between closely related populations when a large number of individuals are studied. To compare the two populations "Student's t-test" followed by Simpson, Roe and Lewontin (1960) was applied. Mean, standard deviation and degrees of freedom were calculated to determine the probability value at 95% confidence intervals. Before deducing any numerical conclusion, a hypothesis was established that the specimens of the two populations belonged to same species and the universally used rejection value of probability, *i.e.*, 5% was considered as a criterion for the rejection of the hypothesis. The result has shown that in case of most of the morphometric characters the probability value is below 5% which proves that the two populations are different.

How often a difference in a given character is likely to be obtained was determined by Dice and Lerans' graphical method as quoted by Hubbs and Perlmutter (1942). In this method, for each character, the range, mean and one standard deviation on each side of the mean and two standard errors on each side of the mean were delineated on a graph (Figs. 1 and 2). Even though this technique makes it possible to compare samples with ease, it does not indicate definitely whether the difference is of specific, subspecific or racial magnitude.

Taxonomic rank of the two populations were determined by measuring the degree of intergradation and divergence. Different methods of measuring intergradation and divergence have been proposed by different authors (Davenport and Blankinship, 1898 ; Pearl, 1930 ; Ginsburg, 1938 ; and Amadon, 1949). Ginsburg (*op. cit.*) used a simple method of measuring the intergradation and divergence of populations and indicated its superiority to the standard methods in taxonomic work. In the present study Ginsburg's method was followed and the result has shown that in case of most of the significant characters (SL/LH, SL/Pre-pelvic, SL/Pelvic fin length, SL/Anal fin length, LH/Snout, LH/Post-orbital, LH/Width of gape of mouth, LH/IOW, LH/LCPD, LH/HCPD) one population intergrades with the other

* Mean values are given in parantheses.

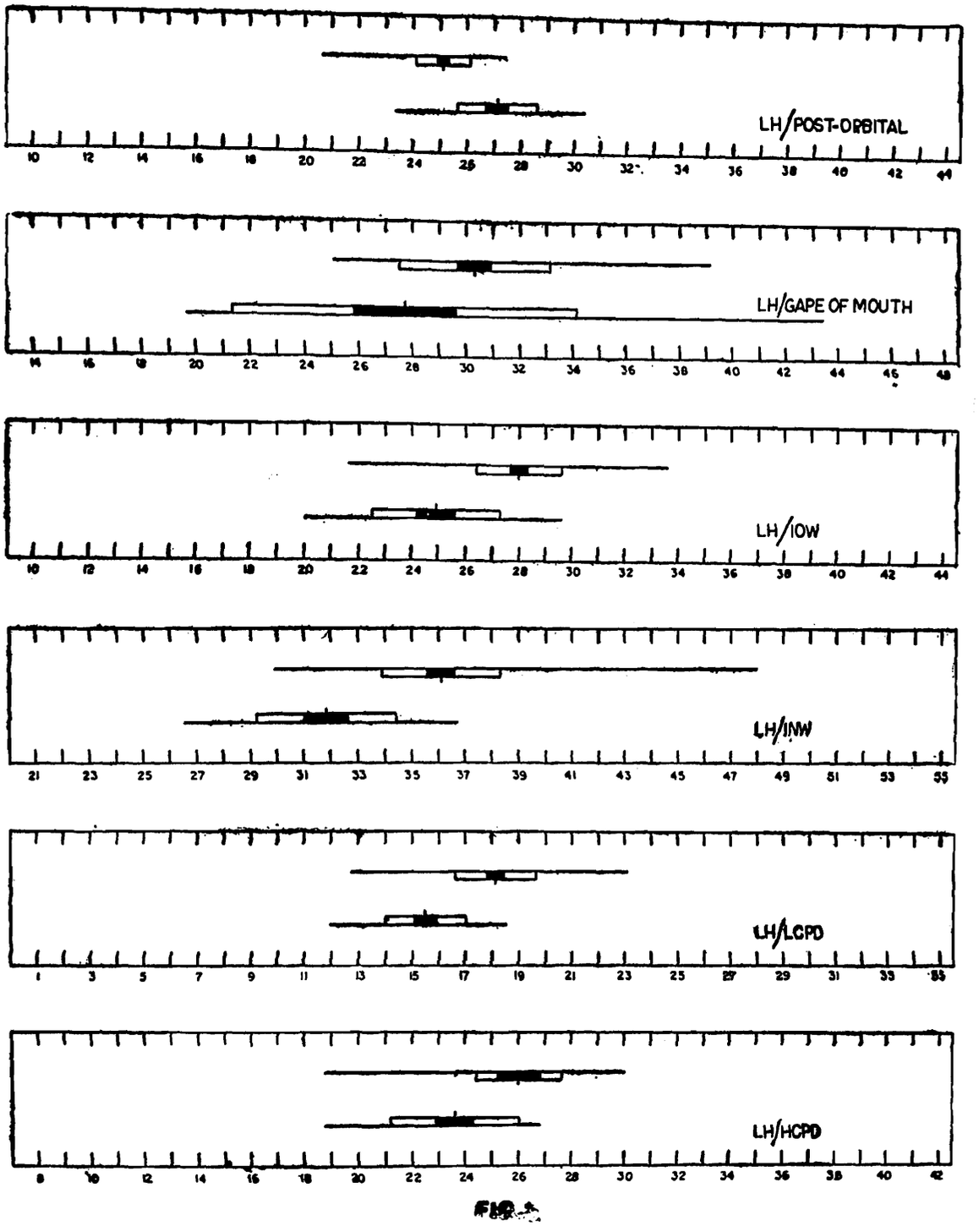

Fig. 2. Graphs showing the variation in some body proportions in the samples of two populations. Upper diagram and lower diagram in each graph represent *L. dyocheilus pakistanicus* and *L. dyocheilus dyocheilus* respectively.

TABLE II—Percentage of intergradation and divergence in respect of certain body proportions between *L. dyocheilus dyocheilus* and *L. dyocheilus pakistanicus*.

Sl. No.	PROPORTIONS	In percentage	
		Intergradation	Divergence
1.	Standard length (SL)/Length of Head (LH)	27.75	72.75
2.	SL/ Body depth	36.15	63.85
3.	SL/Pre-dorsal distance	37.55	62.45
4.	SL/Post-dorsal distance	31.36	68.64
5.	SL/Pre-pelvic distance	25.89	74.11
6.	SL/Pre-anal distance	39.23	60.77
7.	SL/Dorsal fin length	41.84	58.16
8.	SL/Pectoral fin length	37.53	62.47
9.	SL/Pelvic fin length	20.01	79.99
10.	SL/Anal fin length	25.96	74.04
11.	LH/Head width	29.37	70.63
12.	LH/Snout length	22.68	77.32
13.	LH/Post-orbital length	22.68	77.32
14.	LH/Diameter of eye	40.04	59.96
15.	LH/Width of gape of mouth	16.73	83.27
16.	LH/Inter-orbital space width (IOW)	18.11	81.89
17.	LH/Inter-nostrilar space width (INW)	17.5	82.5
18.	LH/Dorsal fin base width	38.8	61.2
19.	LH/Length of Caudal peduncle (LCPD)	20.68	79.32
20.	LH /Least height of Caudal peduncle (HCPD)	27.52	72.48
21.	IOW/Diameter of eye	33.62	66.38
22.	INW/Diameter of eye	32.56	67.44
23.	Snout length/Diameter of eye	35.94	64.06
24.	LCPD/HCPD	33.0	67.0
25.	Pre-anal dist./pre-dorsal dist.	42.75	57.25

qualifying for the rank of a subspecies (Table—II).

CONCLUSION

From the above statistical analysis it can be concluded that the provision of a subspecies rank for the Western Himalayan population of *Labeo dyocheilus* by Mirza and Awan as *L. dyocheilus pakistanicus* is justified. Moreover, *L. dyocheilus pakistanicus* is distinguished from the nominal form, *L. dyocheilus dyocheilus*, by its relatively large head, narrower mouth and shorter snout.

ACKNOWLEDGEMENTS

We are thankful to the Director, Zoological Survey of India for facilities provided and to Prof. M.R. Mirza, Lahore, Pakistan for having kindly gone through the manuscript.

REFERENCES

AMADON, D. 1949. The seventy-five percent rule for subspecies. *Condor*, **51** : 250-258.

DAVENPORT, C. B. and BLANKINSHIP, J. W. 1898. A precise criterion of species. *Science* (N. S.), **7** : 684-695.

DAY, F. 1889. *The Fauna of British India, including Ceylon and Burma. Fishes*, Vol. I. Taylor and Francis, London, XX + 548 pp.

GINSBURG, I. 1938. Arithmetical definitiou of species, subspecies, and race concept with a proposal for a modified nomenclature. *Zoologica*, **23** : 253-286.

HORA, S. L. 1936. On a further collection of fish from the Naga Hills. *Rec. Indian Mus.*, **38** (3) : 317-331.

HUBBS, C. L. and PERLMUTTER, A. 1942. Biometric comparison of several samples with particular reference to racial investigations. *Am. Nat.*, **76** : 582-592.

JAYARAM, K. C. and DAS, M. K. 1980. Systematic position of *Labeo devdevi* Hora with a description of the species (Pisces : Cypriniformes). *Bull. zool. Surv. India*, **2** (2 & 3) : 201-206.

MCCLELLAND, J. 1839. Indian Cyprinidae. *Asiat. Res.*, **19** (2) : 217-471.

MIRZA, M. R. and AWAN, M. I. 1976. Fishes of the Son-Sakesar valley, Punjab, Pakistan, with the description of a new subspecies, *Biologia*, **22** (1) : 27-49.

MUKERJI, D. D. 1934. Report on Burmese fishes collected by Lt. Col. R. W. Burton from the tributary streams of the Mali Hka river of the Myitkyina district (Upper Burma). Part II. *J. Bombay nat. Hist. Soc.*, **37** (1) : 38-80.

PEARL, R. 1930. Introduction to Medical Biometry and Statistics. Philadelphia and London.

SIMPSON, G. C., ROE, A. and LEWONTIN, R. C. 1960. *Quantitative Zoology*. Harcourt, Brace and Company. New York, vii + 440 pp.