

# FRESHWATER FISHES AND ZOOGEOGRAPHY OF PAKISTAN

by

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## CONTENTS

Abstract . . . . .	144
I. Introduction . . . . .	144
Acknowledgements . . . . .	145
II. Geographical account . . . . .	145
Location . . . . .	145
Physiography . . . . .	145
1. The Northern Montane Region . . . . .	146
2. The northwestern hills . . . . .	147
3. The Submontane Indus Region . . . . .	147
4. The Indus plain . . . . .	147
5. The Baluchistan Plateau . . . . .	148
Climate . . . . .	148
Natural vegetation . . . . .	148
Hydrography . . . . .	149
1. The Indus drainage system . . . . .	149
2. Internal drainage system . . . . .	150
3. Coastal drainage system . . . . .	150
III. Historical sketch . . . . .	150
IV. Freshwater fishes of Pakistan . . . . .	152
Class Teleostomi . . . . .	152
Subclass Actinopterygii . . . . .	152
Cohort Taeniopaedia . . . . .	153
Cohort Archaeophylaces . . . . .	153
Cohort Euteleostei . . . . .	153
Superorder Ostariophysii . . . . .	153
Order Cypriniformes . . . . .	153
Order Siluriformes . . . . .	160
Superorder Acanthopterygii . . . . .	162
Order Atheriniiformes . . . . .	163
Order Channiformes . . . . .	163
Order Synbranchiiformes . . . . .	163
Order Perciformes . . . . .	163
Class Elasmobranchii . . . . .	164
V. Zoogeography of Pakistan . . . . .	164
Zoogeographical classification of freshwater fishes . . . . .	165
Primary freshwater fishes . . . . .	165
Secondary freshwater fishes . . . . .	166
Peripheral freshwater fishes . . . . .	166

Zoogeographical divisions of Pakistan . . . . .	167
I. High Asian Division . . . . .	167
II. Aba-Sinh Division . . . . .	168
III. Northwestern Montane Division . . . . .	169
IV. Indus plain, adjoining hills & South Baluchistan Division . . . . .	171
V. Northwestern Baluchistan Division . . . . .	171
VI. Discussion and conclusion . . . . .	174
I. Oriental Region . . . . .	175
II. West Asian Transitional Region . . . . .	176
Summary . . . . .	176
References . . . . .	176

### ABSTRACT

The freshwater fish fauna of Pakistan is briefly discussed. It is predominantly South Asian but High Asian and West Asian elements are also present. The African element is hardly perceptible. Five zoogeographical divisions of Pakistan are proposed on the basis of the composition of their fish fauna: (I) the High Asian Division; (II) the Aba-Sinh Division; (III) the Northwestern Montane Division; (IV) the Indus plain and adjoining hills Division; and (V) the Northwestern Baluchistan Division. South Asia and High Asia are recognized as two subregions within the Oriental Region, while West Asia is treated as a transitional region.

### I. INTRODUCTION

No comprehensive report on the freshwater fishes of Pakistan has been published ever since the inception of this country from the partition of the South Asian subcontinent in 1947. Day (1889) reported about 100 species of freshwater fishes from this area, some of which have proved invalid by subsequent researchers. N. Ahmad (1963) listed 104 species (including 3 exotic species) from this region. Qureshi (1965) published a monograph on the common freshwater fishes of Pakistan. He, however, did not mention a number of important species including the entire subfamily of the snow trouts (*Schizothoracinae*), which abounds in the northern and northwestern parts of Pakistan, viz. Northern Areas, North West Frontier Province, northern Punjab and northeastern Baluchistan. In fact, the subfamily *Schizothoracinae* is the sole representative of the family *Cyprinidae* in the Trans-Himalayan part of Pakistan. Recently, however, a number of important papers on the freshwater fishes of various regions of Pakistan have been published: Ahmad & Mirza (1963b) on the hillstream fishes of Kaghan and Swat; Mirza (1972) on the freshwater fishes of Baluchistan; Mirza (1973 a & b), and Mirza & Ahmad (1974)

on the fishes of North West Frontier Province; and Ahmad & Khan (1974) on the freshwater fishes of Sind. In addition, several new species and subspecies have been described from various parts of this country by Ahmad & Mirza (1963a); Banarescu & Mirza (1965); Mirza (1967); Mirza & Naik (1969); Mirza, Banarescu & Nalbant (1969, 1970); Mirza & Kashmiri (1971); Banarescu & Mirza (1972); and Mirza & Awan (1973). Thus, there is an urgent need for the preparation of a comprehensive report on the freshwater fishes of Pakistan.

The work on the freshwater fishes of Pakistan, which has been published so far, does not include the zoogeographical aspect with the exception of a few cursory remarks by some ichthyologists (Day, 1880; Zugmayer, 1913; Hora, 1937a; Berg, 1940; and Mirza, 1974). The importance of freshwater fishes in zoogeography has, nowever, been widely recognized both by ichthyologists and general zoogeographers. The freshwater fishes are closely bound to the land masses and are inescapably confined to their own drainage system. Their dispersal from one drainage system to another can only be affected by the hydrographic changes caused by geological and climatic factors (exception made, of course, for human interference). So they are most likely to preserve old distribution patterns (Darlington, 1957; Lagler et al., 1962; Norman & Greenwood, 1963). Most of the rivers fall directly or indirectly into the sea but migration from one river system to another is not facilitated by this means, since the sea offers an effective barrier to most of the freshwater fishes. On the basis of the salt tolerance, the freshwater fishes are generally classified into three main categories: the primary freshwater fishes have little or no tolerance for salt waters; the secondary freshwater fishes are confined to the inland waters but have slightly better tolerance for salt waters;

and the peripheral freshwater fishes are primarily marine but spend some time in fresh water during their life histories (De Beaufort, 1964). Myers (1949) has further classified the peripheral fishes but others treat them together. Obviously the primary freshwater fishes are the most important in zoogeography, while the peripheral freshwater fishes have little or no importance from the zoogeographical point of view as marine routes are available to them for dispersal. The secondary freshwater fishes are less important as compared with the primary freshwater fishes but do give some clues about the zoogeography of certain areas (Lagler et al., 1962).

Wallace (1876) made a distinction between geographical distribution and local distribution. Darlington (1957) carried it still further and recognized three levels: a) geographical distribution, in the broadest sense, over the whole world, b) regional distribution in selected areas of the world, and c) local distribution which includes species geography and ecology. In the present report the emphasis is mainly laid upon the regional distribution, although the other aspects are also discussed wherever it is found necessary.

The present publication is based upon the investigations, on systematics, ecology and zoogeography of the freshwater fishes of Pakistan, undertaken by the author since June, 1961. Almost all the regions of Pakistan have been surveyed during this period and the data have been published in various short reports. Since the present report is mainly concerned with the zoogeographical aspect of the freshwater fishes of Pakistan, the origin, evolution and dispersal of the higher taxa are discussed. Except one elasmobranch fish, *Pristis microdon* Latham, 1794, which is known to ascend the river Indus up to a considerable distance beyond the tidal influence, all the other species belong to the infraclass Teleostei, subclass Actinopterygii and class Teleostomi. The classification followed for the teleostean fishes is mainly after Greenwood et al. (1966, 1967), modified after Rosen & Patterson (1969) and Rosen & Greenwood (1970). Since the distribution of fishes is mainly determined by the hydrography and the other physiographic features of land, a brief geographical account is also given before the systematic and zoogeographical discussions are attempted. The work done on the systematics of the freshwater fishes of Pakistan so far, is very briefly reviewed in a historical sketch. Finally, on the basis of the present study, different zoogeographical divisions are proposed.

The present investigations are based on the fishes collected by the author and his associates from different regions of Pakistan, and also on the fish collection present in the Museum of the Zoological Survey Department of Pakistan, Karachi.

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## II. GEOGRAPHICAL ACCOUNT

### *Location*

The Islamic Republic of Pakistan is situated roughly between 24° to 37° N and 61° to 78° E. It is surrounded by Afghanistan and China in the north, Kashmir and India in the east, India and the Arabian Sea in the south, and by Iran and Afghanistan in the west (see fig. 1). Its area is about 806,000 km<sup>2</sup> (310,400 square miles).

### *Physiography*

Before discussing the physiography of Pakistan, a brief account of the physiography of the continent of Asia is necessary. Structurally the northern part of Asia is one stable block of ancient rock which was once a part of the great northern continent, Angaraland. Immediately south of this area lies a system of folded mountains extending from the Mediterranean to the Pacific coast. The Himalayas and the other mountain ranges of Pakistan are a part of this system. South of this complex of folded mountains another block of hard ancient rock is situated which once was part of the great southern continent, Gondwanaland, extending from Brazil to Australia. The Arabian Plateau and the Deccan Plateau are

remnants of this southern block. Between Angaraland and Gondwanaland, there was a shallow sea, known as the Tethys Sea, in the Mesozoic Era and part of the Tertiary. The folded mountains emerged from this sea. Sandy material brought down by the rivers accumulated on the bottom of the sea and formed sandstone. In other parts of the sea, shells and bones of sea animals accumulated and formed limestone. In this way a thick layer of sedimentary rock accumulated between the two ancient continents. With the cooling of its interior, the earth contracted and the two continental blocks were drawn towards each other. The sedimentary rock between them was compressed and contorted to form the folded mountains. These movements in the earth's crust also caused the northern part of the Deccan Plateau to subside and depress. On this subsided

part of the Deccan Plateau materials brought by the rivers from the folded mountains were deposited. Thus, the Indo-Gangetic plain was formed which consists of layers of alluvial deposits over 2000 m thick (K. S. Ahmad, 1969).

Pakistan has a diverse and varied topography ranging from the snow-clad peaks of the Himalayas, the Karakoram and the Hindu Kush in the north to almost near the sea level in the south at the Rann of Kutch. About 40 % of its area is composed of the Indus plain with mountains in the north and west and a plateau in the southwest. It can be divided into the following physiographic regions (cf. figs. 1-2):

#### 1. The Northern Montane Region. —

This region comprises the Himalayan and the Trans-Himalayan ranges and their valleys in the

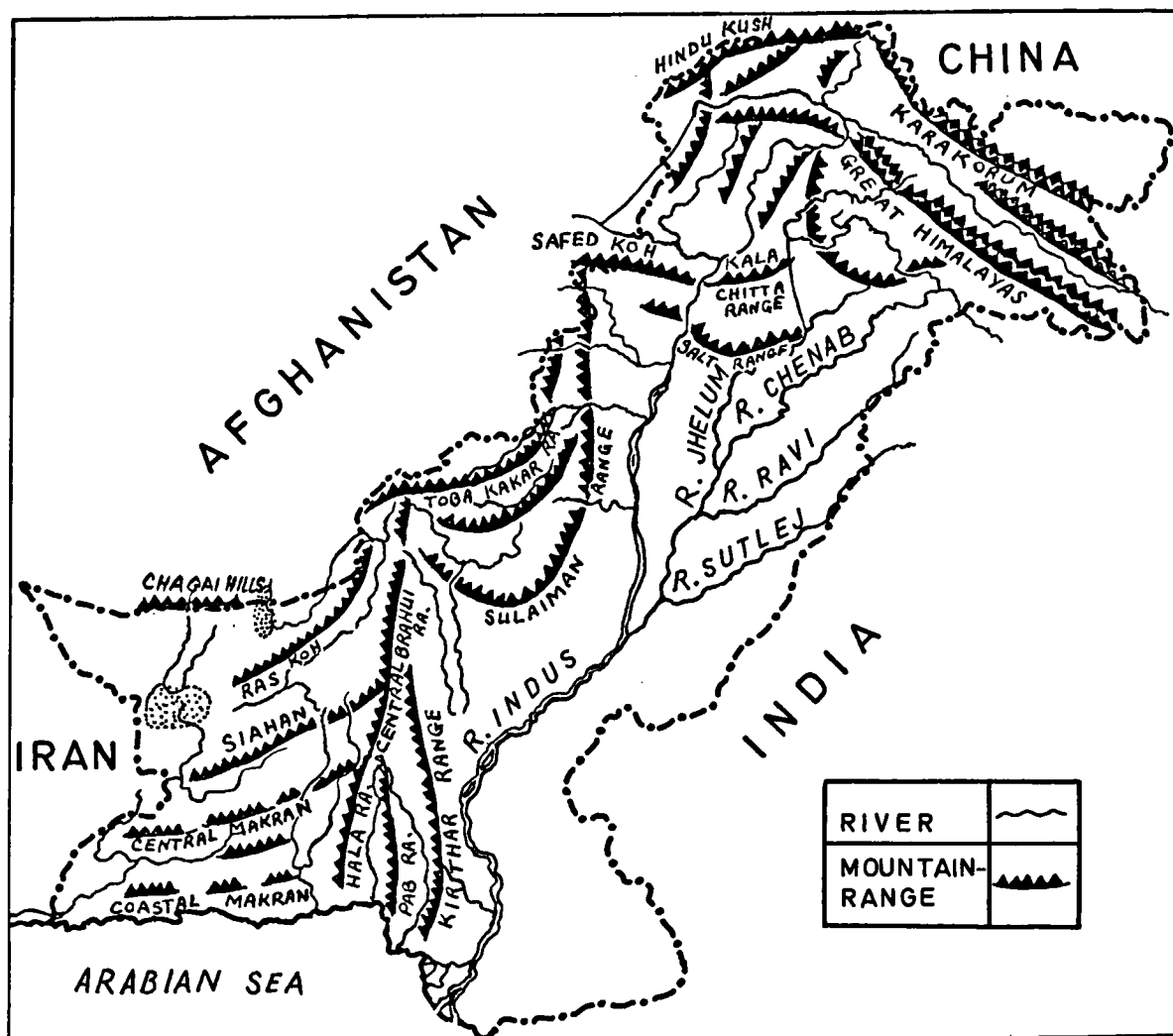


Fig. 1. Physiography of Pakistan and Kashmir.

extreme north of Pakistan. The Himalayas comprise a series of several more or less parallel or even converging ranges intersected by different valleys and plateaus. Their width ranges from 160 to 402 km, while the length of the central axial range, the "Great Himalaya", is about 2412 km from the great bend of the river Indus in the northwest to the similar bend of the Brahmaputra in the southeast (Wadia, 1966). The connecting link between the Himalayas and the Trans-Himalayan ranges is the great mass of the Pamirs — the roof of the world. From the Pamirs the Himalayas extend to the southeast as an unbroken wall of snow-covered mountains with an average height of more than 6100 m (Nanga Parbat 8127 m). North of the Himalayas lies the great range of the Karakoram. It extends from the Pamirs in the northwest to the river Shyok in the southeast. Its length from the river Hunza to the river Shyok is about 402 km. Many of its peaks are above 7315 m, with K2 (Mt. Godwin Austen) 8610 m, the second highest peak in the world. The Hindu Kush Range runs from the Pamirs to the southwest into Afghanistan. Its highest peak — Tirich Mir (7700 m) — is situated in Chitral, Pakistan.

## 2. The northwestern hills. —

From the Hindu Kush, three minor ranges (falling from 7700 m in the north to about 1525 m in the south) run southwards to the river Kabul between which flow the rivers Swat, Panjkora and Chitral. South of the river Kabul lies the Safed Koh Range which runs from west to east and varies from 4734 m in the west to about 1000 m in the angle between the Kabul and the Indus in the east. Across the river Indus, it becomes continuous with an outer Himalayan arc through the Kala Chitta Range up to the Jhelum gorges. The area between the Safed Koh and the river Tochi is a tangle of arid hills up to about 1515 m, with a general west/east trend cut across from northwest to southeast by the upper Kurram Valley. In the Bhattani country, between Bannu and Jandola, there seems to be an arcuate arrangement convex to the west; the spurs of the northwestern hills and of the Salt Range nearly meet in the Pezu gap between Bannu and Dera Ismail Khan (Spate & Learmouth, 1967). Between the rivers Kurram and Gomai lies the hilly area of Waziristan. In the extreme south of Waziristan, the hills merge into the Sulaiman Range between the Punjab and northern Baluchistan.

## 3. The Submontane Indus Region. —

This area consists of: (a) the three plains of Peshawar, Kohat and Bannu, all west of the Indus; (b) the Potwar Plateau, east of the Indus; (c) the Salt Range, marking off the southern boundary of the region both in Bannu and Potwar and cut through by the Indus at the head of the remarkable Kalabagh reentrant (Spate & Learmouth, 1967).

The Vale of Peshawar forms a semicircle of lowland of some 5700 km<sup>2</sup>, surrounded by mountains on three sides and open on the fourth side towards the Potwar Plateau in the east. It is drained by the rivers Kabul, Swat, Kalpani and their tributaries.

The Kohat Valley lies higher than the Peshawar and Bannu plains. It is about 460 m high and is broken by west/east limestone ridges. It is drained by the Kohat Toi which falls into the Indus.

The Bannu plain is an alluvial basin drained by the rivers Kurram and Tochi. The bordering mountains rise abruptly from the basin edge and isolate it more or less completely from the Punjab plain.

The Potwar Plateau lies in the north of the Salt Range. Its height varies from 350 to 600 m. There are a few outlying spurs of the Salt Range in the south and of the Kala Chitta Range in the north. The streams there are generally deep set and of no use for irrigation. The valleys of the Haro and Soan pass across the plateau from the foot hills in the east, to the Indus in the west.

The Salt Range starts in the Jogi Tilla and Bokrala ridge near Jhelum and runs southwest to the north of the river Jhelum for some distance before turning northwest to cross the Indus near Kalabagh (K. S. Ahmad, 1969). West of the Indus, it continues south into the districts of Bannu and Dera Ismail Khan. It is sharply marked off from the Punjab plain in the south but sinks more gently towards the Potwar Plateau in the north. These hills are generally from 750 to 1000 m high but at Sakesar they reach up to 1525 m. The Salt Range consists of two parallel ridges, in between which an elevated fertile plateau is situated, intersected by ravines and salt lakes.

## 4. The Indus plain. —

The Indus plain starts from foot hills of the Himalayas and the Salt Range in the north and continues to the Rann of Kutch and the Arabian Sea in the south. It is surrounded by the hills of the North West Frontier Province and Baluchistan

in the west and passes into the vaster Indo-Gangetic plain. The Indo-Gangetic plain forms a great curve from the Arabian Sea to the Bay of Bengal and is regarded as one of the most important plains of the world. It is more than 3200 km long and from 240 to 480 km broad and has several outstanding features like the dead flatness and gentle seaward slope, the sudden rise of the Himalayas from the level plain, the immense thickness, enormous width and uniform character of the alluvium (Stamp, 1967).

K. S. Ahmad (1969) divided the Indus plain into the upper Indus plain or the Punjab plain and the lower Indus plain or the Sind plain. The Punjab plain comprises the northern part of the Indus plain. It is drained by the Indus and its five main tributaries: the Jhelum, the Chenab, the Ravi, the Beas and the Sutlej. The river Beas lies in Indian territory. The northeastern part of the Punjab plain is about 200 to 300 m high but it gradually decreases in its height towards its southern extremity. The level plain consists chiefly of fertile alluvia deposited by the rivers. Near Sargodha, Chiniot and Sangla some old dry hills rise above the plain. The submontane plain west of the Indus, known as the Derajat or Sulaiman piedmont, is divided into the districts of Dera Ghazi Khan and Dera Ismail Khan. The piedmont deposits slope gradually down to the plain.

The lower Indus plain comprises the Sind Province. It differs from the Punjab plain in that it has been formed by the changing course of the lower part of the Indus. West of the Indus lies the high Kirthar piedmont which slopes gently to the river alluvium. The central Sind plain between the left bank of the Indus and the Thar Desert is a level alluvial plain laid down by the Indus. In the east it merges into desert where the landscape is dominated by sand dunes (K. S. Ahmad, 1969).

#### 5. The Baluchistan Plateau. —

The plateau of Baluchistan lies west of the Sulaiman and Kirthar ranges. The Sulaiman Range runs from south of the river Gomal in the north to the Marri-Bugti hills in the south for a distance of about 480 km. Its highest peak at Takht-i-Sulaiman is about 3360 m, but generally these mountains are about 1830 to 2135 m high. At the southern end of the Sulaiman Range, the Marri and Bugti hills run from southeast to northwest pointing towards the Quetta node. Between the Kunder and the Zhob tributaries of the Gomal runs the Toba Kakar Range from the northeast to the southwest for a distance of about 480 km.

It is up to 2745 m high. The west boundary of the Sind plain is formed by the Kirthar hills which are about 2120 m high. The Baluchistan Plateau is more than 600 m high. Several ranges run across it from northeast to southwest. The Toba Kakar and the Chagai ranges separate it from Afghanistan. The Central Brahui Range runs from northeast to southwest. It is about 362 km long with some of its peaks above 3355 m. It is almost continuous with the Toba Kakar Range in the northeast and with the Kharan-Makran ranges in the southwest thus isolating northwestern Baluchistan from the rest of Pakistan. The area in the northwest is almost desert with a few salt lakes or Hamuns like the Hamun-i-Lora and the Hamun-i-Mashkel. Several ranges like the Ras Koh, the Siahan Range, the Central and the Coastal Makran ranges run from east to west with a somewhat southward trend. The ranges are higher in the northeast and gradually decrease in elevation in the southwest.

#### *Climate*

The climate of Pakistan varies from place to place according to the latitude and the altitude. The whole area lies between roughly 24° and 37° latitude and hence in the warm temperate zone. A large part is situated away from the sea and there are high mountain ranges in the north and west. On the whole, the climate is arid and extreme or of continental type. The temperature varies from several degrees below freezing point in the montane zone during winter to as high as 47°C in some areas in the plains during summer. The rainfall also varies greatly from 7.5 cm in northwestern Baluchistan to about 150 cm in certain areas in the Punjab and North West Frontier Province. Humidity is generally low and the air is dry for the greater part of the year except in the coastal areas where there is plenty of moisture in the air. K. S. Ahmad (1951, 1969) divided this area into four major climatic regions.

#### *Natural vegetation*

Due to low rainfall the natural vegetation generally consists of tough grass or dry stunted bushes with some trees in the less dry areas. In the montane regions there are patches of pine forest. K. S. Ahmad (1969) has classified the forests of Pakistan into 5 categories: (1) the northern and northwestern mountain forests; (2) the Baluchistan hill forests; (3) the riverain or Bela forests; (4) the tidal forests; (5) the Rakhs. The

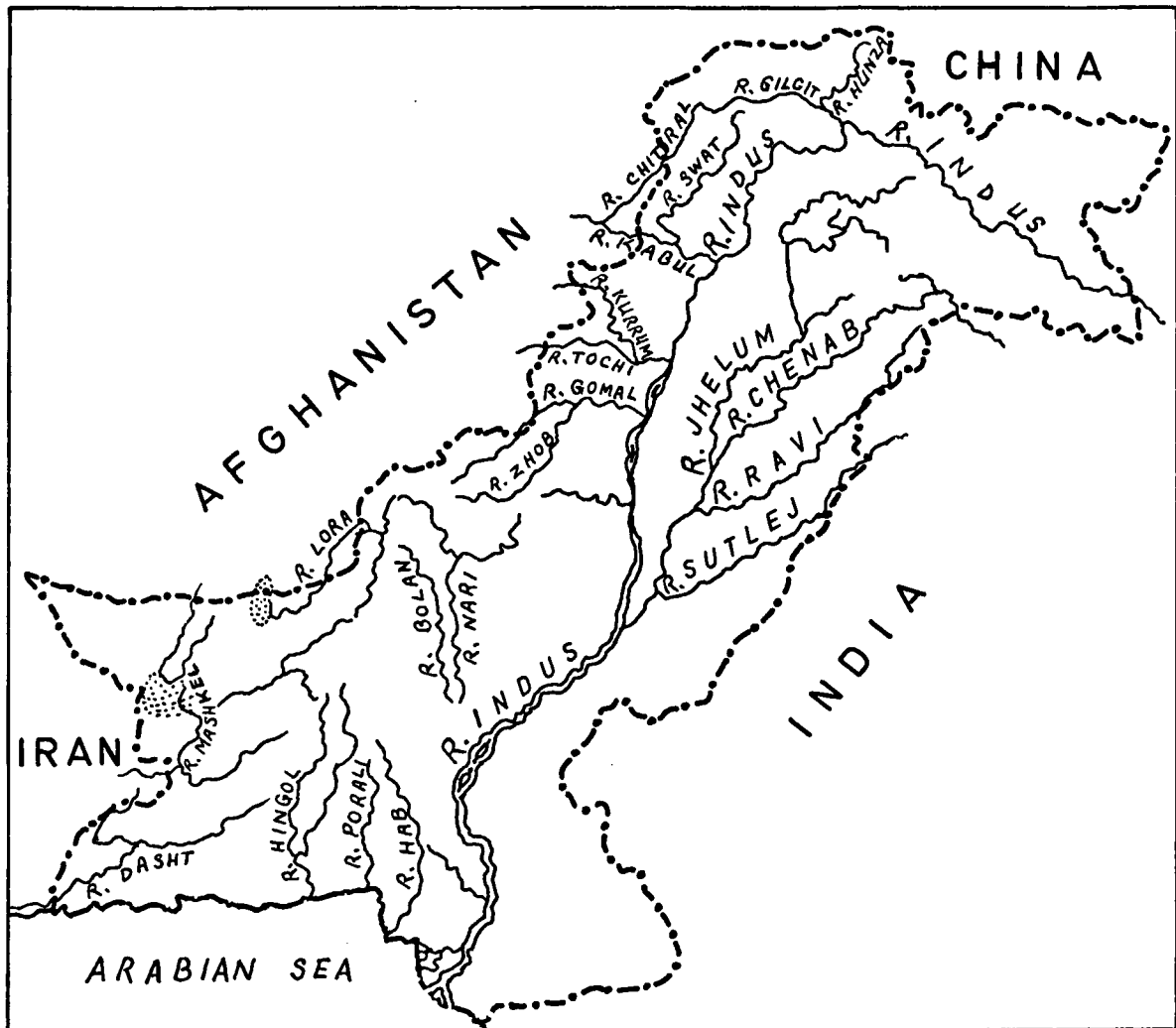


Fig. 2. Hydrography of Pakistan and Kashmir.

area with forests has considerably increased in Pakistan since its independence.

### Hydrography

The water resources of Pakistan are many in the form of streams, rivers, lakes and ponds. The streams and rivers can be grouped into three major systems:

#### 1. The Indus drainage system. —

This system includes the river Indus and its tributaries. The Indus rises on the northern flanks of the Kailas Range in western Tibet. It flows in a great northerly curve until it breaks through that range and is joined by the Gartang. The main river flows between the Kailas and the eastern Ladakh ranges. This long course is generally from southeast to northwest but south of

the lake Panggong it makes a sharp bend and cuts through the Ladakh Range, which it pierces again above the Shyok confluence. The Ladakh Range between the two Indus gaps forms a straight wall of 304 km. The Indus and the Shyok flow parallel 32 to 48 km apart, and between them the range rises 3050 to 5790 m. In the east, in Ladakh, the whole catchment as well as the immediate valley is narrow, but in Baltistan the catchment widens. At Skardu, where the northern Shigar comes in a few kilometres below the Shyok, the Indus is often about 152 m wide and about 3 m deep, even in winter (Spate & Learmouth, 1967). The river Gilgit, after receiving the river Hunza in the north, joins the Indus at Bunji. The Indus here turns to the south round the Nanga Parbat. A few miles downstream the Indus receives the river Astor from the south. From Bunji, the Indus

flows south and west, and passes into the North West Frontier Province. In this province, it receives several small streams including the river Brandu from the Buner Valley and the Siran from the Hazara District. At Attock it receives the river Kabul, which is joined by the rivers Chitral, Swat and Kalpani in its way. From Attock the Indus flows towards the south and receives the rivers Kurram, Tochi and Gomal from the west and the Haro and Soan from the east in addition to several small hill torrents. Near Mithankot, it receives the combined Panjnad, formed by the union of the five great tributaries of the Indus: the Jhelum, the Chenab, the Ravi, the Beas and the Sutlej. The river Beas joins the Sutlej in Indian territory. The Ravi and the Jhelum join the Chenab before it joins the Sutlej near Uch to form the Panjnad. Below Mithankot, the river Indus flows very slowly, and ultimately falls into the Arabian Sea near Karachi. It receives several hill torrents from the Kirthar Range in the west.

## 2. Internal drainage system. —

There are several streams in northwestern Baluchistan which neither join any big river like the Indus, nor fall directly into the sea. Instead they end in the salt lakes or hamuns. Several small streams in the Quetta Pishin District, arising from the Toba Kakar Range, join to form the river Lora. The Lora, after receiving several small tributaries, enters into Afghanistan. After taking a small turn it again passes into the Chagai District where it flows into the Hamun-i-Lora. A similar river is the Mashkel. It originates from eastern Iran and passes into western Baluchistan near the border of the Kharan and Makran districts. After receiving the river Rakhshan from northern Makran, it passes northwards and flows into the Hamun-i-Mashkel. In addition there are other, small seasonal streams, which form temporary lakes or hamuns in northwestern Baluchistan.

## 3. Coastal drainage system. —

Several small rivers and streams in the coastal areas flow directly into the Arabian Sea. Among these, the rivers Hab, Porali, Hingol, and Dasht are the most important.

There are several large lakes in the Sind Province, including the Manchar and Kalri lakes which are the largest lakes in Pakistan.

## III. HISTORICAL SKETCH

The ichthyological studies in the South Asian subcontinent were initiated in Bengal when Hamilton (1822) published his monumental monograph on the "Fishes of the Ganges". This great ichthyologist was one of the pioneers in this field. According to Myers (1964:41): "As the year 1851 dawned, it is notable that in only three minor areas of the earth had the greater part of the fish fauna been discovered, named, and described. One comprised the coastal seas and fresh waters of western Europe, where ichthyology was born. Another was the coastal part of New England and New York, where the work had been done by Mitchill, LeSueur, De Kay, and Storer. The third, almost unbelievably, was the valley of the Ganges, in India, where a remarkable Scotsman, Francis Buchanan Hamilton, had done the job with the help of no one, by 1822".

The earliest work on the fishes of some parts of Pakistan was done by M'Clelland (1842), who published a report on the fishes collected by William Griffith during the years 1835 to 1842 from some areas of Pakistan, Afghanistan and India. He reported 11 species from the Bolan Pass and Quetta, and 25 species from the Khyber Pass including 4 new species: *Opsarius bicirratatus*, *Silurus indicus*, *Ophiocephalus indicus* and *O. montanus*. Another collection of fishes was made by Sir Alexander Burnes during the years 1837-1838 from the rivers Kabul and Indus. The record of these fishes was preserved in the form of 32 drawings present in the library of the Asiatic Society of Bengal. Hora (1927) identified these fishes from the plates and reported on them.

In the second half of the nineteenth century, Francis Day dominated in the field of ichthyology of South Asia. His early work was mostly confined to areas other than Pakistan. In 1871-72, he mentioned 16 species of fishes from the Punjab and Sind in his monograph on the Indian Cyprinidae, and described the following new species: *Barbus (Puntius) punjabensis*, *Barilius (Pachystomus) modestus*, *Chela punjabensis*, *Cirrhhina sindensis*, *Scaphiodon watsoni*, *S. irregularis*, *Barbus (Puntius) waageni*. In his monumental book on the "Fishes of India" (1875-78), he described about 100 species of freshwater fishes from this area, out of which the following species were described as new: *Labeo caeruleus*, *L. microphthalmus*, *L. nigripinnis*. In 1880, he reported 26 species of fishes from the Sind-Baluchistan hills, and described 2 new species, viz. *Scaphiodon microph-*



*thalmus* and *S. milesi* from Quetta and Gwadar, respectively. In 1889, in the "Fauna of British India" series, he reported the same species which were described in the "Fishes of India". Günther (1889) reported 3 species of fishes from north-western Baluchistan. Out of these, two species, viz. *Cirrhitina afghana* and *Noemacheilus kessleri* were described as new. Alcock (1898) reported 5 species from the Yasin River (Northern Areas), including one new species, *Noemacheilus yasinensis*.

In the first half of the present century some additions were made to our knowledge of the fishes of Pakistan by several ichthyologists. Jenkins (1910) described some fishes from the western part of Baluchistan including one new species, *Scaphiodon baluchiorum*. Zugmayer (1912) described the following 6 new fishes from fresh waters of Baluchistan: *Scaphiodon watsoni* var. *belensi*, *S. daukessi*, *Labeo gedrosicus*, *L. macmahoni*, *Noemacheilus baluchiorum* and *N. brahui*. In 1913 he published his comprehensive paper on the fishes of Baluchistan in which he reported 35 species of freshwater fishes in addition to the marine species. Regan (1914) recorded 6 species from southern Waziristan, including two new species, *Discognathus wanae* and *Schizocypris brucei*. While a student at Government College, Lahore, Hora (1919) wrote a report on the fish fauna of Lahore, which he submitted in partial fulfilment for the M.Sc. degree of the Punjab University. He recorded 42 species of fishes from Lahore. This report, however, was not published. In 1921, he described one new species, viz. *Garra montis-salsi*, from the Salt Range, of the Punjab. In 1923, in his paper on the fishes of the Salt Range, he described two new species, *Scaphiodon readingi* and *Noemacheilus punjabensis*, in addition to some already known species. Prashad & Mukerji (1930) recorded 35 species of fishes from the Manchar Lake. In 1933, Hora redescribed 3 loaches from Baluchistan (Hora, 1933a), and one new species, *Noemacheilus prashari* from Kohat (Hora, 1933b). In 1934, he described 5 species from Chitral including one new species, *Noemacheilus choprai*. H. Khan (1934) published his observations on the habits and habitats of 51 species of fishes from the Punjab. Hora & Mukerji (1935) reported *Noemacheilus gracilis* Day, 1876 from a stream about 13 km from Attock, and Mukerji (1936) recorded *Schizothorax longipinnis* Heckel, 1838 from Skardu. N. Ahmad (1943) published a monograph on the fishes of Lahore in which he described 49 species from the areas within a radius of about 24 km

from the Zoological Laboratories of Government College, Lahore. H. Khan (1946) made a fishery survey of the river Indus within the limits of the Punjab and listed only the common game fishes.

The Islamic Republic of Pakistan came into existence in 1947. The work on the freshwater fishes of West Pakistan was very slow during the first 15 years. In 1956, Sufi revised the Oriental fishes of the family Mastacembelidae and described the variations in the 3 species of this genus found in Pakistan. One year later he recorded 33 species of fishes from the Kinjer Lake in Sind (Sufi, 1957a); in another paper (Sufi, 1957b), he reported *Glyptothorax cavia* (Hamilton, 1822) and *G. telchitta* (Hamilton, 1822) from the Peshawar and Hyderabad divisions, respectively. In 1958, he recorded *Chela laubuca* (Hamilton, 1822) from the Khairpur and Hyderabad divisions. Misra (1962) mentioned only 70 species of freshwater fishes from West Pakistan.

During the years 1962-1970, the progress in the field of ichthyology was quite rapid in Pakistan. In 1962, Siddiqi listed 18 species from the river Bolan; R. M. L. Khan (1962) reported 29 species from the Marala-Ravi Link Canal; Sufi (1962) revised the fish fauna of the Manchar Lake and recorded 43 species; Sajid (1962) recorded *Pristis microdon* Latham, 1794 from the river Indus near Hyderabad at a distance of about 293 km from the sea. In 1963, Sufi published a checklist of the fishes of the genus *Glyptothorax* Blyth, 1860 and recorded *G. platypogonoides* (Bleeker, 1855) from the Peshawar Division; N. Ahmad (1963) reported 104 species of freshwater fishes from West Pakistan; Ahmad & Mirza (1963a) described 4 loaches of the genus *Noemacheilus* Van Hasselt, 1823 from Swat, including two new loaches, *N. naziri* and *N. punjabensis naseeri*; in another paper (Ahmad & Mirza, 1963b) they recorded 9 species from Kaghan and Swat. In 1964, Ahmad & Mirza reported 3 species of fishes from the river Kurram near Parachinar. In 1965, Qureshi published a monograph on the common freshwater fishes of Pakistan; Banareescu & Mirza (1965) described a new loach, *Noemacheilus lindbergi*, from Afghanistan and West Pakistan; Mirza (1965) reported 18 species from the Kalat District; Mirza & Naik (1965a & b) recorded 7 species from the Quetta Pishin District, and 22 species from the Sibi District. In 1966, Mirza described 4 species of snow trouts from the Quetta Division; Mirza & Naik (1966) recorded 8 species of fishes from the Loralai District. In 1967, Mirza described a new mah-seer, *Tor zhobensis*, from the river Zhob in Balu-

chistan; Mirza & Naik (1967) revised the fish fauna of the river Bolan and recorded 12 species in addition to those already reported by Siddiqi (1962). In 1968, Mirza discussed the hill-stream fishes from West Pakistan and Azad Kashmir. In 1969, Mirza, Banareescu & Nalbant described two new loaches, *Noemacheilus pakistanicus* and *N. harnaiensis*, from Baluchistan; Mirza (1969) published a paper on the genus *Cyprinion* Heckel, 1842 from West Pakistan and merged *C. irregulare* (Day, 1872) with *C. watsoni* (Day, 1872); Mirza & Naik (1969) recorded 10 species including one new catfish, *Glyptothorax naziri*, from the Zhob District. In 1970, Mirza, Banareescu & Nalbant described 3 new loaches: *Noemacheilus anambarensis*, *N. horai machensis* and *N. rupecola alepidotus* from West Pakistan, and redescribed *N. baluchiorum* Zugmayer, 1912; Mirza (1970a) revised the fishes of Lahore and recorded 16 species in addition to those already reported by N. Ahmad (1943); Mirza (1970b) described 5 species of the subfamily Cultrinae from West Pakistan; Mirza (1970c) recorded *Amblyceps mangois* (Hamilton, 1822) from the upper Jhelum Canal near Shadiwal, Gujrat District.

During the year of 1971, the east wing of Pakistan was separated as an independent state, Bangla Desh. In 1971, Mirza & Kashmiri listed 5 species of the genus *Glyptothorax* from Pakistan and described a new subspecies, viz. *G. conirostris punjabensis*; Mirza merged *Systomus chrysopterus* McClelland, 1839 with *Cyprinus sophore* Hamilton, 1822 (Mirza, 1971a); Mirza (1971b) published a list of freshwater fishes of the Makran District; Islam & Siddiqi (1971) reported 21 species from Jhelum. In 1972, Mirza & Angvi added two more species to the fish fauna of the Zhob Valley; Banareescu & Mirza (1972) described a new loach, viz. *Noemacheilus alepidotus nalbanti* from the northern Punjab and Azad Kashmir; Mirza (1972) published a comprehensive report on 70 species of freshwater fishes of Baluchistan; Khatoon & Baqai (1972) reported 33 species of freshwater aquarium fishes from Sind. In 1973, Mirza published a report on the fish of the Swat Valley and adjoining areas (Mirza, 1973a); Mirza & Awan (1973) reported on a small collection of fishes from the river Indus near Kalabagh, and described two new species, *Nangra robusta* and *Clupisoma naziri*; Mirza & Kashmiri (1973) recorded 28 species from the river Soan; Mirza (1973b) recorded 12 species from the Kohat District and the adjoining areas; Hussain (1973) listed 65 species from the Sind Province in his paper on the fish

and fisheries of the lower Indus Basin. In 1974, Mirza discussed the ichthyogeography of Baluchistan and the adjoining areas of the Indus plain; Mirza & Hameed (1974) described 13 species of sisorid fishes from Pakistan and Azad Kashmir; Mirza & Ahmad (1974) listed 41 species from the Dera Ismail Khan District; Ahmad & Khan (1974) reported 75 species of freshwater fishes from the Sind Province.

#### IV. FRESHWATER FISHES OF PAKISTAN

In Pakistan, there are 156 species of freshwater fishes, belonging to 68 genera, 22 families, 9 orders and 2 classes. Since the present paper deals with the zoogeographical aspect, the exotic species of fishes have been omitted. More emphasis has been given to the ostariophysian fishes (the 47 ostariophysian genera are particularly emphasized) and other primary freshwater fishes, as they are more important from the zoogeographical point of view.

##### Class TELEOSTOMI

The class Teleostomi includes the bony fishes. They are known from the Lower Devonian when four major groups were already well established. This means that they originated much earlier, perhaps in the Ordovician, over 400 million years ago (Lagler et al., 1962). According to McAllister (1968), the subclass Actinopterygii appears to be the most primitive among the subclasses of the Teleostomi. The bony fishes of Pakistan belong to this subclass.

##### Subclass ACTINOPTERYGII

The actinopterygian fossils are known from the Middle Devonian. During this period, these fishes were already represented by several diverse forms. This suggests that they might have evolved much earlier. The earliest actinopterygian fishes were the palaeoniscoids, which were probably the ancestors of the remaining groups like the Chondrostei, Holostei and Teleostei. These three groups represent three gradations in organizational level, the teleostean fishes have passed from Chondrostei through Holostei to Teleostei.

The teleostean fossils are known from the Middle Triassic. Some of them are quite advanced in the details of their structure; it appears that the shift from the holostean to the teleostean level began much earlier, perhaps in the late Palaeozoic (Greenwood et al., 1966; Myers, 1967). According

to Myers (1967: 617), "There is indirect but mounting evidence that the Mesozoic origin of many teleostean groups occurred in fresh water. This is especially true of the great superorder Ostariophysi, to which the majority of the primary freshwater fishes of the world belong, and particularly true of the included order Cypriniformes — the caracoids, cyprinoids, and their very close relatives." From the very beginning, three distinct lines of teleostean fishes are perceptible, which have been recognized as three cohorts by Greenwood et al. (1967), viz. Taeniopaedia, Archaeophylaces and Euteleostei.

#### Cohort TAENIOPAEDIA

This cohort includes the elopomorphs, the eels and the herring-like fishes, which are primarily marine. Some of them are very primitive and quite close to the holostean level of organization. This cohort is represented by two species in the inland waters of Pakistan. One of them, *Gadusia chapra* (Hamilton, 1822), is widely distributed in the Indus plain while the other, *Macrura* (= *Hilsa*) *ilisha* (Hamilton, 1822), is now restricted to the lower parts of the river Indus up to the Ghulam Muhammad Barrage, though it has been found up to Bhakkar in the past (Hora, 1927). They belong to the family Clupeidae, order Clupeiformes and superorder Clupeomorpha.

#### Cohort ARCHAEOPHYLACES

This cohort includes exclusively the freshwater fishes grouped into the superorder Osteoglossomorpha. They are descendents of some pholidophoroid holosteans and have not given rise to other teleostean fishes. They were once almost cosmopolitan, but now they are confined to the tropical regions of South America, Africa, Asia, New Guinea and Australia, except one genus which is found in North America (Greenwood et al., 1966; Banareseu, 1971). In Pakistan this group is represented by two species, *Notopterus notopterus* (Pallas, 1769) and *N. chitala* (Hamilton, 1822), of the family Noptopteridae, order Osteoglossiformes. Both of them are Oriental species and are found in the Indus plain.

#### Cohort EUTELEOSTEI

This cohort comprises the majority of the teleostean fishes, both freshwater and marine. They occupy almost all sorts of aquatic habitats successfully, and range from the ocean depths to altitudes

up to 4600 m. This cohort is represented by two superorders: Ostariophysi and Acanthopterygii.

### Superorder Ostariophysi

The ostariophysian fishes are among the most successful teleostean fishes. According to Rosen & Greenwood (1970), the gonorhynchiforms and the ostariophysians are two sister groups. The gonorhynchid fossils extend up to the Upper Cretaceous. The Cretaceous form of this group is little different from the modern ones. This means that the common ancestor of the two sister groups might be much older. According to the revised classification proposed by Rosen & Greenwood (1970), the Gonorhynchiformes are included in the series Anotophysi, and the Cypriniformes and Siluriformes in the series Otophysi within the superorder Ostariophysi. The series Anotophysi is not represented in Pakistan.

#### Series OTOPHYSI

The members of this series originated from some protacanthopterygians in the ancient southern continent in the Mesozoic Era. The characoids and the siluroids became distinct before the fragmentation of this landmass which occurred either during the Jurassic or, more probably, in the late Triassic. The cyprinoid fishes evolved in Asia from some toothless protocyprinid characoid which got across the Tethys Sea from Africa. In Eurasia, they differentiated into the largest familial group of the Ostariophysi, and invaded in the Tertiary both Africa, across the greatly shrunken Tethys, and North America via the Bering land bridge (Regan, 1922; Myers, 1967). This series comprises two orders, namely the Cypriniformes and the Siluriformes.

#### Order CYPRINIFORMES

In Pakistan this order is represented by the cyprinoid fishes. The cyprinoid fishes originated and evolved in South-East Asia and dispersed westwards along the southern face of the Himalayas through the Indo-Brahm River and along the northern face through a similar water channel in the Tertiary.

The Cyprinoidei are much more successful than any other group of the ostariophysian fishes. In Pakistan, there are 90 species belonging to 29 genera and two families of these fishes, which form more than 57% of the entire freshwater fish fauna

of this country. Among the Cyprinoidei, the Cyprinidae are the most primitive and ancestral.

### Family CYPRINIDAE

This important family of the freshwater fishes is distributed in Africa (except Madagascar), Asia, Europe and North America. They are absent in Australia and South America except those which have been introduced. They originated in South-East Asia and have spread in the other parts of the world. The cyprinid fossils are known from the beginning of the Oligocene deposits (Nikol'skii, 1961), but it appears that the group is much older.

Pakistan has received its cyprinid fauna from three sources:

1. The majority of the cyprinid genera are primarily South-East Asiatic. They have dispersed westwards along the southern face of the Himalayas through the great Indo-Brahm River. These genera have reached up to the Central Brahui Range in Baluchistan but not beyond. Some of the genera, however, have dispersed westwards along southern Baluchistan into southern Iran and even farther.

2. The snow trouts are primarily Central Asiatic. From Central Asia, they have dispersed westwards through some water passage along the northern face of the Himalayas as far as Turkey (Hora, 1952; Banareescu, 1960; Ladiges, 1960). In Pakistan most of them are distributed in the Trans-Himalayan areas but some of them have dispersed in the streams and rivers south of the Himalayas through the Trans-Himalayan sections of the Indus and its tributaries; they have reached northeastern Baluchistan east of the Central Brahui Range (Mirza, 1974).

3. The West Asian genera like *Cyprinion* Heckel and *Capoeta* Cuvier & Valenciennes and the subgenus *Discognathus* Heckel, have been received via some water ways flowing eastwards from West Asia. Among these, only the genus *Cyprinion* has been able to disperse eastwards beyond the Central Brahui Range via southern Baluchistan, while the remaining genus and subgenus are only known from northwestern Baluchistan west of the Central Brahui Range and north of the Kharan-Makran ranges.

The Cyprinidae are represented by 65 species, belonging to 26 genera and 4 subfamilies.

This very speciose family has been divided into various subfamilies by different authors. As pointed out by Regan (1911), Ramaswami (1955), and Banareescu (1968), it is not possible to group the

cyprinid genera into subfamilies on the basis of osteology. The classification followed here is based on over-all similarity and is mainly after Banareescu (1968, 1972).

In view of the large number of species (which comprise more than 41% of the freshwater fish fauna of the country) and genera of the Cyprinidae, a brief account of the subfamilies and genera is given.

### Subfamily CULTRINAE

This subfamily is mainly Oriental except for one genus (*Pelecus* Agassiz, 1835), which is found in Europe (Banareescu, 1967a). It is regarded as the most primitive subfamily among the Cyprinidae of Pakistan (Mirza et al., 1974). In this country it is represented by 5 species, belonging to 3 genera. All the genera are Oriental and none of them extends beyond the Central Brahui Range in the west, and the Siwalik hills in the north. They are, however, widely distributed in the Oriental Region.

#### Genus *Pseudoxygaster* Banareescu, 1967

This genus comprises only a single species *Pseudoxygaster gora* (Hamilton, 1822), which is endemic to the South Asian Subregion of the Oriental Region. Due to the presence of the quadrate-metapterygoid fenestra and the absence of radii in most of the scales, this genus seems to be the most primitive among the Cultrinae of South Asia.

#### Genus *Salmostoma* Swainson, 1839

This genus also is widely distributed in South Asia. Like *Pseudoxygaster*, it has the quadrate-metapterygoid fenestra but its scales have a few radii. Thus it is also one of the most primitive genera among the Cyprinidae. It is represented by two species in Pakistan which are distributed in the Indus plain and the adjoining hilly areas: *Salmostoma bacaila* (Hamilton, 1822) and *S. punjabensis* (Day, 1872).

#### Genus *Chela* Hamilton, 1822

This genus is widely distributed in the Oriental Region as far as Thailand. There is no quadrate-metapterygoid fenestra but the scales have only a few radii. It is represented by two species in Pakistan which are widely distributed in the Indus plain and the adjoining hills: *Chela cachius* (Hamilton, 1822) and *C. laubuca* (Hamilton, 1822).

## Subfamily DANIOINAE

This subfamily is closely related to the Cultrinae as indicated by the presence of the quadrate-metapterygoid fenestra in the genera *Opsariichthys* Bleeker, 1863 and *Zacco* Jordan & Evermann, 1902. They are represented by 8 species belonging to 5 genera in Pakistan. None of them possesses the quadrate-metapterygoid fenestra. Except for the genus *Barilius* Hamilton, 1822 which extends into West Asia and Africa, all the genera are Oriental.

Genus *Barilius* Hamilton, 1822

This genus is represented by 3 species in Pakistan which are restricted to the South Asian Subregion of the Oriental Region: *Barilius vagra* (Hamilton, 1822), *B. bendelisis* (Hamilton, 1822) and *B. bola* (Hamilton, 1822). In Pakistan they are known from the Indus plain and the adjoining hilly areas.

Genus *Danio* Hamilton, 1822

This genus is endemic to the Oriental Region. It is represented by one species in the submontane areas of Pakistan, *Danio devario* (Hamilton, 1822).

Genus *Brachydanio* Weber & De Beaufort, 1916

This Oriental genus is represented by one species in the northern submontane regions of Pakistan, *Brachydanio rerio* (Hamilton, 1822).

Genus *Rasbora* Bleeker, 1859

This genus is widely distributed in the Oriental Region. In Pakistan, only two species have so far been recorded from the Punjab (Misra, 1962): *Rasbora rasbora* (Hamilton, 1822) and *R. dani-conius* (Hamilton, 1822).

Genus *Esomus* Swainson, 1839

This genus is also Oriental. It is represented by one species in the Punjab and Sind Provinces of Pakistan, *Esomus danricus* (Hamilton, 1822).

## Subfamily BARBINAE

This is the largest subfamily of the Cyprinidae, which is widely distributed in the fresh waters of Asia, Africa and Europe. It is represented in Pakistan by 43 species, belonging to 13 genera. Among these, two genera and one subgenus are West Asiatic while the remaining genera are Oriental, but some of them have representatives in West Asia and Africa. Even the ancestors of the West Asian genera are believed to have dispersed from East Asia through Siberia to West Asia (Banarescu, 1972).

Genus *Labeo* Cuvier, 1817

This genus is distributed in Asia and Africa. In Pakistan there are 15 species of this genus out of which 3 species, *Labeo caeruleus* Day, 1877, *L. gedrosicus* Zugmayer, 1912 and *L. macmahoni* Zugmayer, 1912, are endemic to the southwestern parts of Pakistan. The remaining 12 species are widely distributed in South Asia: *L. calbasu* (Hamilton, 1822), *L. gonius* (Hamilton, 1822), *L. rohita* (Hamilton, 1822), *L. dero* (Hamilton, 1822), *L. fimbriatus* (Bloch, 1797), *L. pangusia* (Hamilton, 1822), *L. dyocheilus* (M'Clelland, 1839), *L. boggut* (Sykes, 1841), *L. boga* (Hamilton, 1822), *L. microphthalmus* Day, 1877, *L. sindensis* (Day, 1872) and *L. nigripinnis* Day, 1877.

Genus *Cirrhinus* Cuvier, 1817

This genus is endemic to the Oriental Region. It is represented by two species in the Indus plain and the adjoining hilly areas: *Cirrhinus mrigala* (Hamilton, 1822) and *C. reba* (Hamilton, 1822). Both of them are widely distributed in South Asia.

Genus *Crossocheilus* Van Hasselt, 1823

This genus is also Oriental but extends into Iran and Afghanistan. In Pakistan it is represented by *Crossocheilus latius diplocheilus* (Heckel, 1838), which is widely distributed in the submontane region surrounding the Indus plain and extends into southeastern Iran.

Genus *Garra* Hamilton, 1822

This genus is widely distributed in Asia and Africa. It originated in South-East Asia and then dispersed into West Asia and Africa. In West Asia, it has differentiated into many endemic genera, described by Karaman (1971). A. G. K. Menon (1964) proposed a complicated way of dispersal for these fishes in the form of waves, which was questioned by Karaman (1971). Within this genus two subgenera can be recognized.

Subgenus *Garra* Hamilton, 1822, sensu stricto

This subgenus is widely distributed in Asia and Africa. It is represented by two species in Pakistan: *Garra gotyla* (Gray, 1832) and *G. wanae* (Regan, 1914).

A. G. K. Menon (1964) and Karaman (1971) treated *G. wanae* (Regan, 1914) as a synonym of *G. rossica* (Nikolsky, 1900). The present author does not agree with them as there are 4 barbels in *G. wanae* but only two in *G. rossica*. On request of the author, the types of *G. wanae* were

checked by Mrs. M. Clarke, British Museum (Natural History), London, who made the following remarks: "I have examined the types of *Discognathus wanae* for you and find that they do have four barbels. We have only a few badly preserved specimens of *Garra rossica* for comparison but they appear to differ from *Discognathus wanae* in several characters. *D. wanae* has a higher number of gill rakers (12 compared with 9-11) and also has scales on back, chest and belly whereas *G. rossica* does not."

#### Subgenus *Discognathus* Heckel, 1842

This subgenus is characterized by the presence of two barbels and the poorly developed sucker. The poorly developed sucker was regarded as a primitive feature by A. G. K. Menon (1964), but Karaman (1971) regards it as a degenerate structure. It appears that Karaman's view is more probable as the forms with a poorly developed sucker are restricted to West Asia and not to South-East Asia — the centre of origin for *Garra*. The subgenus *Discognathus* is represented by one species in northwestern Baluchistan west of the Central Brahui Range and north of the Kharan-Makran ranges, *Garra rossica* (Nikolsky, 1900).

#### Genus *Aspidoparia* Heckel, 1843

This genus is Oriental but is represented in West Asia also. There is only one species, *Aspidoparia morar* (Hamilton, 1822) in Pakistan, which is widely distributed in South Asia but is also found in the peripheral areas of West Asia.

#### Genus *Catla* Cuvier & Valenciennes, 1844

This genus is also Oriental. In Pakistan, it is represented by one species in the Indus plain and the adjoining hills, *Catla catla* (Hamilton, 1822).

#### Genus *Amblypharyngodon* Bleeker, 1859

This Oriental genus is also represented by one species in the Indus plain and the adjoining hills, *Amblypharyngodon mola* (Hamilton, 1822).

#### Genus *Osteobrama* Heckel, 1842

This genus is also Oriental. It is represented by one species with three races in the Indus plain and the adjoining hilly areas, *Osteobrama cotio* (Hamilton, 1822).

#### Genus *Tor* Gray, 1833

This genus is widely distributed in Asia and Africa. It is primarily Oriental but has spread into West Asia and Africa from South-East Asia. There

are 4 species of this genus known from Pakistan, one of which (*Tor zhobensis* Mirza, 1967) is endemic to northeastern Baluchistan. The remaining species, *T. putitora* (Hamilton, 1822), *T. tor* (Hamilton, 1822) and *T. mosal* (Hamilton, 1822), are widely distributed in South Asia.

#### Genus *Puntius* Hamilton, 1822

This genus is also Oriental. It originated in South-East Asia and dispersed westwards up to south-eastern Baluchistan. It is not known from north-western Baluchistan. There are 11 species so far known from Pakistan. They can be grouped into 3 sections on the basis of their osteology. Among these species, *Puntius sarana* (Hamilton, 1822) occupies an isolated position. The scales in this species are more or less rectangular and longer than broad as compared with the remaining species in which the scales are somewhat dome-shaped and broader than long. The number of vertebrae in *P. sarana* is about 36 as compared with about 30 in the other species. Thus, it appears that *P. sarana* belongs to a different stock.

Among the remaining species, *P. sophore* (Hamilton, 1822) has a frontoparietal fontanel, which is absent in all other species (including *P. sarana*). This fontanel is absent in all other species of Cyprinidae of South Asia so far studied (Ramaswami, 1955; Mirza, 1973c). So *P. sophore* appears to be phylogenetically distinct.

The other 9 *Puntius* species known from Pakistan are: *P. titius* (Hamilton, 1822), *P. ticto* (Hamilton, 1822), *P. phutunio* (Hamilton, 1822), *P. gelius* (Hamilton, 1822), *P. conchoni* (Hamilton, 1822), *P. punjabensis* (Day, 1872), *P. vittatus* (Day, 1872), *P. terio* (Hamilton, 1822) and *P. waageni* (Day, 1872).

All these species are widely distributed in South Asia, except *P. waageni*, which is endemic to the Salt Range of the Punjab.

#### Genus *Chagunius* Smith, 1939

The occurrence of this genus in Pakistan needs confirmation. According to Misra (1962) this genus is represented in the Punjab (Pakistan) by *C. chagunio* (Hamilton, 1822). This genus also is endemic to the Oriental Region.

#### Genus *Cyprinion* Heckel, 1842

This genus is West Asiatic. It is represented by one species, *Cyprinion watsoni* (Day, 1872), in the submontane areas up to the Safed Koh-Cheerat ranges and the Kala Chitta hills in the north and Azad Kashmir (the river Poonch near Palak) in

the east. This species is also known from Afghanistan, Iran and Masqat.

#### Genus *Capoeta* Cuvier & Valenciennes, 1842

This genus also is West Asiatic. Günther (1889) reported *Capoeta steindachneri* Kessler, 1872 from Nushki in northwestern Baluchistan. But more recent authors (Berg, 1964; Karaman, 1969a) did not extend the range of this genus into this area. It appears that this genus is rare even in northwestern Baluchistan. *C. steindachneri* was treated as a natio of *C. capoeta heratensis* (Kayserling, 1861) by Berg (1964) and Karaman (1969a).

#### Subfamily SCHIZOTHORACINAE

This subfamily includes the famous snow trouts or mountain barbels of the High Asian Subregion of the Oriental Region. They are confined to cold regions as a rule, or at least to localities possessing snow-fed rivers, many of which end in lakes and do not reach the sea. They extend from Anatolia to Afghanistan, Pakistan, U.S.S.R., Kashmir, through Tibet along the Himalayas to the hills of the Yunnan Province of China (Day, 1876; Banarescu, 1960). They are specialized for the hill-stream life and show wonderful adaptations. They are rarely found in the submontane areas. Due to their ecological and zoogeographical importance, they have been nomenclaturally recognized as a subfamily. McClelland (1842) proposed the subfamilial name Schizothoracinae for them, which was widely accepted by the subsequent authors. Recently, however, Karaman (1971) and Banarescu (1972) treated them as a tribe within the subfamily Barbinae. In view of the ecological, zoogeographical and evolutionary significance of this group, the present author is inclined to retain the subfamilial rank. They are closely related to, and perhaps derived from, the Barbinae.

Among the Schizothoracinae, the genus *Schizothorax* appears to be the most primitive and probably ancestral with respect to the remaining genera. The evolution of these fishes appears to have occurred in the direction of the reduction of scales, barbels and number of rows of teeth (Nikol'skii, 1961; Karaman, 1969b). The ancestors of the Schizothoracinae migrated from South-East Asia into Central Asia, probably in the Pliocene, before the major upheavals of the Himalayas (Hora, 1953). In Central Asia, they proliferated into various genera and species and dispersed westwards as far as Turkey (Banarescu, 1960; Ladiges, 1960). Even now, the majority of the genera and species of

this group reside in the torrential streams of Central Asia, although a few of them are also found along the southern face of the Himalayas and the adjoining hill ranges. Since several Himalayan rivers have Trans-Himalayan sources, it appears that the Schizothoracinae might have dispersed into the rivers along the southern face of the Himalayas via the Trans-Himalayan sections of these rivers (A. G. K. Menon, 1954).

In Pakistan, the Schizothoracinae are mainly distributed in the Northern Montane Region but some of them are also found in the northwestern hilly areas up to the Central Brahui Range. There are 9 species, belonging to 5 genera so far known from Pakistan.

#### Genus *Schizothorax* Heckel, 1838

The genus *Schizothorax* Heckel includes the snow trouts with four barbels. It is the most primitive genus among the Schizothoracinae of Pakistan and is closer to the ancestral form. Within this genus, 3 types of snow trouts can be differentiated on the basis of the shape of the mouth, the relative development of the lips and the labial fold, and the presence or absence of the papillated labial sucker. In some species, like *Schizothorax esocinus* Heckel, 1838 and *S. nasus* Heckel, 1838, the mouth is horseshoe shaped and the lower labial fold is interrupted in the middle; in other species, like *S. labiatus* (McClelland, 1839), the mouth is still horseshoe shaped but the lower labial fold is better developed, continuous and trilobed; in still other species, like *S. plagiostomus* Heckel, 1838, the mouth is transverse and crescent shaped, the labial fold is modified into a well developed papillated sucker. From the evolutionary point of view, it appears that the species with horseshoe-shaped mouth and interrupted labial fold are the most primitive. From these species, the snow trouts with horseshoe-shaped mouth and continuous labial fold have evolved by further development of the lips and the labial fold. From the species with continuous labial fold, the species with well developed labial suckers have evolved by further elaboration of the labial fold into a papillated sucker. This is advantageous for clinging to the rocks and stones at the bottom of mountain streams and rivers.

On the basis of the presence or absence of the labial sucker, these snow trouts were assigned to different genera by various authors. Heckel (1838) proposed the genus *Schizothorax* for some species of snow trouts with four barbels and with or without a labial sucker described by him from the

Kashmir Valley. M'Clelland (1839) proposed the name *Oreinus* for the species with a labial sucker and restricted the name *Schizothorax* Heckel for those without it. In 1842, he proposed the name *Racoma* for some snow trout species described by him from Afghanistan. Heckel (1843) proposed another name, *Schizopyge*, for the snow trouts without a sucker. Bleeker (1863) designated *Schizothorax plagiostomus* Heckel as the type species of the genus *Schizothorax* Heckel. Since *S. plagiostomus* possesses a well developed labial sucker, the name *Oreinus* M'Clelland becomes a junior synonym of *Schizothorax* Heckel. Bleeker (1863) also proposed *Schizothorax curvifrons* Heckel, 1838 as the type species of *Schizopyge* Heckel and *Racoma labiata* as the type species of *Racoma* M'Clelland. But most of the authors, including Day and Hora continued the use of the name *Oreinus* M'Clelland for the snow trouts with the labial sucker, and *Schizothorax* Heckel for those without the labial sucker. Misra (1962) advocated for the use of the name *Schizothorax* Heckel instead of *Oreinus* M'Clelland and coined a new name, *Schizothoraichthys* (with *Schizothorax esocinus* Heckel, 1838 as the type species), for the fishes which were included in the genus *Schizothorax* by Day and others. Since the name *Schizopyge* Heckel is already available for these fishes, the name *Schizothoraichthys* Misra becomes a junior synonym of the former.

In view of the present situation, the author is of the opinion that the snow trouts with four barbels and with or without the labial sucker should be included in the genus *Schizothorax* Heckel. On the basis of the shape of the mouth, structure of the lips, and the presence or absence of the labial sucker, however, the following three subgenera may be recognized:

1. *Schizothorax* Heckel, 1838, sensu stricto (type species *S. plagiostomus* Heckel, 1838) with well developed papillated labial sucker.
2. *Racoma* M'Clelland, 1842 (type species *R. labiata* M'Clelland, 1842) with continuous labial fold but without a labial sucker.
3. *Schizopyge* Heckel, 1843 (type species *S. curvifrons* Heckel, 1838) with interrupted labial fold and no labial sucker.

The genus *Schizothorax* is represented by 5 species in Pakistan, one belonging to the subgenus *Schizothorax* (viz. *S. plagiostomus* Heckel, 1838), one to *Racoma* (viz. *S. labiatus* (M'Clelland, 1842)), and three to *Schizopyge* (viz. *S. esocinus* Heckel, 1838, *S. nasus* Heckel, 1838 and *S. longipinnis* Heckel, 1838).

### Genus *Diptychus* Steindachner, 1866

This genus is restricted to the High Asian Sub-region of the Oriental Region. It is represented by one species in the Northern Areas of Pakistan, *Diptychus maculatus* Steindachner, 1866.

### Genus *Ptychobarbus* Steindachner, 1866

This genus also is endemic to High Asia and is represented by one species in the Northern Areas, *Ptychobarbus conirostris* Steindachner, 1866. It was treated as a subgenus of the genus *Diptychus* by Berg (1964), but the present author feels that it deserves the full generic rank.

### Genus *Schizopygopsis* Steindachner, 1866

This genus is mainly represented in High Asia but it is known from West Asia as far as Seistan as well (Annandale & Hora, 1920). In Pakistan, only one species is known, from the Ziarat Valley and the Northern Areas, *Schizopygopsis stoliczkae* Steindachner, 1866.

### Genus *Schizocypris* Regan, 1914

This genus is unique among the Schizothoracinae in its distribution. It was described from southern Waziristan by Regan (1914). Its range was subsequently extended to Baluchistan and Iran. It is not known from the areas north of the Safed Koh-Cheerat ranges. According to Karaman (1969b), it is closely related to the genus *Schizothorax*, and has probably evolved from this genus by the loss of barbels and certain changes in the mouth and lips. Its dental formula is closer to that of *Schizothorax* Heckel. In Pakistan, only one species has so far been found in the northwestern montane area, *Schizocypris brucei* Regan, 1914.

### Family COBITIDAE

The family Cobitidae comprises the loaches which are mainly found in the montane and submontane regions but rarely in the plains. They are distributed in North Africa, Asia and Europe. They live in shallow, clear and swift streams among the stones and pebbles at the bottom.

The Cobitidae originated from some cyprinid ancestor in South-East Asia in the Oligocene and spread westwards as far as Africa. Among the subfamilies of the Cyprinidae, the Gobioidae seem to be closely related to the Cobitidae as they have similar organization in their anatomy. But convergent development for this similarity cannot be ruled out. Within the Cobitidae, there are three main phyletic lines, on the basis of which three



subfamilies — Botinae, Noemacheilinae and Cobitinae — have been recognized. Among these subfamilies, the Botinae show the maximum number of primitive characters and hence are the most primitive; the Noemacheilinae retain some of these characters and hence are intermediate between Botinae and Cobitinae. The Cobitinae differ substantially from the above-mentioned subfamilies and are regarded as the most advanced (Nalbant, 1963).

#### Subfamily BOTINAE

This subfamily is widely distributed in East, South-East and South Asia. In Pakistan, it is represented by only one genus: *Botia* Gray, 1831.

#### Genus *Botia* Gray, 1831

This genus is endemic to the Oriental Region. In Pakistan, it is represented by two species in the Indus plain and the adjoining hilly areas: *Botia lohachatta* Chaudhuri, 1912 and *B. dayi* Hora, 1932.

#### Subfamily NOEMACHEILINAE

This subfamily is widely distributed in the Oriental and Holarctic Regions (excluding North America). It is represented in Pakistan by one genus: *Noemacheilus* Van Hasselt, 1823.

#### Genus *Noemacheilus* Van Hasselt, 1823

More than one hundred species are described under this generic name. These species are quite varied and diverse and form several recognizable groups which, at least, deserve the rank of subgenera (Banarescu & Nalbant, 1964, 1966, 1968). There are 22 species and subspecies of this genus in Pakistan which can be ascribed to the following subgenera:

##### Subgenus *Acanthocobitis* Peters, 1861

This subgenus is endemic to the Oriental Region and is distributed from Pakistan in the west to Thailand in the east. In Pakistan, it is represented by one species which is restricted to the submontane zone surrounding the Indus plain, *Noemacheilus botia* (Hamilton, 1822).

##### Subgenus *Schistura* M'Clelland, 1839

This subgenus is the largest among the Noemacheili and is mainly distributed in West and South Asia. In Pakistan, there are 13 species and subspecies belonging to this subgenus, among which

the following species and subspecies appear to be endemic to this country: 1. *Noemacheilus baluchiorum* Zugmayer, 1912 (endemic to Baluchistan); 2. *N. punjabensis* Hora, 1923 (from the Salt Range of the Punjab); 3. *N. prashari prashari* Hora, 1933 (described from the northwestern hilly areas in the Punjab and North West Frontier Province); 4. *N. naseeri* Ahmad & Mirza, 1963 (described from the Swat Valley); 5. *N. pakistanicus* Mirza & Banarescu, 1969 (known from northeastern Baluchistan); 6. *N. harnaiensis* Mirza & Nalbant, 1969 (from eastern Baluchistan); 7. *N. machensis* Mirza & Nalbant, 1970 (from eastern Baluchistan); 8. *N. anambarensis* Mirza & Banarescu, 1970 (from eastern Baluchistan); 9. *N. alepidotus alepidotus* Mirza & Banarescu, 1970 (from the Swat Valley and adjoining areas of Hazara).

The non-endemic species of the subgenus *Schistura* from Pakistan include: *N. alepidotus nalbanti* Banarescu & Mirza, 1972, *N. kessleri* Günther, 1889, *N. prashari lindbergi* Banarescu & Mirza, 1965, and *N. corica* (Hamilton, 1822).

The loaches of the subgenus *Schistura* in Pakistan are quite diverse and fall into the following sections:

1. *pakistanicus*-group: these loaches have large and robust naked bodies with complete or almost complete lateral line, well developed processes odontiformes, flattened and keeled caudal peduncle, emarginate caudal fin, and lack sexual dimorphism. *N. pakistanicus* Mirza & Banarescu, *N. alepidotus alepidotus* Mirza & Banarescu, and *N. alepidotus nalbanti* Banarescu & Mirza belong to this group.

2. *baluchiorum*-group: these are small loaches with scaled bodies, incomplete lateral line, caudal peduncle not flattened, slightly forked caudal fin, and well developed sexual dimorphism. The loaches of this group are: *N. baluchiorum* Zugmayer, *N. anambarensis* Mirza & Banarescu and *N. machensis* Mirza & Nalbant.

3. *kessleri*-group: these loaches are similar to the *baluchiorum*-group in body size, caudal peduncle, and caudal fin, but differ in the absence of scales and sexual dimorphism. The following loaches belong to this group: *N. kessleri* Günther, *N. prashari prashari* Hora, *N. prashari lindbergi* Banarescu & Mirza, *N. punjabensis* Hora, and *N. naseeri* Ahmad & Mirza.

4. *corica*-group: the loaches of this group differ from the other loaches of the subgenus *Schistura* in having spots instead of vertical bands on the body; sexual dimorphism present or absent; body naked or scaled. The loaches of this group are:

*N. corica* (Hamilton) and *N. harnaiensis* Mirza & Nalbant.

#### Subgenus *Paracobitis* Bleeker, 1863

This subgenus is West Asiatic. It is represented by one species, *Noemacheilus cristatus* Berg, 1898, in northeastern Baluchistan.

#### Subgenus *Triplophysa* Rendahl, 1933

This subgenus includes the High Asian loaches. They were previously included in the subgenus *Hedinichthys* Rendahl, 1933 (Banarescu & Nalbant, 1966; Mirza, 1972), but Banarescu (personal communication) is now of the opinion that these loaches should be included in the subgenus *Triplophysa*. This subgenus is represented in Pakistan by the following species: *Noemacheilus stoliczkai* Steindachner, 1866, *N. gracilis* Day, 1876, *N. yasinensis* Alcock, 1898, *N. brahui* Zugmayer, 1912, *N. stenurus choprai* Hora, 1934, *N. griffithi naziri* Ahmad & Mirza, 1963 and *N. marmoratus* Heckel, 1838. All these species are restricted to the Northern Montane Region except *N. brahui*, which is found in northwestern Baluchistan. Among these, *N. stenurus choprai* Hora and *N. griffithi naziri* Ahmad & Mirza are probably endemic.

#### Subfamily COBITINAE

This subfamily is widely distributed in Eurasia. It contains 14 genera (Banarescu & Nalbant, 1968). Only one genus is represented in Pakistan:

#### Genus *Lepidocephalus* Bleeker, 1859

This genus is represented in Pakistan by one species, *Lepidocephalus guntea* (Hamilton, 1822). Two specimens of this species have recently been collected from the Vale of Peshawar by the present author.

### Order SILURIFORMES

The siluriform fishes originated in the ancient southern continent in the Mesozoic Era before its fragmentation. They differentiated and evolved into different groups in South America, Africa and South Asia. South America and Africa have been their main centres of differentiation as is apparent from the fact that nearly 30 families with about 2000 species are found in South America or Africa (Greenwood et al., 1966). Excepting a few families, like the Ariidae, Doichthyidae, and Plotosidae which are marine, they are mainly confined to the fresh waters of Asia, Europe, Africa, and North and South America. There are 3 families of catfishes, Bagridae, Schilbeidae and Clariidae, common to Africa and South Asia; but they have distinct genera except *Clarias* and *Heterobranchus* which are common to both (Regan, 1922). The siluriform fishes, at least some of them, have better tolerance for salt water and have also, in part, had sea routes available for their dispersal (Myers, 1967).

Among the families of the Siluriformes, the South American Diplomystidae are regarded as the most primitive by Regan (1922), Greenwood et al. (1966), and Lundberg & Baskin (1969). But McAllister (1968) thinks that the family Pimelodidae is the most primitive among the South American families. The Bagridae appear to be the most primitive among the African and South Asian families, and perhaps ancestral to most, if not all, of them (Regan, 1922). The presence of an adipose dorsal fin in most of the primitive catfish families, like the Diplomystidae, Bagridae, Ictaluridae and Pimelodidae, is worth consideration. An adipose dorsal fin is present in most of the protacanthopterygian fishes — an ancestral group of the Ostariophysi. This feature has been retained in the primitive cypriniform fishes, like the Characidae, but is absent in most of the advanced groups, like the Cyprinoidei. So the presence of an adipose dorsal fin in catfish families may be regarded as a primitive feature and its absence as a derived one. This conclusion is further supported by the ontogeny of the genus *Clupisoma* of the family Schilbeidae. An adipose dorsal fin is present in many genera of this family, both in young as well as in adult conditions. But in certain species of the genus *Clupisoma* — such as *C. garua* (Hamilton, 1822) — an adipose dorsal fin is present in the young but is absent in the adult. Thus the family Schilbeidae serves as a connecting link between the catfish families with an adipose dorsal fin and those without it. Since the functional aspect of the adipose dorsal fin is not obvious, it seems reasonable to presume that the catfish families with an adipose dorsal fin are more primitive than those without it. So the families of the Siluriformes known from Pakistan may be arranged accordingly.

In Pakistan, the order Siluriformes is represented by 34 species, belonging to 18 genera in 7 families. All of them are confined to fresh waters except one species, *Mystus gulio* (Hamilton, 1822), which is partly marine.

### Family BAGRIDAE

The family Bagridae is widely distributed in Asia and Africa. In Pakistan, it is represented by two genera, *Rita* Bleeker and *Mystus* Gronovius.

#### Genus *Rita* Bleeker, 1858

This genus is endemic to the Oriental Region. In Pakistan, there is only one species of this genus, *Rita rita* (Hamilton, 1822), which is distributed in the Indus plain and the adjoining hilly areas.

#### Genus *Mystus* Gronovius, 1763

This genus is widely distributed in the Oriental Region but is also represented in West Asia as far as Iraq (M. A. S. Menon, 1960). In Pakistan, there are 8 species — including *Mystus gulio* (Hamilton, 1822) which is partly marine — of this genus known from the Indus plain and the adjoining hilly areas: *M. aor* (Hamilton, 1822), *M. seenghala* (Sykes, 1841), *M. cavasius* (Hamilton, 1822), *M. tengara* (Hamilton, 1822), *M. vittatus* (Bloch, 1797), *M. bleekeri* (Day, 1877) and *M. horai* Jayaram, 1954. Out of these *M. horai* appears to be endemic to Pakistan.

### Family SISORIDAE

The family Sisoridae is widely distributed in the Oriental and West Asian Regions. This is the largest family of catfishes in Pakistan, it is represented by 11 species belonging to 6 genera.

#### Genus *Sisor* Hamilton, 1822

This genus is endemic to South Asia. In Pakistan, it is represented by one species in the submontane areas surrounding the Indus plain, *Sisor rabdophorus* Hamilton, 1822.

#### Genus *Bagarius* Bleeker, 1853

This genus is endemic to the Oriental Region. It was one of the earliest migrants from South-East Asia to India and then to Pakistan. In Pakistan, there is one species of this genus known from the river Suttlej drainage, *Bagarius bagarius* (Hamilton, 1822).

#### Genus *Gagata* Bleeker, 1858

This genus also is endemic to the Oriental Region. It is represented by one species in the submontane region surrounding the Indus plain, *Gagata cenia* (Hamilton, 1822).

#### Genus *Nangra* Day, 1877

This genus is endemic to South Asia. It was

merged with the genus *Gagata* by Hora & Law (1941), but Tilak (1963) came to the conclusion that the two genera are osteologically distinct. Two species of this genus are found in Pakistan, one of which, *Nangra robusta* Mirza & Awan, 1973, is endemic to the river Indus up to Kalabagh; the other species, *N. nangra* (Hamilton, 1822) is known from the Indus plain as well.

#### Genus *Glyptosternum* M'Clelland, 1842

This genus is endemic to the High Asian Subregion of the Oriental Region. It is represented by one species, *Glyptosternum reticulatum* M'Clelland, 1842, in the Kaghan, Swat, Chitral and Gilgit valleys in the northern montane region.

#### Genus *Glyptothorax* Blyth, 1860

This genus is primarily Oriental but extends into West Asia as far as Turkey (Ladiges, 1964). There are 5 species of this genus so far known from Pakistan, out of which *Glyptothorax naziri* Mirza & Naik, 1969 is endemic to Pakistan. This species is polymorphic and at least two forms can be distinguished morphologically. One form occupying the Vale of Peshawar, and the adjoining areas of the Punjab (Haro drainage), has a relatively deep body with shorter maxillary barbels not reaching the tip of the pectoral spine. The other form resides in northeastern Baluchistan and the adjoining part of the North West Frontier Province. It has a more depressed body and longer maxillary barbels reaching up to or beyond the tip of the pectoral spine. It cannot be decided at present whether these forms are biologically distinct to justify nomenclatural recognition as subspecies. More material is needed to solve this problem. The other 4 species of this genus, known from Pakistan are: *G. telchitta* (Hamilton, 1822), *G. cavia* (Hamilton, 1822), *G. platypogonoides* (Bleeker, 1855) and *G. punjabensis* Mirza & Kashmiri, 1971.

### Family SCHILBEIDAE

This family is widely distributed in Asia and Africa but has distinct genera in the two continents. It was established in both continents before their separation into the present conditions, probably in the Mesozoic Era. In Pakistan, there are 5 genera distributed in the Indus plain and adjoining submontane areas.

#### Genus *Ailia* Gray, 1831

This genus is endemic to the South Asian Subregion of the Oriental Region and is rep-

represented by one species, *Ailia coila* (Hamilton, 1822) in Pakistan, which is found in the Indus plain.

#### Genus *Ailichthys* Day, 1871

This genus also is endemic to the South Asian Subregion of the Oriental Region. In Pakistan, it is known by one species, *Ailichthys punctata* Day, 1871, in the Punjab and Sind.

#### Genus *Clupisoma* Swainson, 1839

This genus is widely distributed in the Oriental Region as far as Burma. In Pakistan, it is represented by 3 species in the Indus plain and the adjoining hilly areas: *Clupisoma garua* (Hamilton, 1822), *C. murius naziri* Mirza & Awan, 1973 and *C. atherinoides* (Hamilton, 1822).

#### Genus *Eutropiichthys* Bleeker, 1862

This genus is also distributed in the Oriental Region up to Burma. It is represented in Pakistan by one species, *Eutropiichthys vacha* (Hamilton, 1822), in the Punjab and Sind.

#### Genus *Silonia* Swainson, 1839

This monotypic genus is widely distributed in the Oriental Region as far as Burma. Its occurrence in Pakistan is doubtful. According to Misra (1962), this genus is represented in Pakistan but N. Ahmad (1963) has denied this. It is interesting to note that Burnes collected a specimen of *Silonia silondia* (Hamilton, 1822) from the river Indus near Sehwan in Pakistan (Hora, 1927).

#### Family AMBLYCIPITIDAE

This family is endemic to the Oriental Region. It is represented in Pakistan by the genus *Amblyceps* Blyth, the sole genus of this family (H. M. Smith, 1945).

#### Genus *Amblyceps* Blyth, 1858

This genus is represented in Pakistan by one species, *Amblyceps mangois* (Hamilton, 1822), which is restricted to the submontane areas surrounding the Indus plain, but is widely distributed in the Oriental Region as far as Thailand (H. M. Smith, 1945).

#### Family SILURIDAE

This family is widely distributed in the Oriental Region and is also represented in West Asia

and Europe. It is represented by two genera in Pakistan.

#### Genus *Wallago* Bleeker, 1851

This genus is widely distributed in the Oriental Region as far as Indonesia. In Pakistan, it is represented by one species, *Wallago attu* (Bloch & Schneider, 1801) in the Indus plain and adjoining hilly areas.

#### Genus *Ompok* Lacépède, 1803

This genus is also widely distributed in the Oriental Region. In Pakistan, there are 3 species in the Indus plain and the adjoining hilly areas: *Ompok bimaculatus* (Bloch, 1897), *O. pabda* (Hamilton, 1822) and *O. pabo* (Hamilton, 1822).

#### Family HETEROPNEUSTIDAE

This family is endemic to the Oriental Region. It is represented by one genus in the Indus plain:

#### Genus *Heteropneustes* Müller, 1839

This genus is widely distributed in the Oriental Region. In Pakistan, it is represented by one species, *Heteropneustes fossilis* (Bloch, 1794) in the Indus plain.

#### Family CLARIIDAE

This family is widely distributed in Africa and Asia. According to Misra (1962), it is represented by the genus *Clarias* in Pakistan, but according to N. Ahmad (1963) it is not found there.

#### Genus *Clarias* Gronovius, 1763

The genus *Clarias* is common in Africa and Asia. It is represented by *C. batrachus* Linnaeus, 1758, which is widely distributed in the Oriental Region. As indicated above, its occurrence in Pakistan needs confirmation.

### Superorder Acanthopterygii

This superorder includes the atherinomorph and percomorph fishes which are recognized as two series within this superorder (Rosen & Patterson, 1969). They are almost cosmopolitan and inhabit both marine and fresh waters. They originated from some protacanthopterygian ancestor in the Mesozoic. From the very beginning, they diverged into two major groups, recognized as two series. Within each series there are several diverse forms occupying different habitats.

### Series ATHERINOMORPHA

This series includes only a single order, Atheriniformes.

#### Order ATHERINIFORMES

This order is represented in Pakistan by two suborders, the Cyprinodontoidei and the Exocoetoidei.

##### Suborder CYPRINODONTOIDEI

There is only one family of this suborder known from Pakistan. The cyprinodont fishes are secondary freshwater fishes.

##### Family CYPRINODONTIDAE

This family is distributed in the tropical and the temperate regions of the world. In Pakistan, it is represented by two genera each with one species. One of these genera, *Aphaniops* Hoedeman, 1951, is West Asiatic, whereas the other, *Aplocheilichthys* McClelland, 1839, is Oriental. Both species *Aphaniops dispar stoliczkae* (Day, 1872) and *Aplocheilichthys panchax* (Hamilton, 1822), are distributed in the lower Indus plain and the adjoining hilly areas.

##### Suborder EXOCOETOIDEI

This suborder is mainly marine but some species ascend into rivers and a few species are confined to fresh waters. In Pakistan, it is represented by one family, the Belonidae.

##### Family BELONIDAE

This family is distributed in temperate and tropical waters. The Belonidae are mainly marine, but they have some freshwater genera. In Pakistan, this family is represented by one freshwater species, *Xenentodon cancila* (Hamilton, 1822), in the Indus plain.

### Series PERCOMORPHA

This series includes fishes of variable form and habits. They are mainly marine but many enter into fresh water, and a few are strictly limnic. This series is represented in Pakistan by 3 orders.

#### Order CHANNIFORMES

This order includes some freshwater fishes which are widely distributed in Asia and Africa. In Pakistan, there are 4 species belonging to the genus

*Channa* Gronovius, 1763, family Channidae: *C. marulius* (Hamilton, 1822), *C. striatus* (Bloch, 1793), *C. gachua* (Hamilton, 1822) and *C. punctatus* (Bloch, 1793). They are widely distributed in the Oriental Region. One species, *C. gachua*, extends into Afghanistan and Iran.

#### Order SYNBRANCHIFORMES

This order is widely distributed in the fresh and brackish waters of South and East Asia, Australia, Central and South America, and tropical Africa. Only one species, *Cuchia* (= *Amphipnoides*) *cuchia* (Hamilton, 1822), belonging to the family Cuchiidae (Amphipnoidae), is known from the Punjab Province of Pakistan.

#### Order PERCIFORMES

This is the largest order of the percomorph fishes. They are mainly marine but some are found in fresh waters. Excepting a few species, they are peripheral freshwater fishes. Out of 20 suborders recognized by Greenwood et al. (1966), only the following 5 are represented in the inland waters of Pakistan.

##### Suborder PERCOIDEI

This suborder is represented by 2 families in Pakistan.

##### Family CENTROPOMIDAE (AMBASSIDAE)

This family is represented by one genus, *Chanda* Hamilton, 1822 (= *Ambassis* Cuvier & Valenciennes, 1828) with 3 species in fresh waters of Pakistan, viz. *Chanda* (= *Ambassis*) *nama* Hamilton, 1822, *C. ranga* Hamilton, 1822 and *C. baculis* Hamilton, 1822. All the three species are found in the Indus plain and the adjoining hills and belong to the vicarious freshwater fishes, though the family as a whole is primarily marine.

##### Family NANDIDAE

This family is distributed in fresh waters of Asia, Africa and South America. In Pakistan, it is represented by two genera, *Nandus* Cuvier & Valenciennes, 1831 and *Badis* Bleeker, 1853, each with one species, viz. *Nandus nandus* (Hamilton, 1822) and *Badis badis* (Hamilton, 1822), respectively. Both genera are widely distributed in the Oriental Region, but in Pakistan they are confined to the Indus plain.

### Suborder ANABANTOIDEI

This suborder is widely distributed in tropical and subtropical estuarine and fresh waters of the Old World.

#### Family OSPHRONEMIDAE

This family is widely distributed in Asia and Africa. In Pakistan, there are two species belonging to the genus *Colisa* Cuvier & Valenciennes, 1831 found in the Indus plain and the adjoining hilly areas: *C. fasciata* (Bloch & Schneider, 1801) and *C. lalius* (Hamilton, 1822).

### Suborder MUGILOIDEI

This suborder is almost cosmopolitan and is found in all the seas. Some of them, however, enter into fresh waters.

#### Family MUGILIDAE

This family is widely distributed in warm and temperate seas. Some species ascend the rivers whereas a few are confined to fresh waters. In Pakistan, there are two species of the genus *Mugil* Linnaeus, 1758, which are known to ascend the rivers far beyond the tidal influence, viz. *M. cephalus* Linnaeus, 1758 and *M. speigleri* Bleeker, 1859. The species *Sicamugil cascasia* (Hamilton, 1822) seems to be restricted to fresh water. Another species, *Rhinomugil corsula* (Hamilton, 1822), has also been recorded from fresh waters of Pakistan by Misra (1962) but not by others.

### Suborder GOBIOIDEI

This suborder includes the shore fishes which are widely distributed in the warm and temperate seas; some of them are found in fresh waters.

#### Family GOBIIDAE

This family is widely distributed along the coasts of all tropical and many temperate seas. Many ascend the rivers, but only a few are bound to fresh water. In Pakistan, there are 3 species belonging to the genus *Boleophthalmus* Cuvier & Valenciennes, 1837, and one species of *Periophthalmus* Bloch & Schneider, 1801, which are known to ascend the rivers for a considerable distance, viz. *B. boddarti* (Pallas, 1770), *B. dentatus* Cuvier & Valenciennes, 1837, *B. dussumieri* Cuvier & Valenciennes, 1837 and *P. koelreuteri* (Pallas, 1770). Another species, *Glossogobius giuris* (Hamilton, 1822), is virtually limnic and is widely dis-

tributed in the Indus plain. It is also known from South Africa 320 km inland (Jubb, 1965).

### Suborder MASTACEMBELOIDEI

This suborder includes the family Mastacembelidae. They are widely distributed in Africa and Asia.

#### Family MASTACEMBELIDAE

This family is represented in Pakistan by 3 species belonging to the genera *Mastacembelus* Gronovius, 1763 and *Macrognathus* Lacépède, 1800, viz.: *Mastacembelus armatus* (Lacépède, 1800), *Mastacembelus pancalus* (Hamilton, 1822) and *Macrognathus aculeatus* (Bloch, 1795). They are mostly found in the Indus plain, but *M. armatus* extends into the hilly areas up to 1000 m above sea level.

### Class ELASMOBRANCHII

This class is represented by only one species, *Pristis microdon* Latham, 1794, belonging to the family Pristidae, order Rajiformes, and subclass Selachii. This species was recorded from the river Indus near Hyderabad at a distance of about 300 km from the sea (Sajid, 1962). This widely distributed species is also known to ascend the rivers far beyond the tidal influence in other areas of the world (H. M. Smith, 1945; Miller, 1966).

## V. ZOOGEOGRAPHY OF PAKISTAN

The earliest works in zoogeography were based upon birds and mammals. The importance of the cold-blooded vertebrates was, however, soon realized as they disperse more slowly as compared with the warm-blooded vertebrates. Among the cold-blooded vertebrates, the freshwater fishes have unique value for zoogeographical studies, due to their limited power of dispersal.

There are some observations about the distribution of freshwater fishes in Pakistan and adjoining countries by early workers. McClelland (1842) studied the fish fauna of some parts of Pakistan, Afghanistan and India. He recorded several South Asian species in the river Kabul as far as Jalalabad in Afghanistan and remarked that Jalalabad was the farthest limit to which the South Asian species extended. Day (1876), in his paper on the fishes of Yarkand, made some remarks about the fish distribution in some parts of China, Afghanistan, Pakistan and India and regarded the Himalayas as the boundary between the fish fauna of South Asia and that of Tur-

kistan. In a comprehensive paper (Day, 1877-79) on the fish distribution in South Asia, he discussed the derivation of the South Asian fish fauna. He observed the West Asian and the Malayan elements in the fish fauna of the hilly areas and the African and the South-East Asian elements in the fish fauna of the plains, and concluded that the South-East Asian element appeared to have supplanted the prior African element from the waters of the plains. In 1880, he studied the fish fauna of the Sind-Baluchistan hills and recorded about two dozen South Asian species and only a few West Asian forms from these hills.

In the present century, Blanford (1901) was the first to study the distribution of all the major groups of vertebrates in South Asia. He included the entire Indus plain (Punjab tract) in the Holarctic Region. His analysis of the fish fauna appears to be erroneous. Had he analyzed the fish fauna of the Indus plain more properly, he would have kept this area in the Oriental Region. The early herpetologists, like M. A. Smith (1931) and Mahendra (1939) followed Blanford and pleaded for the removal of this area from the Oriental Region and its inclusion in the Holarctic Region. Zugmayer (1913), studied the fish fauna of Baluchistan and made some very valuable remarks about the distribution of fishes and other vertebrates in this area. He concluded that Baluchistan is the meeting place of three faunal regions, viz. the Oriental Region on one side, and the Mediterranean and the Central Asiatic Subregions of the Palaearctic Region on the other. Hora (1937a) discussed the distribution of the freshwater fishes in South Asia and arrived at the conclusion that the South Asian fish fauna originated in South-East Asia, most probably in Indo-China, and spread westwards by successive waves of migration to South Asia (he used the name India in the old sense) and later to Africa. He further emphasized the dispersal of aquatic animals from east to west but not in the reverse direction, and pointed out that there was no African element in the South Asian freshwater fish fauna. In two other papers, Hora (1937 b & c) compared the fish faunas along the northern and the southern faces of the Himalayas, and noted the great variety of forms towards the east as compared with those in the west along the southern face of the Himalayas. In 1952, he reviewed the fish geography of South Asia and pointed to the similarity of the fish fauna of the Indus and the Ganges river systems. He traced the dispersal of fishes from east to west both along the southern face of the

Himalayas through a system of interconnected freshwater lakes forming the so-called Indo-Braham River during the floods, and along the northern face through a similar channel. That certain South Asian species have dispersed into West Asia and Africa but not in the opposite direction has been observed by other ichthyologists as well (A. G. K. Menon, 1954; Kosswig, 1955; Banarescu, 1960, 1971; Myers, 1966). Berg (1940) discussed the zoogeography of West Asia and some parts of Pakistan. He included northwestern Baluchistan in the Mediterranean Subregion and the northern montane areas in the High Asian Subregion of the Holarctic Region, while the Indus plain and the adjoining hilly areas along with southern Baluchistan were included in the Oriental (Sino-Indian) Region. Mirza (1974) discussed the distribution of the freshwater fishes in Baluchistan and the adjoining areas of the Indus plain and recognized three divisions within this area: northwestern Baluchistan with a dominance of West Asian forms; northeastern Baluchistan with a mixture of South Asian, West Asian and High Asian forms; and South Baluchistan, the Indus plain and adjoining hills with predominantly South Asian forms. Jayaram (1974) discussed the distribution of fishes, amphibians and reptiles in the South Asian subcontinent. He made only a few remarks about these animals in Pakistan. It appears that he has not been able to consult several important publications on the ichthyology and herpetology of Pakistan, which have appeared during the last 27 years. However, his conclusion that "the Yunnan-Assam-Burma amphitheatre is the centre of origin of the bulk of the land vertebrates found in India today" (Jayaram, 1974: 579), seems tenable.

#### *Zoogeographical classification of freshwater fishes*

The freshwater fishes have been differently classified from the zoogeographical point of view. Among these, the classification proposed by Myers (1949) has proved to be the most useful and has been widely accepted by other zoogeographers. The freshwater fishes of marine origin classified as vicarious, complementary, diadromous and sporadic by Myers, have been lumped into the peripheral division by others (Darlington, 1957; De Beaufort, 1964). The freshwater fishes of Pakistan belong to the following zoogeographical categories:

#### *Primary freshwater fishes*

The primary freshwater fishes are further classified into the ostariophysian and non-ostariophysian

fishes. Among the ostariophysian fishes about 50 % belong to the family Cyprinidae. There are 19 South Asian, 5 High Asian and 2 West Asian cyprinid genera in Pakistan.

Among the South Asian cyprinid genera the following are restricted to the Oriental Region: *Salmostoma*, *Chela*, *Pseudoxygaster*, *Danio*, *Brachydanio*, *Esomus*, *Cirrhinus*, *Catla*, *Amblypharyngodon*, *Osteobrama*, *Puntius* and *Chagunius*. In addition, there are some genera which are primarily South Asian but extend into West Asia and a few even to Africa. These are: *Barilius*, *Rasbora*, *Labeo*, *Crossocheilus*, *Garra*, *Aspidoparia* and *Tor*.

The High Asian cyprinid genera are: *Schizothorax*, *Diptychus*, *Ptychobarbus*, *Schizopygopsis* and *Schizocypris*. These genera are mainly distributed in the northern montane areas but the genus *Schizocypris* is not known to extend beyond the Safed Koh Range. Some species of *Schizothorax* sometimes descend into the rivers of the plain.

The West Asian cyprinid genera are: *Cyprinion* and *Capoeta*. The genus *Capoeta* is known from northwestern Baluchistan, but the genus *Cyprinion* is widely distributed in the hilly areas up to the Safed Koh and Kala Chitta ranges. In addition, one West Asian subgenus (*Discognathus*) of the genus *Garra* is represented in northwestern Baluchistan.

The family Cobitidae is represented by three genera, two of which (*Botia* and *Lepidocephalus*) are Oriental, while the third one (*Noemacheilus*) is widely distributed in the Oriental, the Holarctic and the West Asian regions.

The siluriform fishes are represented by 7 families with 18 genera. Among these, the Amblycipitidae and the Heteropneustidae (genera *Amblyceps* and *Heteropneustes*, respectively) are endemic to the Oriental Region, while the other families are widely distributed. The family Bagridae is represented by two Oriental genera (*Rita* and *Mystus*). The genus *Mystus*, however, extends into West Asia. Out of six genera of the family Sisoridae, four (*Sisor*, *Gagata*, *Nangra* and *Bagarius*) are restricted to the Oriental Region, while one genus (*Glyptothorax*) extends into the Holarctic Region; the genus *Glyptosternum* is endemic to High Asia. The family Schilbeidae is widely distributed in Asia and Africa but all the genera known from Pakistan (*Ailia*, *Ailichthys*, *Clupisoma*, *Eutropiichthys* and *Silonia*) are South Asian. The family Siluridae is represented by two Oriental genera, *Wallago* and *Ompok*. The family Clariidae is widely distributed in Asia and Africa. It is represented by one genus, *Clarias*, in Pakistan.

The non-ostariophysian primary freshwater fishes are represented by the families Notopteridae (*Notopterus*), Channidae (*Channa*), Nandidae (*Nandus* and *Badis*), Osphronemidae (*Colisa*) and Mastacembelidae (*Mastacembelus* and *Macrognathus*). All these families are widely distributed in Asia and Africa. It may be noted that all these families, except the Channidae, have been included in the secondary freshwater fishes by Jayaram (1974). Although these families have a somewhat better tolerance for salt water than the ostariophysian fishes, yet their distribution indicates that they should be treated as primary rather than secondary freshwater fishes.

### Secondary freshwater fishes

The secondary freshwater fishes are represented by the family Cyprinodontidae with two genera. One of these (*Aplocheilichthys*) is Oriental, while the other one (*Aphaniops*) is widely distributed in West Asia and some parts of Africa.

### Peripheral freshwater fishes

These are of least importance from the zoogeographical point of view. Most of them are only known from the coastal areas but a few are found in the upper parts of the Indus plain. Following Myers (1949), the peripheral freshwater fishes may be further classified into the following categories:

The vicarious freshwater fishes are marine derivatives living in fresh waters and not migrating to the sea. The following species occurring in Pakistan may be classified into this category: *Gadusia chapra* (family Clupeidae); *Xenentodon cancila* (family Belontiidae); *Cuchia cuchia* (family Cuchiidae); *Chanda nama*, *C. ranga* and *C. baculis* (family Centropomidae); *Glossogobius giuris* (family Gobiidae); *Sicamugil cascasia* and perhaps *Rhinomugil corsula* (family Mugilidae).

The diadromous fishes migrate from the rivers to the sea and vice versa. The following species may be included in this category: *Macrura ilisha* (family Clupeidae); *Mugil cephalus* and *Mugil speigleri* (family Mugilidae).

There are some marine species which are known to enter into the freshwater streams along the Makran coast and the river Indus sporadically. They are *Boleophthalmus dentatus*, *B. boddarti*, *B. dussumieri* and *Periophthalmus koelreuteri* (family Gobiidae) among the Teleostomi; and *Pristis microdon* (family Pristidae) among the Elasmobranchii. They may be classified as sporadic. These fishes are of no importance in zoogeography.



*Zoogeographical divisions of Pakistan*

From the distribution of fishes in Pakistan, it is clear that this country lies in the peripheral zone of the South Asian Subregion of the Oriental Region. Excepting the Trans-Himalayan areas, which contain no representative of the South Asian fishes, the South Asian genera are represented in almost all parts of the country, including north-western Baluchistan. There is no genus among the freshwater fishes which could be regarded as endemic to Pakistan. Out of 68 genera of freshwater fishes only 6 genera are High Asian and 3 West Asian, while most of the remaining genera are South Asian. A few genera of marine origin are almost cosmopolitan.

On the basis of the distribution of the freshwater fishes the following divisions of Pakistan may be recognized (see fig. 3). In the delimitation of these

divisions, the physiography of the country has also been taken into consideration. The mountain ranges can serve as effective barriers to the dispersal of fishes only if they serve as a watershed for the drainage systems on the two opposite sides and if they are not intersected by water channels. In the absence of such a barrier, environmental factors like the water current, the temperature of the water, the nature of the substratum, and the amount of dissolved oxygen and other materials, determine the dispersal of fishes. Thus, most of the snow trouts are restricted to the Trans-Himalayan parts of the Indus system and only a few come down to the submontane areas.

**I. High Asian Division**

This division comprises the northern montane areas of Pakistan above 1500 m including the

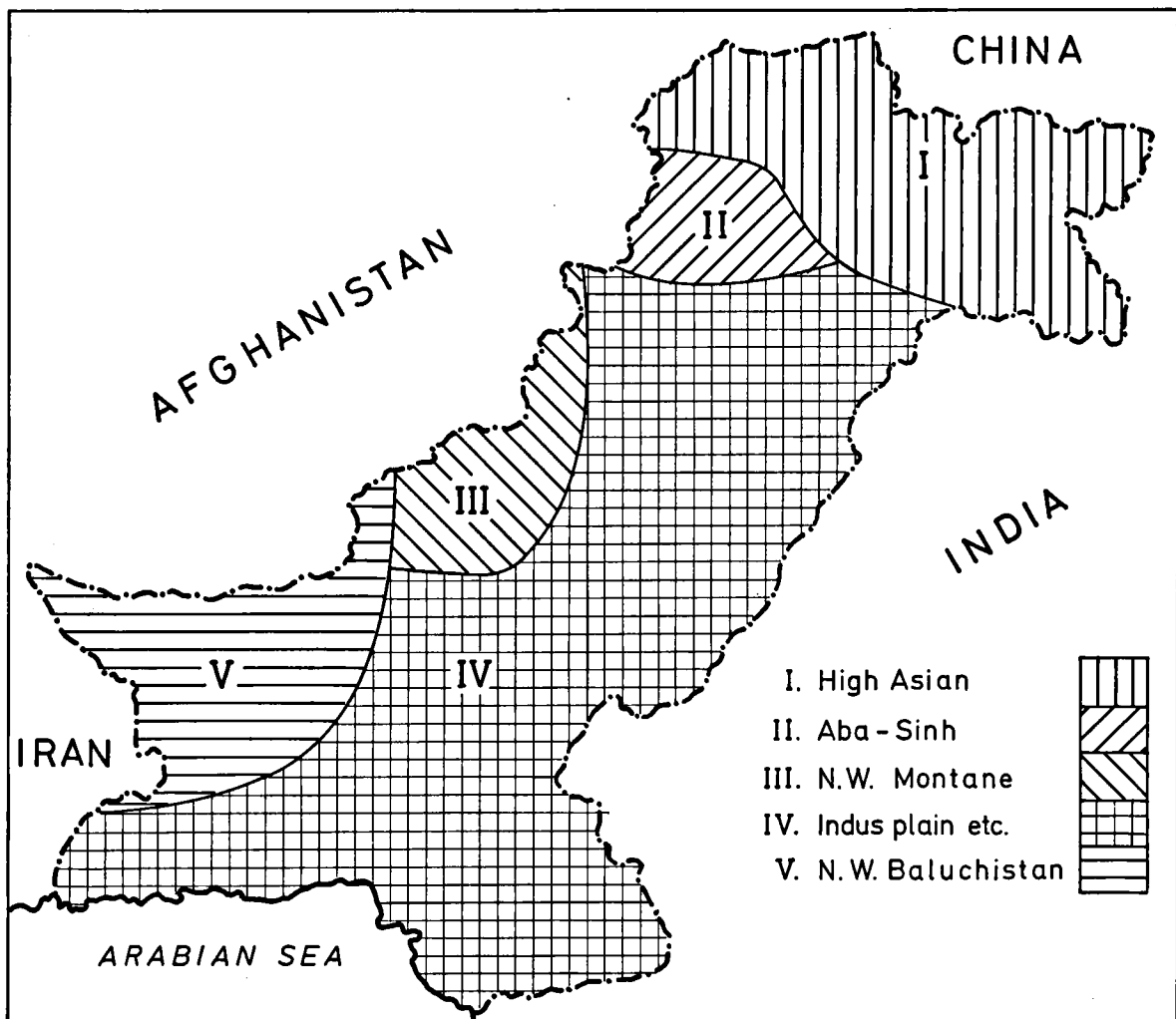


Fig. 3. Zoogeographical divisions of Pakistan and Kashmir.

Northern Areas and the upper parts of the Chitral, Swat and Kaghan valleys in the North West Frontier Province (fig. 3). The streams and rivers of this area are characterized by strong water currents and cool and clear water with rocky to pebbly beds. The temperature of the water rarely reaches 25°C, even in summer. The characteristic genera are *Schizothorax*, *Diptychus*, *Ptychobarbus*, *Schizopygopsis*, *Noemacheilus* (subgenus *Triplophysa*) and *Glyptosternum*. Most of the species are restricted to the Trans-Himalayan part of this division but a few species descend into the Himalayan part and sometimes even into the river Indus up to Attock, in winter.

The High Asian fish fauna is derived from the South-East Asian fish fauna. It has differentiated into different genera and species during the Pliocene or Pleistocene after isolation in the Trans-Himalayan Region by the upheaval of the Himalayas. High Asia was recognized as a sub-region of the Holarctic Region by Berg (1940), but according to Banareescu (1967b), the High Asian Subregion should be included in the Oriental Region.

Within the High Asian Division of Pakistan, two subdivisions may be recognized which have certain species in common but others restricted to them. The subgenus *Schistura* of the genus *Noemacheilus* extends into the Himalayan part of this division but not into the Trans-Himalayan part. On the contrary, some species of snow trouts are restricted to the Trans-Himalayan areas (table I).

## II. A b a - S i n h D i v i s i o n

This division includes the southern parts of the Malakand Division (including the lower part of the Swat Valley and all of the Buner Valley), the Vale of Peshawar and the submontane Hazara, north of the Safed Koh, Cheerat and Kala Chitta ranges (fig. 3). The streams and rivers of this area are generally fast flowing with cool and clear waters and pebbly to sandy beds. Since there is a great range of elevation from 300 m to above 1000 m, the climatic conditions vary from place to place.

The fish fauna of this division is a mixture of South Asian and High Asian forms (table II). No

Table I. Fish fauna of the High Asian Division.

Sr. no.	Scientific name	Trans-Himalayan subdivision	Himalayan subdivision	Status
Class TELEOSTOMI				
Order CYPRINIFORMES				
Family CYPRINIDAE				
1.	<i>Schizothorax plagiostomus</i> Heckel, 1838	+	+	H. Asian
2.	<i>S. esocinus</i> Heckel, 1838	+	+	H. Asian
3.	<i>S. nasus</i> Heckel, 1838	+	—	H. Asian
4.	<i>S. longipinnis</i> Heckel, 1838	+	—	H. Asian
5.	<i>S. labiatus</i> (M'Clelland, 1842)	+	+	H. Asian
6.	<i>Diptychus maculatus</i> Steindachner, 1866	+	—	H. Asian
7.	<i>Ptychobarbus conirostris</i> Steindachner, 1866	+	—	H. Asian
8.	<i>Schizopygopsis stoliczkai</i> Steindachner, 1866	+	—	H. Asian
Family COBITIDAE				
9.	<i>Noemacheilus marmoratus</i> Heckel, 1838	+	+	H. Asian
10.	<i>N. stoliczkai</i> Steindachner, 1866	+	+	H. Asian
11.	<i>N. stenurus choprai</i> Hora, 1934	+	+	End.
12.	<i>N. gracilis</i> Day, 1876	+	+	H. Asian
13.	<i>N. yasinensis</i> Alcock, 1898	+	—	End.
14.	<i>N. griffithi naziri</i> Ahmad & Mirza, 1963	—	+	End.
15.	<i>N. naseeri</i> Ahmad & Mirza, 1963	—	+	End.
16.	<i>N. alepidotus alepidotus</i> Mirza & Banareescu, 1970	—	+	End.
Order SILURIFORMES				
Family SISORIDAE				
17.	<i>Glyptosternum reticulatum</i> M'Clelland, 1842	+	+	H. Asian

Sr. = Serial; H. = High; End. = Endemic to Pakistan.

Table II. Fish fauna of the Aba-Sinh Division.

Sr. no. Scientific name	Status	Sr. no. Scientific name	Status
Class TELEOSTOMI		Order SILURIFORMES	
Order OSTEOGLOSSIFORMES		Family SILURIDAE	
Family NOTOPTERIDAE		33. <i>Wallago attu</i> (Bloch & Schneider, 1801)	S. Asian
1. <i>Notopterus notopterus</i> (Pallas, 1769)	S. Asian	34. <i>Ompok bimaculatus</i> (Bloch, 1797)	S. Asian
Order CYPRINIFORMES		35. <i>O. pabda</i> (Hamilton, 1822)	S. Asian
Family CYPRINIDAE *		Family HETEROPNEUSTIDAE	
2. <i>Salmostoma bacaila</i> (Hamilton, 1822)	S. Asian	36. <i>Heteropneustes fossilis</i> (Bloch, 1794)	S. Asian
3. <i>S. punjabensis</i> (Day, 1872)	S. Asian	Family BAGRIDAE	
4. <i>Barilius vagra</i> (Hamilton, 1822)	S. Asian	37. <i>Mystus seenghala</i> (Sykes, 1841)	S. Asian
5. <i>B. bendelisis</i> (Hamilton, 1822)	S. Asian	38. <i>M. cavasius</i> (Hamilton, 1822)	S. Asian
6. <i>Danio devario</i> (Hamilton, 1822)	S. Asian	39. <i>M. tengara</i> (Hamilton, 1822)	S. Asian
7. <i>Brachydanio rerio</i> (Hamilton, 1822)	S. Asian	40. <i>M. bleekeri</i> (Day, 1877)	S. Asian
8. <i>Labeo dero</i> (Hamilton, 1822)	S. Asian	Family SISORIDAE	
9. <i>Crossocheilus latius diplocheilus</i> (Heckel, 1838)	S. Asian	41. <i>Gagata cenia</i> (Hamilton, 1822)	S. Asian
10. <i>Garra gotyla</i> (Gray, 1832)	S. Asian	42. <i>Glyptothorax cavia</i> (Hamilton, 1822)	S. Asian
11. <i>Aspidoparia morar</i> (Hamilton, 1822)	S. Asian	43. <i>G. platypogonoides</i> (Bleeker, 1855)	S. Asian
12. <i>Amblypharyngodon mola</i> (Hamilton, 1822)	S. Asian	44. <i>G. naziri</i> Mirza & Naik, 1969	End.
13. <i>Tor putitora</i> (Hamilton, 1822)	S. Asian	45. <i>G. punjabensis</i> Mirza & Kashmiri, 1971	S. Asian
14. <i>T. mosal</i> (Hamilton, 1822)	S. Asian	Family SCHILBEIDAE	
15. <i>Puntius sarana</i> (Hamilton, 1822)	S. Asian	46. <i>Clupisoma muriei naziri</i> Mirza & Awan, 1973	End.
16. <i>P. titius</i> (Hamilton, 1822)	S. Asian	Order CHANNIFORMES	
17. <i>P. ticto</i> (Hamilton, 1822)	S. Asian	Family CHANNIDAE	
18. <i>P. sophore</i> (Hamilton, 1822)	S. Asian	47. <i>Channa punctatus</i> (Bloch, 1793)	S. Asian
19. <i>Schizothorax plagiotomus</i> Heckel, 1838	H. Asian	48. <i>C. gachua</i> (Hamilton, 1822)	S. Asian
20. <i>S. esocinus</i> Heckel, 1838	H. Asian	Order PERCIFORMES	
21. <i>S. labiatus</i> (McClelland, 1842)	H. Asian	Family OSPHRONEMIDAE	
Family COBITIDAE		49. <i>Colisa fasciata</i> (Bloch & Schneider, 1801)	S. Asian
22. <i>Botia dayi</i> Hora, 1932	S. Asian	50. <i>C. lalius</i> (Hamilton, 1822)	S. Asian
23. <i>Noemacheilus botia</i> (Hamilton, 1822)	S. Asian	Family MASTACEMBELIDAE	
24. <i>N. corica</i> (Hamilton, 1822)	S. Asian	51. <i>Mastacembelus armatus</i> (Lacépède, 1800)	S. Asian
25. <i>N. stoliczkae</i> Steindachner, 1866	H. Asian	*) Note added in proof. Insert between nrs. 3 and 4:	
26. <i>N. gracilis</i> Day, 1876	H. Asian	<i>Chela cachi</i> (Hamilton, 1822)	
27. <i>N. naseeri</i> Ahmad & Mirza, 1963	End.		
28. <i>N. griffithi naziri</i> Ahmad & Mirza, 1963	End.		
29. <i>N. stenurus choprai</i> Hora, 1934	End.		
30. <i>N. alepidotus alepidotus</i> Mirza & Banarese, 1970	End.		
31. <i>N. prashari prashari</i> Hora, 1933	End.		
32. <i>Lepidocephalus guntea</i> (Hamilton, 1822)	S. Asian		

West Asian species has so far been reported from this area. It is interesting to note that the West Asian genus *Cyprinion*, which is quite common South of the Safed Koh, Cheerat and Kala Chitta ranges in the Kohat Toi and the river Soan, is not represented in the rivers Kabul and Haro north of these ranges. The South Asian genera, such as *Notopterus*, *Salmostoma*, *Chela*, *Barilius*, *Danio*, *Brachydanio*, *Labeo*, *Crossocheilus*, *Garra*, *Aspidoparia*, *Tor*, *Puntius*, *Botia*, *Lepidocephalus*, subgenus *Schistura* of *Noemacheilus*, *Gagata*, *Glyptothorax*, *Mystus*, *Wallago*, *Ompok*, *Clupisoma*,

*Heteropneustes*, *Channa*, *Mastacembelus* and *Colisa* are represented in this division. The High Asian element is represented by the genus *Schizothorax* and the subgenus *Triplophysa* of the genus *Noemacheilus* (table II).

### III. Northwestern Montane Division

This division includes the northeastern part of Baluchistan (comprising the Zhob and Loralai districts and the northern parts of the Sibi and

Table III. Fish fauna of the Northwestern Montane Division.

Sr. no. Scientific name	Ziarat Valley	Nari-Bolan Headwaters	Zhob Valley	N.W. Mountains	Status
Class TELEOSTOMI					
Order CYPRINIFORMES					
Family CYPRINIDAE					
1. <i>Chela cachius</i> (Hamilton, 1822)	—	—	—	+	S. Asian
2. <i>Barilius vagra</i> (Hamilton, 1822)	—	+	+	+	S. Asian
3. <i>Labeo dero</i> (Hamilton, 1822)	—	+	—	+	S. Asian
4. <i>Crossocheilus latius diplocheilus</i> (Heckel, 1838)	—	+	+	+	S. Asian
5. <i>Garra gotyla</i> (Gray, 1832)	—	+	+	+	S. Asian
6. <i>G. wanae</i> (Regan, 1914)	—	—	—	+	End.
7. <i>Aspidoparia morar</i> (Hamilton, 1822)	—	—	—	+	S. Asian
8. <i>Tor putitora</i> (Hamilton, 1822)	—	+	—	+	S. Asian
9. <i>T. zhobensis</i> Mirza, 1967	—	—	+	—	End.
10. <i>Puntius ticto</i> (Hamilton, 1822)	—	+	—	+	S. Asian
11. <i>Cyprinion watsoni</i> (Day, 1872)	—	+	+	+	W. Asian
12. <i>Schizothorax plagiostomus</i> Heckel, 1838	+	+	+	+	H. Asian
13. <i>S. labiatus</i> (McClelland, 1842)	+	+	+	—	H. Asian
14. <i>Schizopygopsis stoliczkae</i> Steindachner, 1866	+	—	—	—	H. Asian
15. <i>Schizocypris brucei</i> Regan, 1914	?	+	+	+	H. Asian
Family COBITIDAE					
16. <i>Noemacheilus botia</i> (Hamilton, 1822)	—	+	—	+	S. Asian
17. <i>N. baluchiorum</i> Zugmayer, 1912	—	+	—	—	End.
18. <i>N. cristatus</i> Berg, 1898	—	—	+	—	W. Asian
19. <i>N. prashari lindbergi</i> Banarescu & Mirza, 1965	—	+	—	—	W. Asian
20. <i>N. pakistanicus</i> Mirza & Banarescu, 1969	—	—	+	—	End.
21. <i>N. harnaiensis</i> Mirza & Nalbant, 1969	—	+	—	—	End.
22. <i>N. anambarensis</i> Mirza & Banarescu, 1970	—	+	—	—	End.
23. <i>N. machensis</i> Mirza & Nalbant, 1970	—	+	—	—	End.
Order SILURIFORMES					
Family SILURIDAE					
24. <i>Ompok pabda</i> (Hamilton, 1822)	—	—	—	+	S. Asian
Family SISORIDAE					
25. <i>Glyptothorax naziri</i> Mirza & Naik, 1969	—	+	+	+	End.
Order PERCIFORMES					
Family MASTACEMBELIDAE					
26. <i>Mastacembelus armatus</i> (Lacépède, 1800)	—	—	+	+	S. Asian

Kachhi districts) and the northwestern mountains along the Pak-Afghan border up to the Safed Koh Range in the north (fig. 3). The elevation of this area is more than 100 m above sea level. The summers are mild but the winters are quite cold. This division is demarcated from the rest of Pakistan by the Safed Koh Range in the north, the Sulaiman-Kohat hills in the east, the Marri-Bugti hills in the south and the Central Brahui Range in the south-west. There is no sharp boundary in the north-west, where this division extends into Afghanistan.

The fish fauna of this division is a mixture of

South Asian, High Asian and West Asian forms (table III). There are six species which appear to be endemic to this division. These are: *Tor zhobensis*, *Noemacheilus pakistanicus*, *N. harnaiensis*, *N. anambarensis* and *N. machensis* from northeastern Baluchistan, and *Garra wanae* from southern Waziristan. It is interesting to note that the genus *Schizocypris* and the West Asian subgenus *Paracobitis* (represented by *Noemacheilus cristatus*) of the genus *Noemacheilus* are restricted to this division in Pakistan.

Within this division at least four subdivisions can be recognized: Ziarat Valley, Nari-Bolan Head-

waters, Zhob Valley, and North-West Mountains. The Ziarat Valley is characterized by having only Schizothoracinae. The Nari-Bolan Headwaters have three endemic species: *Noemacheilus harnaiensis*, *N. anambarensis* and *N. machensis*. The Zhob Valley has *Tor zhobensis* and *N. pakistanicus* as endemic species and *N. cristatus* is so far known only from this valley in Pakistan. The North-West Mountains have only one endemic species: *Garra wanae*. Other species are common to these subdivisions (table III).

#### IV. Indus plain, adjoining hills & South Baluchistan Division

This division comprises more than 50% of the area of Pakistan (see fig. 3). It includes the Indus plain and the adjoining hills (Kohat hills, Potwar Plateau, Salt Range, Sulaiman and Kirthar hills) and the southern part of Baluchistan south of the Marri-Bugti hills and the Central Brahui and Kharan-Makran ranges. The climatic conditions vary from a marine type with moderate temperatures to a continental type with cold winters and hot summers in different parts of this division.

The fish fauna as a whole is predominantly South Asian (table IV). In the hilly areas surrounding the Indus plain in the north and west, and in southern Baluchistan a few West Asian forms are met with (*Cyprinion watsoni*, *Noemacheilus kessleri* and *Aphaniops dispar stoliczkai*). In the extreme north of the Indus plain two species of the High Asian genus *Schizothorax* (*S. plagiostomus* and *S. labiatus*) rarely descend into the upper parts of the rivers of the Punjab plain. In the coastal areas and in the lower Indus plain some peripheral fishes are known to ascend the river Indus and the rivers along the Makran coast. This vast division can be divided into three subdivisions:

##### 1. Indus plain. —

The Indus plain is a part of the vaster Indo-Gangetic plain extending from the Arabian Sea to the Bay of Bengal along the southern limits of the Himalayas in the northern part of the South Asian subcontinent. The fish fauna of this vast plain is essentially the same, except that certain genera found in the Ganges system are not known from the Indus system. Generally, the number of genera of freshwater fishes decreases from east to west. This is understandable because South-East Asia was the centre of diversification for most of the freshwater fishes. From South-East Asia, freshwater fishes have dispersed along the southern face

of the Himalayas from east to west. Hence, there is a greater variety of freshwater fishes in the east than in the west. The fish fauna of the Indus plain is almost entirely South Asian.

##### 2. Potwar Plateau, Salt Range and Kohat hills. —

This area comprises the low hills of the northern Punjab Province and adjoining hilly areas of the North West Frontier Province. The fish fauna is predominantly South Asian, but a few West Asian forms, such as *Cyprinion watsoni* and *Noemacheilus kessleri*, have penetrated from the west. Only two species (*Puntius waageni* and *Noemacheilus punjabensis*) appear to be endemic to this subdivision.

##### 3. South-West hills and South Baluchistan. —

This subdivision comprises the Sulaiman and Kirthar hills and southern Baluchistan south of the Marri-Bugti hills, Central Brahui and Kharan-Makran ranges. The fish fauna of this subdivision is also predominantly South Asian but a few West Asian forms, such as *Cyprinion watsoni*, *Aphaniops dispar stoliczkai*, and perhaps *Noemacheilus kessleri*, are known from this area. According to Berg (1940), the coastal rivers of Baluchistan and eastern Iran belonged to a single river system in the Pliocene, as the area now occupied by the Arabian Sea was a dry land. This river served as a dispersal route for the West Asian forms from West Asia to Pakistan and for the South Asian forms from Pakistan to the southern part of Iran up to the river Shattul-Arab. About half a dozen of marine forms ascend the rivers of the Makran coast far above the tidal influence (Zugmayer, 1913). Only two species, *Labeo macmahoni* from South-West Baluchistan, and *L. caeruleus* from the Sind-Baluchistan hills, appear to be endemic to this subdivision.

The subdivisions 1 and 2 are more or less arbitrary as they have the same composition of fish fauna except that the endemic forms are different (table IV).

#### V. Northwestern Baluchistan Division

This division comprises the northwestern part of Baluchistan west of the Central Brahui Range and north of the Kharan-Makran ranges (fig. 3). There is no boundary on the northern and western sides. Topographically this area varies from western slopes of the Central Brahui Range to arid basins with a few salt lakes. The temperature also varies greatly.

The fish fauna of this division is mainly West Asian but a few South Asian forms have penetrat-

Table IV. Fish fauna of the Indus plain, adjoining hills and South Baluchistan.

Sr. no. Scientific name	Indus plain	Potwar Plateau, Salt Range & Kohat hills	S.W. hills & S. Baluchistan	Status	Sr. no. Scientific name	Indus plain	Potwar Plateau, Salt Range & Kohat hills	S.W. hills & S. Baluchistan	Status
Class TELEOSTOMI									
Order CLUPEIFORMES									
Family CLUPEIDAE									
1. <i>Gadusia chapra</i> (Hamilton, 1822)	+	—	+	S. Asian	76. <i>Rita rita</i> (Hamilton, 1822)	+	+	+	S. Asian
2. <i>Macrura</i> (= <i>Hilsa</i> ) <i>ilisha</i> (Hamilton, 1822)	+	—	+	S. Asian	77. <i>Mystus aor</i> (Hamilton, 1822)	+	—	—	S. Asian
Order OSTEOGLOSSIFORMES									
Family NOTOPTERIDAE									
3. <i>Notopterus notopterus</i> (Pallas, 1769)	+	+	—	S. Asian	78. <i>M. seenghala</i> (Sykes, 1841)	+	+	+	S. Asian
4. <i>N. chitala</i> (Hamilton, 1822)	+	—	—	S. Asian	79. <i>M. cavasius</i> (Hamilton, 1822)	+	+	+	S. Asian
Order CYPRINIFORMES									
Family CYPRINIDAE									
5. <i>Chela cachius</i> (Hamilton, 1822)	+	+	+	S. Asian	80. <i>M. tengara</i> (Hamilton, 1822)	+	+	—	S. Asian
6. <i>C. laubuca</i> (Hamilton, 1822)	+	—	—	S. Asian	81. <i>M. vittatus</i> (Bloch, 1797)	+	—	—	S. Asian
7. <i>Salmostoma bacaila</i> (Hamilton, 1822)	+	+	+	S. Asian	82. <i>M. bleekeri</i> (Day, 1877)	+	+	—	S. Asian
8. <i>S. punjabensis</i> (Day, 1872)	+	+	—	S. Asian	83. <i>M. gulio</i> (Hamilton, 1877)	+	—	+	S. Asian
9. <i>Pseudoxygaster gora</i> (Hamilton, 1822)	+	—	—	S. Asian	84. <i>M. horai</i> Jayaram, 1954	?	+	—	End.
10. <i>Barilius vagra</i> (Hamilton, 1822)	+	—	—	S. Asian	Family AMBLYCIPITIDAE				
11. <i>B. bendelisis</i> (Hamilton, 1822)	+	+	+	S. Asian	85. <i>Amblyceps mangois</i> (Hamilton, 1822)	+	+	—	S. Asian
12. <i>B. bola</i> (Hamilton, 1822)	?	—	—	S. Asian	Family SCHILBEIDAE				
13. <i>Rasbora rasbora</i> (Hamilton, 1822)	+	—	—	S. Asian	86. <i>Clupisoma garua</i> (Hamilton, 1822)	+	—	—	S. Asian
14. <i>R. daniconius</i> (Hamilton, 1822)	+	+	+	S. Asian	87. <i>C. murius naziri</i> Mirza & Awan, 1973	+	+	—	End.
15. <i>Danio devario</i> (Hamilton, 1822)	+	+	+	S. Asian	88. <i>C. atherinoides</i> (Hamilton, 1822)	+	—	—	S. Asian
16. <i>Esomus danricus</i> (Hamilton, 1822)	+	+	+	S. Asian	89. <i>Eutropichthys vacha</i> (Hamilton, 1822)	+	—	—	S. Asian
17. <i>Garra gotyla</i> (Gray, 1832)	+	+	+	S. Asian	90. <i>Ailia coila</i> (Hamilton, 1822)	+	—	—	S. Asian
18. <i>Tor putitora</i> (Hamilton, 1822)	+	+	+	S. Asian	91. <i>Ailichthys punctata</i> Day, 1871	+	—	—	S. Asian
19. <i>T. tor</i> (Hamilton, 1822)	?	—	—	S. Asian	92. <i>Silonia silondia</i> (Hamilton, 1822)	?	—	—	S. Asian
20. <i>Puntius sarana</i> (Hamilton, 1822)	+	+	+	S. Asian	Family HETEROPNEUSTIDAE				
21. <i>P. titius</i> (Hamilton, 1822)	+	+	+	S. Asian	93. <i>Heteropneustes fossilis</i> (Bloch, 1794)	+	—	—	S. Asian
22. <i>P. phutunito</i> (Hamilton, 1822)	+	+	+	S. Asian	Family SILURIDAE				
23. <i>P. gelius</i> (Hamilton, 1822)	+	+	+	S. Asian	94. <i>Wallago attu</i> (Bloch & Schneider, 1801)	+	+	—	S. Asian
24. <i>P. sophore</i> (Hamilton, 1822)	+	+	+	S. Asian	95. <i>Ompok bimaculatus</i> (Bloch, 1797)	+	+	—	S. Asian
25. <i>P. ticto</i> (Hamilton, 1822)	+	+	+	S. Asian	96. <i>O. pabda</i> (Hamilton, 1822)	—	+	+	S. Asian
26. <i>P. conchionius</i> (Hamilton, 1822)	+	+	+	S. Asian	97. <i>O. pabo</i> (Hamilton, 1822)	?	—	—	S. Asian
27. <i>P. punjabensis</i> (Day, 1872)	+	+	+	S. Asian	Family CLARIIDAE				
28. <i>P. vittatus</i> (Day, 1872)	+	+	+	S. Asian	98. <i>Clarias batrachus</i> (Linnaeus, 1758)	?	—	—	S. Asian
29. <i>P. terio</i> (Hamilton, 1822)	+	+	+	S. Asian	Order ATHERINIFORMES				
30. <i>P. waageni</i> (Day, 1872)	—	+	+	End.	Family CYPRINODONTIDAE				
31. <i>Cyprinion watsoni</i> (Day, 1872)	—	+	+	W. Asian	99. <i>Aplocheilichthys panchax</i> (Hamilton, 1822)	+	—	+	S. Asian
32. <i>Labeo calbasu</i> (Hamilton, 1822)	+	—	—	S. Asian	100. <i>Aphaniops dispar stoliczkae</i> (Day, 1872)	+	—	+	W. Asian
33. <i>L. gonius</i> (Hamilton, 1822)	+	—	—	S. Asian	Family BELONIDAE				
34. <i>L. rohita</i> (Hamilton, 1822)	+	—	—	S. Asian	101. <i>Xenentodon cancila</i> (Hamilton, 1822)	+	—	—	S. Asian
					Order CHANNIFORMES				
					Family CHANNIDAE				
					102. <i>Channa asiatica</i> (Hamilton, 1822)	+	—	—	S. Asian

37. <i>L. pangusia</i> (Hamilton, 1822)	+	—	—	S. Asian	104. <i>C. gachua</i> (Hamilton, 1822)	—	+	+	S. Asian
38. <i>L. dyocheilus</i> (M'Clelland, 1839)	+	+	—	S. Asian	105. <i>C. punctatus</i> (Bloch, 1793)	+	+	+	S. Asian
39. <i>L. boggut</i> (Sykes, 1841)	+	—	—	S. Asian					
40. <i>L. boga</i> (Hamilton, 1822)	+	—	—	S. Asian					
41. <i>L. microphthalmus</i> Day, 1877	+	+	—	S. Asian	Order PERCIFORMES				
42. <i>L. caeruleus</i> Day, 1877	—	—	+	End.	Family CENTROPOMIDAE (= AMBASSIDAE)				
43. <i>L. sindensis</i> (Day, 1872)	+	+	+	S. Asian	106. <i>Chanda</i> (= <i>Ambassis</i> ) <i>nama</i> Hamilton, 1822	+	+	+	S. Asian
44. <i>L. nigripinnis</i> Day, 1877	+	—	+	S. Asian	107. <i>C. ranga</i> Hamilton, 1822	+	—	—	S. Asian
45. <i>L. macmahoni</i> Zugmayer, 1912	—	—	—	End.	108. <i>C. baculis</i> Hamilton, 1822	+	—	—	S. Asian
46. <i>Cirrhinus mrigala</i> (Hamilton, 1822)	+	+	+	S. Asian	Family NANDIDAE				
47. <i>C. reba</i> (Hamilton, 1822)	+	+	+	S. Asian	109. <i>Nandus nandus</i> (Hamilton, 1822)	+	—	—	S. Asian
48. <i>Crossocheilus latius diplocheilus</i> (Heckel, 1838)	+	+	+	S. Asian	110. <i>Badis badis</i> (Hamilton, 1822)	+	—	—	S. Asian
49. <i>Osteobrama cotio</i> (Hamilton, 1822)	+	+	—	S. Asian	Family OSPHRONEMIDAE				
50. <i>Amblypharyngodon mola</i> (Hamilton, 1822)	+	+	—	S. Asian	111. <i>Colisa fasciata</i> (Bloch & Schneider, 1801)	+	+	—	S. Asian
51. <i>Aspidoparia morar</i> (Hamilton, 1822)	+	+	—	S. Asian	112. <i>C. lalius</i> (Hamilton, 1822)	+	—	—	S. Asian
52. <i>Catla catla</i> (Hamilton, 1822)	+	—	—	S. Asian	Family MASTACEMBELIDAE				
53. <i>Chagunius chagunio</i> (Hamilton, 1822) ?	+	—	—	S. Asian	113. <i>Mastacembelus armatus</i> (Lacépède, 1800)	+	+	+	S. Asian
54. <i>Schizothorax plagiosomus</i> Heckel, 1838	+	—	—	H. Asian	114. <i>M. pancalus</i> (Hamilton, 1822)	+	—	—	S. Asian
55. <i>S. labiatus</i> (M'Clelland, 1842)	+	—	—	H. Asian	115. <i>Macrogynathus aculeatus</i> (Bloch, 1795)	+	—	—	S. Asian
Family COBITIDAE					Family MUGILIDAE				
56. <i>Botia lohachatta</i> Chaudhuri, 1912	+	+	+	S. Asian	116. <i>Mugil cephalus</i> Linnaeus, 1758	+	—	+	Cosmopolitan
57. <i>B. dayi</i> Hora, 1932	—	+	+	S. Asian	117. <i>M. speigleri</i> Bleeker, 1859	+	—	+	S. Asian
58. <i>Noemacheilus botia</i> (Hamilton, 1822)	—	+	+	S. Asian	118. <i>Sicamugil cascasia</i> (Hamilton, 1822)	+	—	—	S. Asian
59. <i>N. corica</i> (Hamilton, 1822)	+	+	—	S. Asian	119. <i>Rhinomugil corsula</i> (Hamilton, 1822)	?	—	—	S. Asian
60. <i>N. baluchiorum</i> Zugmayer, 1912	—	+	+	End.	Family GOBIIDAE				
61. <i>N. kessleri</i> Günther, 1889	—	+	+	W. Asian	120. <i>Glossogobius giuris</i> (Hamilton, 1822)	+	—	+	S. Asian
62. <i>N. prashari prashari</i> Hora, 1933	—	+	—	End.	121. <i>Boleophthalmus boddarti</i> (Pallas, 1770)	+	—	+	S. Asian
63. <i>N. punjabensis</i> Hora, 1923	—	+	—	End.	122. <i>B. dentatus</i> Cuvier & Valenciennes, 1837	+	—	+	S. Asian
64. <i>N. alepidotus alepidotus</i> Mirza & Banarescu, 1970	—	+	—	End.	123. <i>B. dussumieri</i> Cuvier & Valenciennes, 1837	+	—	+	S. Asian
65. <i>N. alepidotus nalbanti</i> Banarescu & Mirza, 1972	—	+	—	S. Asian	124. <i>Periophthalmus koelreuteri</i> (Pallas, 1770)	+	—	+	S. Asian
Order SILURIFORMES					Order SYNBRANCHIFORMES				
Family SISORIDAE					Family CUCHIIDAE (AMPHIPNOIDAE)				
66. <i>Sisor rabdophorus</i> Hamilton, 1822	+	+	—	S. Asian	125. <i>Cuchia</i> (= <i>Amphipnous</i> ) <i>cuchia</i> (Hamilton, 1822)	+	—	—	S. Asian
67. <i>Bagarius bagarius</i> (Hamilton, 1822)	+	—	—	S. Asian	Class ELASMOBRANCHII				
68. <i>Gagata cenia</i> (Hamilton, 1822)	+	+	—	S. Asian	Order RAJIFORMES				
69. <i>Nangra nangra</i> (Hamilton, 1822)	+	—	—	S. Asian	Family PRISTIDAE				
70. <i>N. robusta</i> Mirza & Awan, 1973	+	+	—	End.	126. <i>Pristis microdon</i> Latham, 1794	+	—	—	Cosmopolitan
71. <i>Glypto thorax telchitta</i> (Hamilton, 1822)	+	—	—	S. Asian					
72. <i>G. cavia</i> (Hamilton, 1822)	+	+	—	S. Asian					
73. <i>G. platypogonoides</i> (Bleeker, 1855)	+	+	—	S. Asian					
74. <i>G. naziri</i> Mirza & Naik, 1969	+	+	—	End.					
75. <i>G. punjabensis</i> Mirza & Kashmiri, 1971	+	+	—	S. Asian					

Table V. Fish fauna of the Northwestern Baluchistan Division.

Sr. no. Scientific name	Lora drainage	Mashkel drainage	Status
Class TELEOSTOMI			
Order CYPRINIFORMES			
Family CYPRINIDAE			
1. <i>Labeo dero</i> (Hamilton, 1822)	—	+	S. Asian
2. <i>L. gedrosicus</i> Zugmayer, 1912	—	+	End.
3. <i>Aspidoparia morar</i> (Hamilton, 1822)	—	+	S. Asian
4. <i>Crossocheilus latius diplocheilus</i> (Heckel, 1838)	—	+	S. Asian
5. <i>Garra rossica</i> (Nikolsky, 1900)	+	—	W. Asian
6. <i>Cyprinion watsoni</i> (Day, 1872)	+	+	W. Asian
7. <i>Capoeta capoeta heratensis</i> (Kayserling, 1861)	+	—	W. Asian
Family COBITIDAE			
8. <i>Noemacheilus kessleri</i> Günther, 1889	+	+	W. Asian
9. <i>N. brahui</i> Zugmayer, 1912	+	—	W. Asian
10. <i>N. prashari lindbergi</i> Banarescu & Mirza, 1965	—	+	W. Asian
11. <i>N. baluchiorum</i> Zugmayer, 1912	—	+	End.
Order ATHERINIFORMES			
Family CYPRINODONTIDAE			
12. <i>Aphaniops dispar stoliczkai</i> (Day, 1872)	—	+	W. Asian

ed from the south. The fish fauna of the Lora drainage system is exclusively West Asian but that of the Mashkel drainage system is a mixture of West Asian and South Asian forms. The division as a whole may be included in West Asia. There is some controversy about the zoogeographical position of West Asia. Berg (1940) included West Asia in the Mediterranean Subregion of the Holarctic Region. But most of the zoogeographers are of the opinion that West Asia should be regarded as a transitional zone as there is a mixture of different elements from the Holarctic, Oriental and Ethiopian Regions (De Beaufort, 1951; Darlington, 1957).

Within this division, two subdivisions may be recognized: 1. the Lora drainage system north of the Ras Koh Range with exclusively West Asian forms, and 2. the Mashkel drainage system south of this range, with a mixture of West Asian and South Asian forms (table V). Only one species, *Labeo gedrosicus*, appears to be endemic to the Mashkel drainage system.

## VI. DISCUSSION AND CONCLUSION

The freshwater fish fauna of Pakistan is predominantly South Asian. Some High Asian genera (*Schizothorax*, *Diptychus*, *Ptychobarbus*, *Schizopygopsis*, *Schizocypris* and *Glyptosternum*), however, have penetrated into the northern montane

and submontane areas up to the Central Brahui Range, while one West Asian genus (*Cyprinion*) has been able to disperse into Baluchistan and the submontane areas surrounding the Indus plain up to the Safed Koh and Kala Chitta ranges in the north. Another West Asian genus (*Capoeta*) just reaches the northwestern frontier area of Baluchistan. The West Asian subgenus *Discognathus* of the genus *Garra* is also restricted to northwestern Baluchistan.

There are a few genera of primary freshwater fishes, which are common to South Asia and Africa, but they are represented by the South Asian species. It appears that even these genera are primarily Oriental but have dispersed westwards through West Asia into Africa. "In other words, as in any intercontinental, filter-bridge invasion, it was almost entirely the common, dominant Asiatic genera which colonized Africa. Also, there can be no doubt in this instance that the transfer was a one-way affair, for none of the older African groups reached Asia". (Myers, 1966: 768).

Thus the fish fauna of Pakistan is composed of three elements: the South Asian, the High Asian and the West Asian element. Among these the South Asian element is predominant. Excepting the Trans-Himalayan part of Pakistan, which contains exclusively High Asian genera, South Asian genera are represented in all the areas of Pakistan. At the species level, there are about 75 % South



Asian, 9 % High Asian, 4 % West Asian and 12 % endemic forms among the freshwater fishes. Even the majority of the endemic forms are closely related to certain South Asian species.

The fish faunas of South Asia and High Asia originated from the same ancestral South-East Asian stock. The present dissimilarity between them is "probably due to their differentiation in different geological ages, long isolation and the resulting segregation" (Hora, 1937b: 247).

The fish fauna of High Asia belongs to three basic groups: Schizothoracinae, Noemacheilinae and *Glyptosternum*. Among these the Schizothoracinae are specially modified "Oriental barbels", the Noemacheilinae have evolved from the South-East Asian ancestral stock, and *Glyptosternum* is closely related to (and probably derived from) the Oriental *Glyptothorax*. The ancestors of these fishes migrated to the High Asian areas probably in the Pliocene and differentiated into the present forms after their isolation due to the Himalayan orogeny. Their dispersal from east to west had been possible through some water channel or a system of interconnected lakes forming a westward flowing river during the floods along the northern face of the Himalayas. Thus the High Asian fish fauna has been able to penetrate as far as Anatolia. Regan (1922) included Central Asia in the Palaearctic Region. Similarly, Berg (1940) recognized this area as the High Asian Subregion in the Holarctic Region. But according to Banareescu (1967b & personal communication), High Asia should be included as a subregion in the Oriental Region. The present study supports his conclusion.

There is no controversy about the zoogeographical position of South Asia. It has been included in the Oriental Region, by almost all the zoogeographers, under different names.

A great confusion exists about the zoogeographical position of West Asia. It was included in the Palaearctic Region by Regan (1922) and in the Mediterranean Subregion of the Holarctic Region by Berg (1940). According to Banareescu (1960), the freshwater fish fauna of West Asia has an indisputable South Asian (Indo-Malayan) character. He proposed the inclusion of this area as a subregion in the Oriental Region. Recently, however, he has changed his view and is of the opinion that the fish fauna of this area is closer to the Holarctic than to the Oriental Region (Banareescu, 1973). But the fish fauna of West Asia shows a transition between the Oriental, the Holarctic and perhaps the Ethiopian Regions. Darlington's (1957) con-

clusion that southwestern Asia is a region of double transition of fish faunas, the transition being from African to Oriental forms in one direction, and from tropical to northern forms in another, seems quite valid even today. West Asia is, therefore, treated as a transitional region.

From the above discussion it follows that the freshwater fish fauna of Pakistan is predominantly Oriental and that the High Asian Division should be included in the High Asian Subregion of the Oriental Region; the Aba-Sindh Division, the Northwestern Montane Division, and the Indus plain and adjoining hills Division belong to the South Asian Subregion of the Oriental Region; while the Northwestern Baluchistan Division may be included in the West Asian Transitional Region.

The herpetofauna of Pakistan shows a somewhat similar distribution. It is mainly composed of High Asian, South Asian and West Asian forms, but a few African genera are also represented. No endemic genus has so far been described from Pakistan. The number of endemic species and subspecies is also small. The High Asian forms are distributed in the northern montane areas, the West Asian forms are found in Baluchistan and adjoining areas, while the Indus plain and the adjoining hilly areas are mainly occupied by South Asian forms (Minton, 1966; Mertens, 1969). The avian and mammalian faunas have a more or less similar composition but the African element is well represented (Quadri, 1971).

In short, the following zoogeographical regions and subregions are represented in Pakistan:

### I. Oriental Region

The limits of this great region have been recently extended to include High Asia and East Asia (Banareescu, 1967b & 1972). According to Darlington (1957), the Oriental Region includes tropical Asia and its closely associated islands, including Ceylon, Sumatra, Java, Borneo, Formosa, and the Philippines. From the ichthyological point of view, the Oriental Region comprises most of eastern, central and southern Asia, south of the Stanovoi and adjacent mountain ranges forming the watershed between the Amur and the Lena drainage systems and the northern slopes of the mountains of High Asia. Its western, southern and southeastern limits are the same as defined by Darlington and other zoogeographers.

Within this region, the High Asian and the South Asian Subregions extend into Pakistan.

(i) **High Asian Subregion.** The High Asian Subregion comprises the mountain ranges and the elevated plateaus of High Asia. The boundaries of this subregion are ill-defined as there are no watersheds between High Asia and the adjoining areas. The upper parts of all the rivers originating from High Asia are inhabited by the peculiar High Asian fish fauna. Broadly speaking, most of Afghanistan, Kirghizia, Sinkiang, Tibet, Kashmir, and the northern parts of Pakistan and India up to the southern slopes of the Himalayas, belong to this subregion. The zoogeographical division I of Pakistan represents this subregion.

(ii) **South Asian Subregion.** This subregion comprises the South Asian subcontinent south of the Himalayan and adjacent ranges in the North West Frontier Province and Baluchistan. It is demarcated by the watershed between the Mekong and the Song Koi drainage systems from the East Asian Subregion, by the southern slopes of the Himalayas and the Hindu Kush from the High Asian Subregion, and by the Central Brahui Range, Kharan-Makran ranges, and the adjacent ranges in

Iran from the West Asian Transitional Region. The zoogeographical divisions II, III and IV of Pakistan belong to this subregion.

## II. *West Asian Transitional Region*

The West Asian Transitional Region shows a complex freshwater fish fauna. There are elements from the Oriental, Holarctic and Ethiopian Regions. Several endemic genera of fishes have recently been recognized by Karaman (1971). This region comprises northwestern Baluchistan, western Afghanistan, central and southern Iran, Iraq, and some parts of Syria and Palestine. In the eastern part of this region, there is a transition from Oriental to Holarctic faunas, while in the southwestern part, there appears to be a transition from Holarctic to African elements.

Within West Asia, at least two subregions can be recognized: 1. The Iranian Subregion, and 2. the Syrian-Euphratic Subregion. The Iranian Subregion extends into northwestern Baluchistan in Pakistan (zoogeographical division V).

## SUMMARY

1. The freshwater fish fauna of Pakistan has been analyzed. Since the present paper deals with the zoogeographical aspects of the fish fauna, the exotic fishes have been omitted.

2. The fish fauna of Pakistan is predominantly South Asian, but High Asian and West Asian genera are also represented. The African element is hardly perceptible.

3. On the basis of the distribution of their freshwater fishes, the following five divisions are proposed: I. High Asian Division, comprising the northern Himalayan and the Trans-Himalayan areas; II. Aba-Sinh Division, including the Buner Valley, lower parts of the Swat Valley, the Vale of Peshawar and the submontane Hazara; III. Northwestern Montane Division, which includes the northwestern mountains along the Pak-Afghan border between the Safed Koh Range in the north and the Central Brahui Range in the west, while its northwestern, eastern and southern boundaries are ill-defined; IV. Indus plain and adjoining hills Division, which comprises the Indus plain, the Potwar Plateau, the Salt Range, the Kohat hills and

southern Baluchistan; V. Northwestern Baluchistan Division, including the areas west of the Central Brahui Range and north of the Kharan-Makran ranges.

4. The South Asian and the High Asian fish faunas have originated from the same basic stock. Their difference is due to long isolation and differentiation during the various geological ages. It is, therefore, suggested that South Asia and High Asia should be included in the Oriental Region as two subregions. The West Asian fish fauna shows a mixture of Oriental, Holarctic and African faunas. It is, therefore, recognized as a West Asian Transitional Region.

5. It is concluded that Pakistan lies in the Oriental Region, except northwestern Baluchistan, which belongs to the West Asian Transitional Region. Among the zoogeographical divisions of Pakistan, the division I belongs to the High Asian Subregion of the Oriental Region, the divisions II, III and IV belong to the South Asian Subregion of the Oriental Region, while the division V may be included in the West Asian Transitional Region.

## REFERENCES

- AHMAD, K. S., 1951. Climatic regions of West Pakistan. *Proc. Pakist. Sci. Conf.*, 3 (2) : 101-135.
- , 1969. A geography of Pakistan: 1-262 (Oxford University Press, Karachi).
- AHMAD, M. F. & S. A. KHAN, 1974. A checklist of the freshwater fishes of Sind Province, Pakistan. *Biologia, Lahore*, 20 (2) : 119-131.
- AHMAD, N., 1943. Fishes of Lahore. *Bull. Dep. Zool. Panjab Univ.*, 1: 352-374.
- , 1963. Fish fauna of West Pakistan: 1-5 (Government Printing West Pakistan, Lahore).
- AHMAD, N. D. & M. R. MIRZA, 1963a. Loaches of genus *Noemacheilus* Hasselt from Swat State, West Pakistan. *Pakist. J. Sci.*, 15 (2) : 75-81.
- & —, 1963b. Hill stream fishes of Kaghan and Swat. *Scientist, Karachi*, 6 (4) : 153-161.
- & —, 1964. Some fishes from the Kurram River near Parachinar. *Pakist. J. scient. Res.*, 16 (2) : 44-46.
- ALCOCK, A. W., 1898. Report on the natural history results of the Pamir Boundary Commission: 37-38, pls. I-II (Superintendent of Government Printing, Calcutta).
- ANNANDALE, N. & S. L. HORA, 1920. The fish of Seistan.

- Rec. Indian Mus., 18 (4) : 151—203, pls. XV—XVII.
- BANARESCU, P., 1960. Einige Fragen zur Herkunft und Verbreitung der Süßwasserfischfauna der europäisch-mediterranen Unterregion. Arch. Hydrobiol., 57 (1/2) : 16—134.
- , 1967a. Studies on the systematics of Cultrinae (Pisces, Cyprinidae) with description of a new genus. Revue roum. Biol. (Zool.), 12 (5) : 297—308.
- , 1967b. [Book review of:] The cyprinid fishes of China, vol. I. By Hs. W. Wu. Copeia, (2) : 491—493.
- , 1968. Recent advances in teleost taxonomy and their implications on freshwater zoogeography. Revue roum. Biol. (Zool.), 13 (3) : 153—160.
- , 1971. Competition and its bearing on freshwater faunas. Revue roum. Biol. (Zool.), 16 (3) : 153—164.
- , 1972. The zoogeographical position of the East Asian freshwater fish fauna. Revue roum. Biol. (Zool.), 17 (5) : 315—323.
- , 1973. Some reconsiderations on the zoogeography of the Euro-Mediterranean freshwater fish faunas. Revue roum. Biol. (Zool.), 18 (4) : 257—264.
- BANARESCU, P. & M. R. MIRZA, 1965. *Noemacheilus lindbergi* n. sp., a new loach from Afghanistan and West Pakistan. Senckenberg. biol., 46 (4) : 265—269.
- & —, 1972. *Noemacheilus alepidotus nalbanti* nova subsp., a new loach from Rawlakot, Azad Kashmir. Biologia, Lahore, 18 (2) : 121—123.
- BANARESCU, P. & T. NALBANT, 1964. Süßwasserfische der Türkei, 2. Teil Cobitidae. Mitt. hamb. zool. Mus. Inst., 61: 159—201, Taf. I—VIII.
- & —, 1966. The 3rd Danish Expedition to Central Asia, zoological results 34. Cobitidae (Pisces) from Afghanistan and Iran. Vid. Medd. dansk naturh. Foren., 129 : 149—186.
- & —, 1968. Cobitidae (Pisces, Cypriniformes) collected by the German India Expedition. Mitt. hamb. zool. Mus. Inst., 65 : 327—351, Taf. I—II.
- BEAUFORT, L. F. DE, 1951. Zoogeography of land and inland waters: i—viii, 1—208 (Sidgwick & Jackson, London).
- , 1964. Notes on the distribution of freshwater fishes. Copeia, (1) : 60—65.
- BERG, L. S., 1940. Zoogeografiya presnovodnykh ryb Perednei Azii [Zoogeography of the freshwater fishes of Anterior Asia]. Uchen. Zap. leningr. gos. Univ., 56 : 3—31.
- , 1964. Freshwater fishes of the U.S.S.R. and adjacent countries, II (4th ed.) : 1—496 (Israel Program for Scientific Translations, Jerusalem).
- BLANFORD, W. T., 1901. The distribution of vertebrate animals in India, Ceylon and Burma. Phil. Trans. R. Soc., (B) 194 : 335—436.
- BLEEKER, P., 1863. Systema Cyprinoideorum revisum. Ned. Tijdschr. Dierk., 1 (6—9) : 187—218.
- DARLINGTON, P. J. JR., 1957. Zoogeography. The geographical distribution of animals: i—xi, 1—675 (John Wiley, New York).
- DAY, F., 1871-72. Monograph of Indian Cyprinidae, I—VI. J. Asiat. Soc. Beng., (II) 40 (2) : 95—143, pl. IX; (3) : 277—336, pl. XXI; (4) : 337—367, pls. XXII—XXIII; 41 (1) : 1—29, pl. I; (3) : 171—198; (4) : 318—327.
- , 1876. On the fishes of Yarkand. Proc. zool. Soc. Lond., 1876 : 781—807.
- , [1875-]78. The fishes of India, I: 1—168, pls. I—XXXIX; II: 169—369, pls. XLI—LXXVIII; III: 369—552, pls. LXXIX—CXXIII; IV: 553—778, pls. CXXIV—CXCV (Bernard Quaritch, London).
- , 1877-79. Geographical distribution of Indian freshwater fishes, I—III. J. Linn. Soc. (Zool.), 13 (67) : 138—155; (70) : 338—353; 14 (78) : 534—579.
- , 1880. On the fishes of Afghanistan. Proc. zool. Soc. Lond., 1880 : 224—232.
- , 1889. The fauna of British India including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. BLANFORD. Fishes, I: i—xx, 1—548; II: i—xiv, 1—509 (Taylor & Francis, London, etc.).
- GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN & G. S. MYERS, 1966. Phyletic studies of teleostean fishes with a provisional classification of living forms. Bull. Am. Mus. nat. Hist., 131 (4) : 339—455.
- GREENWOOD, P. H., G. S. MYERS, D. E. ROSEN & S. H. WEITZMAN, 1967. Named main divisions of teleostean fishes. Proc. biol. Soc. Wash., 80 : 227—228.
- GÜNTHER, A., 1889. Fishes. In: J. E. T. AITCHISON ed., The zoology of the Afghan Delimitation Commission. Trans. Linn. Soc. Lond., (Ser. 2, Zool.) 5 (3) : 106—109, pl. 12 figs. A—C.
- HAMILTON, F., 1822. An account of the fishes found in the river Ganges and its branches: i—vii, 1—405, pls. 1—39 (A. Constable & Co., Edinburgh/Hurst, Robinson & Co., London).
- HECKEL, J. J., 1838. Fische aus Caschmir, gesammelt und herausgegeben von Carl Freiherrn v. Hügel, beschrieben von Joh. Jacob Heckel: [i—iv], i—x, 11—112, Taf. I—XIII (P. P. Mechtaristen, Wien).
- , 1843. Ichthyologie. In: J. VON RUSSEGER, Reisen in Europa, Asien und Africa, mit besonderer Rücksicht auf die naturwissenschaftliche Verhältnisse der betreffenden Länder, unternommen in den Jahren 1835 bis 1841, I (2) : 991—1099 (E. Schweizerbart, Stuttgart).
- HORA, S. L., 1919 (unpubl.). Fishes of Lahore.
- , 1921. Indian cyprinoid fishes belonging to the genus Garra, with notes on related species from other countries. Rec. Indian Mus., 22 (5) : 633—687, pls. XXIV—XXVI.
- , 1923. Fish of the Salt Range, Punjab. Rec. Indian Mus., 25 (4) : 377—386, pl. VIII.
- , 1927. On the manuscript drawings of fish in the library of the Asiatic Society of Bengal. III. Fish drawings among the zoological drawings in the collection of Lieut. Col. Sir Alexander Burnes (1805-1841) by Dr. P. B. Lord. J. Proc. Asiat. Soc. Beng., (N.S.) 22 (3) : 117—125.
- , 1933a. Notes on fishes in the Indian Museum. XX. Loaches of the genus Nemachilus from Baluchistan. Rec. Indian Mus., 35 (2) : 182—188, pl. V figs. 3—7.
- , 1933b. Notes on fishes in the Indian Museum. XXI. On a new species of Nemachilus from Kohat, N.W.F. Province. Rec. Indian Mus., 35 (2) : 189—191, pl. V figs. 1—2.
- , 1934. The fish of Chitral. Rec. Indian Mus., 36 (3) : 279—320, pls. III—IV.
- , 1937a. Geographical distribution of Indian freshwater fishes and its bearing on the probable land connections between India and the adjacent countries. Curr. Sci., 5 : 351—356.
- , 1937b. Comparison of the fish-faunas of the northern and the southern faces of the great Himalayan Range. Rec. Indian Mus., 39 (3) : 241—250.

- , 1937c. Distribution of Himalayan fishes and its bearing on certain palaeogeographical problems. *Rec. Indian Mus.*, **39** (3) : 251—259.
- , 1952. Recent advances in fish geography of India. *J. Bombay nat. Hist. Soc.*, **51** (1) : 170—188.
- , 1953. Fish distribution and Central Asian orography. *Curr. Sci.*, **22** : 93—97.
- HORA, S. L. & N. C. LAW, 1941. Siluroid fishes of India, Burma and Ceylon. IX. Fishes of the genera *Gagata* Bleeker and *Nangra* Day. *Rec. Indian Mus.*, **43** (1) : 9—27, pl. I.
- HORA, S. L. & D. D. MUKERJI, 1935. Pisces. In : P. C. VISSER & J. VISSER-HOOFT eds., *Wissenschaftliche Ergebnisse der Niederländischen Expeditionen in den Karakorum und die angrenzenden Gebiete in den Jahren 1922. 1925 und 1929/30*, I : 426—445, pls. II—IV (F. A. Brockhaus, Leipzig).
- HUSSAIN, Z., 1973. Fish and fisheries of the lower Indus Basin (1966-67). *Agriculture Pakist.*, **24** : 297—322.
- ISLAM, A. & M. N. SIDDIQI, 1971. Fishes of Jhelum with some new records from the Punjab. *Biologia, Lahore*, **17** (1) : 27—44.
- JAYARAM, K. C., 1974. Ecology and distribution of freshwater fishes, amphibia and reptiles. In : M. S. MANI ed., *Ecology and biogeography in India. Monographiae biol.*, **23** : 517—584 (W. Junk, The Hague).
- JENKINS, J. T., 1910. Notes on fish from India and Persia, with descriptions of new species. *Rec. Indian Mus.*, **5** (2) : 123—140, pl. VI.
- JUBB, R. A., 1965. Freshwater fishes of the Cape Province. *Ann. Cape prov. Mus.*, **4** : [i—xii], 1—72, pls. I—XIX.
- KARAMAN, M. S., 1969a. Süßwasserfische der Türkei, 7. Teil, Revision der kleinasiatischen und vorderasiatischen Arten des Genus *Capoeta* (*Varicorhinus*, partim). *Mitt. hamb. zool. Mus. Inst.*, **66** : 17—54, Taf. I—VI.
- , 1969b. Zwei neue Süßwasserfische aus Afghanistan und Iran. *Mitt. hamb. zool. Mus. Inst.*, **66** : 55—58, Taf. VII.
- , 1971. Süßwasserfische der Türkei, 8. Teil, Revision der Barben Europas, Vorderasiens und Nordafrikas. *Mitt. hamb. zool. Mus. Inst.*, **67** : 175—254, Taf. 1—2.
- KHAN, H., 1934. Habits and habitats of food fishes of the Punjab. *J. Bombay nat. Hist. Soc.*, **37** (3) : 655—668. 1 pl.
- , 1946. A fishery survey of river Indus. *J. Bombay nat. Hist. Soc.*, **46** (3) : 529—535, pls. I—III.
- KHAN, R. M. L., 1962. Fish and fishery of M.R. Link Canal. *Agriculture Pakist.*, **13** (2) : 313—321.
- KHATOON, S. & I. D. BAQAI, 1972. A preliminary report on the freshwater aquarium fishes of Sind with a new record from Pakistan. *Biologia, Lahore*, **18** (2) : 135—141.
- KOSSWIG, C., 1955. Zoogeography of the Near East. *Syst. Zool.*, **4** (2) : 49—73, 96.
- LADIGES, W., 1960. Süßwasserfische der Türkei, 1. Teil, Cyprinidae. *Mitt. hamb. zool. Mus. Inst.*, **58** : 105—150.
- , 1964. Süßwasserfische der Türkei, 3. Teil, restliche Gruppen. *Mitt. hamb. zool. Mus. Inst.*, **61** : 203—220.
- LAGLER, K. F., J. E. BRADACH & R. R. MILLER, 1962. *Ichthyology, the study of fishes: i—xiii, 1—545* (John Wiley & Sons Inc., New York).
- LUNDBERG, J. G. & J. N. BASKIN, 1969. The caudal skeleton of the catfishes, order Siluriformes. *Am. Mus. Novit.*, **2398** : 1—49.
- MAHENDRA, B. C., 1939. The zoogeography of India in the light of herpetological studies. *Sci. & Cult.*, **4** : 1—11.
- MCALLISTER, D. E., 1968. The evolution of branchiostegals and associated opercular, gular, and hyoid bones and the classification of teleostome fishes, living and fossil. *Bull. natn. Mus. Can.*, **221** : i—xiv, 1—239.
- MCLELLAND, J., 1839. Indian Cyprinidae. *Asiat. Reschs.*, **19** (2) : 217—471, pls. XXXVII—LXI.
- , 1842. On the freshwater fishes collected by William Griffith during his travels from 1835 to 1842. *Calcutta J. nat. Hist.*, **2** : 560—589.
- MENON, A. G. K., 1954. Fish geography of the Himalayas. *Proc. natn. Inst. Sci. India*, **20** : 467—493.
- , 1964. Monograph of the cyprinid fishes of the genus *Garra* Hamilton. *Mem. Indian Mus.*, **14** : 173—260, pls. I—V.
- MENON, M. A. S., 1960. On a third collection of fish from Iraq. *Rec. Indian Mus.*, **54** (3/4) : 139—158, pl. 2.
- MERTENS, R., 1969. Die Amphibien und Reptilien West-Pakistans. *Stuttg. Beitr. Naturk.*, **197** : 1—96.
- MILLER, R. R., 1966. Geographical distribution of Central American freshwater fishes. *Copeia*, (4) : 773—802.
- MINTON, S. A., 1966. A contribution to the herpetology of West Pakistan. *Bull. Am. Mus. nat. Hist.*, **134** (2) : 27—184, pls. 9—36.
- MIRZA, M. R., 1965. Fish fauna of Kalat District and its zoogeographical significance. *Pakist. J. Sci.*, **17** (5/6) : 249—251.
- , 1966. Schizothoracinae of Quetta Division. *Pakist. J. scient. Res.*, **18** (1) : 26—29.
- , 1967. *Tor zhobensis* sp. nov., a new mahseer from the river Zhob, West Pakistan. *Pakist. J. scient. Res.*, **19** (1) : 54—56.
- , 1968. Hill stream fishes and their propagation. *Proc. West Pakistan Fishery Officers Conference* : 171—181 (Superintendent, Government Printing West Pakistan, Lahore).
- , 1969. Fishes of genus *Cyprinion* Heckel (Cyprinidae, Osteichthyes) from West Pakistan. *Pakist. J. Zool.*, **1** (2) : 141—150.
- , 1970a. A contribution to the fishes of Lahore including revision of classification and addition of new records. *Biologia, Lahore*, **16** (2) : 71—118.
- , 1970b. Cultrinae (Cyprinidae, Cypriniformes, Osteichthyes) from West Pakistan. *Pakist. J. Sci.*, **22** (5/6) : 291—294.
- , 1970c. Record of *Amblyceps mangois* (Amblycipitidae, Siluriformes, Osteichthyes) from West Pakistan. *Pakist. J. Zool.*, **2** (2) : 249—250.
- , 1971a. A note on the status of *Systomus chrysopterus* McClelland, 1839 (Pisces, Cyprinidae). *Biologia, Lahore*, **17** (1) : 49—54.
- , 1971b. Freshwater fishes of Makran, with a note on the swim-bladder of *Cyprinion microphthalmum* (Day). *Pakist. J. Zool.*, **3** (2) : 240—242.
- , 1972. Freshwater fishes of Baluchistan Province, Pakistan. *Biologia, Lahore*, **18** (2) : 152—190.
- , 1973a. Aquatic fauna of Swat Valley, Pakistan, part I: fishes of Swat and adjoining areas. *Biologia, Lahore*, **19** (1/2) : 119—144.
- , 1973b. Fishes of Kohat and adjoining areas. *Pakist. J. Sci.*, **25** (4—6) : 253—254.
- , 1973c. Discovery of frontoparietal fontanel in *Puntius sophore* (Hamilton) (Pisces, Cyprinidae). *Pakist. J. Zool.*, **5** (2) : 209.

- , 1974. Freshwater fishes and ichthyogeography of Baluchistan and adjoining areas of the Indus plain. *Biologia*, Lahore, 20 (1): 67—82.
- MIRZA, M. R. & E. AHMAD, 1974. Fishes of Dera Ismail Khan District, N.W.F.P., Pakistan. *Biologia*, Lahore, 20 (1): 99—101.
- MIRZA, M. R., M. K. ALAM & R. KAUSAR, 1974. A note on the osteology of the Cultrinae (Pisces, Cyprinidae) of Pakistan. *Biologia*, Lahore, 20 (2): 181—182.
- MIRZA, M. R. & R. ANGI, 1972. A note on the fish fauna of Zhob Valley with the record of *Noemacheilus rhadineus* Regan from Pakistan. *Biologia*, Lahore, 18 (1): 88—90.
- MIRZA, M. R. & M. I. AWAN, 1973. Two new catfishes (Pisces, Siluriformes) from Pakistan. *Biologia*, Lahore, 19 (1/2): 145—159.
- MIRZA, M. R., P. BANARESCU & T. T. NALBANT, 1969. Two new loaches of the genus *Noemacheilus* from West Pakistan. *Pakist. J. Zool.*, 1 (1): 87—90, pls. I—II.
- , — & —, 1970. A little-known and three new loaches of the genus *Noemacheilus* (Pisces, Cobitidae) from West Pakistan. *Biologia*, Lahore, 16 (1): 47—58.
- MIRZA, M. R. & K. HAMEED, 1974. Sisorid fishes (Osteichthyes, Sisoridae) of Pakistan and Azad Kashmir. *Biologia*, Lahore, 20 (1): 83—97.
- 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*, Lahore, 17 (2): 87—93.
- & —, 1973. Fishes of the river Soan in Rawalpindi District, Pakistan. *Biologia*, Lahore, 19 (1/2): 161—182.
- MIRZA, M. R. & I. U. NAIK, 1965a. Fishes of Quetta — Pishin District. *Pakist. J. Sci.*, 17 (2/3): 83—86.
- & —, 1965b. Fishes of Sibi District. *Agriculture Pakistan*, 16 (2): 223—233.
- & —, 1966. Fish and fisheries of Loralai District. *Pakist. J. scient. Res.*, 18 (4): 196—198.
- & —, 1967. A check list of the fish of the Bolan River. *Pakist. J. Sci.*, 19 (2/3): 113—115.
- & —, 1969. Fishes of Zhob District with the description of a new species. *Pakist. J. Sci.*, 21 (5/6): 121—125.
- MISRA, K. S., 1962. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.*, 57 (1—4): i—xxvi, 1—320.
- MUKERJI, D. D., 1936. Yale North India Expedition, XVIII. Report on fishes. Part II: Sisoridae and Cyprinidae. *Mem. Conn. Acad. Arts Sci.*, 10: 323—359.
- MYERS, G. S., 1949. Salt-tolerance of fresh-water fish groups in relation to zoogeographical problems. *Bijdr. Dierk.*, 28: 315—322.
- , 1964. A brief sketch of the history of ichthyology in America to the year 1850. *Copeia*, (1): 33—41.
- , 1966. Derivation of the freshwater fish fauna of Central America. *Copeia*, (4): 766—773.
- , 1967. Zoogeographical evidence of the age of the South Atlantic Ocean. In: *Proceedings of the International Conference on Tropical Oceanography*, November 17-24, 1965, Miami Beach, Florida. The Friedrich Frans Koczy Memorial Volume (Institute of Marine Science, University of Miami). *Stud. trop. Oceanogr.*, 5: 614—621.
- NALBANT, T. T., 1963. A study of the genera of Botiinae and Cobitinae (Pisces, Ostariophysi, Cobitidae). *Trav. Mus. Hist. nat. "Gr. Antipa"*, 4: 343—379.
- NIKOL'SKII, G. V., 1961. Special ichthyology, 2nd edition: 1—538 (Israel Program for Scientific Translations, Jerusalem).
- NORMAN, J. R. & P. H. GREENWOOD, 1963. A history of fishes, 2nd edition: i—xxxii, 1—398, pls. I—VII (Ernest Benn, London).
- PRASHAD, B. & D. D. MUKERJI, 1930. On the fishes of the Manchar Lake (Sind). *J. Bombay nat. Hist. Soc.*, 34 (1): 164—169.
- QADRI, M. A. H., 1971. Problems of wildlife and natural environments and ecology. *Proc. Pakist. Sci. Conf.*, 23 (2): 1—20.
- QURESHI, M. R., 1965. Common freshwater fishes of Pakistan: i—viii, 1—61 (Government of Pakistan Press, Karachi).
- RAMASWAMI, L. S., 1955. Skeleton of cyprinoid fishes in relation to phylogenetic studies. 7. The skull and Weberian Apparatus of Cyprininae (Cyprinidae). *Acta zool.*, Stockh., 36: 199—242.
- REGAN, C. T., 1911. The classification of the teleostean fishes of the Order Ostariophysi. 1. Cyprinoidea. *Ann. Mag. nat. Hist.*, (8) 8 (43): 13—32, pl. II.
- , 1914. Two new cyprinid fishes from Waziristan collected by Major G. E. Bruce. *Ann. Mag. nat. Hist.*, (8) 13 (74): 261—263.
- , 1922. The distribution of the fishes of the order Ostariophysi. *Bijdr. Dierk.*, 22: 203—208.
- ROSEN, D. E. & P. H. GREENWOOD, 1970. Origin of the Weberian Apparatus and the relationship of the ostariophysian and gonorhynchiform fishes. *Am. Mus. Novit.*, 2428: 1—25.
- ROSEN, D. E. & C. PATTERSON, 1969. The structure and relationships of the paracanthopterygian fishes. *Bull. Am. Mus. nat. Hist.*, 141 (3): 357—474, pls. 52—78.
- SAJJID, A. S., 1962. Occurrence of the fish *Pristis microdon* Latham in the river Indus near Hyderabad. *Agriculture Pakistan*, 13: 547—548.
- SIDDIQI, S. A., 1962. River Bolan. *Agriculture Pakistan*, 13: 306—312.
- SMITH, H. M., 1945. The fresh-water fishes of Siam, or Thailand. *Bull. U.S. natn. mus.*, 188: i—xi, 1—622, pls. 1—9.
- SMITH, M. A., 1931. The fauna of British India including Ceylon and Burma. Reptilia and Amphibia, 1: i—xxviii, 1—185 (Taylor & Francis, London).
- SPATE, O. H. K. & A. T. A. LEARMOUTH, 1967. India and Pakistan, a general and regional geography: i—xxxiii, 1—829 (Methuen & Co., London).
- STAMP, L. D., 1967. Asia, a regional and economic geography: i—xvii, 1—731 (Methuen & Co., London).
- SUFI, S. M. K., 1956. Revision of the Oriental fishes of the family Mastacembelidae. *Bull. Raffles Mus.*, 27: 93—146, pls. 13—26.
- , 1957a. Fish fauna of Kinjer Lake (West Pakistan) with an account of the major fishing implements employed by the local fishermen. *Agriculture Pakistan*, 8 (3): 208—229.
- , 1957b. Occurrence of fishes of the genus *Glyptothorax* in Peshawar and Hyderabad divisions of Pakistan. *Pakist. J. Sci.*, 9 (4): 170—172.
- , 1958. Occurrence of the fish *Chela laubuca* (Hamilton) in the Hyderabad and Khairpur divisions of West Pakistan with notes on the synonyms of *Chela cachius* (Hamilton). *Pakist. J. scient. Res.*, 10 (2): 62—64.
- , 1962. Check list of the fishes of the Manchar Lake

- (West Pakistan) with a note on the effect of Sukkur Barrage and canalization of the feeding channels on the fish fauna of the lake. *Agriculture Pakist.*, 13 (2) : 499—503.
- , 1963. Check list of the fishes of the genus *Glyptothorax* Blyth of West Pakistan with record of *Glyptothorax platypogonoides* (Bleeker) from Peshawar Division (West Pakistan). *Biologia*, Lahore, 9 (1) : 23—27.
- TILAK, R., 1963. The osteocranium and the Weberian apparatus of the fishes of the family Sisoridae (Siluroidea) : A study in adaptation and taxonomy. *Z. wiss. Zool.*, 168 (3/4) : 281—320.
- WADIA, N. D., 1966. *Geology of India*: i—xx, 1—536 (Macmillan & Co., London).
- WALLACE, A. R., 1876. The geographical distribution of animals, with a study of the relations of living and extinct faunas as elucidating the past changes of the earth's surface, 1: i—xxi, 1—503; 2: i—vii, 1—607 (Macmillan & Co., London).
- ZUGMAYER, E., 1912. Eight new fishes from Baluchistan. *Ann. Mag. nat. Hist.*, (8) 10 (60) : 595—599.
- , 1913. *Wissenschaftliche Ergebnisse der Reise von Dr. Erich Zugmayer in Balutschistan 1911. Die Fische von Balutschistan mit einleitenden Bemerkungen über die Fauna des Landes*. *Abh. bayer. Akad. Wiss. (math.-phys. Klasse)*, 26 (6) : 1—35.

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