THE FISHES OF THE KASHMIR VALLEY

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The fishes of the Kashmir Valley

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Abstract

Standardised fishing along the Jhelum River and in associated lakes between Uri and Srinagar in the Kashmir Valley yielded 14 native and four introduced fish species over a period of eight years. Five species of *Schizothorax* are recognised, four of which are specialised lotic forms (*S. labiatus*, *S. plagiostomus*, *S. esocinus*, *S. curvifrons*), and one of which is chiefly found in lakes (*S. niger*). *Schizothorax* species differ in colour pattern, morphometry, scale counts, gill-raker counts, pharyngeal bone and tooth shape, and mouth shape. Only *S. niger* may be endemic to the valley, but data on similar fishes from other areas are scarce. The species commonly known as *Labeo diplostomus* is recognised as a *Bangana* species and as distinct from *B. dero*. The only other labeonin found is *Crossocheilus diplochilus*. Introduced cyprinids identified are *Cyprinus carpio, Carassius carassius*, and *Puntius conchonius*, the last-mentioned, however, reported as naturally occurring in the Kashmir Valley by others. The only cobitid species found is identified as *Botia birdi*, but it is possible that it is a synonym of *B. almorhae. Schistura punjabensis* is identified with *S. nalbanti* and *S. paludani* as junior synonyms. *Triplophysa marmorata* and *T. kashmirensis* are identified as the only *Triplophysa* species in the valley, but the systematics of the western Himalayan *Triplophysa* requires more extensive revision. *Triplophysa ajmonis* may be a synonym of *T. kashmirensis* or *T. microps. Triplophysa ladacensis* is tentatively synonymised with *T. tenuicauda*, and *T. gracilis* with *T. microps.* Three sisorid catfishes occur in the valley, viz. *Glyptosternon reticulatum*, *Glyptothorax kashmirensis,* and *G. pectinopterus*, the last-mentioned not reported before from the Kashmir Valley. The introduced mosquitofish, *Gambusia holbrooki,* is well established in the Kashmir Valley. *Tor putitora*, previously reported from the Valley, was not encountered and is believed to be extirpated. Introduced *Salmo trutta* and *Oncorhynchus mykiss* were not encountered, but may be restricted to headwaters out of reach of the survey team. No high-altitude cold-water forms were encountered.

The 14 species contrast with high numbers presented in recent lists of Kashmir Valley fish species, up to 42 species, and show clearly that biodiversity assessments cannot be made by literature studies only. The systematic status of most of the Kashmir Valley species is in strong need of deeper study, including comparisons with populations or taxa from a much wider area. The only three species that may be endemic are *Schizothorax niger*, *Triplophysa marmorata* and *T. kashmirensis*, but it is likely that the *Triplophysa* species will be found to be identical to species reported from the Kabul and upper Indus drainages. *Schizothorax niger* is mainly a lacustrine species and, owing to the paucity of warm-water lakes in the region, may indeed have a restricted distribution.

The upper Jhelum fish fauna combines elements of the low-altitude Himalayan region (*Schizothorax, Triplophysa*, *Glyptosternon*), which is essentially rheophilic but not cold-water adapted, with a more southern, warm-water rheophilic fauna extending along the base of the Himalayas (*Bangana diplostoma, Crossocheilus diplochilus, Glyptothorax* species, *Schistura punjabensis*). The native species are mostly restricted either to the upper Indus or to the Indus drainage. Species richness and relative endemism are, however, low, and for want of comparative data from adjacent areas it is difficult to stress much conservation value for the Kashmir Valley fishes. Population densities of some of the migratory species, principally the *Schizothorax* species may be adversely affected by the Uri barrage (the new Mohra Dam), but the fauna as a whole is affected negatively not by single factors but rather by the combined pressure from barrages, dams, pollution, overfishing, and introduction of exotic species.

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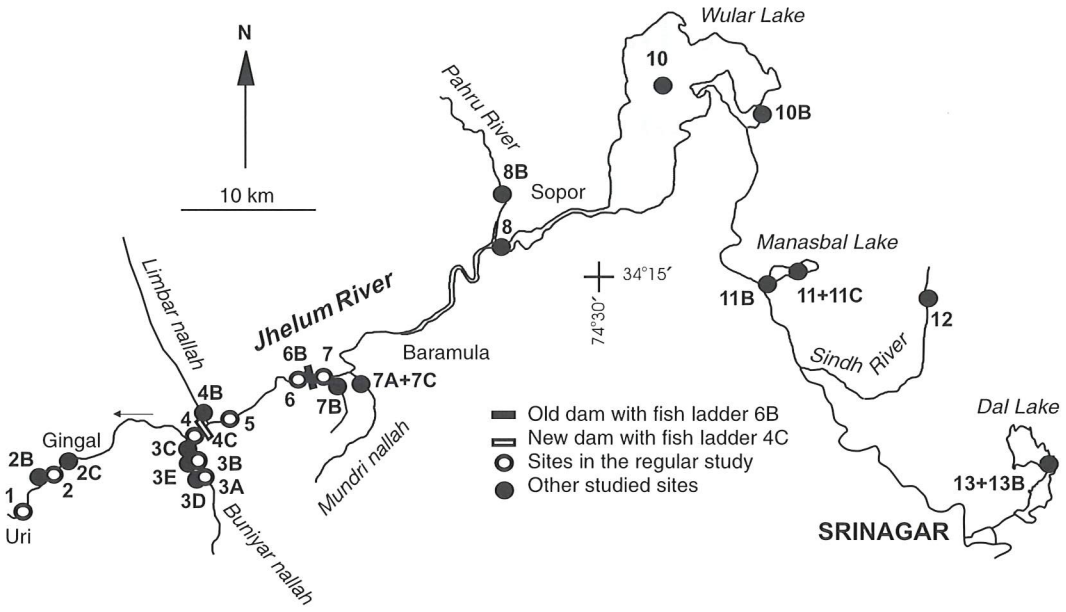

Fig. 1.
Sketch map of the lower Kashmir Valley showing location of collecting sites.

Introduction

The fish fauna of the Jhelum River is one of the earliest local fish faunas known to science. The first collections were made by the Austrian baron Carl Alexander Anselm von Hügel (1795–1870) at the end of a long trip through Eurasia over the period 1831–1836. Samples were deposited in the Naturhistorisches Museum in Vienna, Austria. The ichthyologist of that museum, Jacob Heckel, published two well illustrated taxonomic accounts of the fish collection, summing to 16 species all of which he considered to be new to science (Heckel, 1838, 1844). Ten of the species belong to the group of cyprinid fishes now commonly referred to as oreinins, schizothoracines, mountain barbels or snow trout, and in the minds of ichthyologists and others interested in fishes, the Kashmir Valley will forever remain The Snow Trout Place, or, as we suggest below, The Snow Barbel Place.

The present report lists and comments on the fishes collected during the 1990-1997 Aquatic Environmental Impact Assessment of the Uri hydroelectric power station construction at Uri, little downstream of Srinagar (Fig. 1). Due to circumstances beyond the field team's control, sampling was restricted to the immediate vicinity of the construction site, and the famous lakes near Srinagar could be visited only occasionally. Nonetheless, a substantial sample of aquatic organisms was obtained and the information is sufficient both to establish a valuation of the fish diversity at the construction site, and to update the list of fishes known from the Kashmir Valley, which is the purpose of the present contribution.

Material and Methods

Fishes were collected during short field trips of up to three weeks from 1990 till 1997, during different seasons and with a variety of methods as described in detail by Andersson (1998, this volume). Collecting sites are illustrated in Fig. 1. Detailed descriptions of the sites are given by Andersson (1998, this volume). The benthofauna is described by Lingdell & Engblom (1998, this volume). Aspects on conservation and fish biology are covered by Enderlein & Yousuf (1998, this volume) and Wickström (1998, this volume). Altogether 3906 fish specimens were obtained from the Kashmir Valley and 724 specimens from Shimla. Almost all specimens were measured and weighed in the field, and fixed in 10% formalin. Field measurements are total length (TL), measured from the tip of the snout to the end of the caudal fin with the lobes (if any) folded. All samples are now preserved in ethanol and deposited in the Department of Vertebrate Zoology, Swedish Museum of Natural History, Stockholm, Sweden (NRM). A condensed list is provided in Appendix 1, and a complete listing can be obtained from the Internet at the NRM fish collection web site (http://www.nrm.se/ve/pisces/).

Geographical names in languages not using the Latin alphabet are rendered either in English customary transliteration or, when known, the standard transliteration of the country in which the place is located. Thus, we use the In-

dian Ganga instead of the British Ganges as the name for the major north Indian river. We use Shimla, which is the current Indian spelling for the Himachal Pradesh city also frequently called Simla, which is the traditional British spelling.

Kashmir Valley (Vale of Kashmir) is herein understood as the valley of the Jhelum River upriver from Uri, including both the plains and the hill slopes defining the valley. Other authors have probably used the names Kashmir Valley and Kashmir with a slightly different connotation.

Local names of fishes are as recorded by Yousuf *et al.* (MS), and follow their transliteration. These names are assumed to be in Kashmiri, and may be different from names for the same species used beyond the Kashmir Valley.

The Swedish-Indian Uri Aquatic Environmental Impact Assessment project that gathered the data and samples for this report is hereafter referred to as the Uri AEIA.

A most significant part of the Uri hydroelectric power plant is the dam, the new Mohra Dam, formed by blocking the river between the mouth of the Limbar nallah and the mouth of the Buniyar nallah. In assessing risk status, we concentrate on the construction of the barrage and the formation of the dam.

Measurements were taken with digital callipers connected to a data recording computer, recording to 0.01 mm precision, rounded to the nearest 0.1 mm; or recorded manually to the nearest 0.1 mm. Counts were taken under a binocular stereo dissection microscope. Methods follow standard procedures, and the terminology should be self-explanatory. The following particulars apply. Standard (SL), head, preanal, predorsal, prepelvic, prepectoral and snout length was taken with the middle of the upper jaw, not the tip of the snout as the anterior reference point. Fin lengths were measured from the origin of the fin to the tip of the longest ray, except that the dorsal-fin height was measured as the length of the last unbranched ray. Caudal peduncle length was taken from the base of the last anal ray to the middle of the caudal-fin base (*Schizothorax*), or to the end of the caudal peduncle determined as a vertical through the end of the hypural plate (*Triplophysa*). Head width and head depth were measured very slightly posterior to the orbit.

Counts of scales in a lateral series or in the lateral line do not include scales on the caudal-fin base. The last dorsal and anal-fin ray is regarded as being split to near the base and counted as one, although it may sometimes appear superficially as two rays. Gill-raker counts include all gill rakers externally on the first gill arch. The last unbranched ray in the dorsal and anal fin of cyprinds may be heavily ossified, and is then referred to as a spine.

Statistics were calculated and statistical graphics made using SYSTAT version 7.01 (SPSS, Inc., 1997). Principal components were calculated using log-transformed measurements in a covariance matrix. Linear regression lines were tested for distinctness in a two-step procedure first testing for homogeneity of slopes (whether lines parallel), and if parallel, by ANCOVA.

Collection acronyms include BMNH (The Natural History Museum, London), NMW (Natural History Museum, Vienna), and NRM (Swedish Museum of Natural History, Stockholm).

Species and supraspecific classification were evaluated using the phylogenetic species concept and a heuristic version of phylogenetic systematics appropriate for the task.

Information given on each species below is not exhaustive. Longer notes are provided for sympatric congeneric species only, in which case there was a need to compare species with a similar appearance. Thus, accounts of the genera *Triplophysa* and *Schizothorax* are more detailed because the species included may be difficult to distinguish. *Triplophysa* and *Schizothorax* are also the only fish genera in the Kashmir Valley that *might* include species endemic to the upper Jhelum, and therefore need more attention.

Special concern is given to nomenclature as it has to be updated, and thus also explained. After Day's (1875–88) exhaustive treatise of the Indian fauna, Hora in the 1920s–1940s published numerous reports on collections as well as quite a number of generic revisions. Those dated works form the actual basis for Indian fish taxonomy, including nomenclature. Thus, nomenclatural shifts herein should not be considered surprising, and the changes proposed here are only minor compared to what may be anticipated for the majority of Indian fishes. The standards for zoological nomenclature are published in the International Code of Zoological Nomenclature (1985), referred to in this report as ICZN.

We use the ending –ini for names in the family-level category tribe. ICZN Article 29a exempts tribes from having any particular suffix to the name. Thus, Oreinidae (with mandatory family name ending) could be used as well as the original Oreini for oreinins (p. 114). As the use of the original form (Oreini in our example) is not mandatory, we use the ending –ini for all tribes, following ICZN Recommendation 29A. The snow-barbel tribe is thus Oreinini.

Synopsis of the Jhelum fish fauna in the area affected by the Uri Hydropower Station

After Heckel (1838, 1844), who listed 16 species from the Jhelum, numerous fish collections have been made in the Kashmir Valley and surrounding areas. Silas (1960), Das & Subla (1963, 1964), Saxena & Koul (1966) and Nath (1986) summarised most of the collecting history and/or provided new checklists which contain increasing numbers of species.

Silas (1960) based his review on collections made in March-April 1954 by S.L. Hora, but also on older material in the collection of the Zoological Survey of India in Calcutta. As with most other lists of fishes from Kashmir, there is no precise information on the origin of the fishes or even authentic illustrations. It cannot be assumed that all fishes are from the Kashmir Valley itself. Silas listed 28 species level taxa, including two introduced species, whereas Hora *et al.* (1955), summarising the same collection, only reported 17 species, unfortunately without providing names.

Das & Subla (1963, 1964) produced a new list of species, based on field work between 1961 and 1964 including 36 'species'. Three of them, however, are apparently just additional introduced species (*Cyprinus carpio* Linnaeus, 1758, *Puntius conchonius* (Hamilton, 1822), and *Oncorhynchus mykiss* (Walbaum, 1792)), and one is a culture form of another (mirror carp of normal carp). Saxena & Koul (1966) listed 39 species-level taxa, being a literature compilation. Nath (1986) listed 42 species from Kashmir Valley, apparently mainly or only based on literature reports. None of these papers provided any detailed documentation to permit assessment of the status or originality of the records.

The present survey is thus the first ever more comprehensive report to include collecting data for actual specimens, photographs of representative specimens and diagnostic characters enabling the reader to make a rash critical evaluation of the identifications. Our list also contains only species actually sampled, except for the salmonids on which reliable current reports are available, and the extirpated *Tor putitora* (Hamilton, 1822). The main shortcoming may thus be the lack of samples from higher altitudes in the valley, that may contain other species. We were fortunate in having photographs of types of oreinins and *Bangana diplostoma* described by Heckel, but not of *Triplophysa* or *Tor*. We were not permitted to examine the type specimens of species described by Heckel (1838) for the current analysis. Thus, there is still a theoretical possibility that we may have misapplied some name.

The Uri AEIA encountered 14 native and four introduced fish species, which are described in more detail below. We failed to locate *Tor macrolepis* (Heckel, 1838), described from the valley, but later synonymised with *T. putitora*, a major, migrating food fish in the Indus drainage, reported from all of the rivers of the southern Himalayan slope. Mirza & Javed (1986) reported a 110 cm specimen in the Mangla Dam Museum in Pakistan, but the species can reach a length of 2.75 m (Jhingran, 1991). It seems likely that the loss of *T. putitora* from the upper Jhelum is due to migration barriers, especially the Mangla Dam, which does not permit any fish passage. Mirza & Bhatti (1996) summarised biological data of *Tor putitora* in the Indus drainage. Only one of the native species is a new record for the valley, viz., the small hillstream catfish *Glyptothorax pectinopterus,* which may have escaped collecting earlier because of its small size combined with preference for fast current. The introduced *Carassius carassius* (Linnaeus, 1758) was not yet reported from the Kashmir Valley in 1990 when the Uri AEIA started. Other species appear under different names, compared here to earlier lists.

None of the introduced salmonid species were encountered, although the presence of both brown trout, *Salmo trutta* (Linnaeus, 1758), and rainbow trout, *Oncorhynchus mykiss*, is confirmed by local spokesmen.

In the absence of specimens, the identity of the brown trout introduced cannot be asserted. It might be *Salmo trutta*, common in north-western Europe and most common in trout stockings elsewhere. Kashmir Valley trout was first introduced from Scottish stock imported in December 1900 and released from the following year, but followed by other importations (Mitchell, 1918). The current stock seems to be strongest in the Lidder, Sindh, Bringh, Erin and Madhumati rivers (Jhingran, 1991).

Oncorhynchus mykiss was released first from a stock imported from England in 1912 (Mitchell, 1918). The species is usually called *Salmo gairdneri* Richardson, 1836 in older literature. The synonymy of the North American *S. gairdneri* with the Kamchatkan *O. mykiss* was established by Okazaki (1984) and popularised by Smith & Stearley (1989).

An attempt to introduce the huchen, *Hucho hucho* (Linnaeus, 1758), apparently failed as the stock was identified as possibly Atlantic salmon, *S. salar.* This stock was eventually hybridised in ponds with resident brown trout, and at least

the hybrids were released into natural waters (Mitchell, 1918). Later attempts with *S. salar* in 1965 and the American salmon (*S. omiscomaycus* Walbaum, 1792; for name, see Kottelat 1997: 140) in 1969 apparently failed (MacCrimmon & Gots, 1979; Jhingran, 1991), although *S. salar* appears in the list of Fotedar & Qadri (1974).

Salvelinus namaycush (Walbaum, 1792) and *S. fontinalis* (Mitchill, 1814), have also been introduced (Saxena & Koul, 1966; Nath, 1986; Jhingran, 1991), but are no longer expected to exist in the Kashmir Valley. The former has already been noted as a failed introduction by Saxena & Koul (1966). Jhingran (1991: 151), however, stated that *S. fontinalis* survives in Kashmir, but suffering low fecundity and high mortality.

Also absent from the samples are the large, high-altitude cold-water oreinins *Ptychobarbus conirostris* Steindachner, 1866, and *Diptychus maculatus* Steindachner, 1866, which were first reported by Silas (1960), and *Schizopygopsis stolickai* Steindachner, 1866, added by Das & Subla (1964). These species were not recorded by Tilak (1987) in his revision of Indian oreinins as occurring in the Kashmir Valley, and their presence there needs further work. Either the records are based on market fish brought in from Ladakh where those species are common, or the species occur in upper reaches of the Jhelum or tributaries that were not accessible to the Uri AEIA. Consequently, the status of some of the most highly specialised Himalayan fish species could unfortunately not be evaluated by the project.

The status of *Triplophysa ajmonis* (Di Caporiacco, 1933), described from the upper Sindh River, but never mentioned by Indian authors, remains uncertain. It may be the same species as the *T. gracilis* (Day, 1877) reported by Menon (1987) from about the same place. The descriptions suggest *T. microps* (Steindachner, 1866), otherwise only known from the Indus in Ladakh, but differ in details. If the upper Sindh form is distinct from *Triplophysa marmorata* and *T. kashmirensis*, then this may be a species limited to higher altitudes and thus not found by the Uri AEIA team. The Sindh *Triplophysa* is discussed on p. 145.

Puntius sophore (Hamilton, 1822), a small systomin cyprinid, was listed by Saxena & Koul (1966) as introduced in the Kashmir Valley, but has not been recorded from there since. The record could be for misidentified *P. conchonius*, or may concern some other part of Jammu & Kashmir as Saxena & Koul (1966) did not appear to be particularly concerned with the difference between the state and the valley. The species was listed from the lower Jhelum by Mirza & Ahmad (1987).

The small hillstream labeonin cyprinid *Garra gotyla* (Gray, 1830) was found in the Sutlej (p. 153), but the species was not obtained in the Kashmir Valley. It was recorded from the Kashmir Valley by Saxena & Koul (1966), Nath (1986), and Das & Subla (1964), and it has been reported from the Jhelum downstream of the Kashmir Valley (Menon, 1964). As it is not known to be a cold-water species, it seems unlikely that it was missed over the 8-year survey.

Silas (1960), Das & Subla (1964), and Saxena & Koul (1966) reported *Labeo dyocheilus* (M'Clelland, 1839) from Kashmir, which would be the same species as *Labeo pangusia* (Hamilton, 1822) collected by the Uri AEIA in the Sutlej (p. 153). The literature on *Bangana dero* (Hamilton, 1822), *B. diplostoma*, and *L. dyocheilus* is confused, and it remains possible that the record refers to misidentified *Bangana diplostoma*. *Labeo pangusia* is a very large species, reaching more than 50 cm in length, and is unlikely to have been missed by the Uri AEIA. Alternatively, the species may have been present but is extirpated.

Numerous nemacheiline balitorids of the genus *Triplophysa* have been reported from the Kashmir Valley. Das & Subla (1964) listed no less than six species. The systematics of the upper Indus species of this genus is so confused that little importance can be attached to past identifications. We recognise two species.

The silurid catfish *Silurus lamghur*, described by Heckel (1838), is listed under the name of *Ompok bimaculatus* (Bloch, 1797), a very widespread lowland species by, e.g., Silas (1960) and Saxena & Koul (1966). No silurid species has since then been reliably reported from the Kashmir Valley and Hügel's material was probably collected from further downstream in the Jhelum or from elsewhere. Das & Subla (1964) made a special note that they had never seen it. No *Ompok* was found in the Jhelum in Pakistan (Mirza & Ahmad, 1987). The low number of 53 anal-fin rays given by Heckel (1838) and shown on his figure suggests that *S. lamghur* is rather more close to *O. pabda* (Hamilton, 1822), another widespread species, reported to have 50-56 anal rays by Misra (1976). Day (1877a), Misra (1976), and Talwar & Jhingran (1991) synonymised *S. lamghur* with *O. pabda*. Mirza (1975) reported *O. pabda*, *O. bimaculatus*, and *O. pabo* (Hamilton, 1822) as occurring in the Indus basin of Pakistan.

Also, the snow barbel fauna is much smaller than has been proposed by most authors, with only five instead of up to 14 species as detailed below, p. 115.

The following classification lists all fish species known or expected from the Kashmir Valley between Dal Lake and Uri, and gives an idea of the taxonomic diversity. Among the native species, only two orders (Cypriniformes, carps; and Siluriformes, catfish) and four families (Cyprinidae, Cobitidae, Balitoridae, and Sisoridae) are represented. The assemblage is, however, representative for the sub-Himalayan region.

Superorder Ostariophysi

Order Cypriniformes
- Family Cyprinidae
  - Subfamily Cyprininae
    - Tribe Cyprinini
      - *Cyprinus carpio* Linnaeus, 1758 — Introduced
      - *Carassius carassius* (Linnaeus, 1758) — Introduced
      - *Tor putitora* (Hamilton, 1822) — Extirpated
    - Tribe Systomini
      - *Puntius conchonius* (Hamilton, 1822) — Introduced
    - Tribe Oreinini
      - *Schizothorax plagiostomus* Heckel, 1838
      - *Schizothorax labiatus* (McClelland & Griffith, 1842)
      - *Schizothorax curvifrons* Heckel, 1838
      - *Schizothorax niger* Heckel, 1838
      - *Schizothorax esocinus* Heckel, 1838
    - Tribe Labeonini
      - *Bangana diplostoma* (Heckel, 1838)
      - *Crossocheilus diplochilus* (Heckel, 1838)
- Family Cobitidae
  - Subfamily Botiinae
    - *Botia birdi* Chaudhuri, 1909
- Family Balitoridae
  - Subfamily Nemacheilinae
    - *Schistura punjabensis* (Hora, 1923)
    - *Triplophysa marmorata* (Heckel, 1838)
    - *Triplophysa kashmirensis* (Hora, 1922)

Order Siluriformes
- Family Sisoridae
  - *Glyptosternon reticulatum* McClelland & Griffith, 1842
  - *Glyptothorax kashmirensis* Hora, 1923
  - *Glyptothorax pectinopterus* (McClelland, 1842)

Superorder Protacanthopterygii

Order Salmoniformes
- Family Salmonidae
  - Subfamily Salmoninae
    - *Salmo trutta* Linnaeus, 1758 — Introduced
    - *Oncorhynchus mykiss* (Walbaum, 1792) — Introduced

Superorder Acanthopterygii

Order Cyprinodontiformes
- Family Poeciliidae
  - Subfamily Poeciliinae
    - *Gambusia holbrooki* Girard, 1859 — Introduced

Key to species

The key includes one species not collected by the Uri AEIA team, but which may have survived in other parts of the Kashmir Valley, namely *Tor putitora*, and the two species of salmonids reported to have been introduced into the valley but which were not sampled.

1 Adipose fin present 2
Adipose fin absent 6

2 Body covered with scales; no barbels around mouth; spindle shaped, compressed; mouth terminal 3
Body without scales; barbels present around mouth; depressed; mouth inferior 4

3 Caudal fin without spots, posterior margin truncate; no iridescent band along middle of side at any size ..... *Salmo trutta*
Caudal fin with numerous small black spots, posterior margin concave; iridescent band along middle of side in adults ..... *Oncorhynchus mykiss*

4 Caudal fin truncate or slightly convex; adipose fin low, its base much longer than that of the anal fin, covering about half of back between dorsal and caudal fins; margins of maxillary barbel and paired fins with plicated skin forming suction pads, but no thoracic sucker present ..... *Glyptosternon reticulatum*
Caudal fin emarginate; adipose fin short, its base about as long as that of the anal fin; plicated tissue present on chest 5

5 No suction pads on paired fins; dorsal spine pungent; large oval or V-shaped thoracic sucker formed by plicated skin present ..... *Glyptothorax kashmirensis*
Suction pads on paired fins; dorsal spine flexible distally; small crescent-shaped thoracic sucker formed by plicated skin present ..... *Glyptothorax pectinopterus*

6 Jaws toothed; no barbels; mouth upward-directed; dorsal fin inserted posterior to vertical through anal-fin insertion; caudal fin rounded or truncate, never forked or emarginate; males with anterior anal-fin rays forming a long, stiff, pointed tip (gonopodium) ..... *Gambusia holbrooki*
Jaws toothless; barbels present or absent; mouth terminal or inferior; dorsal fin inserted in advance of or at vertical from anal-fin insertion; caudal fin forked or emarginate, rarely truncate or subtruncate; anal fin without gonopodium 7

7 Scales present on body 8
Scales absent from body 19

8 Four pairs of barbels; an erigible spine below eye; body strongly compressed; contrasted pattern of vertically arranged black stripes or vermiculations on sides and fins ..... *Botia birdi*
Barbels absent, or only one or two pairs; no spine below eye; shape variable, never strongly compressed; colour pattern plain or with horizontal stripe or dark humeral and caudal blotches 9

9 Scales along anal-fin base distinctly enlarged; last unbranched dorsal-fin ray thick and serrated posteriorly; all anal-fin rays flexible, smooth; scales very small, more than 80 along lateral line; rostral and maxillary barbels present 10
Scales along anal-fin base not enlarged; last unbranched dorsal- and anal-fin rays soft or thickened, with or without serrations; scales large, less than 45 along lateral line; barbels present or absent 14

10 Gill rakers 14–22; mouth inferior or subinferior; dark spots on sides never contrasted against ground colour; lower lip folds wide, and may be continuous as a wide translateral papillated fold or as lateral folds with a more or less developed median pad separated from the isthmus by a postlabial groove; lower jaw with or without sharp margin 11
Gill rakers 8–16 or 21–28; mouth terminal or subterminal; dark spots on sides may be contrasted; no postlabial groove medially; lower lip folds not widened; lower jaw with smooth margin 12

11 Upper and lower lip forming a smoothly angled junction; lower lip folds covered with conspicuous, short, round-tipped papillae and typically forming a wide translaterally continuous free fold overlying a deep transverse postlabial groove separating from isthmus; lower jaw greatly thickened and margined by a deep cornified cover with sharp keratinous cutting margin; horny cover extensively exposed in ventral aspect; mouth typically inferior; prominent rostral fold ..... *S. plagiostomus*

Upper and lower lip forming a sharp angle running adnate for some distance or with a deep groove marking the mouth angle; lower lip typically discontinuous medially, each lateral lip fold separated symphyseally by thickened skin separated from lip folds by a deep groove and often projecting like a median lobe; lower jaw not developing a thick cornified cover and normally without keratinised sharp cutting edge; mouth typically subinferior, rostral fold not overlying significant portion of upper lip ..... *Schizothorax labiatus*

12 Gill rakers 8–15; head long and slightly depressed; body overall light with contrasted black spots at least in small specimens ..... *Schizothorax esocinus*

Gill rakers 12–16 or 21–28; head short, compressed laterally; body greyish or dark brown to blackish, with only sparse or indistinct spots 13

13 Gill rakers 12–16; body overall usually very dark; barbels and lower lip folds thick ..... *Schizothorax niger*

Gill rakers 21–28; body greyish, rarely dark brown or black; barbels and lower lip fold thin. ..... *Schizothorax curvifrons*

14 Rostral and maxillary barbels present 15

Barbels absent, or only maxillary barbels present 17

15 Branched dorsal-fin rays 18–20 ..... *Cyprinus carpio*

Branched dorsal-fin rays 8 16

16 Mouth inferior; rostral fold fringed, with numerous papillated digitiform projections along margin ..... *Crossocheilus diplochilus*

Mouth terminal; no rostral fold ..... *Tor putitora*

17 Branched dorsal-fin rays 18–20 ..... *Carassius carassius*

Branched dorsal-fin rays 8–11 18

18 Maxillary barbels present; last unbranched dorsal-fin ray flexible, without serrations; mouth inferior, upper lip generally covered by rostral fold; body elongate ..... *Bangana diplostoma*

No barbels; last unbranched dorsal-fin ray strong, serrated along posterior margin; mouth terminal, no rostral fold; notably deep-bodied ..... *Puntius conchonius*

19 No spine-bearing pads below eye or on pectoral fins in males; caudal peduncle as deep as rest of body; several dark, clearly defined vertical bars across side ..... *Schistura punjabensis*

Males with spine-bearing pads anteriorly on cheek and on upper surface of pectoral fin; caudal peduncle not as deep as rest of body; colour pattern irregular, variable, never any clearly defined vertical bars 20

20 Dorsal fin with 7 branched rays; lateral line ending before vertical from dorsal-fin origin; caudal fin truncate, subtruncate or at most slightly concave ..... *Triplophysa marmorata*

Dorsal fin with 8, rarely 7 branched rays; lateral line complete; caudal fin distinctly emarginate ..... *Triplophysa kashmirensis*

Species accounts

Cyprinus carpio Linnaeus, 1758 (Figs 2–3)

Original description

Cyprinus Carpio Linnaeus, 1758: 320 (Europa).

Fig. 2. Cyprinus carpio. *NRM 37356, 78.5 mm SL. Living specimen, freshly captured from Dal Lake, 27 October 1997.*

Local names. Punjabe Gad (Kashmiri), Carp (English).

Diagnostic characters. Deep-bodied, laterally compressed. Mouth subterminal, lips thick. Rostral and maxillary barbels present. Scales in a lateral series 33–36 (much fewer in mirror carp form), branched dorsal-fin rays 18–20, branched anal-fin rays 5 in Kashmir Valley specimens. Lateral line usually complete, but canals vary in degree of development, often obsolete, occasionally developed only on anterior scales. Last unbranched dorsal- and anal-fin ray strong, serrated along posterior margin. Dark brown or grey dorsally, lighter on sides, scale bases on sides each with a dark spot, underside whitish; fins dusky.

Among the specimens sampled seven have normal scale cover, but two individuals have enlarged scales, representing the cultured variety called mirror carp.

Similar species in the Kashmir Valley. *Cyprinus carpio* can be distinguished from the most similar species in the Uri-Srinagar area, *Carassius carassius*, by having barbels. No other Kashmir Valley fish species possesses a strong, serrated last unbranched anal-fin ray as characteristic of *Carassius* and *Cyprinus.*

Material. Altogether nine specimens, the largest 197 mm SL, were obtained from Dal Lake and from the Jhelum River at Gantamulla and upstream from Chala bridge, sites 5 and 7 (Fig. 3). The species is reported locally to be very common in lakes (Das & Subla, 1964; Fotedar & Qadri, 1974).

Conservation aspects and risk assessment. The local population of *C. carpio* seems to be well established and may pose a threat to the endemic lake-dwelling species, especially *Schizothorax niger*, in competing for space and food, and in increasing water turbidity. According to Fotedar & Qadri (1974), *C. carpio* provides for 70–75% of the total fish catch (presumably by weight), in the Kashmir 'State' (presumably means Kashmir Valley). Fotedar & Qadri (1974) considered *C. carpio* to present serious competition to local oreinins, whose numbers would be dwindling for this reason. There is, however, no information on the precise interactions of carp and oreinins, and the relative roles of pollution, dams and introductions of exotic fishes in decline of local endemics. There is, unfortunately, no hope that the carp may be exterminated in Kashmir, and the abundance of the species may be promoted by the addition of the Mohra Dam. *Cyprinus carpio* is an endangered species in its natural range of distribution (Lelek, 1987).

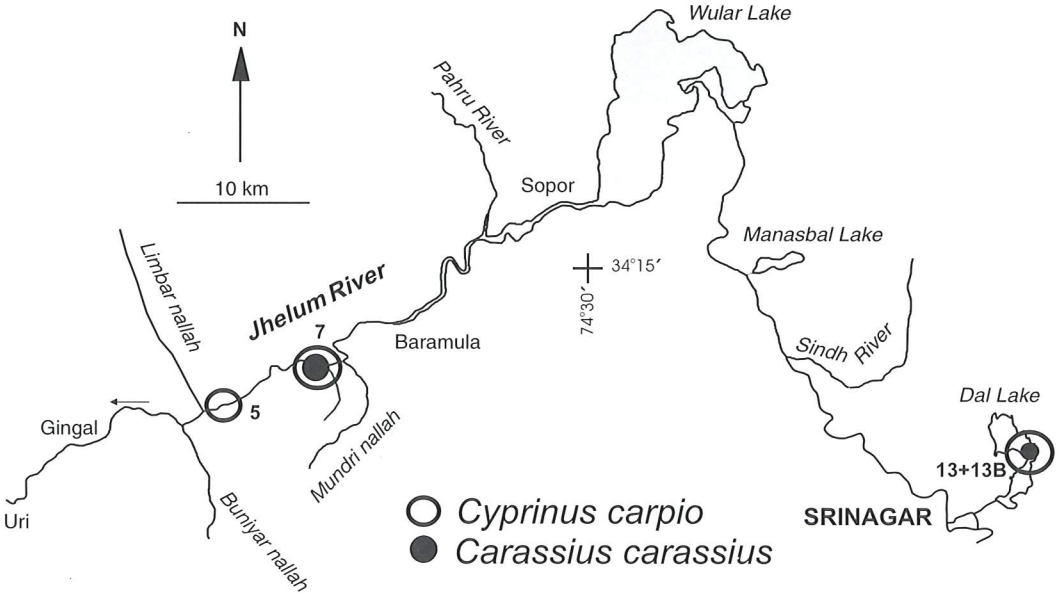

Fig. 3. *Location of sampling sites yielding* Carassius carassius *and* Cyprinus carpio *in the Kashmir Valley Uri AEIA.*

Remarks. The systematics of *Cyprinus* is confused. Most western authors recognise only one species, *Cyprinus carpio*, which, however, is restricted to eastern and central Europe, and which has been introduced in numerous locations particularly in Europe. The very similar eastern-most species, which may be identified as *C. viridiviolaceus* Lacépède, 1803 pending a full revision (cf. Svetovidov, 1933), is widely introduced in Asian locations including Myanmar (pers. obs.) and possibly northern India.

Cyprinus carpio was introduced in Kashmir and/or the Kashmir Valley in 1955 (Jhingran, 1991) or 1956 (Das & Subla, 1964; Fotedar & Qadri, 1974), although Saxena & Koul (1966) insist on 1953. Although the specimen figured herein (Fig. 2) has some red in the anal fin, none of the specimens collected by the Uri AEIA was noted to have the characteristic red anal fin and red ventral caudal-fin lobe of *C. viridiviolaceus.* The Kashmir *Cyprinus* thus probably represents an introduction originally from Europe.

Carassius carassius (Linnaeus, 1758) (Figs 3–4)

Original description

Cyprinus Carassius Linnaeus, 1758: 320 (Europa).

Fig. 4.
Carassius carassius. *NRM 37329, 97.0 mm SL Living specimen, freshly captured from Dal Lake, 27 October 1997.*

Local names. Gang Gad (Kashmiri), Crucian carp (English).

Diagnostic characters. Deep-bodied, laterally compresssed. Mouth terminal, strongly curved, with thick lips, but no barbels. The third dorsal and anal-fin rays are strong and serrated posteriorly. Scales in a lateral series 31–33, lateral line scales tubed only on anterior 12 to 25 scales, branched dorsal-fin rays 18–20, branched anal-fin rays 6–7, gill rakers about 26–27 in Kashmir Valley specimens. Colour grey on back, lighter on sides, underside whitish, fins dusky.

Similar species in the Kashmir Valley. The only similar species in the Kashmir Valley is *Cyprinus carpio*, which can be distinguished by its barbels. *Carassius carassius* and *Cyprinus carpio* are the only species in the upper Jhelum possessing a strong and serrated last unbranched anal-fin ray.

Material. Only 11 specimens were obtained by the Uri AEIA, including one from site 7, and the rest from Dal Lake, the largest specimen 103 mm SL.

Conservation aspects and risk assessment. The Kashmir Valley population of *Carassius carassius* seems to be well established and may pose a serious threat to the endemic lake-dwelling species, especially *Schizothorax niger.* There is, unfortunately, no hope that the crucian carp may be exterminated in Kashmir. Research is needed to investigate the local biology of *C. carassius* and the species needs to be monitored for abundance, fecundity and trophic preferences. The Uri project is not likely to have any adverse effects on *C. carassius.*

Remarks. The systematics of the pan-Palearctic genus *Carassius* is confused, and the identification here may very well have to be revised after systematic revision of the genus. See Kottelat (1997) for a review of *Carassius* systematics with further references. There are no naturally occurring *Carassius* species in the Indus drainage or otherwise on the Indian subcontinent. The natural distribution of *C. carassius* includes most of Europe. There is no published record of the introduction of *C. carassius* into the Kashmir Valley, but it probably came in accidentally together with introductions of *Cyprinus carpio*, with which it is easily confused. The species has been present in India since 1874 (Jhingran, 1991: 154).

Puntius conchonius (Hamilton, 1822) (Figs 5–6)

Original description

Cyprinus conchonius Hamilton, 1822: 317, 389 (ponds of the north-east of Bengal, and in the rivers Kosi and Ami).

Synonyms

Systomus pyrropterus M'Clelland, 1839: 283, pl. 44, fig. 1 (ponds in Upper Assam; spelt *pyropterus* on p. 285 and 314, but spelling on p. 285 corrected in Errata page).

Puntius conchonius khagariansis Srivastava & Datta Munshi in Datta Munshi & Srivastava, 1988: 186, pl. 23, fig. 4 (Khagaria district, Bihar).

Fig. 5.
Puntius conchonius. *NRM 40234, 34.5 mm SL. Living specimen, freshly captured from Jhelum River below Lower Jhelum Barrage at Gantamulla (Site 6), 18 October 1997.*

Local names. Rosy barb (English).

Diagnostic characters. A small deep-bodied cyprinid species, the largest specimens sampled being about 45 mm SL, but known to reach at least 85 mm SL elsewhere. Preserved specimens are silvery or fawn with a black, rounded blotch at the base of the caudal peduncle and often black margin to the dorsal fin. There is no dark blotch in the humeral region, and no black spot at the dorsal-fin base as in many similar species found elsewhere. Barbels are absent. The lateral line is short, extending only for about 5–13 scales from the head. The third unbranched dorsal-fin ray is osseous and serrated posteriorly. Branched dorsal-fin rays 8, branched anal-fin rays 5; scales in a lateral series 20–24.

Similar species in the Kashmir Valley. Small *Carassius carassius* and *Cyprinus carpio* are similar in general appearance, but have a conspicuously longer dorsal fin (18–20 instead of 8 branched dorsal-fin rays) and no black blotch on the side. *Cyprinus carpio* also has two pairs of long barbels. Saxena & Koul (1966) listed *P. sophore* (Hamilton, 1822) from the Kashmir Valley, but we have not been able to verify the record. *Puntius sophore* can be distinguished from *P. conchonius* by having a smooth instead of a serrated dorsal-fin spine, complete lateral line, and the caudal spot situated much closer to the caudal-fin base.

Material. *Puntius conchonius* was found regularly in electrofishing stations downstream of Wular Lake, and also in both Manasbal and Wular Lake where most abundant (Fig. 6). Altogether 176 specimens were sampled, from sites 1–2, 4–8, 10–11, 7A, 8B, and 10B. It is probably widely distributed in lakes and small streams in the valley. The largest specimens are about 45 mm SL.

Conservation aspects and risk assessment. The Kashmir Valley population of *Puntius conchonius* appears to be well established. As elsewhere, the species occupies many different biotopes, including small streams, shores of large rivers, and lakes. The species will probably not be negatively affected by the Mohra Dam, but may instead benefit from an increase in still or slow flowing waters.

Remarks. *Puntius conchonius* is probably an introduced species in the Kashmir Valley. It was first reported from there by Das & Subla (1964), who listed species collected during a survey between 1961 and 1964. The species is not mentioned in the report of the 1954 survey of the Kashmir Valley (Silas, 1960). *Cyprinus carpio* was introduced in the Kashmir Valley around 1955–1956, and it is likely that the *P. conchonius* were accidentally introduced at the same time. It seems highly unlikely that an abundant species would have escaped unnoticed over more than 100 years of regular collecting efforts.

Elsewhere *P. conchonius* is common in ponds

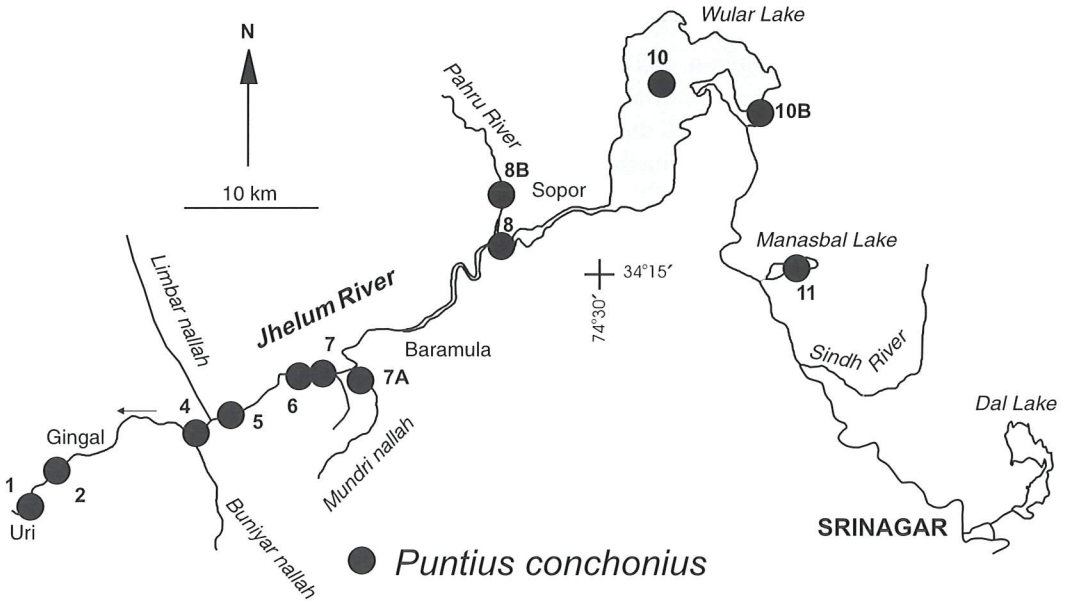

Fig. 6.
Location of sampling sites yielding Puntius conchonius *in the Kashmir Valley Uri AEIA.*

and streams in the lowland Brahmaputra and Ganga drainages, and in adjacent drainages (Jayaram, 1991). It occurs disjunct also in the Kaveri drainage in Tamil Nadu (Jayaram, 1991). Mirza (1975) and Ahmad *et al.* (1976) listed *P. conchonius* only from the Indus Plain in Pakistan, but it is reported as far north as the Kabul River at Jalalabad and near Daruntah in Afghanistan and from between Khowst (Afghanistan) and Peshawar (Pakistan) (Coad, 1981).

Das & Nath (1971) considered *P. conchonius* to be naturally occurring in the Kashmir Valley, and also reported it from the Punch Valley, which has more warmwater species, but which is currently apparently influenced by the Mangla Dam which has many introduced species. In the absence of earlier collections, introduction cannot be excluded for either river.

Jayaram (1991) gave a maximum length of 12 cm TL for this species, listing specimens up to 85 mm SL. Considering the large samples taken in the Kashmir Valley, their much smaller size (to 45 mm SL) is notable. Ahmad *et al.* (1976) reported their largest specimen from the Indus Plain in Pakistan to be only 34 mm long.

Puntius waageni (Day, 1872), based on specimens from the Salt Range, has not been reliably reported since its description. According to Day it has a smooth last unbranched dorsal-fin ray, but in other respects this species may be the same as *P. conchonius*, alternatively if the Indus form is distinct from the Ganga-Brahmaputra *P. conchonius*, it should be identified as *P. waageni*. Resolving the systematic position of Indus *P. conchonius* will be instrumental in deciding on cases of doubtful naturalness in a given locality.

There is currently no clear understanding of the systematics of the numerous species of smaller Asian and African cyprinine cyprinids. Generally, the Asian species are lumped in *Puntius* Hamilton, 1822, whereas the African species are lumped with *Barbus* Cuvier & Cloquet, 1816, even though the latter is a well diagnosed genus occurring chiefly in the Mediterranean region (Howes, 1987).

The majority of generic names proposed for South Asian cyprinines apply to genera more or less well diagnosed and mostly holding larger species. Two generic names are immediately available for the catch-all assemblage of smaller Asian species. *Puntius*, with the type species *Puntius sophore,* is the more generally used name. *Systomus* M'Clelland (1839), with the type species *S. immaculatus* M'Clelland (1839), which is generally considered to be a synonym of *S. sarana* (Hamilton, 1822), was recently revived by Rainboth (1996) for a small selection of species, but without further discussion. Rainboth's diagnoses of *Puntius* (smooth dorsal-fin spine and presence of maxillary barbels) and *Systomus* (two or four barbels) seem to exclude *P. conchonius* from either (and the type species of *Puntius* from *Puntius*) and can be used for Cambodian species only.

Puntius conchonius shows most similarity with small species including, e.g., *P. ticto* (Hamilton), *P. stoliczkanus* (Day), and *P. phutunio* (Hamilton), the *conchonius* group of Taki *et al.* (1978). They have vertical bars or lateral blotches, including a bar or blotch above the anal-fin base or proximally on the caudal peduncle, serrated dorsal-fin spine and lack of barbels, and commonly also a short ('incomplete') lateral line. *Puntius sophore*, however, although lacking barbels, has a smooth dorsal-fin spine, complete lateral line, and the caudal spot much closer to the caudal-fin base. It also has a frontoparietal fontanel, that is not reported from any other Asian *Puntius* sensu lato (Mirza, 1973b, 1975). *Systomus sarana* has two pairs of barbels, complete lateral line, and different colour pattern, which varies but does not include the posterior blotch or bar characteristic of *conchonius*-like species.

Although *P. conchonius* is clearly not congeneric with either *S. sarana* or *P. sophore*, we refer it here to *Puntius* awaiting a generic revision to provide a name for the group to which it belongs. We have not compared extensively with *P. conchonius* material from other parts of its range, but our impression is that the Kashmir Valley material is on average of smaller size and more slender than material from West Bengal.

Schizothorax Heckel, 1838

Original description

Schizothorax Heckel, 1838 (ten species included; type species *S. esocinus* Heckel, designated by M'Clelland, 1842: 570, disputed; next designation *S. plagiostomus* Heckel, designated by Bleeker, 1863a: 196, 1863a:26, 1863c: 262; gender masculine).

Synonymy

Barbus (*Oreinus*) McClelland, 1838: 943 (included species: *Barbus guttatus* McClelland, *B. maculatus* McClelland; type species *O. guttatus* designated by Bleeker, 1863a:196, 1863b: 26).

Racoma McClelland & Griffith in M'Clelland, 1842: 576 (listed both as genus, p. 573 and as subgenus (probably of *Barbus*), p. 576; also spelt *Rocoma* on p. 576; included species

Racoma gobioides, R. chrysochlora, R. nobilis, R. labiatus, and *R. brevis* McClelland & Griffith in M'Clelland; type species *R. labiatus* designated by Bleeker, 1863a: 198, 1863b:26).

Schizopyge Heckel, 1847: 285 (six species included; type species *Schizothorax curvifrons* Heckel, designated by Bleeker, 1863a: 196, 1863b: 26).

Englottogaster Gistel, 1848: X (unnecessary replacement name for *Oreinus* McClelland).

Opistocheilos Bleeker, 1859: 425 (no species included; four species included in Bleeker, 1860: 115; type species *Schizothorax plagiostomus* Heckel, designated by Jordan 1919: 287).

Paraschizothorax Bleeker, 1863c: 262 (type species by monotypy *Schizothorax huegelii* Heckel).

Paratylognathus Sauvage, 1880: 227 (type species by monotypy *Paratylognathus davidi* Sauvage).

Aspiostoma Nikolsky, 1897: 345 (type species by monotypy *A. zarudnyi* Nikolsky).

Schizothoraichthys Misra, 1962: 48 (type species by original designation *Schizothorax esocinus* Heckel).

Paraschizothorax Cao, 1964: 168 (type species by original designation *Schizothorax oconnori* Lloyd; preoccupied by *Paraschizothorax* Bleeker, 1863).

Tetrostichodon Tchang, Yueh & Hwang, 1964: 273 (type species by original designation *Schizothorax oconnori* Lloyd).

Local names. Kashmiri gad (Kashmiri). Snow barbels, snow trout, mountain barbels (English). In the Kashmir Valley each species is also identified by its own name.

Diagnostic characters. *Schizothorax* species, like other members of the Oreinini, can be recognised by a series of enlarged scales on each side along the posterior abdominal midline and anal-fin base, which non-imbricating across the ventral midline from about the level of the tips of the pelvic fin caudad. *Schizothorax* species can be distinguished from other snow barbels by characters in combination: possession of scales covering all of the sides, well developed maxillary and rostral barbels, serrated last unbranched dorsal-fin ray, three rows of pharyngeal teeth.

Similar species in the Kashmir Valley. Snow barbels are readily distinguished from all other fishes in Kashmir Valley by the enlarged anal scales. There is some superficial similarity with other elongate cyprinids, particularly in the case of smaller sizes and particularly with the labeonins *Crossocheilus diplochilus* and *Bangana diplostoma*. From these, *Schizothorax* species can be easily distinguished by their very small scales, numbering more than 80 along the lateral line, in contrast to the large, well pronounced scales of the labeonins, numbering about 40 or less. The well developed barbels may give the impression of *Cyprinus*, but again *Schizothorax* can be immediately separated by their small scales, and also much shorter dorsal fin (6–8 branched rays instead of 18–20).

Schizopygopsis stolickai Steindachner (1866) is widely reported from nearby drainages, including the upper Indus at Leh, and the Sutlej, but not from the Jhelum although it might be present in the upper reaches that have not been surveyed. It can conveniently be distinguished from *Schizothorax* species by lacking scales on the sides, lacking barbels, and in having only two rows of pharyngeal teeth.

Material. Nearly half (1844) of the specimens (3906) sampled by the Uri AEIA belong to species of the genus *Schizothorax*. Most of the fish biomass is made up of *Schizothorax*, which are not only abundant but also grow fairly large, adult sizes commonly between 300 and 500 mm TL. All other fish species in the Valley are fairly small, except for *Bangana*. Particular species of *Schizothorax* are more or less well represented. *Schizothorax plagiostomus* is most common, with 664 specimens, followed by *S. curvifrons* (365 specimens) and *S. labiatus* (219 specimens). Only *S. niger* (30 specimens) appears to be uncommon, probably mainly because it is primarily lacustrine, and little sampling was done in lakes. *Schizothorax esocinus* (151 specimens) is also not as abundant as the others in the running water, a phenomenon probably associated with its carnivorous habits. Juveniles were largely left unidentified even though they comprise 22.5% of the specimens (altogether 415 unidentified juveniles).

Risk assessment and conservation aspects. The main biological concern for the *Schizothorax* species is whether they make extensive migrations or not, as the Uri hydropower plant will provide a formidable barrier to migration.

The local biology of Kashmir Valley oreinins has been relatively well studied by researchers from the University of Srinagar and other institutions. Additional information was gathered by the Uri AEIA, and is reported by Enderlein & Yousuf (1998, this volume).

Aspects of the reproductive biology of *Schizothorax plagiostomus* in the Sindh River was studied by Qadri *et al.* (1983). Ova were already ripe in December but spawning only occurred in April-June, and chiefly in May, probably in response to extrinsic factors such as warmer

water and increased photoperiod. Spawning was preceded by only slight migration. Fecundity averaged 12,744 eggs in 20 females 220–475 mm TL.

Spawning of *S. curvifrons* was studied by Sunder (1984), based on commercial catches. The smallest reproducing female was 194 mm. Ova were ripe in January, but spawning only occurred from May till July and chiefly in June. Sex ratio was 1:1, but more large females than males were found, and males matured slightly earlier and at smaller sizes. Spawning was confirmed in the Vishaw and Bringi streams.

According to observations made in 1977 by Vass *et al.* (1980), *Schizothorax niger* breeds in shallow parts of Dal Lake. Breeding extended over a period of two months from the first week of March till end of April. The eggs were either scattered in clutches along the bottom, or adhering to submerged willow roots. Only 50% of the eggs collected were found viable. Breeding females 310–409 mm long (SL or TL) stripped manually contained 15,100-17,200 eggs.

Schizothorax esocinus breeds in the river in April and May, migrating from lakes to nearby streams, and from the main river Jhelum to tributaries with gravel beds (Koul, 1988).

There seems to be no precise information available on *S. labiatus*, but Uri AEIA information supports the general view that except for the lacustrine *S. niger*, the oreinins spawn in spring-early summer.

None of the species seems to perform any longer migrations. The *Schizothorax* species will thus be relatively little influenced by the new dam. However, *S. plagiostomus*, and then probably also *S. labiatus*, seem to have feeding grounds in the torrential parts downstream Buniyar nallah. It is possible that a significant part of the breeding population comes from that region and ascends tributaries above the new dam to breed. Fish ladders may thus be necessary, and are possibly sufficient to enable those fishes to ascend to suitable breeding grounds.

The concern is otherwise mainly with the one species identified as probably endemic to the Kashmir Valley, namely *S. niger*. That species appears to be predominantly lacustrine, inhabiting lakes well upstream from Uri, and breeding in the lakes. It will not be affected by the new Mohra Dam, but may be in peril following introductions of exotic lacustrine species and pollution. The other *Schizothorax* species are fairly widespread in the upper Indus drainage, although it is difficult to precisely delimit their ranges owing to the confused state of the work on their taxonomy.

Remarks. The *Schizothorax* species reported here are commonly referred to one or another of various genera or subgenera including *Schizopyge*, *Racoma, Oreinus* and *Schizothoraichthys*.

Cyprinine systematics relies to a large extent on a simplified set of mouth characters to the exclusion of consideration of other traits to diagnose genera. 'Suctorial' mouths or lower lips and cutting edges to the lower jaw or both jaws are used repeatedly to diagnose many genera. In oreinin systematics such a subdivision has been made much more complex by the use of generic or subgeneric names not respecting the relative priority or the type species for each nominal genus.

In the most recent comprehensive revision of Indian Oreinini, Tilak (1987), basing the nomen-clature on Misra (1962), distinguished two genera and subdivided one into two subgenera:

Schizothorax, diagnosed by the 'presence of a strip of hard papillated structure at the chin, the margin of the lower jaw having a firm and hard horny covering and a thick lower lip with a free posterior edge'.

Schizothoraichthys, diagnosed by the absence of a 'strip of hard papillated structure on the chin'.

Schizothoraichthys (Schizothoraichthys), diagnosed by an 'interrupted lower labial fold'.

Schizothoraichthys (Racoma), diagnosed by the 'presence of an uninterrupted lower labial fold'.

Thus the extreme species with a prominent posteriorly positioned and heavily cornified lower jaw, with a keratinised cutting edge and a wide continuous lower labial fold are placed in *Schizothorax*, which would include *S. plagiostomus* and *S. richardsonii* reported in this paper. The species with a rather wide lower lip and thickened symphyseal pad are placed in *Racoma,* which would include *S. labiatus* of the present paper. Remaining species, with no particular modification of the lower lip, are placed in *Schizothoraichthys*, including *S. esocinus*, *S. curvifrons* and *S. niger* reported here. The fact that both *Racoma* and *Schizopyge* have priority over *Schizothoraichthys* if they contain the same species, did not occur to Misra or Tilak. Also, *Paraschizothorax* Bleeker, *Paratylognatus*, and *Aspiostoma* predate *Schizothoraichthys* for species with a 'normal' lower jaw.

Wu & Wu (1992), in a revision of Chinese Oreinini, also distinguished *Schizothorax* for the same group of species as Tilak but with a more elaborate diagnosis. Instead of *Schizothoraichthys* they rightly used *Racoma* for the group including *S. labiatus*, also with a more elaborate diagnosis, and distinguishing between subgenera *Racoma* with thick and wide lower lip folds and *Schizopyge* with a thin lower lip. This arrange-

Table 1. *Comparison of classifications of* Schizothorax *in the two major recent revisions. That of Tilak (1987) does not follow the nomenclatural rules. That of Wu & Wu (1992) is based on the assumption that McClelland's designation of* S. esocinus *as type species is invalid, whereas the corrected version in the right-hand column is based on* Schizothorax *with* S. esocinus *as type species.*

Tilak, 1987	Wu & Wu, 1992	Wu & Wu corrected
Schizothorax	*Schizothorax*	*Oreinus*
Schizothoraichthys (Racoma)	*Racoma*	*Schizothorax*
Schizothoraichthys (Racoma)	*Racoma (Racoma)*	*Schizothorax (Racoma)*
Schizothoraichthys (Schizothoraichthys)	*Racoma (Schizopyge)*	*Schizothorax (Schizothorax)*

ment had already been argued by Mirza & Saaed (1988) and Mirza (1991).

Other reviews of Kashmir and upper Indus *Schizothorax* (principally Malik, 1966; Mirza & Awan, 1979; Raina & Narain, 1992) or oreinins (e.g., Cao, 1964; Tilak & Sinha, 1975) provide additional schemes based on about the same names.

Whereas we feel that *Schizothorax* in our treatment may be a catch-all of the less spectacular Oreinini, we find it inadvisable at this time to recognise more than one genus, and use the name *Schizothorax* (but see below for relative priority of *Oreinus* and *Schizothorax*). With the exception of the work of Wu & Wu (1992), which excels in ample and extensive species level taxonomic coverage, oreinin systematics after Heckel and McClelland has been an endless reshuffling of names with reference to 'suctorial disks', 'papillated structures' 'cutting lower jaw margin', and 'median lower lip lobe.' We note that similar 'generic' characters occur in other oreinins, and that it is often difficult or arbitrary to assign specimens to one or another 'genus' among the *Schizothorax* proper. We also note that there is no consensus concerning names, and that our understanding of the type species of *Schizothorax* as explained below, would produce yet one more version in addition to schemes of Tilak (1987) and Wu & Wu (1992) without really increasing the understanding of the systematics of the group.

We therefore lump most of the scaled and barbelled oreinins in *Schizothorax* here. The other alternative would be to follow the classification in Wu & Wu (1992) with the changes of names shown in Table 1.

In addition to shortcomings of generic nomenclature, we note that Tilak's (1987) understanding of species level systematics includes sweeping synonymisation of species similar to *S. plagiostomus* that is incongruent with ours and Wu & Wu's (1992) observations, and recognition of a large number of Kashmir Valley species described by Heckel (1838) which obviously should be synonymised with other Kashmir Valley species.

The type species of *Schizothorax* is *S. esocinus* Heckel, designated by M'Clelland (1842: 570). M'Clelland's designation has been disputed by various authors (e.g., Tilak & Sinha, 1975) as summarised and endorsed by Tilak (1987), on the grounds that M'Clelland would only be making a reference to a 'typical' structure of *Schizothorax*, which is not a valid designation under ICZN Article 67c(2). Tilak (1987) pointed out that nowhere in his writings does M'Clelland otherwise designate any types of genus-level taxa.

However, by rearranging the actual wording of M'Clelland's text Tilak (1987) mis-cited M'Clelland (1842) and put unnecessary interpretation into M'Clelland's text which runs in full:

'The annexed figures which represent the bones of the head in these species [*Schizothorax* species], shew [sic] that as previously described they embrace two distinct groups, known by the elongation of the head. Fig. 1 represents the bones of the head and jaws in *Schizothorax esocinus*, *Heck.* and Fig. 2 the same bones in *Schizothorax plagiostomus, id.* The first is the type of *Schizothorax proprius*, and the latter of *Oreinus*, a subdivision which the collections of Mr. Griffith are sufficient to establish, and which in the descriptions which follow, we have noticed in more detail.'

The expression 'type' does not appear anywhere else in the same paper, but in addressing taxa M'Clelland always referred to species, genera and forms, or even 'groups' as in the cited text, not to typical structures. The expression 'is the type of' instead of 'is typical of' must be understood verbatim. There is no reason to assume anything other than what is actually expressed, namely that *S. esocinus* ('the first') is the type of *Schizothorax*, and *S. plagiostomus* ('the latter') is the type of *Oreinus.* ICZN Article 67c(2) does not apply since mention of a particular structure as 'type' or 'typical' is not made. Article 69a(iv) reads that a subsequent type species designation is made when an author 'states that it is the type or type species (for whatever reason, right or wrong), or uses an equivalent term, and if it is clear that the author accepts it as the type species.' M'Clelland stated exactly that *S. esocinus* 'is the type of' *Schizothorax*. Any other interpretation violates ICZN Article 69a(iv). M'Clelland's (1842) designation of type species for *Oreinus* is invalid, however, since the genus originally included only *O. maculatus* and *O. guttatus* (McClelland, 1838).

Later in the same paper M'Clelland (1842) recognised not just two 'groups', but three sub-

genera or genera. They are the new taxon *Racoma* McClelland & Griffith, and the previously recognised *Schizothorax* Heckel (including *S. esocinus*) and *Oreinus* McClelland (including *O. plagiostomus*). Genus-level taxa are given explicit diagnoses and included species are briefly described. There is no doubt whatsoever concerning M'Clelland's understanding of these genus-level taxa, and what species are to be included, and that he arrived at genus-level status by considering representative ('type') species. That he did not give further mention to type species is irrelevant.

Most authors date *Oreinus* to M'Clelland (1839) and have overlooked or ignored McClelland (1838) (e.g., Tilak, 1987). Although Eschmeyer & Bailey (1990: 585) considered McClelland (1838) as having been published in 1839 and perhaps after M'Clelland (1839) because of cross references to that later paper, they provided no evidence. In fact, the two papers make reciprocal cross references. The only plates in McClelland (1838), plates LV and LVI, are reproduced as a single plate LVII in M'Clelland (1839), and is the only landscape-oriented plate in that work suggesting that it was first made for the smaller format of the 'Journal of the Asiatic Society of Bengal'. Figure 3a in McClelland (1838), however, has been moved from its original position to the left of figure 3b to a position below figure 6. M'Clelland (1839) was presented in September 1838 according to the title page; and at that time plates and other particulars must have been known to McClelland to the extent that he could include the information in McClelland (1838), published in the November 1838 issue of the 'Journal of the Asiatic Society of Bengal'. The latter was possibly issued only in 1839, but we have no information regarding this matter. The issue is important for the relative priority of the names *Schizothorax* and *Oreinus*, both obviously published in 1838. ICZN Article 21 specifies how date of publication should be determined when not clearly stated in the publication itself. There is no known publication date for Heckel (1838), only the information on the title page that it was printed in 1838. It was available to M'Clelland (1839), who provided a detailed review of Heckel's paper, and received by him after 5 September 1838. With available information, referring to ICZN Art. 21(c), Heckel (1838) must be dated 31 December 1838, and McClelland (1838) must be dated 30 November 1838. With this dating *Oreinus* would have priority over *Schizothorax*. We prefer, however, to retain the traditional order of priority here, pending a more thorough investigation of the publication dates of the papers in question.

Schizothoracini or Oreinini?

Three family-level names have been used for snow barbels in a wider sense, based on the generic names *Schizothorax, Oreinus* or *Opistocheilos*, respectively, the first supposedly dating from M'Clelland (1842), the others dating from Bleeker (1863a-b). Most recent authors (e.g., Tilak, 1987; Mirza, 1991, and Wu & Wu, 1992) have adopted the first, whereas Rainboth (1991) suggested the second.

In McClelland's (1838, 1839, 1842) papers it is rarely obvious what he means by different taxonomic categories that today are clearly defined. Thus his 'subfamily' Schizothoracinae cited as 'Schizothoracinae, McClell.' (M'Clelland, 1842: 575), although listed under the family Cyprinidae, is better read as the plural form of *Schizothorax*, referring to *Racoma*, *Schizothorax* and *Oreinus*, which are variously listed as genera or subgenera of *Schizothorax* or *Barbus*. There is no indication that McClelland would have deserted his elaborate division of the Cyprinidae into subfamilies Paeonominae (including *Barbus*, with *Oreinus* as subgenus), Sarcoborinae and Apalopterinae (McClelland, 1838, 1839). Although there might be an option to take McClelland verbatim, 'Schizotoracinae' may belong as well in the genus-group level. We do not consider usage of 'Schizothoracinae' in M'Clelland (1842) to be a family-level name, referring to ICZN Article 11(2) which requires a family-group name to 'be clearly used to denote a suprageneric taxon and not merely as a plural noun or adjective referring to the members of a genus'.

Bleeker's (1863a-b) names, Opistocheili and Oreini, are both available as family-level names. We here select Oreini to have priority over Opistocheili, and consequently use the family-level name Oreinini for the snow barbels, following Howes (1991) and Rainboth (1991) in treating the group as a tribe of the subfamily Cyprininae. Mirza (1991), ranking oreinins (his Schizothoracinae) as a subfamily, proposed Diptychini, Schizopygopsini and Lepidopygopsini for supposed oreinins with reduced squamation. All these are accepted herein in Oreinini with the exclusion only of *Lepidopygopsis* Raj, 1941, from Kerala, which has not been demonstrated to be an oreinin at all.

Snow trout, snow carp or mountain barbels?

Schizothorax, and even the oreinins have been referred to in English literature as snow trout, snow carp, snow minnow, mountain barbel

Fig. 7.
Schizothorax plagiostomus. *NRM 40230, 93.0 mm SL. Living specimen, freshly captured from Jhelum River below Lower Jhelum Barrage at Gantamulla (Site 6), 18 October 1997.*

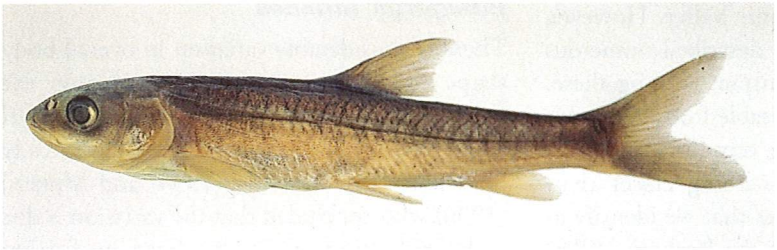

Fig. 8.
Schizothorax curvifrons. *NRM 30369, 106 mm SL. Preserved specimen collected in the Jhelum River near Chala bridge (Site 5), 5 July 1994.*

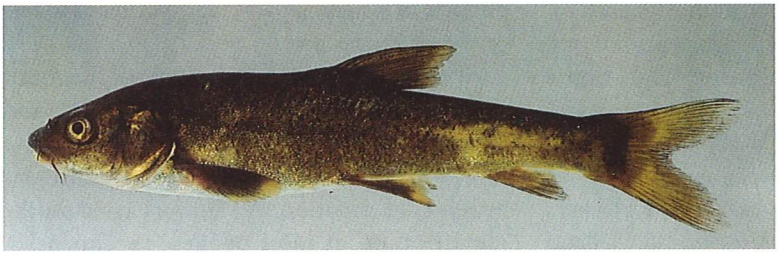

Fig. 9.
Schizothorax niger. *NRM 40250, 70.8 mm SL. Living specimen, freshly captured from Dal Lake, 27 October 1997.*

Fig. 10.
Schizothorax esocinus. *NRM 40157, 105.6 mm SL. Living specimen, freshly captured from Jhelum River above Lower Jhelum Barrage at Gantamulla, S side (Site 7), 17 October 1997.*

Fig. 11.
Schizothorax labiatus. *NRM 40231, 70.3 mm SL. Living specimen, freshly captured from Jhelum River below Lower Jhelum Barrage at Gantamulla (Site 6), 18 October 1997.*

(e.g., Mirza, 1991) or even Indian trout (Tilak & Sinha, 1975). There seems to be no established standard and in this context we suggest the use of snow barbel for the following resons: The names snow trout and Indian trout are taxonomically misleading. Other names proposed suggest small size (snow minnow) or a pond-cultured variety of carp (snow carp). Oreinins certainly deserve their own name, but there seems to be no immediate selection available. *Kashmiri gad* or any of the local Kashmiri names seem too general or too anonymous for use in English. Instead we would like to emphasise the numerous similarities with the European barbels, genus *Barbus*, including polyploidy (Zan *et al.*, 1986) and body shape of stream inhabiting forms. For this reason M'Clelland's (1839) suggestion of mountain barbel is appropriate, but the expression which we endorse, snow barbel, preserves more of local charm.

Kashmir Valley Schizothorax

Heckel (1838) described 10 species of *Schizothorax* from Kashmir. Some of them were indicated to come from the Jhelum river and all of them probably came from the Kashmir Valley.

Schizothorax plagiostomus (Fig. 7), *S. curvifrons* (Fig. 8), *S. niger* (Fig. 9), and *S. esocinus* (Fig. 10) are valid species, also represented in the Uri AEIA samples, described in considerable detail and extensively figured. Unfortunately there is no mention of gill raker counts, which would have been helpful for later confirmation of identifications.

Schizothorax sinuatus is apparently the same as *S. plagiostomus* and through the action of the first reviser (Misra, 1949), the latter name takes priority.

There are, curiously, no specimens of *S. labiatus* (Fig. 11) in Heckel's material, although the species appears to be common in the Kashmir Valley. The original description of *S. labiatus* is based on specimens from Afghanistan (M'Clelland, 1842). Heckel (1838, 1844) reported the local name Tsesch for *S. sinuatus*, and as that name obviously corresponds to Chush in the transciption used here, the Kashmiri name currently applied on *S. labiatus*, we believe that *S. labiatus* somehow became represented by a specimen of *S. plagiostomus* with a narrow lower lip fold in Hügel's collection. *Schizothorax labiatus* was first reported from the Kashmir Valley by Silas (1960).

Remaining taxa have not been identified as valid species in our material, but three apparently represent variation within *S. curvifrons*: *S. micropogon*, *S. longipinnis* and *S. huegelii*. *Schizothorax micropogon* may then represent

Rama Gad, the slightly darker *S. curvifrons* collected from lakes. *Schizothorax planifrons* apparently represents *S. niger*. *Schizothorax nasus* has a somewhat long snout, but no transversely extended papillated lower lip fold or 'trilobate' lower lip. Its status remains uncertain until the type material can be examined, but it probably represents *S. plagiostomus*. Heckel (1838, 1844) gave the local name as Dongu, which is probably a variant of Khont, the current Kashmiri name for *S. plagiostomus*.

No other *Schizothorax* species have been described from the Kashmir Valley. However, M'Clelland (1839, 1842) described numerous similar taxa from Afghanistan. Among these, *Racoma labiatus* is recognisable from the figure and description as having very broad lips, the lower lip 'trilobed', thus being closer than anything else to the species that we identify as *Schizothorax labiatus* from the Kashmir Valley. The type locality is in the Kabul drainage in the lower Kunar River at Pashat. *Oreinus griffithi*, also from Pashat, appears to be the same as *S. plagiostomus*. *Racoma nobilis*, from Afghanistan, is apparently the same as *S. esocinus,* judging from the original description and figure (M'Clelland, 1842). The status of other species described by M'Clelland (1842) are less certain although most of these can apparently be synonymised with one or another of Heckel's (1838) species or with *S. labiatus*. McClelland worked only with skins or drawings and notes provided by the collector, limiting his option to provide detailed descriptions. *Racoma gobioides*, from the Amu-darya drainage, is apparently the same as *S. regelii* Herzenstein, 1889, type locality Amu-darya, or *S. fedtschenkoi* Kessler, 1872, type locality Zeravschan River (cf. descriptions and figures in Berg, 1932). *Racoma chrysochlora* and *S. ritchieana* are probably *S. labiatus. Racoma brevis* from the Helmand River was described as having 'lips covered with a thick fleshy membrane, which forms a loose appendage to the lower jaw' and may be *S. labiatus* as well, but there are no later records of *S. labiatus* from the Helmand basin. Judging from the description *S. intermedius* could be *S. curvifrons* or *S. esocinus*, but the surviving syntype, BMNH 1843.2.25.1, is referable to *S. labiatus* (pers obs., cf. also Günther, 1868:165). *Schizothorax edeniana* may be *S. plagiostomus,* and *S. barbatus* seems to be *S. esocinus* from the original description, but it was described with a mouth shape recalling *S. plagiostomus* by Günther (1868: 168).

Three *Schizothorax* species have been described from the Indus in Ladakh: *Schizothorax ladacensis* Zugmayer (1909) is obviously the same as *S. labiatus, S. montanus* Zugmayer (1909) agrees with *S. esocinus*, and *S. skarduensis* Mirza & Awan, 1978 is obviously a synonym of *S. plagiostomus.*

Raina & Narain's (1992) revision of Kashmir *Schizothorax* recognised eight species from the Kashmir Valley proper. The revision was obviously mainly or exclusively based on literature, which somehow does not include Tilak's (1987) revision of the genus.

Intraspecific variation

There is considerable variation in overall body shape and also in mouth shape among the *Schizothorax* specimens sampled in the Uri AEIA. Variation in mouth shape has already been illustrated by Hora (1934) and Mukerji (1936) who concluded that the variation is due to hybridisation. There has been no further substantiation of this hypothesis. Nonetheless, variation in general shape and particular mouth structure is so strong that it sometimes poses an obstacle in assigning particular specimens to one or the other species.

We base our identifications of Kashmir Valley *Schizothorax* on measurements and counts of series of specimens representing five morphotypes that seem to us to represent extremes of variation. All authors agree on the identification of most of these specimens. A very small number of specimens, about 1% of the large individuals, combine characters that are otherwise found exclusively in one species. Morphometric and meristic data taken from samples of 10–25 specimens of the 'typical' morphs support the identifications based on visual sorting, and are further confirmed by numerous blind checks. We thus feel confident that there are five species of *Schizothorax* in our samples. Other collections from the same area do not contain additional species. Careful study of Heckel's (1838) descriptions and figures and photographs of his type specimens indicate that they fall within the variation that we have found in fresh material and that they can be assigned to one or the other species. We are well aware that others may not find identification as easy, but expect that almost all specimens can be identified by rapid visual inspection using our key and figures. Our scheme also agrees closely with identifications made by fishermen in the Kashmir Valley (Yousuf *et al.,* MS).

The aberrant individuals combine characters of *S. labiatus* and *S. plagiostomus* or, less common, *S. curvifrons* and *S. plagiostomus*. There are specimens of *S. curvifrons* with a well developed sharp edge to the lower jaw but no other traits

of *S. plagiostomus*. Since most *Schizothorax* species feature mandibular labial papillae, and they are only hyperdeveloped and associated with a straight translateral labial fold and short lower jaw in *S. plagiostomus*, we regard *S. labiatus* and occasional *S. curvifrons* with well developed lower jaw papillae as intraspecific variation. There are no *S. plagiostomus* specimens lacking lower lip fold papillae. The trilobate condition of lips in *S. labiatus* depends on the development of the median pad, which never actually develops into a true median lobe as in some specimens of *Tor*, and it often remains rather weakly developed; such specimens may resemble *S. curvifrons*, but have a longer snout and fewer gill rakers.

For the most part Uri AEIA team observers found the distinction between *S. plagiostomus* and *S. labiatus* arbitrary. Both species show much variation in the shape of the head, especially snout length, and in the development of lips. In keeping with the majority of *S. labiatus*, however, specimens with papillated lips and/or a short sharp cutting edge along the margin of the lower jaw also retain a rounded jaw shape and especially a groove separating parallel proximate ends of the upper and lower lips. Such specimens never develop the characteristic thickened lower jaw of *S. plagiostomus*.

Schizothorax plagiostomus can almost always be separated by its short, deep cornified lower jaw, with a transverse or, usually, only slightly curved sharp cutting margin, and a rounded, smooth corner connecting the upper and lower lip, giving the fish a characteristic profile. The rostral fold is wider than in any other Kashmir Valley *Schizothorax* species. Some such individuals, however, have only a weakly developed lower lip fold and groove, thus resembling short-snouted and extensively papillated *S. labiatus*. The particular lower jaw structure of *S. plagiostomus* is referred to as 'sector' mouth by Howes (1982) and occurs, with variation in particulars, in several other labeonin and cyprinin genera, including *Bangana* covered in this paper. The sector mouth is characterised by a thick cover of cornified whitish tissue over the anterior margin of the lower jaw, seen as a modification of the lower lip by Howes (1982), with the addition of a band of sharp-margined darker and harder tissue, considered keratinised by Howes (1982), forming a cutting edge usually running anteroventrally on the exposed margin of the lower jaw. This keratinised cutting edge usually comes off easily in preserved specimens.

On the basis of available material there is no possibility of definitely identifying the cause of this variation. We believe some of it may be due to introgression, but some is probably developmental and atavistic.

Identifiable atypical specimens occur mostly among *S. labiatus* and *S. plagiostomus*, the two species that specialise in hypertrophied lip structures. Those species also share the faster running waters and may even share spawning grounds. Thus introgression is not improbable, but it is highly unlikely that it is extensive. Most of the variation observed will fall within developmental processes (Tilak, 1987: figs. 19–24).

In the Chitral-Kunar drainage in Afghanistan, Hora (1934) found *S. labiatus*, *S. plagiostomus* (called *S. sinuatus* var. *griffithii*), and *S. esocinus,* and reported and figured a series of specimens representing mouth shape characters normally found exclusively in either *S. labiatus* or *S. plagiostomus*. Acknowledging that some of the variation is due to rate of ontogenetic development, Hora nevertheless classed most of the intermediates as hybrids. Hora explained the high degree of introgression with the observation that the two species share habitat and breed in the same period, implying a normal state of hybridisation which seems quite unrealistic given that the two species occur syntopically over most of their ranges. Most of Hora's intermediates, as figured, would probably have been classed as *S. labiatus* by us.

Schizothorax samples available from other areas are scarce or do not permit reconstruction of the *Schizothorax* community from which they were taken. We have recorded one museum sample from Gilgit (BMNH 1880.3.15:712) containing *S. curvifrons, S. labiatus*, *S. esocinus*, and *S. plagiostomus*. Scarce collecting reports, e.g., Hora (1934), Mirza (1966), also suggest that at least *S. labiatus* and *S. plagiostomus* normally occur together. Mirza & Ejaz (1992) list 13 fish species from the Neelum River (=Kishen Ganga River, a tributary of the Jhelum joining it at Muzaffarabad), four of which are *Schizothorax* species, namely *S. plagiostomus, S. labiatus*, *S. esocinus*, and *S. micropogon*. The last-mentioned species can be assumed to be *S. curvifrons* in our nomenclature.

Only *S. plagiostomus* and *S. progastus* (=*S. labiatus*?) were reported from the Punch river, a more downstream tributary of the Jhelum (Das & Nath, 1971), and other co-occurrences of *S. labiatus* and *S. plagiostomus* were reported by Mirza & Awan (1979).

The Kashmir Valley *Schizothorax* community is apparently not entirely unique for the valley although it seems to hold more species than any other *Schizothorax* locality. The community, even though incompletely known from most localities, is stable over a wide area and must

have been established at some period before the present-day Kashmir Valley became accessible to fishes. Reproductive barriers are apparently maintained at a species rather than population level. Samples from other sites imply that there is similar variability in mouth structure, and thus we would rule out hybridisation caused by man-induced stress, e.g., reduced suitable spawning sites, what seems unlikely since most of the valley remains in wilderness state. There is no evidence to support the presence of natural differences in spawning migration routes or spawning seasons for *S. plagiostomus* or *S. labiatus,* that might have changed as a consequence of dam construction.

Terashima (1984) described an interesting assemblage of three *Schizothorax* species which he considered endemic to Lake Rara in Nepal. *Schizothorax macrophthalmus* and *S. raraensis* resemble *S. labiatus* in mouth structures according to Terashima's fig. 3, but *S. raraensis* more so. The first is planktivorous and has 17–23 gill rakers; the second is insectivorous and has 11–15 gill rakers. *Schizothorax nepalensis* resembles *S. plagiostomus* in mouth features including a sharp keratinised edge to the lower lip, and it is also herbivorous, scraping sessile algae. We examined one *S. macropthalmus* specimen (BMNH 1981.5.21:3, Lake Rara, collected by Pillai, 109.3 mm SL) and found it to be very similar to *S. curvifrons* in mouth shape and overall appearance. It has 21 gill rakers. Two other specimens from the same collection (BMNH 1981.5.21:1-2, 203-212 mm SL) have mouth structures similar to *S. labiatus*, but only 11–12 gill rakers and are thus identified as *S. raraensis.* Only a representative of the *S. esocinus* morphotype would thus be missing from the Rara *Schizothorax* community, but no species similar to it has been recorded from the Ganga-Brahmaputra drainage.

General diagnosis of Schizothorax *species*

Kashmir Valley *Schizothorax* species are all elongate, laterally compressed, with short head and eyes lateral, not visible from below. The third dorsal-fin ray is thickened and has strong serrations along the posterior margin. Lateral line along middle of side, often slightly irregular, complete. Maxillary and rostral barbels present, short. Snout tubercles often present. Caudal fin forked. Anal fin slightly longer in females than in males of comparable size. Lateral line scales distinctly larger than other scales on the side. Scales of the abdominal midline from about tips of pelvic fins enlarged, deep, non-imbricating across ventral midline, instead leaving a naked area exposing the genital opening and some of the vent anterior to it, enlarged scales continuing along each side of the anal-fin base. Colour usually dark grey on dorsum, lighter on sides, underside whitish. Often small dark spots scattered over sides, more prominent in small specimens. Pharyngeal teeth 5, 3, 2/2, 3, 5.

Schizothorax plagiostomus Heckel, 1838 (Figs 7, 12–18, 20, 30–33)

Original description

Schizothorax plagiostomus Heckel, 1838:16, pl. 1 (Caschmir).

Synonymy

Schizothorax sinuatus Heckel, 1838: 21, pl. 2 (Caschmir).

? *Schizothorax nasus* Heckel, 1838: 32, pl. 6 (Caschmir).

Schizothorax skarduensis Mirza & Awan, 1978: 199, fig 1 (Skardu) [Not seen.].

Oreinus Griffithii McClelland, 1842: 581 (Affghanistan, Koonur river, Pushut).

Local names. Khont (Kashmiri).

Diagnostic characters. Elongate, fusiform, with projecting snout. Mouth distinctly inferior, wide (Fig. 12), and lower jaw very deep, short (Fig. 13), and with a sharp keratinised anteroventral cutting edge. Lower lip fold expanded and papillose. Pharyngeal teeth in three rows, 5, 3, 2/2, 3, 5 (2). The first tooth of the main row much smaller than the others, conical and re-curved; second tooth largest, somewhat swollen at apex, with the tip recurved; all other teeth with the tip semitruncate (Fig. 15). A series of enlarged scales along the anal-fin base. Scales very small, 89–99 in the lateral line (Fig. 16). Branched dorsal-fin rays 7(4), 8(21). Branched anal-fin rays 5(25). Gill rakers 15(1), 17(5), 18(4), 19(3), 20(6), 21(4), 22(1) (Fig. 17).

Similar species in the Kashmir Valley. *Schizothorax plagiostomus* is most similar to *S. labiatus*, which is often found syntopic (Fig. 18), differing in having shorter lower jaw and wider mouth (Fig. 12–14, Tables 2, 4–5), but also averaging shorter and wider head and wider interorbital space and internarial width (Tables 2, 4–5). Almost all specimens can be conveniently distinguished as *S. plagiostomus* has a wider, almost transverse mouth, with a thick cornified cover, sharp keratinous cutting edge and wide papillose lip of lower jaw, whereas *S. labiatus* has a rounded lower jaw, with narrow cornified tip, no cutting edge, and lips restricted to wide lateral flaps and a more or less well developed median thickening, without enlarged

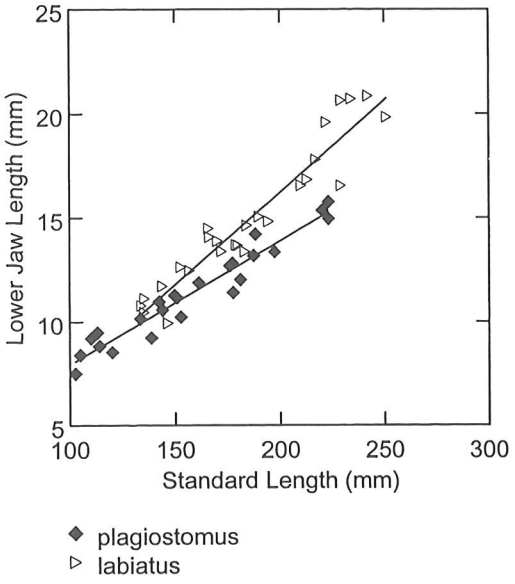

Fig. 12
Schizothorax plagiostomus *and* S. labiatus. *Lower jaw length plotted against standard length to show longer lower jaw of* S. labiatus *(Y=-1.5091+0.0886X, r=0.9533, N=26) compared to* S. plagiostomus *(Y=1.9647+ 0.0596X, r=0.9682, N=24). Regression lines fail homogeneity test at P=0.0001.*

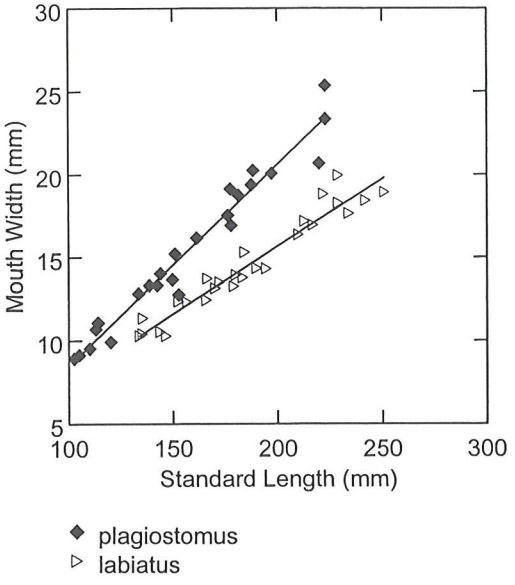

Fig. 13.
Schizothorax plagiostomus *and* S. labiatus. *Mouth width plotted against standard length to show narrower mouth of* S. labiatus *(Y=-0.6308+0.0815X, r=0.9684, N=26) compared to* S. plagiostomus *(Y=-3.6728+ 0.1214X, r=0.9782, N=24). Regression lines fail homogeneity test at P<0.0001.*

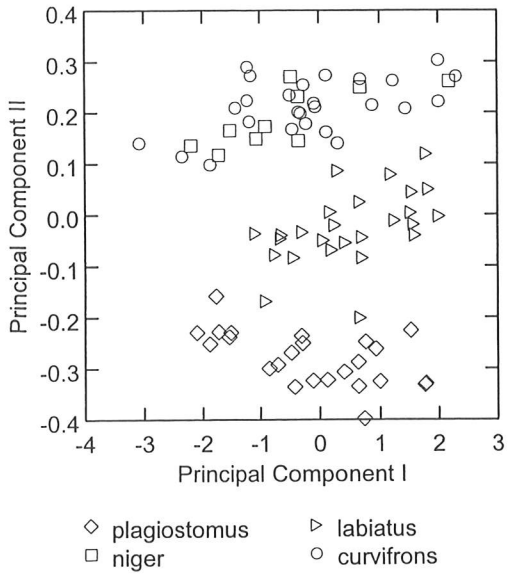

Fig. 14. Schizothorax. *Plot of first two principal components, mainly illustrating variation in mouth width, and other characters in the head region (preanal length, prepectoral length, head length, eye diameter, nostril to snout tip length); see also Table 4.*

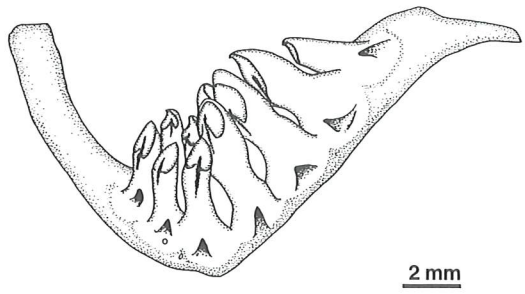

Fig. 15.
Schizothorax plagiostomus. *Left side pharyngeal bone in lateral aspect. NRM 41266, 258 mm SL.*

papillae. In lateral aspect the snout of *S. plagiostomus* projects before the mouth to a greater degree than in *S. labiatus*. Occasional individuals of *S. labiatus*, however, have a cornified lower jaw edge, and even a sharp cutting margin. These individuals can be distingished by the longer lower jaw, which needs to be measured. Small indviduals of both species (less than 10 cm SL, but sometimes larger) often have lip characters mentioned here less developed, and generally resemble *S. labiatus* more than *S. plagiostomus*. There are no differences in pharyngeal dentition, colour, scale counts or gill-raker counts.

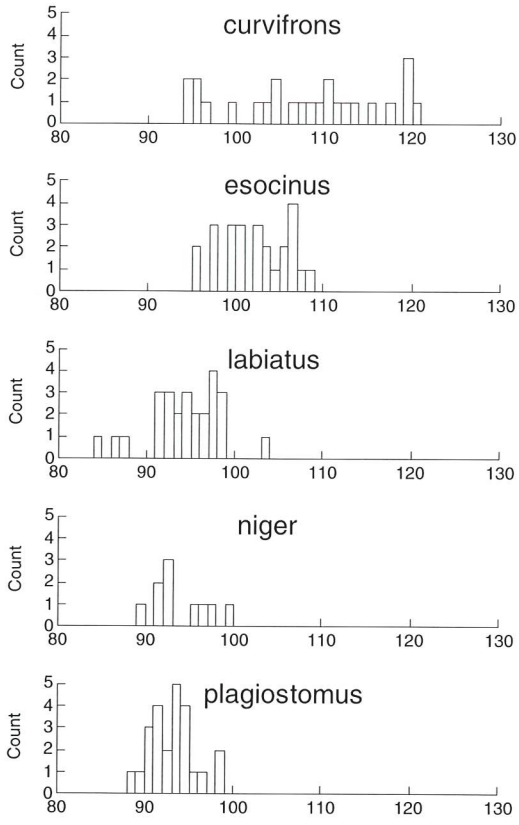

Fig. 16.
Schizothorax. *Variation in lateral line scale count in Kashmir Valley species of* Schizothorax.

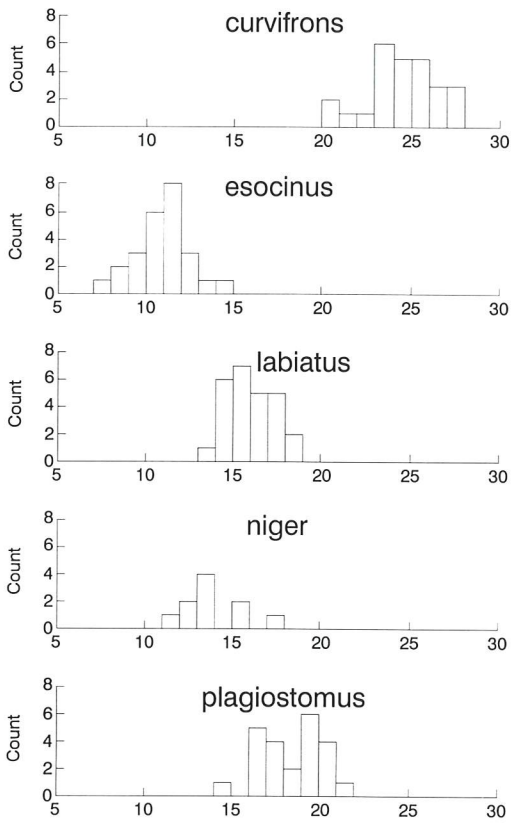

Fig. 17.
Schizothorax. *Variation in total gill raker count in Kashmir Valley species of* Schizothorax.

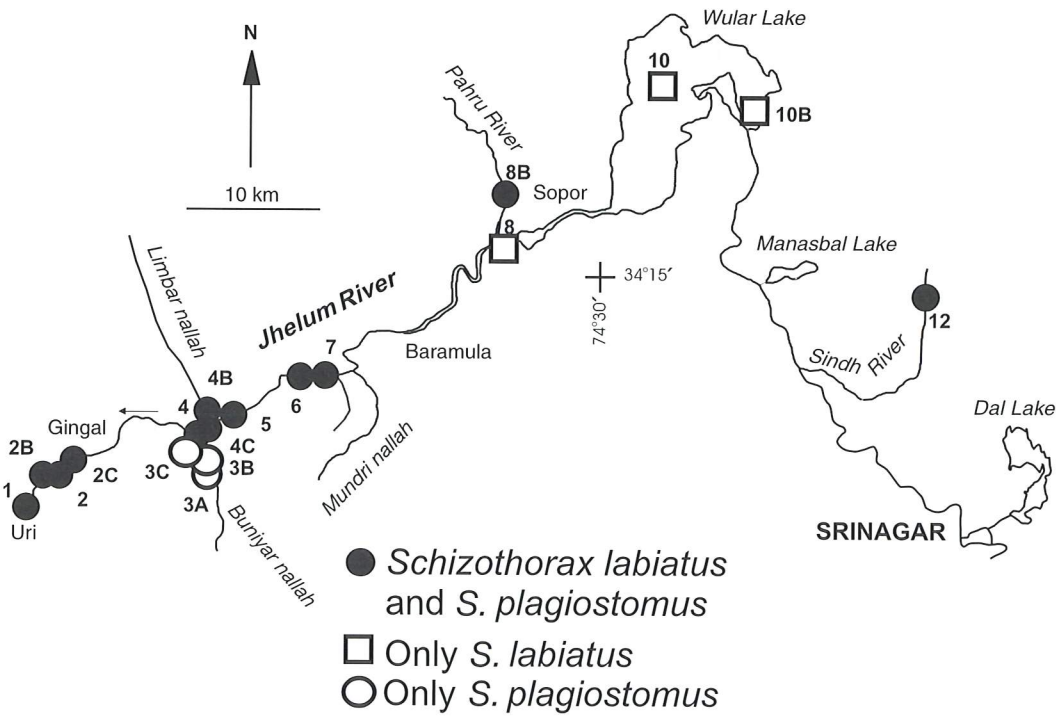

Fig. 18.
Location of sampling sites yielding Schizothorax plagiostomus *and* Schizothorax labiatus *in the Kashmir Valley Uri AEIA.*

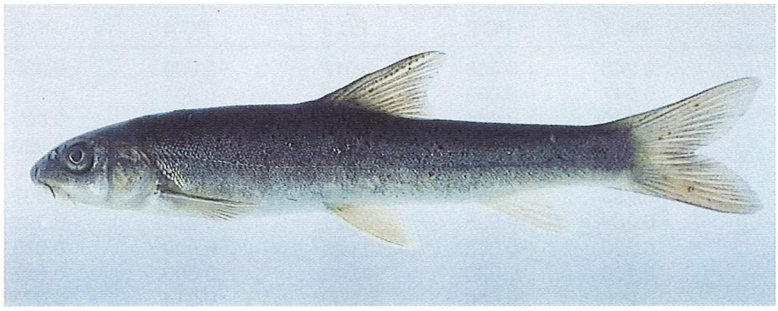

Fig. 19.
Schizothorax richardsonii. *NRM 36962, 112.2 mm SL. Living specimen, freshly captured from Sutlej River downstream Tata Pani, Saror Stream just upstream Shiva Cave (Sutlej Site 30), 4 November 1997.*

Fig. 20.
Schizothorax plagiostomus *and* S. richardsonii. *Head length length plotted against standard length to show shorter head of* S. richardsonii *(Y=6.7435+0.1648X, r=0.9572, N=10) compared to* S. plagiostomus *(Y=3.5464+0.2033X, r=0.9929, N=24). Regression lines fail homogeneity test at P=0.0171.*

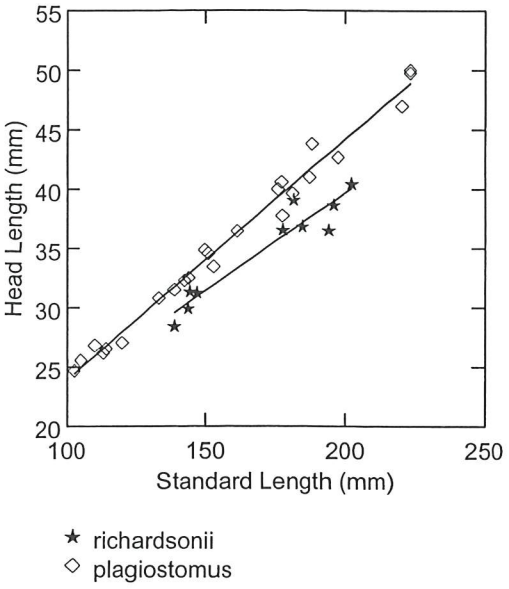

Table 2. Schizothorax plagiostomus. *Measurements from 24 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	24	102.7	223.0	157.9	37.49
Preanal length	24	73.5	79.0	76.0	1.40
Prepelvic length	24	48.9	53.7	51.7	1.47
Predorsal length	24	49.0	55.7	52.2	1.64
Prepectoral length	24	20.7	24.7	22.8	0.99
Head length	24	21.3	24.4	22.7	0.83
Pectoral-fin length	24	18.1	21.4	19.9	0.97
Pelvic-fin length	24	16.9	20.4	18.5	0.79
Dorsal-fin height	24	18.9	24.9	21.0	1.51
Anal-fin height	24	17.1	23.5	20.8	1.62
Caudal peduncle length	24	16.3	19.9	17.9	0.95
Caudal peduncle depth	24	9.3	12.2	10.7	0.70
Body depth	24	19.7	25.8	22.6	1.86
Head depth	24	12.5	14.1	13.4	0.43
Upper jaw length	24	6.6	8.4	7.5	0.43
Lower jaw length	24	6.4	8.4	7.3	0.52
Mouth width	24	8.3	11.4	9.7	0.80
Eye diameter	24	4.6	7.3	5.7	0.68
Interorbital width	24	7.3	9.4	8.3	0.47
Internarial width	24	3.9	4.9	4.4	0.31
Head width	24	11.4	12.7	12.0	0.38
Snout length	24	8.0	9.7	8.8	0.44
Nostril to snout length	24	4.3	6.1	5.1	0.48
Rostral barbel length	24	2.8	5.6	4.0	0.64
Maxillary barbel length	24	1.5	4.8	2.7	0.93

Table 3. Schizothorax richardsonii. *Measurements from 10 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	10	138.8	202.3	171.0	24.77
Preanal length	10	72.9	76.2	74.5	0.96
Prepelvic length	10	49.1	52.1	50.3	0.81
Predorsal length	10	47.3	51.0	48.8	1.30
Prepectoral length	10	18.0	21.8	20.4	1.14
Head length	10	18.8	21.7	20.5	0.89
Pectoral-fin length	10	15.6	18.2	17.4	0.75
Pelvic-fin length	10	14.7	17.0	16.1	0.66
Dorsal-fin height	10	15.1	20.6	18.1	1.66
Anal-fin height	10	15.9	20.5	18.4	1.46
Caudal peduncle length	10	18.1	20.3	19.2	0.81
Caudal peduncle depth	10	9.4	10.9	10.3	0.54
Body depth	10	19.5	21.0	20.1	0.53
Head depth	10	12.1	13.2	12.7	0.31
Upper jaw length	10	6.3	7.7	6.8	0.42
Lower jaw length	10	6.1	6.8	6.5	0.26
Mouth width	10	9.4	11.1	10.1	0.53
Eye diameter	10	4.1	5.1	4.6	0.41
Interorbital width	10	6.9	8.2	7.5	0.46
Internarial width	10	4.0	4.8	4.3	0.26
Head width	10	10.4	12.0	11.2	0.54
Snout length	10	6.9	9.2	8.1	0.70
Nostril to snout length	10	4.3	5.9	5.1	0.56
Rostral barbel length	10	2.1	3.0	2.5	0.27
Maxillary barbel length	10	1.1	2.0	1.5	0.30

Material. *Schizothorax plagiostomus* is by far the most abundant *Schizothorax* species in the sampling area, with 664 specimens obtained, from sites 1–2, 4–7, 2B–C, 3A–C, 4B–C, 8B, 12, and markets (Fig. 18). It is thus the only *Schizothorax* species ascending the Buniyar Nallah, and is absent from lakes. The largest sample consists of 70 specimens from site 5 in 1997. The largest specimen is 310 mm SL.

Remarks. Tilak (1987) assigned all Indian *Schizothorax* with broad papillated lower lip fold to *S. richardsonii,* the oldest available name, with the exception of *S. kumaonensis* Menon (1971). We retain here the name *S. plagiostomus* for the Kashmir Valley species, and believe it may be widespread in and restricted to the Indus drainage. Extensive comparisons need to be made to test this assumption. Our samples from Shimla are identified as a different species for which the name *S. richardsonii* (Gray) is available (Fig. 19). There is no known type material and no locality information for *S. richardsonii*, and the figure published by Gray (1830–1832: pl. 94, fig. 2) could be taken to represent all *S. plagiostomus* like *Schizothorax.* Our Shimla specimens differ from Kashmir Valley *S. plagiostomus* in a somewhat shorter head (Fig. 20, Table 3), the distinguishing character provided for *S. kumaonensis* by Tilak, and associated prepelvic and prepectoral lengths (Tables 2, 3). The maxillary barbel is on average longer and the rostral barbel shorter in *S. richardsonii* (Tables 2, 3). Dark spots on the sides are larger and much more prominent in *S. richardsonii* from Shimla than in *S. plagiostomus.*

Table 4. Schizothorax. *Character loadings on principal components 1–5, summarising 23 morphometric characters from four species (*S. esocinus *excluded). Pooled samples of* Schizothorax curvifrons *(N=26),* S. niger *(N=10),* S. plagiostomus *(N=24), and* S. labiatus *(N=26). See also Fig. 14.*

	PC 1	PC 2	PC 3	PC 4	PC 5
SL	0.245	0.038	0.012	-0.000	0.008
Preanal length	0.247	0.052	0.009	0.004	0.005
Prepelvic length	0.240	0.047	0.002	0.005	0.002
Predorsal length	0.235	0.040	0.002	0.000	-0.002
Prepectoral length	0.231	0.057	-0.034	0.006	-0.003
Head length	0.235	0.051	-0.031	0.003	-0.007
Pectoral-fin length	0.262	-0.025	0.021	0.014	0.021
Pelvic-fin length	0.250	-0.028	0.020	0.009	0.026
Dorsal-fin height	0.196	-0.020	-0.019	0.000	0.027
Anal-fin height	0.295	-0.048	0.000	0.014	0.023
Caudal peduncle length	0.226	0.017	0.024	-0.002	0.018
Caudal peduncle depth	0.265	-0.032	0.031	-0.013	-0.023
Body depth	0.238	0.003	0.038	-0.042	-0.049
Head depth	0.228	0.034	0.011	0.012	-0.011
Upper jaw length	0.280	-0.045	-0.081	0.008	-0.023
Lower jaw length	0.256	0.049	-0.058	0.008	-0.010
Mouth width	0.287	-0.096	0.010	0.057	-0.026
Eye diameter	0.155	0.051	-0.004	-0.003	0.017
Interorbital width	0.269	0.033	0.044	0.009	-0.005
Internarial width	0.305	-0.025	0.044	-0.012	0.003
Head width	0.233	0.027	0.022	0.011	-0.006
Snout length	0.283	-0.034	-0.046	-0.024	0.005
Nostril to snout length	0.308	-0.059	-0.018	-0.058	0.017
Variance explained	1.475	0.044	0.024	0.010	0.008
Percentage of total variance explained	92.7	2.7	1.5	0.6	0.5

There is also an earlier name for Kumaun *Schizothorax*, viz. *S. petrophilus* M'Clelland (1839), which was described, but not named, already by M'Clelland (1835). *Oreinus maculatus* McClelland (1838) was described from mountain streams at Shimla, and is recognised from the figure in McClelland (1838, 1839) as a species similar to or identical with *S. richardsonii*. Günther (1868) listed skins from Afghanistan as types of *O. maculatus*, but they cannot be.

Descriptive information in published records of *S. plagiostomus* (often identified as *O. sinuatus*, *O. plagiostomus* or *S. richardsonii*) is usually insufficient to positively identify the species. As *S. richardsonii* is obviously present in the Sutlej drainage, Punjab records could be for that species.

There are several reports from Pakistan, suggesting that the species occurs in fast-running water from the Zhob drainage northwards through the Kurram, Kabul, Swat, Gilgit, and upper Indus (Mirza & Awan, 1979). Zhang *et al.* (1995) reported *S. plagiostomus* from the Xizang part of the Indus drainage. Das & Nath (1971) listed *S. plagiostomus* from the Punch.

Schizothorax specimens from the Ayeyarwaddy/Yiluowadi Jiang drainage in Myanmar and China differ from *S. richardsonii* and *S. plagiostomus* in colour pattern, having even larger black spots on the sides. We did not, however, include this or other extralimital material in our morphometric comparison. Wu & Wu (1992) provided descriptive data and comparisons for *S. richardsonii*-like species from the Yaluzangbu Jiang/Brahmaputra, Yiluowadi Jiang/Ayeyarwaddy, Nu Jiang/Thanlwin and Lancang Jiang/Mekong drainages.

In the principal component analysis (Fig. 14, Table 4), there is a separation of *Schizothorax* species by head characters on Component II, placing *S. plagiostomus* and *S. labiatus* and *S. niger*+*S. curvifrons* apart mainly by mouth width, but also other characters related to eye size and head length. *Schizothorax niger* and *S. curvifrons* cannot be distinguished by this character set. In this analysis barbel lengths and *S. esocinus* were excluded to improve the clarity of the graph. Barbel length is efficient in separation only of *S. niger* and *S. curvifrons* (below).

Schizothorax labiatus (McClelland & Griffith, 1842) (Figs 11–14, 16–18, 21, 30–33)

Original description

Racoma labiatus McClelland & Griffith in M'Clelland, 1842: 578, pl. 15, fig. 1 (Pushut, Koonar river near Jullalabad).

Synonymy

Schizothorax Ritchieana McClelland & Griffith in M'Clelland, 1842: 580 (Affghanistan).

?*Schizothorax intermedius* McClelland & Griffith in M'Clelland, 1842: 579 (Cabul river at Jullalabad. Tarnuck river).

Schizothorax ladacensis Zugmayer, 1909: 433 (Indus near Leh).

Local names. Chush (Kashmiri).

Table 5. Schizothorax labiatus. *Measurements from 26 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	26	134.0	251.0	186.0	35.48
Preanal length	26	75.5	80.1	77.1	1.32
Prepelvic length	26	50.5	54.2	52.5	0.99
Predorsal length	26	49.6	56.4	52.3	1.61
Prepectoral length	26	22.7	26.4	24.2	0.98
Head length	26	22.7	26.2	24.1	0.85
Pectoral-fin length	26	16.3	21.6	18.1	0.95
Pelvic-fin length	26	15.5	19.2	16.8	0.79
Dorsal-fin height	26	17.2	22.2	19.7	1.48
Anal-fin height	26	17.1	21.5	19.5	1.18
Caudal peduncle length	26	14.7	18.8	17.1	1.04
Caudal peduncle depth	26	8.5	10.7	9.7	0.46
Body depth	26	17.4	24.3	21.4	1.84
Head depth	26	11.3	14.1	12.8	0.61
Upper jaw length	26	6.5	9.1	7.8	0.61
Lower jaw length	26	6.8	9.0	8.0	0.53
Mouth width	26	7.0	8.7	7.8	0.40
Eye diameter	26	4.4	6.8	5.6	0.46
Interorbital width	26	6.7	8.6	7.7	0.41
Internarial width	26	3.2	4.8	4.1	0.31
Head width	26	10.6	11.9	11.2	0.33
Snout length	26	8.1	10.1	9.1	0.54
Nostril to snout length	26	4.2	6.8	5.1	0.55
Rostral barbel length	26	2.6	6.1	4.9	0.76
Maxillary barbel length	26	1.7	3.5	2.7	0.54

Diagnostic characters. Elongate, fusiform, with a prognathous upper jaw; a lower jaw with wide lip folds usually separated by a distinct raised pad. Pharyngeal teeth in three rows, 5, 3, 2/2, 3, 5 (2). The first tooth of the main row much smaller than the others, conical and recurved; second tooth largest, somewhat swollen at apex, with the tip recurved; all other teeth with the tip recurved or semitruncate (Fig. 21). A series of enlarged scales along the anal-fin base. Scales very small, 85–104 in the lateral line (Fig. 16). Branched dorsal-fin rays 7(13), 8(12). Branched anal-fin rays 5(25). Gill rakers 14(1), 15(6), 16(7), 17(5), 18(5), 19(1) (Fig. 17).

Similar species in the Kashmir Valley. *Schizothorax labiatus* is most similar to *S. plagiostomus*, with which it is frequently syntopic (Fig. 18), differing in having a longer lower jaw and narrower mouth (Figs 12–14, Tables 2, 4–5). Almost all specimens can be conveniently distinguished as *S. plagiostomus* has a wider, almost transverse mouth, with a thick cornified pad, sharp cutting edge and wide papillose lower jaw lip, whereas *S. labiatus* has a rounded lower jaw, with a narrow cornified margin, no keratinised cutting edge, and lips restricted to wide lateral flaps and a more or less well developed median thickening, without enlarged papillae. In lateral aspect the snout of *S. plagiostomus* projects before the mouth to a greater degree than in *S. labiatus*. Occasional individuals of *S. labiatus*, however, have a widely exposed cornified lower jaw margin, as well as a sharp cutting margin. These individuals can be distingished by the longer lower jaw, which needs to be measured. Small indviduals of both species (less than 10 cm SL, but sometimes also larger specimens) often have lip chararacters that are less developed, and generally resemble *S. labiatus* more than *S. plagiostomus*. There are no differences in pharyngeal dentition, colour, scale counts, or gill-raker counts.

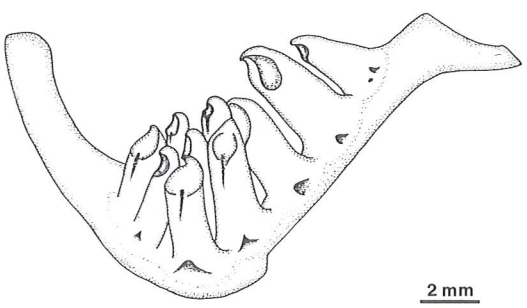

Fig. 21. Schizothorax labiatus. *Left side pharyngeal bone in lateral aspect. NRM 41265, 216 mm SL.*

Material. Uri AEIA samples contain 219 specimens from sites 1–2, 4–8, 10, 12, 2B–C, 4B–C, 8B, 10B, and markets (Fig. 18). The largest sample contains 65 specimens from site 8B. The largest specimen is 296 mm SL.

Remarks. Hora (1934) acted as the first reviser in giving priority to *S. labiatus* over *S. ritchieana*, which was described in the same paper. No *S. labiatus*-like species have been named from the Kashmir Valley. Silas (1960) was the first to report the species from there. M'Clelland (1839) described *S. progastus* from Upper Assam, and Günther (1861) named *S. hodgsonii* from Nepal, both with lips similar to *S. labiatus*. *Schizothorax ladacensis* was described as having a fleshy lower lip with median and lateral lobes, but also with a striated cornified covering to the lower jaw. The species was figured by Zugmayer (1910), and is tentatively synonymised with *S. labiatus* here. *Schizothorax labiatus* apparently has a distribution similar to *S. plagiostomus*. It was reported from the Indus drainage in Xizang, China, by both Wu & Wu (1991) and Zhang *et al.* (1995), from the Punch by Das & Nath (1971; as *S. progastus*) and from many localities in Afghanistan and Pakistan by M'Clelland (1842), Hora (1934, 1935; as *S.chrysochlora* in the latter paper), and Mirza & Awan (1979). It apparently occupies hill streams from the Zhob drainage north through the Kurram, Kabul, Chitral, Swat, upper Indus, and the Jhelum south to the Punch Valley.

Schizothorax intermedius has been widely cited from the Helmand and Talimu He drainages and Aral Sea tributaries (Berg, 1932, Coad, 1981), probably refering to a suite of species. The problem of identification of *S. intermedius* has been addressed in some detail, but without solution, by Hora (1935). The original descrip-

tion was based on three specimens from the Kabul (Indus drainage) and Tarnak (Helmand drainage) rivers and suggested a species similar to *S. esocinus* or *S. curvifrons* in the mouth shape. A syntype, BMNH 1843.2.25.1, 177 mm SL, labeled from Affghanistan, has somewhat thick lips and is tentatively identified by us as *S. labiatus*. This specimen and one more possible syntype were re-described by Günther (1868: 165) who commented on the discrepancies with McClelland's description.

Schizothorax curvifrons Heckel, 1838 (Figs 8, 14, 22–26, 30–32)

Original description

Schizothorax curvifrons Heckel, 1838:25, pl. 3 (Caschmir).

Synonymy

Schizothorax longipinnis Heckel, 1838: 27, pl. 4 (Caschmir).

Schizothorax Hügelii Heckel, 1838: 36, p. 7 (Caschmir).

Schizothorax micropogon Heckel, 1838: 41, p. 8, fig. 1 (Caschmir).

Local name. Satter gad (Kashmiri).

Diagnostic characters. Elongate, fusiform, with a short, blunt and slightly prognathous upper jaw. Lips thin, not expanded into wide folds. A series of enlarged scales along the anal-fin base. Pharyngeal teeth in three rows, 5, 3, 2/2, 3, 5 (2). The first tooth of the main row much smaller than the others, conical and recurved; second tooth largest, somewhat swollen at apex, with the tip truncate in two aspects; all other teeth with the tip truncate, forming a semidorsal aspect (Fig. 22). Scales very small, 95–121 in the lateral line (Fig. 16). Branched dorsal-fin rays 6(10), 7(15). Branched anal-fin rays 5(25). Gill rakers 21(1), 22(1), 23(1), 24(6), 25(5), 26(5), 27(3), 28(3) (Fig. 17).

Similar species in the Kashmir Valley. *Schizothorax curvifrons* differs from all other Kashmir Valley *Schizothorax* in having more gill rakers (21–28 vs. 8–13 in *S. esocinus*, 14–19 in *S. labiatus*, 15–22 in *S. plagiostomus*, 12–18 in *S. niger*) and in the thin lips, without enlarged lateral or median flaps found in *S. labiatus* or *S. plagiostomus*, or the fleshy appearance of *S. niger*. *Schizothorax curvifrons* and *S. niger* are also the only of those species which may have 6 dorsal-fin rays.

Schizothorax curvifrons appears to be the

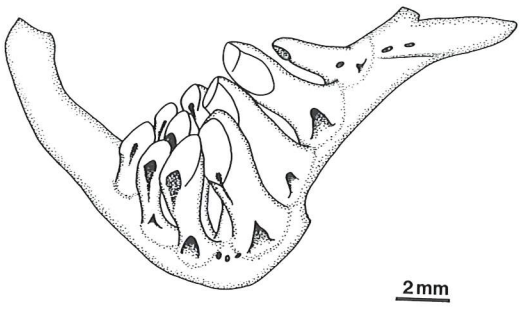

Fig. 22. Schizothorax curvifrons. *Left side pharyngeal bone in lateral aspect. NRM 41263, 246 mm SL.*

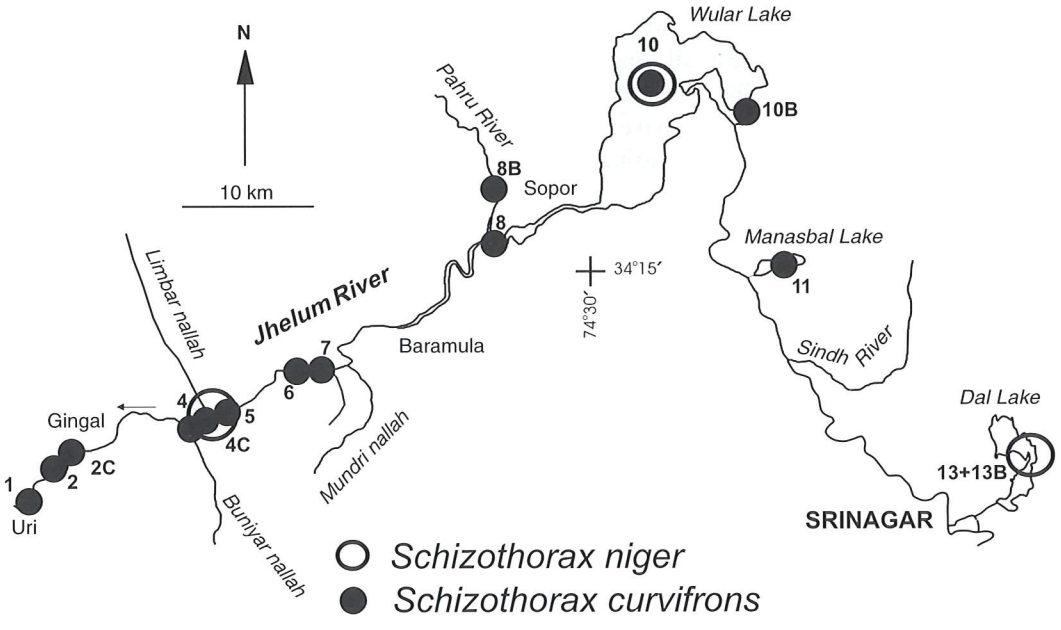

Fig. 23. *Location of sampling sites yielding* Schizothorax curvifrons *and* Schizothorax niger *in the Kashmir Valley Uri AEIA.*

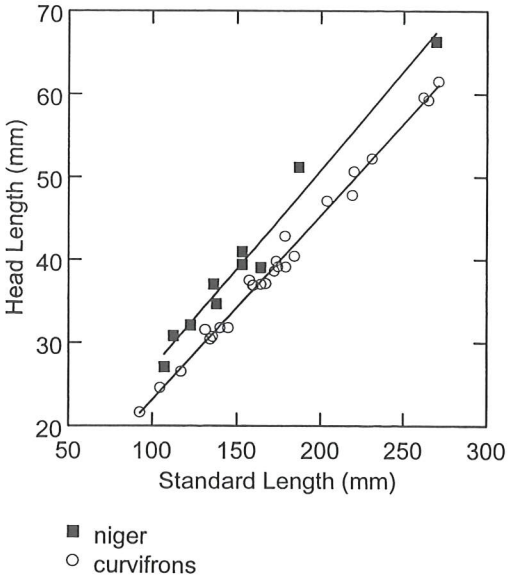

Fig. 24.
Schizothorax curvifrons *and* S. niger. *Head length plotted against standard length to show longer head of* S. niger *(Y=3.0756+0.2385X, r=0.9859, N=10) compared to* S. curvifrons *(Y=0.9642+0.2218X, r=0.9957, N=26). See also Fig. 30. Regression lines significantly different at P<0.0005.*

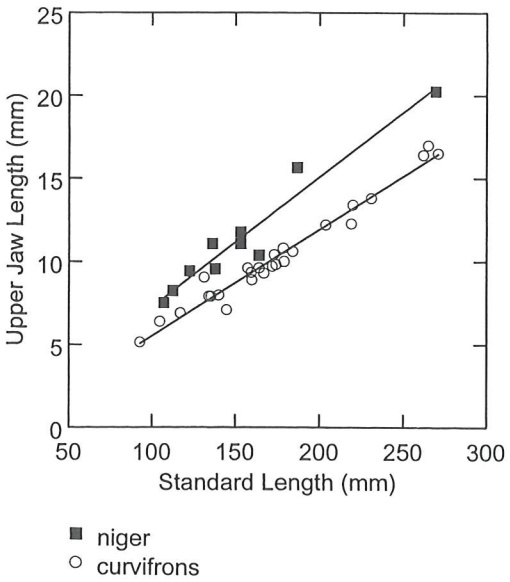

Fig. 25.
Schizothorax curvifrons *and* S. niger. *Upper jaw length plotted against standard length to show longer upper jaw of* S. niger *(Y=-0.5406+0.0781X, r=0.9685, N=10) compared to* S. curvifrons *(Y=-0.8562+0.0639X, r=0.9833, N=26). Regression lines fail homogeneity test at P=0.0206.*

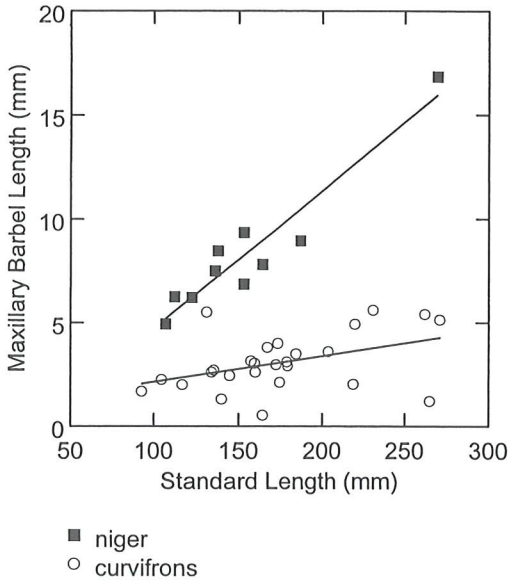

Fig. 26.
Schizothorax curvifrons *and* S. niger. *Maxillary barbel length plotted against standard length to show longer barbel of* S. niger *(Y=-1.8894+0.0125, r=0.0662, N=10) compared* to S. curvifrons *(Y=0.9048+0.0125, r=0.4300, N=26). The long-barbelled* S. curvifrons *is from Dal Lake. Regression lines fail homogeneity test at P<0.0005.*

Table 6. Schizothorax curvifrons. *Measurements from 26 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	26	92.7	271.0	174.7	9.30
Preanal length	26	76.3	81.2	78.3	0.25
Prepelvic length	26	49.3	54.1	52.3	0.24
Predorsal length	26	48.0	55.0	51.8	0.32
Prepectoral length	26	22.1	25.1	23.3	0.16
Head length	26	21.8	24.0	22.8	0.12
Pectoral-fin length	26	15.9	18.3	17.0	0.10
Pelvic-fin length	26	14.7	16.6	15.8	0.11
Dorsal-fin height	26	14.2	21.6	18.2	0.38
Anal-fin height	26	14.3	19.7	17.0	0.25
Caudal peduncle length	26	15.0	18.9	17.1	0.18
Caudal peduncle depth	26	7.5	9.8	9.0	0.11
Body depth	26	17.5	24.9	20.8	0.31
Head depth	26	11.9	14.9	13.1	0.14
Upper jaw length	26	4.9	6.9	5.9	0.07
Lower jaw length	26	6.1	8.0	7.2	0.10
Mouth width	26	6.0	8.3	6.8	0.12
Eye diameter	26	4.4	7.2	5.8	0.13
Interorbital width	26	7.3	9.0	8.2	0.09
Internarial width	26	3.1	4.8	3.9	0.07
Head width	26	10.8	12.5	11.5	0.10
Snout length	26	6.3	7.9	7.3	0.08
Nostril to snout length	26	3.3	4.8	4.1	0.08
Rostral barbel length	26	0.7	3.7	2.8	0.14
Maxillary barbel length	26	0.3	3.9	1.8	0.15

morphometrically and meristically most variable species of the *Schizothorax* of the Kashmir Valley, but can always be recognised by the combination of average high scale count (Fig. 16), higher gill-raker number (Fig. 17), and thin lips. *Schizothorax curvifrons* and *S. niger* occur together in both Dal and Wular lakes and at the single river locality known for *S. niger* (Fig. 23). The most similar species is *S. niger* which is generally darker, and has thicker lips and longer barbels. Morphometrically the two species are very close, and there is overlap in diagnostic proportional measurements (Tables 6–7; Figs. 24–26). In Figures 25–26, illustrating separation in head length, upper jaw length and barbel length, one Dal Lake specimen of *S. curvifrons* is seen to approach *S. niger* in long maxillary barbel and long upper jaw. Lake specimens of *S. curvifrons* are much darker than river specimens, and colour alone cannot be used to separate *S. curvifrons* from *S. niger.* For field identification the fleshy lips and barbels of *S. niger* provide the best diagnostic character.

Material. The Uri AEIA samples contain 365 specimens from sites 1–2, 4-8, 10–11, 2C, 4C, 10B, and markets (Fig. 23). The largest sample consists of 128 specimens taken from Wular Lake in 1990. The largest specimen is 337 mm SL.

Remarks. We have verified only one occurrence of *S. curvifrons* outside the Kashmir Valley, in a sample from Gilgit (BMNH 1880.3.15: 712) containing also *S. labiatus*, *S. esocinus*, and *S. plagiostomus*. The *S. intermedius* reported from the Kabul drainage by Hora (1935) may be this species, and we are of the impression that *S. curvifrons* is distributed over a larger area than currently known. Collections of *Schizothorax* specimens are rarely as large as those that have generally been obtained from the Kashmir Valley. Outside the valley, commonly only one or a few specimens are sampled on each occasion, owing mainly to difficulties in collecting and preserving large rheophilic fishes.

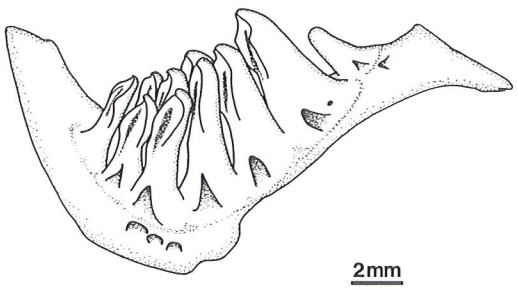

Fig. 27.
Schizothorax niger. *Right side pharyngeal bone in lateral aspect (reversed). NRM 41264, 273 mm SL.*

Schizothorax niger Heckel, 1838 (Figs 9, 16–17, 23–27, 30–33)

Original description

Schizothorax niger Heckel, 1838:29, pl. 5 (Caschmir).

Synonymy

Schizothorax planifrons Heckel, 1838: 44, pl. 8, fig. 2 (Caschmir).

Local names. Ale gad (Kashmiri).

Diagnostic characters. Elongate, fusiform, with a short, blunt and slightly prognathous upper jaw. Lips thick, but not expanded into wide folds. A series of enlarged scales along the anal-fin base. Pharyngeal teeth in three rows, 5, 3, 2/2, 3, 5 (2). The first tooth of the main row much smaller than the others, conical and pointed; second tooth largest, somewhat swollen at apex, with the tip semi-recurved; all other teeth with the tip semi-recurved (Fig. 27). Scales very small, 92–100 in the lateral line (Fig. 16). Branched dorsal-fin rays 6(9), 7(1). Branched anal-fin rays 5(10). Gill rakers 12(1), 13(2), 14(4), 16(2), 18(1) (Fig. 17).

Similar species in the Kashmir Valley. *Schizothorax niger* differs from all other Kashmir Valley *Schizothorax* in the combination of thick, but not otherwise expanded lower lip folds, short snout and few gill rakers. Notably, *S. niger* is the only species of *Schizothorax* in the Kashmir Valley with almost exclusively 6 dorsal-fin rays, the others usually having 7–8.

Material. Only 30 specimens are contained in the Uri AEIA samples, 23 of them from Dal Lake in 1997, the others from sites 4C, 5 and 10 (Wular Lake) (Fig. 23).

Remarks. *Schizothorax niger* was collected almost exclusively from both Wular and Dal Lakes, strongly suggesting that *S. niger* does not normally occur in running water, although one specimen appeared in the Mohra Dam in 1997. The most similar species in the valley is *S. curvifrons*.

There are no records of *S. niger* from outside the Kashmir Valley, and there are no similar species reported from elsewhere. Actually, there are very few permanent lakes in the sub-Himalayan region and thus very few habitats available for lake dwelling *Schizothorax*. Lake Rara in Nepal holds three endemic species as discussed above, p. 117. The other lake endemics in the genus are the Chinese *Schizothorax taliensis* Regan, 1907 from Lake Erhai, with 19–25 gill rakers; *S. microstomus* (Huang, 1982) from Lugu Lake, with 19–27 gill rakers; *S. ninglangensis* Wang, Zhang & Zhuang, 1981, also from Lugu Lake,

Table 7. Schizothorax niger. *Measurements from 10 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	10	107.0	269.4	154.2	47.13
Preanal length	10	76.7	82.3	78.6	1.63
Prepelvic length	10	52.5	55.6	54.1	0.97
Predorsal length	10	52.2	56.8	54.8	1.67
Prepectoral length	10	24.7	29.1	26.6	1.50
Head length	10	23.8	27.4	26.0	1.25
Pectoral-fin length	10	15.7	18.5	17.1	0.94
Pelvic-fin length	10	14.0	17.0	15.8	0.95
Dorsal-fin height	10	16.9	22.3	20.1	2.00
Anal-fin height	10	14.5	19.2	16.7	1.44
Caudal peduncle length	10	15.9	19.1	17.2	1.09
Caudal peduncle depth	10	8.1	9.9	9.0	0.52
Body depth	10	17.6	26.7	21.1	2.83
Head depth	10	12.4	15.1	13.8	0.75
Upper jaw length	10	6.3	8.4	7.4	0.59
Lower jaw length	10	7.1	10.1	8.2	0.89
Mouth width	10	6.7	8.3	7.6	0.59
Eye diameter	10	4.7	6.8	6.0	0.65
Interorbital width	10	6.9	8.6	8.0	0.48
Internarial width	10	3.0	4.1	3.5	0.32
Head width	10	11.3	13.1	12.0	0.62
Snout length	10	7.3	8.8	7.9	0.49
Nostril to snout length	10	3.7	4.6	4.0	0.27
Rostral barbel length	10	2.7	4.2	3.4	0.46
Maxillary barbel length	10	1.6	2.9	2.3	0.52

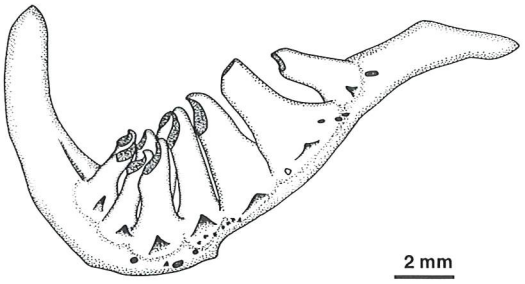

Fig. 28. Schizothorax esocinus. *Left side pharyngeal bone in lateral aspect. NRM 41267, 207 mm SL.*

with 15–22 gill rakers (data from Wu & Wu, 1992). These species and *S. macrophthalmus* from Lake Rara tend to resemble *S. curvifrons* in the higher gill raker number, and also appear to be specialised planktivores.

Pandit *et al.* (1992) provided morphometric and biological data on *S. niger* from Dal Lake. They did not mention gill rakers or other identification criteria, and it is thus possible that *S. curvifrons* may have formed part of the sample.

Schizothorax esocinus Heckel, 1838 (Figs 10, 16–17, 28–32)

Original description

Schizothorax esocinus Heckel, 1838:48, pl. 9 (Caschmir).

Synonymy

Racoma nobilis McClelland & Griffith in M'Clelland, 1842: 577, pl. 15, fig. 4 (Afghanistan).

? *Schizothorax barbatus* McClelland & Griffith in M'Clelland, 1842: 580 (Cabul river at Jullalabad).

Schizothorax punctatus Day, 1877b: 785 (Cashmere Lake).

Schizothorax montanus Zugmayer, 1909: 434 (Indus near Leh).

Local name. Chhurru (Kashmiri).

Diagnostic characters. Elongate, fusiform, with a long snout, only slightly prognathous upper jaw or jaws equal. Pharyngeal teeth in three rows, 5, 3, 2 / 2, 3, 5 (2). The first tooth of the main row much smaller than the others, conical and recurved; second tooth largest, somewhat swollen at apex, with the tip recurved; all other teeth with the tip recurved, with the apical regions somewhat expanded laterally and bent forward so as to bring the grinding surface to a semidorsal aspect, the tips

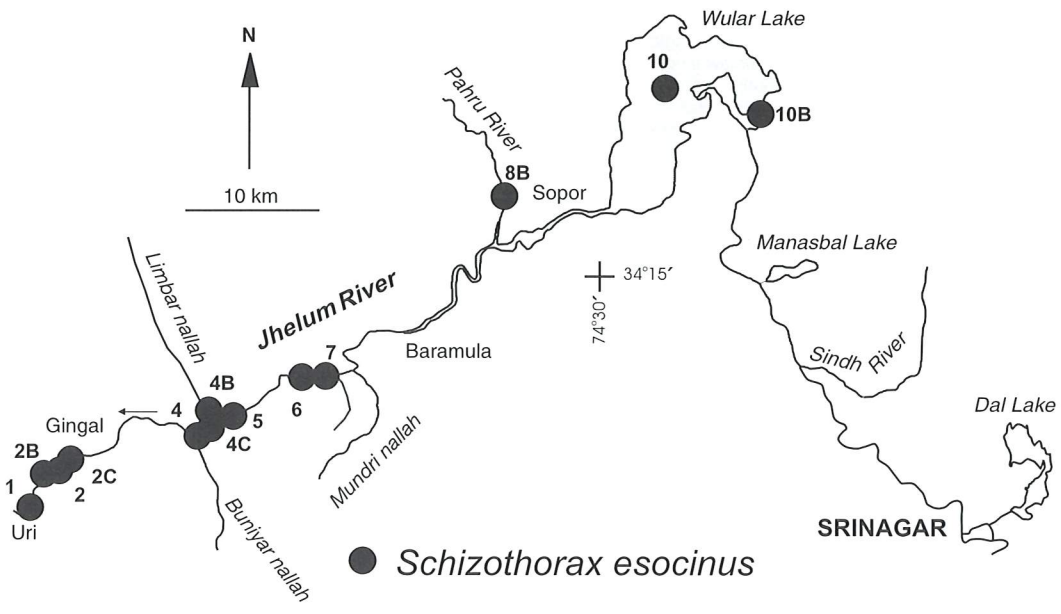

Fig. 29. *Location of sampling sites yielding* Schizothorax esocinus *in the Kashmir Valley Uri AEIA.*

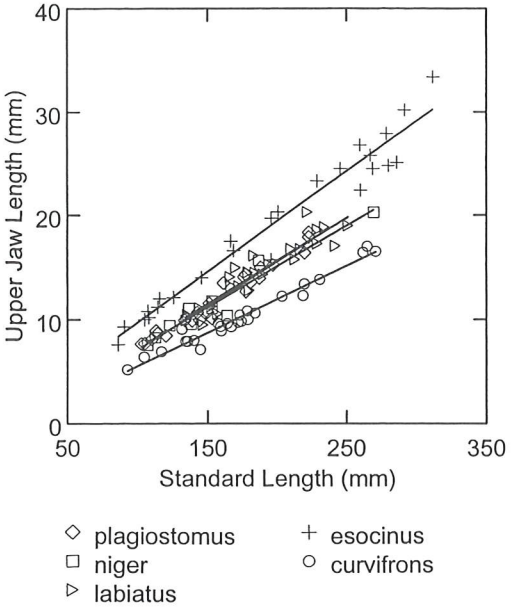

Fig. 30.
Schizothorax. *Upper jaw length plotted against standard length to show longer upper jaw of* S. esocinus *(Y= 0.0395+0.0968X, r=0.9782, N=25), and shorter upper jaw of* S. curvifrons *compared to other* Schizothorax *species (*S. labiatus, *Y=-0.7990+0.0820X, r=0.9333, N=26;* S. plagiostomus, *Y=-1.3071+0.0840X, r=0.9792, N=24;* S. curvifrons, *Y=-0.8562+0.0639X, r=0.9833, N=26;* S. niger, *Y=-0.5406+0.0781X, r=0.9685, N=10).*

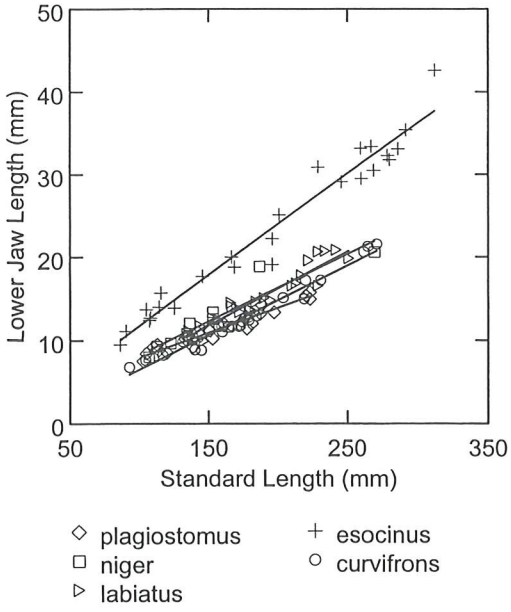

Fig. 31.
Schizothorax. *Lower jaw length plotted against standard length to show longer jaw of* S. esocinus *(Y=-0.5054+0.1225X, r=9.9793, N=25) compared to other* Schizothorax *species (*S. labiatus, *Y=-1.5091+0.0886X, r=0.9533, N=26;* S. plagiostomus *(Y=1.9647+0.0596X, r=0.9682, N=24;* S. curvifrons, *Y=-1.8061+0.0831X, r=9.9810, N=26;* S. niger, *Y=0.2055+0.0806X, r=0.9259, N=10). See Fig. 32 for further analysis.*

Table 8.
Schizothorax esocinus. *Measurements from 25 specimens expressed as per cent of SL, except SL which is in mm.*

Measurement	N	Min	Max	Mean	SD
SL (mm)	25	86.0	311.8	196.1	75.31
Preanal length	25	72.1	80.4	77.1	1.83
Prepelvic length	25	50.8	56.2	53.8	1.38
Predorsal length	25	50.4	56.3	52.9	1.39
Prepectoral length	25	24.8	30.2	28.2	1.32
Head length	25	25.2	31.1	28.8	1.34
Pectoral-fin length	25	14.7	17.8	16.0	0.81
Pelvic-fin length	25	13.7	17.1	15.4	0.78
Dorsal-fin height	25	14.6	22.3	17.7	2.16
Anal-fin height	25	14.6	18.5	17.0	1.03
Caudal peduncle length	25	14.9	24.3	17.3	1.75
Caudal peduncle depth	25	8.2	9.8	9.1	0.42
Body depth	25	16.2	21.3	19.5	1.28
Head depth	25	11.1	14.9	12.8	1.08
Upper jaw length	25	8.0	10.7	9.7	0.68
Lower jaw length	25	9.8	13.7	12.0	0.91
Mouth width	25	7.7	12.1	9.2	1.10
Eye diameter	25	4.6	8.3	6.1	1.03
Interorbital width	25	6.4	8.7	7.3	0.53
Internarial width	25	3.8	4.9	4.3	0.33
Head width	25	9.9	12.3	11.2	0.70
Snout length	25	6.6	11.5	10.0	0.97
Nostril to snout length	25	4.8	6.5	5.7	0.44
Rostral barbel length	25	2.4	6.1	4.4	0.79
Maxillary barbel length	25	1.1	5.4	2.7	1.30

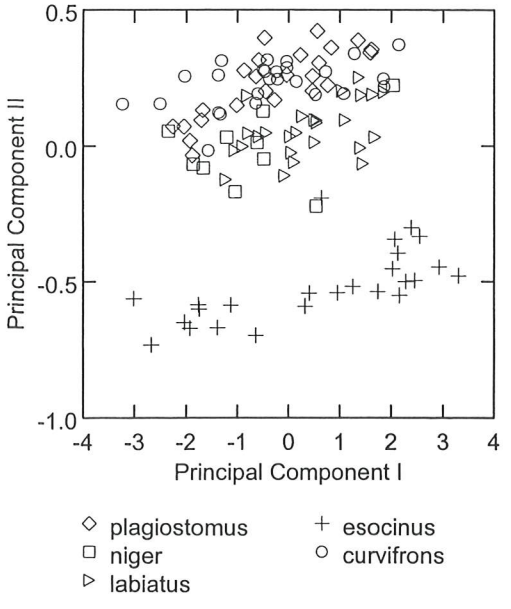

Fig. 32. Schizothorax. *Plot of scores of second principal component on first component, mainly illustrating longer lower jaw of* S. esocinus. *See also Table 9.*

Table 9. Schizothorax. *Character loadings on principal components 1–5, summarising 23 morphometric characters. Pooled samples of* Schizothorax curvifrons *(N=26),* S. niger *(N=10),* S. esocinus *(N=25),* S. plagiostomus *(N=24), and* S. labiatus *(N=26).*

	PC 1	PC 2	PC 3	PC 4	PC 5
SL	0.294	0.025	0.036	0.003	-0.002
Preanal length	0.294	0.024	0.047	0.003	0.005
Prepelvic length	0.291	0.009	0.042	0.002	0.006
Predorsal length	0.285	0.016	0.038	0.001	-0.001
Prepectoral length	0.293	-0.061	0.046	0.007	0.009
Head length	0.300	-0.071	0.041	0.003	0.005
Pectoral-fin length	0.291	0.080	-0.019	0.019	0.009
Pelvic-fin length	0.288	0.067	-0.021	0.017	0.004
Dorsal-fin height	0.224	0.049	-0.019	0.052	0.005
Anal-fin height	0.324	0.069	-0.043	0.032	0.014
Caudal peduncle length	0.269	0.030	0.022	0.003	-0.016
Caudal peduncle depth	0.307	0.062	-0.022	-0.019	-0.014
Body depth	0.275	0.070	0.008	-0.034	-0.036
Head depth	0.264	0.028	0.027	-0.009	0.016
Upper jaw length	0.344	-0.123	-0.047	0.010	0.008
Lower jaw length	0.341	-0.173	0.038	-0.005	0.004
Mouth width	0.339	-0.025	-0.091	-0.038	0.053
Eye diameter	0.196	-0.025	0.044	0.012	0.000
Interorbital width	0.310	0.076	0.033	-0.017	0.010
Internarial width	0.344	0.021	-0.022	-0.031	-0.013
Head width	0.271	0.038	0.023	-0.012	0.013
Snout length	0.339	-0.058	-0.039	0.022	-0.024
Nostril to snout length	0.358	-0.053	-0.061	-0.001	-0.049
Variance explained	2.068	0.099	0.037	0.010	0.009
Percentage of total variance explained	91.6	4.4	1.6	0.4	0.4

recurved posteriorly (Fig. 28). A series of enlarged scales along the anal-fin base. Scales very small, 96-108 in the lateral line (Fig. 16). Branched dorsal-fin rays 7(3), 8(22). Branched anal-fin rays 5(25). Gill rakers 8(1), 9(2), 10(3), 11(6), 12(8), 13(3), 14(1), 15(1) (Fig. 17).

Similar species in the Kashmir Valley. *Schizothorax esocinus* differs from all other Kashmir Valley *Schizothorax* in lower gill-raker number (8–15 vs. 21–28 in *S. curvifrons*, 14–19 in *S. labiatus*, 15–22 in *S. plagiostomus,* 12–18 in *S. niger*) and in the much longer jaws, without enlarged lips or tuberculate pads. Also the colour pattern is distinctive, with light ground colour and contrasting black spots in most specimens.

Material. Uri AEIA samples consist of 151 specimens of *S. esocinus*, from sites 1–2, 4–7, 10, 2B–C, 4B, 8B, and 10B. The largest sample consists of 37 specimens obtained from site 7 in 1997. The largest specimen is 390 mm SL.

Remarks. *Schizothorax esocinus* is sometimes described as 'pike-like', which is certainly not the case. Such information is misleading. It has the appearance of a *Schizothorax* with longer head and jaws (Figs 30–32; Table 8). In this respect it contrasts with all other Kashmir Valley *Schizothorax*. In a principal component analysis, Fig. 32, Table 9, *S. esocinus* stands out as highly distinctive. Most of the variation in the second component is due to the much longer jaw lengths of *S. esocinus*.

Schizothorax esocinus may be restricted in distribution to the upper Indus, including parts in Ladakh, Gilgit, the Kabul drainage and the upper Jhelum drainage. Synonymy of *Racoma nobilis* and *S. barbatus* is tentative, based on original descriptions, but seems reasonable. In describing syntypes of *S. barbatus*, Günther (1868) gave the impression of a mouth morphology similar to *S. plagiostomus*. Those types can no longer be found in the BMNH collection. The synonymy of *S. punctatus* was effectively demonstrated by Zugmayer (1910). Unlike *S. plagiostomus* and *S. labiatus*, *S.esocinus* does not seem to extend south of the Salt Range, but since *S. esocinus* is everywhere relatively scarce, it could be that its absence from Zhob, Kurram, and Punch collections are due to the limited size of those collections.

The description of *S. montanus* Zugmayer (1909), based on a 500 mm specimen from Leh (Ladakh), suggests that it may be this species, and it was already synonymised with *S. esocinus* by Wu & Wu (1991). Tilak (1987) listed several specimens of *S. esocinus* from Sheh and Chuglamsar on the upper Indus in Ladakh. We examined one specimen from Gilgit (BMNH 1880.3.15:712). Wu & Wu (1991) reported and figured *S. esocinus* from Bostan Hu in the Talimu He drainage, but we believe it may be a different species, of which several similar forms have been described from the Talimu He basin, especially since their synonym list includes *S. dayi* Herzenstein (type locality Lop-nur), considered a synonym of *S. biddulphi* Günther by Cao (1964). The taxonomy of piscivorous *Schizothorax* species, which seem to occur only in the uper Indus, Amu-darya, Syr-darja and Talimu He drainages, is in need of revision.

Bangana diplostoma (Heckel, 1838) (Figs 33–34)

Original description

Varicorhinus diplostomus Heckel, 1838:67, pl. 11 ([Fluss Tschilum und den mit ihm in Verbindung stehenden Landseen]).

Synonymy

Tylognathus valenciennesii Heckel, 1844: 378, fig. p. 378 (replacement name for *Varicorhinus diplostomus*).

Labeo microphthalmus Day, 1877a: 542, pl. 132, fig. 4 (Himalayas, from the Punjab, Murree and Kangra, also Cashmere).

Cirrhina Sindensis Day, 1872: 319 (Sind Hills).

Labeo horai Fowler, 1924: 95, fig. 8 (Sutlej River near Loodianali).

Local name. Ropput (Kashmiri).

Fig. 33.
Bangana diplostoma. *NRM 30144, male, 232 mm SL. Preserved specimen from Jhelum River, Gantamulla, downstream of Lower Jhelum Barrage, N bank (Site 6), 7 July 1994.*

Diagnostic characters. Reaches at least 30 cm SL in the Kashmir Valley. Elongate, fusiform, but with a flattened chest and belly, slighly deeper than wide. Eye small, lateral. Snout blunt, rounded, with ethmoid furrow little developed. Large specimens have a few minute white cysts in the infraorbital, ethmoid and rostral fields that appear like rudimentary tubercles. There is no obvious sexual dimorphism in tuberculation, body shape, fin shape or colour pattern.

Mouth subterminal with a rostral fold covering most or all of the upper jaw; wide, only slightly curved. Rostral fold with a few distal soft papillae in the largest specimen. No rostral barbel; a long, flattened maxillary barbel contained within the mouth corner lacuna, often with a skin flap emerging from its base and commonly resembling the maxillary barbel so much as to appear as a second barbel. Upper jaw with soft skin margin, without keratinised cutting edge, upper lip undifferentiated except at junction with lower lip, the bridging skin flap papillose internally and reverted to expose papillae. Lower lip deeply separated from lower jaw margin, its inner face with about five transverse rows of compressed, distally slightly expanded and rather firm papillae which also give the appearance of a fringed margin to the lip, although there are no soft papillae on the external face. Postlabial groove short, restricted to the lateral one-fourth of the mouth width. Lower jaw cornified cover raised dorsally, labial margin rounded in most specimens, but may also bear a sharp rostrad directed keratinised cutting edge. Pharyngeal teeth 5, 4, 2 / 2, 4, 5; shape and arrangement as in labeonins generally, densely packed, with wide, cupped crowns.

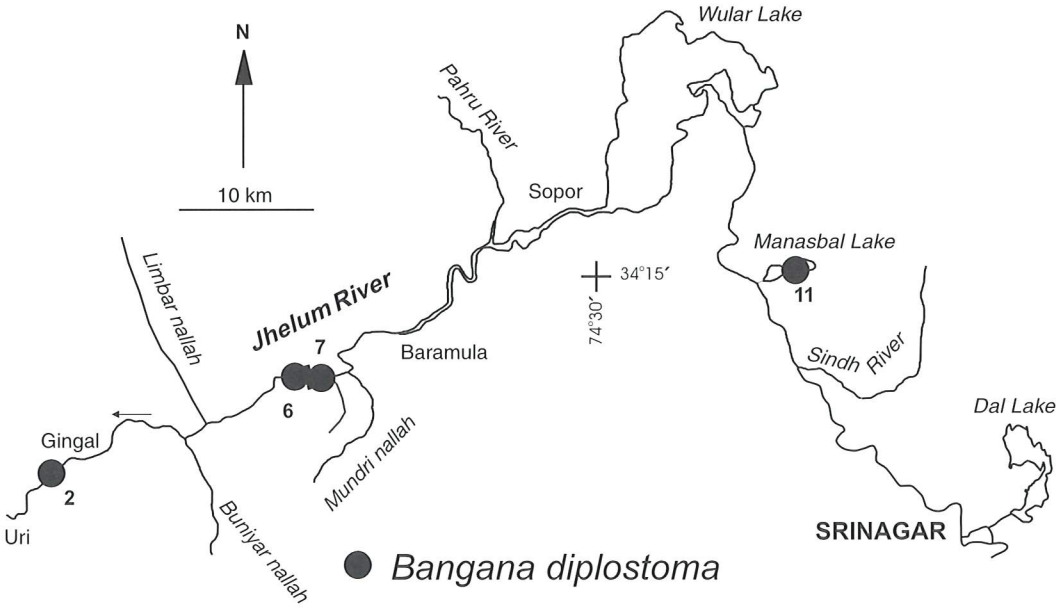

Fig. 34.
Location of sampling sites yielding Bangana diplostoma *in the Kashmir Valley Uri AEIA.*

Lateral line making very slight descent behind head, running about straight for most of its length. Lateral line scales 38(2), 39(3), 40(5), 41(1), excluding scales on caudal-fin base. Scales from dorsal-fin origin to lateral line 9–10, from lateral line to anal-fin origin 8–9. Dorsal fin inserted well in advance of vertical from pelvic-in origin; distal margin distinctly concave with unbranched ray and first two branched rays forming a long lobe which when laid back extends nearly as far back on the dorsum as the last branched ray. Branched dorsal-fin rays 10(9), 11(3). Pectoral fin extending to vertical from dorsal-fin origin. Anal fin inserted well behind vertical from base of last ray of dorsal fin; distal margin concave, anterior rays when laid back not reaching to the caudal-fin base. Branched anal-fin rays 5(12). Caudal fin deeply forked, lobes of about equal length.

Colour in preservative greyish dorsally, lighter below lateral line, to whitish along ventral midline. Head greyish, subopercle, lower limb of preopercle, lower half of cheek and most of lips, and underside of head lighter, to whitish. Fins similar in colour to adjacent body, paired fins lighter than unpaired fins. Black pigment on scale bases on, above and below about lateral line scales 4–5, forming indistinct dark blotch which are more evident in small specimens. Also a dark grey blotch on the middle of the side of the caudal peduncle, close to the caudal-fin base, is distinct in smaller specimens only. There is no particular pigmentation of the pectoral-fin base area.

Similar species in the Kashmir Valley. *Crossocheilus diplochilus* is similar in general shape and large scales (about 36 scales in the lateral row), but remains smaller, has papillae on both lips and cornified sheath much narrower. *Bangana dero*, which the Uri AEIA collected in the Sutlej, has deeper ethmoidal furrow (depression across top of snout) and numerous large acanthoid tubercles on the snout. *Labeo pangusia* in the Sutlej has much longer snout, also with numerous well developed tubercles, lacks the lateral flap of the rostral fold, and has the inner surface of the lower lip covered by costae (transverse plicae) instead of papillae. *Bangana diplostoma* can easily be distinguished from *Schizothorax* by the much larger scales (38–41 vs. more than 80 in the lateral series), and particulars of the mouth shape.

Material. *Bangana diplostoma* was collected from Manasbal Lake and two downstream sites (Fig. 34). Eighteen specimens were collected in 1990-1997, from sites 2, 6, 11, and the fish market (sites 6-7). Two are juveniles, 71.3-72.1 mm SL. The remainder are adults, 183-297 mm SL. Three other specimens were also studied, namely NRM 26964 (158 mm SL) and 12519 (163-167 mm SL), from earlier collections.

Conservation aspects and risk assessment. Compared to oreinins, *B. diplostoma* is rare in the upper Jhelum. One possible explanation may be that it shares the same spatial and trophic niches as *S. plagiostomus* and *S. labiatus*, and is found here at a higher altitude than is otherwise common for *Bangana* species. Conditions may thus be suboptimal for *B. diplostoma*. Another possibility may be that the species was abundant but migratory, and that conditions have changed so that the current Kashmir Valley population is a captive remnant of a much larger migrating population. There is no reliable information on migration in *B. diplostoma*, however. According to Raina (1988), the species he identified as *Labeo dero* from Dal Lake, would be primarily lacustrine and spawn in early summer in the lake, without migration, but would obviously move to running water over the winter.

There is little and conflicting information on the distribution of *B. diplostoma* and the species with which it is commonly confused, *B. dero*, but apparently *B. diplostoma* is widespread in the Indus drainage, and may even be present in the internal Rakhshan drainage. It is replaced by *B. dero* in the Sutlej and Himalayan rivers draining to the Ganga and Brahmaputra.

Considering the probable wider distribution in the Indus drainage, the occurrence in the Jhelum is not critical to the survival of the species. The low frequency in catches suggests also that *B. diplostoma* may not be critical to the fish communities along the sector of the Jhelum examined. The low frequency, however, also suggests that *B. diplostoma* may show a stronger initial reaction to changes in the environmental conditions than commoner species.

Remarks. No sexual dimorphism was found in our material of *B. dero* or *B. diplostoma*. This is contrary to observations by Hora & Misra (1936) who found more snout tubercles and longer anterior dorsal-fin rays in male *B. dero* from near Dehra Dun, Ganga basin. Their material consisted of 9 males, 158-238 mm, and 8 females, 137–160 mm, suggesting that development of tubercles and dorsal fin may be size-related as well. Among the Jhelum *B. diplostoma*, snout tuberculation appears better developed in the larger specimens.

There is no information concerning the precise type locality of *B. diplostoma*. Heckel (1838) did not mention a specific locality or local name. The single specimen could have come from waters downstream of the Kashmir

Valley. The present specimens agree very well with Heckel's (1838) description and with a photo of the holotype (NMW 48829).

Bangana diplostoma was first described in the genus *Varicorhinus* Rüppell. This genus as currently understood consists of mostly large-scaled cyprinins with a sharp cutting edge to the lower jaw but without a lower lip. All *Varicorhinus* species are African, but numerous Asian and Middle East cyprinids have been referred to *Varicorhinus* at some point or another. Heckel (1843) erected the genus and Bleeker (1863a: 25, 1863b: 194) later made *diplostoma* the type species of *Tylognathus*, a name that was subsequently used mostly for various South East Asian species. Most authors after Heckel instead placed *diplostoma* in *Labeo* Cuvier, distributed over Africa and South Asia. The African species of *Labeo* were revised by McGregor Reid (1985), who made some comparisons with Asian *Labeo*, and among other things pointed out the distinctness and validity of *Tylognathus*, with *diplostoma* as type species, and included other Asian species such as *Cyprinus dero*. We agree with McGregor Reid (1985) to the extent that *diplostoma* and *dero* are distinct from *Labeo*. However, *Bangana* Hamilton (1822), with *dero* as type species (designated by Jordan & Evermann, 1917: 115), and rehabilitated by Kottleat (1984), has priority over *Tylognathus*. The genus includes labeonines of a generally slender shape with 10–11 branched dorsal-fin rays, lacking rostral barbels, having a rostral fold with short lateral flap, a heavily cornified lower jaw with a keratinised cutting edge, and a postlabial groove of very short, lateral extension. The genus is widely distributed, found from the Indus westward to the Mekong drainage, and southward in India to at least the Kaveri and Vaigai drainages.

There is no implication in Hamilton (1822) as to the gender of *Bangana*. The name is derived from the Bengali *bhanggon* or *bhanggan*, used locally for species of the fish family Mugilidae (Hamilton, 1822; see also Venkateswarlu, 1984: 48–49, spelt *bhangan* and *bhangon*), and rendered *banggana* in one place by Hamilton (1822:277). Variants *bhangonbata, bhanga, bhangnan-bata, bhanganbata, bhanga* and *bhangan* are, however, given as Bengali names of *Bangana bata* (Hamilton) and to some extent *B. boga* (Hamilton) by Shaw & Shebbeare (1938), Venkateswarlu (1984), Rahman (1989), and Talwar & Jhingran (1991). *Bangana* has thus been modified from the original Bengali, and must be treated as feminine, having a natural feminine Latin ending (ICZN, Article 30(d)). Even if *Bangana* is considered as badly transcripted Bengali, this language does not use gender, and consequently ICZN Article 30(c) does not apply.

The species eithet *diplostomus* is based on the Greek words διπλοοζ, double, and στομα, mouth. We interpret the ending *-us* as a Latin adjectivisation, with the alternative endings *–a*, and *–um*. As *Bangana* is feminine, the name then becomes *B. diplostoma*.

Bengana and *Bengala* as used by Gray (1832) are misspellings of *Bengana*, but were misunderstood as generic names by Jordan & Evermann (1917) and Eschmeyer & Bailey (1990). 'Bengana Gray', type species 'Cyprinus (Bengana) falcata Gray' (actually *Cyprinus falcatus* Bloch), of Eschmeyer & Bailey (1990) is thus not available. The oldest available generic name for *Cyprinus (Bangana) elanga* Hamilton is *Megarasbora* Günther, 1868, not 'Bengala Gray'.

Gymnostomus Heckel (1843) (type species *Cyprinus ariza* Buchanan, 1807) is apparently a junior synonym of *Bangana*. No types are known of *B. ariza*, which was described in a report on fishes from a site in the upper Kaveri drainage, but which was indicated to have a wider distribution in the rivers of southern India. Buchanan (1807) even provided the Bengali name *Bangun Batta*. Judging from the figure and the mention in the diagnosis of the ridge on the lower jaw, it is certainly a *Bangana* species. The name is applied by Indian ichthyologists to a *Bangana* species from southern India (Talwar & Jhingran, 1991) of which we examined specimens from the Vaigai (NRM 14578, 30665-30666) and Kaveri (NRM 41305) drainages. *Incisilabeo* Fowler (1937) (type species *Labeo behri* Fowler) is another synonym of *Bangana*.

Day (1877a) used the name *Labeo diplostomus* for the Brahmaputra-Ganga species that should better be referred to as *Bangana dero*. Apparently later authors have been of the impression that *B. diplostoma* would be a senior synonym of *Labeo dero*, and cite *Labeo diplostomus* from Day (Talwar & Jhingran, 1991; Wu & Wu, 1992). It is difficult to judge the geographical distribution of *B. diplostoma* on the basis of available literature; however, the species may be widely distributed in the Indus drainage. *Labeo microphthalmus* is based mainly on the *Labeo diplostomus* reported by Beavan (1872) from Rawalpindi, and we confirm the synonymy on the basis of examination Beavan's specimen (syntype, BMNH 1872.1.30:2, 131 mm SL). We also synonymise *Labeo sindensis*, after examining a syntype (BMNH 1889.2.1: 253, 175.2 mm SL). *Labeo horai*, from near Ludhiana on the upper Sutlej, appears to be *B.*

diplostoma on the basis of the detailed description and figure, but the identity needs to be verified from the holotype.

Labeo gedrosicus Zugmayer (1912), from Panjgur, Pakistan, appears from the description to be a *Bangana* species, very similar to *B. diplostoma*. It would have 14 rather than 17 pectoral-fin rays and 6-7 instead of 5 anal-fin rays. It is confusing that Zugmayer (1913) reported *Bangana diplostoma* as syntopic in the Rakhshan River at Panjgur and with characters such as 'horizontal stripe and vertical bars'. Mirza (1972) and Coad (1996) listed *B. dero* (including *B. diplostoma*) from Baluchistan, but *L. gedrosicus* seems not to have been collected since Zugmayer.

Hora (1936a) described the differences between *Labeo dero* and *L. dyocheilus* (=*L. pangusia*) in considerable detail, correcting earlier misidentifications by Mukerji (1934) and Hora & Mukerji (1936), and described the Myanmar form as *L. devdevi*. Hora insisted on retaining the name *Labeo diplostomus* for two Kashmir specimens (the same as those reported by Mukerji, 1936), but was unable to suggest any diagnostic characters. Mukerji (1936) examined about the same material of *L. dero*, and including the same two specimens from Srinagar and Pampur respectively, but used the name *L. diplostomus* merely following Day.

Bangana diplostoma as herein understood may differ from *B. dero* only in the much shallower ethmoidal furrow and much reduced snout tubercles. We have not found any morphometric or meristic differences and the colour pattern appears to be the same.

Bangana dero is reliably reported from along the southern slope of the Himalayas, from Abor Hills (Arunachal Pradesh) west to Dehra Dun (Uttar Pradesh) (Hora, 1936a), and in our collection even from Sutlej (p. 153). The only possible *B. dero* that we have been able to examine from the Indus drainage except for specimens from Shimla, is a skin labeled Peshowar, BMNH 1843.2.25:41, apparently from Griffith's collection. *Labeo nigripinnis* (Day, 1877a), described from Sind, is a *Bangana* species, possibly small *B. dero*, but may also be a distinct species, having only 35-36 instead of at least 38 lateral line scales (examined syntypes BMNH 1889.2.1: 244–249, 40.4–152.4 mm SL). Mirza (1977) emphasised the synonymy of *B. diplostoma* with *B. dero*, and it is therefore uncertain whether *B. dero* reported from Pakistan are *B. dero* or *B. diplostoma*, but the numerous reports of *B. dero* from Pakistan are probably mainly or only for *B. diplostoma*.

Mirza (1975) listed 15 *Labeo* species from Pakistan and Coad (1981) listed *L. dero*, *L. diplostomus*, *L. angra* (Hamilton), *L. dyocheilus*, *L. gonius* (Hamilton) and *L. pangusia* from the Kabul River in Afghanistan, obviously based on literature records only.

Crossocheilus diplochilus (Heckel, 1838) (Figs 35–36)

Original description

Barbus diplochilus Heckel, 1838: 53, pl. 10, fig. 1 (Caschmir).

Synonyms

Tylognathus barbatulus Heckel, 1844: 376, fig. p. 376 (replacement name for *Barbus diplochilus* Heckel).

?Labeo macmahoni Zugmayer, 1912: 597 (Dasht River, near Suntsar and Turbat).

Discognathus adiscus Annandale, 1919: 68, pl. 10, fig. 2 (Seistan).

Crossochilus latius punjabensis Mukerji, 1934: 53 (Katas Nallah, Salt Range and Khewra Gorge (about 2,000 ft. elevation)).

Local name. Tetther (Kashmiri).

Diagnostic characters. A small species, reaching approximately 130 mm SL. Elongate, fusiform, but with a flattened chest and belly. Eyes dorsolateral. Shallow but distinct ethmoidal furrow; deep rhinal furrow immediately posterior to base of rostral barbel. Barbels two pairs, rostral and maxillary, both short. Tubercles minute, concentrated to infraorbital field. Mouth inferior, broad. Upper jaw without lip except in corner of mouth where upper lip and lateral division of lower lip joining in an expanded and tuberculate pad; a transverse band of minute rostrocaudally elongate short papillated fields along external margin of each jaw. Rostral fold usually leaving upper jaw margin well exposed; without lateral lobe; rostral margin of fold fringed, with wide, flattened, digitiform, extensively papillated projections. Median division of lower lip narrowly separated from lower jaw, thick and extensively papillose, with indistinct transverse postlabial groove; lateral margins approximately parallel and width not coextensive with mouth width. Upper jaw with narrow cornified and keratinous cover which not forming sharp edge; lower jaw with moderately thick cornified cover and keratinous surface, which also does not form a sharp edge.

Lateral line complete, running in a straight line from head to caudal fin; comprising 35-36 scales, plus two scales on caudal fin. Scales in transverse row 5 above, 4 below lateral line.

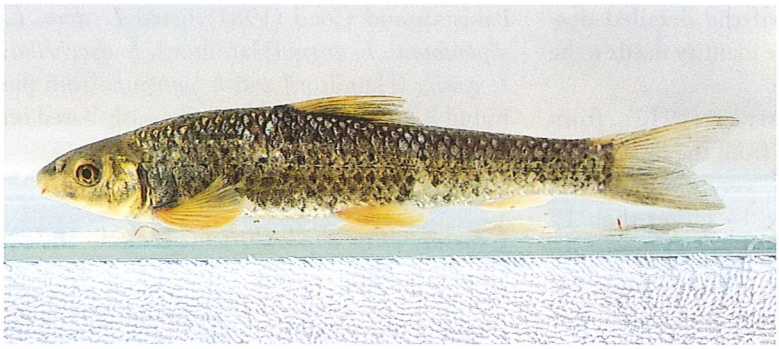

Fig. 35. *Crossocheilus diplochilus. NRM 37361, 116.5 mm SL. Living specimen, freshly captured from Jhelum River downstream of Gantamulla, just upstream of Chala Bridge (Site 5), 20 October 1997.*

Dorsal fin concave, with long anterior lobe; branched rays 8. Anal fin notably short, also concave, with last unbranched ray longest; branched anal-fin rays 5. Caudal fin deeply emarginate. Pectoral fin with 13–15 branched rays.

Colour brownish or greyish, belly and abdomen whitish; usually with a broad darker stripe along the side, more common and evident in small than in large specimens. Well preserved specimens show clearly a pattern consisting of a dark spot on each scale leaving the scale margin light, more evident on scales ventrally on the side and giving the overall impression of horizontal stripes. There are no blotches in the humeral region or on the caudal peduncle. The lower lobe of the caudal fin is marked by a diffuse, large dark blotch.

Similar species in the Kashmir Valley. *Bangana diplostoma* is similar in general shape and large scales (but with about 40 scales in the lateral line), but grows much larger. It has a smooth margin to the rostral fold, and lacks rostral barbels. It also has a dark humeral blotch and dark blotch on the caudal peduncle.

Material. *Crossocheilus diplochilus* appears to be ubiquitous and abundant in the area (Fig. 36). 1150 specimens were obtained in total from sampling sites 1–2, 4–8, 10–11, 2B–C, 6B, 8B, and 10B, i.e., along the mainstream Jhelum and in Manasbal and Wular lakes. 600 specimens were taken in Wular Lake on one occasion in November 1990, and the species is well represented in other lake samples. Four more specimens are available from Dal and Anchar Lakes, collected in 1952. Most of the Uri AEIA specimens are less than 100 mm long. The largest specimen is 128.6 mm SL.

Conservation aspects and risk assessment. *Crossocheilus diplochilus* is abundant in the Uri AEIA samples, apparently preferring lakes and main river banks, and not ascending cold-water tributaries. Thus, *C. diplochilus* may be restricted to an area strongly influenced by both the new Mohra Dam and urban pollution. It is not known to make long migrations, but the mouth structure, and benthic habits suggest that it is primarily a lotic species feeding from epilithic growth and the abundance in Wular Lake may be opportunistic. Koul (1988), however, reported the species to spawn from June to mid-July in vegetation in slow running streams, canals feeding paddy fields, and in shallow pools of water. *Crossocheilus* may be negatively affected by the construction of the Mohra Dam which reduces the extent of suitable running water habitats. On the other hand, the population seems to be strong, and remaining areas sufficient to maintain the species. It would be desirable to investigate possible annual migration in and out of lakes to better understand the

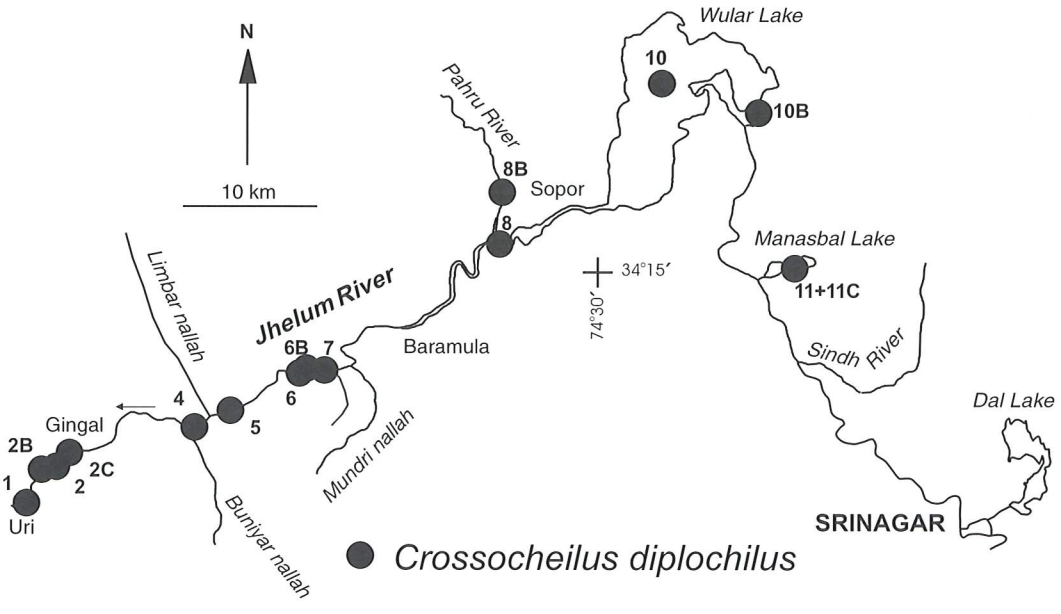

Fig. 36. *Location of sampling sites yielding* Crossocheilus diplochilus *in the Kashmir Valley Uri AEIA.*

dependence of the species on different habitats. There are no summer collections from lakes. Information from collections outside the Kashmir Valley suggests that *C. diplochilus* is fairly widespread and abundant in suitable localities.

Remarks. Generic classification of this species is highly uncertain and subject to revision. Most current literature (e.g., Banarescu, 1986; Talwar & Jhingran, 1991) place *Crossocheilus diplocheilus* in *Crossocheilus* Kuhl & van Hasselt, 1823 (type species *C. oblongus* Kuhl & van Hasselt, 1823, designated by Bleeker, 1863a: 24, 1863b: 192). We examined specimens of several South East Asian *Crossocheilus* species, including the type species, and cannot confirm co-generic status.

Among other differences, *Crossocheilus oblongus* lacks maxillary barbels, and the lower jaw appears receded into a ventral depression of the snout, which is also much longer than in *C. diplochilus;* the thickened tissue covering the lower jaw is widened rostrally and deeply separated from the lower jaw; the upper lip is free from the upper jaw and margined with minute projections, whereas in *C. diplochilus* the skin covering of the upper jaw is very thin and does not develop into a lip except at the corner of the mouth. There is a distinct lateral lobe to the rostral fold unlike in *C. diplochilus*.

We have not been able to examine specimens of *Tariqilabeo macmahoni* (Zugmayer, 1912) from the Dahst River on the coast of Pakistan. It is the type species of the monotypic genus *Tariqilabeo* Mirza & Saboohi (1990). Zugmayer's (1912, 1913) description of the species strongly suggests *Crossocheilus diplochilus*, and Mirza & Saboohi's (1990) diagnosis of *Tariqilabeo* does not preclude the possibility.

If *T. macmahoni* would turn out to be generically distinct from *C. diplochilus*, *Gonorhynchus* McClelland (1838) may be an alternative generic name. Most authors may have confused *Gonorhynchus* McClelland with *Gonorynchus* Scopoli, 1777 (for a genus of marine fishes, Gonorynchidae), as both are apparently inspired by the pre-Linnaean name Gonorhynchus from Gronovius (1763); and still others, e.g., Jordan & Evermann (1917) and Eschmeyer & Bailey (1990: 166) dated *Gonorhynchus* McClelland from M'Clelland (1839). McClelland (1838) gave no clear indication of author or species included in *Gonorhynchus*. A number of species were mentioned in M'Clelland (1839), however. The type species was designated by Jordan & Evermann (1917) as *Gonorhynchus brevis* M'Clelland, an unnecessary replacement name for *Cyprinus gohama* Hamilton, 1822 (and *dyangra*, Hamilton MS name), which is usually considered a synonym of *Crossocheilus latius* (Hamilton).

Our reasons for not assigning *C. diplochilus* to *Gonorhynchus* herein are that the status of *C. gohama* and *C. latius* still has to be worked out, and that preliminary findings do not provide unequivocal evidence that *C. diplochilus* is closely related to *C. gohama* or *C. latius*, or that the latter two are definitely distinct from *Crossocheilus* s. str. In synonymising *C. gohama* under *C. latius* Day (1877a: 548) acted as the first reviser and gave priority to *C. latius*, which name should be used if the two are considered conspecific, even though he expressed the reverse opinion soon afterwards (Day, 1878b: 11).

Although *Crossocheilus diplochilus* is usually regarded as a synonym or subspecies of *Crossocheilus latius* (type locality Tista River), they are strikingly distinct in general appearance as already demonstrated by Mukerji (1934) and Hora & Misra (1938: Plate II).

Bianco & Banarescu's (1982) synonymisation of *Discognathus adiscus*, described from Seistan, with *C. diplocheilus* is confirmed by examination of two syntypes (BMNH 1919.3.16: 7-8). *Hemigarra elegans* (Günther, 1868), from the Euphrates River, with which *D. adiscus* was synonymised by Karaman (1971) and Coad (1981), is a distinct species (examined syntypes, BMNH 1850.10.21:31-35). Among other characters, *H. elegans* has an entire instead of fringed rostral fold and lacks scales on the chest.

Silas (1960) synonymised *Crossocheilus punjabensis* with *C. diplochilus*.

Crossocheilus diplochilus appears to be widely distributed in the hill streams of the Indus drainage in Pakistan, Afghanistan and India, extending also into Iranian Seistan and into the coastal drainage of Bahu Kalat in Pakistan (Mirza, 1975; Banarescu, 1986; Coad, 1996; Das & Nath, 1971).

Botia birdi Chaudhuri, 1909 (Figs 37–38)

Original description

Botia birdi Chaudhuri, 1909: 339 (Rupar, where the Sirhind Canal diverges from the Sutlej).

Synonymy

Botia javedi Mirza & Syed, 1995: 379, fig. p. 379 (Michni 34°.11'N, 71°.28'E (about 24 km north of Peshawar), Kabul river drainage).

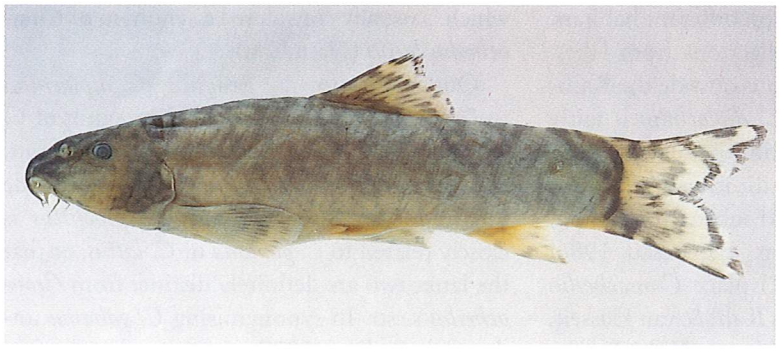

Fig. 37.
Botia birdi. *NRM 36920, 87.9 mm SL. Preserved specimen from Dal Lake, collected 27 October 1997.*

Local name. Rama gurun (Kashmiri).

Diagnostic characters. Kashmir Valley specimens examined are up to 110 mm SL. Body elongate, strongly compressed laterally. Young yellowish, with conspicuous colour pattern of brown elliptical looped bands across dorsum, and bars or blotches along side. Adults with fine dark reticulated pattern on sides, and contrasted dark stripes on unpaired fins. A bifid preorbital spine just in front of eye. Caudal fin deeply emarginate. Four pairs of short barbels, of which two rostral, one maxillary and one mandibular. The scales are very small, not obvious without magnification. Branched dorsal-fin rays 8–9; branched anal-fin rays 5; pectoral-fin rays 14; branched pelvic-fin rays 6.

Similar species in the Kashmir Valley. *Botia birdi* is similar to the balitorids in small size, elongate shape, and small, barbel-margined mouth. It can be distinguished in particular by the completely scaled body, presence of mandibular barbels, prominent preorbital spine, the longer branch of which is as long as the eye, and its peculiar colour pattern with large brown circles and bars.

Material. Only three specimens of *B. birdi* were obtained by the Uri AEIA, 30.6–99.4 mm SL, sampled from sites 7–8, and from Dal Lake (Fig. 38).

Conservation aspects and risk assessment. Only a few specimens of *B. birdi* were obtained by the Uri AEIA. The species may, however, be abundant in the Kashmir Valley lakes, which were not thoroughly surveyed. *Botia birdi* is apparently widespread in the Indus drainage. Nearly no information is available on the biology of the species, but it is a benthic bottom feeder and obviously prefers lentic habitats. The species is not expected to make major migrations. Koul (1988), however, reports it to migrate from the lakes into the Jhelum to breed on sandy beds in July-August. Koul noted that unspent fish was caught in large quantities, and that the population might suffer from this practise. We do not find reason to consider any negative effects on the species as a whole or the local population from the Uri hydroelectric power project.

Remarks. *Botia birdi* was first reported from Kashmir by Day (1878a: 606, as *B. almorhae*), and as *B. birdi* first by Hora (1922b). Few specimens were obtained by the Uri AEIA (Fig. 38), and the species may be more common in lakes (cf. Saxena & Koul, 1966).

Both young and adult specimens of *B. birdi* strongly resemble *Botia almorhae* Gray (1831) from Almora, Uttar Pradesh, Ganga drainage. The same or similar species are reported from a large part of northern India and Pakistan, commonly under the name of *B. lohachata* Chaudhuri, 1912, described from Bihar

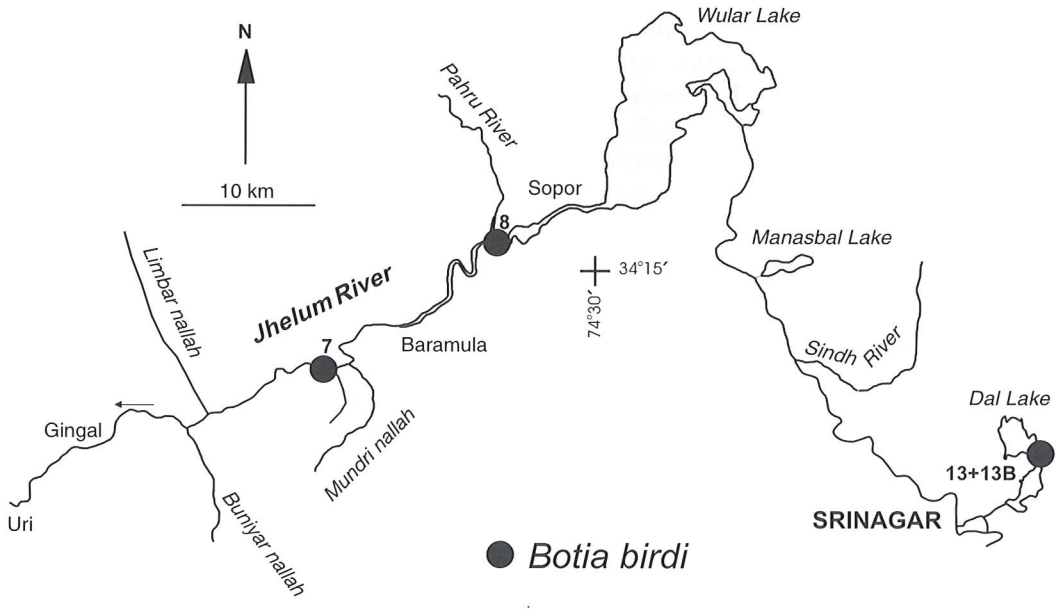

Fig. 38.
Location of sampling sites yielding Botia birdi *in the Kashmir Valley Uri AEIA.*

(Menon, 1993, Talwar & Jhingran, 1991, Misra, 1975). Menon (1993) synonymised *B. lohachata* with *B. almorhae*, and distinguished *B. birdi* as having a shorter pelvic fin, not reaching to the anal-fin origin and shorter anal fin not reaching to the caudal-fin base. Menon's (1993) various figures of specimens identified as *B. almorhae* and *B. birdi* show the pelvic fin mostly not reaching the anal-fin origin and in at least one of the *B. birdi* the anal fin reaches to the caudal-fin base (Menon, 1993: plate 7, fig. 5). *Botia javedi* Mirza & Syed (1995) is apparently based on a very large (15.5 cm SL) male specimen of *B. birdi*. It is described as having the pelvic fin not reaching to the vent and the anal fin almost reaching to the caudal-fin base.

We examined the holotype of *B. almorhae* (BMNH uncatalogued, 144.6 mm SL), additional series of *B. birdi* from the Kashmir Valley in the BMNH collection (BMNH 1956.4.12: 1–2. 3–4, 5–6 from Tahl Bel nallah, Chattabal and Dal Lake in the Kashmir Valley; BMNH 1872.4.17: 27 from Kashmir), and similar fishes from Almora (BMNH 1889.2.1: 1492–3), Bengal (BMNH uncat., 1872.4.17: 104) and Chachar Stream (BMNH 1891.9.14: 35), and believe *B. birdi* to be distinct from *B. almorhae*, although a more in-depth comparative study is called for. Unfortunately, most of these specimens are in a poor state of preservation, and colour pattern details could not be studied. The only large specimen of *B. birdi* obtained by the Uri AEIA is also discoloured (Fig. 37). Mirza & Syed (1995) described the 15.5 cm SL holotype of *B. javedi* as brown dorsally, cream coloured ventrally, without stripes on the body, but all fins with stripes. Chaudhuri (1909) described the dorsum of the syntypes (12.4–13.3 cm long) as 'variegated by irregular elliptical loops of brownish black; these loops send down broad brownish black bands on each side, but all these bands stop short of the ventral surface and sometimes interlace with each other'.

Botia birdi (Indus drainage) has shorter fins than *B. almorhae* (Ganga drainage), especially the pectoral fin which does not reach to the vertical from the dorsal-fin origin (vs. to or beyond), is somewhat deeper in overall aspect, and never develops the characteristic reticulate pattern of very small light spots in brown network, usually in horizontal rows, as typical of *B. almorhae* (Ganga drainage). We thus retain the name *B. birdi* here. We note, however, that males seem to have longer fins than females of the same size, and the fin-length difference needs to be studied using larger samples. In female *B. almorhae* the pelvic fin does not reach to the anal-fin origin, and the anal fin does not reach to the caudal-fin base. Although Menon recorded *B. birdi* only from Kashmir and Kangra Valleys (Sutlej drainage), it obviously has a wider distribution including the Kabul drainage and perhaps a wider portion of the Indus plains (cf. Mirza, 1975). It was reported from the Kishen Ganga by Mirza & Ejaz (1992).

Chaudhuri (1909) considered his specimens, the largest 13.3 cm long (probably total length) as 'young', remarking that 'full-sized ones weigh up to 1 1/2 lb. each'.

Schistura punjabensis (Hora, 1923) (Figs 39–40)

Original description

Nemachilus punjabensis Hora, 1923b: 384, fig.3 (Pind Dadan Khan Tehsil of the Jhelum District).

Synonymy

Noemacheilus sargandensis paludani Banarescu & Nalbant, 1966: 167, fig. 9 (small tributary of Pech River, Kabul River drainage, at Gusalek, NE Afghanistan).

Noemacheilus alepidotus nalbanti Banarescu & Mirza, 1972: 121, pl. 1, fig. 1 (Rawlakot, Azad Kashmir, Jhelum drainage).

Local name. Ara gurun (Kashmiri).

Diagnostic characters. Reaches about 80 mm SL in the Kashmir Valley. Elongate, with the caudal peduncle about as deep as the rest of the body, and a low crest dorsally extending a short distance rostrad from the caudal-fin base. Eyes high on the head. In larger specimens upper jaw with median, truncate projection, and lower jaw markedly concave symphysially. Scales absent. Lateral line extending only to above the anal fin. Mouth inferior, with thick lips. Barbels three pairs, of which two rostral, one maxillary. Branched dorsal-fin rays 7; branched anal-fin rays 5. Caudal fin emarginate. Brownish with about 9–10 dark vertical bars. Dorsal and caudal fins with rows of small spots, and a black spot at base of anterior dorsal-fin rays.

Similar species in the Kashmir Valley. Similar only to other loaches. *Botia birdi* has a contrasted pattern of wide brown stripes forming circles blotches and bars and the body covered with scales. *Triplophysa kashmirensis* has a complete lateral line reaching to the caudal fin, and an irregular pattern of blotches instead of vertical bars. *Triplophysa marmorata* has a

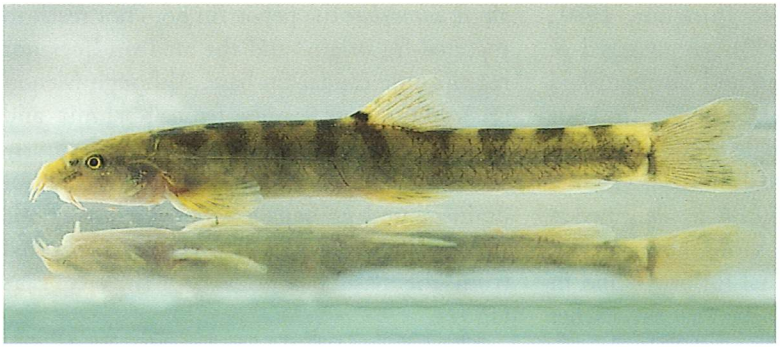

Fig. 39.
Schistura punjabensis. *NRM 40133, 55.5 mm SL. Living specimen, freshly captured from Buniyar nallah about 300m upstream of mouth (Site 3C), 25 October 1997.*

shorter lateral line, not extending beyond the dorsal fin, and an irregular blotchy colour pattern instead of vertical bars.

Material. Altogether, the Uri AEIA obtained 106 specimens from sites 1–2. 4–7, 2B, 3A–C, 7A–B, i.e., all running water and in or close to the mainstream Jhelum downstream of Baramula. The largest specimen is 79.7 mm SL; most specimens are smaller than 60 mm SL. Most samples are small, 1–5 specimens. The largest sample consists of 22 specimens from a small Jhelum tributary near Gingal (site 2B), and the next largest sample (12 specimens) is from the same place.

Conservation aspects and risk assessment. *Schistura punjabensis* is relatively abundant in the lower part of the Kashmir Valley and apparently widespread in hillstreams surrounding the northern Indus plain. Although the biology of the species remains little known, it is not indicated as a migrating species. The species is strictly lentic, and occurs chiefly in the area affected by the Mohra Dam. Impoundment of the river may affect the species negatively. It may be unable to ascend the fish ladder, but will probably maintain reproducing populations in various small streams.

Remarks. *Schistura punjabensis* is common in the lower part of the Kashmir Valley (Fig. 40). Day was the first to report the species from Kashmir, first as *Nemacheilus rupecola* (McClelland) (Day, 1877b: 799, 1878b: 19) then as *N. spilopterus* (Day 1878a). Specimens are deposited in the Natural History Museum, London (BMNH 1889.2.1:1700–2, Kashmir). Day's figure (1878a: pl. 153, fig. 9), however, shows and is captioned *S. rupecula* McClelland.

The taxonomic status of the more than 20 *Schistura* species described from the Indus drainage is in serious need of revision. Mirza *et al.* (1981) considered four scaleless *Schistura* species in the upper Indus in Pakistan, viz. *S. alepidota* (Mirza & Banarescu, 1970), *S. pakistanica* (Mirza & Banarescu, 1969), *S. nalbanti* (Banarescu & Mirza, 1972) and *S. paludani* (Banarescu & Nalbant, 1966). *Schistura punjabensis* is shown with a symbol on the lower Jhelum in Pakistan on their map 4, but it is not otherwise mentioned in the paper.

Hora (1923b) gave a detailed description and excellent figure of *N. punjabensis*. Our examination of a paratype of *Schistura nalbanti* (BMNH 1977.7.5:2) from Rawlakot on the India-Pakistan border downstream of the Kashmir Valley, confirms Menon's (1987) synonymisation with *S. punjabensis*. Mirza *et al.* (1981) separated *Schistura paludani* from *S. nalbanti* (=*S. punjabensis*) by stronger adipose crest, continuous dark stripe on caudal-fin base, and different body proportions. The crest develop-

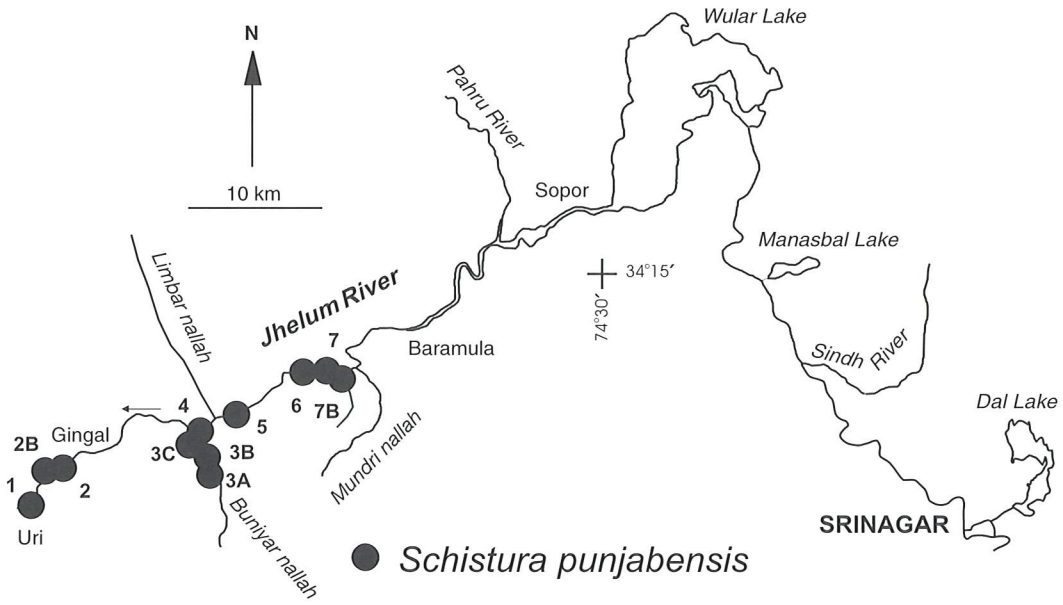

Fig. 40.
Location of sampling sites yielding Schistura punjabensis *in the Kashmir Valley Uri AEIA.*

ment varies widely within the large sample of *S. punjabensis* from Kashmir Valley, and the dark stripe across the caudal fin base is very variable, continuous or interrupted. The only proportional difference appearing in Mirza *et al.*'s list of distinguishing proportional measurements would be the eye diameter (50–56% of interorbital width in *S. paludani*, 57.5–66.7% in *S. nalbanti*). In small Kashmir Valley specimens, less than 50 mm SL, the eye diameter is nearly equal to the interorbital width, but the latter becomes proportionally wider in larger specimens, so the eye diameter is about 75–80% of the interorbital width in specimens over 60 mm SL. We believe, however, that our methods of measuring eye diameter and interorbital width may be different from those of Mirza *et al.* (1981). The type locality of *S. paludani* thus seems to extend the distribution of *S. punjabensis* into the Kabul drainage. Mirza & Ejaz (1992) reported *S. nalbanti* from the Kishen Ganga, and Das & Nath (1971) listed the species from the Punch River. Mirza *et al.* (1994) reported *S. punjabensis* from as far west as the Zhob drainage in NW Pakistan.

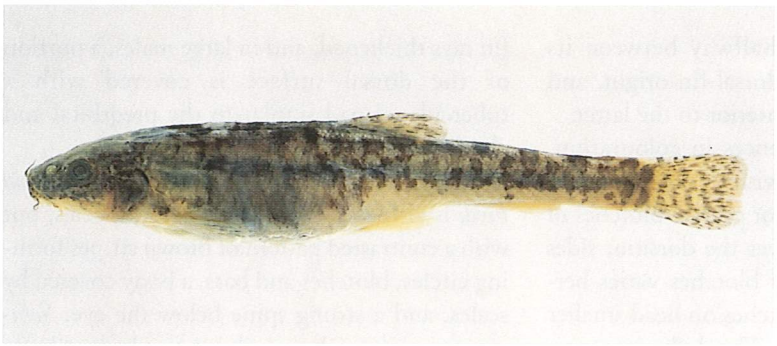

Fig. 41.
Triplophysa marmorata, *NRM 41244, female, 71.8 mm SL. Preserved specimen from Wular Lake (Site 10), collected 26 November 1990.*

Triplophysa marmorata (Heckel, 1838) (Figs 41–44)

Original description

Cobitis marmorata Heckel, 1838: 76, pl. 12, fig. 1 (Caschmir).

Synonymy

Cobitis vittata Heckel, 1838: 80, pl. 12, fig. 3 (Caschmir).

? *Nemachilus griffithi* var. *afghana* Hora, 1935: 797, fig. 4c (springs at Sar-i-Chasma; Chahiltran stream).

Local names. Ara gurun (Kashmiri).

Diagnostic characters. Reaches 112 mm SL in the Kashmir Valley. Elongate, with eyes high on head, mouth inferior. Scales absent. Barbels two rostral, one maxillary pair. Branched dorsal-fin rays 7(18). Dorsal-fin origin equidistant between tip of snout and caudal-fin base in most specimens; predorsal distance distinctly shorter in three specimens, and distinctly longer in one specimen. Branched anal-fin rays 5(17), 6(1). Pelvic fin inserted slightly posterior to vertical from dorsal-fin origin, reaching to vent, but never to anal-fin origin. Pectoral-fin rays 8(1), 9(8), 10(5). The caudal fin in small specimens (27.8-36.5 mm SL) is slightly emarginate, with the upper lobe slightly longer. In most adults truncate or subtruncate, although in some the upper lobe slightly longer. Only in one female, 72.7 mm SL, the caudal fin has a slightly convex hind margin. Lateral line short,

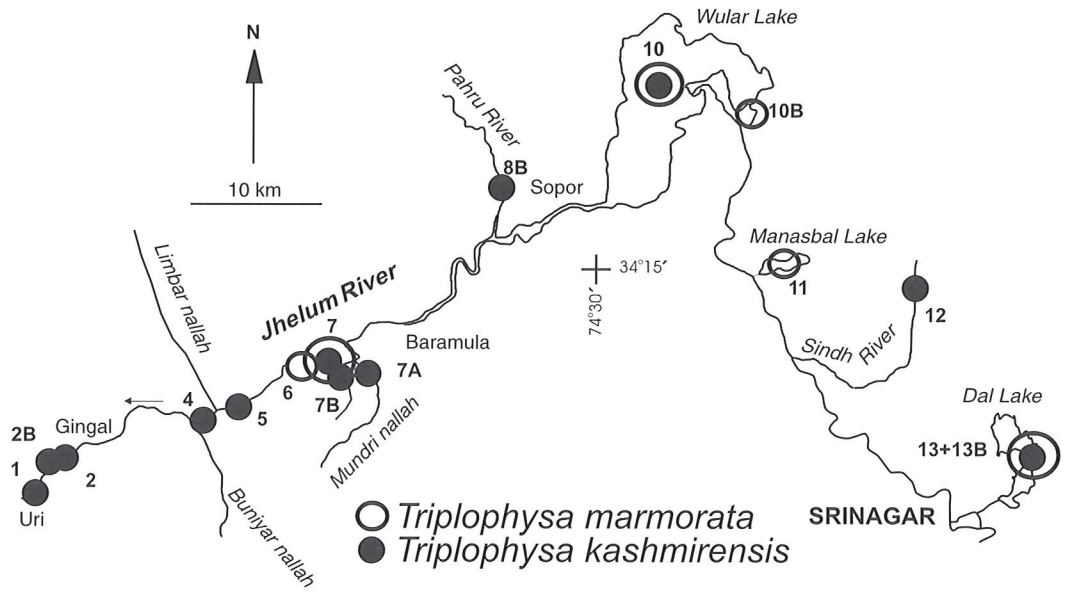

Fig. 42.
Location of sampling sites yielding Triplophysa marmorata *and* T. kashmirensis *in the Kashmir Valley Uri AEIA.*

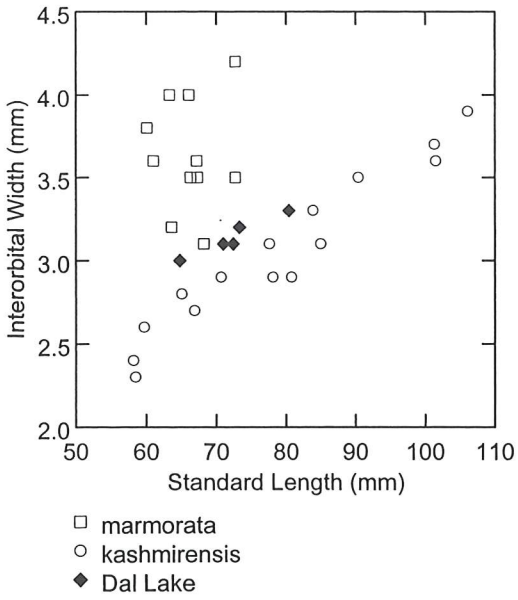

Fig. 43.
Triplophysa marmorata *and* T. kashmirensis. *Interorbital width plotted against SL to show wider interorbital space of* T. marmorata. *Black diamonds are* T. kashmirensis *from Dal Lake.*

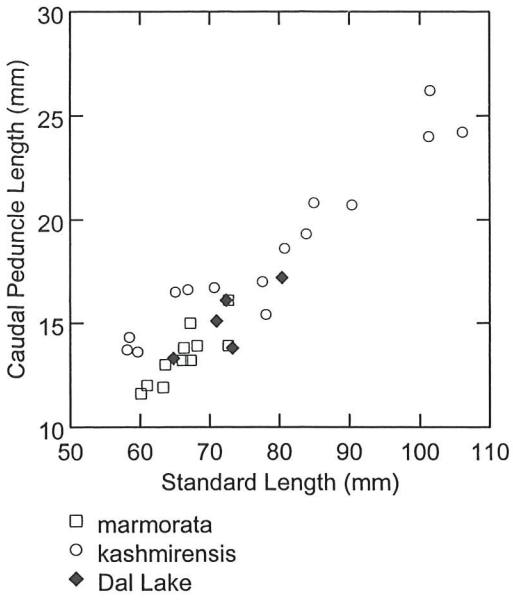

Fig. 44.
Triplophysa marmorata *and* T. kashmirensis. *Caudal peduncle length plotted against SL to show average longer caudal peduncle of* T. kashmirensis *from running water. Black diamonds are* T. kashmirensis *from Dal Lake.*

usually extending only halfway between its origin and vertical from dorsal-fin origin, and always terminating well anterior to the latter.

No obvious sex differences in colouration. Ground colour pale yellowish or whitish. Markings consist of brownish or greyish blotches of different sizes scattered over the dorsum, sides and head. Average size of blotches varies between individuals, and blotches on head smaller than on sides and dorsum. The dark pigmentation is often concentrated to form an indistinct stripe along the middle of the side, and usually there are up to four dark cross bars on the dorsum anterior to the dorsal fin and also up to four dark cross bars dorsally on the caudal peduncle. These cross bars are discernible only in dorsal view. Blackish blotch dorsally on the caudal-fin base usually not distinct. Dorsal fin with three rows of dark spots crossing the rays; three spots on the anterior margin and a spot at the base of the third unbranched ray particularly distinct. Pectoral fin with dark spots on dorsal aspect, usually arranged in three rows. Pelvic and anal fins without dark pigment. Caudal fin with up to six vertical rows of dark spots. The spots on the caudal fin vary in size and darkness between individuals.

Males have an elevated pad of thick skin extending between the eye and mouth, and another on the cheek, the two pads separated by the exposed preorbital lateralis canal. In large males pads are covered with sharp conical tubercles. Males also have the middle pectoral-fin rays thickened, and in large males, a portion of the dorsal surface is covered with a tuberculated pad similar to the preorbital and cheek pads.

Similar species in the Kashmir Valley. *Botia birdi* is also a small, bottom living species, but with a contrasted pattern of brown stripes forming circles, blotches and bars, a body covered by scales, and a strong spine below the eye. *Schistura punjabensis* has an about evenly deep body (caudal peduncle not constricted), and a low adipose fold along the dorsal margin of the caudal peduncle, lateral line ending above anal fin, and distinct vertical bars. *Triplophysa marmorata* is similar to *T. kashmirensis,* and is occasionally collected in the same places as that species (Fig. 42). It differs, however, in having only 7 instead of 8 branched rays in the dorsal fin, 8–10 instead of 10–12 pectoral-fin rays, a short lateral line ending before a vertical from the origin of the dorsal fin, a truncate, subtruncate, or only slightly concave caudal-fin margin, and a narrower interobital distance (Table 10; Fig. 43) .

Material. The Uri AEIA samples contain 29 specimens of *T marmorata*, 27.8–75.9 mm SL, from sites 6–7, 10–11, 13, 10B. The largest sample is from Wular Lake (site 10, 14 specimens), and includes also the largest specimen collected by the Uri AEIA, a male 75.9 mm SL. The largest specimen of this species examined by us is 117.6 mm SL (BMNH 1870.11.30:66, Cashmere, leg. Jerdon). One sample of 11 small

Table 10. Triplophysa marmorata *and* T. kashmirensis. *Measurements expressed as per cent of SL, except SL which is in mm and caudal peduncle depth as percent of caudal peduncle length.*

	T. marmorata					*T. kashmirensis*				
Measurement	*N*	*Min*	*Max*	*Mean*	*SD*	*N*	*Min*	*Max*	*Mean*	*SD*
SL (mm)	11	42.7	75.9	63.4	8.55	20	58.2	106.1	77.3	14.24
Head length	11	21.0	23.9	22.3	0.95	20	18.9	21.9	20.3	0.81
Snout length	11	7.3	11.1	8.7	0.95	20	8.1	9.3	8.6	0.33
Body depth	11	12.9	17.5	15.0	1.36	20	12.4	17.8	14.6	1.54
Orbital diameter	11	4.5	5.9	5.2	0.42	20	4.1	5.8	4.9	0.51
Interorbital width	11	4.5	6.3	5.5	0.60	20	3.5	4.6	4.0	0.31
Caudal peduncle depth	11	6.5	8.4	7.6	0.55	20	5.6	7.1	6.5	0.37
Caudal peduncle length	11	18.8	22.3	20.2	1.16	20	18.8	25.8	22.8	1.82
Caudal peduncle depth as % of length	11	29.3	42.9	37.5	3.99	20	21.8	34.8	28.7	3.14

specimens (27.8-36.5 mm SL) from site 7 was taken together with five similar-sized *T. kashmirensis*.

Conservation aspects and risk assessment. *Triplophysa marmorata* is not known with certainty from outside the Kashmir Valley, but the taxonomic status of upper Indus *Triplophysa* species, which include similar-looking forms, is in great need of revision, and we do not think that *T. marmorata* is endemic to the Kashmir Valley. In contrast to the sympatric *T. kashmirensis*, which is mainly found in running water, *T. marmorata* is apparently more adapted to lake conditions, being found in all sampled lakes. The biology of this and other *Triplophysa* species is insufficiently known. Nothing suggests that *T. marmorata* would be a migrating species, however. The low number of specimens obtained by the Uri AEIA is probably a sampling artifact. In the Kashmir Valley *Triplophysa marmorata* lives mainly upstream of the area affected by the Mohra Dam, and as a lacustrine species it will probably be positively, if at all, affected by the new dam.

Remarks. *Triplophysa* Rendahl (type species: *Nemacheilus hutjertjuensis* Rendahl) is a characteristic group found on the Qinghai-Xizang Plateau and in Central Asia. The genus is absent from the southern slope of the Himalayas, and the only Indian localities are in the upper parts of the Indus drainage in Jammu & Kashmir and Lahul & Spiti (Himachal Pradesh). Zhu (1989) and Banarescu & Nalbant (1995) reviewed the generic diagnosis and the nomenclatural history of the group.

Triplophysa species range mostly between about 60 to 190 mm SL in length, the largest species being *T. siluroides* (Herzenstein), reaching 482 mm (Zhu, 1989). They are totally scaleless and have a relatively slender caudal peduncle which is sometimes described as 'whiplike' in some species, and which is useful for separation in the field from syntopic *Schistura* species, which have a caudal peduncle that is nearly as deep as the rest of the body. Sexual dimorphism is marked. Males have tubercle-bearing, elevated skin on the sides of the head, separated into two fields by the suborbital lateralis canal. There is also a field of tubercles on the dorsal aspect of the pectoral fin. Tubercles on those pads are numerous, close-set, sharp and conical (Hora, 1922a: fig. 5), unlike other tubercles that may be present on the head and body, which appear as small, rounded elevations. Menon (1987) recognised 10 *Triplophysa* species in Indian waters.

The taxonomic status of various *Triplophysa* species described from the upper Indus drainage, especially those recorded from the Kashmir Valley and Ladakh, is not well understood. In the absence of a thorough species-level revision of the genus, it is difficult to estimate the geographical distribution of particular species. Most species are reported from very restricted areas, but very few studies (e.g., Hora, 1936b) deal with more than one species at a time, and regional endemism may be overestimated. It is probable that the number of species occurring in the Indus drainage is significantly less than the number of nominal species reported for the area.

In the Uri AEIA samples, the genus *Triplophysa* is represented by two species. The more abundant species has a complete lateral line, clearly emarginate caudal fin, eight branched dorsal-fin rays, males with thickened cheek and pectoral-fin skin, but without spine-like tubercles on cheek and pectoral-fin pads. This species is here identified as *T. kashmirensis*, q. v. The second species is much less abundant, and most specimens are from lake samples. It has a short lateral line, never extending as far as the level of the dorsal fin, a subtruncate, truncate or very feebly emarginate caudal fin, seven branched dorsal-fin rays, and males with well exposed projections on tuberculate preorbital, cheek and pectoral pads. We identify this species as *Triplophysa marmorata.*

Heckel (1838) described and figured two scaleless balitorid species which he called *Cobitis marmorata* and *C. vittata*, respectively, but which are referable to *Triplophysa*. Both would

have a rounded caudal fin, 7 branched dorsal-fin rays and 9 branched pectoral-fin rays. The only differences mentioned are in the general colour pattern. *Triplophysa marmorata* would have the sides marked by irregular dark wavy lines forming horizontal or vertical stripes, half circles, spots or ocellar spots; the most conspicuous stripes being horizontal and extending on both sides of the upper sides, chiefly posterior to the dorsal fin, and leaving a completely immaculate space between them. The caudal peduncle pattern is shown clearly in Heckel's illustration of the dorsal aspect (Heckel, 1838: pl. 12, fig. 2). *Triplophysa vittata,* in contrast, would have 9-10 transverse short dark vertical bars behind the dorsal fin, and an irregular dark band along the middle of the side. Both species would have a rounded caudal fin with the middle rays longer, and a complete lateral line. Heckel emphasised the caudal-fin shape as a diagnostic character for both species, referring to it as *subrotundata*, *ausgebuchtet,* and *halbmondformig*, and described it in greater detail as follows: 'The end of the caudal fin forms a distally extended, slight curve, the longest rays are in the middle and reach 4/5 of the length of the head' (translated from the German). The Kashmiri names *Tschottür* (*C. marmorata*) and *Gurua* (*C. vittata*) given by Heckel suggest that the material may have come from the Kashmir Valley. *Tschottür* is apparently a variant of *Tetther*, the Kashmiri name for *Crossocheilus diplochilus* and *Gurua* represents *Ara gurun*, the Kashmiri name for nemacheilines in general.

The only other *Triplophysa* species that has been reported as having a rounded instead of truncate or emarginate caudal fin is *T. ladacensis* (Günther, 1868) from Ladakh. Re-examination of the holotype of *T. ladacensis* (BMNH 1860.3.19:789) suggests, however, that the marginal caudal-fin rays have been broken off, and the fin was probably truncate or emarginate in the fresh specimen, as already observed by Day (1878b: 16). Our *Triplophysa* material from the Kashmir Valley contains no specimens with a rounded caudal fin.

The colour pattern is extremely variable in individuals of *Triplophysa* species, from a fine peppering all over the sides to any pattern of bold, large dark blotches, and the variation is similar across species, but we have not seen anything like the colour pattern described and figured by Heckel for *T. marmorata*. In some specimens assigned herein to *T. marmorata*, however, there is a row of blotches along the back, similar to the band shown in the corresponding position in Heckel's figure. However, in most of our specimens there are vertical bars across the dorsal margin of the caudal peduncle as in most *Triplophysa* species. The common pattern is rather characterised by a blotched dorsum and a dark stripe along the middle of the side, more like that illustrated by Heckel for *T. vittata.* Since the colour pattern is nevertheless extremely variable within *Triplophysa* species, including the one identified herein as *T. marmorata*, we find no reason to distinguish more than one species on the basis of available information.

Cobitis marmorata has priority over *C. vittata* from Günther (1868: 356), who acted as first reviser in selecting *C. marmorata* as a senior synonym of *C. vittata*.

Although Menon (1987) included the rounded (as contrasted to truncate) caudal-fin shape as a major character in his key to Indian *Triplophysa*, the material he actually reported as *T. marmorata* from Wular Lake and streams in the Kashmir Valley was described as having a truncate caudal fin, and also said to have an incomplete lateral line, ending before the dorsal fin. The species reported herein as *T. marmorata* conforms to Menon's description.

Hora (1922a) also reported both *T. vittata* and *T. marmorata* from the Kashmir Valley. In his key, these species are placed far apart by the position of the anterior origin of the dorsal fin, said to be about equidistant between the snout tip and the caudal-fin base in *T. vittata*, and nearer the base of the caudal fin than to the tip of the snout in *T. marmorata*. In the Uri AEIA sample of *T. marmorata* from Wular Lake, NRM 13126, the predorsal distance is the longer in three specimens, the shorter in one specimen, and about equal in 10 specimens. Thus, the position of the dorsal fin is apparently more variable than Hora thought.

Triplophysa afghana, from the Kabul River, figured by Hora (1933, fig. 1) as *Nemachilus griffithii* Günther (1868) and by Banarescu & Nalbant (1966: pl. 19, figs 4–5), was said to have an almost complete lateral line, or the lateral line is only irregularly interrupted towards the end (Hora, 1933; Banarescu & Nalbant, 1966), but the species seems otherwise to correspond to *T. marmorata* from the Kashmir Valley, having 7 branched dorsal-fin rays and a caudal fin which never clearly described, but obviously not deeply emarginate. Hora (1933) reported and illustrated the caudal fin as obliquely truncate, but Hora (1935) illustrated it as slightly concave; Banarescu & Nalbant (1966) described it as 'slightly emarginate'. Unfortunately, no specimens of *T. afghana* have been available for study. The types of *N. griffithii* can no longer be found in the BMNH

collection, but a specimen from the Helmand basin and apparently representing *T. griffithi* differs from both *T. kashmirensis* and *T. marmorata* in having a much narrower caudal peduncle (BMNH 1905.4.7:8, Seistan). Also *T. choprai* (Hora, 1934) from the Chitral, a tributary of the Kabul River may be distinct. It has a very slender caudal peduncle, emarginate caudal fin and complete lateral line. Of the six paratypes examined (BMNH 1932.8.2:1–6), five have 9 branched dorsal-fin rays and one has 8.

Both *T. marmorata* and *T. vittata* were reported from the Punch Valley by Nath (1981).

Until comparison with *T. afghana* and fresh material of other extralimital *Triplophysa* species can be made, it may be premature to consider *T. marmorata* as endemic to the Kashmir Valley, although there are no confirmed records from outside the valley.

Comparative morphometry shows that *T. marmorata* has a wider interorbital space than *T. kashmirensis*, and it is also much more variable between individuals in the narrow size range examined (Fig. 43; Table 10). *Triplophysa marmorata* has a somewhat shorter caudal peduncle (Fig. 44; Table 10), than *T. kashmirensis* of the same length sampled from running water. The difference may correlate with a preference for lacustrine habitats in *T. marmorata* to a greater extent than in *T. kashmirensis*. Lake specimens of the latter identified by lateral line length and caudal-fin shape have a somewhat shorter caudal peduncle than *T. kashmirensis* sampled from lotic habitats, and overlap with *T. marmorata* in this respect (Fig. 44), and also tend to have a somewhat greater interorbital space (Fig. 43). In other morphometric characters they conform to *T. kashmirensis* and are identified as such, but the variation suggests that morphometry may be influenced by habitat. Figure 44 also suggests, however, that small *T. kashmirensis* from running water have propor-tionally longer caudal peduncle than all other *Triplophysa* from the Kashmir Valley, as it is not obvious whether the small *T. kashmirensis* from Dal Lake or those from the river belong to the regression line of the larger *T. kashmirensis.*

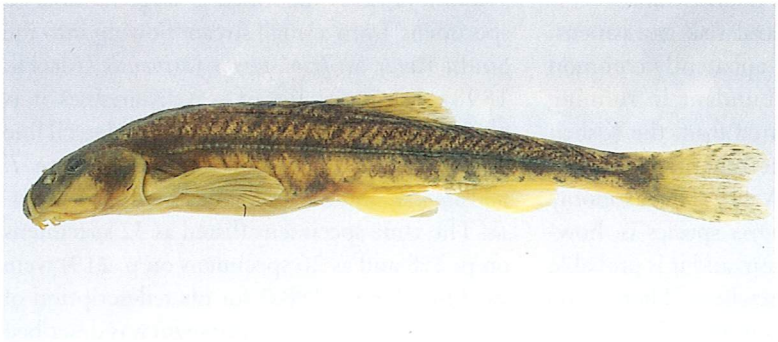

Fig. 45.
Triplophysa kashmirensis. *NRM 41243, male, 92.8 mm SL Preserved specimen from Sindh River at Nuna (Site 12), collected 29 November 1990.*

Triplophysa kashmirensis (Hora, 1922) (Figs 42–45)

Original description

Nemachilus kashmirensis Hora, 1922a: 76 (Verinag, Kukarnag and in a small stream flowing from the Kashmir waterworks reservoir to the trout farm at Harwan).

Synonymy

? *Nemachilus ajmonis* Di Caporiacco, 1933: 342, fig. p. 342 (stagno inter Sonamarg et Baltal, m. 2800).

Local names. Ara gurun (Kashmiri).

Diagnostic characters. The largest specimen from the Kashmir Valley is 106 mm SL. Elongate, with a long slender caudal peduncle. Body shape notably variable, especially with regard to the degree of elongation and form of the head. Eyes high on the head. Scales absent. Mouth inferior, with thick lips. Barbels three pairs, of which two rostral and one maxillary. Branched dorsal-fin rays 7(2), 8(13). Dorsal-fin origin about equidistant between tip of snout and caudal-fin base. Branched anal-fin rays 5(14), 6(1). Pelvic fin inserted slightly posterior to vertical from dorsal-fin origin, reaching beyond vent and usually to the anal-fin origin. Pectoral-fin rays 10(3), 11(12). Caudal fin emarginate. Lateral line extending all the way to the caudal-fin base.

No obvious sex differences in colouration. Ground colour pale yellowish or whitish. Markings consist of brownish or greyish blotches of different sizes scattered over the dorsum, sides and head. Average size of blotches varies between individuals, and blotches on head smaller than on sides and dorsum. Three wide brown dark bars across the dorsal midline in advance of the dorsal fin, and four (rarely three or five) similar bars across the dorsal midline between the dorsal-fin base and the caudal-fin base. Sides with irregularly distributed brown blotches down to the level of the pelvic fin insertion. About 10 dark, roundish brown blotches along the middle of the side, often not distinct in the general spotting of the sides. Commonly, mid-side blotches confluent to form a horizontal greyish stripe along the

middle of the side, and then other spots less evident. Dorsal fin with three rows of dark spots crossing the rays; three spots on the anterior margin and a spot at the base of the third unbranched ray particularly distinct. Pectoral fin dark on dorsal aspect. Pelvic and anal fins without dark pigment. Caudal fin with three vertical rows of dark spots which irregularly arranged and giving the impression that the fin is irregularly spotted all over. The spots on the caudal fin vary in size and darkness between individuals.

Males have an elevated pad of thick skin extending between the eye and the mouth, but unlike in most *Triplophysa* spine-like tubercles either do not develop or they remain in the pad without erupting. Males also have the middle pectoral-fin rays thickened, and in large males a portion of the dorsal surface is covered with a pad similar to the preorbital pad, and also without sharp conical tubercles.

Similar species in the Kashmir Valley. *Botia birdi* is also a small, bottom living species, but with a contrasted pattern of brown stripes forming circles, blotches and bars, a scaled body and a strong spine below the eye. *Schistura punjabensis* has an about evenly deep body (not constricted in the caudal peduncle), a lateral line ending above the anal fin, and distinct vertical bars. *Triplophysa marmorata* has a lateral line ending before the dorsal fin, pectoral-fin rays 8–10, truncate or subtruncate caudal fin, wider interorbital distance (Table 10; Fig 43), and usually 7 branched dorsal-fin rays

Material. Altogether 124 specimens were sampled by the Uri AEIA, from sites 1–2, 4–5, 7, 10, 12, 2B, 7A–B, 8B, and Dal Lake. The largest specimen is 106 mm SL. Most specimens are over 50 mm SL. The largest sample, 49 specimens was taken in the Sindh River, site 12, in November 1990. The species was not found in the Buniyar nallah, but otherwise seems to prefer small tributaries, although it also occurs in lakes and in the Jhelum mainstream.

Conservation aspects and risk assessment. *Triplophysa kashmirensis* is apparently common in the Valley and most abundant in running water. The species is reported from the Kishen Ganga, but not otherwise reliably identified from outside the Kashmir Valley. The taxonomy of Indus drainage *Triplophysa* species is, however, in great need of revision, and it is probable that the species occurs elsewhere. There is no information about migrating behaviour in the species, but it is not expected to make long migrations. Although many samples are in the area affected by the Mohra Dam, the strongest sample is from the Sindh River, and judging from the generally small size of mainriver Jhelum specimens compared to those taken from the Sindh site, it is possible that the species mainly occurs in the colder tributaries, and that the presence in the Jhelum proper or in the lakes, represent only a part of the life cycle or frequent downstream drift. It will be of interest to study the life cycle of the species, especially habitat preferences of different life stages, to better understand its dependency on different habitats within the valley. According to Koul (1988), the species migrates from tributaries to the Jhelum to spawn in early June, staying till mid-August. Available data suggest, however, that the influence of the new dam on *T. kashmirensis* will be negligible.

Remarks. Identification of the most common species of *Triplophysa* in the Kashmir Valley (Fig. 42) met with several difficulties owing to the poor understanding of the systematics of Western Himalayan loaches. We adopt herein the earliest name that definitely refers to the species, but future revision may show that it is the same as some species described earlier from outside the Kashmir Valley.

It is apparently not referable to *T. marmorata* (or *T.vittata*), differing in having 8 instead of 7 dorsal-fin rays and a clearly concave or emarginate caudal-fin margin. See *T. marmorata* (above) for further comparisons. It is clearly the same as *Nemacheilus kashmirensis* Hora (1922a, 1934), first described on the basis of specimens from Verinag and Kukarnag springs and a 'small stream flowing from the Kashmir waterworks reservoir to the trout farm at Harwan' (in Srinagar). According to Hora (1934) it has 8 branched dorsal-fin rays, a complete lateral line, and an emarginate caudal fin, and the males lack tuberculate pads on the head and pectoral fins. Hora (1922a, 1934) gave useful information on the general morphology of the species. Actually the thickened skin pads are present, but spine-like tubercles are not developed.

Hora (1922a) identified a 'large number of specimens' from a small stream flowing into the Sindh River as *Triplophysa yasinensis* (Alcock, 1898). From the list of sex differences it is obvious that the females (with a short lateral line and rounded or truncate caudal fin) are *T. marmorata*, and the males may be *T. kashmirensis*. The same specimens (listed as 32 specimens on p. 218 and as 26 specimens on p. 219) were used by Menon (1987) for his redescription of *T. yasinensis*. *Triplophysa yasinensis* was described from one specimen collected in the Yasin River, a tributary of the Gilgit River which joins the Indus downstream of Ladakh. It apparently has a very slender caudal peduncle and emarginate

caudal fin, judging from the original description and two preserved specimens from Gilgit (BMNH 1880.3.15:13–14, 74.4–111.3 mm SL). The validity of *T. yasinensis* is questionable as similar species have been described from the Western Himalayas. The species is, however, not reliably reported from the Kashmir Valley.

Hora (1936b) described or reported several *Triplophysa* species from the upper Indus and Shyok in Ladakh, and also reported on collections from Wular Lake and a lake at Shadipur identified as *Nemachilus vittatus*. Upper Indus and Shyok species were described from small samples and without clear statements concerning diagnostic characters even for the new species, *N. deterrai, N. hutchinsonii* or *N. panguri*. Menon (1987) made no mention of *N. hutchinsoni* from the upper Shyok drainage (Ladakh), but it was synonymised without further explanation with *T. yasinensis* by Talwar & Jhingran (1991), who included also *T. kashmirensis* in that species. *Triplophysa shehensis* Tilak in Menon (1987) from Sheh, Ladakh, agrees with *T. microps* in having 7 branched dorsal fin rays, incomplete lateral line, and truncate caudal fin, but is said to have the pelvic fin inserted behind a vertical from the dorsal-fin origin.

Hora (1922a) reported one specimen of *Nemachilus ladacensis* (Günther, 1868) from 'Kashmir', 6.5 inches long (153 mm SL in Hora & Mukerji, 1935). The same specimen was illustrated in an outline figure by Hora & Mukerji (1935) and might be *T. kashmirensis*. The holotype of *T. ladacensis*, BMNH 1860.3.19:789, a male, 63.5 mm SL, with locality Ladakh, represents a species not found by the Uri AEIA team. The caudal fin is damaged, and its shape is no longer determinable. The lateral line is very short, not attaining the vertical from the dorsal-fin origin. The caudal peduncle is relatively slender. *Triplophysa ladacensis* may represent a junior synonym of *Triplophysa tenuicauda* (Steindachner, 1866), the only other *Triplophysa* species in Ladakh with a slender caudal peduncle.

Mirza & Ejaz (1992) reported *T. kashmirensis* and *T. microps* from the Kishen Ganga, a tributary of the Jhelum downstream of Uri, and it seems likely that *T. kashmirensis* occurs in this neighbouring river. Careful review of the literature and examination of a limited material of *Triplophysa* from the upper Indus, suggests that *T. kashmirensis* does not occur in Ladakh or in the Gilgit drainage which apparently holds no more than 2-3 species (*T. microps, T. tenuicauda*, and *T. stolickai* the oldest available names), the remaining being junior synonyms of one of those. Further study and collecting is needed to understand the distribution of *Triplophysa* in northern Pakistan and the Kabul drainage, and it seems plausible that *T. kashmirensis* will be found in similar habitats, still not explored, in nearby drainages. The record of *T. stolickai* from the Punch (Das & Nath, 1971), may be an indication of wider distribution of *Triplophysa* species in the upper Indus, the species identification open to doubt in view of the general confusion marking *Triplophysa* systematics. Nath (1981) reported *T. kashmirensis* from the Punch Valley.

Two literature records of *Triplophysa* species from the Kashmir Valley could be for *T. kashmirensis*, but may very well also represent a distinct species (*T. microps*, or *T. ajmonis*). The localities are at higher elevation in the Sindh drainage, outside the Uri-Srinagar river stretch subject of this report.

Menon (1987) reported specimens of *T. gracilis* (Day, 1877b) from the Sutlej basin at Roper, Kashmir Valley ('enclosed lake, 4 miles from Sonamarg' [84 km from Srinagar on the road to Leh, close to Zoji La, could be any of Krishnasar, Vishensar and Gangabal Lakes]), Ladakh and Nubra Valley, but based the redescription only on the Kashmir Valley specimens. Menon referred to 7 branched dorsal-fin rays, a complete lateral line, caudal fin slightly emarginate, and pelvic fin inserted slightly in advance of the dorsal fin. Menon considered *T. gracilis* to have a very wide distribution including the Indus headwaters and the Karakax He Valley (Tarim/Talimu He basin).

A syntype of *T. gracilis* examined by us, BMNH 1889.21.17:26, male, 80.2 mm SL, from Basgo (on the Indus, downstream of Leh), is in a very bad state of preservation. It has been squeezed, and the head is greatly distorted. It has a truncate caudal fin and the lateral line extends to below the dorsal fin, with scattered short canals extending to approximately the level of the origin of the anal fin. The eyes are very small and the caudal peduncle not particularly slender. This specimen is tentatively identified as *Triplophysa microps* (Steindachner, 1866), which may be common in Ladakh, and which is distinct from *T. kashmirensis* in having a truncate caudal fin, a short lateral line, and the pelvic fin inserted anterior to a vertical from the orgin of the dorsal fin. *Triplophysa gracilis* was synonymised with *T. microps* by Zhu (1989).

Nemachilus ajmonis was described from a pond at Sonamarg, communicating with the Sindh River (Di Caporiacco, 1933). The locality could be the same as for Menon's (1987) *T. gracilis*. The two syntypes, 86.5–96 mm TL,

were not re-examined by us, but the description strongly suggests *N. kashmirensis*, although the dorsal-fin origin is said to be behind the pelvic-fin origin, even further caudad than shown for *T. microps* by Steindachner (1866: pl. 13, fig. 3–3a) or Zhu (1989: fig. p. 122). In *T. kashmirensis* the relative position of the pelvic-fin position varies, but the insertion is either at the vertical from the dorsal-fin origin or distinctly posterior to the vertical. The dorsal fin of *N. ajmonis* is shown with 6 branched rays on Di Caporiacco's figure, but the dorsal-fin count is given as 8 in the text. *Triplophysa microps*, however, has a short lateral line, 7, rarely 6, branched dorsal-fin rays and a truncate or only slightly emarginate caudal-fin as distinguished from *T. ajmonis* (pers. obs.; Zhu, 1989). The possibility of the existence of one more species of *Triplophysa* at a high altitude in the Kashmir Valley cannot be excluded, however. The 29 mm TL specimen of *Nemachilus stolickai* reported by Di Caporiacco from Kangan, at 2000 m ASL, is said to have 10 dorsal-fin rays, suggesting that the unbranched rays were included in the counts; then the count of 8 given for *N. ajmonis* would be extremely low. The information provided by Di Caporiacco (1933) for his *N. stolickai* is insufficient for recognition of the species.

Glyptosternon reticulatum McClelland & Griffith, 1842 (Figs 46–47)

Original description

Glyptosternon reticulutus McClelland & Griffith in M'Clelland, 1842:584, pl. 6 (Sir-i-Chusma, at the source of the Cabul river; spelt *reticulatus* in list on p. 574).

Synonymy

Exostoma stoliczkae Day, 1877b: 782 (Basgo, Sneema, and Leh or Ladak on the headwaters of the Indus).

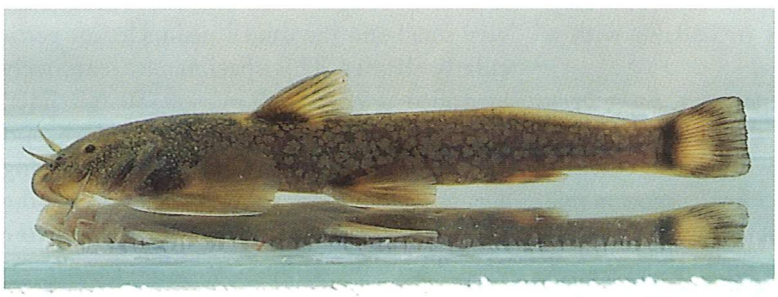

Fig. 46.
Glyptosternon reticulatum. *NRM 40241, 83.6 mm SL. Living specimen, freshly captured from Buniyar nallah downstream of Workers Camp (Site 3B), 22 October 1997.*

Local name. Nayid (Kashmiri).

Diagnostic characters. Reaches ca 24 cm SL in the Kashmir Valley. Elongate, abdominally subcylindrical, caudally compressed; body depth about uniform from head to caudal fin. Head short, wide and depressed. Eyes minute, dorsal, covered by skin. Body and portions of paired fins covered by small tubercles, which larger on head than on sides. Barbels four pairs, including nasal, maxillary and two mental pairs. Maxillary barbels basally thick, subbasally connected to cheek by membrane, distally tapering; ventral aspect of proximal part with folded skin forming adhesive surface. Dorsal, anal and caudal fins short. Dorsal-fin spine flexible. Dorsal and anal fins each with 6 branched rays. Caudal fin truncate or very slightly convex. Paired fins broad; pectoral fin unbranched ray wide, with transverse striae on ventral aspect forming adhesive surface; pelvic fin unbranched ray wide, first and second rays with transverse striae on ventral aspect forming adhesive surface. Low adipose fin extending along more than 50% of dorsum between dorsal and caudal fins, connecting to the keel formed dorsally at the base of the caudal fin. Pectoral and pelvic fins broad. No thoracic adhesive organ. Mouth inferior, wide. Lateral line complete. Large specimens overall grey; underside of head, abdomen and ventral aspects of pectoral and pelvic fins, and anterior margin of anal fin whitish. The largest specimen, 235 mm SL, shows indistinct darker spots scattered over sides and dorsum. Small specimens, ca 50-60 mm, lighter, with fins tending to whitish or even hyaline on both sides. Caudal fin with a blackish spot basally, a wide dark bar across the middle, and a narrow black posterior margin. With increasing size the darker pigment areas of the caudal fin expand, enclosing a large whitish submarginal blotch and a light blotch at each posterior corner of the fin, the light areas finally fading in the specimens over 150 mm SL.

Similar species in the Kashmir Valley. The two other sisorid species in the Jhelum River, *Glyptothorax kashmirensis* and *G. pectinopterus*, have a much shorter adipose fin (the base of the adipose fin corresponding in length to that of the anal fin), an emarginate or forked caudal fin, and an adhesive apparatus between the pectoral fins. There are no other catfish species in the upper Jhelum.

Material. There are 74 specimens available from the Uri AEIA stations 2B, 3A–C, and 12. Most samples and specimens are from the Buniyar nallah, and remaining samples are also from tributaries. No specimen was taken in the Jhelum or its lakes. The largest specimen is 235 mm

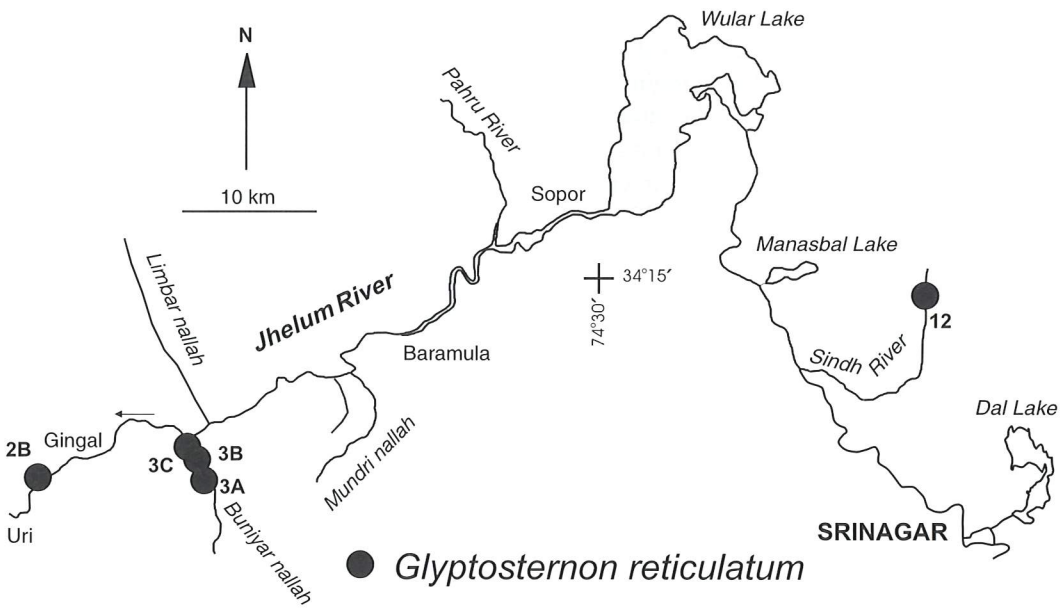

Fig. 47. *Location of sampling sites yielding* Glyptosternon reticulatum *in the Kashmir Valley Uri AEIA.*

SL; most of the specimens are 50–100 mm SL.

Conservation aspects and risk assessment. *Glyptosternon reticulatum* is a highly specialised bottom-living rheophilic species known with certainty only from a few localities in the upper Indus, including the Kashmir Valley. Although the biology of *G. reticulatum* is little known, it is not expected to be migratory, and the Kashmir Valley population may be considered resident. Nearly all Uri AEIA samples are from the Buniyar nallah, and the species may be primarily inhabiting hill streams in the valley. We expect that the population is more extensive in localities not covered by the survey and that the impact of the Mohra Dam will not significantly affect the Kashmir Valley population of *G. reticulatum*.

Remarks. This is the only *Glyptosternon* species reported from the Indus drainage where it have has a discontinuous distribution in the Kabul (Chitral, Swat), upper Jhelum, upper Indus in Ladakh, and in the Gilgit River (Mirza, 1973a; Mirza & Hameed, 1974; Mukerji, 1936; Hora, 1934; Hora & Silas, 1952). It occurs also in the Kishen Ganga (Mirza & Ejaz, 1992) and the Punch (Das & Nath, 1971), both tributaries to the Jhelum.

The species was first recorded from the Kashmir Valley by Hora (1923a) as *Glyptosternum stoliczkae*. Das & Subla (1964) reported it both as *Glyptosternum reticulatum* and *Exostoma stolizckae*. Useful descriptions of this species can be found in Hora (1934) and Mirza & Hameed (1974). *Glyptosternon reticulatum* appears to be restricted to running water (Fig. 47), but is not uncommon in the Kashmir Valley. Judging from its shape and on the basis of the observa-tions reported by Hora (1934) for Chitral specimens, it is apparently a specialised benthic species living off epilithic insect larvae, but it does not occur in the strongest current.

Berg (1933) included material from the upper Amu-darya, upper Syr-darya, and Tarim Rivers, synonymising *Exostoma oschanini* Herzenstein, 1889, *E. labrax* Grazianov, 1907, and *E. gracile* Grazianov, 1907, with *G. reticulatum*. In the absence of a critical comparison of *Glyptosternon* from those rivers and the Indus, the overall synonymisation, followed by later authors (e.g., Hora, 1934; Mukerji, 1936; Coad, 1981) appears to have been too hasty. Berg's (1933: fig. 550) illustration of a specimen from Derbent suggests a colour pattern very different from that of Indus specimens, with numerous, conspicuous dark spots on body and fins, and a much longer adipose fin than *G. reticulatum*. The name *G. oschanini* is available for this form, and *G. akhtari* Silas (in Hora & Silas, 1952), from Afghanistan, is apparently the same species. The Tarim/Talimu He distribution remains unconfirmed. The two other species in the genus are *G. maculatum* (Regan) from the Yaluzangbu Jiang/Brahmaputra River in Xizang, China (Wu & Wu, 1992), and *G. malaisei* Rendahl & Vestergren, from the upper Ayeyarwaddy in Myanmar.

Misra (1976) recognised both *G. stoliczkae* and *G. reticulatum* as valid. In the key (Misra, 1976: 300-301), *G. reticulatum* is said to have the adipose fin continuous with the caudal fin, and *G. stoliczkae* would have the adipose fin separated from the caudal fin ('not continuous'). In the description of *G. stoliczkae*, however, the caudal fin is said to be 'united or not united with [the] adipose [fin]'. The illustration of *G. stoliczkae* (Misra, 1976: fig. 52) is

a crude copy of Day's (1878b: pl. 1, fig 1) illustration, and shows a short adipose fin whereas in Day's original the adipose fin extends all the way to the caudal-fin base.

Our 235 mm SL specimen may be the largest known specimen of *G. reticulatum*. Talwar & Jhingran (1991) gave 15.8 cm as maximum length although Day (1877b, 1878b) stated the length of the longest specimen as 7 inches (17.8 cm) (apparently total length), and Hora's (1923a) longest specimen was 230 mm total length.

The original description included the two spellings *reticulutus* and *reticulatus*. Later authors used the latter spelling, assuming, as we do, that *reticulutus* is a printer's error. Since the etymology was not explained, we cannot be completely sure about the intention of the author, however (cf. ICZN Article 32c(ii)). We thus select here *G. reticulatus* to be the correct original spelling (ICZN Article 32b).

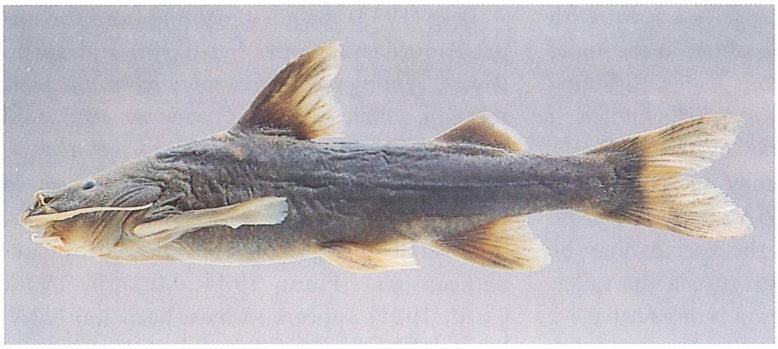

Fig. 48.
Glyptothorax kashmirensis. *NRM 41245, 76.5 mm SL. Preserved specimen from Jhelum River below Lower Jhelum Barrage at Gantamulla (Site 6), collected 11 May 1993.*

Glyptothorax kashmirensis Hora, 1923 (Figs 48–49)

Original description

Glyptothorax kashmirensis Hora, 1923a: 22, fig. 2 (Kashmir Valley).

Synonymy

? *Glyptothorax conirostris punjabensis* Mirza & Kashmiri, 1971: 88, fig. 1 (Rawal Dam, Rawalpindi). [Not seen.]

Local name. Nayid (Kashmiri).

Diagnostic characters. Reaches about 10 cm SL in the Kashmir Valley. Elongate; head short, wide and depressed; body laterally compressed, slightly tapering from midbody to caudal fin. Eyes minute, dorsal, covered by skin. Body and fin bases covered by small tubercles which elongate, ridge-like, on top and sides of head. Mouth inferior, wide. Barbels four pairs, including nasal, maxillary and two mental pairs. Maxillary barbels basally thick, subbasally only narrowly connected to the cheek by a membrane, distally tapering. No adhesive tissue on barbels or fins. Thoracic adhesive organ about oval in outline, made up of elongate folds anteriorly arranged longitudinally, posteriorly more latero-medially extended; centrally a depression which may be unmodified or which includes rounded papillae; the organ is often not closed caudal to the central depression. Lateral line complete. Supraoccipital process not in contact with first dorsal pterygiophore. Pectoral fin long and wide, with broad, flattened, posteriorly serrated spine. Dorsal, anal, pelvic, and adipose fins relatively small. Dorsal fin with 6

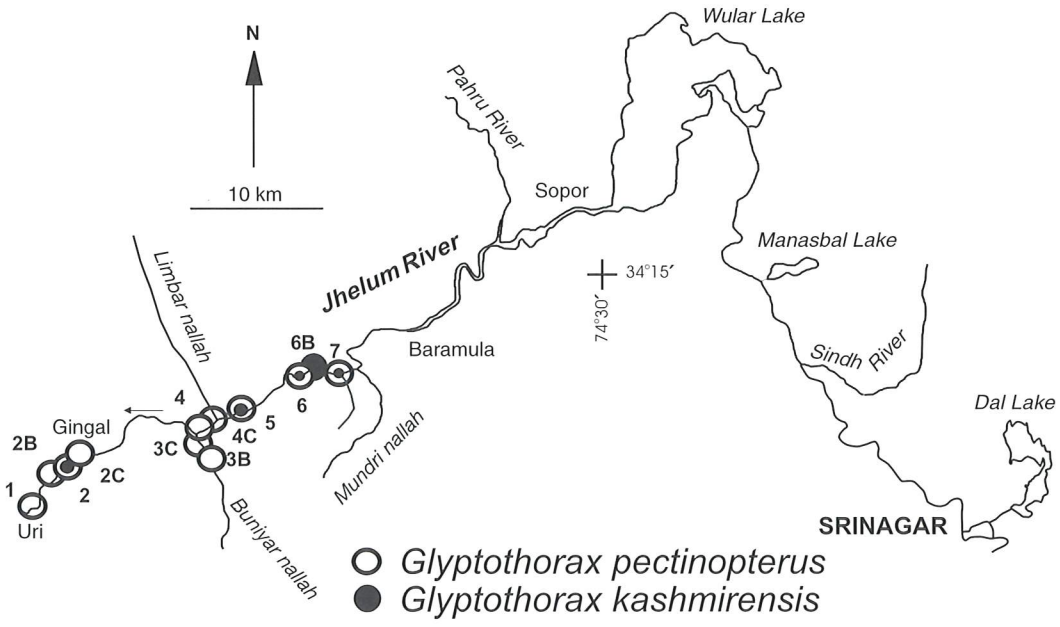

Fig. 49.
Location of sampling sites yielding Glyptothorax pectinopterus *and* G. kashmirensis *in the Kashmir Valley Uri AEIA*

branched rays; spine strong, serrated posteriorly. Anal fin higher than adipose and dorsal fin, about triangular, with short last ray; branched anal-fin rays 7. Adipose fin opposite anal fin, similar in shape and base length (covering less than 30% of the distance between dorsal and caudal fin bases) but not as high as anal fin. Caudal fin deeply forked.

Similar species in the Kashmir Valley. Of the two other sisorid species in the Jhelum River *Glyptosternon reticulatum* has a much longer adipose fin, a truncate caudal fin, a flexible dorsal-fin spine, a smooth chest without adhesive organ, and suction pads on paired fins; *Glyptothorax pectinopterus* has a light stripe along the middle of the dorsum, a smaller, chevron-shaped suction disk, suction pads on the unpaired fins and the distal half of the dorsal-fin spine flexible.

Material. Altogether 184 specimens were sampled from sites 2, 5–7, and 6B. The majority, 153 specimens, were collected from the fish ladder on 8 July 1994. Nineteen specimens were taken below the barrage on 11 May 1993. Remaining samples contain 1–3 specimens only. All sites are in the Jhelum and none in the tributaries. The largest specimen is 97 mm SL, most specimens are between 65 and 95 mm SL.

Conservation aspects and risk assessment. *Glyptothorax kashmirensis* is a little-known specialised rheophilic and benthic species of small dimensions. The Uri AEIA collecting sites suggest that *G. kashmirensis* is restricted to the main channel of the Jhelum, not ascending tributaries. It possibly migrates, as there was an aggregation below the barrage and the species was abundant in the ladder. It seems unlikely that a species with adhesive organs would be washed down the ladder. Thus, the population of *G. kashmirensis* is certainly affected by the Uri construction, but the species may be capable of efficient use of the fish ladder. *Glyptothorax kashmirensis* apparently has a wider geographical distribution, probably occurring in all suitable habitats in the eastern Indus drainage. The Uri project therefore is not a threat to the species. The species should be monitored for migration in the fish ladder. It is probably unable to leap, but may pass falls and similar obstacles by use of the adhesive organ.

Remarks. The genus *Glyptothorax* is widespread in South Asia, from the Tigris-Euphrat basin eastwards to Vietnam and eastern China. There are more than 50 species recognised as valid, most of them with a highly restricted geographical distribution. *Glyptothorax kashmirensis* is apparently very similar to *G. stoliczkae* Steindachner, described from Shimla, and which would differ in having a smooth rather than rugose skin and lacking a central pit in the thoracic adhesive tissue (Talwar & Jhingran, 1991).

Mirza & Hameed (1974) reviewed Pakistani *Glyptothorax* species, recognizing seven species, one of which *(G. platypogonoides* (Bleeker)) was later described as *G. stocki* Mirza & Nijssen, 1978. In their key they distinguished *G. kashmirensis* from *G. punjabensis* by the dorsal-fin spine being smooth rather than serrated, the adhesive area almost rounded rather than U or V-shaped and a pectoral fin as long as the head or slightly longer rather than shorter. We find the dorsal-fin spine serrated in *G. kashmirensis*, as already discovered by Rashida *et al.* (1996) The adhesive thoracic tissue is commonly 'V-shaped' in *G. kashmirensis* from Kashmir Valley. At least the adhesive organ is never round. Rashida et al (1996) described variation in the shape of the adhesive organ including 'O' type (=closed) and 'U' type (=open caudally). The pectoral fin is confirmed to be as long as or (in males only) longer than the head. Although *G. punjabensis* seems to be the same species as *G. kashmirensis*, it is notable that Mirza & Hameed (1986) reported their longest specimen of *G. punjabensis* to be 191 mm long (probably total length), which is about 60 mm longer than the largest Kashmir specimens available. *Glyptothorax kashmirensis* can be distinguished from *G. naziri* Mirza & Naik, 1969 and *G. stocki* by the supraoccipital process and first dorsal-fin pterygiophore being slightly separated instead of in contact.

Glyptothorax kashmirensis has been reported from Chamba State (Himachal Pradesh) by Menon (1955) and from the Kishen Ganga by Mirza & Hameed (1974). There is also a record from the Kurram River in NW Pakistan (Rashida *et al.*, 1996). Mirza & Hameed (1974) reported *G. punjabensis* from near Lahore, Shadiwal (Sohan River), the Upper Jhelum Canal, Khatki (Kabul drainage), Ghazi (Siran River) and Kotli (upper Jhelum drainage). They suggested, however, that two species might be involved. Ahmad *et al.* (1976) added Shadiwal and Qadirabad Colony (middle Chenab River drainage), and Jinnah Barrage (upper Indus drainage), on the margin of the Indus plain. Das & Nath (1971) listed the species from the Punch River.

Glyptothorax pectinopterus (McClelland, 1842) (Figs 49–50)

Original description

Glyptosternon pectinopterus McClelland, 1842: 587 (The Mountains of Simla).

Synonymy

No synonyms recorded.

Local name. Nayid (Kashmiri).

Diagnostic characters: Reaches about 70 mm SL in the Kashmir Valley. Elongate; head short, wide and slightly wider than deep; body laterally compressed, slightly tapering from dorsal-fin region to caudal fin. Eyes minute, dorsal, covered by skin. Body and fin rays covered by small tubercles which uniform in size. Mouth inferior, wide. Barbels four pairs, including nasal, maxillary and two mental pairs. Maxillary barbels basally thick, subbasally only narrowly connected to cheek by membrane, distally tapering. No adhesive tissue on barbels. Pectoral fin with thick pad of plicated skin ventrally on spine, and pelvic fin with similar tissue ventrally on first two rays. Thoracic adhesive organ slightly wider than long, chevron-shaped, concave posteriorly, made up of elongate folds arranged longitudinally. Lateral line complete. Supraoccipital process not in contact with first dorsal pterygiophore. Pectoral fin wide, with broad, flattened, posteriorly serrated spine. Dorsal, anal, pelvic, and adipose fins relatively small. Dorsal fin with 5 branched rays; spine strong basally, without serrations, distal half, however, flexible. Anal fin higher than adipose and dorsal fin, with rounded margin; branched anal-fin rays 6. Adipose fin opposite anal fin, similar in base length (covering less than 30% of the distance between dorsal and caudal fin bases) but not as high. Caudal fin deeply emarginate.

Colour brownish or greyish; abdomen and underside of head fawn or whitish. Fin margins light. A contrasted light stripe along the middle of the dorsum, from the end of the dorsal-fin base to the base of the caudal fin. Light spots bilaterally on supraoccipital, joining to a light stripe to dorsal-fin base. Cheek marked by light blotch. Young specimens usually with an indistinct light stripe from postcleithrum caudally to below adipose fin where fading out. Caudal fin basally dark grey or brown, followed by narrow light vertical stripe, the rest brownish or greyish except for contrasted light tips of caudal-fin lobes.

Similar species in the Kashmir Valley. Of the two other sisorid species in the upper Jhelum River *Glyptosternon reticulatum* has a much longer adipose fin, a truncate caudal fin, and a smooth chest without adhesive organ; and *Glyptothorax kashmirensis* lacks the light stripe along the back, has a larger, oval or V-shaped suction disk, lacks suction pads on the unpaired fins, and has a pungent instead of distally flexible dorsal-fin spine.

Material. The Uri AEIA sample consists of 87 specimens from the Kashmir Valley, the largest 70 mm SL, most specimens between 50 and 60 mm SL. The species was found both in the main Jhelum and in tributaries, including the Buniyar nallah, and four specimens are from the fish ladder (sites 1–2, 4–7. 2B–C, 3B–C, 4C). The largest sample, 31 specimens, was taken from a small sidestream (site 2). All other samples consist of only one or a few specimens (maximum eight).

Conservation aspects and risk assessment. *Glyptothorax pectinopterus* is a small, benthic and rheophilic species with limited distribution also in the upper tributaries of the Sutlej and in the upper Ganga. The species is small enough to escape normal fishing efforts and may have a much wider distribution than currently known. There is practically no information available on the biology of *G. pectinopterus*. Judging from the wide distribution it does not seem to be a vulnerable species. The Uri AEIA samples are from several different habitats, suggesting that the new dam will have little influence on the local population of the species.

Remarks. *Glyptothorax pectinopterus* is a new record for the Kashmir Valley. It was reported from Azad Kashmir by Mirza & Hameed (1974) and from the Punch Valley by Das & Nath (1971). In the Indus drainage the species has only been collected in the upper Jhelum and the upper Sutlej; there are several records from the upper Ganga in Uttar Pradesh (Hora, 1923a; Menon, 1955; Misra, 1976). We also obtained the species in both the Ganga and the

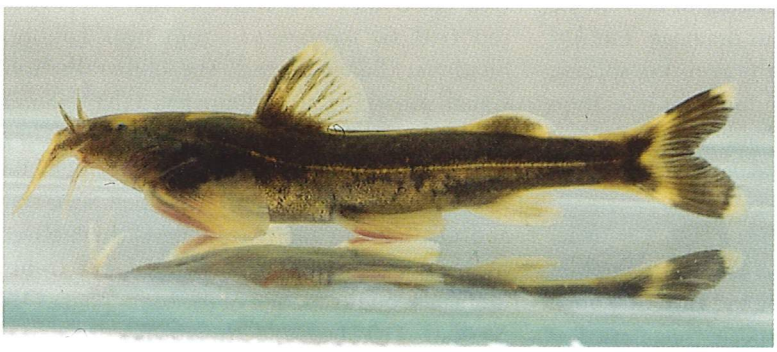

Fig. 50.
Glyptothorax pectinopterus. *NRM 36903, 57.9 mm SL. Living specimen, freshly captured from Buniyar nallah downstream of Workers Camp (Site 3B), 22 October 1997.*

Sutlej near Shimla, which is the type locality of the species. M'Clelland's (1842) description is poor. We and earlier authors rather base the identification on Hora's (1923a) concept of *G. pectinopterus.* This is the only fish species in the Kashmir Valley that also occurs in the Ganga basin. Although Talwar & Jhingran (1991) gave a maximum length as 17.8 cm, we are of the impression that our specimens are fully adult and that the species does not exceed 80 mm SL. The largest Sutlej specimen is 74 mm SL.

Gambusia holbrooki Girard, 1859 (Figs 51–52)

Original description

Gambusia holbrooki Girard, 1859: 62 (Palatka, E Florida; Charleston, South Carolina).

Local names. No Kashmiri name recorded. In English it is known as mosquitofish.

Fig. 51.
Gambusia holbrooki, *NRM 41246, male, 19.7 mm SL. Preserved specimen from the Jhelum River above Lower Jhelum Barrage at Gantamulla (Site 7), collected 18 October 1997.*

Diagnostic characters. *Gambusia holbrooki* is the only member of the family Poeciliidae in the Kashmir Valley. It is a small species, with female specimens 23 mm SL verified in the Uri AEIA samples, but known to exceed 60 mm in other localities. Males remain smaller, the largest 20 mm SL in the Uri AEIA samples. It is elongate, with the pectoral fin positioned relatively high on the side in distinction to small cyprinids, and the dorsal fin is situated well behind a vertical from the middle of the anal fin. Adults feature a dark bar beneath the eye, a reticulated pattern formed by dark scale margins, and dark spots in the dorsal and caudal fins. Large gravid females have notably extended belly and a dark blotch in front of the anal fin. Males can be distinguished from other Kashmir Valley fishes by the modified anal fin, with prolonged and stiffened anterior rays, which serves to transmit sperm packets to the genital opening of the female.

Similar species in the Kashmir Valley. None.

Material. Altogether 90 specimens, the largest 23 mm, were obtained from sites 7–8, 10, 7A, and 10B. The majority are from site 8, where 72 specimens were taken on 23 November 1990.

Conservation aspects and risk assessment. *Gambusia holbrooki* has been introduced in the Kashmir Valley and evidently maintains a stable breeding population. It was found in both running water and in Wular Lake, and is not expected to be negatively affected to any significant extent by the Uri construction.

Remarks. *Gambusia holbrooki* was found both in Wular Lake and in running water at Sites 7, 7A, and 8 (Fig 52). It is a prolific live-

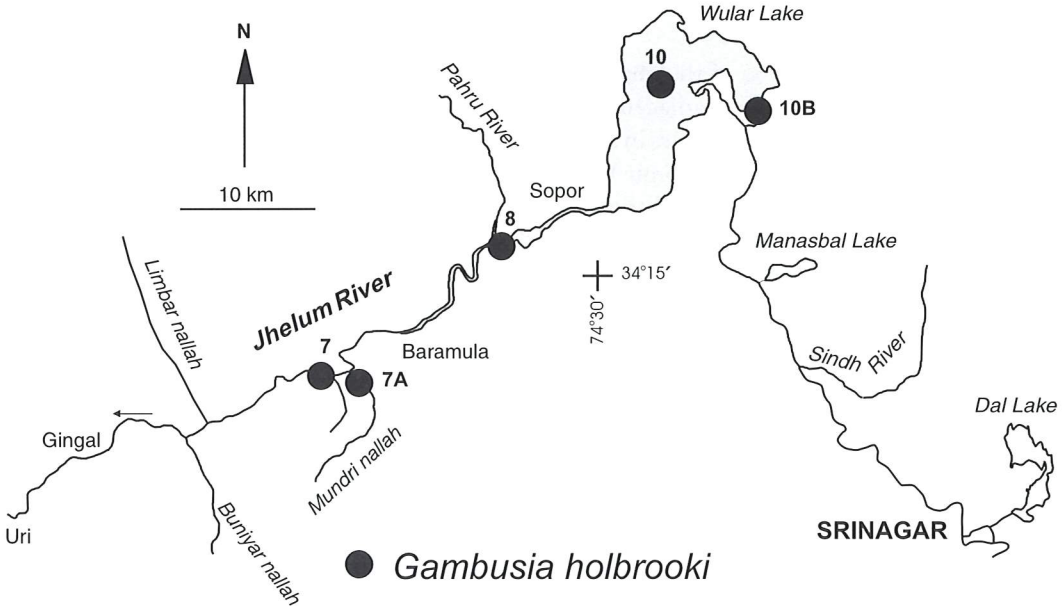

Fig. 52.
Location of sampling sites yielding Gambusia holbrooki *in the Kashmir Valley Uri AEIA.*

bearer, reputed to feed chiefly on mosquito larvae for which reason it has been introduced in numerous places in the tropical and subtropical regions of Africa, Asia and Europe. Das & Rampal (1968), working on the life history of *G. holbrooki* in the Kashmir Valley, considered that it may be destructive to larval fishes as well.

Gambusia holbrooki was first collected from the Kashmir Valley (Dal, Wular and Manasbal Lakes, and paddy fields near Srinagar) in 1954 (Hora, 1955). There seems to be no documentation of the introduction to the Kashmir Valley, but Hora (1955) regarded the species as being firmly established there in 1954. According to Talwar & Jhingran (1991) *G. affinis* (probably rather *G. holbrooki* judging from fin formula provided) was introduced into India in 1928 from Italy.

Gambusia holbrooki occurs naturally in eastern North America. It is commonly regarded as a subspecies of *G. affinis*, from which it can be distinguished by having 7 rather than 6 branched dorsal-fin rays, and a series of hooks on the third gonopodial ray in males. Records of introduced *G. affinis* probably mostly refer to *G. holbrooki.* Coad (1981) listed records of *G. holbrooki* from Afghanistan; Ahmad & Mirza (1976) and Talwar & Jhingran (1991) listed *G. affinis* as introduced into many parts of Pakistan and India respectively. The species reaches a length of slightly over 6 cm SL. Kashmir Valley samples thus consist of comparatively small specimens.

Synopsis of comparative collections made near Shimla, in the Ganga and Indus basins

One of the objectives of the Uri AEIA was to survey adjacent drainages to compare fish communities in similar habitats with conditions in the Kashmir Valley to be able to assess both taxonomic distinctiveness and biological parameters. Due to access problems, only one additional region could eventually be sampled for four days in November 1997. These samples are from the Saror Stream close to the mouth in the Sutlej River, a tributary of the Indus River, and two sites on the Giri River, a tributary of the Ganga River.

The samples are listed in Table 11; see Fig. 53 for a sketch map of the sampling area. There are 14 positively identified distinct species, and one sample of juveniles that probably belong to *Opsarius barna.* Thus the number of species is overall the same as in the Kashmir Valley. Ten species were found in the Giri, and six species in the Sutlej.

Four species feature characteristics of rheophilic species, and are mainly distributed along the southern Himalayan hill streams: *Schizothorax richardsonii* was found in both the Sutlej (Fig. 19) and the Giri, other species were more localised. *Bangana dero* and *Labeo pangusia*, from the Sutlej, are known from both the Ganga and the Indus drainages, the latter usually referred to as *Labeo dyocheilus. Labeo dyocheilus pakistanicus* Mirza & Awan (1976), is apparently based on young of the same species. *Garra gotyla* (Gray) is previously reported from Shimla (Hora, 1921). The *Crossocheilus* species is tentatively identified as *C. gohama* (Hamilton) and seems to be larger and more elongate than *C. latius* that we have seen from West Bengal, and is also much more slender than *C. diplochilus* from Kashmir Valley. *Pseudecheneis sulcata* (McClelland) is common in mountain streams in the Ganga-Brahmaputra basin. It is not known from the Indus drainage. Like *Glyptosternon reticulatum* it has adhesive tissue on the paired fins, but also wide transverse skin folds anteriorly on the abdomen apparently serving as attachment organ. *Glyptothorax pectinopterus* was found in both the Giri and the Sutlej, and is also common in the Jhelum samples.

Tor chelynoides (McClelland, 1838) is originally described from Shimla. Talwar & Jhingran (1991) synonymised *Tor zhobensis* Mirza with *T. chelynoides*, but we find the head shape of *T. chelynoides* to be similar to that of other *Tor*, including an elongate snout and with fleshy lips with a median pad separating the folds of the lower lip. *Tor zhobensis,* in contrast, has a blunt snout and thin lips. The two species are similar in having fairly small scales on the side (about 33 in *T. chelynoides*; 32–37 in *T. zhobensis*) and small chest scales compared to other *Tor* species. Data on *T. zhobensis* are from Mirza & Javed (1986). Although McClelland spelt the name *Barbus Chielynoides*, he gave the etymology as Χελυνοιδηζ, from which we deduce that 'chielynoides' is a typographical lapsus, i.e., an incorrect original spelling according to ICZN Article 32c(ii), and consequently we use the correct spelling, *chelynoides.*

Opsarius cocsa (Hamilton) is widespread in northern India, usually called *Barilius bendelisis* (Buchanan). Also *O. barna* (Hamilton) is common in running water in northern India. *Mastacembelus armatus* (La Cépède) is the only spiny eel collected by the Uri AEIA. According to Talwar & Jhingran (1991) it is found com-

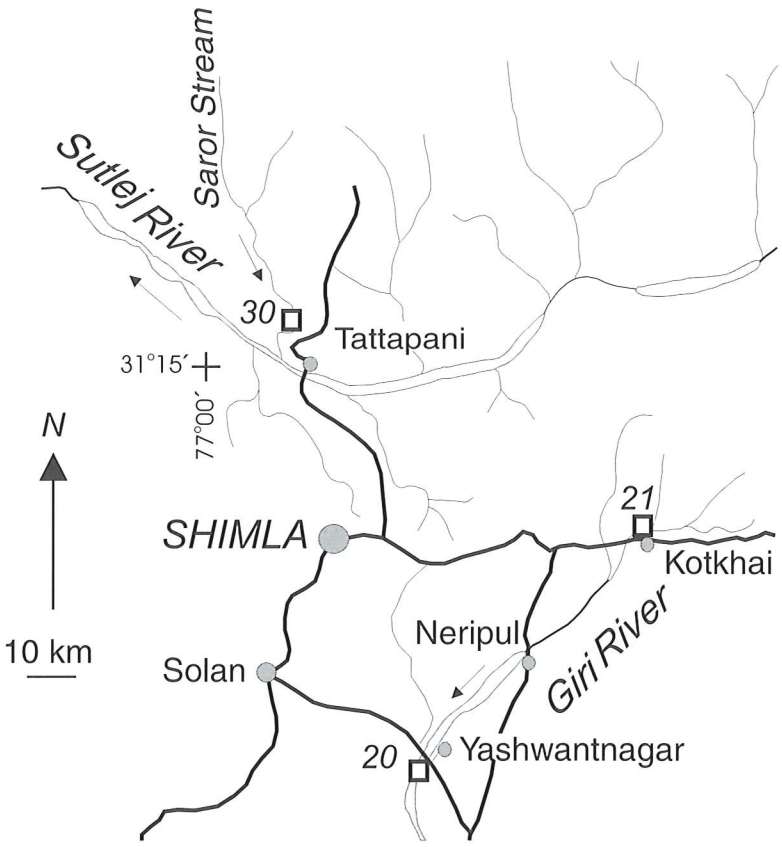

Fig. 53.
Sketch map of the Shimla area in Himachal Pradesh, India, to show location of collecting sites 30 (Indus drainage) and 20–21 (Ganga drainage). Thicker lines represent roads.

monly at 'quite high altitudes' in the river Tawi and its tributaries in Jammu. It is otherwise mainly a lowland species. Revision may show that the current concept of the extremely widespread and variable *M. armatus* sensu Sufi (1956) and Talwar & Jhingran (1991) is a complex of species.

There are four species of balitorid loaches in the Shimla samples, but notably no *Triplophysa* species. *Acanthocobitis botia* (Hamilton) is reported from a large portion of northern India and Pakistan, including the Brahmaputra, Ganga and Indus drainages (Menon, 1987). *Schistura montana* McClelland was originally described from Shimla, and occurs only in the upper Ganga drainage, whereas *S. corica* (Hamilton) is reported from most of the foot of the Himalayas including the Brahmaputra, Ganga, and Sutlej (Menon, 1987). Two *Schistura* specimens from Sutlej are similar to *S. afasciata* Mirza & Banarescu, but lack scales and have a shorter lateral line. *Schistura afasciata* is otherwise known only from the holotype, collected in the Indus tributary Dor River in northern Pakistan (Mirza *et al.*, 1981).

Discussion

The 14 native species sampled by the Uri AEIA (1990-1997) apparently represent the entire fish fauna present in habitats available for collecting. It is notable that some species were encountered in very low numbers, suggesting that habitat segregation is considerable. Since sampling was concentrated on running waters close to the Jhelum, species from lentic habitats are underrepresented. The native species are dominated by an assemblage of oreinin cyprinids, most of which are rheophilic or otherwise lotic, but also all the other native species are rheophilic.

The low number of species contrasts with high numbers presented in recent lists of Kashmir Valley fish species, up to 42 species (Nath, 1986), and show clearly that biodiversity assessments cannot be made on the basis of literature studies only.

Although some species reported from the Kashmir Valley (*Garra gotyla*, *Labeo dyocheilus*, and the oreinins *Schizopygopsis stolickai*, *Diptychus maculatus*, and *Ptychobarbus conirostris*) were not found by the Uri AEIA, information about their supposed precise distribution in the valley is not available. None of them would be

Table 11.
Fishes collected in the vicinity of Shimla, November 1997 listed by station with number of specimens collected at each site. Sites 20 and 21 are in the Giri, Ganga drainage, Site 31 is in the Sutlej, Indus drainage. Opsarius *sp. cf.* barna *are juveniles.*

Family	*Species*	*Site 20*	*Site 21*	*Site 31*
Cyprinidae	*Tor chelynoides*	25	68	
Cyprinidae	*Schizothorax richardsonii*	65	361	60
Cyprinidae	*Crossocheilus gohama*			11
Cyprinidae	*Bangana dero*			6
Cyprinidae	*Labeo pangusia*			8
Cyprinidae	*Opsarius cocsa*	49		
Cyprinidae	*Opsarius sp. cf. barna*	14		
Cyprinidae	*Opsarius barna*	3		
Balitoridae	*Acanthocobitis botia*	6		
Balitoridae	*Schistura corica*	2		
Balitoridae	*Schistura montana*	12	16	
Balitoridae	*Schistura sp. cf. afasciata.*			2
Sisoridae	*Pseudecheneis sulcata*		4	
Sisoridae	*Glyptothorax pectinopterus*	4	2	14
Mastacembelidae	*Mastacembelus armatus*	1		

endemic to the Kashmir Valley, and all are actually widely distributed, but mainly in areas with colder climate. Habitats more suitable for the cold-water oreinins are available in upper reaches of tributaries falling into the Jhelum in the sampling area. If additional species are present upstream in tributaries, they obviously do not pass through or migrate in the Uri-Srinagar section of the Jhelum, and are thus not considered by us to be affected by the new dam.

Mirza & Ejaz (1992) provided a list of the fish species of the Kishen Ganga River which is very similar to our results. The Kishen Ganga is a tributary of the Jhelum joining it downstream of the Kashmir Valley, and is apparently similar in general features. Mirza & Ejaz (1992) found *Salmo trutta*, *Labeo dero* (probably *Bangana diplostoma*), *Schizothorax plagiostomus*, *S. labiatus*, *S. esocinus*, *S. micropogon* (probably *S. curvifrons*), *Botia birdi*, *Schistura nalbanti* (probably *S. punjabensis*), *Triplophysa microps*, *T. kashmirensis*, *Glyptothorax kashmirensis* and *Clupisoma naziri* Mirza & Awan, and added *Glyptosternon reticulatum* based on an earlier report. This list suggests that the fauna of the other major branch of the upper Jhelum is very similar to that of the Kashmir Valley, and that the inventory of the Kashmir Valley is close to or complete, and also suggests that the Kashmir Valley community is not unique. Only the schilbeid catfish, *Clupisoma naziri* represents a family not reported from the Kashmir Valley. *Clupisoma garua* (Hamilton) is reported to be common in fast flowing streams in the Punch Valley further downstream in the Jhelum drainage (Talwar & Jhingran, 1991).

Das & Nath (1971) listed 20 species of fishes from the Punch Valley, a left bank tributary to the Jhelum little upstream of the Mangla Dam. Of those, *B. dero* appears to be *B. dero* rather than *B. diplostoma*, according to the description by Das & Nath (1965). The *Schizothorax progastus* might be expected to be *S. labiatus*, but the description by Das & Nath (1965) suggests *S. plagiostomus* or *S. richardsonii.* The schilbeid catfish *Clupisoma sykesii* (Jerdon) must be *C. garua*. The identity of other species is occasionally doubtful (generic names corrected herein): *Puntius conchonius*, *Neolissochilus hexagonolepis* (McClelland) (some *Tor* species?), *Barilius vagra* (Hamilton), *Schizothorax plagiostomus*, *Garra gotyla*, *G. mullya* (Sykes), *Crossocheilus diplochilus*, *Triplophysa stolickai*, *Schistura punjabensis*, *S. prashari* (Hora), *Acanthocobitis botia*, *Glyptothorax kashmirensis*, *G. pectinopterus*, *Glyptosternon reticulatum*, *Channa striata* (Bloch), *C. gachua* (Hamilton), *Mastacembelus armatus.*

The Punch assemblage is richer than that of the Kashmir Valley, but contains same or similar taxa (oreinins; the same sisorid species, *Triplophysa*, *Schistura punjabensis, Bangana*) reflecting fast running waters. At the time of the survey, the Mangla dam was in effect, and Das & Nath (1971) note that after the construction of the dam, 'there has been a mass invasion of Poonch [=Punch] waters by large schools of fish (particularly comprised by *Garra gotyla* (Gray) and *Ophicephalus* [=*Channa*] *gachua* (Ham.))'. With *Barilius,* a possible *Neolissochilus* species, *Mastacembelus, Clupisoma,* and *Channa* (snakeheads), the Punch fauna gives the impression of warmer waters and availability of quiet water bodies. The lower Punch is rather a part of the Indus plain, and the inventory of Das & Nath (1971) may have been biased towards the upper portions. Nath (1986, with references) added several more species, including '*Labeo dyocheilus*', *Puntius ticto* (Hamilton), *Tor putitora*, *Triplophysa marmorata*, *T. vittata*, *T. kashmirensis*, *Schistura rupecula*, *Glyptothorax conirostris*, and *G. lineatus* (Day). We consider it unlikely that 'schools' of *Channa* and *Garra* would have been significant invaders, or that the Mangla Dam would have had much effect on the lower Punch fauna except for possibly adding introduced species. Shah (1996) reported that 52 fish species were found in the Mangla Dam after it was closed, several of them introduced for fish culture.

Mirza & Ahmad (1987) and Islam & Siddiqi (1971) reported on the fishes of the lower Jhelum between Mangla and the mouth in the Chenab. Of the 31 species, which appear to represent mainly market surveys, only three may be identical to Kashmir Valley species, viz. *Schizothorax plagiostomus*, *Tor putitora*, and '*Labeo dero*' (provided the name is applied on *Bangana diplostoma*). The earliest report on lower Jhelum fishes (Bleeker, 1854) listed 11 species that suggest a common lowland north Indian fauna unrelated to that of the Kashmir Valley, but the identifications are in need of revision.

Of the 14 species that we obtained from Shimla streams (Table 11), only two (*Schizothorax richardsonii* and *Glyptothorax pectinopterus*) were taken in both the Ganga and the Sutlej drainages, and only one species (*G. pectinopterus*) was also collected in the Jhelum River. Even though the sampling effort was limited, the distinctness from the Kashmir Valley fauna is indisputable.

It is notable that the Sutlej (Indus) sample contains mostly species well known from the Ganga-Brahmaputra drainage. The only poss-

ible endemic or genuinely Indus species may be *Schistura* sp. cf. *afasciata*. As already noted above, references to *Bangana dero*, *B. diplostoma*, *Labeo pangusia* and *L. dyocheilus* in local reports are so confused that it is difficult to obtain a clear picture of the actual distribution of the species involved.

With eight strictly benthic, three clearly bottom-oriented and benthivorous (*Bangana, Labeo*, and *Schizothorax*), two small surface feeders (*Opsarius* species) and only one small *Tor* species that appears to be a midcolumn dweller, the Shimla fauna is overall benthic and rheophilic just like in the Kashmir Valley. However, cold temperate elements other than *Schizothorax richardsonii* are absent. There are no *Glyptosternon* or *Triplophysa*, and actually only one species of *Schizothorax*. Differences from the Kashmir Valley are certainly to some extent explained by historical factors, the Shimla fauna being part of the general Ganga hillstream fauna, and the Kashmir Valley fauna derived from a geographically isolated upper Indus fauna. However, the Shimla fauna also represents a warmer temperature zone albeit the degree of rheophilic adaptation may be similar.

The systematic status of most of the Kashmir Valley species is in serious need of deeper study, including comparisons with populations or taxa from a much wider area. Although Silas (1960) considered 42% endemicity in the valley, the figure seems to be largely based on recognition of a large number of nominal *Schizothorax* species described by Heckel (1838), and reflects the danger of evaluating endemicity without extensive geographical comparisons and thorough systematic revision. Throughout this paper, numerous remarks have been made on taxonomic difficulties. The solution to those often requires extensive systematic revisions beyond the scope of this report. It is important to notice, however, that correct taxonomic identifications and species recognition, is of fundamental importance to species conservation. An endemism level of 42% should call for extreme conservation measures, and may turn out extremely costly. A level of 7–21% (1–3 species) is drastically less. Conservation measures for 1–3 species certainly also require serious consideration, but have better chances of being successful. The situation in the Kashmir Valley is not catastrophic even for the endemic species. However, available information suggests that one endemic species may be in peril, namely *Schizothorax niger*.

The only three species that may be endemic are *Schizothorax niger*, *Triplophysa marmorata* and *T. kashmirensis*, but it is likely that the *Triplophysa* species will be found to be identical to species reported from the Kabul and upper Indus drainages. *Schizothorax niger* is mainly a lacustrine species, and owing to the paucity of warm water lakes in the region, may indeed have a restricted distribution.

Aside from endemic species, the fauna is interesting for combining elements of the low-altitude Himalayan region (*Schizothorax, Triplophysa*, *Glyptosternon*), which is essentially rheophilic and moderately cold-water adapted, with a more southern, warm-water rheophilic fauna extending along the Himalayas (*Bangana diplostoma, Crossocheilus diplochilus, Glyptothorax* species, *Schistura punjabensis*). The species are mostly either restricted to the upper Indus or to the Indus drainage. Species richness and relative endemism are, however, low, and for want of comparative data from adjacent areas it is difficult to stress much conservation value for the Kashmir Valley fishes.

The Kashmir Valley fish community has low diversity at higher levels, with only four families and 2–5 species present of several genera. It is thus also systematically depauperate. The dominant rheophilic species, i.e., the *Schizothorax,* are r strategists covering the most important niches of new or catastrophic hill stream habitats, viz. herbivory, benthivory, planktivory, and piscivory. This may indicate that the Kashmir Valley fauna is populated only opportunistically by fishes. All native species (except *S. niger*) now present in the Valley are to some extent rheophilic and there is no way of deciding whether they colonise the Valley with some frequency, or whether they have been in the area continuously throughout the Pleistocene. Although oreinin fossils are reported from the Kashmir Valley (Hora, 1937), the total absence of extreme cold-water forms combined with the presence of widespread warm-water taxa suggests that the fauna may have evolved by post-glacial colonisation from downstream refugia. Testing of this hypothesis requires, however, better knowledge of the adjacent drainages and coordinated efforts to revise species apparently occurring in different drainages.

The Kashmir Valley is co-extensive with the Karewa sedimentary basin which is up to 800 m thick and predominantly lacustrine, the base dated to about 4 myBP (Gaur & Kotlia, 1987). The Karewa beds contain highly fragmentary fish fossils identified by Hora (1937) as of oreinin origin, and from his descriptions apparently definitely from cyprinid fishes. Gaur & Kotlia (1987) identified fragments as predominantly *Cyprinus carpio*, a fish certainly not occurring in the area until introduced in the

1950s. Their fish identifications, including also *Schizothorax esocinus, S. sinuatus, Schizopygopsis* sp., *Diptychus* sp., and Cypriniformes, indet., are thus open to doubt, and have probably been influenced by the Recent composition of the Valley fish fauna. The absence of obvious catfish remains suggests that the fauna may have been predominantly lacustrine and dominated by cyprinids, apparently oreinins judging from the few fossils examined by Hora (1937), but on the other hand specimens were identified mainly by scales and spines. Fish have apparently been present in the basin since the Pliocene. Pleistocene depositions suggests that the Kashmir Valley remained periglacial during glaciations, but subject to a colder and drier climate (Gaur & Kotlia, 1987; Bhattacharyya, 1989).

For many years, and despite all taxonomic problems, the Kashmir Valley fish fauna has remained one of the best known and most extensively studied fish faunas of the northern part of the Indian subcontinent. There are, however, very few collections from and nearly no useful, modern studies on adjacent drainages. Extensive comparative studies including other upper Indus communities will be instrumental to understanding the evolution of the seemingly unique fish community in the Kashmir Valley. The construction of the Uri hydroelectric power station does not alone threaten this diversity, and some of the negative effects can be overcome by fish ladders and fishing regulations. The combined effects of dams, barrages, pollution, introductions of exotic fishes and overfishing, however, pose a serious threat to the native aquatic life of the Kashmir Valley in a longer perspective.

Acknowledgements

The composition of the Uri AEIA field team has varied over the years, but all members deserve credit for their preservation skills producing so many straight specimens, which has greatly facilitated the study of the samples. In addition to one of the authors (EÅ), the field team consisted of Anders Silfvergrip (NRM), Olof Enderlein and Håkan Wickström (Institute of Freshwater Research), Pär-Erik Lingdell and Eva Engblom (Limnodata HB), Paul Andersson, and the Indian team led by A.R. Yousuf (Post Graduate Department of Zoology, University of Kashmir, Srinagar). The enthusiasm and patience of Lennart Nyman, project superviser, and the organisational skill and similar patience of field team leader Olof Enderlein, must be emphasised. Other important support was provided by Jan Essner (Swedish International Development Agency, SIDA, New Delhi), Anna Persson (Swedish Embassy, New Delhi), and B.S.K. Naidu (National Hydroelectric Power Company, Ltd, NHPC, New Delhi), who supervised all practical arrangements for the field work, B.A. Mir, Stig Holmqvist, and Claes Enander (Uri Civil), who hosted the field team in the Uri Camp, and fisheries officials in Shimla, especially J. Chauhan.

Ante Strand, Stockholm University Library, helped to locate literature. Oliver Crimmen and Patrick Campbell provided access to collections in the Natural History Museum (London) during a visit there. Barbara Herzig-Strachil, former curator of fishes at the Natural History Museum in Vienna (NMW), made available photos of type specimens of species described by Heckel and deposited in the NMW. Maurice Kottelat identified a subsample of nemacheilines and guided us in the quagmire of Indian fish nomenclature. Base maps were prepared by Pär-Erik Lingdell.

We divided the work between us as follows. SOK supervised the work and wrote the paper. BD and FF took all data from the *Schizothorax*. BD and SOK did most of the final sorting of weird-looking *S. plagiostomus* and *S. labiatus*. FF took photos of dead fish and made the drawings of pharyngeal bones. EÅ participated in the field work except in 1990, took photos of living fishes, wrote the progress reports, and performed the first sorting and rough identification of the material from each trip. The samples from the first field trip in 1990 were sorted and identified by Anders Silfvergrip, and his comments were influential on the succeeding taxonomic work strategy.

References

Ahmad, M.F., S.A. Khan & M.R. Mirza. 1976. A checklist of the freshwater fishes of the Indus Plain, Pakistan. Biologia, 22: 229–259.

Alcock, A.W. 1898. Report on the natural history results of the Pamir boundary commission. Office of the Superindendent of Government Printing, India, Calcutta.

Andersson, P. 1998. This volume.

Annandale, N. 1919. Note on fish of the genus *Discognathus* from India and Persia. Records of the Indian Museum, 18: 65–78.

Banarescu, P.M. 1986. A review of the species of *Crossocheilus*, *Epalzeorhynchos* and *Paracrossochilus* (Pisces, Cyprinidae). Travaux du Muséum d'Histoire Naturelle "Grigore Antipa", 28: 141–161.

Banarescu, P. & M.R. Mirza. 1972. *Noemacheilus alepidotus nalbanti* nova subsp., a new loach from Rawlakot, Azad Kashmir. Biologia, 18:121–123.

Banarescu, P. & T. Nalbant. 1966. The 3rd Danish Expedition to Central Asia. Zoological Results 34. Cobitidae (Pisces) from Afghanistan and Iran. Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening, 129: 149–186.

Banarescu, P.M. & T.T. Nalbant. 1995. A generical classification of Nemacheilinae with description of two new genera (Teleostei: Cypriniformes: Cobitidae). Travaux du Muséum d'Historia Naturelle "Grigore Antipa", 35: 429–496.

Beavan, R. 1872. Descriptions of two imperfectly known species of cyprinoid fishes from the Punjab, India. Proceedings of the Scientific Meetings of the Zoological Society of London, 1872: 150–153.

Berg, L.S. 1932. [Les poissons des eaux douces de l'U.R.S.S. et des pays limitrophes.] 3rd ed. Partie I. Izdanie Vsesoioznogo Instituta Ozernogo i Retjnogo Ribnogo Xozjaistva, Leningrad, pp. 1–543.

Berg, L.S. 1933. [Les poissons des eaux douces de l'U.R.S.S. et des pays limitrophes.] 3rd ed. Partie II. Izdanie Vsesoioznogo Instituta Ozernogo i Retjnogo Ribnogo Xozjaistva, Leningrad, pp. 547–899.

Bhattacharyya, A. 1989. Vegetation and climate during the last 30,000 years in Ladakh. Palaeogeography, Palaeoclimatology, Palaeoecology, 73: 25–38.

Bianco, P.G. & P. Banarescu. 1982. A contribution to the knowledge of the Cyprinidae of Iran (Pisces, Cypriniformes). Cybium (3), 6: 75–96.

Bleeker, P. 1854. Nalesingen op de ichthyologische fauna van Bengalen en Hindostan. Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen, 25 (8): 1–166.

Bleeker, P. 1859. Conspectus systematis Cyprinorum. Natuurkundig Tijdschrift voor Nederlandsch-Indië, 20: 421–441.

Bleeker, P. 1860. De Visschen van den Indischen Archipel, beschreven en Toegelicht. Deel II. Cyprini. Acta Societatis Scientiarum Indo-Neêrlandicae, 7: 1–492.

Bleeker, P. 1863a. Systema Cyprinoideorum revisum. Nederlandsch Tijdschrift voor de Dierkunde, 1: 187–218.

Bleeker, P. 1863b. Atlas Ichthyologique des Indes orientales néêrlandaises. Frédéric Muller, Amsterdam.

Bleeker, P. 1863c. Notice sur les noms de quelques genres de la famille des Cyprinoïdes. Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen. Afdeeling Natuurkunde, 15: 261–264.

Buchanan, F. 1807. A Journey from Madras through the countries of Mysore, Canara, and Malabar. Vol. III. T. Cadell and W. Davies; Black, Parry, and Kingsbury; London.

Cao W.-X. 1964. Schizothoracinae. Pp. 137–197 in Wu, H.W. (ed.), The cyprinid fishes of China, Vol. 1. Shanghai. [In Chinese.]

Chaudhuri, B.L. 1909. Descriptions of new species of *Botia* and *Nemacheilus*. Records of the Indian Museum, 3: 339–342.

Coad, B.W. 1981. Fishes of Afghanistan, an annotated check-list. National Museums of Canada Publications in Zoology, 14: 1–26.

Coad, B.W. 1996. Freshwater fishes of Iranian and Pakistani Baluchistan. Biologia, 42: 1–18.

Das, S.M. & S. Nath. 1965. The ichthyofauna of Poonch Valley (Jammu and Kashmir State). Kashmir Science, 2: 147–155.

Das, S.M. & S. Nath. 1971. A revision of fishes from Jammu province, India. Kashmir Science, 8: 1–22.

Das, S.M. & C. Rampal. 1968. The life-history of *Gambusia affinis Holbrooki* (Baird & Girard), the mosquito fish in Kashmir. Kashmir Science, 5: 36–43.

Das, S.M. & B.A. Subla. 1963. The ichthyofauna of Kashmir: Part I. "History, topography, origin, ecology and general distribution". Ichthyologica, 2: 87–106.

Das, S.M. & B.A. Subla. 1964. The ichthyofauna of Kashmir: Part II. "The speciation of Kashmir fishes with two new records of species". Ichthyologica, 3: 57–62.

Datta Munshi, J.S. & M.P. Srivastava. 1988. Natural history of fishes and systematics of freshwater fishes of India. Narendra Publ. House, Delhi.

Day, F. 1872. Monograph of Indian Cyprinidae, (Part VI). Journal of the Royal Asiatic Society of Bengal, 41: 318–326.

Day, F. 1875, 1876, 1877a, 1878a, 1888. The fishes of India; being a natural history of the fishes known to inhabit the seas and fresh water of India, Burma, and Ceylon. London, pp. 1–168 (1875),

169-368 (1876), 369–552 (1877), i-xx + 553–779 (1878), 779–816 (1888).

Day, F. 1877b. On the fishes of Yarkand. Proceedings of the Zoological Society of London, 1876: 781–807.

Day, F. 1878b. Scientific results of the Second Yarkand Mission; based upon the collections and notes of the late Ferdinand Stoliczka, PhD. Ichthyology. Government of India, Calcutta.

Di Caporiacco, L. 1933. Pesci raccolti durante la Spedizione italiana al Karakoram 1929-VII. Monitore Zoologico Italiano, 44: 339–344.

Enderlein, O. & A.R. Yousuf. 1998. This volume.

Eschmeyer, W.N. & R.M. Bailey. 1990. Genera of Recent fishes. Pp. 7–433 in Eschmeyer, W.N., Catalog of the genera of Recent fishes. California Academy of Sciences, San Francisco.

Fotedar, D.N. & M.Y. Qadri. 1974. Fish and fisheries of Kashmir and the impact of carp, *Cyprinus carpio*, on the endemic fishes. Journal of Science, 2: 79–89.

Fowler, H.W. 1924. Notes and descriptions of Indian fresh-water fishes. Proceedings of the Academy of Natural Sciences of Philadelphia, 76: 67–101.

Fowler, H.W. 1937. Zoological results of the Third de Schauensee Siamese Expedition. Part VIII. — Fishes obtained in 1936. Proceedings of the Academy of Natural Sciences of Philadelphia, 89: 125–264.

Gaur, R. & B.S. Kotlia. 1987. Palaeontology, age, palaeoenvironment and palaeoecology of the Karewa intermontane basin of Kashmir (J&K, India). Rivista Italiana di Paleontologia e Stratigrafia, 93: 237–250.

Girard, C.F. 1859. Ichthyological notices. Proceedings of the Academy of Natural Sciences of Philadelphia, 1859: 56–68, 100–104, 113–122.

Gistel, J. 1848. Naturgeschichte des Thierreichs, für höhere Schulen. Stuttgart. [Not seen.]

Gray, J.E. 1830-1832. Illustrations of Indian Zoology; chiefly selected from the collection of Major-General Hardwicke, F.R.S., Vol. I. London.

Gray, J.E. 1831. Description of twelve new genera of fish, discovered by Gen. Hardwicke, in India, the greater part in the British Museum. Zoological Miscellany, 1831: 7–10.

Gronovius, L.T. 1763. Zoophylacii Gronoviani fasciculus primus exhibens Animalia quadrupeda, Amphibia atque Pisces, quae in Museo suo adservat, rite examinavit, systematice disposuit, descripsit atque iconibus illustravit. Lugduni Batavorum.

Günther, A. 1861. List of the cold-blooded vertebrata collected by B.H. Hodgson, Esq., in Nepal. Proceedings of the Zoological Society of London, 1861: 213–227.

Günther, A. 1868. Catalogue of the fishes in the British Museum. Volume seventh. London.

Hamilton, F. 1822. An account of the fishes found in the river Ganges and its branches. Edinburgh & London.

Heckel, J.J. 1838. Fische aus Caschmir. Carl Freiherrn v. Hügel, Wien.

Heckel, J.J. 1843. Ichthyologie. Pp. 991–1099 in Russegger, J., Reisen in Europa, Asien und Afrika, mit besonderer Rücksicht auf die naturwissenschaflichen Verhältnisse der betreffenden Länder, unternommen in den Jahren 1835 bis 1841. Erster Band. Zweiter Theil. Stuttgart.

Heckel, J.J. 1844. Fische Kaschmir's nebst einem Anhang von drei neuen Arten aus Indien, gesammelt von Freiherrn Carl V. Hügel. Pp. 350–392 in Hügel, C. v., Kaschmir und das Reich der Siek. Vierter Band. Zweite Abtheilung. Hallberger'sche Verlagshandlung, Stuttgart.

[Heckel, J.J.] 1847. Naturhistorischer Anhang [to Ichthyologie in Heckel, 1843]. Pp. 207–360 in Russegger, J., Reisen in Europa, Asien und Afrika, mit besonderer Rücksicht auf die naturwissenschaflichen Verhältnisse der betreffenden Länder, unternommen in den Jahren 1835 bis 1841. Zweiter Band. Dritter Theil. Stuttgart.

Hora, S.L. 1921. Indian cyprinoid fishes belonging to the genus *Garra*, with notes on related species from other countries. Records of the Indian Museum, 22:633–687.

Hora, S.L. 1922a. Notes on fishes in the Indian Museum, III. On fishes belonging to the family Cobitidae from high altitudes in Central Asia. Records of the Indian Museum, 24: 63–83.

Hora, S.L. 1922b. Notes on fishes in the Indian Museum, IV. On fishes belonging to the genus *Botia* (Cyprinidae). Records of the Indian Museum, 24: 313–321.

Hora, S.L. 1923a. Notes on fishes in the Indian Museum, V. On the composite genus *Glyptosternon* McClelland. Records of the Indian Museum, 25: 1–44.

Hora, S.L. 1923b. Fish of the Salt Range, Punjab. Records of the Indian Museum, 25: 377–385.

Hora, S.L. 1933. Fish of Afghanistan. Journal of the Bombay Natural History Society, 36: 784–802.

Hora, S.L. 1934. The fish of Chitral. Records of the Indian Museum, 36: 279–319.

Hora, S.L. 1935. On a collection of fish from Afghanistan. Journal of the Bombay Natural History Society, 37: 784–802.

Hora, S.L. 1936a. On a further collection of fish from the Naga Hills. Records of the Indian Museum, 38: 317–331.

Hora, S.L. 1936b. Report on fishes. Part 1: Cobitidae. Memoirs of the Connecticut Academy of Arts & Sciences, 10: 299–321.

Hora, S.L. 1937. On fossil fish-remains from the Karewas of Kashmir. Records of the Geological Survey of India, 72: 178–187.

Hora, S.L. 1955. Fisheries of certain tropical fishes in natural cold waters of India. Journal of the Bombay Natural History Society, 53: 138–140.

Hora, S.L. & K.S. Misra. 1936. Sexual dimorphism in the carp *Labeo dero* (Hamilton). Records of the Indian Museum, 38: 341–342.

Hora, S.L. & K.S. Misra. 1938. Fish of Deolali. Part III. Journal of the Bombay Natural History Society, 11: 20–38.

Hora, S.L. & D.D. Mukerji. 1935. Pisces. Pp. 426–445 in Corporaal, J.B. (ed.), Wissenschaftliche Ergebnisse der Niederländischen Expeditionen in den Karakorum und die angrenzenden Gebiete 1922, 1925 und 1929/30. C. Visser und Jenny Visser-Hooft, Leipzig.

Hora, S.L. & D.D. Mukerji. 1936. Fish of the Eastern Doons, United Provinces. Records of the Indian Museum, 38: 133–146.

Hora, S.L., G.M. Mulik & H. Khajuria. 1955. Some interesting features of the aquatic fauna of the Kashmir Valley. Journal of the Bombay Natural History Society, 53: 140–143.

Hora, S.L. & E.G. Silas. 1952. Notes on fishes in the Indian Museum. XLVII. — Revision of the glyptosternoid fishes of the family Sisoridae, with descriptions of new genera and species. Records of the Indian Museum, 49: 5–29.

Howes, G.J. 1982. Anatomy and evolution of the jaws in the semiplotine carps with a review of the Genus *Cyprinion* Heckel, 1843 (Teleostei: Cyprinidae). Bulletin of the British Museum (Natural History) (Zoology series), 42: 299–335.

Howes, G.J. 1987. The phylogenetic position of the Yugoslavian cyprinid fish genus *Aulopyge* Heckel, 1841, with an appraisal of the genus *Barbus* Cuvier & Cloquet, 1816 and the subfamily Cyprininae. Bulletin of the British Museum (Natural History) (Zoology series), 52: 165–196.

Howes, G. J. 1991. Systematics and biogeography: an overview. Pp. 1–33 in Winfield, I.J. & J.S. Nelson (eds), Cyprinid fishes. Systematics, biology and exploitation. Chapman & Hall, London.

International Code of Zoological Nomenclature. 1985. Third Edition, London.

Islam, A. & M.N. Siddiqi. 1971. Fishes of Jhelum with some new records from the Punjab. Biologia, 17: 27–44. [Not seen.]

Jayaram, K.C. 1991. Revision of the genus *Puntius* Hamilton from the Indian Region. Records of the Zoological Survey of India, Occasional Paper, (135): 1–178.

Jhingran, V.G. 1991. Fish and fisheries of India. 3rd ed. Hindustan Publishing Corporation, Delhi.

Jordan, D.S. 1919. The genera of fishes part II. From Agassiz to Bleeker, 1833–1858, twenty-six years, with the accepted type of each. Leland Stanford Junior University Publications, University Series, Stanford University, California.

Jordan, D.S. & B.W. Evermann. 1917. The genera of fishes. From Linnaeus to Cuvier, 1758–1833, seventy-five years, with the accepted type of each. Leland Stanford Junior University Publications, University Series, Stanford University, California.

Karaman, M.S. 1971. Süsswasserfische der Türkei. 8. Teil. Revision der Barben Europas, Vorderasiens und Nordafrikas. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut, 67:175–254.

Kottelat, M. 1984. A review of the species of Indochinese fresh-water fishes described by H.-E. Sauvage. Bulletin du Muséum national d'Histoire Naturelle, (4) 6: 791–822.

Kottelat, M. 1997. European freshwater fishes. Biologia, 52, Suppl. 5: 1–271.

Koul, B.L. 1988. Observations on the spawning seasons and spawning grounds of Kashmir teleosts. Pp. 54–57 in Nath, S. (ed.), Recent advances in fish ecology, limnology and ecoconservation. Creative Publishers, New Delhi.

Lelek, A. 1987. The freshwater fishes of Europe. Vol. 9. Threatened fishes of Europe. Aula-Verlag, Wiesbaden.

Lingdell, P.-E. & E. Engblom. 1998. — This volume.

Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata. Holmiae.

M'Clelland, J. 1835. Description of the (so called) Mountain Trout of Kemaon. Journal of the Asiatic Society of Bengal, 4: 39–41.

McClelland, J. 1838. Observations on six new species of Cyprinidae, with an outline of a new classification of the family. Journal of the Asiatic Society of Bengal, 7: 941–948.

M'Clelland, J. 1839. Indian Cyprinidae. Asiatic Researches, 19: 217–471.

M'Clelland, J. 1842. On the fresh-water fishes collected by William Griffith, Esq., F.L.S. Madras Medical Service, during his travels under the orders of the Supreme Government of India, from 1835 to 1842. Calcutta Journal of Natural History, 2: 560–589.

MacCrimmon, H.R. & B. L. Gots. 1979. World distribution of Atlantic salmon, *Salmo salar*. Journal of the Fisheries Research Board of Canada, 36: 422–457.

McGregor Reid, G. 1985. A revision of African species of *Labeo* (Pisces: Cyprinidae) and a re-definition of the genus. Theses Zoologicae, volume 6, Verlag J. Cramer, Braunschweig.

Malik, G.M. 1966. A revision of the fishes of the genus *Oreinus* McCl. from Kashmir and in the Indian Museum, Calcutta, with the description of a new variety. Kashmir Science, 3: 125–144.

Menon, A.G. K. 1964. Monograph of the cyprinid fishes of the genus *Garra* Hamilton. Memoirs of the Indian Museum, 14: 173–260.

Menon, A.G. K. 1971. Taxonomy of fishes of the genus *Schizothorax* Heckel with the description of a new species from Kumaon Himalayas. Records of the Zoological Survey of India, 63: 195–208.

Menon, A.G. K. 1987. The fauna of India and the adjacent countries. Pisces Vol. IV Teleostei-Cobitoidea Part I Homalopteridae. Director, Zoological Survey of India, Calcutta.

Menon, A.G.K. 1993. The fauna of India and the adjacent countries. Pisces Vol. IV Teleostei-Cobitoidea Part 2 Cobitidae. Director, Zoological Survey of India, Calcutta.

Menon, M.A.S. 1955. Notes on fishes of the genus *Glyptothorax* Blyth. Records of the Indian Museum, 52: 27–54.

Mirza, M. R. 1966. Schizothoracinae of Quetta Division. Pakistan Journal of Scientific Research, 18: 26–29.

Mirza, M.R. 1972. Freshwater fishes of Baluchistan Province, Pakistan. Biologia, 18: 153–190.

Mirza, M.R. 1973a. Aquatic fauna of Swat Valley, Pakistan, Part I Fishes of Swat and adjoining areas. Biologia, 19: 119–144.

Mirza, M.R. 1973b. Discovery of frontoparietalle fontanel in *Puntius sophore* (Pisces, Cyrpinidae) [sic]. Pakistan Journal of Zoology, 5: 209.

Mirza, M.R. 1975. Freshwater fishes and zoogeography of Pakistan. Bijdragen tot de Dierkunde, 45:143–180.

Mirza, M.R. 1977. A note on the freshwater fish fauna of Pakistan. Pakistan Journal of Zoology, 9: 109–110.

Mirza, M.R. 1991. A contribution to the systematics of the schizothoracine fishes (Pisces: Cyprinidae) with the description of three new tribes. Pakistan Journal of Zoology, 23:339–341.

Mirza, M.R. & I. Ahmad. 1987. Fishes of the River Jhelum in Sargodha District. Biologia, 33: 253–263.

Mirza, M.R. & A.A. Awan. 1978. *Schizothorax skarduensis* (Pisces Cyprinidae), a new fish from Pakistan. Biologia, 24: 199–203. [Not seen.]

Mirza, M.R. & A.A. Awan. 1979. Fishes of the genus *Schizothorax* Heckel, 1838 (Pisces, Cyprinidae) from Pakistan and Azad Kashmir. Biologia, 25: 1–21.

Mirza, M.R. & M.I. Awan. 1976. Fishes of the Son-Sakesar Valley, Punjab, Pakistan, with the description of a new subspecies. Biologia, 22: 2–49.

Mirza, M.R. & M.N. Bhatti. 1996. Systematics and biology of the golden mahseer of the Indus river system. Biologia, 42: 31–35.

Mirza, M.R. & A. Ejaz. 1992. Fishes of the River Neelum with the record of *Botia birdi* and *Triplophysa microps* from Azad Kashmir. Pakistan Journal of Zoology, 24: 168–169.

Mirza, M.R. & K. Hameed. 1974. Sisorid fishes (Osteichthyes, Sisoridae) of Pakistan and Azad Kashmir. Biologia, 20: 83–97.

Mirza, M.R & N.N. Javed. 1986. A contribution to the fishes of the genus *Tor* Gray (Pisces, Cyprinidae) from Pakistan and Azad Kashmir. Biologia, 32, Suppl.: 71–82.

Mirza, M.R., M.N. Javed & M. Tariq. 1994. A note on the fish fauna of the river Zhob, Pakistan. Pakistan Journal of Zoology, 26: 189.

Mirza M.R. & K.M. Kashmiri. 1971. A note on the fishes of the genus *Glyptothorax* Blyth (Osteichthyes, Sisoridae) from West Pakistan with the description of a new subspecies. Biologia, 17: 87–93. [Not seen.]

Mirza, M.R., T.T. Nalbant & P.M. Banarescu. 1981. A review of the genus *Schistura* in Pakistan with the description of new species and subspecies (Pisces, Cobitidae, Noemacheilinae). Bijdragen tot de Dierkunde, 51: 105–130.

Mirza, M.R. & N. Saboohi. 1990. A note on the freshwater fishes of the River Dasht with the description of *Tariqilabeo* new subgenus (Pisces, Cyprinidae). Pakistan Journal of Zoology, 22: 405–406.

Mirza, M.R. & T. Saeed. 1988. A note on the systematics of the genus *Schizothorax* Heckel, 1838 (Pisces: Cyprinidae). Pakistan Journal of Zoology, 20:312–314.

Mirza, M.R. & S. Syed. 1995. *Botia javedi*, new species (Pisces: Cobitidae) from the River Kabul, Pakistan. Pakistan Journal of Zoology, 27: 378–379.

Misra, K.S. 1949. A note on the systematic position of two cyprinid fishes of the genus *Oreinus* McClelland from Kashmir. Journal of the Zoological Society of India, 1: 39–40.

Misra, K.S. 1962. An aid to the identification of the common commercial fishes of India and Pakistan. Records of the Indian Museum, 57: 1–320.

Misra, K.S. 1976. The fauna of India and the adjacent countries. Pisces (Second edition) Vol. III Teleostomi: Cypriniformes; Siluri. Director, Zoological Survey of India, Calcutta.

Mitchell, F.J. 1918. How trout were introduced into Kashmir. Journal of the Bombay Natural History Society, 26: 295–299.

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. Journal of the Bombay Natural History Society, 37: 38–80.

Mukerji, D.D. 1936. Report on fishes. Part II: Sisoridae and Cyprinidae. Memoirs of the Connecticut Academy of Arts & Sciences, 10: 323–359.

Nath, S. 1981. On a collection of cobitid loaches of the genus *Noemacheilus* van Hasselt from Poonch Valley (Jammu and Kashmir). Journal of the Bombay Natural History Society, 78: 612–613 [Not seen.]

Nath, S. 1986. A check-list of fishes of Jammu and Kashmir State (India) with remarks on the ichthyogeography of the state. Journal of the Zoological Society of India, 38: 83–98.

Nikolsky, A.M. 1897. [Reptiles, amphibiens et poissons, recueillis par Mr. N. Zaroudny dans la Perse orientale]. Annuaire du Musée Zoologique de l'Academie Impériale des Sciences de St.-Pétersbourg, 2: 306–348. [In Russian.]

Nyman, L. 1998. This volume.

Okazaki, T. 1984. Generic divergence and its zoogeographic implications in closely related species *Salmo gairdneri* and *Salmo mykiss*. Japanese Journal of Ichthyology, 31: 297–311.

Pandit, A.K, A.R. Yousuf, M.H. Balkhi & G. Firdous. 1992. Morphometric study of a schizothoracine fish of Kashmir. Pp. 11–16 in Yousuf, A.R., M.K. Raina & M.Y. Qadri (eds), Current Trends in Fish and Fishery Biology and Aquatic Ecology. University of Kashmir, Srinagar.

Qadri, M.Y., S. Mir & A.R. Yousuf. 1983. Breeding biology of *Schizothorax richardsonii* gray and hard [sic]. Journal of the Indian Institute of Science, 64C: 73–81.

Rahman, A.K.A. 1989. Freshwater fishes of Bangladesh. Zoological Society of Bangladesh, Dhaka.

Raina, H.S. 1988. Studies on rhythm of oocyte maturation and reproductive cycling in *Labeo dero* (Hamilton) (Teleostei) from a temperate Himalayan lake. Zoologischer Anzeiger, 220: 344–352.

Raina, M.K. & K. Narain. 1992. A key to the species of the genus *Schizothorax* Heckel, 1838 (Cyprinidae: Cypriniformes) from Kashmir with a note on its taxonomy. Pp. 3–10 in Yousuf, A.R., M.K. Raina & M.Y. Qadri (eds), Current Trends in Fish and Fishery Biology and Aquatic Ecology. University of Kashmir, Srinagar.

Rainboth, W.J. 1991. Cyprinids of South East Asia. Pp. 156-210 in Winfield, I.J. & J.S. Nelson (eds), Cyprinid fishes. Systematics, biology and exploitation. Chapman & Hall, London.

Rainboth, W.J. 1996. Fishes of the Cambodian Mekong. FAO species identification field guide for fishery purposes. Food and Agriculture Organization of the United Nations, Rome.

Rashida, M. R. Mirza & M. Saleem. 1996. A contribution to the systematics and biology of *Glyptothorax kashmirensis* Hora (Pisces: Sisoridae) from Pakistan and Azad Kashmir. Biologia, 42: 59–60.

Sauvage, H.E. 1880. Description de quelques poissons de la collection du Muséum d'histoire naturelle. Bulletin de la Société Philomatique de Paris (7), 4: 220–228.

Saxena, D.B. & B.N. Koul. 1966. Fish and fisheries of Jammu and Kashmir State. Part I. Fisheries resources and problems. Ichthyologica, 5: 45–52.

Shah, I.H. 1996. Fish and fisheries of Mangla reservoir: a review. Biologia, 42: 37–42.

Shaw, G.E. & E.O. Shebbeare. 1938. The fishes of northern Bengal. Journal of the Royal Asiatic Society of Bengal, Science, 3: 1–137.

Silas, E.G. 1960. Fish from the Kashmir Valley. Journal of the Bombay Natural History Society, 57: 66–77.

Smith, G.R. & R.F. Stearley. 1989. The classification and scientific names of rainbow and cutthroat trouts. Fisheries, 14: 4–10.

Steindachner, F. 1866. Ichthyologische Mittheilungen. (IX.). Verhandlungen d. k.k. zoologisch-botanischen Gesellschaft in Wien, 1866: 761–796.

Sufi, S.M.K. 1956. Revision of the Oriental fishes of the family Mastacembelidae. Bulletin of the Raffles Museum, Colony of Singapore, (27): 93–146.

Sunder, S. 1984. Studies on the maturation and spawning of *Schizothorax curvifrons* Heckel from River Jhelum, Kashmir. Journal of the Indian Institute of Science, 65C: 41–51

Svetovidov, A.N. 1933. Über den europäischen und ostasiatischen Karpfen (*Cyprinus carpio*). Zoologischer Anzeiger, 104: 257–261.

Taki, Y., A. Katsuyama & T. Urushido. 1978. Comparative morphology and interspecific relationships of the cyprinid genus *Puntius*. Japanese Journal of Ichthyology, 25: 1–8.

Talwar, P.K. & A.G. Jhingran. 1991. Inland fishes of India and adjacent countries, vols. 1–2. Oxford & IBH Publishing Co., New Delhi.

Tchang T.-L, Yueh T.-H. & Hwang C.-H. 1964. Notes on fishes of southern Tibet, China, with proposal of one new genus, *Tetrostichodon*. Acta Zoologica Sinica, 16:272–282. [In Chinese.]

Terashima, A. 1984. Three new species of the cyprinid genus *Schizothorax* from Lake Rara, Northwestern Nepal. Japanese Journal of Ichthyology, 31: 122–135.

Tilak, R. 1987. The fauna of India and the adjacent countries. Pisces (Teleostomi) Sub-family: Schizothoracinae. Director, Zoological Survey of India, Calcutta.

Tilak, R. & N.K. Sinha. 1975. A study of the fishes of the subfamily Schizothoracinae (Pisces, Cyprinidae). I. On the generic status of *Schizothorax* Heckel, 1838. Annales Zoologici, 32: 290–297.

Vass, K.K., H.S. Raina & S. Sunder. 1980. On the breeding behaviour of *Schizothorax niger* Hackel [sic] in Dal Lake. Journal of the Bombay Society of Natural History, 76: 179–184.

Venkateswarlu, T. 1984. Scientific, common and vernacular names of fishes of India. Records of the Zoological Survey of India, Occasional paper (56): 1–96.

Wickström, H. 1998. This volume.

Wu Y. & Wu C. 1992. The fishes of the Qinghai-Xizang Plateau. Sichuan Publishing House of Science & Technology, Chengdu, China. [In Chinese.]

Yousuf, A.R., M.H. Balkhi, M. F. Mir & G. Firdous. MS (not dated). Report on an interview survey among fishermen of the Jhelum River system, Kashmir, India. 7 pp., xeroxed.

Zan R., Song Z. & Liu W. 1986. Studies on karyotypes and nuclear DNA contents of some cyprinoid fishes, with notes on fish polyploids in China. Pp. 877-885 in Uyeno, R., R. Arai, T. Taniuchi & K. Matsuura (eds), Indo-Pacific Fish Biology: Proceedings of the Second International Conference on Indo-Pacific Fishes, Ichthyological Society of Japan, Tokyo.

Zhang C., Cai B. & Xu T. 1995. Fishes and fish resources in Xizang, China. Chinese Agriculture Press, Beijing. [In Chinese.]

Zhu S. 1989. The loaches of the subfamily Nemacheilinae in China (Cypriniformes: Cobitidae). Jiangsu Science and Technology Publishing House, Nanjing. [In Chinese.]

Zugmayer, E. 1909. Descriptions of four new cyprinoid fishes from High Asia. Annals and Magazine of Natural History (8), 4: 432–435.

Zugmayer, E. 1910. Beiträge zur Ichthyologie von Zentral-Asien. Zoologische Jahrbücher. Abteilung für Systematik, Geographie und Biologie der Tiere, 29: 275–298.

Zugmayer, E. 1912. Eight new fishes from Baluchistan. Annals and Magazine of Natural History (8), 10: 595–599.

Zugmayer, E. 1913. Wissenschaftliche Ergebnisse der Reise von Dr. Erich Zugmayer in Balutschistan 1911. Die Fische von Balutchistan. Mit einleitenden Bemerkungen über die Fauna des Landes. Abhandlungen der Königlich Bayerischen Akademie der Wissenschaften, Mathematisch-physikalische Klasse, 26 (6): 1–35.

Appendix 1

List of Uri AEIA samples preserved in the NRM, by species, in alphabetical order. See Enderlein & Yousuf (1998, this volume) for reports arranged by year and sampling event.

Bangana diplostoma

NRM	N	Site	Date
13127	1	2	21 Nov 1990
30144	2	6	7 Jul 1994
13249	6	6	18 Nov 1990
13248	3	6	21 Nov 1990
13250	1	6	21 Nov 1990
13129	1	11	27 Nov 1990
13247	4	Market	22 Nov 1990

Botia birdi

NRM	N	Site	Date
13101	1	7	17 Nov 1990
41073	1	8	23 Nov 1990
36920	1	13	27 Oct 1997

Carassius carassius

NRM	N	Site	Date
36691	1	7	18 Oct 1997
37329	9	13	27 Oct 1997
41261	1	13	27 Oct 1997

Crossocheilus diplochilus

NRM	N	Site	Date
30124	6	1	4 Jul 1994
30362	25	1	4 Jul 1994
20079	5	1	12 May 1993
37380	9	1	23 Oct 1997
36904	6	1	23 Oct 1997
30130	41	2	6 Jul 1994
30152	20	2	6 Jul 1994
30153	8	2	6 Jul 1994
20083	27	2	8 May 1993
37350	19	2	24 Oct 1997
20107	2	2B	8 May 1993
20084	7	2C	4 May 1993
30201	2	2C	11 Jul 1994
36918	1	2C	16 Oct 1997
30378	23	4	5 Jul 1994
13133	1	4	19 Nov 1990
36902	2	4	21 Oct 1997
30370	19	5	5 Jul 1994
20082	1	5	7 May 1993
13124	2	5	19 Nov 1990
37393	21	5	20 Oct 1997
37361	1	5	20 Oct 1997
40237	1	5	20 Oct 1997
30288	7	6	7 Jul 1994
30147	10	6	7 Jul 1994
30151	12	6	7 Jul 1994
37498	54	6	18 Oct 1997
13148	3	6	18 Nov 1990
13123	1	6	21 Nov 1990
30275	63	6B	9 Jul 1994
30138	21	7	7 Jul 1994
20081	41	7	13 May 1993
36943	32	7	17 Oct 1997
40155	26	7	17 Oct 1997
40269	2	7	17 Oct 1997
13149	3	7	18 Nov 1990
13145	2	8	23 Nov 1990
13251	5	8B	24 Nov 1990
13252	4	8B	24 Nov 1990
13130	7	10	26 Nov 1990
13256	107	10+10B	26 Nov 1990
13257	134	10+10B	26 Nov 1990
13258	122	10+10B	26 Nov 1990
13259	133	10+10B	26 Nov 1990
13260	104	10+10B	26 Nov 1990
13125	8	11	27 Nov 1990

Cyprinus carpio

NRM	N	Site	Date
30371	1	5	5 Jul 1994
30137	2	7	7 Jul 1994
30125	1	7	8 Jul 1994
20078	3	7	13 May 1993
37356	1	13	27 Oct 1997
37335	1	13	27 Oct 1997

Gambusia holbrooki

NRM	N	Site	Date
36692	3	7	18 Oct 1997
41246	2	7	18 Oct 1997
13100	2	7A	22 Nov 1990
13105	25	8	23 Nov 1990
13104	47	8	23 Nov 1990
13171	2	10+10B	26 Nov 1990
14835	5	10B	26 Nov 1990
14836	4	10B	27 Nov 1990

Glyptosternon reticulatum

NRM	N	Site	Date
20066	2	2B	8 May 1993
40235	3	2B	19 Oct 1997
40236	1	2B	19 Oct 1997
30285	3	3A	3 Jul 1994
20065	5	3A	6 May 1993
13102	1	3A	16 Nov 1990
37372	31	3A	22 Oct 1997
40242	2	3A	22 Oct 1997
37374	19	3B	22 Oct 1997
40241	1	3B	22 Oct 1997
13103	1	3B	22 Nov 1990
13172	3	3B	22 Nov 1990
37348	1	3C	25 Oct 1997
28197	1	12	29 Nov 1990

Glyptothorax kashmirensis

NRM	N	Site	Date
30392	1	2	6 Jul 1994
20057	1	2	8 May 1993
13106	1	5	19 Nov 1990
37338	1	5	20 Oct 1997
30289	3	6	7 Jul 1994
20056	18	6	11 May 1993
41245	1	6	11 May 1993
37355	3	6	18 Oct 1997
30270	31	6B	9 Jul 1994
30274	32	6B	9 Jul 1994
41304	20	6B	9 Jul 1994
41334	35	6B	9 Jul 1994
41335	35	6B	9 Jul 1994
13107	1	7	17 Nov 1990
13112	1	7	18 Nov 1990

Glyptothorax pectinopterus

NRM	N	Site	Date
30363	4	1	4 Jul 1994
20063	1	1	12 May 1993
36906	8	1	23 Oct 1997
30132	27	2	6 Jul 1994
30155	6	2	6 Jul 1994
20059	4	2	8 May 1993
37354	6	2	24 Oct 1997
37336	1	2	24 Oct 1997
20060	2	2B	8 May 1993
20058	1	2B	9 May 1993
36979	4	2B	19 Oct 1997
40130	1	2B	19 Oct 1997
13109	1	2B	21 Nov 1990
20062	1	2C	10 May 1993
36903	1	3B	22 Oct 1997
37347	1	3C	25 Oct 1997
40134	1	3C	25 Oct 1997
30379	3	4	5 Jul 1994
20061	2	4	11 May 1993
13111	1	4	19 Nov 1990
36734	3	4C	25 Oct 1997
40135	1	4C	27 Oct 1997
30375	1	5	5 Jul 1994
20064	1	5	7 May 1993
37397	1	5	20 Oct 1997
13110	3	6	18 Nov 1990
28195	1	7	18 Nov 1990

Puntius conchonius

NRM	N	Site	Date
36634	1	1	23 Oct 1997
36908	3	1	23 Oct 1997
13099	1	2	21 Nov 1990
37344	7	2	24 Oct 1997
37346	1	2	24 Oct 1997
37345	1	4	21 Oct 1997
13093	1	5	19 Nov 1990
37396	1	5	20 Oct 1997
40234	1	6	18 Oct 1997
37341	1	6	18 Oct 1997
30142	3	7	7 Jul 1994
36944	23	7	17 Oct 1997
40153	1	7	17 Oct 1997
36693	10	7	18 Oct 1997
13095	1	7A	22 Nov 1990
13094	1	8	23 Nov 1990
13098	19	8	23 Nov 1990
13273	2	8B	24 Nov 1990
13170	20	10+10B	26 Nov 1990
14837	16	10B	27 Nov 1990
13132	62	11	27 Nov 1990

Schistura punjabensis

NRM	N	Site	Date
30365	2	1	4 Jul 1994
20075	1	1	12 May 1993
30133	5	2	6 Jul 1994
30154	6	2	6 Jul 1994
20072	2	2	8 May 1993
20071	22	2B	8 May 1993
20076	5	2B	9 May 1993
36980	12	2B	19 Oct 1997
40131	1	2B	19 Oct 1997
13144	3	2B	21 Nov 1990
14839	1	2B	21 Nov 1990
30277	9	3A	3 Jul 1994
30286	6	3A	3 Jul 1994
13135	1	3A	16 Nov 1990
30280	1	3B	3 Jul 1994
37343	2	3C	25 Oct 1997
40133	1	3C	25 Oct 1997
40249	1	3C	25 Oct 1997
30380	4	4	5 Jul 1994
30372	1	5	5 Jul 1994
20073	1	5	7 May 1993
14830	1	6	17 Nov 1990
37342	1	6	18 Oct 1997
13142	4	6	18 Nov 1990
30141	1	7	7 Jul 1994
20074	2	7	13 May 1993
13138	4	7	17 Nov 1990
13143	2	7	18 Nov 1990
13139	3	7A	22 Nov 1990
20077	1	7B	13 May 1993

Schizothorax curvifrons

NRM	N	Site	Date
30398	1	1	4 Jul 1994
23002	1	1	12 May 1993
30128	16	2	6 Jul 1994
30157	5	2	6 Jul 1994
23007	2	2	8 May 1993
23009	1	2	8 May 1993
40248	1	2	24 Oct 1997
30161	2	2C	11 Jul 1994
30390	4	2C	11 Jul 1994
36917	1	2C	16 Oct 1997
23004	1	4	11 May 1993
36460	1	4C	27 Oct 1997
36461	1	4C	27 Oct 1997
40136	2	4C	27 Oct 1997
40137	1	4C	27 Oct 1997
40227	1	4C	27 Oct 1997
40228	1	4C	27 Oct 1997
30369	2	5	5 Jul 1994
31424	1	5	7 May 1993
13092	1	5	19 Nov 1990
30150	1	6	7 Jul 1994
37333	2	6	18 Oct 1997
13219	4	6	18 Nov 1990
13193	4	6	18 Nov 1990
13209	1	6	18 Nov 1990
13192	3	6	21 Nov 1990
13195	1	6	21 Nov 1990
30136	21	7	7 Jul 1994
23008	20	7	13 May 1993
40156	5	7	17 Oct 1997
40229	1	7	17 Oct 1997
40240	5	7	17 Oct 1997
40268	5	7	17 Oct 1997
40272	7	7	17 Oct 1997
40274	2	7	17 Oct 1997
13194	1	7	17 Nov 1990
13188	1	8	23 Nov 1990
13227	1	8B	24 Nov 1990
13119	6	10	26 Nov 1990
13121	5	10	26 Nov 1990
13122	1	10	26 Nov 1990
13218	11	10	26 Nov 1990
13190	1	10+10B	26 Nov 1990
13191	1	10+10B	26 Nov 1990
13199	3	10+10B	26 Nov 1990
13203	1	10+10B	26 Nov 1990
13214	11	10+10B	26 Nov 1990
13215	16	10+10B	26 Nov 1990
13216	10	10+10B	26 Nov 1990
13217	10	10+10B	26 Nov 1990
13224	7	10+10B	26 Nov 1990
13228	26	10+10B	26 Nov 1990
13230	6	10+10B	26 Nov 1990
13240	16	10+10B	26 Nov 1990

13241	20	10+10B	26 Nov 1990
13153	9	11	27 Nov 1990
13154	1	11	27 Nov 1990
13186	1	11	27 Nov 1990
23001	1	Market	11 May 1993
13206	1	Market	22 Nov 1990
13261	19	Srinagar	30 Nov 1990
13264	11	Srinagar	30 Nov 1990
13262	20	Srinagar	30 Nov 1990
13263	19	Srinagar	30 Nov 1990
41263	1	Srinagar	30 Nov 1990

Schizothorax esocinus

NRM	N	Site	Date
30121	1	1	4 Jul 1994
30361	1	1	4 Jul 1994
30126	8	2	6 Jul 1994
41267	1	2	6 Jul 1994
30156	2	2	6 Jul 1994
23015	4	2	8 May 1993
37362	1	2	24 Oct 1997
20122	2	2B	8 May 1993
20119	1	2C	4 May 1993
36919	1	2C	16 Oct 1997
30377	3	4	5 Jul 1994
13162	3	4	19 Nov 1990
37360	2	4	21 Oct 1997
30387	5	4B	11 Jul 1994
40226	1	4C	27 Oct 1997
30368	3	5	5 Jul 1994
20118	1	5	7 May 1993
13158	1	5	19 Nov 1990
37389	4	5	20 Oct 1997
37340	1	5	20 Oct 1997
30146	2	6	7 Jul 1994
20117	1	6	11 May 1993
37370	3	6	18 Oct 1997
37359	2	6	18 Oct 1997
36687	1	6	18 Oct 1997
13157	1	6	18 Nov 1990
13204	6	6	18 Nov 1990
30135	9	7	7 Jul 1994
31369	1	7	7 Jul 1994
20121	4	7	13 May 1993
20124	1	7	13 May 1993
23016	1	7	13 May 1993
20120	1	7	13 May 1993
36942	7	7	17 Oct 1997
36686	1	7	17 Oct 1997
40154	3	7	17 Oct 1997
40157	20	7	17 Oct 1997
40158	1	7	17 Oct 1997
40262	4	7	17 Oct 1997
40263	1	7	17 Oct 1997
13205	3	7	17 Nov 1990
13155	2	7	18 Nov 1990
13161	2	7	18 Nov 1990
13272	4	8B	24 Nov 1990
13198	2	8B	24 Nov 1990
13156	1	10	26 Nov 1990
13159	1	10+10B	26 Nov 1990
13269	1	10+10B	26 Nov 1990
20123	2	Market	11 May 1993
13239	6	Market	21 Nov 1990
14950	4	Market	21 Nov 1990
13160	7	Market	22 Nov 1990

Schizothorax labiatus

NRM	N	Site	Date
30123	1	1	4 Jul 1994
41301	1	1	4 Jul 1994
36632	1	1	23 Oct 1997
40279	1	1	23 Oct 1997
30127	8	2	6 Jul 1994
41343	6	2	6 Jul 1994
41339	1	2	6 Jul 1994
20105	4	2	8 May 1993
23013	1	2	8 May 1993
37352	1	2	24 Oct 1997
37358	1	2	24 Oct 1997
36689	1	2	24 Oct 1997
20116	1	2B	8 May 1993
36916	1	2C	16 Oct 1997
41345	1	4	5 Jul 1994
41347	3	4	11 May 1993
13165	2	4	19 Nov 1990
40278	3	4	21 Oct 1997
30389	3	4B	11 Jul 1994
40138	2	4C	27 Oct 1997
30367	3	5	5 Jul 1994
20112	3	5	7 May 1993
13167	1	5	19 Nov 1990
37392	2	5	20 Oct 1997
40277	1	5	20 Oct 1997
41336	1	5	20 Oct 1997
30287	1	6	7 Jul 1994
41265	1	6	7 Jul 1994
30148	3	6	7 Jul 1994
41341	1	6	11 May 1993
41340	1	6	11 May 1993
37364	14	6	18 Oct 1997
40231	1	6	18 Oct 1997
40232	1	6	18 Oct 1997
37367	3	6	18 Oct 1997
36684	1	6	18 Oct 1997
13166	3	6	18 Nov 1990
41338	1	6	18 Nov 1990
13197	7	6	18 Nov 1990
13202	3	6	18 Nov 1990
13242	1	6	21 Nov 1990
31370	6	7	7 Jul 1994
41342	1	7	13 May, 1993
36941	1	7	17 Oct 1997
40239	3	7	17 Oct 1997
40265	1	7	17 Oct 1997
40266	2	7	17 Oct 1997
13168	7	7	18 Nov 1990
13222	2	7	18 Nov 1990
41337	1	7	18 Nov 1990
13180	2	8	23 Nov 1990
13212	8	8B	24 Nov 1990
13243	2	8B	24 Nov 1990
13210	6	8B	24 Nov 1990
13231	5	8B	24 Nov 1990
13232	10	8B	24 Nov 1990
13233	6	8B	24 Nov 1990
13234	11	8B	24 Nov 1990
13235	14	8B	24 Nov 1990
13245	4	8B	24 Nov 1990
31422	7	8B	24 Nov 1990
41344	2	8B	24 Nov 1990
13229	4	10+10B	26 Nov 1990
13211	1	12	29 Nov 1990
23011	2	Market	11 May 1993
23012	1	Market	11 May 1993
13207	1	Market	21 Nov 1990
13237	2	Market	21 Nov 1990
13163	5	Market	22 Nov 1990
13164	6	Market	22 Nov 1990

Schizothorax niger

NRM	N	Site	Date
41260	1	4C	27 Oct 1997
37339	1	5	20 Oct 1997
13120	5	10	26 Nov 1990
37373	1	13	27 Oct 1997
37327	13	13	27 Oct 1997
37337	3	13	27 Oct 1997
40250	1	13	27 Oct 1997
40251	1	13	27 Oct 1997
40252	1	13	27 Oct 1997
40253	1	13	27 Oct 1997
40254	1	13	27 Oct 1997
41264	1	13	27 Oct 1997

Schizothorax plagiostomus

NRM	N	Site	Date
30122	6	1	4 Jul 1994
30360	11	1	4 Jul 1994
41266	1	1	4 Jul 1994
20102	9	1	12 May 1993
20094	5	1	12 May 1993
13175	7	1	20 Nov 1990
37381	7	1	23 Oct 1997
37331	21	1	23 Oct 1997
36905	2	1	23 Oct 1997
36462	1	1	23 Oct 1997
30391	8	2	6 Jul 1994
30158	3	2	6 Jul 1994
20101	12	2	8 May 1993
20110	24	2	8 May 1993
13178	1	2	21 Nov 1990
13187	1	2	21 Nov 1990
13189	2	2	21 Nov 1990
37369	14	2	24 Oct 1997
37326	1	2	24 Oct 1997
36688	1	2	24 Oct 1997
37371	5	2	24 Oct 1997
37332	6	2	24 Oct 1997
20108	10	2B	8 May 1993
20109	3	2B	8 May 1993
23006	1	2B	8 May 1993
40132	1	2B	19 Oct 1997
20099	4	2C	4 May 1993
23005	2	2C	4 May 1993
30160	2	2C	11 Jul 1994
37499	4	2C	16 Oct 1997
30281	1	3A	3 Jul 1994
30282	24	3A	3 Jul 1994
30283	19	3A	3 Jul 1994
20095	3	3A	6 May 1993
20096	4	3A	6 May 1993
37328	23	3A	22 Oct 1997
40243	1	3A	22 Oct 1997
30278	6	3B	3 Jul 1994
37330	14	3B	22 Oct 1997
36949	1	3B	22 Oct 1997
13181	6	3B	22 Nov 1990
37368	5	3C	25 Oct 1997
30376	9	4	5 Jul 1994
20106	2	4	11 May 1993
13184	13	4	19 Nov 1990
13225	3	4	19 Nov 1990
37357	6	4	21 Oct 1997
30388	5	4B	11 Jul 1994
36459	1	4C	27 Oct 1997
30366	16	5	5 Jul 1994
20100	17	5	7 May 1993
20113	1	5	7 May 1993
13173	5	5	19 Nov 1990
13183	16	5	19 Nov 1990
13221	6	5	19 Nov 1990
37382	12	5	20 Oct 1997
37383	10	5	20 Oct 1997
37390	6	5	20 Oct 1997
37391	37	5	20 Oct 1997
37394	7	5	20 Oct 1997
36685	1	5	20 Oct 1997
30145	9	6	7 Jul 1994
20093	7	6	11 May 1993
20092	1	6	11 May 1993
37351	3	6	18 Oct 1997
37353	1	6	18 Oct 1997
37363	2	6	18 Oct 1997
37365	20	6	18 Oct 1997
37366	12	6	18 Oct 1997
40230	1	6	18 Oct 1997
40233	1	6	18 Oct 1997
13174	3	6	18 Nov 1990
13177	13	6	18 Nov 1990
13236	5	6	18 Nov 1990
31368	5	7	7 Jul 1994
20091	16	7	13 May 1993
20111	13	7	13 May 1993
40238	2	7	17 Oct 1997
40264	9	7	17 Oct 1997
40267	9	7	17 Oct 1997
40271	9	7	17 Oct 1997
40275	4	7	17 Oct 1997
13196	1	7	17 Nov 1990
13176	8	7	18 Nov 1990
13182	11	7	18 Nov 1990
13185	11	7	18 Nov 1990
13226	14	7	18 Nov 1990
13244	4	8B	24 Nov 1990
13238	1	8B	24 Nov 1990
13246	5	8B	24 Nov 1990
13220	2	12	29 Nov 1990
13213	6	Market	21 Nov 1990
13208	1	Market	22 Nov 1990

Schizothorax sp. (mostly juveniles)

NRM	N	Site	Date
20115	1	1	12 May 1993
13266	6	1	20 Nov 1990
31423	17	1	20 Nov 1990
40280	1	1	23 Oct 1997
31203	3	2	6 Jul 1994
30140	1	2	6 Jul 1994
23010	12	2	8 May 1993
13267	20	2	21 Nov 1990
36982	1	2B	19 Oct 1997
13223	134	2B	21 Nov 1990
14838	6	2B	21 Nov 1990
30159	1	2C	11 Jul 1994
30149	1	2C	11 Jul 1994
37376	1	2C	16 Oct 1997
37377	1	2C	16 Oct 1997
30276	3	3A	3 Jul 1994
31415	2	3A	3 Jul 1994
30284	19	3A	3 Jul 1994
13265	48	3A	16 Nov 1990
30279	15	3B	3 Jul 1994
37349	4	3C	25 Oct 1997
41346	2	4	5 Jul 1994
41348	2	4	11 May 1993
31419	4	4	19 Nov 1990
30374	8	5	5 Jul 1994
37395	4	5	20 Oct 1997
41287	1	6	11 May 1993
30139	52	7	7 Jul 1994
40273	2	7	17 Oct 1997
40276	4	7	17 Oct 1997

31420	25	7	18 Nov 1990
13268	6	8B	24 Nov 1990
31418	5	8B	24 Nov 1990
37334	1	13	27 Oct 1997
40255	1	13	27 Oct 1997
30401	1	No data	1994

Triplophysa kashmirensis

NRM	N	Site	Date
30364	14	1	4 Jul 1994
20068	1	1	12 May 1993
13131	3	1	20 Nov 1990
30134	5	2	6 Jul 1994
20070	5	2	8 May 1993
20069	7	2B	8 May 1993
36981	1	2B	19 Oct 1997
13146	3	2B	21 Nov 1990
30381	6	4	5 Jul 1994
30373	3	5	5 Jul 1994
30143	5	7	7 Jul 1994
13141	1	7	18 Nov 1990
13147	1	7	18 Nov 1990
13137	1	7A	22 Nov 1990
20067	4	7B	13 May, 1993
13253	1	8B	24 Nov 1990
13271	2	8B	24 Nov 1990
40221	6	10	26 Nov 1990
40222	1	10	26 Nov 1990
13255	18	12	29 Nov 1990
41243	1	12	29 Nov 1990
41247	10	12	29 Nov 1990
41248	20	12	29 Nov 1990
36900	2	13	27 Oct 1997
36901	1	13	27 Oct 1997
36696	1	13	27 Oct 1997
40256	1	13	27 Oct 1997

Triplophysa marmorata

NRM	N	Site	Date
13270	1	6	18 Nov 1990
41268	11	7	7 Jul 1994
13126	12	10	26 Nov 1990
41244	1	10	26 Nov 1990
41262	1	10	26 Nov 1990
13169	1	10+10B	26 Nov 1990
13140	1	11	27 Nov 1990
36907	1	13	27 Oct 1997