

## ON THE FISH FAUNA OF LADAKH WITH NOTES ON ZOOGEOGRAPHY

RAJ TILAK

*Zoological Survey of India, Dehra Dun.*

### INTRODUCTION

Steindachner (1966) was the first worker to report on the fishes of Ladakh, collected by Dr. Stoliczka and described three new genera of Schizothoracinae viz. *Schizopygopsis* from Henle, *Diptychus* from Leh and *Ptychobarbus* from Henle together with three new species of the genus *Noemacheilus* viz. *N. tenuicauda* from Henle, *N. stoliczkae* from Tso Morari, Rupshu and *N. microps* from Leh. Subsequently, these species of fishes were included in the Catalogue of the fishes of the British Museum by Guenther (1868) who described *Noemacheilus ladacensis* from head waters of the Indus river in Ladakh. Day (1876-1877) described *Exostoma stoliczkae* from Leh and *Noemacheilus gracilis* from head waters of the Indus river; he also recorded *Schizothorax richardsonii* (= *Oreinus sinuatus*), *Schizothoraichthys esocinus*, *Ptycnobarbus conirostris*, *Schizopygopsis stoliczkae*, *Diptychus maculatus* and *Noemacheilus stoliczkae* from Ladakh. Zugmayer (1909, 1910) described two species, *Schizothorax ladacensis* Zugmayer and *S. montanus* Zugmayer from Indus river near Leh but no reference to these species appear to have been made by subsequent workers on the Ladakh fishes. It is not possible to study and check up the exact systematic position of the fishes described by Zugmayer (1909, 1910) due to lack of material of these species and, therefore, these taxa are being included here in the fauna of Ladakh. As and when material of these species is available, the systematic status of these species will be decided in future; these species are very closely related to *Schizothorax richardsonii* (Gray). Hora (1922) recorded *N. ladacensis*, *N. stoliczkae*, *N. tenuicauda*, *N. microps* definitely from localities within Ladakh. Subsequently, Hora and Mukerji (1935) worked out the collection of fishes obtained by Mr. J.A. Sillem as member of Netherlands Karakoram Expedition (1929-1930) and reported the presence of *Schizothoraichthys esocinus*, *Schizopygopsis stoliczkae*, *Diptychus maculatus*, *Ptychobarbus conirostris*, *Noemacheilus stoliczkae*, *N. gracilis* and *N. tenuicauda* from the Indus river system in Ladakh. Hora (1936) and Mukerji (1936) worked out the collections of fishes made from Ladakh during Yale North India Expedition (1932) and reported seven species of the genus *Noemacheilus* of which three were new to science (viz. *N. stoliczkae* Steindachner, *N. gracilis* Day, *N. microps* (Steindachner), *N. tenuicauda* (Steindachner), *N. dettrai* Hora, *N. hutchinsoni* Hora and *N. panguri* Hora). In addition to these species, they also recorded six species of Schizothoracinae (viz. *Schizothoraichthys (Racoma) labiatus* (McClelland), *S. (Schizothoraichthys) esocinus*

(Heckel), *Schizothorax richardsonii* (Gray), *Schizopygopsis stoliczkae* Steindachner, *Diptychus maculatus* Steindachner and *Ptychobarbus conirostris* Steindachner) and one species of a Sisorid (*Glyptosternum reticulatum* McClelland). Talwar (1978) has recently described *Gymnocypris biswasi* Talwar and recorded *S. stoliczkae*, *N. deterrai*, *N. ladacensis* and *N. panguri* from Ladakh.

The fishes described by Heckel (1838) and Silas (1978) were from the Kashmir Valley and not from Ladakh although some species of this Valley are distributed in Ladakh also as can be seen from the list of fishes reported from Ladakh. The list of fishes of Kashmir drawn up by Das (1965) is a compilation from earlier literature and does not clearly indicate species exclusively found in Ladakh. Talwar (1978) drew up a list of fishes from Ladakh comprising 26 species of which at least 9 species (*S. curvifrons*, *S. hugelii*, *S. longipinnis*, *S. nasus*, *S. niger*, *S. micropogon*, *S. planifrons*, *S. progsastus* and *N. yarkandensis*) were never definitely reported from any locality in Ladakh nor did this author study them in his collection although these species existed in the surrounding area such as the Kashmir Valley and the Pamir mountains. The existence of these species in Ladakh is, therefore, neither supported by literature nor by the material studied by Talwar (1978). The works of Das *et al.* (1964), Das and Nath (1965), Das and Subla (1966) and Saxena (1968) are not based on actual collection of fishes from Ladakh. Thus, through a review of literature on the fishes of Ladakh together with the study of the material collected by the present author from this area during 1977, it is now possible to enumerate 22 species of fishes actually recorded from Ladakh area of Jammu & Kashmir. Among these, two species of the genus *Noemacheilus* (*N. drassensis* and *N. shehensis*) are described here as new species. *Schizothorax micropogon* is recorded from Ladakh definitely for the first time.

#### SYSTEMATIC LIST

Order SILURIFORMES

Family SISORIDAE

1. *Exostoma stoliczkae* Day
2. *Glyptosternum reticulatum* (McClelland)

Order CYPRINIFORMES

Family CYPRINIDAE

Sub-family SCHIZOTHORACINAE

3. *Diptychus maculatus* Steindachner
4. *Gymnocypris biswasi* Talwar
5. *Ptychobarbus conirostris* Steindachner
6. *Schizopygopsis stoliczkae* Steindachner
7. *Schizothorax richardsonii* (Gray)

8. *Schizothoraichthys (Racoma) labiatus* (McClelland)
9. *Schizothoraichthys (Schizothoraichthys) esocinus* (Heckel)
10. *Schizothorax ladacensis* Zugmayer
11. *Schizothorax montanus* Zugmayer
12. *Schizothoraichthys (Schizothoraichthys) micropogon* (Heckel)

Family COBITIDAE

13. *Noemacheilus deterrai* Hora
14. *Noemacheilus drassensis* sp. nov.
15. *Noemacheilus gracilis* Day
16. *Noemacheilus hutchinsoni* Hora
17. *Noemacheilus ladacensis* Guenther
18. *Noemacheilus microps* (Steindachner)
19. *Noemacheilus panguri* Hora
20. *Noemacheilus shehensis*, sp. nov.
21. *Noemacheilus stoliczkae* (Steindachner)
22. *Noemacheilus tenuicauda* (Steindachner)

SYSTEMATIC NOTES

Systematic notes on some of the important species in the present collection are given below. The two new species of the genus *Noemacheilus* are also described here along with figures.

*Schizothorax richardsonii* (Gray)

1832. *Cyprinus richardsonii* Gray, III. *Indian Zool.*, pt. 10, pl.14, Fig. 2 (Type-locality : not mentioned)
1838. *Schizothorax palgiostomus, sinuatus* Heckel, *Fische aus Caschmir* p.16, pl.1 (Type-locality : Kashmir).
1971. *Schizothorax richardsonii* : Menon, *Rec. zool. Surv. India*, 63(1-4), p.203.
1978. *Schizothorax skarduensis* Mirza and Awan, *Biologia*, 24, pp. 199-203.

*Material examined* (i) 1 ex. (180 mm. total length), Suru river, Kargil, Ladakh, 2.9.1977, coll. R. Tilak (ii) 8 Exs. (107-198 mm. total length), Sheh Canal, Ladakh, 10.9.1977, Coll. R. Tilak.

*Remarks* This species has a characteristic transverse and hard papillated strip at the chin, behind which the labial fold is continuous. It can be distinguished from *S. kumaonensis*, the other species of this genus reported from Kumaon Himalaya (Uttar Pradesh), in the longer head whose length is contained from 4.05-5.05 times in the standard length (Versus 4.85-5.76 times). The sexes are distinctly separate; the male bears tubercles on the snout while the female has a smooth snout. Mirza and Awan (1978) have described a new specie *S. skarduensis* from Pakistan; the only point of

difference of this species with *S. richardsonii* is the longer barbels. The length of barbels is a highly variable character in this species. The shape and structure of the papillated strip at the chin are of intermediate nature between those of *Schizothorax* and *Schizothoraichthys*. Specimen of this kind are usually met with and are due to hybridization (Tilak, 1987).

*S. richardsonii* is a highly versatile species as far as its adjustment to the various ecological conditions at different altitudes is concerned. This is the only species which is distributed in all streams of Himalaya between 700-3500 mts.

*Distribution* : Throughout Himalaya including Ladakh; Afghanistan.

***Schizothoraichthys (Racoma) labiatus* (McClelland)**

1842. *Racoma labiatus* McClelland, *Calcutta J. nat. Hist.*, 2, p. 578, pl. XV, Fig. I  
(Type-locality : Kunar River near Jallabad, Afghanistan).

1936. *Schizothorax labiatus* : Mukerji, *Men. Conn. Acad. Sci., Letter*, 10, p. 333.

*Material examined* : 1 ex. (193 mm. total length) Sheh canal, Ladakh, 12.9.1977, Coll. R. Tilak.

*Remarks* : The characteristic feature of this species is the presence of trilobed lower lip which has a continuous labial fold. The strip of hard papillated structure at the chin is absent. The intermediate lobe of the lower lip may be well developed or small. There are four barbels, the last ray of the dorsal fin is bony, posteriorly serrated, the pharyngeal teeth triserial (5-4-3/3-4-5) etc. The species was reported for the first time by Mukerji (1936). The present material is the second collection of the species from Ladakh. It is found in rapid running waters.

*Distribution* : Ladakh and Kashmir Valley (J. & K.) : Afghanistan.

***Schizothoraichthys (Schizothoraichthys) micropogon* (Heckel)**

1838. *Schizothorax micropogon* Heckel, *Fische aus Caschmir*, p.41, pl. viii, Fig. 1  
(Type-locality: Kashmir).

1936 *Schizothorax micropogon* : Mukerji, *Mem. Conn. Acad. Sci., Letters*, 10, p. 343.

*Material examined* : 1 ex. (141 mm. total length), Sheh canal, Ladakh, 8.9.1977. Coll. R. Tilak.

*Remarks* : In size, this is the smallest species among schizothoracids and is sexually mature at 141 mm. total length. The lower lip has an interrupted sub-labial groove. The scales along the anal sheath are small and not bigger than those of the rest of the body.

This species is being definitely reported for the first time from Ladakh.

*Distribution* : Ladakh and Kashmir Valley (J. & K.).

***Schizothoraichthys (Schizothoraichthys) esocinus* (Heckel)**

1838. *Schizothorax esocinus* Heckel, *Fische aus Caschimir*, p.48, pl. ix (Type-locality : Kashmir).

1936. *Schizothorax esocinus* : Mukerji, *Mem. Conn. Acad. Sci., letters*, 10, p. 335.

**Material examined** : (i) 2 exs. (148-170 mm. total length), Sheh Canal, Ladakh, 5.9.1977, Coll. R. Tilak (ii) 1 ex. (168 mm. total length), Irrigation Canal, Sheh, Ladakh, 7.9.1977, Coll. R. Tilak; (iii) 6 exs. (69-170 mm. total length), Sheh Canal, Ladakh, 8-13.9.1977, Coll. R. Tilak (iv) 1 ex. (64 mm. total length), Indus river near Chuglamsar, 3 Kms. east of Leh, Ladakh, 11.9.1977, Coll. R. Tilak.

**Remarks** : This species distinguishes itself from all other species of this genus in possessing a deep cleft of the mouth. The body bears dark irregular spots. The lower labial fold is interrupted in the middle. Mukerji (1936) has indicated that *S. punctatus* Day is synonymous with this species.

**Distribution** : Ladakh and Kashmir Valley (J. & K.) : Afghanistan.

***Diptychus maculatus* Steindachner**

1866. *Diptychus maculatus* Steindachner, *Verh. zool.-bot. Ges. Wien XVI*, p. 788, pl. 13, Fig. 5 (Type-locality : Tibet, 11200 ft.)

1936. *Diptychus maculatu* : Mukerji, *Mem. Conn. Acad. Sci., Letters*, 10.p.354.

**Material examined** : (i) 1 ex. (163 mm. total length), Suru river, Tilichchi Village near Kargil, 3.9.1977, Coll. R. Tilak (ii) 32 exs. (46-92 mm. total length), Suru river near Andoo Village, Kargil, Ladakh, 4.9.1977, Coll. R. Tilak (iii) 7 exs. (168-210 mm. total length) Dumkhar nullah, nearly 20 Kms. west of Khalsi, Ladakh, 16.9.1977, Coll.R. Tilak (iv) 1 ex. (227 mm. total length) Tribhuchan Nullah, 4 Kms. from Drass, Ladakh, 18.9.1977, Coll. R.Tilak (v) 3 exs. (147-182 mm. total length), Drass Nullah Drass, Ladaky, 18.9.1977, Coll. R. Tilak.

**Remarks** : This species is characterised by the presence of an inferior mouth with a sharp horny covering on the lower jaw, 2 maxillary barbels, scales on the body present only above the lateral line, pharyngeal teeth in 2 rows (4-3/3-4) and the last undivided ray of the dorsal fin soft and unserrated.

**Distribution** : Chandra Bhaga river in Lahaul & Spiti Valley, Himachal Pradesh and Indus river and its tributaries in Ladakh; Tibet, Nepal, Karakash and Yarkand rivers of Central Asia.

***Ptychobarbus conirostris* Steindachner**

1866. *Ptychnobarbus conirostris* Steindachner, *Verh. zool.-bot., Ges. Wien, XVI*, p.790, pl. 17, Fig. 4 (Type-locality : Ladakh, 15200 ft.).

1936. *Ptychobarbus conirostris* : Mukerji, *Mem. Conn. Acad. Sci., Letters*, X, pp. 356-359.

**Material examined** : (i) 14 exs. (98-176 mm. total length), Irrigation Canal at Sheh, nearly 12 Kms. east of Leh, Ladakh, 8.9.1977, Coll. R. Tilak (ii) 8 exs. (99-172 mm.

total length), same locality as at No. i, 10.9.1977, Coll. R. Tilak (iii) 1 ex. (164 mm. total length), Indus river Chuglamsar, 7 Kms. east of Leh, 11.9.1977, Coll. R. Tilak (iv) 17 exs. (162-192 mm. total length), Indus river near Khalsi, Ladakh, 15.9.1977, Coll. R. Tilak (v) 2 exs. (190-198 mm. total length), Indus river, 2 Kms. upstream from Khalsi, Ladakh, 16.9.1977, Coll. R. Tilak.

**Remarks :** This species is characterised by the presence of a subterminal mouth, last undivided ray of the dorsal fin soft and unserrated, body completely scaled, only 2 maxillary barbels present, pharyngeal teeth in 2 rows (4-3/3-4) and the body uniformly spotted.

**Distribution :** Head waters of Indus river, Gompo and Nubra Valley, Ladakh; Tibet.

### *Schizopygopsis stoliczkae* Steindachner

1866. *Schizopygopsis stoliczkae* Steindachner, *Verh. zool.-bot., Ges. Wien*, XVI, p. 785, pl. 16, Fig. 2 (Type-locality : Ladakh).

1936. *Schizopygopsis stoliczkae* : Mukerji, *Mem. Conn. Acad. Sci., Letters*, 10, p. 351.

**Material examined** (i) 1 ex. (178 mm. total length), Irrigation Canal, nearly 12 Kms. east of Leh, Ladakh, 7.9.1977, Coll. R. Tilak (ii) 176 exs. (58-188 mm. total length), Sheh, Ladakh, 8.9.1977, Coll. R. Tilak (iii) 5 exs. (63-120 mm. total length), Sheh, 10.9.1977, Coll. R. Tilak (iv) 2 exs. (141-167 mm. total length), Indus river near Gomak Village, Ladakh, 11.9.1977, Coll. R. Tilak (v) 3 exs. (134-167 mm. total length), Indus river near Chuglamsar Village, 7 Kms. east of Leh, Ladakh, 11.9.1977, Coll. R. Tilak.

**Remarks :** The absence of scales on the body except along the Lateral line and a shoulder patch, barbels absent, pharyngeal teeth in 2 rows (4 or 3-3/33 or 4), the last undivided ray of the dorsal fin bony and serrated and the inferior mouth with a sharp horny covering on the lower jaw.

**Distribution :** From Badakshan and the Pamirs to the eastern Himalaya including the upper reaches of the Oxus, the Indus, the Sutlej and Brahmaputra rivers.

### *Noemacheilus drassensis*, sp. nov.

B. III, D. III-IV/7, P. I/10-11, V. I/7, A. III-IV/5, C. 15.

It is an elongated form with the head and body slightly depressed. The dorsal profile is arched between the base of the dorsal fin and the snout, and it slopes down to the base of the caudal fin. The head is moderately long and bluntly pointed. The length of head is contained from 5.87-6.0 times in total length and 4.90-5.12 times in standard length. The width of head is contained 1.43-1.66 times and its height 1.65-1.77 times in its length. The eye is almost in the middle of head but in many specimens, it is slightly in the anterior half of head. The diameter of eye is contained 6.32-6.6 times in head length, 2.8-2.85 times in length of snout and 1.6-1.8 times interorbital width. The eyes are not visible from the ventral side of head.

The mouth opening is crescentic and transverse. It is bordered by fleshy lips which are continuous at the corners of the mouth. The lower lip is interrupted in the middle where two small median lobes are formed. The lower lip is reflected backwardly so that a shovel-shaped part of the lower jaw is left naked. The lips are striated.

The outer rostral barbels are the longest. The outer rostral and the maxillary barbels are nearly equal to 2 diameters of eye. The body is devoid of scales. The lateral line is incomplete it runs upto the end of the dorsal fin and thereafter it becomes faint and completely obliterated above and behind the anal fin.

The depth of body is maximum opposite the middle of the pectoral fin and is contained 7.68-9.3 times in total length and 6.56-7.8 times in standard length. The caudal peduncle is not whip-like as in many other high altitude species of *Noemacheilus*. The height of caudal peduncle is contained 2.05-2.08 times in its length.

The dorsal fin originates slightly behind the origin of the ventral fin and is nearer the caudal base than the tip of the snout. The distance between the anterior origin of the dorsal fin and the base of the caudal fin, when carried forward, falls on the nostrils. The longest ray of the dorsal fin is contained 1.32-1.45 times and the length of its base 1.66-1.97 times in length of head. The tip of the dorsal fin is almost cut square. The pectoral fins are broad and the edge is pointed in the middle. The 4th branched ray of the pectoral fin is longest and forms the tip of the fin; its length is contained from 1.19-1.23 times in head length., The 3rd and 4th branched rays of the ventral fin are the longest and reach upto the tip of the fin. The 2nd and the 3rd branched rays of the anal fin reach upto its tip and their length is contained 1.5-1.6 times in length of head. The ventral fins do not reach the anal opening and the anal fin extends only half-way to the base of the caudal fin. The caudal fin is emarginate. The 3rd and 4th branched rays of the caudal fin form the tips of each of the two lobes of the fin. The unbranched rays of both the lobes of caudal are shorter and do not reach tip of the fin. The length of the caudal fin is contained 1.0-1.14 times in length of head.

**Sexual dimorphism** : There is a marked sexual dimorphism in this species; it is of a similar nature as described in *N. tibetanus* and other species of the genus *Noemacheilus* of high altitude areas (Hora, 1922). In the male, there is a slit-like deep groove in front of the eye. The groove extends between anterior border of eye and base of outer rostral barbels and marks off a fleshy appendage. The skin of the appendage and some portion of the cheek below it are roughened by the presence of minute tubercles. Similar tubercles are present on the dorsal side of the branched rays of the pectoral fin. These rays of the pectoral fin are thickened and bony.

In the female, the groove between the eye and the thickening of the pectoral rays, and covering of the tubercles on both these structures are absent.

**Colour** : The body bears irregular colour markings which form a reticulum in the anterior half of the body while they take the shape of irregular vertical bands behind the dorsal fin. There are 10-11 dark saddle-shaped bands on the back. The 4-5 bands on the

back, behind the dorsal fin, are more prominent than those present in the area anterior to the dorsal fin. The ventral and lateral sides of the head bear reticulations of dark colour. The ventral sides of head and body are pale olivaceous in colour. There are 3 dark bands at the base of the dorsal fin. There are 3-4 rows of dark spots on the dorsal fin. There are a few rows of dark spots on the pectoral fin. The ventral and anal fins are normally yellowish but in some specimens, 1-2 dark spots are present on the middle rays of these fins. There are 3-4 irregular rows of dark spots on the caudal fin. There is a vertical dark band at the base of the caudal fin.

*Distribution* Drass, Ladakh (J. & K.).

*Holotype* : F. NRS/ZSI-1206, 1 example (106 mm. total length) *male*, a stream near Drass (Ladakh, J. & K.), 19.9.1977, Coll. R. Tilak.

*Paratype* : F. NRS/ZSI-1207, 7 examples *male* and 11 examples *female* (43-97 total length), locality data same as that of the Holotype.

*Relationships* : *N. drassensis*, sp. nov. is a small sized fish which lives under stones in a small stream near Drass by the side of Srinagar-Leh highway. Since Drass has been recorded as the second coldest place in the world, the streams near about this place remain under a heavy cover of snow for major part of the year and the present species is adapted to live under harsh conditions.

This species is close to *N. microps* Steindachner but differs from it in many features. Steindachner (1866) described *N. microps* from headwaters of Indus river at an altitude of 16000 ft. above sea level. Günther (1867) considered *N. microps* near to *N. rupecola* (McClelland) while Day (1878) doubtfully synonymised it with *N. rupecola*. Hora and Mukerji (1935) studied 57 examples of *N. microps* from Karakash river at Alinazar Kurgan and remarked that this small-sized fish has small eyes. The characters in which the present species differs from *N. microps* are the following.

1. *N. drassensis* has a deeper body than that of *N. microps* the depth of body is contained 7.68-9.3 times in total length in the new species whereas the same dimension is 9.0-12.0 times in *N. microps*.

2. The eyes are larger in *N. drassensis*, being 6.32-6.6 times in head length against 7.0-7.5 times in *N. microps*.

3. The postdorsal distance, when carried forward, falls on the nostrils in *N. drassensis* whereas in *N. microps*, it falls behind the eye.

4. The colour pattern is different in both species.

*Noemacheilus shehensis*, sp. nov.

B. III, D. III/7-8, P.I./11-12, V II/8, A. III/5, C. 16.

It is an elongated and robust-looking fish with the anterior part of the body slightly depressed while the posterior part being compressed with a long tail. The tip of the snout is broadly pointed. The length of head is contained 4.41-4.96 times in total length



and 3.76-4.23 times in standard length. The width of head is contained from 1.68-2.06 times in the length of head. The eye is situated partly in the anterior half of head and is nearer the tip of snout than the opercular margin. They are not visible from the ventral side of head. The diameter of eye is contained from 4.87-6.33 times in the length of head, from 2.06-2.55 times in length of snout and 1.17-1.73 times in the interorbital width. The mouth is crescentic and transverse; it is situated on the ventral side somewhat behind the tip of the snout and is encircled by fleshy lips. The lips are continuous at the corners of the mouth. The lower lip is interrupted in the middle by a deep symphyseal furrow. On either side of the furrow, a small lobe of the lip is formed. The lips are striated and cover the jaws completely. The barbels are short and thick. The maxillary and outer rostral barbels are either as long as or slightly smaller than the eye while the inner rostral barbels are smaller and not more than  $\frac{3}{4}$  th of eye diameter.

The deepest part of the body is somewhere between the head and the base of the dorsal fin. The maximum depth of body is contained from 6.97-9.4 times in total length and 5.84-8.0 times in standard length. The lateral line is incomplete and extends on the body upto a point opposite  $\frac{1}{3}$ rd length of the pectoral fin. The head and body are without scales.

The caudal peduncle is thin and narrow; its height is more than the diameter of eye and is contained from 2.87-4.07 times in its length.

The dorsal fin is inserted opposite the ventral fin and its origin is equidistant between the base of the caudal fin and the nostrils. The longest ray of the dorsal fin is almost equal to that of the pectoral fin and is much smaller than the head. The longest ray of the dorsal fin is contained from 1.62-1.85 times and the length of the base of the dorsal fin 1.30-1.56 times in head length. The last undivided ray of the dorsal fin is much smaller than the 1st branched ray of the same fin. The upper edge of the dorsal fin is truncate or slightly crenulate. The pectoral fin is broad and pointed in the middle; the 3rd and 4th branched rays form the tip of this fin. It is smaller than the head and is separated from the ventral fin by a distance equal to its own length. The ventral fin is smaller than the pectoral fin. The ventrals almost extend upto the anal opening or fall short of it by a small distance. They do not extend upto the anal fin which does not reach the base of the caudal fin. The longest ray of the anal fin is contained from 1.87-2.25 times in head length. The caudal fin is longer than all other fins of the body but smaller than the head. The length of the caudal fin is contained from 1.30-1.54 times in head length. The posterior border of the caudal fin is concave and both the lobes of this fin are of equal extent.

*Swim-bladder* The swim-bladder is divided into two parts : (1) the anterior part, consisting of two rounded lateral chambers, enclosed in bony capsules and connected to each other through a small transverse tube, (2) a large posterior part, lying free in the abdominal cavity and connected with the transverse tube by another short tube. A small tube connects the anterior part of the bladder with the oesophagus. The posterior part of

the bladder is uniformly smooth without any constriction and represents a single chamber which extends upto the posterior end of the body cavity. The length of the posterior chamber is contained from 3.0-3.4 times in the total length of the fish. The bony capsules around the anterior chambers of the swim-bladder lie just above the bases of the pectoral fins and deep beneath the skin without giving any external indication of their presence.

**Colouration** In spirit preserved specimens, the ground colour of the body is pale-olivaceous. The dorsal and lateral sides of the head bear reticulations of dark colour. The dorsal and lateral sides of the body are generally dark coloured and bear somewhat irregular, wavy and vertical bands of different lengths. Some of the bands run across the mid-dorsal side of the body like a saddle. The bands do not extend lower than 3/4th part of the side of the body. The dorsal, pectoral and caudal fins bear 3-4 cross series of spots. The base of the caudal fin bears a cross series of dark spots. The ventral and anal fins bear a dark cross band on each. The membrane inbetween the last undivided and the first divided rays of the anal fin bear an elongated dark mark.

**Sexual dimorphism** : The sexes in this species can be easily distinguished in the following characters: (1) In the male, there is an elongated fleshy pad between the end of the maxillary and the anterior edge of the orbit. The pad is separated from the skin of the cheek by a groove on the ventral edge of the pad. The pad is absent in the female. (2) The barbels are somewhat longer in the males than in the female specimens. (3) In the male, a fleshy genital papilla with a terminal male genital pore is present behind the anal aperture. In the female specimens, no genital papilla is present and the female genital opening is wide and opens just behind the anal aperture. The testes are elongated and flattened yellowish white bodies with a somewhat wavy margin. The male ducts from the two testes unite medially and open jointly at the male genital pore. In the female, the ovaries are massive structures; the ovaries of the two sides are fused with each other through nearly 2/3rd of their posterior part. The common oviduct opens at the female genital pore. The ovaries contain ova of various stages of maturity even in specimens at 110 mm. total length.

**Bionomics** The narrow and whip-like tail in this species indicates that it is adapted to live in fast currents of water and can swim fastly. But the presence of an extensive swim-bladder in the abdominal cavity indicates that it has lake-dwelling habit. This species was collected from a side channel of the Indus river entering fish-rearing tanks where water is almost stationary and moves at a very slow pace. The environment of the fish provides both fast running water as well as stationary tank-water with very slight movement.

The gut contents of a large number of specimens were studied; the food of this species consists completely of insect larvae (dipterous) although some sand particles or rarely a shelled crustacean has also been seen. The gut length is nearly 4/5th of the total length of the fish and suggests animal feeding habit. It is a bottom feeder.

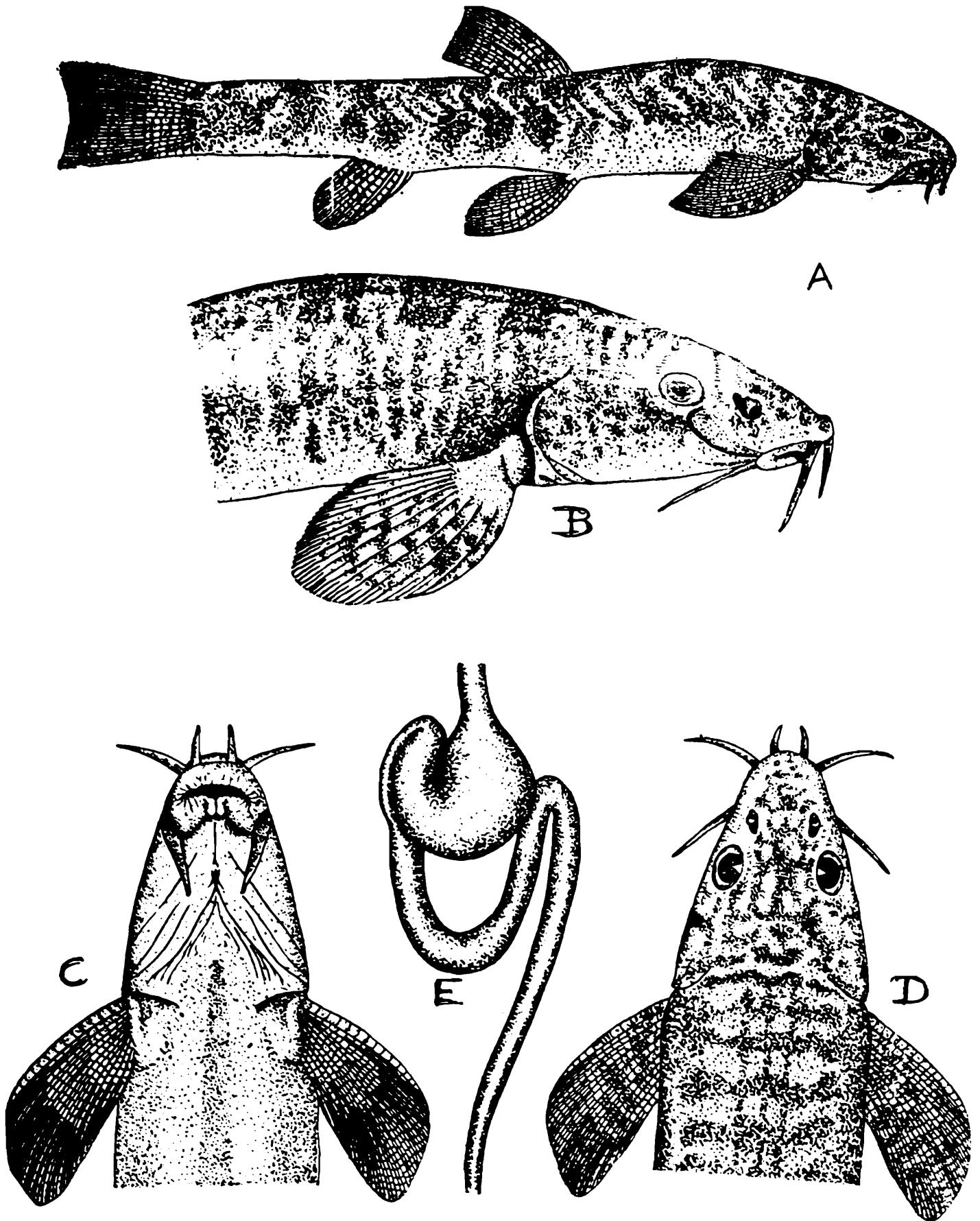


Fig. 1. (A) *Noemacheilus drassensis*, sp.nov. - lateral view; (B) Head and anterior part of body - lateral view; (C) Ventral aspect of head and anterior part of body; (D) Dorsal aspect of head and anterior part of body; (E) The gut.

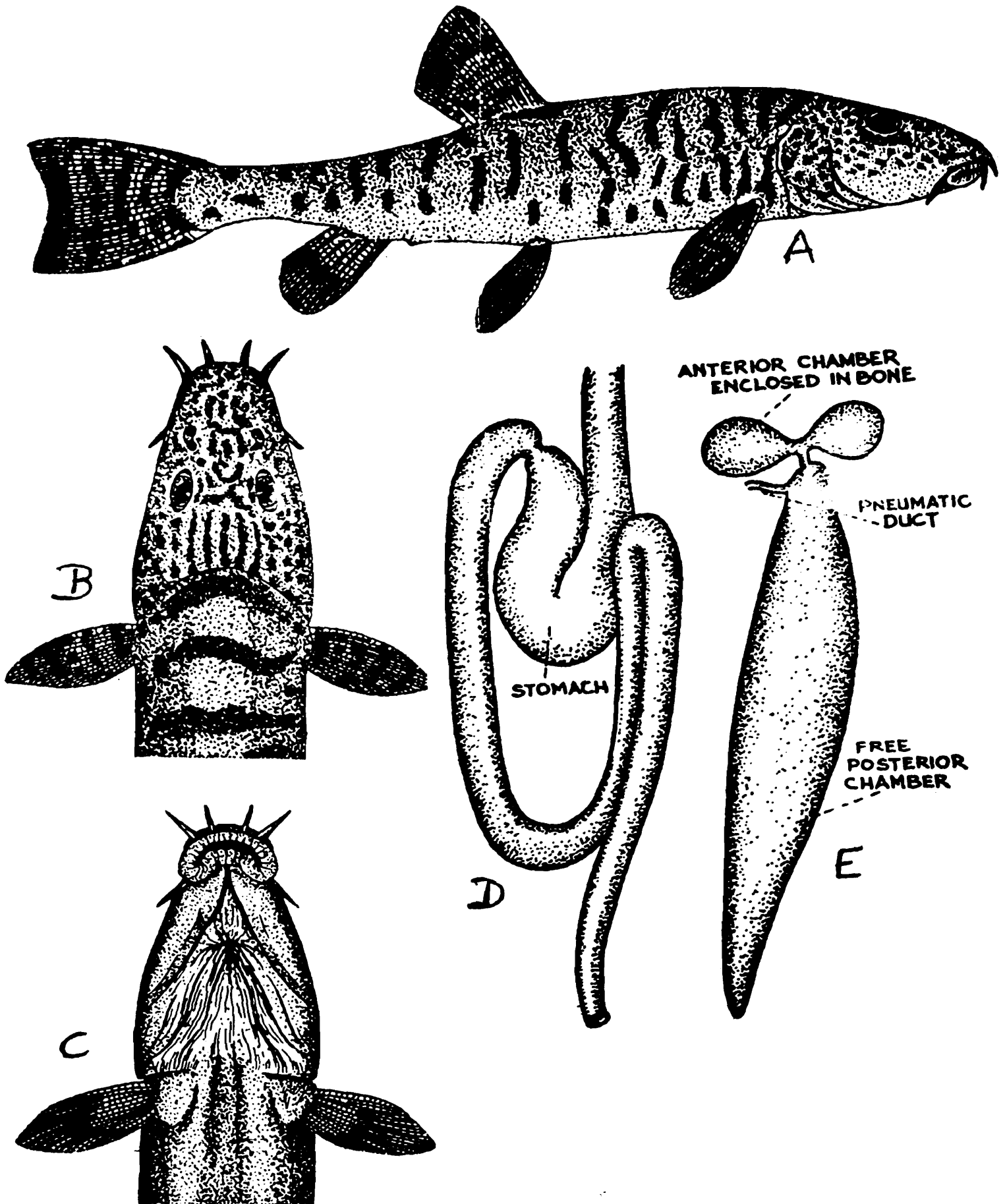


Fig. 2. (A) *Noemacheilus shehensis*, sp. nov. - lateral view; (B) Dorsal view of head and anterior part of body; (C) Ventral view of head and anterior part of body; (D) Gut; (E) Swim-bladder.

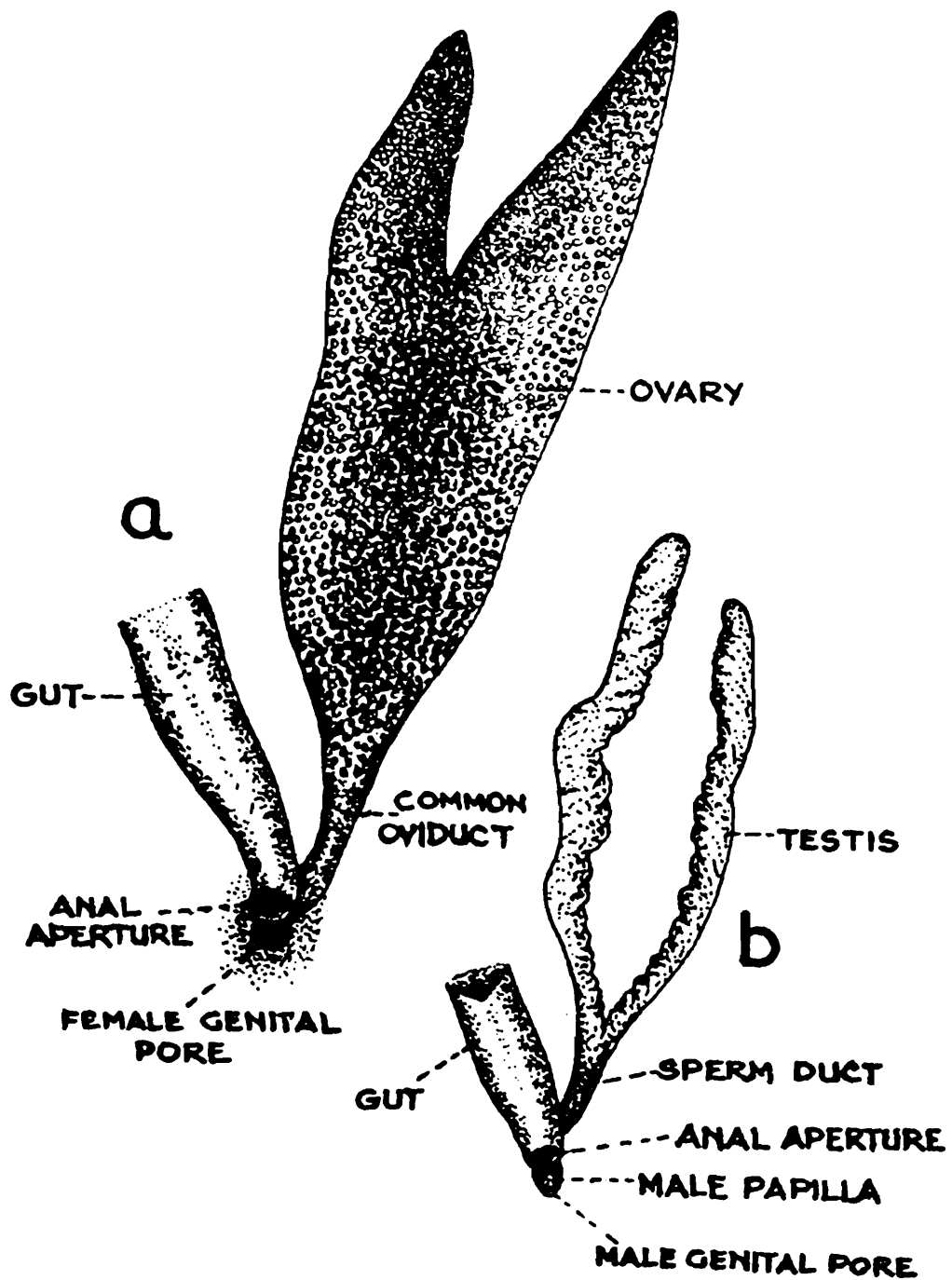


Fig. 3. (A) Female gonads and related structures of *N. shehensis*; (B) Male gonads and related structures of *N. shehensis*.

**Relationships** : In the possession of an extensive posterior part of the swim-bladder in the abdominal cavity (Diplophysid type), this species falls under a group of species comprising *N. hutjertjuonsis* Rendahl, *N. stewarti* Hora, *N. panguri* Hora, *N. deterrai* Hora, *N. hutchinsoni* Hora etc. The three latter species are described by Hora (1936) from Ladakh and the present species differs from them all in its specific colouration of the body and the morphometric measurements.

**Holotype** : I example (132 mm. total length) Regd. No. NRS/ZSI-1208, Irrigation canal at Sheh, nearly 12 Kms. east of Leh (Ladakh), 8.9.1977, Coll. R. Tilak.

**Paratypes** : 4 examples (81-133 mm. total length), Regd. No. NRS/ZSI-1209 (Locality data same as that of holotype). : 25 examples (55-150 mm. total length), Regd. No. NRS/ZSI-1210, Irrigation canal at Sheh, nearly 12 Kms. east of Leh (Ladakh), 10.9.1977, Coll. R. Tilak.

#### *Noemacheilus stoliczkae* (Steindachner)

1866. *Cobitis stoliczkae* Steindachner, *Verh. zool.-bot. Ges. wien*, XVI, p. 793, pl. xiv, Fig. 2 (Type-locality : Tso Murari, Rupshu, Ladakh).

1936. *Noemacheilus stoliczkae*: Mukerji, *Mem. Conn. Acad. Sci., Letters*, 10, p. 306.

**Material** : (i) 1 ex. (113 mm. total length), a stream at Sheh, nearly 12 Kms. east of Leh, Ladakh, 8.9.1977, Coll. R. Tilak.

**Remarks** : This species is much allied to *N. tenuicauda* but can be distinguished in the height of the caudal peduncle being contained from 3.4-4.0 times in its length. A very wide interpretation has so far been given to this species which is also widely distributed. It feeds on dipterous and caddis-fly larvae.

**Distribution** : Ladakh; Central Asia.

#### *Noemacheilus tenuicauda* (Steindachner)

1866. *Cobitis tenuicauda* Steindachner, *Verh. zool. -bot. Ges. Wien*, XVI, p. 792, pl. XVII, fig. 3 (Type-locality : Hanle, Ladakh).

1936. *Noemacheilus tenuicauda*: Hora, *Mem. Conn. Acad. Sci., Letter*, 10, p. 311.

**Material** : (i) 10 exs. (59-113 mm. total length), a stream at Sheh, nearly 12 Kms. east of Leh, Ladakh, 8.9.1977, Coll. R. Tilak.

**Remarks** : This species is characterised by the following characters: (1) The ventral fins extend posteriorly beyond the anal opening. (2) The swim-bladder has two anterior lateral chambers only: the posterior chamber is absent. (3) The eyes are situated in the middle of the head and the snout is almost equal in length to the post-orbital part of head. (4) The anterior origin of the dorsal fin is nearer to the base of the caudal fin than the tip of the snout. The distance between the anterior origin of the dorsal and the base of the caudal fin, when carried forward, falls on the nostrils. (5) The height of the caudal peduncle lies 4.88-5.0 times in its own length.

This species is distinguished from *N. stoliczkae* in its narrower caudal peduncle.

*Distribution* : Ladakh.

### ZOOGEOGRAPHIC REMARKS

The cyprinid, the cobitid and the silurid fishes so far recorded from Ladakh are essentially palaeartic in origin and are specialised in many ways. Tilak (in press) has already indicated that the palaeartic cyprinids of the subfamily Schizothoracinae have entered the Indian origin through the northern side across the Himalaya during the late Pleistocene era. This hypothesis is in line with the Pamir-Kashmir theory enunciated by Das (1965, 1966) and Das and Subla (1964, 1970). Hora's Satpura Hypothesis (Hora, 1937; 1944; 1949; 1953; Menon, 1951; 1954; 1978; Silas, 1952) explained the distribution of fresh-water fishes through the eastern gate via Assam, Satpura range and then along the Western Ghats to peninsular India. According to that observation, the fresh-water fishes of India originated mainly in southern China and Malaya, and spread westwards. This invasion from the East apparently began in the lower Eocene as soon as the terrestrial connection between India and other parts of Asia was established. Tilak and Husain (1978), based on the distribution of some of the fresh-water fishes of Indo-gangetic plains, suggested a revision of Hora's Satpura Hypothesis and explained the entry of fishes towards West along the base of Himalaya in Indo-gangetic plains. The pattern of distribution of Schizothoracinae, siluriform and cobitid fauna, allied to those of Ladakh forms, into Kashmir Valley and the Indian region along southern face of Himalaya has neither been explained on the basis of Hora's Hypothesis nor the modification suggested for that Hypothesis by Tilak and Husain (1978).

Based on the biogeographical theory, proposed by Henning (1966) and Brundin (1975), Novacek and Marshall (1976) opined that South America was most likely the area of origin of Ostariophysan fishes. Contrary to this explanation, Briggs (1979) suggested that the Oriental region was the center of evolutionary radiation for the Ostariophysan and other advanced groups of primary fresh-water fishes; this suggestion corroborates Hora's Satpura Hypothesis, modification of Hora's Hypothesis by Tilak and Husain (1978) and the present hypothesis of a northern entry for Schizothoracinae. The evolution of Schizothoracid fishes is a recent event than the evolution of the family Cyprinidae as a whole.

The existence of *Glyptosternum reticulatum* (McClelland), species of the genera *Schizothorax* and *Schizothoraichthys* in Ladakh on the one hand and Kashmir and Poonch Valleys on the other (Silas, 1960; Das, 1965; Sharma and Sharma, 1974; Talwar, 1978; Nath, 1981, Tilak, in press) indicates that the drainage of these areas was contiguous with one another before the rise of Himalaya and these fishes moved freely in these areas. After the uplift of Himalaya, the major stock of these fishes got cut off from these Valleys because of the eruption of very high ranges, causing disruption of the common drainage of the two areas (Tilak, in press). The existence of a larger number of genera and species of Schizothoracids and some specialised siluridus in

Ladakh indicates that this area has been the parental home of these fishes. This belief is further strengthened on the basis of the present day distribution of *Diptychus maculatus*, particularly in Ladkakh on the one side and Lahaul Valley (Himachal Pradesh) on the other (Tilak, 1976: and in press). This supports the fact that the drainage of Chandra-Bhaga river (Chenab) in Lahaul Valley was at one time connected with that of Ladakh. The introduction of *Glyptosternum*, *Schizothorax* and *Schizothoraichthys* into the drainage system on the southern face of Himalaya probably took place from Kashmir through the Poonch Valley into the Chenab drainage and further into other river systems along Himalaya. Since the introduction of *Schizothorax* and *Schizothoraichthys* into the drainage system along the southern face of Himalaya is a subsequent event, these fishes had to cross through the water-ways of very low altitudes (nearly 600 mts.) where they lived for hundreds of years before they gradually started ascending into the rivers along southern side of Himalaya. *Glyptosternum* did not find an opportunity to move further along with Schizothoracid fishes and remained limited upto the Chenab drainage; this happened probably because of the peculiar mode of living of this fish which remains clinging to rocks near the bottom of water. Since living in torrential streams of higher oxygen contents has been the inherent quality of schizothoracids, they again started invasion of the higher reaches of Himalayan streams during the recent era but so far they have not achieved those altitudes at which their parental stock lived in Kashmir or Ladakh; this can be clearly seen from the present-day distribution of these fishes in Himalayan rivers which drain into the Indo-gangetic plains. Even the same species, such as *Schizothorax richardsonii*, which thrives comfortably at an altitude of 4000 mts. and higher in Ladakh, is not found in the streams and rivers on the southern side of Himalaya at altitudes higher than 1500 mts or so. These series of events in the distribution of silurids and schizothoracids clearly indicate that the dispersal of Central-Asiatic fishes took place through the northern gate via the Kashmir and Poonch Valleys towards the East along Himalaya.

#### SUMMARY

On the basis of a collection of fishes from various localities in Ladakh together with the reports published by other workers, a list of 22 species of fishes so far recorded from this region has been presented here. Among these, there are two new species of the genus *Noemacheilus* which have been described and figured here for the first time. Taxonomic notes on important species included in this list have been added. Since the fish fauna recorded and studied here is totally palaeartic, it has a great zoogeographic significance and when compared with the fauna of Kashmir and the rivers on the southern face of Himalaya, supports the view that the palaeartic fishes entered the Indian region through the northern route via the Kashmir and Poonch Valleys. The evidence for such a hypothesis is clearly presented by the Schizothoracid fishes which have a peculiar pattern of distribution.



## ACKNOWLEDGEMENT

The author feels grateful to the Director, Zoological Survey of India, Calcutta for his continuous encouragement and award of facilities to work in the department. He is thankful to Director of Fisheries, Govt. of Jammu & Kashmir, Srinagar and members of staff of that department for their help in various ways.

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