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November 29, 1979

Dr. R.J. Behnke
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Dear Bob,

I was wondering if you could help me. The copy of Saadati's thesis loaned to me was missing p. 21; if your copy has this page a xerox copy would be much appreciated.

Cichlids from Israel are starting to arrive here and as I mentioned before I would like to do an osteological comparison. I would also like to see the Iranian species formally described and was wondering if we could co-author on this. My material consists of 12 collections, about 150 specimens, largest fish 120 mm TL. Le me know what you think.

Sincerely,

Brian

Brian W. Coad, Ph.D.

P.S. What do you think of the hostage situation?

Ottawa
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June 11, 1980

Dr. R.J. Behnke,
Department of Fishery and Wildlife Biology,
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U.S.A. 80523

Dear Bob,

Thanks for your letter and Al-Kahem's thesis. I hope Al-Kahem is able to make more collections in the Arabian Peninsula, as you say there is probably more of interest there.

The only collecting in the Tigris basin numbered less than 200 is 172 in Saadati's thesis. If you have more complete data on this, it would be a help.

I've sent off the cichlid description to Clark Hubbs.

You were correct in recognizing *Garra persica* as distinct from other *Garra* of Iran. I have 12 topotypes from the Bampur River and 107 specimens from drainages which flow to the Straits of Hormoz. These all have III 7 in the dorsal fin and 16 branched rays in the caudal fin. Other *Garra* in Iran have D III 8, C 17 except two samples from the upper reaches of the Kul River in Fars which have D III 7, C 17. There also are differences in body proportions in samples from different drainages but to assign subspecies to *G. persica* would require more collections to put the analysis on a firm basis. I suspect *G. persica* like many other species in Iran, shows variations between populations which could be attributed to isolation of small gene pools and consequent genetic drift. I'm still working up the *Garra* samples however.

The Afghanistan MS is to be published by the National Museum. It started out as a personal list just to clarify the species which might be found in Iran but only known so far from Afghanistan. It took me so long to untangle localities, etc., that I polished it up as an article for publication. The Tigris-Euphrates list has the same initial purpose.

.../2

Ottawa
K1A 0M8

I hope Saadati is surviving the turmoil in Iran; but having been there when the revolution was in progress, I know that for most people life goes on as before with the odd interruption and numerous minor inconveniences. It would be interesting to know what the Department of the Environment and MMTT is doing in the biological field these days (if anything?).

Yours sincerely,

Brian

Brian W. Coad, Ph.D.
Research Associate.

P.S. I'm having a bibliography on the freshwater fishes of S.W. Asia typed up. When it's completed I'll send you a copy and maybe you could add any references I've missed.

[Reprint from *J. Bombay nat. Hist. Soc. Vol. 75 No. 2* 500–501]
1978

MISCELLANEOUS NOTE

21. RANGE EXTENSION FOR THE SNAKEHEAD *OPHIOCEPHALUS GACHUA* HAMILTON-BUCHANAN (OSTEICHTHYES: CHANNIDAE) IN IRAN

The snakeheads are freshwater fishes of tropical Africa and southern Asia with an interrupted distribution being absent from Iran and the Arabian Peninsula according to Nelson (1976). However one species, *Ophiocephalus gachua,* has been recorded from Iran in the upper or middle reaches of the Bampur River, Baluchistan (Nikolsky 1899). In addition a single specimen has been caught in an irrigation ditch 2 Km. south of Sabzeveran (=Jiroft) in the drainage of the River Haliri, Kerman Province on 6 May 1977 (28° 39′N, 57° 45′E). This locality lies over 300 Km. to the north-west of the Bampur River at Bampur and is the most westerly locality for the genus *Ophiocephalus.*

The specimen is a female, 135 mm total length, with 33 dorsal fin rays, 22 anal fin rays, 16 pectoral fin rays, 5 ventral fin rays, and 43 scales in the lateral line with 4 scales above and 9 scales below the lateral line. In the live specimen the caudal, dorsal and anal fins were edged with a strong orange colour and the anal fin was light orange. All these fins had an iridescent green colour between the fin rays. In the preserved specimen the orange fin margins become white (cf. Kahsbauer, 1963).

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October 29, 1977.

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POISONOUS AND VENOMOUS FRESHWATER FISHES OF IRAN

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ABSTRACT The poisonous, ichthyocrinotoxic and venomous freshwater fishes of Iran are reviewed. Three species are implicated in ichthyosarcotoxism, fourteen in ichthyootoxism, one in ichthyocrinotoxism and two in envenomations. Some potentially poisonous venomous fishes are discussed. The classification and distribution of each species is given, the symptoms of toxism described and, where known, the pharmacology and toxicology are outlined.

Pahlavi Medical Journal 9:388-407, 1978

The purpose of this paper is to review those freshwater* fishes recorded from Iran which are known to be toxic to man or have been implicated in poisoning or en-

* The freshwater ichthyofauna of Iran is here taken to include the southern Caspian Sea which has a salinity of 12 to 13‰ (1). Certain marine fishes found in the Persian Gulf and Gulf of Oman have been recorded elsewhere as entering rivers but in the absence of published records for Iran these have not been included here (e.g. the highly venomous Plotosus lineatus (Thunberg)).

venomation. This topic is of some practical importance since expanding studies on the Iranian fauna and development of the fishing industry and fish culture will increase the frequency of contact between toxic fishes and man. In addition to reviewing the known toxic fishes of Iran the opportunity is taken to point out gaps in our knowledge of their anatomy, toxicity and systematics. Information on pathology, chemistry and pharmacology is poor or completely absent.

Cases of poisoning are often difficult to determine – they may merely be examples of poor culinary expertise and consequent bacterial contamination and as such outside the scope of this paper. Non-venomous spiny-rayed fishes may inflict a wound if carelessly handled introducing foreign matter into the flesh. If the wound is inadequately cleaned infection may result. For this reason certain spiny-rayed fishes have been regarded as venomous fishes. Only a detailed anatomical and pharmacological investigation can resolve such doubtful cases.

DEFINITIONS

Toxic fishes may be divided conveniently into three groups (2,3): A) the poisonous or cryptotoxic fishes, in which body tissues contain a harmful substance, B) ichthyocrinotoxic fishes which secrete glandular toxins into the environment without a delivery mechanism. These toxins probably act as warning or repellent substances, and C) venomous, phanerotoxic or acanthotoxic fishes in which a toxin is secreted in special cells or a gland and delivered via a venom apparatus such as a spine. Venom apparatus is also used in a more general sense to include the gland and its duct as well as the spine.

The toxins of venomous fishes are usually large molecules, readily destroyed by heat or digestive enzymes.

Cases of fish poisoning due to cryptotoxic or ichthyocrinotoxic fishes involve ingestion of some part of the fish's body. However poisoning does not include ingestion of fish contaminated with pathogenic bacteria. Halstead (2) has divided poisonous or cryptotoxic fishes into several categories of which two concern us here: 1) ichthyosarcotoxic fishes in which the toxin is found in the mucus, skin, muscles or viscera. These toxins are generally not destroyed by heat or digestive enzymes and are believed to be small molecules, and

2) ichthyotoxic fishes in which the toxin is restricted to the gonads (usually the eggs or roe) while other parts of the body are edible even during the reproductive season. These toxins may, in some case, be resistant to heat so cooking is not a safeguard. The majority of poisonous Iranian freshwater fish belong to this category. Nikolsky (4) suggests that toxic eggs are a protective adaptation against being eaten by birds in shallow waters. The eggs are apparently harmless to some other species of fish such as Noemachilus, a genus commonly found throughout Iran.

REVIEW OF TOXIC FISHES

Illustrations and anatomical descriptions of the following species may be found in appropriate publications(5-7).

A. Poisonous fishes

1. Ichthyosarcotoxic fishes.

Only two species reported from Iranian waters have been implicated in this type of poisoning:

Class: Cephalaspidomorphi*

Family: Petromyzonidae

Caspiomyzon wagneri (Kessler), the Caspian

* Classification of fishes follows Nelson (8)

lamprey is found in the Caspian Sea and its tributary rivers. Its poisonous status has been reported by Pawlowsky (9), Maass (10) and Hiyama (11).

Class: Chondrichthyes

Family: Carcharhinidae

Carcharhinus menisorrah (Müller and Henle), the gray reef shark is a marine species which ascends rivers and has been recorded from the Arvand river and Tigris River (6,12) and possibly the Karun River as far north as Ahwaz (13,14). Its poisonous status has been discussed by Banner and Helfrich (15), Li (16) and Halstead and Schall (17).

Intoxication results from eating the flesh, skin or surface mucus of raw or cooked Caspian lamprey and from eating the liver or muscle of the gray reef shark (2). Tropical sharks are especially dangerous to eat. In the case of the lamprey, symptoms develop in a few hours and include nausea, vomiting, dysenteric diarrhoea, tenesmus, abdominal pain and weakness. Recovery occurs in several days and treatment is symptomatic. A biogenic amine in the muscle, skin and mucus is believed to be responsible. Consumption of the gray reef shark's flesh results in mild gastroenteritis with diarrhoea.

However, ingestion of shark liver is believed to have a relatively high mortality rate. Symptoms develop within 30 minutes and according to Halstead (2) include at first nausea, vomiting, diarrhoea, abdominal pain, anorexia, headache, prostration, rapid weak pulse, malaise, insomnia, cold sweats, oral paresthesias and burning sensations of tongue, throat and esophagus. Later, neurological symptoms become more pronounced and include extreme weakness, trismus, muscular cramps, sensation of heaviness of limbs, blepharospasm, dilatation of pupils, tingling sensation of fingertips, joint aches, delirium, ataxia, incontinence, dysuria, desquamation, pruritus, respiratory distress, coma and death. Treatment is symptomatic. Halstead and Schall (17) have investigated the toxicology of C. menisorrah from the Line Islands and found both liver and gonads to be toxic. Aqueous extracts injected intraperitoneally into white mice resulted in death within 36 hours preceded by paralysis, diarrhoea, lacrimation, ruffling of hair, ataxia and hypoactivity. The pharmacology of C. menisorrah liver is apparently similar to ciguatoxin from the teleost Lutjanus bohar (16).

Prevention of poisoning by these two species is by avoidance and in the case of the Caspian lamprey by soaking in concentrated brine for several hours before cooking, as cooking alone is insufficient. These two species are unlikely to be a public health problem in Iran since the lamprey lacks scales and the shark is regarded (erroneously) as being scaleless and Muslim dietary laws prohibit their consumption. The lamprey is, however, of economic importance in the U.S.S.R. section of the Caspian Sea.(18).

A special case of ichthyosarcotoxism is ichthyoallyeinotoxism or hallucinogenic fish poisoning reported for Mugil cephalus Linnaeus (Order Perciformes, Family Mugilidae) by Helfrich and Banner (19), Helfrich (20,21) and Bouder et al (22). This is a cosmopolitan species which has been introduced to the Caspian Sea from the Black Sea. All other species of fishes implicated in this type of poisoning are tropical Indo-Pacific species and given the sporadic and unpredictable occurrence ofichthyoallyeinotoxism, it is doubtful if it will prove to be of importance in Iranian freshwater populations. The poison is ingested when eating the head or flesh of this species, the head reputedly being the most dangerous part. The poison is not destroyed by cooking. Symptoms develop within a few minutes or up to about two hours after ingestion and may last for a day or more. The poison affects the central nervous system and the victim suffers dizziness, loss of equilibrium, lack of motor coordination, a feeling of constriction about the chest, hallucinations and mental depression. Other complaints consist of itching, burning of the throat, muscular weakness and rarely abdominal distress. No fatalities are known and this is a mild form of ichthyosarcotoxism (2). Treatment is symptomatic, as there is no known specific antidote, but first the stomach should be completely evacuated.

2. Ichthyootoxic fishes

Fourteen species of Iranian fishes have been implicated in this category but since this is one of the less well known types of poisoning other species may yet be discovered. The toxicity of gray reef shark gonads has been referred to above and the majority are discussed below.

Class: Osteichthyes

Order: Acipenseriformes

Family: Acipenseridae

Acipenser guldenstadti Brandt

Acipenser ruthenus Linnaeus

Acipenser stellatus Pallas

Huso huso Linnaeus

Order: Salmoniformes

Family: Esocidae

Esox lucius Linnaeus

Family: Salmonidae

Salmo trutta Linnaeus

Order: Cypriniformes

Family: Cyprinidae

Abramis brama (Linnaeus)

Cyprinus carpio Linnaeus

Schizothorax zarudnyi (Nikolsky)

Tinca tinca (Linnaeus)

Order: Siluriformes

Family: Siluridae

Silurus glanis Linnaeus

Order: Gadiformes

Family: Gadidae

Lota lota (Linnaeus)

Order: Atheriniformes

Family: Cyprinodontidae

Aphanius species

Order: Perciformes

Family: Percidae

Perca fluviatilis Linnaeus

All the species listed above, with the exception of Schizothorax zarudnyi and the Aphanius species, are found in rivers draining into the Caspian Sea and some, such as the sturgeons (Acipenser and Huso) and the pike (Esox), also enter the Caspian Sea proper. Silurus glanis is also found in Lake Reza'iyeh drainages and Salmo trutta in the Darya-i-Nemek basin. Schizothorax zarudnyi is reported from Seistan, an endorheic drainage basin of eastern Iran and western Afghanistan*. Four species of the genus Aphanius, namely A. dispar, A. ginaonis, A. sophiae and possibly A. mento are found in southwestern and southern Iran. There are no reports on the toxicity of these four species but a related species A. calaritanus (Cuvier and Valenciennes) from southern Europe and North Africa has been implicated and Iranian Aphanius may also prove to be ichthyootoxic fishes.

* This species may be synonymous with S. intermedius McClelland which has been implicated in ichthyootoxism by Knox (23) and Hiyama (11).

There are numerous literature reports implicating some of the above species in ichthyootoxisms and these are summarised by Halstead (2). However,comparatively little is known about valid cases in certain species and there are only isolated reports for Salmo trutta, Silurus glanis and Perca fluviatilis. In addition Salmo trutta is represented in Iran by a distinct subspecies, caspius, whose toxicity has not been investigated (24). Early reports of poisoning due to sturgeon eggs or roe (economically important in Iran as caviar) have been attributed to poor preservation and consequent bacterial contamination with such pathogens as Proteus vulgaris and Escherichia coli (2). However, Miescher (25) has obtained a toxic substance ("sturin") from the milt or sperm of Acipenser sturio, a species not found in Iran, and a similar toxin may occur in Iranian Acipenser. Schizothorax and Tinca roe is said to be particularly dangerous and deaths have resulted from eating roe of Schizothorax. Annandale (7) has noted from experience that the roe of freshly cooked S. zarudnyi is toxic but also suspected the flesh and maintained that the people of Seistan were unaware of the toxic nature of the fish.

Symptoms develop soon after ingestion of the eggs and consist of abdominal pain, nausea, vomiting, diarrhoea, dizziness, headache, fever, bitter taste, dryness of the mouth, intense thirst, sensation of chest constriction, cold sweats, rapid irregular weak pulse, low blood pressure, cyanosis, pupillary dilatation, syncope, chills, dysphagia and tinnitus. Severe cases show muscular cramps, paralysis, convulsions, coma and death. Victims generally recover within 3 to 5 days with supportive therapy but it may take longer (2). Treatment is symptomatic and there is no known antidote or therapeutic data available. The patient's stomach should be evacuated as soon as possible after ingestion of the roe.

The toxicity of Esox lucius roe was investigated by McCrudden (26) who injected fresh aqueous extracts intravenously into rabbits. This caused respiratory distress, convulsion and death within one hour. On the basis of these observations the primary effects of the poison were believed to be on the central nervous system. Fresh roe fed to dogs and cats produced only mild intoxication but this like the aqueous extracts of roe was taken from outside the breeding season and thus probably was not very toxic. Boiling destroyed the toxicity of the poison and this along with various chemical properties suggested that the poison was an albumin protein.

Prevention of ichthyootoxism is avoidance of eating roe of these and other fishes during the breeding season as cooking does not always destroy the toxin.

B. Ichthyocrinotoxic fishes.

Only one species of the Iranian freshwater ichthyofauna has been implicated in this category, the Caspian lamprey (9,10). Its classification and distribution are given above under ichthyosarcotoxic fishes. The locality of the toxin is uncertain and may be in the flesh or the external mucus coat of the skin or in both. The relationship of this toxin to that involved in ichthyosarcotoxism in this species is unknown. Contact of the mucus with human mucous membranes causes inflammation. Other symptoms, which include nausea, vomiting, dysenteric diarrhoea, tenesmus, abdominal pain and weakness, develop within a few hours after ingestion while recovery occurs within several days (2). Treatment is symptomatic. Public health and prevention are unlikely to be a problem in Iran for reasons referred to above.

C. Venomous fishes.

Three species of Iranian fishes have been implicated in envenomation, namely:

Class:	Osteichthyes
Order:	Siluriformes
Family:	Heteropneustidae
	Heteropneustes fossilis (Bloch)
Family:	Siluridae
	Silurus glanis Linnaeus
Order:	Perciformes
Family:	Percidae
	Perca fluviatilis Linnaeus

The two catfish species (Heteropneustes and Silurus) carry venom glands in an integumentary sheath around the pectoral fin spines. These sharp spines readily enter the victim's flesh. The integumentary sheath is delicate and easily broken exposing the venom glands so that their toxin can enter the wound caused by the spine. Wriggling movements by the fish and teeth on the spine (best developed in Heteropneustes) lacerate the flesh enabling the venom to enter more easily and often causing a secondary infection such as tetanus.

Heteropneustes fossilis has been reported from the Arvand river and Tigris-Euphrates drainages by Khalaf (6) and Mahdi (12) and may be the source of the following quotation taken from Caras (27), "From Tehran comes a report of a diminutive black fish found in Shatt-el-Arab river. It reputedly has killed twenty-eight people with a venomous 'bite'. Death is said to be swift." The mortality was hopefully an exaggeration. The venomous "bite" is also anomalous but it is worth noting that this species unlike most catfishes, will show aggressive stinging behaviour using its pectoral spines when threatened (2). Local fishermen are well aware of the dangers of capturing this food fish since they break off the pectoral spines with a stake (12). Bhimachar (28) has examined the venom of Indian Heteropneustes and found it to have both neurotoxic and haemotoxic components. Subcutaneous injection of glycerinated venom in frogs resulted in hypoactivity, tonic convulsions, collapse and death within 15-20 minutes. Washed bovine red blood cells inoculated with venom showed marked hemolysis.

The distribution of Silirus glanis has been given above under ichthyootoxism. Couplin (29) and Citterio

(3) implicate this species in envenomations.

The symptoms of catfish envenomations are as follows. An instantaneous stinging, throbbing or scalding sensation develops which may be localised or spread along the affected limb. In mild cases violent pain may last 48 hours or more. After effects such as loss of the use of a thumb for 5½ months have been recorded for Plotosus lineatus, a marine catfish which may enter Iranian freshwater (31). Envenomation by this species can be fatal. The flesh in the vicinity of a catfish envenomation becomes ischaemic, cyanotic and then redness and swelling develop. In severe cases there may be a massive oedema spreading to the whole limb and lymphadenopathy, numbness and gangrene about the site of envenomation. Shock often accompanies severe stings

Halstead (2) recommends the following treatment which should be applied as soon as possible. The wound should be irrigated with cold water which removes venom, acts as a vasoconstrictor reducing absorption of toxin and also acts as a mild anaesthetic. A tourniquet can be used immediately above the wound but it should be released every few minutes to facilitate circulation. The wound should be probed for integumentary sheath fragments which must be removed or envenomation will continue. After cleansing, the wounded limb should be placed in hot water for 30-90 minutes at as high a temperature as can be sustained by the victim without tissue damage. Magnesium sulphate can be added to the water as it acts as a mild anaesthetic. After hot water immersion the wound should be cleaned and sutured. Most stings are on the foot or hand which lend themselves to the treatment outlined above. Antitetanus agents are recommended and antibiotic agents may be useful. Intramuscular or intravenous demerol is effective in controlling pain. The primary shock from the sting responds to the usual supportive measures but secondary shock as a result of the venom's action on the cardiovascular system may require immediate therapy. Elevation of an injured limb is advisable.

The distribution of Perca fluviatilis has been given above under ichthyootoxism. Bottard (32) described a venom apparatus for the dorsal fin spines of this species but later work shows that Bottard mistook mucus cells for venom glands. Therefore it is unlikely that this species is venomous (2).

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Fishes of Afghanistan,

an annotated check-list

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Abstract

A check-list of the fishes reported from Afghanistan is given with details of distribution and synonyms. A total of 84 species are recorded from Afghanistan and an additional 18 species from contiguous or confluent drainages. The most speciose of the three major drainages is the Kabul River (27.7%) followed by the Amu Darya (20.4%) and the Helmand River (16.7%). The Kabul River basin is the smallest in area but contains elements from the Oriental fauna of the Indus River. The endorheic Helmand River basin has the largest area but is the most isolated hydrographically and has the least diverse faunaa. The Amu Darya basin has a fauna derived mostly from the Caspian Sea basin. The fauna is dominated by Cyprinidae (56.9%) and Cobitidae (24.5%) with Siluriformes making up most of the remainder (11.8%). Minor families are the Acipenseridae, Salmonidae, Channidae and Mastacembelidae. Three major and five minor basins were considered and 67 species were found in only one basin, 15 in two basins, 12 in three basins, 7 in four basins and 1 (<u>Garra rossica</u>) in five basins. The fauna is a mixture of Oriental and Palaearctic species.

Résumé

Une liste des poissons retrouvés en Afghanistan est donnée avec des détails sur leur aires de répartition et des synonymes. Un total de 84 espèces sont rapportées en Afghanistan et 18 espèces dans les drainages contigus òu affluents. Des trois drainages majeurs, celui avec le plus d'espèces est la rivière Kabul (27.7%) suivi par l'Amu Darya (20.4%) et la rivière Helmand (16.7%). Le bassin de la rivière Kabul couvre l'aire la plus petite mais contient des éléments de la faune orientale de l'Indus. Le bassin endoréique de la rivière Helmand couvre la région la plus étendue mais a été le plus isolé au point de vue hydrographique et donc contient le moins d'espèces. Le bassin de l'Amu Darya a une faune dérivée surtout du bassin de la mer Caspienne. La faune est dominée par les Cyprinidae (56.9%) et les Cobitidae (24.5%); les Siluriformes composant presque tout le reste (11.8%). Les familles mineures sont les Acipenseridae, les Salmonidae, les Channidae et les Mastacembelidae. Trois bassins majeurs et cinq mineurs ont été examinés et 67 espèces ont été trouvées dans un bassin seulement, 15 dans deux bassins, 12 dans trois bassins, 7 dans 4 bassins et 1 espèce (*Garra rossica*) dans 5 bassins. La faune est un mélange d'espèces orientales et paléoartiques.

Introduction

A list of fishes reported from Afghanistan was compiled as part of continuing studies on the systematics of fishes of southwest Asia. There has not been a compilation for fishes reported from Afghanistan since the work of Hora (1933b) and a number of revisionary works and field collections have both added to and altered that list.

Afghanistan is not a natural area of southwest Asia and the list presented here draws on distributional information from adjacent countries. A brief review of works on fishes of Afghanistan is given below. Details of distribution, including attempts to clarify obscure locality data, and synonymies are given within the list itself. A section on hydrography describes the waters of Afghanistan to facilitate comprehension of the distribution data in the list and includes some variant spellings for locality names.

The first report of significance on the fishes of Afghanistan was written by McClelland (1842) based on collections made by William Griffith in the three major drainage basins of the country, the Helmand, Amu Darya, and Kabul. Unfortunately, some collections "may have fallen into improper hands" and others "were spoiled in consequence of the jolting motion of the camels" or "were kept merely in salt" McClelland 1842: 561). As a result, species were described from damaged specimens or from drawings only, and some of McClelland's species are of uncertain systematic status. Hora (1927) has examined and commented on the fish drawings in the Library of the Asiatic Society of Bengal from the collection of

Alexander Burnes made by P.B. Lord during a mission to Kabul in 1836-1838. The provenance of specimens reported from the Kabul River is uncertain and may refer to localities outside Afghanistan, although it seems likely that three drawings of Schizothorax species are from the upper reaches of the Kabul River. Hora (1929) examined specimens in the British Museum (Natural History) of two species of Cobitidae collected by William Griffith in Afghanistan and was able to resolve problems of the distribution and systematic status. In 1932 Hora was also able to clarify the identity of Glyptosternum reticulatum McClelland.

Keyserling (1861) described six species including five new species of Cyprinidae from what is now Afghanistan based on collections made under the leadership of N. Chanikoff in 1858-1859.

An expedition to Yarkand was dispatched by the Government of India in 1873 under the leadership of Douglas Forsyth. The fishes collected were described by Day (1876, 1878). Two of the four species collected from the headwaters of the Amu Darya were described as new.

Day's (1880) article "Fishes of Afghanistan" referred to collections from what is now Pakistani Baluchistan and is of marginal interest.

Günther (1889) reported on collections made by J.E.T. Aitchison, naturalist of the Afghan Delimitation Commission, on a journey from Quetta through Sistan to the Hari Rud and the Murgab River on the southern, western and northwestern boundaries of Afghanistan. Three new species were described out of seven collected.

Alcock (1898) briefly listed four species collected by the Pamir Boundary Commission in the upper Amu Darya drainage.

N.A. Zarudnyi collected fishes in eastern Iran (Khorasan and Sistan) on three journeys in 1896, 1898 and 1900-1901. This material was deposited at the U.S.S.R. Academy of Sciences Zoological Institute in Leningrad and formed the subject of papers by Nikolsky (1897, 1899, 1900), Zarudnyi (1904), and Berg (1913; 1949). Nikolsky's works described five new species from drainages common to Iran and Afghanistan, and Berg (1913) described a new species from an area of eastern Khorasan, the exact locality of which is uncertain. It may have been in the Daqq-e Tondi drainage shared with Afghanistan or possibly from waters draining west into Iran. Other localities in Zarudnyi's collections are difficult to determine with accuracy.

Regan (1914) described a small (six species) collection of fishes made by G.E. Bruce in the Wana Toi, a tributary of the Gumal River in Pakistani Waziristan. Two of the species were described as new.

The Sistan basin was visited by A.H. McMahon and others in 1902-1904 with the Sistan Arbitration Commission and by officers of the Zoological Survey of India in 1918. The McMahon collections were described by Regan (1906), who found two new species out of five collected, and Chaudhuri (1909), who reported a new species of loach. Annandale (1919) described two new species of Discognathus (= Garra) collected in Sistan and collaborated on a review (Annandale and Hora, 1920) of the fishes of Sistan based on both the McMahon and Zoological Survey of India collections.

The Zoological Survey of India collected fishes in the Chitral valley in 1929 under the leadership of B.N. Chopra. This material was examined by Hora (1934) who described five species, one of which was new, from this drainage which eventually becomes the Konar River in Afghanistan.

In two papers, published in 1933(b) and 1935, S.L. Hora reviewed the known fishes of Afghanistan and described collections from various localities in the Kabul, Amu Darya and Helmand systems collected by R. Maconachie, A.E. Farwell, E.W. Fletcher and others. These collections comprised nine species, one of which was described as new.

A collection of fish made in the upper Helmand River and in Sistan by S.A. Akhtar were presented to the Zoological Survey of India and described by Vijayalakshmanan (1950). One new species was described out of four collected.

Fowler and Steinitz (1956) described two new species of Schizothoracini from Iranian Sistan collected by P.J.F. Schumacher and deposited in the Academy of Natural Sciences of Philadelphia.

Bănărescu and Mirza (1965) described a new species of cobitid collected by K. Lindberg and purporting to come from the Farah River. This species is in the Hebrew University of Jerusalem Museum. Bănărescu and Nalbant (1966) reviewed the species of Cobitidae from Afghanistan and Iran based on material from several museums and specimens collected by the Danish Scientific Investigations in Iran, the Third Danish Expedition to Central Asia in Afghanistan and by K. Lindberg in Afghanistan.

Karaman (1969) described a new species of <u>Schizocypris</u> from the collections of the Zoological Museum in Hamburg obtained by Dr. Kullman from the Chamkani River drainage of Afgahistan.

Balon and Hensel (1970) examined the material from an expedition of the Zoological Institute of the College of Agriculture, Brno in 1967 which visited the Qonduz drainage and the environs of Jalalabad. Four species were described, one as new and these are deposited in the Slovak National Museum in Bratislava.

Bănărescu and Nalbant (1975) reported on nine species, one described as new, collected by Dr. Kullman in the Kabul and Chamkani River drainage and deposited in the Zoological Museum of Hamburg and the Institute of Biological Sciences in Bucharest.

Moravec and Amin (1978) examined parasites of fishes from northeast Afghanistan collected in 1974 from fifteen localities mostly in the Amu Darya and Kabul River drainages. The specimens are in the University of Bratislava in the collections of Karol Hensel.

Early information on fishes from drainages shared with the U.S.S.R. has been summarised by Berg (1948-1949). More recent works include Shaposhnikova (1950) on fishes of the Amu Darya with an analysis of distribution in different reaches of this river, Nikolski and Tzentilovich (1951) on fishes of the Murgab basin, Svetovidov (1952) on the ichthyofauna of the Amu Darya in southern Tadzhikistan, Turdakov (1963) on the fishes of Kirghizia and others.

The fishes of Pakistan have been studied extensively by M.R. Mirza and various co-workers. Much of this work, which includes drainages shared with Afghanistan, has been summarized in Mirza (1975).

The principal works on Iranian fishes are Berg's (1949) study mentioned earlier which brings together much previous work, Saadati's (1977) thesis on collections made in 1974 and 1976 by R.J. Behnke and members of the Department of the Environment, Tehran, and Coad (1979) based in part on collections made in Iranian Sistan and Baluchestan during 1977.

? after a locality name indicates that it could not be found in gazetteers or distinguished from other localities of the same name. Spelling of locality names follows the appropriate country gazetteer of the United States Board on Geographic Names.

Hydrography

The source of surface water in Afghanistan is precipitation and consequent snow melt over the central mountain ranges extending from the Pamir mountain knot at the western termination of the Karakoram southwestward as the Hendo Kosh (= Hindu Kush) and its outliers such as the Selseleh-ye Kuh-e Baba, Selseleh-ye Band-e-Torkestan, Paropamisus Mountains, Selseleh-ye Safid Kuh, Selseleh-ye Siah Kuh and the ranges of the Hazarajat. Maximum flow is the spring and early summer and minimum flow is in late summer to winter over much of the country. Many rivers dry up along sections of their course or are reduced to isolated pools during the latter period. This natural condition is aggravated by water abstraction for irrigation and other purposes and rivers tend to disappear before reaching their principal river or lake. In the Pamir and Nurestan areas of the northeast melting glaciers feed the rivers in July and August and there is minimum yield during winter because of freezing. Rivers along the northeast border of Afghanistan are affected by the monsoon of India and so have maximum flows twice a year in July to September and January to April. Springs and associated pools and marshes are additional habitats for fishes. Kariz (or ghanat) serve as refuges for small populations of fishes (Coad, 1980) throughout eastern, southern and southwestern Afghanistan. There are few freshwater lakes in Afghanistan, the largest being those of Sistan which lie mostly in Iran but are hydrographically part of Afghanistan. Major perennial rivers and their tributaries are the Amu Darya, Qonduz (= Kunduz), Kowkcheh (= Kokcha), Band-e Amir, Kabul, Lowgar (= Logar), Panjsher, Laghman, Konar (= Kunar), Sorkh Ab, Helmand, Arghandab and Hari Rud (Dupree, 1973) and presumably also the Morghab (= Murgab).

The waters of Afghanistan may be divided into eight drainage basins for convenience, of which the Kabul, Chamkani-Kurram and Zhob-Gowmal drain to the sea via the Indus River, the remainder being endorheic or arheic basins (Figure 1). A complete listing of all drainages and water bodies is not given since not all river basins have been equally well collected for fishes. Reference may be made to Dupree (1973) for additional information.

1. Kabul River basin

The Kabul River has its source at Sar Chashmeh (= Sar-i-Chashma) in the Selseleh-ye Kuh-e Paghman and flows east to join the Indus River north of Attock over a 350 km course. The river is dammed in several places including the Daruntah gorge. There are several major rivers tributary to the Kabul. From the Hindu Kush to the north flows the Panjsher, about 320 km in length, which itself has a number of tributaries including the Gowr Band (= Ghorband or Chorband River). The Laghman River comprising the Alingar and Alishang Rivers enters the Kabul downriver from the Panjsher northwest of Jalalabad. The Konar (= Kunar) River joins the Kabul near Jalalabad after a course of 400 km from the Hindu Kush to the north. An upper tributary from the west is the Pech (= Pich) River while the Chitral River from the east flows into the upper Konar from Pakistan. The 200 km long Lowgar (= Logar) River, with several tributaries, rises in the eastern Hazarajat and flows east to enter the Kabul River east of Kabul. The Sorkh Rud (or Sorkh Ab but not the Sorkh Ab of the Qonduz River drainage) is a southern tributary of the Kabul River entering west of Jalalabad. The Paghman River is a small stream which rises in the Selseleh-ye Kuh-e Paghman and runs southeast past Paghman to join the Kabul River about 24 km from Kabul. The Chahiltran (?) stream is recorded by Hora (1935) as being a tributary of the Kabul River about 10 km west of Kabul. The Salang River (or South Salang Brook) flows from the southern slope of the Salang range to enter the Panjsher River near Golbahar (Moravec and Amin, 1978).

The Swat and Khiali Rivers, northern and southern tributaries respectively of the Kabul River, are found in Pakistan east of the Afghan border. Ichthyological data from these drainages are included in the list (as are data from the Chitral River) since the species reported may prove to have a wider distribution when more collections are made.

2. Chamkani (= Kurram) River basin

The Chamkani River rises in the western Selseleh-ye Safid Kuh of eastern Afghanistan and flows southeast for about 320 km via Bannu to the Indus River. It is known as the Kurram River in its Pakistani portion. Ichthyological data are from the Pakistan reach near Parachinar and from the Matun River (= Pir Jani Kwarah) drainage in Afghanistan. The Matun River is a right bank tributary to the Chamkani River.

3. Zhob-Gowmal basin

The Zhob River lies wholly within northeast Pakistani Baluchistan rising in the Toba Kakar Range flowing east then northeast for about 370 km to join the Gowmal (= Gumal) River as a right bank tributary. The Gowmal River rises in Afghanistan and flows south-southeast to the Pakistan border and then in an easterly direction to reach the Indus River when in flood. The Wana Toi (toi = stream) is a left bank tributary of the Gumal River in Pakistani Waziristan flowing from the north. Ichthyological data are from Pakistan drainages.

4. Pishin Lora basin

The Pishin Lora (lora = stream) rises in the central Toba Kakar Range of northeast Pakistani Baluchistan and flows southwest for about 400 km to the Hamun-i Lora (= Hamun-e Lowrah) on the Afghan border (hamun = salt waste or marshy lake). A section of its middle course lies in southern Afghanistan. Ichthyological data are based on collections from the Pakistani sections of this river.

5. Helmand-Sistan basin

The Helmand River has its source in the Selseleh-ye Kuh-e Baba east of Farakhulm near the source of the Kabul River. Its flow is southwesterly for about 1300 km (Dupree, 1973) or 1050 km (Anon., 1966) before it empties into the Sistan Lakes through several effluents. This river, with its tributaries, drains about 40% of Afghanistan and has the largest drainage basin. Only the Helmand River has a large and continuous flow at all times of the year. One of several dams in the Helmand basin is located on the Helmand River at Kajaki. Major tributaries of the Helmand, lying to the southeast, are the Arghandab River 560 km long, the Tarnak River 320 km long, and the Ghazni River 240 km long which flows into the salty Ab-e Istadeh-ye Moqor (= Ab-i-Istada Lake) and continues as the Lurah (= Lora) River (not the Pishin Lora of Pakistan). The relationships of these rivers are shown in Figure 1. The Dasht-e-Navar (= Nawar) (dasht = plain or depression) lies at a height of 3000 m between the headwaters of the Arghandab and Ghazni Rivers and has no outlet. The intermittent Khash River lies to the northwest of the Helmand River. Its 480 km course flows from the western Hazarajat to join the Helmand near the Iranian border. The short Khospas River feeds Jehil-e Puzak (= Hamun-e Puzak) one of the Sistan lakes and lies northwest of the Khash River. The Farah River has its source in the Paropamisus Mountains and flows for 320 km southwest to the Hamun-e Saberi another Sistan lake west of Jehil-e Puzak. The Harut or Adraskan River flows from a source southeast of Herat to the Hamun-e Saberi also. The Anar Darreh (darreh = stream) is a right bank tributary of the Harut in its lower course.

The Sistan basin consists of several lakes of variable extent and connection depending on the water flow from the rivers of Afghanistan. Most of the Sistan lakes lie in Iran but are here treated hydrographically as part of Afghanistan. The northern basins are fed by the Harut, Farah and Khospas Rivers and are usually the first to fill with water which eventually spreads to form an expanse of water, the

Hamun-e Helmand, 160 km long by 8-24 km wide. Depth is usually between 1 and 3 metres and never exceeds 5 metres. The Shelah (= Shelagh) River carries overflow south and then east to the Gowd-e Zereh (= Gaud-i-Zirreh, gowd = depression), a salt flat in Afghanistan. This has a flushing effect and helps prevent an accumulation of salts and maintains a freshwater character for the Sistan lakes. Iranian Sistan is a network of irrigation canals dispersing the water from Afghanistan. The flooding of the lakes and the irrigation network facilitate fish movements to most parts of the basin and records of fish species are not given in more detail than "Sistan". Ichthyological data are available from several parts of the Helmand drainage and from the Sistan lakes.

Three endorheic or arheic basins lie on the Iran-Afghanistan border between the Sistan basin and the Hari Rud basin to the north. These are the Daqq-e Tondi (daqq = marsh), Daqq-e Patargan and the Namaksar Lake of which only the latter has been investigated cursorily for fishes in its Iranian drainage.

6. Hari Rud basin

The Hari Rud rises in the Selseleh-ye Kuh-e Baba and flows west for about 490 km before turning north as the Iran-Afghanistan border for 160 km. At Serakhs it enters the U.S.S.R. and is known as the Tedzhen, and is eventually lost in the Karakum. The Jam River is an Iranian tributary from the west. There are ichthyological data from drainages of all three countries.

7. Murgab River basin

The Murgab (or Morghab in Afghanistan) (not to be confused with the Murgab in the Pamirs) River has its source in the western Hindu Kush between the Paropamisus and the Selseleh-ye Band-e-Torkestan, flowing west then north to the Afghanistan-Turkmenistan border for 350 km, and for another 350 km into the Karakum Desert before being lost in the sands north of Merv or Mary. Several ichthyological surveys of the Murgab have been carried out in its U.S.S.R. section and it is from these that much of the check-list data are obtained. The Kushka (Koshk in Afghanistan) River rises in the Paropamisus of Afghanistan and flows northwest and then north through Koshk-e Kohneh or Kushk in Afghanistan and Kushka in Turkmenistan to join the Murgab River in Turkmenistan.

8. Amu Darya basin

The Amu Darya (classical Oxus; darya = river or stream) forms the northern boundary of Afghanistan with Tadzhikistan, Uzbekistan and Turkmenistan of the U.S.S.R. Its total length is about 2500 km (figures vary in different gazetteers) in its course from the Pamirs to the Aral Sea. The lower 1300 km are wholly within the U.S.S.R. The Amu Darya is the second largest drainage basin in Afghanistan.

A number of fish species are known from the Aral Sea proper but do not penetrate into rivers. These are not included in the list. Species apparently restricted to the lower reaches of the Amu Darya are included as it is conceivable that they may penetrate upriver either naturally or through the agency of man. Records of species collected in the

Zeravshan River and its two arms the Karadar'ya and Akdar'ya are not included in the list. The Zeravshan disappears in the desert north of Chardzhou and does not reach the Amu Darya although it was connected in the past and has a common fish fauna (Berg, 1948-1949).

In its upper reaches the Amu Darya is known as the Ab-e Vakhan (or Wakhan River) becoming the Ab-e Panja or Panj River (Pyandzh River in the U.S.S.R.) when it receives the Pamir River near Qal'eh-ye Panjeh. The Pamir River forms the border between southern Tadzhikistan and the Vakhan corridor of Afghanistan. The Aq Su (Aksu or Oksu) is found in the eastern part of the Vakhan corridor and forms part of the headwaters of the Murgab River which drains north then west as the Bartang River through Tadzhikistan to join the Panj River near Rushan. The Gunt River is another right bank tributary of the Panj River from Tadzhikistan joining at Khorog. The Panj River is called the Amu Darya by the Afghans when it is joined by the Kowkcheh (= Kokcha) River. In the U.S.S.R., however, Amu Darya is restricted to the river below the entry of the Vaksh River from Tadzhikistan. Other major right bank tributaries of the Amu Darya are the Kafirnigan River from Tadzhikistan joining at Aivadzh and the Surkhandar'ya from Uzbekistan joining near Termez.

The Kowkcheh (= Kokcha) River flows from the Hindu Kush near the border of Afghanistan and Pakistan for 320 km north and then west into the Panj River. It receives several small tributaries in its upper reaches.

The Qonduz (= Kunduz) River enters the Amu Darya nears its junction with the Vaksh River. It is 480 km in length and is known by two different names for sections of its upper reaches. From its source to Bolowleh (= Bulola) it is the Bamian River, and from Bolowleh to Dowshi (= Doshi) the Sorkh Ab. The Andarab River joins at Dowshi as a right bank tributary and the river becomes the Qonduz at this point. The North Salang Brook is a tributary of the Andarab River draining north from the Salang Pass. The Payan Deh River (= Darra Ashraf) and the Magh stream (= Margh) are Sorkh Ab tributaries near Bazar-e Taleh and are about 6 km apart (Hora, 1935). A major right bank tributary of the lower Qonduz River is the Khanabad River.

The Kowkchek and Qonduz are the two major tributaries of the Amu Darya from Afghanistan. West of the Qonduz, several rivers drain towards but do not reach the Amu Darya, their waters being lost in the Turkestan Plains and the Karakum or extracted for irrigation. These rivers are included in the Amu Darya basin in the list. The Kholm (= Tashkurgan) River is about 190 km in length and flows almost due north from the northern Hindu Kush and is lost north of Tashkurgan or Kholm. The Balkh Ab or Balkh River is 480 km long and in its upper course it is known as the Band-e Amir River from its source in the Sang Zard near the Band-e Amir lakes until it is joined by the Suf River (= Darra Yusuf), a right bank tributary. The Band-e Amir flows westerly in its upper reaches before turning northward. The Ishkabad canal system on the plains drains off water from the Balkh River. The Sar-e-Pol River, and to its west the Qeysar River (= Ab-i-Qaisar) are two other rivers which flow from the Band-e Torkestan and are lost in the plains. Both are about 320 km long. These two rivers have not been studied ichthyologically.

Collection data are available from work on the Amu Darya and its tributaries in the U.S.S.R., in the Vakhan corridor of Afghanistan and in major tributaries of the Amu Darya from Afghanistan.

Faunal Supplementations

A number of species have been introduced to and have become established in the Aral Sea either in a deliberate stocking programme or accidentally (e.g. see Baimov, 1968; Baymov, 1970; Dergaleva and Markevich, 1976; Mordukhai-Boltovskoi, 1979). Some of these species have been reported to enter freshwater elsewhere in their range and may penetrate into the upper Amu Darya. None have been reported in the Amu Darya where it forms the northern border of Afghanistan, 1300 km from the Aral Sea. The U.S.S.R. has also been very active in stocking programmes for its southern republics and Afghanistan, unintentionally, may well acquire species new to its ichthyofauna from such programmes (e.g. Aliev, 1965; Borisova, 1972; Dergeleva and Markevich, 1976; Dukravets and Machulin, 1978).

A fish research and breeding centre was established at Daruntah in Afghanistan with Chinese help in 1967 and four varieties of carp were introduced (species not specified; Dupree, 1973). Moravec and Amin (1978) list native and introduced species of fish from Afghanistan examined by them for parasites. There appears to be no other published information on introduced species and whether they have become established in Afghan waters. Only those species reported from Afghanistan or contiguous water bodies are included in the check-list.

Check-List

The arrangement of orders and families follows Nelson (1976) and genera and species are listed alphabetically in each family. Species marked * have not been reported from Afghanistan but occur in adjacent or contiguous drainage basins. Species marked # have been introduced into Afghanistan.

Order 1. Acipenseriformes

Family 1. Acipenseridae

1. Acipenser nudiventris Lovetzky, 1828. Amu Darya from the Aral Sea to Kirovabad on the Panj River but almost entirely exterminated (Berg, 1948-1949).

2. Pseudoscaphirhynchus hermanni (Kessler, 1877). Mouths of Amu Darya upriver to Termez on the Afghan border with Uzbekistan (Berg, 1948-1949).

3. Pseudoscaphirhynchus kaufmanni (Bogdanow, 1874). Delta of Amu Darya to the Panj River (Berg, 1948-1949).

Order 2. Salmoniformes

Family 2. Esocidae

1. *Esox lucius Linnaeus, 1758. Amu Darya from the Aral Sea to Pitnyak (41^{o} 12'N, 61^{o} 21'E in the lower reaches of the Amu Darya) (Berg, 1948-1949).

Family 3. Salmonidae

1. Salmo gairdneri Richardson, 1836. About 500,000 fingerlings have been released from the Qarghah fisheries near Kabul since 1966 into the Salang and Panjsher Rivers (Dupree, 1973).
2. Salmo trutta Linnaeus, 1758. As S. t. aralensis Berg, 1908 in the Amu Darya from the Aral Sea to Turtkul (41^{o} 28'N, 61^{o} 00'E), Kafirnigan River basin and therefore presumably Afghanistan (Berg, 1948-1949; Maksunov, 1971). Kuderskii (1974) suggested that some large trout of the upper Amu Darya are this subspecies. Salmo trutta oxianus Kessler 1874 is found in the upper reaches of the Amu Darya, Panj River and Bamian River drainage including at Shekari (34^{o} 54'N, 68^{o} 02'E), Sorkh Ab drainage, Kowkchek River and North Salang Brook (a tributary of the Andarab River) (Hora, 1933b; 1935; Berg, 1948-1949; Balon and Hensel, 1970: Maksunov, 1971; Moravec and Amin, 1978). Berg in Hora (1933b) considered the trout of Afghanistan to be Salmo trutta aralensis morpha oxianus. S. orientalis McClelland, 1842 is a synonym. S. trutta fario Linnaeus, 1758 has been introduced to Chitral and Swat valleys in Pakistan (Mirza, 1976) and the Pishin Lora drainage (Mirza and Naik, 1965).

Order 3. Cypriniformes

Family 4. Cyprinidae

This family contains many species in the Oriental Region and there are conflicting views on the generic placement of some species. Mirza (1975) is followed for this list.

Vinciguerra (1915-1917) reported Schizothorax kessleri Herzenstein, 1889 from the Murgab River (? locality). Berg (1948-1949) placed this species in S. pseudaksiensis Herzenstein, 1889 and did not confirm its presence in the Murgab River. It is therefore omitted from this list.

1. * Abramis brama (Linnaeus, 1758). As A. b. orientalis Berg, 1949 in lakes along the Amu Darya as far as Tash-sak (?) above Turtkul (41° 28'N, 61° 00'E) (Berg, 1948-1949). Banarescu (1964) indicated a distribution in the higher reaches of the Amu Darya in Afghanistan.

2. * Abramis sapa (Pallas, 1811). As A. s. bergi Belyaev, 1929 in the Amu Darya upriver to Pitnyak (41° 12'N, 61° 20'E) as A. s. b. natio aralensis Tjapkin, 1939 (Berg, 1948-1949).

3. Alburnoides bipunctatus (Bloch, 1782). As A. b. eichwaldi (Filippi, 1863) in Turkmenia from the Murgab River to Archman (38° 33'N, 57° 09'E), upper Amu Darya (Berg, 1948-1949), and in the Margh (probably Magh) stream, a tributary of the Sorkh Ab at Tala (presumably Bazar-e-Taleh (35° 25'N, 68° 14'E)) (Hora, 1935). A single small specimen recorded from the Helmand basin (Sistan) of Iran by Saadati (1977) may be an error.

4. Alburnoides taeniatus (Kessler, 1874). Amu Darya from the delta to the mouth of the Kafirnigan River, common above Termez on the Afghan border with Uzbekistan (Berg, 1948-1949), Qonduz River at Qonduz and Khanabad River at Khanabad (Moravec and Amin, 1978). As A. t. taeniatus nat. nikolskyi in the Amu Darya (Turdakov and Piskarev, 1955).

5. Amblypharyngodon mola (Hamilton, 1822). Reported from the Kabul River at Jalalabad as Leuciscus mola by McClelland (1842).

6. Aspidoparia jaya (Hamilton, 1822). Reported from the Kabul River at Jalalabad by McClelland (1842) as Leuciscus margarodes (McClelland, 1838). L. margarodes is considered to be a synonym of A. jayi by Day (1875-1878) but Günther (1868) regarded its affinities as uncertain.

7. *Aspidoparia morar (Hamilton, 1822). Southeastern Iran, Swat River drainage of Pakistan and presumably Afghanistan (Mirza, 1973; Coad, 1979).

8. Aspiolucius esocinus (Kessler, 1874). Amu Darya and lower reaches of its tributaries in Tadzhikistan, and lower Panj River (Berg, 1948-1949; Zharov, 1973).

9. Aspius aspius (Linnaeus, 1758). As A. a. taeniatus natio iblioides (Kessler, 1872) in the Amu Darya from the Aral Sea to the Kafirnigan River (Berg, 1948-1949). Babeyev (1977) listed this species as A. aspius iblioides

10. Barbus brachycephalus Kessler, 1872. Amu Darya from the Aral Sea to Fayzabadkala (37^{o} 19'N, 68^{o} 58'E) on the Panj River (Berg, 1948-1949; Maksunov, 1971).

11. Barbus capito (Güldenstädt, 1773). As B. capito conocephalus Kessler, 1872 in the Amu Darya from the Aral Sea to Fayzabadkala (37^{o} 19'N, 68^{o} 58'E) on the Panj River, Qonduz River at Qonduz and its drainage (Berg, 1948-1949; Maksunov, 1971; Moravec and Amin, 1978), Andarab River at Banu (presumably Banow 35^{o} 38'N, 69^{o} 15'E) as a

hybrid with a Schizothorax sp. (Hora, 1935). Listed as B. c. capito (Güldenstädt, 1773) by Karaman (1971).

12. Barilius vagra (Hamilton, 1822). Rivulet at Khost (Khowst or Matun where Matun River is listed at 33° 19'N, 69° 59'E in the Chamkani River drainage), Kabul River at Jalalabad (Bănărescu and Nalbant, 1975), and near Daruntah (Moravec and Amin, 1978), Zhob River drainage (Mirza, 1974), the Wana Toi, a tributary of the Gumal River in Pakistan (32° 20'N, 69° 30'E) (Regan, 1914). Opsarus (sic, = Opsarius) bicirratus McClelland, 1842 (from Jalalabad) and Opsarius piscatorius McClelland, 1842 (from Seharanpore [?]) are synonyms (Day, 1875-1878; Mirza, 1970).

13. Capoeta capoeta (Güldenstädt, 1773). As C. c. heratensis (Keyserling, 1861) in the Helmand River, Harirud at Herat and its drainage in Iran, Tedzhen and Murgab Rivers, Qonduz River and north Afghanistan, and as C. c. h. natio steindachneri (Kessler, 1872) in the upper Amu Darya from Termez on the Afghan border with Uzbekistan to Kirovabad on the Panj River (Berg, 1948-1949; Amanov, 1970; Saadati, 1977). Reported from the Qonduz River at Qonduz and the Khanabad River at Khanabad as C. heratensis steindachneri by Moravec and Amin (1978). C. steindachneri Kessler, 1872 reported by Günther (1889) from the Koshk River at Koshk-e Kohneh (34° 52'N, 62° 31'E) and from Nushki in Pakistani Baluchistan and Scaphiodon asmussii Keyserling, 1861 from warm springs at Sultan Karaul (?), 13 kilometres northeast of Herat, are synonyms (Hora, 1933b; Karaman, 1969). Berg (1933; 1949) noted that Günther's record from Nushki is in error because labels were mixed up. As C. c. gracilis (Keyserling, 1861) in Turkmenia, north slope of Kopet Dag east

nearly to Archman (38^o 33'N, 57^o 09'E) (Berg, 1948-1949). _Capoeta_ _gibbosa_ Nikolsky, 1897 from Bukhsani in southeastern Khorasan, Iran (locality uncertain, may be in a drainage shared with Afghanistan) is a synonym (Karaman, 1969) although Berg (1949) retained it as a distinct species

14. * _Capoeta_ _fusca_ Nikolsky, 1897. Reported from the Iranian drainage of the Namakzar (34^o 00'N, 60^o 30'E) which lies on the Iran-Afghanistan border (Nikolsky, 1896; Berg, 1949; Saadati, 1977). _C_. _nudiventris_ Nikolsky, 1897 is a synonym (Karaman, 1969).

15. _Capoetobrama_ _kuschakewitschi_ (Kessler, 1872). Amu Darya to the Panj River at Kirovabad and Fayzabadkala (37^o 19'N, 68^o 58'E), Surkhan and Kafirnigan Rivers (Berg, 1948-1949), Qonduz River at Qonduz and the Khanabad River at Khanabad (Moravec and Amin, 1978). Turdakov and Piskarev (1955) place Amu Darya specimens in _C_. _k_. _kuschakewitschi_ var. _macrophthalmus_.

16. # _Carassius_ _auratus_ (Linnaeus, 1758). Kabul River near Daruntah and breeding pools at Daruntah (Moravec and Amin, 1978), Sistan (Coad, 1980), Pishin Lora drainage (Mirza and Naik, 1965) lower Amu Darya drainage (Shaposhnikova, 1950; Turdakov, 1963).

17. * _Chalcalburnus_ _chalcoides_ (Güldenstädt, 1772). As _C_. _chalcoides_ _aralensis_ (Berg, 1923) in the Amu Darya from the Aral Sea to Kushkantau (?) (Berg, 1948-1949).

18. _Cirrhinus_ _burnesiana_ McClelland, 1842. Described from Jalalabad this species is of uncertain status. Günther (1868) placed it in _Tylognathus_.

19. _Cirrhinus_ _reba_ (Hamilton, 1822). Reported from the Kabul River by McClelland (1842) as _Gobio_ _limnophilus_ McClelland, 1834 and synonymised with _Cirrhinus_ _reba_ in Day (1875-1878).

20. *Crossocheilus latius* (Hamilton, 1822). Kurram River (Chamkani River in its Afghan reaches) near Parachinar in Pakistan (Ahmad and Mirza, 1964), and as *C. l. diplochilus* (Heckel, 1838) from the Wana Toi, a tributary of the Gumal River in Pakistan (32° 20'N, 60° 30'E) (Regan, 1914), Zhob River drainage in Pakistan (Mirza, 1974), Khost (Khowst or Matun 33° 19'N, 69° 59'E) in the Chamkani River drainage (Banarescu and Nalbant, 1975), and Quetta and Pishin in Pakistani Baluchistan (Day, 1880; Zugmayer, 1913). *Tylognathus barbatulus* Heckel, 1844 is a synonym (Berg, 1933; Mirza, 1972).

21. # *Ctenopharyngodon idella* (Valenciennes, 1844). Breeding pools at Daruntah in the Kabul River drainage (Moravec and Amin, 1978).

22. *Cyprinion watsoni* (Day, 1872). River at Kushk (Koshk-e Kohneh 34° 52'N, 62° 31'E) in northwest Afghanistan (Berg (1949) considered this record by Günther (1889) to be in error because of mixed up labels) and Nushki and Quetta in Pakistani Baluchistan (Day, 1880; Günther, 1889; Berg, 1949), Khost (Khowst or Matun 33° 19'N, 69° 59'E), and between Khost and Mangal (34° 08'N, 69° 43'E) in the Chamkani River drainage (Banarescu and Nalbant, 1975), Sistan (Regan, 1906; Berg, 1949), Zhob River drainage, Pishin Lora drainage (Mirza, 1964), Kurram River near Parachinar in Pakistan (Ahmad and Mirza, 1964), Wana Toi, a tributary of the Gumal River in Pakistan (32° 20'N, 69° 30'E) (Regan, 1914). *Scaphiodon irregularis* Day, 1872, *Scaphiodon microphthalmum* Day, 1880, *Barbus milesi* Day, 1880, *Cirrhina afghana* Gunther, 1889 and *Scaphiodon macmahoni* Regan, 1906 are synonyms (Berg, 1933; Karaman, 1971). Mirza (1969) recognised *Cyprinion microphthalmum* and *Cyprinion milesi* as distinct species.

23. Cyprinus carpio Linnaeus, 1758. Amu Darya from the Aral Sea to the Panj River, Murgab River (Berg, 1948-1949), Tedzhen River (Muhomedieva, 1967), Lake Gusar (?) in Amu Darya drainage of Afghanistan (Bănărescu and Nalbant, 1975), Qonduz River at Qonduz, and the Khanabad River at Khanabad (Moravec and Amin, 1978).

24. Danio devario (Hamilton, 1822). Reported from the Kabul River by McClelland (1842) as Perilimpus (sic, = Perilampus) ostreographus McClelland, 1839 and placed in Danio devario in Day (1875-1878).

25. Esomus danricus (Hamilton, 1822). Reported from the Kabul River by McClelland (1842) as Perilimpus (sic) sutiha (Hamilton, 1822), and synonymized with Esomus (or Nuria) danrica in Day (1875-1878).

26. * Garra gotyla (Gray, 1832). Zhob River drainage (Mirza, 1974).

27. Garra rossica (Nikolsky, 1900). Tedzhen, Murgab and Koshk Rivers, Shila (?Shelah) River in Afghanistan, Pishin Lora drainage, Helmand River, Sistan, Wana Toi, a tributary of the Gumal River in Pakistan (32° 20'N, 69° 30'E) (Berg, 1948-1949; Mirza, 1972, 1974). Discognathus phryne Annandale, 1919 and Discognathus wanae Regan, 1914 are synonyms (Menon, 1964). G. wanae may be a distinct species according to Mirza (1975). Specimens from the Helmand and Koshk Rivers identified by Günther (1889) as Discognathus lamta (Hamilton, 1822) were G. rossica (Berg, 1933). Discognathus variabilis Heckel, 1843 reported from the Harut River drainage at Anardareh (Anar Darreh, 32° 46'N, 61° 39'E) and from Nih (?) and Seri-Tschah (?) by Keyserling (1861) may have been this species. D. variabilis Heckel, 1843 reported from Sistan by Nikolsky (1899) and by Regan (1906) were this species (Menon, 1964).

28. * *Garra rufa* Heckel, 1843. Berg (1913) described *Garra persica* from Kiabad or Kjabad in Zirkuh or Zirckuch, an area of eastern Khorasan in Iran which may be Kuh-e Ziri (32° 48'N, 59° 50'E) and may lie in the Daqq-e Tondi drainage which is shared with Afghanistan. Menon (1964) placed *G. persica* in *Garra rufa obtusa* Heckel, 1843. This uncertain locality may be waters draining west into Iran.

29. *Gobio gobio* Linnaeus, 1758. As *G. g. lepidolaemus* Kessler, 1872 in the Amu Darya at Termez on the Afghan border with Uzbekistan and down river, Kafirnigan River, Tedzhen and its drainage in Iran, Murgab and Koshk Rivers (Günther, 1889; Berg, 1948-1949; Saadati, 1977). *Bungia nigrescens* Keyserling, 1861 from the Harirud at Herat is a synonym (Berg, 1949).

30. # *Hemiculter leucisculus* (Basilewsky, 1855). Qonduz River at Qonduz and the Khanabad River at Khanabad (Moravec and Amin, 1978).

31. **Hemigarra elegans* (Günther, 1868). As *H. e. adiscus* (Annandale, 1919) from Sistan (Karaman, 1971). Annandale (1919) described *adiscus* as a species of *Discognathus* and Menon (1964) considered it to resemble *Crossocheilus diplochilus* (Heckel, 1838) (see *Crossocheilus latius*).

32. # *Hypophthalmichthys molitrix* (Valenciennes, 1844). Breeding pools at Daruntah, Kabul River drainage (Moravec and Amin, 1978).

33. *Labeo angra* (Hamilton, 1822). Reported from the Kabul River at Jalalabad as *Cyprinus angra* by McClelland (1842). Day (1875-1878) places *C. angra* in *Labeo*.

34. *Labeo dero* (Hamilton, 1822). Kabul River near Daruntah (Moravec and Amin, 1978).

35. *Labeo diplostomus* (Heckel, 1838). Reported from Lolpore (?), Kabul River by McClelland (1842) as *Gobio malacostomus* McClelland, 1838. Placed in *L. diplostomus* in Day (1875-1878).

36. *Labeo dyocheilus* (McClelland, 1839). Reported from the Kabul River as *Gobio bicolor* McClelland, 1839 by McClelland (1842). Day (1875-1878) placed this species in synonymy with *Labeo dyocheilus*.

37. *Labeo gonius* (Hamilton, 1822). Reported from the Kabul River at Jalalabad as *Cyprinus curchius* Hamilton, 1822, by McClelland (1842). Day (1875-1878) synonymized *C. curchius* with *Labeo gonius* while Günther (1868) placed it in *Labeo cursa* (Hamilton, 1822).

38. *Labeo pangusia* (Hamilton, 1822). Reported from the Kabul River by McClelland (1842) as *Gobio pangusia*.

39. * *Leuciscus idus* (Linnaeus, 1758). As *L. i. oxianus* (Kessler, 1872) in the Amu Darya from the Aral Sea to Pitnyak (41° 12'N, 61° 20'E) (Berg, 1948-1949).

40. *Leuciscus latus* (Keyserling, 1861). Harirud at Herat, Murgab and Tedzhen Rivers, Probably a subspecies of *L. lehmanni* (Svetovidov, 1967). *Squalius transcaspiensis* Berg, 1898, from the Tedzhen, is a synonym (Berg, 1948-1949).

41. * *Leuciscus lehmanni* Brandt, 1852. Surkhandar'ya and Kafirnigan Rivers. Closely related to *L. leuciscus baicalensis* natio *kirgisorum* Berg, 1913 from the Kafirnigan river (Berg, 1948-1949; Shaposhnikova, 1950).

42. * *Leuciscus leuciscus* Linnaeus, 1758. As *L. l. baicalensis* natio *kirgisorum* Berg, 1913 in the Kafirnigan River (Berg, 1948-1949). Turdakov (1963) and Svetovidov (1967) listed this species as *L. leuciscus kirgisorum* Berg, 1913.

43. *Pelecus cultratus* (Linnaeus, 1758). Amu Darya from the Aral Sea to the Panj River (Berg, 1948-1949).

44. # *Pseudorasbora parva* (Schlegel, 1842). Khanabad River at Khanabad (Moravec and Amin, 1978).

45. *Ptychobarbus conirostris* Steindachner, 1866. Afghanistan (Mirza and Hameed, 1975). No other record, occurrence and distribution in Afghanistan is uncertain.

46. *Puntius conchonius* (Hamilton, 1822). Kabul River at Jalalabad, and between Khost (Khowst or Matun 33° 19'N, 69° 59'E) in Afghanistan and Peshawar in Pakistan in the Indus (?Chamkani) River drainage (Bănărescu and Nalbant, 1975), and the Kabul River near Daruntah (Moravec and Amin, 1978).

47. *Puntius sarana* (Hamilton, 1822). Reported from the Kabul River by McClelland (1842) as *Systomus immaculatus* McClelland, 1839 which Day (1875-1878) synonymized with *Barbus* (or *Puntius*) *sarana*.

48. *Puntius sophore* (Hamilton, 1822). McClelland (1842) reported two species, *Systomus sophore* and *Systomus chrysopterus* McClelland, 1839, from the Kabul River. Mirza (1971) has placed the latter in *Puntius sophore*. Day (1875-1878) considered *Systomus sophore* to be a synonym of *Barbus stigma* (Hamilton, 1822).

49. * *Puntius ticto* (Hamilton, 1822) Lower Swat River drainage of Pakistan (Mirza, 1973).

50. # *Rhodeus sinensis* Gunther, 1868. Breeding pools at Daruntah, Kabul River drainage (Moravec and Amin, 1978).

51. *Rutilus rutilus* (Linnaeus, 1758). As *R. r. aralensis* Berg, 1916 in the Amu Darya from the Aral Sea to Petroaleksandrovsk (41° 28'N, 61° 00'E) and Pitnyak (41° 12'N, 61° 20'E) in lakes (Berg, 1948-1949). As

R. r. bucharensis (Nikolskiy, 1933) in the Amu Darya, tributaries and adjacent flood plain lakes upriver from Termez on the Afghan border with Uzbekistan (Amanov, 1974). Berg (1948-1949) regarded this subspecies as a natio of R. r. aralensis. R. rutilus (no subspecies listed) is reported from a pool near the Khanabad River at Khanabad (Moravec and Amin, 1978).

52. Salmostoma bacaila (Hamilton, 1822). Reported from the Kabul River as Opsarius baicala (sic, = bacaila) by McClelland (1842).

53. * Salmostoma punjabensis (Day, 1872). Reported from the Swat River drainage of Pakistan (Mirza, 1973).

54. * Scardinius erythrophthalmus (Linnaeus, 1758). Amu Darya from the Aral Sea to Pitnyak (41° 12'N, 61° 20'E) (Berg, 1948-1949). Bǎnǎrescu (1964) indicated a distribution in the upper Amu Darya in Afghanistan.

55. Schizocypris brucei Regan, 1914. Sistan (Annandale and Hora, 1920), Wana Toi, a tributary of the Gumal River in Pakistan (32° 20'N, 69° 30'E) (Regan, 1914), Zhob River drainage of Pakistan (Mirza, 1974), Kurram River (Mirza and Hameed, 1975).

56. Schizocypris ladigesi Karaman, 1969. Kankai (?) River between Khost (Khowst or Matun 33° 19'N, 69° 59'E) and Thangall (Mangal 34° 08'N, 69° 43'E) in the Chamkani River drainage (Karaman, 1969). Khost, and Ali Khel (33° 57'N, 69° 43'E) north of Khost, and Jalalabad (Bǎnǎrescu and Nalbant, 1975).

57. Schizopygopsis stoliczkae Steindachner, 1866. Upper Amu Darya in the Pamirs, upper Helmand River, and Indus River basin (but not apparently in Kabul River). As infraspecies or subspecies sewerzowi

Herzenstein, 1890 in the delta of Helmand River and upper Amu Darya in the Pamirs (Day, 1876; Alcock, 1898; Berg, 1948-1949; Regan, 1906; Vijayalakshmanan, 1950; Mirza and Hameed, 1975).

58. *Schizothorax anjac (Fowler and Steinitz, 1956). Zabol in Sistan (Fowler and Steinitz, 1956). Regarded as a synonym of Schizothorax zarudnyi by Saadati (1977).

59. Schizothorax barbatus McClelland, 1842. Described from the Kabul River at Jalalabad by McClelland (1842). Status uncertain.

60. Schizothorax chrysochlora (McClelland, 1842). Lolpore (?), Kabul River (McClelland, 1842), Panjsher River, Ali Khel (33^{o} 57'N, 69^{o} 43'E) north of Khost and Khost (Khowst or Matun (33^{o} 19'N, 69^{o} 59'E)) in Chamkani River drainage (Bănărescu and Nalbant, 1975), Lowgar River (Hora, 1935), and Kabul River near Daruntah (Moravec and Amin, 1978).

61. Schizothorax edeniana McClelland, 1842. Described from the Kabul River at Koti-i-Ashruf (Kowt-e-'Ashrow (34^{o} 27'N, 68^{o} 48'E)), Mydan valley (?Kowt-e Ashrow), and Sar Chashmeh (34^{o} 26'N, 68^{o} 39'E) by McClelland (1842). Status uncertain but Day (1876) suggested it may be a synonym of Schizothorax irregularis Day, 1876.

62. Schizothorax esocinus (Heckel, 1838). Afghanistan (Mirza and Hameed, 1975), Kabul and Helmand River drainages (McClelland, 1842; Hora, 1933b; Berg, 1949), Chitral River drainage (Mirza, 1973). Schizothorax punctatus Day, 1876 and possibly Racoma nobilis McClelland, 1842 are synonyms (Hora, 1934).

63. Schizothorax gobioides (McClelland, 1842). Described from the Bamian River in the genus Racoma by McClelland (1842). Status uncertain.

64. Schizothorax intermedius McClelland, 1842. S. i. forma typica found in the upper Amu Darya, Panj River, Gunt River at Khorog (37° 30'N, 71° 36'E), Bartang River at Rushan (= Kalai-Vamar 37° 57'N, 71° 33'E), Tanymas River at Kyzyltokoy (?) (river listed at 38° 25'N, 72° 40'E in the drainage of the Bartang River), Pamir River, Indus and Helmand River basins, S. i. morpha eurystomus Kessler, 1872 in the upper Helmand River and Amu Darya (Oreinus plagiostomus McClelland, 1842 and Schizothorax minutus Kessler, 1872 are synonyms), and S. i. morpha fedtschenkoi Kessler, 1872 in the Helmand River, Konar River, Kabul River at Jalalabad, Amu Darya and the Aq Su (S. regeli Herzenstein, 1889 is a synonym and also possibly Racoma labiatus McClelland, 1842 and Racoma brevis McClelland, 1842) (McClelland, 1842; Kessler, 1874; Alcock, 1898; Vinciguerra, 1915-1917; Berg, 1932b; Berg, 1948-1949; Balon and Hensel, 1970). Also reported from the Tarnak River, Band-e-Amir basin, (brooklets flowing out of Band-e-Amir lakes), Koshk River, Jam River and Lowgar River without morpha being cited (McClelland, 1842; Günther, 1889; Hora, 1933b; 1935; Moravec and Amin, 1978). Günther's (1889) record from the Koshk River is in error because of mixed up labels (Berg, 1933; 1949).

65. Schizothorax labiatus (McClelland, 1842). Farakhollum (Farakhulm 34° 31'N, 68° 08'E) about 16 kilometres south of Gardan Dival (34° 30'N, 68° 15'E) (Vijayalakshmanan, 1950), Panjsher River near Golbahar (35° 09'N, 69° 17'E) (Moravec and Amin, 1978), Konar River and Kabul River near Jalalabad (McClelland, 1842; Berg, 1949), Zhob River, Chitral and Swat River drainages of Pakistan (Mirza, 1973; 1974). Schizothorax ritchieana McClelland, 1842 from the Helmand River is a synonym (Mirza, 1972) although Berg (1949) placed it in Schizothorax intermedius.

66. Schizothorax microcephalus Day, 1876. P'anja or Panjah, waters going to the Oxus (Day, 1876; 1878). Alcock (1898) stated that Day's specimen was from Kala Panja (i.e. Qal'eh-ye Panjeh (37° 00'N, 72° 35'E) on the Panj River and the type is lost. It may be a synonym of S. intermedius.

67. Schizothorax pelzami Kessler, 1870. Murgab and Tedzhen Rivers, Iranian drainages of Tedzhen River, Germab River at Geok-tepe (38° 09'N, 57° 58'E) (Berg, 1948-1949; Saadati, 1977). S. raulinsii Günther, 1889 from the Harirud near Khusan (?) is a synonym (Berg, 1933; 1949).

68. Schizothorax plagiostomus Heckel, 1838. Afghanistan, Chitral and Swat valleys of Pakistan, Zhob River drainage (Mirza, 1973; 1974). Oreinus sinuatus Heckel, 1838 is a synonym (Mirza, 1973) and is listed from Dasht-e-Navar, 150 km. north of Ghazni (sic, but Dasht-e-Navar at 33° 44'N, 67° 45'E lies about 60 km west of Ghazni on maps), Zensai (?) on the Pich River (Bănărescu and Nalbant, 1975), Salang River, Panjsher River at Golbahar (35° 09'N, 69° 17'E) and Paghman River at Paghman (34° 36'N, 68° 57'E) in the Kabul River drainage (Hora, 1933b; Moravec and Amin, 1978), the Kurram River near Parachinar in Pakistan (Ahmad and Mirza, 1964), Farakhollum (Farakhulm 34° 31'N, 68° 08'E) about 16 kilometres south of Gardan Dival in the Helmand River drainage and at Gardan Dival (34° 30'N, 68° 15'E). Oreinus griffithi McClelland, 1842 from the Konar River and Sar Chashmeh (34° 26'N, 68° 39'E) is a synonym (McClelland, 1842; Hora, 1935; Vijayalakshmanan, 1950), as is Oreinus maculatus McClelland, 1839 from the Kabul River, Gandomak and the Ali Musjid stream in the Khyber Pass (McClelland 1842; Hora, 1933b; Mirza and Naik, 1969).

69. *Schizothorax schumacheri Fowler and Steinitz, 1956. Zabol in Sistan (Fowler and Steinitz, 1956). Regarded as a synonym of Schizothorax intermedius by Saadati (1977).

70. Schizothorax zarudnyi (Nikolsky, 1897). Sistan (Nikolsky, 1897). Barbus microlepis Keyserling, 1861 from the Harut or Adraskan River drainage at Anardareh (Anar Darreh, 32° 46'N, 61° 39'E) is a synonym (Hora, 1933b; Berg, 1949).

71. Tor putitora (Hamilton, 1822). Kabul River near Daruntah and its drainage (Mirza, 1973; Mirza and Awan, 1976; Moravec and Amin, 1978). Cyprinus mosal Hamilton, 1822 from Jalalabad is listed as a synonym in Mirza (1970) but is recognized as a species in Mirza (1975).

72. * Tor zhobensis Mirza, 1967. Zhob River basin, Pakistan (Mirza, 1967).

Family 5. Cobitidae

This family contains a large number of species in the genus Noemacheilus. Subgenera are given generic rank by some authors, e.g. see Berg (1948-1949), Bănărescu (1977) and Mirza (1975).

1. Noemacheilus (Triplophysa) akhtari Vijayalakshmanan, 1950. Helmand River at Farakhollum (Farakhulm 34° 31'N, 68° 08'E), about 16 kilometres south of Gardan Dival (34° 30'N, 68° 15'E) (Vijayalakshmanan, 1950). May be a synonym of N. griffithi griffithi according to Bănărescu and Nalbant (1966).

2. Noemacheilus (Schistura) alepidotus Mirza and Bănărescu, 1970. As N. a. alepidotus from the Swat River drainage and the Ghowr Band (= Chorband) River in the Kabul River basin (Mirza, Bănărescu and Nalbant, 1970; Moravec and Amin, 1978). Previously mis-identified as N. rupicola inglisi Hora, 1935 by Ahmad and Mirza (1963). First described as a subspecies of N. rupicola by Mirza and Bănărescu (Mirza, Bănărescu and Nalbant, 1970).

3. Noemacheilus (Triplophysa) amudarjensis Rass, 1929. Amu Darya from Chardzhou (39° 06'N, 63° 34'E) to Aivadzh (presumably on the Kafirnigan River) as N. a. amudarjensis Rass, 1929 and as N. a. choresmi Berg, 1932 in the Amu Darya delta (Berg, 1932a; Berg, 1948-1949).

4. Noemacheilus (Schistura) baluchiorum Zugmayer, 1912. Sistan and from Kajaki (= Kajkai) (the town is listed at 32° 16'N, 65° 03'E and the dam lies northeast) in the Helmand River drainage. Regarded by Banarescu and Nalbant (1966) as a valid species but Berg (1949) placed it in the synonymy of N. montanus (McClelland, 1839) from Simla. Mirza, Banarescu and Nalbant (1970) considered specimens from Kajaki to represent a new species but do not give a formal description and name.

5. Noemacheilus (Paracobitis) boutanensis (McClelland, 1842). Sistan and the Helmand River drainage (Hora, 1929; Bănărescu and Nalbant, 1966).

6. Noemacheilus (Triplophysa) brahui Zugmayer, 1912. Nushki and Pishin in Pakistani Baluchistan near the border with Afghanistan (Zugmayer, 1912; Hora, 1933a), the Pishin Lora drainage in Pakistan (Mirza, 1974), and Kabul (Bănărescu and Nalbant, 1966).

7. * Noemacheilus (Triplophysa) choprai Hora, 1934. Chitral and Swat River drainages in Pakistan (Hora, 1934; Ahmad and Mirza, 1963). Probably a subspecies of N. stenurus q.v.

8. * Noemacheilus (Schistura) corica (Hamilton, 1822). Bannu in Pakistan in the drainage of the Kurram River (Hora, 1933a).

9. Noemacheilus (Paracobitis) cristatus Berg, 1898. Ashkhabadka River (? at Ashkhabad), northern Kopet-Dag streams east of Archman (38° 33'N, 57° 09'E) and west of the Tedzhen River (Berg, 1948-1949), Murgab River and at Qual-el Chabrak, 180 km east of Herat (possibly Shahrak 34° 06'N, 64° 18'E) and at Obeh (or Owbeh 34° 22'N, 63° 10'E) in the drainage of the Harirud (Bănărescu and Nalbant, 1966), Helmand River drainage, Zhob River drainage of Pakistan (Mirza, 1974).

10. * Noemacheilus (Deuterophysa) dorsalis (Kessler, 1872). Amu Darya basin in the mountains, Kafirnigan River. As N. d. kafirnigani Turdakov, 1946 in the Kafirnigan River (Berg, 1948-1949).

11. Noemacheilus (Triplophysa) farwelli Hora, 1935. Helmand River (Hora, 1935; Bănărescu and Nalbant, 1966).

12. Noemacheilus (Paracobitis) ghazniensis Bănărescu and Nalbant, 1966. Ghazni River at Ghazni (town is at 33° 33'N, 68° 26'E and the dam lies northwest) (Bănărescu and Nalbant, 1966).

13. Noemacheilus (Triplophysa) griffithi (Günther, 1868). Type form in Sistan basin, Arghandab River near Kandahar (Hora, 1929; 1935), N. g. afghana (Hora, 1935) in Kabul River near Kabul and other localities in the drainage of the Kabul River such as the Sar Chashmeh (34° 26'N, 68° 39'E), Arbarp (?) about 18 kilometres west of Kabul, Kowtal-e-Shebar, Ownay (=Unai) valley (Kabul sources) Jannichel (?probably Kabul River drainage), Chahiltran(?) stream, Ghowr Band

(= Chorband) River, Salang River, brooklets at Kariz-e Mir (34° 38'N, 69° 03'E) and Paghman River at Paghman (34° 36'N, 68° 57'E) (Hora, 1933b; 1935; Moravec and Amin, 1978), and N. g. naziri Ahmad and Mirza, 1963 in the Swat River, Pakistan (Bănărescu and Nalbant, 1966; Bănărescu and Nalbant, 1975). The fish listed as Cobitis marmorata Heckel by McClelland (1842) was probably N. griffithi according to Hora (1929).

14. Noemacheilus (Schistura) kessleri Günther, 1889. Pishin Lora drainage in Pakistan (Mirza, 1974), Nushki and Pishin in Pakistani Baluchistan near the border with Afghanistan (Günther, 1889; Hora, 1933a), Jannichel (? probably Kabul River drainage), Ghazni River at Ghazni (town is at 33° 33'N, 68° 26'E and the dam lies northwest) (Bănărescu and Nalbant, 1966). Nikolski (1900) recorded this species from Keliate-marg (?) incorrectly placing this locale in the Zirkuh (or probably Kuh-e Ziri (32° 48'N, 59° 50'E) of Iran. Berg (1949) stated this locality to be in the Nehbandan (31° 32'N, 60° 04'E) district which drains southeast to Sistan. As N. k. turcomanus Nikolsky, 1947 in the Kushka River (Berg, 1948-1949).

15. Noemacheilus (Triplophysa) kullmanni Bănărescu and Nalbant, 1975. Ab-e-Nawar spring, presumably at Dasht-e-Navar 33° 44'N, 67° 45'E (Bănărescu and Nalbant, 1975).

16. * Noemacheilus (Oreias) kuschakewitschi Herzenstein, 1890. As N. k. pardalis Turdakov, 1941 from the Dyushambinka River in Kafirnigan River basin. Berg (1948-1949) and Turdakov (1963) regarded this subspecies as a full species but Bănărescu and Nalbant (1966) listed it as a subspecies.

17. *Noemacheilus* (*Paracobitis*) *longicauda* (Kessler, 1872). Tedzhen and Murgab River drainages (Berg, 1948-1949), Khanabad River at Khanabad (Moravec and Amin, 1978). Regarded as a distinct species by Bănărescu and Nalbant (1966) but placed as a subspecies of *N*. *malapterurus* by Berg (1948-1949).

18. *Noemacheilus* (*Paracobitis*) *malapterurus* (Valenciennes, 1846). As *N*. *m*. *longicauda* (Kessler, 1872) in the Tedzhen, Murgab, Amu Darya and Panj River (Berg, 1948-1949), and as *N*. *malapterurus* *macmahoni* Chaudhuri, 1909 in the Helmand River in Sistan (Bănărescu and Nalbant, 1964). Specimens from the Tedzhen and Murgab Rivers may be referable to *N*. *malapterurus* *macmahoni* or *N*. *malapterurus* *malapterurus* (Bănărescu and Nalbant, 1964). Bănărescu and Nalbant (1966) revised their earlier synonomy of *N*. *macmahoni* with *N*. *malapterurus* and placed it in *N*. *rhadineus* Regan, 1906. In addition *N*. *longicauda* was listed as a distinct species.

19. * *Noemacheilus* (*Schistura*) *naseeri* Ahmad and Mirza, 1963. Described as a subspecies of *N*. *punjabensis* from the Swat River drainage but regarded by Mirza (1973) as a distinct species.

20. *Noemacheilus* (*Orthias*) *oxianus* Kessler, 1877. Amu Darya from its mouth to Kirovabad on the Panj River (Berg, 1948-1949).

21. * *Noemacheilus* (*Schistura*) *pakistanicus* Mirza and Bănărescu, 1969. Zhob River drainage in Pakistan (Mirza, Bănărescu and Nalbant, 1969; Mirza, 1974).

22. *Noemacheilus* (*Schistura*) *prashari* Hora, 1933. As *N*. *p*. *lindbergi* Bănărescu and Mirza, 1965, reported from a Farah River tributary at Siaw

(but Si Av is at 32° 13'N, 62° 43'E in the Khospas River drainage) and as _N. p. haarlovi_ Bănărescu and Nalbant, 1966 from Pirzada (presumably Pir Zadeh, 31° 38'N, 65° 03'E) west of Kandahar in the Helmand River drainage (Bănărescu and Mirza, 1965; Bănărescu and Nalbant, 1966; Mirza, Bănărescu and Nalbant, 1969).

23. _Noemacheilus_ (_Paracobitis_) _rhadineus_ Regan, 1906. Helmand River at Kajaki (= Kajkai) (the town is listed at 32° 16'N, 65° 03'E and the dam lies northeast), Tedzhen and Murgab Rivers, and Zhob River drainage of Pakistan (Mirza and Angvi, 1972; Bănărescu and Nalbant, 1966). _N. macmahoni_ Chaudhuri, 1909 from Sistan is a synonym (Bănărescu and Nalbant, 1966).

24. _Noemacheilus_ (_Schistura_) _sargadensis_ Nikolsky, 1899. As _N. s. turcmenicus_ Berg, 1932 from a stream near Gyaurs (37° 47'N, 58° 44'E) east of Ashkhabad and Kel'te-chinar River (?) near Gyaurs (Berg, 1932a; 1948-1949) and as _N. s. paludani_ Bănărescu and Nalbant, 1966 from a tributary of the Pech River in the Kabul River basin at Gusalek (?) (Bănărescu and Nalbant, 1966). Placed in the genus _Schistura_ by Bănărescu (1977). The type form is found in Iranian Baluchistan (Berg, 1949). Also reported as _N. sargadensis_, from the Bejestan High Land basin in Iran, possibly in a drainage shared with Afghanistan (Saadati, 1977).

25. *_Noemacheilus_ (_Triplophysa_) _stenurus_ Herzenstein, 1888. As _N. s. choprai_ Hora, 1934 from the Chitral and Swat River drainages in Pakistan (Ahmad and Mirza, 1963) and as the type form from the effluents of the Helmand (Regan, 1906). Hora (1922) placed these specimens in _N. tenuis_.

Mirza (1973) regarded this as a valid species while Berg (1948-1949) regarded N. stenurus as a synonym of N. stoliczkae (q.v.).

26. Noemacheilus (Triplophysa) stoliczkae (Steindachner, 1866). Upper Amu Darya (the Aq Su), Gunt River at Khorog (37° 30'N, 71° 36'E), Tanymas River at Kyzyltokoy (?) (river listed at 38° 25'N, 72° 40'E in the drainage of the Bartang River), upper Helmand River, Indus River mountain basins (Day, 1876; Berg, 1932b; Berg, 1948-1949), and the Bamian River near Bamian (Moravec and Amin, 1978). N. s. uranoscopus Kessler, 1872 was listed as from the basin of the Amu Darya, the Indus, the Helmand? (sic), and the Band-e-Amir (brooklets flowing out of Band-e-Amir lakes) (Berg, 1948-1949; Moravec and Amin, 1978). Berg (1948-1949) considered N. stenurus Herzenstein, 1888, recorded from the effluents of the Helmand River, to be a synonym. Hora (1922) considered specimens identified as N. stoliczkae from Sistan (Annandale and Hora, 1920) to be N. tenuis.

27. Noemacheilus (Triplophysa) tenuis Day, 1876. Upper Amu Darya drainage in the Pamirs (the Aq Su), Koshk on the Koshk River, Gunt River, Sistan (Day, 1876; Alcock, 1898; Berg, 1948-1949; Annandale and Hora, 1920; Hora, 1922). Regarded as a distinct species by Bănărescu and Nalbant (1966) but as a subspecies of N. stoliczkae by Annandale and Hora (1920).

28. Sabanajewia aurata (Filippi, 1865). Tedzhen and Murgab Rivers and tributaries of the Aral Sea (Bănărescu and Nalbant, 1966). As S. aurata aralensis (Kessler, 1877) in the Amu Darya basin to the Pamirs (Berg, 1948-1949) but distributionally restricted to the lower Amu Darya by Banarescu and Nalbant (1966).

Order 4. Siluriformes

Family 6. Bagridae

1. *Mystus seenghala* (Sykes, 1841). Afghanistan (Günther, 1864). *Bagrus lamarii* Valenciennes, 1839 is a synonym (Misra, 1976).

2. *Mystus tengara* (Hamilton, 1822). Afghanistan (Günther, 1864). *Pimelodus anisurus* McClelland, 1842 from the Kabul River at Jalalabad is possibly a synonym (Day, 1875-1878).

3. *Rita rita* (Hamilton, 1822). Reported from the Kabul River and Khyber Pass by McClelland (1842) as *Pimelodus rita*.

Family 7. Siluridae

Silurus afghana Günther, 1864 was described from Afghanistan in error since collections were mixed. This species is from Assam (Misra, 1976).

1. *Ompok bimaculatus* (Bloch, 1797). Afghanistan (Mirza, 1972).

2. *Ompok canio* (Hamilton, 1822). Reported from Afghanistan as *Silurus indicus* McClelland, 1842 (Misra, 1976) from the Kabul River at Jalalabad.

3. *Ompok pabda* (Hamilton, 1822). Kabul River in Afghanistan (Day, 1880), Wana Toi, a tributary of the Gumal River in Pakistan (32^{o} 20'N, 69^{o} 30'E) (Regan, 1914).

4. *Silurus glanis* Linnaeus, 1758. Amu Darya, Qonduz River at Qonduz (Berg, 1948-1949; Moravec and Amin, 1978), Murgab (Nikolski and Tzentilovich, 1951).

5. *Wallago attu* (Schneider, 1801). Pishin Lora drainage of Pakistan (Zugmayer, 1913).

Family 8. Schilbeidae

1. * *Clupisoma naziri* Mirza and Awan, 1973. Khiali River near Khatki (34^{o} 10'N, 71^{o} 35'E) a tributary of the Kabul River in Pakistan (Mirza and Awan, 1973). Listed as a subspecies of *C. murius* Hamilton, 1822 by Mirza (1975).

Family 9. Sisoridae

1. *Glyptosternum akhtari* Silas, 1952. Bamian River (Hora and Silas, 1952).

2. *Glyptosternum reticulatum* McClelland, 1842. Upper reaches of the Amu Darya, Bamian River, Kabul River drainage including the Sar Chashmeh (34^{o} 26'N, 68^{o} 39'E), Panjsher River, near Golbahar (35^{o} 09'N, 69^{o} 17'E), Salang River, brook at Estalef (34^{o} 50'N, 69^{o} 05'E) Paghman River at Paghman (34^{o} 36'N, 68^{o} 57'E) and Surchab (presumably the Sorkh Rud but may be the Sorkh Ab) River, and Chitral valley (McClelland, 1842; Hora and Silas, 1952; Mirza, 1973; 1975; Moravec and Amin, 1978), Andarab River at Banu (presumably Banow 35^{o} 38'N, 69^{o} 15'E)

(Hora, 1935). Hora (1933b; 1934) and Berg (1948-1949) listed synonyms which include Exostoma stoliczkae Day, 1876, Exostoma oschanini Herzenstein, 1889 and Exostoma labrax Gratsianov, 1907.

3. * Glyptothorax cavia (Hamilton, 1822). Khiali River, probably near Khatki (34^{o} 10'N, 71^{o} 35'E), a tributary of the Kabul River in Pakistan and also from the Swat River drainage of Pakistan (Mirza, 1973).

4. Glyptothorax jalalensis Balon and Hensel, 1970. Kabul River tributary near Jalalabad (Balon and Hensel, 1970).

5. * Glyptothorax naziri Mirza and Naik, 1969. Zhob River drainage of Pakistan (Mirza and Naik, 1969).

6. * Glyptothorax punjabensis Mirza and Kashmiri, 1971. Khiali River near Khatki (34^{o} 10'N, 71^{o} 35'E) a tributary of the Kabul River in Pakistan (Mirza, 1973; Mirza and Hameed, 1974).

7. * Glyptothorax stocki Mirza and Nijssen, 1978. Swat River in the Kabul River drainage of Pakistan. This species was misidentified as G. platypogonoides (Bleeker, 1855) by previous authors (Mirza and Nijssen, 1978).

Order 5. Atheriniformes

Family 10. Poeciliidae

1. # Gambusia affinis (Baird and Girard, 1853). An introduced species found in Sistan and the Tedzhen and Murgab Rivers as G. a. holbrooki

(Girard, 1859) (Turdakov, 1963; Muhomedieva; 1967; Coad, 1979) and in the Amu Darya basin (Turdakov, 1963; Amanov, 1974), in a pool near the Khanabad River at Khanabad and in the Kabul River near Kabul (subspecies not noted) (Moravec and Amin, 1978). G. a. patruelis (Baird and Girard, 1853) is reported from the Pishin Lora drainage (Mirza and Naik, 1965).

Order 6. Gasterosteiformes

Family 11. Gasterosteidae

1. * Pungitius platygaster (Kessler, 1859). As P. platygaster aralensis (Kessler, 1877) from the Aral Sea and Amu Darya delta (Berg, 1948-1949).

Order 7. Perciformes

Family 12. Percidae

1. * Gymnocephalus cernua (Linnaeus, 1758). Amu Darya delta (Berg, 1948-1949). Bănărescu (1964) indicated a distribution upriver in the Amu Darya to Afghanistan.
2. * Perca fluviatilis Linnaeus, 1758. Amu Darya from the Aral Sea to Sultan-Uizdag (ca. 42° 05'N, 60° 40'E) (possibly to Turtkul (41° 28'N, 61° 00'E)) (Berg, 1948-1949).
3. * Stizostedion lucioperca (Linnaeus, 1758). Amu Darya delta (Berg, 1948-1949). Bănărescu (1964) indicated a distribution in the upper reaches of the Amu Darya in Afghanistan.

Family 13. Gobiidae

1. # *Rhinogobius similis* Gill, 1860. Reported from a pool near the Khanabad River at Khanabad (Moravec and Amin, 1978).

Family 14. Channidae

1. *Ophiocephalus gachua* Hamilton, 1822. Afghanistan in the Kabul River drainage (Day, 1876; 1880; Nikolsky, 1899; Balon and Hensel, 1970). *O. montanus* McClelland, 1842 from Jalalabad is a synonym (Günther, 1861; Day, 1880; Berg, 1949).

2. *Ophiocephalus punctatus* Bloch, 1793. Afghanistan in the Kabul River drainage. *O. indicus* McClelland, 1842 from the Kabul River is a synonym (Day, 1875-1878; Day, 1880).

Family 15. Mastacembelidae

1. * *Mastacembelus armatus* (Lacépède, 1800). Zhob River drainage of Pakistan (Mirza, 1975). Sufi (1957) did not report it from Afghanistan but Day (1876) mentioned its occurrence without further details.

Discussion

The ichthyofauna of Afghanistan is impoverished, compared with the lowland Indus basin to the east, as a consequence of the isolation and altitude of its drainages. The greatest diversity in species is found in the smallest of the three major drainages, the Kabul River basin, which drains to the Indus River. The majority of the species are Oriental and have ascended the Kabul River within the borders of Afghanistan. This includes all the Cyprinidae except the Schizothoracini, the Siluriformes except Glyptosternum reticulatum and Glyptothorax jalalensis, and the Channidae. The upper reaches of the Kabul basin are dominated by a variety of snow trout (Schizothoracini) and cobitid species which are adapted to cold, fast mountain streams.

The second largest drainage (in its Afghanistan basin) is that of the Amu Darya which flows into the Aral Sea and has the second largest number of species. The Aral Sea and Amu Darya fauna includes the endemic relict genera Aspiolucius and Pseudoscaphirhynchus and such endemic species as Alburnoides taeniatus, Capoetobrama kuschakewitschi, Leuciscus lehmanni, Noemacheilus amudarjensis, N. oxianus (Berg, 1948-1949) and Glyptosternum akhtari. The fauna of the Aral Sea and Amu Darya shows evident affinities with the Caspian Sea fauna and transgressions have linked these basins at various times in the past including the end of the Pleistocene via the Uzboi Valley (Berg, 1948-1949). Some species of the Amu Darya and Caspian basins are identical even at the subspecies level, eg. Alburnoides bipunctatus eichwaldi and Aspius aspius taeniatus, and provide evidence for a later transgression than the one which allowed access to the Amu Darya of the ancestors of endemic genera. Species found in common between the Amu Darya and Caspian Sea basins include *Acipenser nudiventris*, *Salmo trutta*, *Barbus brachycephalus*, *B. capito*, *Capoeta capoeta*, *Pelecus cultratus*, *Rutilus rutilus*, *Noemacheilus malapterurus*, *Sabanajewia aurata* and *Silurus glanis*. The lower Amu Darya and Aral Sea proper contain additional species shared with the Caspian basin but not reported from Afghanistan (see Berg, 1948-1949). The fish fauna of the upper Amu Darya is impoverished in comparison with the lower parts of the drainage basin (Shaposhnikova, 1950). Certain species found here are also found in the upper reaches of adjacent drainages, e.g. *Glyptosternum reticulatum* is also found in the Kabul system and the Tarim basin, and Berg (1948-1949) attributes this common fauna to headwater capture and impoundment of rivers by glaciers in the Pleistocene such that lakes were formed and different basins connected.

The Helmand River drainage is the largest of the three major drainage basins of Afghanistan and has the least diverse ichthyofauna in terms of number of species. It apparently lacks an extended or extensive past connection to a richer faunal area like the Kabul and Amu Darya basins. Only the families Cyprinidae and Cobitidae are found here. Seven of 27 species are found also in the Amu Darya (including Hari-Tedzhen and Murgab drainages) and seven others are found in the Indus River drainages. *Noemacheilus stoliczkae* and *Schizothorax intermedius* are found in all three major drainages presumably as a result of headwater capture. Of the remaining eleven species *Hemigarra elegans*, *Noemacheilus brahui* and *N. prashari* are found in other drainages of eastern Iran and Pakistani

Baluchistan and Schizothorax anjac, S. schumacheri, S. zarudnyi, Noemacheilus akhtari, N. boutanensis, N. farwelli, N. ghazniensis and N. kullmani are endemic. Reservations about the specific validity of the first two species have been expressed and the systematics of Noemacheilus leaves much to be desired.

The Murgab and Hari-Tedzhen basins contain a fauna similar to the Amu Darya and as Berg (1948-1949) pointed out this is indicative of the former connection of these rivers. Eight species are found in all three systems (if Leuciscus latus is a subspecies of L. lehmanni), a further two are found in the Murgab and Amu Darya only (Noemacheilus tenuis and Silurus glanis) and it may be noted that the Murgab lies closer to the Amu Darya than the Hari-Tedzhen, and the remaining species have a wider distribution across southwest Asia.

The minor drainages of the Chamkani-Kurram and Zhob-Gowmal rivers are part of the Indus basin and their fauna reflects this strongly with the addition of three endemic species Tor zhobensis, Noemacheilus pakistanicus and Glyptothorax naziri and such species of wider distribution in southwest Asia west of the Indus basin as Cyprinion watsoni, Garra rossica and Noemacheilus cristatus.

The fauna of the Pishin Lora also includes Indus elements (Wallago attu and Crossocheilus latius) and the remainder are more widely distributed in southwest Asia.

I have resisted the temptation to assign areas of Afghanistan to named faunal provinces and regions as this is a static concept. Both Berg (1948-1949) and Bănărescu (1977) named areas in some detail. The area evidently contains a mixture of Oriental and Palaearctic species, of northern and southern species and of high and low altitude-adapted species. A number of species have been described as endemic to Afghanistan, particularly in the genera Schizothorax and Noemacheilus but the systematics of these genera are poorly understood and the species may well prove ultimately to be synonymous with more widely distributed species. Bearing this in mind and the fact that some species have a wide distribution in southwest Asia, the fauna is about equally divided between Oriental and Palaearctic species. The fauna is dominated by Cyprinidae (56.9%), Cobitidae (24.5%) and to a lesser extent by Siluriformes (11.8%).

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(Breeding of white amur (*Ctenopharyngodon idella* [Val.]), silver carp (*Aristichthys nobilis* Rich.) and bighead *Hypophthalmichthys molitrix* (Val.) in the Amu-Darya basin). Vopr. Ikhtiol., 5: 593-599.

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Table 1. Distribution of fishes of Afghanistan and adjacent drainages

Drainage	Kabul	Chamkani-Kurram	Zhob-Gowmal	Pishin Lora	Helmand-Sistan	Hari-Tedzhen	Murgab	Amu Darya	Number of Drainages Per Species/Subspecies
Species									
1. Acipenser nudiventris	-	-	-	-	-	-	-	+	1
2. Pseudoscaphirhynchus hermanni	-	-	-	-	-	-	-	+	1
3. Pseudoscaphirhynchus kaufmanni	-	-	-	-	-	-	-	+	1
4. a. Salmo trutta aralensis	-	-	-	-	-	-	-	+	1
b. Salmo trutta oxianus	-	-	-	-	-	-	-	+	1
5. Alburnoides bipunctatus eichwaldi	-	-	-	-	-	+	+	+	3
6. Alburnoides taeniatus	-	-	-	-	-	-	-	+	1
7. Amblypharyngodon mola	+	-	-	-	-	-	-	-	1
8. Aspidoparia jaya	+	-	-	-	-	-	-	-	1
9. Aspidoparia morar	?	-	-	-	-	-	-	-	? 1
10. Aspiolucius esocinus	-	-	-	-	-	-	-	+	1
11. Aspius aspius taeniatus	-	-	-	-	-	-	-	+	1
12. Barbus brachycephalus	-	-	-	-	-	-	-	+	1
13. Barbus capito conocephalus	-	-	-	-	-	-	-	+	1
14. Barilius vagra	+	+	+	-	-	-	-	-	3

15. Capoeta capoeta heratensis*	-	-	-	-	+	+	+	+	4
16. Capoeta fusca*	-	-	-	-	-	-	-	-	1
17. Capoetobrama kuschakewitschi	-	-	-	-	-	-	-	+	1
18. Cirrhinus burnesiana	+	-	-	-	-	-	-	-	1
19. Cirrhinus reba	+	-	-	-	-	-	-	-	1
20. Crossocheilus latius diplocheilus	-	+	+	+	-	-	-	-	3
21. Cyprinion watsoni	-	+	+	+	+	-	-	-	4
22. Cyprinus carpio	-	-	-	-	-	+	+	+	3
23. Danio devario	+	-	-	-	-	-	-	-	1
24. Esomus danricus	+	-	-	-	-	-	-	-	1
25. Garra gotyla	-	-	+	-	-	-	-	-	1
26. Garra rossica	-	-	+	+	+	+	+	-	5
27. Gobio gobio lepidolaemus	-	-	-	-	-	+	+	+	3
28. Hemigarra elegans adiscus	-	-	-	-	+	-	-	-	1
29. Labeo angra	+	-	-	-	-	-	-	-	1
30. Labeo dero	+	-	-	-	-	-	-	-	1
31. Labeo diplostomus	+	-	-	-	-	-	-	-	1
32. Labeo dyocheilus	+	-	-	-	-	-	-	-	1
33. Labeo gonius	+	-	-	-	-	-	-	-	1
34. Labeo pangusia	+	-	-	-	-	-	-	-	1
35. Leuciscus latus	-	-	-	-	-	+	+	-	2

36. Leuciscus lehmanni	-	-	-	-	-	-	-	+	1
37. Leuciscus leuciscus kirgisorum	-	-	-	-	-	-	-	+	1
38. Pelecus cultratus	-	-	-	-	-	-	-	+	1
39. Ptychobarbus conirostris	?	-	-	-	-	-	-	?	? 1-2
40. Puntius conchonius	+	+	-	-	-	-	-	-	2
41. Puntius sarana	+	-	-	-	-	-	-	-	1
42. Puntius sophore	+	-	-	-	-	-	-	-	1
43. Rutilus rutilus bucharensis	-	-	-	-	-	-	-	+	1
44. Salmostoma bacaila	+	-	-	-	-	-	-	-	1
45. Schizocypris brucei	-	+	+	-	+	-	-	-	3
46. Schizocypris ladigesi	+	+	-	-	-	-	-	-	2
47. Schizopygopsis stoliczkae	-	-	-	-	+	-	-	+	2
48. Schizothorax anjac	-	-	-	-	+	-	-	-	1
49. Schizothorax barbatus	+	-	-	-	-	-	-	-	1
50. Schizothorax chrysochlora	+	+	-	-	-	-	-	-	2
51. Schizothorax edeniana	+	-	-	-	-	-	-	-	1
52. Schizothorax esocinus	+	-	-	-	+	-	-	-	2
53. Schizothorax gobioides	-	-	-	-	-	-	-	+	1
54. Schizothorax intermedius	+	-	-	-	+	-	-	+	3
55. Schizothorax labiatus	+	-	+	-	+	-	-	-	3
56. Schizothorax microcephalus	-	-	-	-	-	-	-	+	1

57. Schizothorax pelzami	–	–	–	–	–	+	+	–	2
58. Schizothorax plagiostomus	+	+	+	–	+	–	–	–	4
59. Schizothorax schumacheri	–	–	–	–	+	–	–	–	1
60. Schizothorax zarudnyi	–	–	–	–	+	–	–	–	1
61. Tor putitora	+	–	–	–	–	–	–	–	1
62. Tor zhobensis	–	–	+	–	–	–	–	–	1
63. Noemacheilus akhtari	–	–	–	–	+	–	–	–	1
64. Noemacheilus alepidotus	+	–	–	–	–	–	–	–	1
65. Noemacheilus amudarjensis	–	–	–	–	–	–	–	+	1
66. Noemacheilus baluchiorum	–	–	–	–	+	–	–	–	1
67. Noemacheilus boutanensis	–	–	–	–	+	–	–	–	1
68. Noemacheilus brahui	+	–	–	+	–	–	–	–	2
69. Noemacheilus choprai	+	–	–	–	–	–	–	–	1
70. Noemacheilus corica	–	+	–	–	–	–	–	–	1
71. Noemacheilus cristatus	–	–	+	–	+	+	+	–	4
72. Noemacheilus farwelli	–	–	–	–	+	–	–	–	1
73. Noemacheilus ghazniensis	–	–	–	–	+	–	–	–	1
74. a. Noemacheilus griffithi afghana	+	–	–	–	–	–	–	–	1
b. Noemacheilus griffithi griffithi	–	–	–	–	+	–	–	–	1
75. a. Noemacheilus kessleri kessleri	+	–	–	+	+	–	–	–	3
b. Noemacheilus kessleri turcomanus	–	–	–	–	–	–	+	–	1
76. Noemacheilus kullmani	–	–	–	–	+	–	–	–	1
77. Noemacheilus longicauda	–	–	–	–	–	+	+	+	3

78. Noemacheilus malapterurus	-	-	-	-	+	+	+	+	4
79. Noemacheilus oxianus	-	-	-	-	-	-	-	+	1
80. Noemacheilus pakistanicus	-	-	+	-	-	-	-	-	1
81. a. Noemacheilus prashari haarlovi	-	-	-	-	+	-	-	-	1
b. Noemacheilus prashari lindbergi	-	-	-	-	+	-	-	-	1
82. Noemacheilus rhadineus	-	-	+	-	+	+	+	-	4
83. Noemacheilus sargadensis paludani *	+	-	-	-	-	-	-	-	1
84. Noemacheilus stenurus choprai	+	-	-	-	-	-	-	-	1
85. Noemacheilus stoliczkai uranoscopus	+	-	-	-	+	-	-	+	3
86. Noemacheilus tenuis	-	-	-	-	+	-	+	+	3
87. Sabanajewia aurata	-	-	-	-	-	+	+	+	3
88. Mystus seenghala	+	-	-	-	-	-	-	-	1
89. Mystus tengala	+	-	-	-	-	-	-	-	1
90. Rita rita	+	-	-	-	-	-	-	-	1
91. Ompok bimaculatus	+	-	-	-	-	-	-	-	1
92. Ompok canio	+	-	-	-	-	-	-	-	1
93. Ompok pabda	+	-	+	-	-	-	-	-	2
94. Silurus glanis	-	-	-	-	-	-	+	+	2
95. Wallago attu	-	-	-	+	-	-	-	-	1
96. Glyptosternum akhtari	-	-	-	-	-	-	-	+	1
97. Glyptosternum reticulatum	+	-	-	-	-	-	-	+	2
98. Glyptothorax jalalensis	+	-	-	-	-	-	-	-	1

99.	Glyptotharax naziri	-	-	+	-	-	-	-	-	1
100.	Ophiocephalus gachua	+	-	-	-	-	-	-	-	1
101.	Ophiocephalus punctatus	+	-	-	-	-	-	-	-	1
102.	Mastacembelus armatus	-	-	+	-	-	-	-	-	1
	Number of species per drainage	44-45	9	15	6	27	12	15	32-33	
	Species per drainage as % of total ichthyofauna	27.7	5.6	9.3	3.7	16.7	7.4	9.3	20.4	

* Namaksar drainage of Iran and presumably Afghanistan. Subspecies not defined (see text for details)

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PLEASE POST

20 September 1988

Dear Colleague:

This letter solicits the following items for the second issue (1989) of the Newsletter of the Canadian Association of Ichthyologists:

1. Summary of current research (see example)
2. Papers published or in press 1988 (see example overleaf)
3. Travel plans including field work
4. Announcements and news, e.g. requests for help, forthcoming books, services available, meetings, new students, grants, scholarships and fellowships, concerns, trivia, etc.
5. Description of research units

The CAI is an informal organization whose primary goal is to improve communication among ichthyologists in Canada and those interested in Canadian fishes. There is no formal membership. Anyone may contribute information of interest.

Contributions will be re-typed in the language received (French or English). Deadline for submissions is 30 November 1988. Mailing is Christmas 1988.

I must emphasise that this Association is for all those interested in fishes and it is not devoted solely to taxonomy and systematics.

Note that the Canadian Conference for Fisheries Research (CCFFR) is meeting at Québec City on 4-5 January 1989.

Finally, can I ask for $2.⁰⁰ from any contributor or recipient to offset mailing costs?

Brian W. Coad

Brian W. Coad
Curator of Fishes

Example:

Williams, Robert R. G., Research Associate, Department of Zoology, The University of Alberta, Edmonton, Alberta T6G 2E9 (403) 432-4762

1) prepare manuscripts on the phylogenetic position of Lepidogalaxias salamandroides, and my hypothesis that the Esocoidei and Salmonidae form a clade

2) prepare sections of my Ph.D. Thesis, entitled "The Phylogenetic Relationships of the Salmoniform Fishes Based on the Suspensorium and its Muscles", for publication

3) continue work with Dr. Mark V. H. Wilson on the description of a new salmoniform fossil species from the Palaeocene of Alberta, and the description of the oldest known fossil salmonid, Eosalmo driftwoodensis, from the Eocene of British Columbia

4) attend ASIH in June in Ann Arbor, if funds permit

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S. V. P. AFFICHER

le 20 septembre 1988

Cher collègue:

Nous sollicitons les items suivants pour le prochain numéro (1989) du Bulletin de l'Association canadienne des ichtyologues:

1. Sommaire de votre recherche en cours (voir exemple)
2. Publications parues ou sous presse en 1988 (voir exemple)
3. Voyages prévus (études sur le terrain, conférences)
4. Annonces et nouvelles, e.g. demandes d'aide, livres à paraître, services disponibles, réunions, nouveaux étudiants, subventions, bourses, préoccupations, faits divers, etc.
5. Statut de la recherche ichtyologique dans votre institution

L'ACI est un organisme sans structure officielle dont le but principal est d'améliorer la communication entre les ichtyologues canadiens et ceux qui s'intéressent à notre ichtyofaune. Le bulletin de l'association accepte toutes les contributions.

Les contributions écrites seront redactylographiées en français ou en anglais telles que soumises. La date limite pour celles-ci est le 30 novembre 1988. Le bulletin sera publié vers la fin décembre 1988.

Je désire mettre l'accent sur le fait que cette association ne s'adresse pas uniquement aux taxinomistes et systématiciens. En fait, nous désirons regrouper toutes les personnes qui s'intéressent aux diverses disciplines de l'ichtyologie.

Veuillez noter que la réunion annuelle du Comité canadien de recherche sur les pêcheries (CCRP) se tiendra à Québec les 4 et 5 janvier 1989.

En terminant puis-je vous demander de contribuer 2.°°$ afin de défrayer les frais postaux associés avec l'envoi du bulletin.

Claude B. Renaud

Claude B. Renaud
conservateur adjoint des poissons

Exemple:
Chapleau, François, Post-doctorat, Sect. d'ichtyologie, Musée national des sciences naturelles, Ottawa, Ontario K1P 6P4 (613) 996-1755

1) rédaction de manuscrits sur la validité du statut monophylétique de la famille Soleidae et du sous-ordre Soleoidei (Pleuronectiformes) et analyse cladistique des relations phylogénétiques de l'ensemble des familles et sous-familles de poissons plats

2) Je serai présent à la réunion annuelle du CCRP à Ottawa (janvier 1988) et au meeting annuel de l'American Society of Ichthyologists and Herpetologists à Ann Arbor (juin 1988)

Chapleau, F. 1988. Comparative osteology and intergeneric relationships of the tongue soles (Pisces: Pleuronectiformes: Cynoglossidae). Journal canadien de zoologie 66: 1214-1232.

Recent Publications from the Ichthyology Section

The following items were not included in this mailing as only limited copies are available (on request). See also items in "On lampreys and fishes".

Chapleau, François. 1988. Comparative osteology and intergeneric relationships of the tongue soles (Pisces; Pleuronectiformes; Cynoglossidae). Canadian Journal of Zoology, 66:1214-1232.

Chapleau, François. 1988. Erratum: Comparative osteology and intergeneric relationships of the tongue soles (Pisces; Pleuronectiformes: Cynoglossidae). Canadian Journal of Zoology, 66:1903

Chapleau, François, Johansen, Peter H., and Williamson, Mark. 1988. The distinction between pattern and process in evolutionary biology: the use and abuse of the term "strategy". Oikos 53(1): 136-138.

Coad, Brian W. 1987. Review of "A Field Guide to Atlantic Coast Fishes of North America" by C. Richard Robins and G. Carleton Ray, illustrations by John Douglass and Rudolf Freund. 1986. Houghton Mifflin Company, Boston. xi + 354 pp. + 64 plates. U.S.$14.95. Canadian Field-Naturalist, 101(2):314-315.

Coad, Brian W. 1987. Review of "A Functional Biology of Sticklebacks" by R. J. Wootton. 1984. University of California Press, Berkeley and Los Angeles; Croom Helm, London and Sydney. 265 pp., illus. U.S.$29.75, £17.95. Canadian Field-Naturalist, 101(2):316-317.

Coad, B. W. 1987. Zoogeography of the Freshwater Fishes of Iran, p. 213-228, 1 figure, 2 tables. In: Krupp, Friedhelm, Schneider, Wolfgang and Kinzelbach, Ragnar (Eds.). Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East, Mainz, 1985. Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaften), 28, Dr. Ludwig Reichert Verlag, Wiesbaden, 338 pp.

Coad, Brian W. (Editor). 1988. Newsletter of the Canadian Association of Ichthyologists, Ottawa, 1:1-31, 1 figure.

Coad, Brian. 1988. Sucker run. Trail & Landscape, 22(2):66-68, 2 figures.

Coad, Brian W., McAllister, Don E. and Blouw, D. Max. 1988. Morphological diagnosis of the White Stickleback of Canada. Program and Abstracts, American Society of Ichthyologists and Herpetologists, 68th Annual Meeting, 24-29 June 1988, Ann Arbor, Michigan. p. 76 (abstract of poster presentation).

Coad, Brian W. 1988. Bass, p. 184-185, 1 figure (Volume I). In: The Canadian Encyclopedia. 2nd Edition, 4 volumes, xxxix + 2736 pp. Hurtig Publishers, Edmonton.

Coad, Brian W. 1988. Catfish, p. 378, (Volume I). In: The Canadian Encyclopedia. 2nd Edition, 4 volumes, xxxix + 2736 pp. Hurtig Publishers, Edmonton.

Coad, Brian W. 1988. Gar, p. 873 (Volume II). In: The Canadian Encyclopedia. 2nd Edition, 4 volumes, xxxix + 2736 pp. Hurtig Publishers, Edmonton.

Coad, Brian W. 1988. Minnow, p. 1364 (Volume II). In: The Canadian Encyclopedia. 2nd Edition, 4 volumes, xxxix + 2736 pp. Hurtig Publishers, Edmonton.

McAllister, Don E. 1988. Review of "Fishes of the North-eastern Atlantic and the Mediterranean, Volume II". Edited by P. J. P. Whitehead at al. UNESCO, Paris. Canadian Field-Naturalist, 101(4):646.

McAllister, Don E. 1988. Review of "The Inland Fishes of New York" by Clarence L. Smith. New York Department of Environmental Conservation, Albany. Canadian Field-Naturalist, 101(4):646-647.

McAllister, Don E. 1988. Review of "Smith's Sea Fishes" by M. M. Smith and P. C. Heemstra. Experimental Biology, 47:226.

McAllister, Don E. 1988. A glowing future for marine aquarium fishes.... the peaceful Philippine revolution under the seas. Tropical Fish Hobbyist, 36(12):84-86, 3 colour photographs.

McAllister, Don E. 1988. Sea Wind. Bulletin of the International Marinelife Alliance, Canada. Vols. 2(1), 2(2) and 2(3).

On lampreys and fishes:
a memorial anthology
in honor of Vadim D. Vladykov

Guest editors:
DON E. McALLISTER & EDWARD KOTT

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Contents

Environmental Biology of Fishes Vol. 23, No. 1–2, pp. 115–125, 1988

Aphanius vladykovi, a new species of tooth-carp from the Zagros Mountains of Iran (Osteichthyes: Cyprinodontidae)

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Key words: Orogenic events, Isolation, Pupfish, Taxonomy

Synopsis

A new species of tooth-carp, *Aphanius vladykovi,* is described from the Zagros Mountains of Iran. The new species is uniquely characterised by a high count of lateral line scales and by different pigmentation patterns from its closest, putative relative *A. sophiae.* It also possesses several meristic and morphometric differences with topotypic *A. sophiae.* It became separated from a common ancestor with *A. sophiae* by orogenic events which led to the formation of the Zagros Mountains and the isolation of the upper reaches of the Karun River basin by the development of *tangs,* narrow passes through the mountains with high water flow and steep gradient which prevent gene flow between lowland and mountain populations of these small fishes.

Introduction

The Cyprinodontidae are represented in Iran by four species. These are *Aphanius ginaonis* (Holly, 1929) restricted to a hot spring near Bandar Abbas at the Straits of Hormuz, *A. mento* (Heckel, 1843) which is found in the Tigris River basin in Iran, *A. dispar* (Rüppell, 1828) found in all the coastal drainages of the Persian Gulf and the Sea of Oman and in inland basins of Baluchestan, and *A. sophiae* (Heckel, 1849) found in the Tigris River basin, rivers draining to the northern Persian Gulf, and certain internal basins, namely the Kor River basin, the Lake Maharlu basin, possibly the Esfahan basin, and the Namak Lake basin (Coad 1987). This paper describes a fifth, new species from the Zagros Mountains in the upper reaches of the Karun River drainage which empties at the head of the Persian Gulf.

Materials and methods

Counts and measurements follow Hubbs & Lagler (1958). Gill raker counts are the total number of rakers on the first gill arch and fin ray counts are the total number of rays in each fin. Vertebrae counts include the hypural plate as one vertebra. Measurements which include the anterior end of the fish are to the snout tip, not the protruding lower jaw. Dorsal and anal fin lengths are from the fin origin to the posteriormost tip of the fins. Scale counts, except those in lateral series, are given as ranges only since scales are strongly embedded in places or overlain by thick skin in the new species and accurate counts are not possible without staining. Counts for these characters agree generally with those made on alizarin-stained material.

Abbreviations: SL = standard length; HL = head length; NMC = National Museum of Natural Sciences, National Museums of Canada, Ottawa;

NMW = Naturhistorisches Museum, Wien.

The specimens on which the description is based were as follows: Holotype: NMC 79-0247, male, 36.6 mm SL, Iran, Shahrestan-e Bakhtiari va Chahar Mahall, large pool, 3 km west of Boldaji, 31° 57′ N, 51° 01′ E, 9 June 1977, B.W. Coad and S. Mansoorabadi. Paratypes: NMC 79-0247A, 35 males 21.6–36.4 mm SL and 16 females 23.5–40.2 mm SL, same locality as holotype. NMC 79-0248, male, 30.3 mm SL, Iran, Shahrestan-e Bakhtiari va Chahar Mahall, stream, 3 km east of Boldaji, 31° 55′ N, 51° 05′ E, 9 June 1977, B.W. Coad and S. Mansoorabadi.

Comparative material: *Aphanius sophiae,* NMC 79-0025, female 31.6 mm SL, Iran, Fars, Kor River at Marv Dasht, 29° 51′ N, 52° 46′ 30″ E; NMC 79-0059, 19 males 18.1–39.3 mm SL and 11 females 24.5–31.9 mm SL, Iran, Fars, Pulvar River, 8 km south of Sivand, 30° 01′ 30″ N, 52° 57′ E, 18 April 1976, B.W. Coad and S. Coad; NMC 79-0061, 3 females 23.2–32.1 mm SL, Iran, Fars, stream tributary to Pulvar River, 14 km south of Sa'adatabad, 30° 04′ N, 53° 01′ E, 18 April 1976, B.W. Coad and S. Coad; NMC 79-0062, 2 males 24.0–26.6 mm SL and 4 females 26.5–42.0 mm SL, Iran, Fars, spring, 17 km south of Sa'adatabad, 30° 05′ N, 53° 00′ E, 18 April 1976, B.W. Coad and S. Coad; NMC 79-0067, male 25.7 mm SL, Iran, Fars, qanat at Zarqan, ~29° 46′ N, ~52° 43′ E, 27 April 1976, B.W. Coad and S. Coad; NMC 79-0292, 4 males 26.5–31.1 mm SL and 2 females 29.7–34.4 mm SL, Iran, Fars, Lapu'i spring near Zarqan, 29° 48′ N, 52° 39′ E, 30 June 1974, H. Assadi; NMC 79-0342, female 39.4 mm SL, Iran, Fars, Kor River at Band-e Amir, 29° 49′ N, 52° 51′ E, 22 November 1977, B.W. Coad; NMC 79-0498, 4 males 19.7–25.2 mm SL and 2 females 17.4–20.0 mm SL, Iran, Fars, spring in Kor River basin, 30° 05′ N, 52° 27′ E, 4 October 1978, B.W. Coad.

All the above material of *A. sophiae* is from the drainage basin of the Kor River, the type locality of this species. All specimens were counted and measured for Tables 1 to 3 except the smallest female in NMC 79-0498. The following material comprises part of an extensive type series of specimens and nominal species referred to *A. sophiae.* This material was in some instances decoloured and all the specimens had shrunk noticeably since they were catalogued in 1844 compared to relatively fresh material at hand from the type locality. Accordingly, although they were examined to confirm descriptions of this species they were not measured for inclusion in Tables 1 to 3.

Lebias sophiae (syntypes of *Aphanius sophiae*): NMW 60327 (8 specimens), 25.2–31.1 mm SL, Iran, Fars, 'Salzquellen v. Persepolis', Th. Kotschy; NMW 22616/623, (8), 26.1–29.0 mm SL, as above; NMW 75067 (7), 24.7–27.4 mm SL, Iran, Fars, 'Persepolis', Th. Kotschy; *Lebias crystallodon* (holotype and synonym of *A. sophiae*), NMW 15175, 40.1 mm SL, Iran, Fars, 'Nemek Deira [*sic*] bei Persepolis', Th. Kotschy; *Lebias punctatus* (syntypes and synonym of *A. sophiae*), NMW 15070 (5), 29.9–35.6 mm SL, Iran, Fars, 'Nemek Deira [*sic*] bei Persepolis', Th. Kotschy; NMW 59609 (6), 21.4–34.7 mm SL, as above; NMW 59837 (5), 26.6–35.7 mm SL, as above; NMW 15156 (14), 19.2–32.1 mm SL, Iran, Fars, 'Salzquellen von Persepolis', Th. Kotschy.

Taxonomy

Diagnosis

The new species is clearly distinguished from all other members of the genus *Aphanius* sensu stricto in Iran and the Middle East by the higher number of lateral line scales (36–47). Other members of the genus *Aphanius,* and the related *Kosswigichthys,* have 32, usually 30 scales or less in lateral series (Jenkins 1910, Berg 1949, Villwock 1964, Parenti 1981, Villwock et al. 1983, Tortonese 1986). Male colour on the dorsal fin is much darker and the anal fin is light compared to *A. sophiae,* the species which most closely resembles the new species. Females lack the typical large spot at the base of the caudal fin found in *A. sophiae.* There are also further differences in meristic and morphometric characters which are demonstrated statistically although ranges overlap.

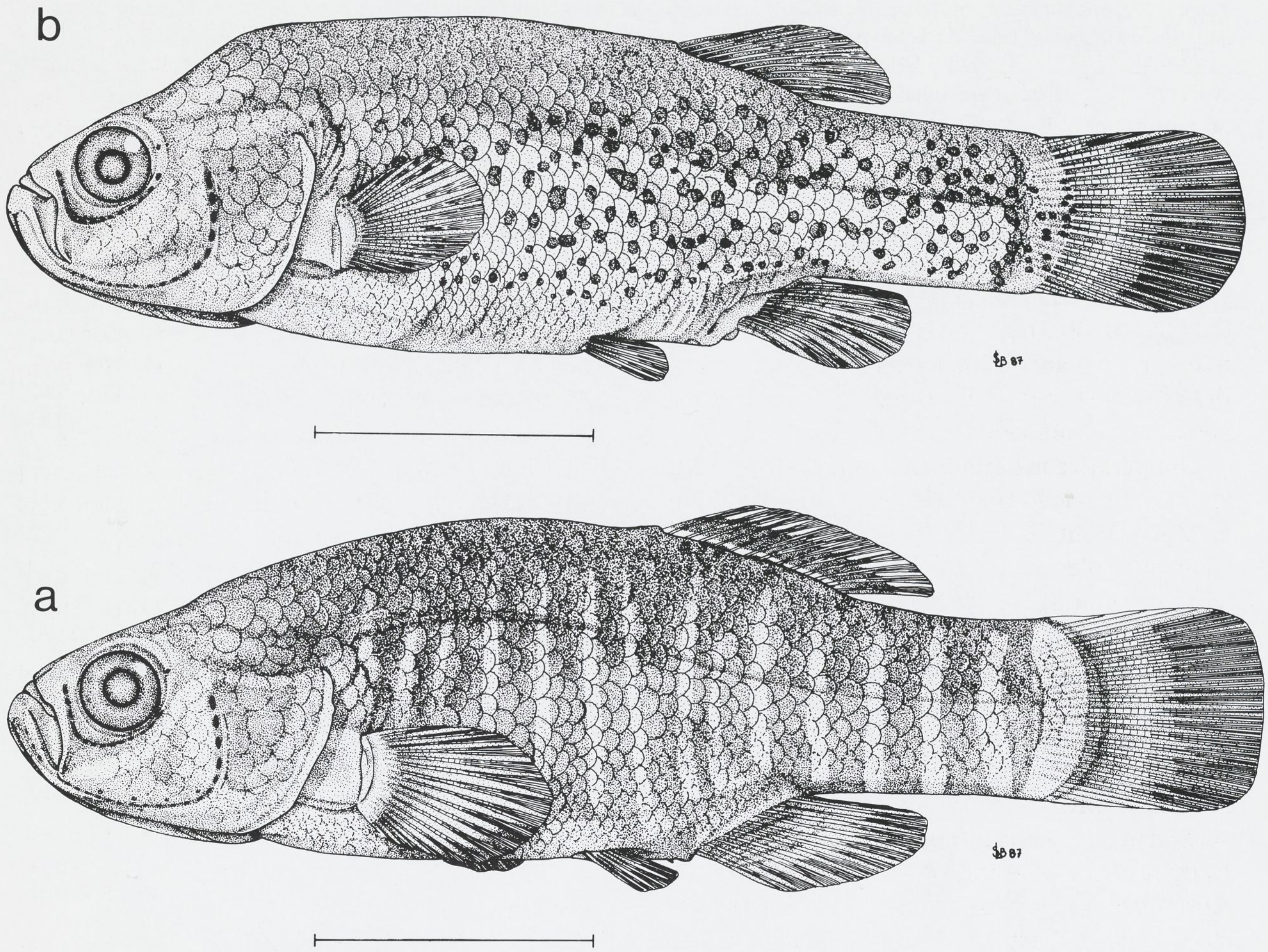

Fig. 1. Male (*a*) holotype of *Aphanius vladykovi* (NMC 79-0247), 36.6 mm SL and adult (*b*) female (NMC 79-0247A, 36.0 mm SL.

Description

The general shape of a male and a female *A. vladykovi* can be seen in Figure 1. Table 1 summarises meristic characters and Table 2 morphometric characters in *A. vladykovi,* and in *A. sophiae* the putative closest relative. Table 3 summarises differences between sexes within both these species and between sexes between both species. Eight of 10 meristic characters are significantly different between the two species and these apply equally to both sexes except for vertebral characters. Significant differences are found in 13 of 21 morphometric characters and these apply equally to both sexes except for the caudal peduncle character. There were no differences within *A. vladykovi* (or *A. sophiae*) between sexes for meristic characters. Sexual dimorphism in *A. vladykovi* was found in 10 of 21 morphometric characters and this was matched by *A. sophiae* with one addition (pelvic fin length in head length).

Scale rows around the caudal peduncle numbered 20–25 in *A. vladykovi* and 15–20 in *A. sophiae,* scales above the lateral line were 6–9 and 4–7 respectively, scales between the lateral line and the anal fin were 8–12 and 5–8 respectively and scales between the lateral line and the pelvic fin were 11–15 and 6–9 respectively. These figures indicate that scales are smaller and more numerous all over the body in the new species. Scales are regularly

Table 1. Meristic characters of *Aphanius vladykovi* and *A. sophiae* (n = number of specimens, x = mean, S.D. = standard deviation; underlined numbers = value for holotype).

Lateral line scales

		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	n	x	S.D.
A. vladykovi	♂	–	–	–	–	–	–	–	–	–	–	–	1	5	12	4	6	4	3	–	–	–	1	1	37	39.4	2.35
	♀	–	–	–	–	–	–	–	–	–	–	–	1	3	3	2	4	2	–	1	–	–	–	–	16	39.0	1.86
A. sophiae	♂	–	–	6	9	7	7	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	30	28.6	1.16
	♀	1	–	1	5	10	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	28.8	1.17

Total dorsal fin rays

		11	12	13	14	15	n	x	S.D.
A. vladykovi	♂	1	17	18	1	–	37	12.5	0.61
	♀	3	4	9	–	–	16	12.4	0.81
A. sophiae	♂	–	7	13	9	1	30	13.1	0.82
	♀	1	3	14	4	1	23	13.0	0.83

Total anal fin rays

		10	11	12	13	n	x	S.D.
A. vladykovi	♂	–	8	18	11	37	12.1	0.72
	♀	–	5	7	4	16	11.9	0.77
A. sophiae	♂	1	11	12	6	30	11.8	0.82
	♀	–	7	15	1	23	11.7	0.54

Total pectoral fin rays

		14	15	16	17	18	19	n	x	S.D.
A. vladykovi	♂	2	12	18	5	–	–	37	15.7	0.78
	♀	2	6	7	1	–	–	16	15.4	0.81
A. sophiae	♂	1	4	18	5	2	–	30	16.1	0.85
	♀	–	3	13	5	1	1	23	16.5	0.93

Total pelvic fin rays

		5	6	7	8	n	x	S.D.
A. vladykovi	♂	6	30	–	1	37	5.9	0.52
	♀	3	12	1	–	16	5.9	0.50
A. sophiae	♂	4	26	–	–	30	5.9	0.35
	♀	5	18	–	–	23	5.8	0.42

Total gill rakers

		10	11	12	13	n	x	S.D.
A. vladykovi	♂	7	27	3	–	37	10.9	0.52
	♀	1	14	1	–	16	11.0	0.37
A. sophiae	♂	1	18	9	2	30	11.4	0.68
	♀	1	20	12	–	23	11.5	0.59

Total vertebrae

		27	28	29	30	n	x	S.D.
A. vladykovi	♂	2	15	19	1	37	28.5	0.65
	♀	–	9	7	–	16	28.4	0.51
A. sophiae	♂	3	21	6	–	30	28.1	0.55
	♀	5	8	10	–	23	28.2	0.80

Precaudal vertebrae

		10	11	12	13	n	x	S.D.
A. vladykovi	♂	1	5	23	8	37	12.0	0.69
	♀	–	–	13	3	16	12.2	0.40
A. sophiae	♂	–	7	19	4	30	11.9	0.60
	♀	–	4	18	1	23	11.9	0.46

Table 1. Continued.

		Caudal vertebrae 15	16	17	n	x	S.D.
A. vladykovi	♂	1	17	19	37	16.5	0.56
	♀	–	12	4	16	16.3	0.45
A. sophiae	♂	2	20	8	30	16.2	0.55
	♀	1	13	9	23	16.3	0.57

	Male flank bars 9	10	11	12	13	14	15	16	17	18	19	20	21	n	x	S.D.
A. vladykovi	3	8	8	10	3	5	–	–	–	–	–	–	–	37	11.5	1.48
A. sophiae	–	4	1	2	3	5	4	6	3	1	–	–	1	30	14.3	2.63

Table 2. Morphometrics for *Aphanius vladykovi* and *A. sophiae* (values for male holotype included in total male values).

			Holotype	Number	Range	Mean	Standard deviation
Standard length / Head length	*A. vladykovi*	♂	3.1	37	3.0–3.5	3.2	0.10
		♀		16	3.0–3.5	3.3	0.13
	A. sophiae	♂		30	3.2–3.6	3.5	0.11
		♀		23	3.2–4.0	3.6	0.18
Standard length / Predorsal length	*A. vladykovi*	♂	1.5	37	1.5–1.6	1.5	0.04
		♀		16	1.5–1.6	1.5	0.05
	A. sophiae	♂		30	1.6–1.8	1.7	0.05
		♀		23	1.6–1.7	1.7	0.05
Standard length / Prepelvic length	*A. vladykovi*	♂	1.8	37	1.7–1.9	1.8	0.05
		♀		16	1.7–1.9	1.8	0.05
	A. sophiae	♂		30	1.8–2.0	1.9	0.07
		♀		23	1.7–2.0	1.9	0.09
Standard length / Preanal length	*A. vladykovi*	♂	1.5	37	1.4–1.6	1.5	0.02
		♀		16	1.4–1.5	1.5	0.04
	A. sophiae	♂		30	1.5–1.6	1.5	0.04
		♀		23	1.4–1.5	1.5	0.04
Standard length / Body depth	*A. vladykovi*	♂	3.0	37	2.8–3.4	3.0	0.16
		♀		16	3.0–3.3	3.1	0.11
	A. sophiae	♂		30	2.7–3.9	3.2	0.25
		♀		23	3.0–3.9	3.4	0.23
Standard length / Head depth	*A. vladykovi*	♂	3.8	37	3.5–4.3	3.9	0.16
		♀		16	3.7–4.2	4.0	0.14
	A. sophiae	♂		30	3.7–4.4	4.1	0.18
		♀		23	3.9–4.7	4.3	0.23
Head length / Head width	*A. vladykovi*	♂	1.6	37	1.4–1.6	1.5	0.07
		♀		16	1.4–1.5	1.5	0.05
	A. sophiae	♂		30	1.4–1.7	1.5	0.07
		♀		23	1.2–1.7	1.5	0.11

Table 2. (Continued).

			Holotype	Number	Range	Mean	Standard deviation
Head length / Head depth	*A. vladykovi*	♂	1.2	37	1.1–1.3	1.2	0.05
		♀		16	1.2–1.3	1.2	0.04
	A. sophiae	♂		30	1.1–1.3	1.2	0.05
		♀		23	1.1–1.3	1.2	0.07
Head length / Orbit diameter	*A. vladykovi*	♂	3.6	37	2.7–3.6	3.2	0.22
		♀		16	2.8–3.9	3.2	0.29
	A. sophiae	♂		30	2.9–3.6	3.2	0.18
		♀		16	2.8–3.6	3.2	0.19
Head length / Snout length	*A. vladykovi*	♂	3.6	37	3.4–4.2	3.9	0.23
		♀		16	3.3–4.1	3.9	0.23
	A. sophiae	♂		30	3.6–4.2	3.9	0.18
		♀		16	3.2–4.2	3.8	0.26
Head length / Interorbital width	*A. vladykovi*	♂	2.5	37	2.2–2.8	2.5	0.13
		♀		16	2.3–2.8	2.5	0.15
	A. sophiae	♂		30	2.2–2.7	2.5	0.14
		♀		23	2.3–2.7	2.5	0.13
Head length / Postorbital length	*A. vladykovi*	♂	2.0	37	1.9–2.3	2.1	0.10
		♀		16	1.9–2.3	2.1	0.12
	A. sophiae	♂		30	2.0–2.4	2.2	0.11
		♀		23	2.0–2.3	2.2	0.08
Head length / Mouth width	*A. vladykovi*	♂	3.2	37	2.7–3.6	3.2	0.21
		♀		16	2.8–3.4	3.1	0.19
	A. sophiae	♂		30	2.8–3.6	3.2	0.19
		♀		23	2.8–3.5	3.2	0.19
Head length / Dorsal fin length	*A. vladykovi*	♂	1.2	37	1.1–1.4	1.2	0.07
		♀		16	1.3–1.6	1.4	0.09
	A. sophiae	♂		30	0.9–1.2	1.0	0.08
		♀		23	1.0–1.4	1.2	0.12
Head length / Anal fin length	*A. vladykovi*	♂	1.5	37	1.3–1.7	1.5	0.08
		♀		16	1.4–1.8	1.6	0.12
	A. sophiae	♂		30	1.1–1.5	1.3	0.09
		♀		23	1.3–1.6	1.4	0.12
Head length / Pectoral fin length	*A. vladykovi*	♂	1.7	37	1.6–1.9	1.8	0.09
		♀		16	1.8–2.3	1.9	0.13
	A. sophiae	♂		30	1.5–1.8	1.6	0.09
		♀		23	1.4–2.0	1.7	0.08
Head length / Pelvic fin length	*A. vladykovi*	♂	4.1	37	3.5–5.5	4.2	0.42
		♀		16	3.3–5.5	4.3	0.58
	A. sophiae	♂		30	2.5–3.5	2.9	0.24
		♀		23	2.7–3.7	3.2	0.34
Dorsal fin length / Anal fin length	*A. vladykovi*	♂	1.3	37	1.1–1.3	1.2	0.07
		♀		16	1.0–1.3	1.1	0.09
	A. sophiae	♂		30	1.1–1.4	1.3	0.08
		♀		23	1.0–1.4	1.2	0.11

Table 2. (Continued).

			Holotype	Number	Range	Mean	Standard deviation
Pectoral-pelvic fin distance / Pectoral fin length	*A. vladykovi*	♂	1.3	37	1.1–1.5	1.3	0.09
		♀		16	1.4–2.0	1.6	0.14
	A. sophiae	♂		30	1.1–1.6	1.3	0.09
		♀		23	1.1–2.0	1.5	0.21
Pelvic-anal fin distance / Pelvic fin length	*A. vladykovi*	♂	1.3	37	1.3–2.4	1.7	0.24
		♀		16	1.5–2.8	2.0	0.32
	A. sophiae	♂		30	1.1–1.7	1.4	0.15
		♀		23	1.3–2.0	1.6	0.14
Caudal peduncle length / Caudal peduncle depth	*A. vladykovi*	♂	1.3	37	1.2–1.5	1.3	0.09
		♀		16	1.4–1.6	1.4	0.07
	A. sophiae	♂		30	1.2–1.6	1.3	0.13
		♀		23	1.4–1.8	1.5	0.11

Table 3. Meristic and morphometric differences within and between male and female *A. vladykovi* and *A. sophiae* (p at left is significance probability for differences between male and female *A. vladykovi;* p at right is the same for *A. sophiae;* central p values are between species for the same sex).

Character	*A. vladykovi*			*A. sophiae*
Lateral line scales	♂	$p>0.05$	$p<0.001$	$p>0.05$
	♀		$p<0.001$	
Total dorsal fin rays	♂	$p>0.05$	$p<0.01$	$p>0.05$
	♀		$p<0.05$	
Total anal fin rays	♂	$p>0.05$	$p>0.05$	$p>0.05$
	♀		$p>0.05$	
Total pectoral fin rays	♂	$p>0.05$	$p<0.05$	$p>0.05$
	♀		$p<0.01$	
Total pelvic fin rays	♂	$p>0.05$	$p>0.05$	$p>0.05$
	♀		$p>0.05$	
Total gill rakers	♂	$p>0.05$	$p<0.01$	$p>0.05$
	♀		$p<0.01$	
Total vertebrae	♂	$p>0.05$	$p<0.01$	$p>0.05$
	♀		$p>0.05$	
Precaudal vertebrae	♂	$p>0.05$	$p>0.05$	$p>0.05$
	♀		$p<0.05$	
Caudal vertebrae	♂	$p>0.05$	$p<0.05$	$p>0.05$
	♀		$p>0.05$	
Male flank bars			$p<0.001$	
Standard length / Head length	♂	$p<0.01$	$p<0.001$	$p<0.02$
	♀		$p<0.001$	
Standard length / Predorsal length	♂	$p>0.05$	$p<0.001$	$p>0.05$
	♀		$p<0.001$	
Standard length / Prepelvic length	♂	$p>0.05$	$p<0.001$	$p>0.05$
	♀		$p<0.001$	
Standard length / Preanal length	♂	$p>0.05$	$p>0.05$	$p>0.05$
	♀		$p>0.05$	
Standard length / Body depth	♂	$p<0.05$	$p<0.001$	$p<0.01$
	♀		$p<0.001$	

Table 3. (Continued).

Character	*A. vladykovi*		*A. sophiae*	
Standard length	♂	p<0.05	p<0.001	p<0.001
Head depth	♀		p<0.001	
Head length	♂	p>0.05	p>0.05	p>0.05
Head width	♀		p>0.05	
Head length	♂	p>0.05	p>0.05	p>0.05
Head depth	♀		p>0.05	
Head length	♂	p>0.05	p>0.05	p>0.05
Orbit diameter	♀		p>0.05	
Head length	♂	p>0.05	p>0.05	p>0.05
Snout length	♀		p>0.05	
Head length	♂	p>0.05	p>0.05	p>0.05
Interorbital width	♀		p>0.05	
Head length	♂	p>0.05	p<0.001	p>0.05
Postorbital length	♀		p<0.02	
Head length	♂	p>0.05	p>0.05	p>0.05
Mouth width	♀		p>0.05	
Head length	♂	p<0.001	p<0.001	p<0.001
Dorsal fin length	♀		p<0.001	
Head length	♂	p<0.001	p<0.001	p<0.001
Anal fin length	♀		p<0.001	
Head length	♂	p<0.01	p<0.001	p<0.01
Pectoral fin length	♀		p<0.001	
Head length	♂	p>0.05	p<0.001	p<0.001
Pelvic fin length	♀		p<0.001	
Dorsal fin length	♂	p<0.001	p<0.001	p<0.001
Anal fin length	♀		p<0.01	
Pectoral-pelvic fin distance	♂	p<0.001	p>0.05	p<0.001
Pectoral fin length	♀		p>0.05	
Pelvic-anal fin distance	♂	p<0.001	p<0.001	p<0.001
Pelvic fin length	♀		p<0.001	
Caudal peduncle length	♂	p<0.001	p>0.05	p<0.001
Caudal peduncle depth	♀		p<0.01	

arranged over the body, embedded and each scale overlaps adjacent scales. Anterior flank scales are a vertical oval with circuli and radii restricted to the posterior field. Numbers of circuli and radii are body and scale size dependent and so are fewer in *A. vladykovi* than in *A. sophiae* of comparable body size. Teeth are found in both jaws of the superior mouth in a single row and are tricuspid. Teeth are hyaline or discoloured with brown in patches. Detailed tooth counts were not made as this character varies widely and may be size dependent. There are up to 21 teeth in the upper jaw of *A. vladykovi.* Gill rakers are short, just reaching the base of the adjacent raker when adpressed to the gill arch. All fins are rounded distally. The origin of the anal fin is enclosed by a fleshy sheath which is most apparent in large females but is also present in males. The peritoneum is dark brown and the gut has a single large loop.

The cephalic sensory pores are reduced to a series of neuromasts in both *A. vladykovi* and *A. sophiae.* Live adult males bear creamy bars on yellowish flanks. The pelvic fins and the edge of the caudal fin are yellow, the anal fin has an orange-yellow edge and the pectoral fins are orange-yellow. The dorsal fin is white with a wide blue-black band in the centre and a narrow blue-black band at the base. In some males the basal band is absent.

Live adult females have a slight bluish tinge to their flanks and flank spots are brown. Pigmentation in preserved specimens is as follows. The dorsal fin bands are dark and remain darker in preservative than the pigmentation seen in male *A. sophiae* which is more diffuse, tending to several horizontal rows of speckles, and which is not formed into a strongly distinct band or bands. Other fins are lightly pigmented being finely speckled with melanophores with the dorsal and pectoral fins the darkest. The anal fin is fleshy and not hyaline but pigmentation is light and not dark as in *A. sophiae.* There is some tendency to formation of one or two narrow bars on the anal fin, paralleling the base, but these are weakly developed or absent in most fish. A mid-dorsal stripe is not apparent, perhaps because the dorsal flanks and the back are darker than in females. Flank bars are light alternating with darker and broader bars. The lighter bars become broader posteriorly. There is a light, wide bar at the base of the tail which was not included in counts in Table 1. The sides of the head and upper and lower jaws are pigmented with scattered melanophores while the underside of the head is not. The belly is also free of extensive melanophores. The most characteristic feature of females is the large number of scattered spots on the flank, extending from behind the head to the base of the tail. These spots do not extend to the dorsal flank or the back. The distinctive, large and often lozenge-shaped spot on the central caudal base of *A. sophiae* females is absent from the new species. The upper flank and the back are more heavily pigmented than the flanks (except for the flank spots). The lower surface of the head and the belly are melanophore free as in males and the sides of the head and the upper and lower jaws are heavily pigmented. The dorsal fin is finely pigmented on the rays and membranes and is generally darker than the caudal fin which is also finely pigmented. The other fins have very little pigment but all are fleshy and therefore not hyaline. There is some suggestion of a thin horizontal stripe near the base of the dorsal fin in the largest specimens but this is never well developed.

Zoogeography

Fosssil cyprinodonts have been described from the Oligocene of the Paris basin and the early Tertiary of the Aral Sea when this vast area was occupied by the Tethys Sea (Kosswig 1967, Parenti 1981) and Priem (1908) has described a cyprinodont from the Miocene of Iran. Kosswig (1955) regards *Aphanius* in the Middle East as relicts of the Tethys. The mountain populations of *A. vladykovi* and *A. sophiae* in Iran may well have risen with the post-Pliocene uplift of the Zagros Mountains. *Aphanius* species are small fishes with a low dispersal ability (Kosswig 1967) and it is here considered unlikely that the ancestor of *A. vladykovi* dispersed from lowland populations into an existing, high range of mountains represented today by the Zagros.

Oberlander (1965) has carried out an extensive study on the origin of the Zagros drainage patterns. Streams do not follow the line of least resistance but often incise the higher part of mountain ridges which are anticlines composed of the Oligocene-Miocene Asmari Limestone. This situation arises because the rising Zagros ridges were eroded by a superposed drainage pattern already antecedent to the exhumation of overlying sediments of later Miocene marls and evaporites. The trend of the Zagros ridges is in a NW-SE direction and streams often cross this direction at right angles. This has resulted in the development of *tangs,* narrow clefts in the Zagros ridges with very swift waters, which may be up to 2400 metres deep with vertical sides rising from the water surface to over 300 metres. *A. vladykovi* is found in the uppermost reaches of the Karun River basin which drains to the head of the Persian Gulf and is a tributary of the Tigris-Euphrates basin. In this locality it is isolated above a series of *tangs* which effectively block gene flow between *A. vladykovi* and lowland populations of other *Aphanius* species including those referred to *A. sophiae.*

Relationships

The closest relative of *A. vladykovi* is apparently *A. sophiae*. This conclusion is based on preliminary

Fig. 2. Type locality of *Aphanius vladykovi.*

studies of a number of populations of *Aphanius* species in Iran and because of the observations of Parenti (1981). She has distinguished derived members of the genus *Aphanius* as *'Aphanius'*, without formally designating a new genus. One of the distinguishing features of *'Aphanius'* is that cephalic sensory pores are reduced to neuromasts, a character observed by Parenti for *A. mento,* which is also found in *A. vladykovi* and *A. sophiae*. Particular differences are found between these three species in pigmentation patterns. *A. vladykovi* and *A. sophiae* are distinct but the presence of male flank bars and female flank spots are shared between the two species in contrast to other Iranian *Aphanius*. *A. mento* males have silvery-speckled fins and body (see Goren & Rychwalski 1978, Coad 1980, Krupp 1983 and Villwock et al. 1983 for illustrations and descriptions).

The high number of scales found in *A. vladykovi* is only matched by some populations of species in the genus *Anatolichthys* Kosswig and Sozer, 1945. This genus is restricted to four localities in southwestern Anatolia (Kosswig 1964) and has been synonymised with *Kosswigichthys* Sozer, 1942 (Parenti 1981) or *Aphanius* Nardo, 1827 (Villwock 1982). *'Anatolichthys'* populations are polymorphic for scale counts which reach as high as 55 through reduction in scale size. Some high scale count populations are in unusually bitter, salty lakes to which they have, perhaps, become adapted, although the adaptation is believed to be physiological with high scale counts incidental (Kosswig 1961, Villwock 1964, 1970). The high scale count of *A. vladykovi* is not due to an unusual reduction in scale size and this new species does not show loss of scales and an individual variability in scale size which are remarkable features of *'Anatolichthys'* (see Villwock 1964: Fig. 8, 1984: Fig. 1, 10). The new species from Iran is isolated from other populations of *Aphanius* sensu lato, particularly those of southwest Anatolia, and is not in water of an unusual chemical composition.

Habitat

The type locality lies at an altitude of ~2380 metres on a small plain between high ranges at the easternmost edge of the Zagros Mountains (Fig. 2). The Kuh-e Kukalar range to the southwest reaches 4298 metres. The type locality was a large pool, artificially dammed, in the upper reaches of the Karun River basin which drains to the head of the Persian Gulf. Pool width was estimated at 300 metres and specimens were captured in shallow water at about 40 cm depth. The pool was composed of fresh water which was cloudy over a bottom of mud and pebbles. The shore was grassy and the pool contained large amounts of *Myriophyllum* and marginal rushes. At 1515 hours on a warm, windy and sunny day, water temperature was 29° C, pH was 6.5 and conductivity 0.2 millimhos. The second locality was slightly lower in altitude and was a mud-bottomed stream 3–4 metres wide with pools up to 1 metre deep. At 1545 hours water temperature was 22° C, pH was 6.2 and conductivity was 0.45 millimhos. Current was slow and the stream had moderate amounts of *Myriophyllum*. The stream banks lacked bushes or trees.

Etymology

The new species is named for the late Professor V.D. Vladykov who worked in Iran on the fisheries of the Caspian Sea basin, collected extensive material there and accepted the author as his graduate student to study those specimens.

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Vadim had a keen eye for taxonomic characters and women! At the 1974 ASIH meeting, sponsored by the National Museum of Natural Sciences, Ottawa, V.D. Vladykov to the right of Brian and Sylvie Coad.

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Shark attacks in the rivers of southern Iran

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Synopsis

The literature on shark attacks in freshwaters of southern Iran is reviewed and 11 attacks with 3 fatalities recorded from local informants for the period 1953 to 1985. The species of shark responsible is probably the bull shark, *Carcharhinus leucas,* whose presence in the Tigris River is confirmed by preserved specimens in the British Museum (Natural History). The Iranian records represent a significant proportion (~28%) of the documented cases world-wide for unprovoked, freshwater attacks.

Introduction

Records of sharks in rivers draining to the head of the Persian Gulf may be traced in the Arabic work 'Wonders of Creation' by Zakariya al-Qazwini published in 1263 A.D. and later translated into Persian. These fishes were reported from Basrah on the Tigris River and were formidable because of their voracity and teeth like the points of spears, swords or saws. Günther (1874) gave the first modern report of freshwater sharks, at Baghdad on the Tigris about 850 river km from the sea. Kennedy (1937), Khalaf (1961), Mahdi (1962) and Al-Daham (1976) confirm the presence of sharks far inland and Kennedy comments that, although less frequent at Baghdad than at Basrah nearer the mouth of the Tigris River, they were reported there every year.

Iranian reports of sharks are confirmed to brief mentions by Sykes (1902) and Blegvad & Loppenthin (1944) and to a more extensive article by Hunt (1951). Sykes (1902) saw sharks in the Ab-e-Gargar at Shushtar and said that men, women, children, horses and sheep were attacked and only the massive water buffalo was safe. Blegvad & Loppenthin (1944) noted that every year several people, especially children, fell victim to these sharks. Hunt (1951) was a member of the Royal Army Medical Corps, stationed at Ahvaz on the Karun River during the Second World War. He reported 13 cases of shark attack of which 12 died from their injuries. A further 10 cases were reported on from the Karun River, Khowr-e Bahmanshir and Shatt-al-Arab with 2 deaths. Many minor cases were probably not reported and the high mortality rate was attributed to the victims being mostly young children or old people either undernourished or feeble and to slow transport to medical facilities under the devastating summer heat on the Khuzestan plains. Size estimates for the sharks ranged up to about 2 metres and they were said to invade the Khowr-e Bahmanshir and the Karun River from July to September when freshwater flow was at a minimum and tidal penetration of salt water at its highest. Victims were paddling, swimming, bathing, washing vehicles or fishing. These records have been partly summarised in the International Shark Attack File which is now maintained at the National Underwater Accident Data Center, University of Rhode Island, Kingston, R.I. However this File has been without funds for gathering foreign data for many years and has no post-1960 freshwater records from Iran (John J. McAniff, in litt. 1986).

New records

In this note we report on attacks from 1953 to 1985. Information from local people indicates that attacks are common and occur every year although perhaps less frequently than in the past as direct use of the rivers for water supplies has declined. Local legend has it that attacks have decreased since shark oil is no longer used to caulk boats but this must rank with Blegvad & Loppenthin's (1944) report that sharks at Khorramshahr station gather under palm trees in order to eat the falling dates! Since the start of the Iran-Iraq war a number of soldiers have fallen victim to sharks but we have no details on these attacks.

The documented attacks are as follows. In April 1953 Mr. Nasser Seemrookh and Mr. Kaaby both lost an arm to sharks in the Karun River near Ahvaz but survived. Ahvaz is about 275 river km from the sea. The shark was estimated to be about 1.5 metres long and was grey in colour. Mr. Seemrookh was swimming in mid-river and the attack took place about 200 metres from a sewage outlet and about 400 metres from a slaughter-house. Mr. Seemrookh lost his right arm (and wrist-watch!) from the elbow downwards. In 1954 Mr. Kasem Jasem was attacked in the Karun River in the Hesamabad area of Shushtar and died shortly thereafter. Shushtar is about 420 river km from the sea. His son Abbas was attacked at the same place on the same day but survived to give this report. A girl was fatally attacked in a village a short distance from Hesamabad on the same day. These three incidents may be attributable to the same shark. In 1957 a Mr. Falah was attacked in Hesamabad but survived to report this incident. Also in 1957, a Mr. Paniry was attacked near Band Misan in Shushtar and survived. Mr. Kalantar and Mr. Nagib were attacked in Ahvaz in 1971 and survived. An undated report of an incident in Ahvaz resulted in the loss of a foot for Mr. Jabar-Kaaby. In 1985 a fisherman was attacked at Ramin near Ahvaz and was dead when pulled from the water. Attacks are also reported as a regular occurrence in modern times in the Khowr-e Bahmanshir. The victims were mostly swimming, their clothing was black, grey, white and in one case red, and attacks occurred in bright daylight, in moderate current and at relatively cool water temperatures. These rivers are turbid with very low water visibility. The circumstances surrounding each attack are fragmentary and no particular pattern can be discerned. A total of 11 attacks with 3 fatalities are verified for the period 1953–1985 and doubtless more occurred which were not reported or were not found in our local enquiries. The earlier records bring the total to 34 attacks with 17 fatalities. These notes indicate that shark attacks are a continuing problem in the rivers of southern Iran.

Discussion

The sharks are probably bull sharks, *Carcharhinus leucas* (Valenciennes in Müller and Henle, 1839). Garrick (1982) revised the genus *Carcharhinus* and examined the head of a specimen from Al Karradah near Baghdad which proved to be this species and one of us (BWC) has seen this specimen in the British Museum (Natural History), London (BM (NH)) where it bears the annotation that the fish was 1.25 metres long. A second whole specimen of this species, also from Baghdad, was 82 cm total length. Bull sharks are common in all tropical and subtropical seas and are known to travel far up rivers and into lakes including the Mississippi River, Lake Nicaragua and the Amazon River in the Americas, the Zambezi and Limpopo rivers of Africa, and the Hooghly river of India, Lake Jamoer of New Guinea and rivers and lakes of Australia. Compagno (1984) reports that bull sharks appear heavy and slow but are quick and agile when attacking prey. He believes that this species may well be the most dangerous tropical shark and

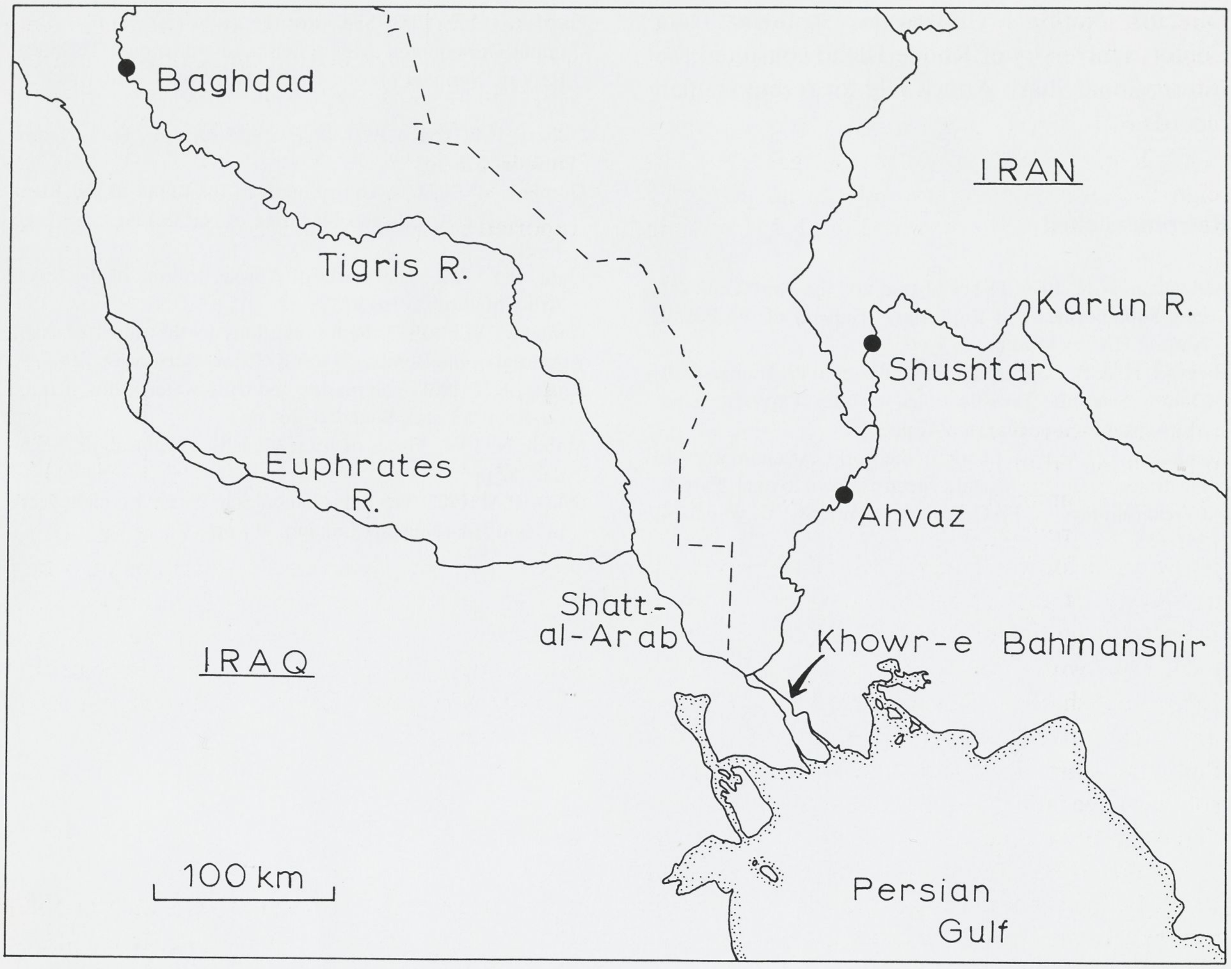

Fig. 1. Simplified drainage map of the rivers draining to the head of the Persian Gulf with shark attack localities.

the frequency of reported attacks in southern Iran bears this out.

Schultz and Malin in Gilbert (1963) summarise shark attacks for the world based on a documented file in the Division of Fishes of the United States National Museum. Unprovoked shark attacks in freshwater numbered less than 100 for the period 1837–1961 excluding Iranian records (a more accurate count is not possible because reports from several countries are vague as to numbers; 41 cases are from Australia where reports are best documented). Iranian records, numbering 34 in total from 1941–1985, are therefore a significant proportion (~28%) of reported freshwater attacks worldwide. In Iran half the attacks were fatal while for Australia about 60% were fatal.

Material examined

Carcharhinus leucas: BM(NH) 1874.4.28:9, Tigris River near Baghdad; BM(NH) 1924.10.1:1 (head only), Al Karradah on Tigris River near Baghdad.

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We are grateful to our various informants who relived the unfortunate circumstances surrounding shark attacks on themselves and their relatives. BWC is grateful for the opportunity to examine material housed in the Fish Section of the British Museum (Natural History) through the hospitality of K. Banister and A. Wheeler. John J. McAniff,

Director, National Underwater Accident Data Center, University of Rhode Island consulted the International Shark Attack File for recent Iranian records.

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A bibliography on the freshwater fishes of southwest Asia

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This bibliography reflects my current interests on the systematics of freshwater fishes of southwest Asia. Coverage of systematic works is therefore extensive but the numerous works on fisheries or "ecology" of southern Russian republics have not been included exhaustively. However, there are few works on the biology of fishes over much of southwest Asia and the bulk of recorded literature is systematic papers. Some papers on fish parasites, the aquatic environment, pollution, hydrology, geology, climate and past environments are also included but these were not searched for specifically.

The area of coverage is Afghanistan, Pakistan west of and not including the Indus River drainage, Iran, Iraq, Syria, the Arabian Peninsula, the Levant, Anatolian Turkey, Cyprus, the Greek islands along the coast of Turkey such as Rhodes, and the southern areas of the U.S.S.R. south of the Caucasus mountains (Azarbaidzhan, Armenia, Georgia) and south of the Kara Kum (Turkmenistan). The southern Caspian Sea south of a line from Baku to Krasnovodsk is also included. Relevant papers from adjacent areas are cited.

Zoological Record forms the source for most systematic works included here.

Additions and corrections are welcomed.

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Your reference

Our reference

Date 9th February 1982

Dear Dr Coad,

Many thanks indeed for the package of reprints. I was particularly interested in your new 'Pseudophoxinus' and now, also we have the two specimens you sent.

I have just returned from a short departure into catfishes, to cyprinids, and particularly to the phoxiniid group. I have prepared a short paper on a revised synonymy of Phoxinus wherein I treat Phoxinellus, Pseudophoxinus etc as synonyms of Phoxinus (they all have the same set of synapomorphies). Of course not all species presently included in Phoxinus belong there, and many genera presently included in the synonymy of Phoxinus are valid.

Soon, I hope to send you a reprint of a paper on the anatomy of the genus Cyprinion. I am afraid Berg etc have been wrong in their synonymies of C. watsoni, C. microphthalmum and C. milesi are 'good' taxa and have quite different jaw structure from that of C. watsoni. Thus, I would support Mirza's conclusions (ref. p. 10 in your check-list of the Fishes of Afghanistan).

- Mirza changed mind
Therefore 3 → 2 sp
Kerman - sp
2 mm only
C. watsoni.

With all good wishes,

Yours sincerely,

Gordon Howes

Gordon Howes
Freshwater Fish Section

- quick . Mer
review - ref.
not all cits

REDESCRIPTION OF *BARILIUS MESOPOTAMICUS* BERG, 1932
A POORLY KNOWN CYPRINID FISH
FROM THE TIGRIS-EUPHRATES BASIN

by

Brian W. COAD (1) and Friedhelm KRUPP (2)

ABSTRACT.– The cyprinid fish *Barilius mesopotamicus* Berg, 1932 based on a single specimen, is redescribed from 259 specimens from Turkey, Syria, Iraq and Iran. This species is endemic to the present Tigris-Euphrates basin but is also found in a probable Pleistocene tributary of this basin, the Dalaki River of Iran, since cut off by the post-Pleistocene rise in sea level. An aberrant population is described from a Euphrates tributary in Iraq.

RÉSUMÉ.– *Barilius mesopotamicus* Berg, 1932, poisson de la famille des Cyprinidae, avait été décrit d'après un seul spécimen. Une nouvelle description est donnée, fondée sur 259 spécimens provenant de la Turquie, la Syrie, l'Iran et l'Iraq. Cette espèce est endémique du bassin de l'Euphrate et du Tigre, mais on la trouve aussi dans le Dalaki en Iran, qui est probablement un affluent pléistocène de ce bassin, isolé depuis par une montée post-pléistocène du niveau de la mer. Une population aberrante d'un affluent de l'Euphrate en Iraq est décrite.

Barilius mesopotamicus was briefly described by Berg (1932) from a single specimen collected in 1914. The type locality was given as « (Siaret) Seid-Hassan, an der persisch-türkischen Grenze, unter 33° 20' n. Br., 46° 20' ö. L. Seid-Hassan liegt am Flusse Gawi, welcher sich mit dem Kundschian (Gundschian)-tschai vereinigt ; der letztere mündet in den Tigris ». Seyyed Hasan (33° 06' N, 46° 11' E) lies on a tributary of the Kanjan Cham River near the Iranian town of Mehran on the Iran-Iraq border. This tributary is presumably the Gawi River, although it is not named on maps available to us nor does it appear in gazetteers. Berg (1949) recorded a second specimen with 9 branched dorsal fin rays from Mendeli (= Mandali at 33° 45' N, 45° 32' E in Iraq, not 33° 42' N as given by Berg) which lies on the Ab Rayan, known as the Gangir River in Iran. Beckman (1962) briefly described this species from the Euphrates River in Syria and differed from Berg in stating that pharyngeal teeth are in three, not two, rows and that the lateral line may be complete. Apart from these two points, the description did not add to Berg's original work. Al-Rawi *et al.* (1978) recorded this species from the Little

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Cybium, 1983, 7 (1) : 47-56.

Zab River (Nahr az-Zab as-Saghir) basin in Iraq without a description. Other records and descriptions of this species have apparently been taken from Berg's original description and from Beckman's brief description (e.g. Khalaf, 1961 ; Mahdi, 1962 ; Kähsbauer, 1963 ; Mahdi and Georg, 1969 ; Al-Nasiri and Hoda, 1976 ; see also comments in Banister, 1980).

The purpose of this redescription is to give a more detailed account of the species and to record its distribution in southwest Asia.

Materials and methods

Specimens examined are listed below. Original locality data are cited. Data in parentheses are interpretations of original data.

Abbreviations : – NMC = National Museum of Natural Sciences, Ottawa, Canada ; BM (NH) = British Museum (Natural History), London, England ; SMF = Senckenberg Museum, Frankfurt, F.R. Germany ; ISBB = Institutul de Stiinte Biologice, Bucuresti, Roumanie ; SL = standard length.

Iran

NMC 79-0120, 3, 19.3-50.7 mm SL, Bushehr, Dalaki River near Konar Takhteh, 29° 28' N, 51° 21' E, 20 October 1976, B.W. Coad, S. Coad, K. Evans and J. Halpern.

NMC 79-0357, 1, 27.6 mm SL, Khuzestan, irrigation ditch in Karkheh River drainage, 3 km from Susangerd, 31° 34' N, 48° 12' E, 26 January 1978, B.W. Coad and S. Coad.

NMC 79-0363, 11, 21.4-30.2 mm SL, Khuzestan, Karkheh River, 80 km north of Ahvaz, 31° 52' N, 48° 20' E, 27 January 1978, B.W. Coad and S. Coad.

NMC 79-0365, 7, 20.0-34.4 mm SL, Khuzestan, Doveyrich River drainage, 32° 25' N, 47° 36.5' E, 28 January 1978, B.W. Coad and S. Coad.

NMC 79-0367, 1, 34,2 mm SL, Khuzestan, Meymeh River, 11 km north of Dehloran, 32° 44.5' N, 47° 09.5' E, 28 January 1978, B.W. Coad and S. Coad.

NMC 79-0368, 29, 21.6-41.9 mm SL, Khuzestan, Karkheh River, 32° 24.5' N, 48° 09' E, 28 January 1978, B.W. Coad and S. Coad.

NMC 79-0372, 2, 30.7-33.1 mm SL, Khuzestan, Dez River near Chogha Zanbil, ca. 32° 02' N, 48° 30' E, 29 January 1978, B.W. Coad and S. Coad.

NMC 79-0377, 3, 28.0-39.4 mm SL, Khuzestan, Karkheh River, 88 km north of Andimeshk, ca. 32° 57' N, 47° 50' E, 29 January 1978, B.W. Coad and S. Coad.

NMC 79-0378, 7, 31.9-42.4 mm SL, Khuzestan, stream tributary to Karkheh River, ca. 32° 48' N, 48° 04' E, 29 January 1978, B.W. Coad and S. Coad.

NMC 79-0379, 21, 23.8-46.0 mm SL, Khuzestan, Dez River, 32° 12' N, 48° 27' E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0380, 10, 25.3-41.0 mm SL, Khuzestan, stream tributary to Dez River, ca. 32° 10' N, 48° 35' E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0381, 7, 24.3-31.2 mm SL, Khuzestan, stream west of Shushtar, ca. 32° 10' N, 48° 35'E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0382, 4, 25.9-30.8 mm SL, Khuzestan, Karun River at Shushtar, 32° 03' N, 48° 51' E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0383, 8, 28.6-34.8 mm SL, Khuzestan, Ab-e Shur drainage, 31° 59.5' N, 49° 06' E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0384, 3, 26.8-40.8 mm SL, Khuzestan, Ab-e Shur drainage, 32° 00' N, 49° 07' E, 30 January 1978, B.W. Coad and S. Coad.

NMC 79-0392, 3, 35.0-39.3 mm SL, Khuzestan, Zard River, 25 km north of Ramhormoz, ca. 31° 32' N, 49° 48' E, 31 January 1978, B.W. Coad and S. Coad.

NMC 79-0396, 35, 25.1-48.8 mm SL, Khuzestan, Kheyrabad River, 20 km from Behbehan, 30°

32' N, 50^{o} 23.5' E, 1 February 1978, B.W. Coad and S. Coad.
ISSB unregistered, 1, 48.7 mm SL, Hablerud River, Gulf drainage, near Borazjan, (probably Helleh River, ca. 29^{o} 20' N, 51^{o} 15' E), 28 May 1976, P. Bianco and S. Zeruman.

Iraq
BM(NH) 1974.2.22. : 1256-1266, 11, 33.7-46.2 mm SL, stream between Habaniyah and Euphrates (town or Hawr (= lake al-Habbaniyah and Nahr al-Furat), ca. 33^{o} 22' N, 43^{o} 34' E), 25 September 1957.

Syria
BM(NH) 1968.12.13 : 221-236, 16, 30.8-42.4 mm SL, Tigris River at Ain Divar (Nahr Dijlah at Ain Diwar), 37^{o} 17' N, 42^{o} 11' E, 17 November 1958, W.C. Beckman.
BM(NH) 1968.12.13 : 217-220, 4, 18.5-47.4 mm SL, Euphrates River at Mayadine (Nahr al-Furat at al-Mayadin), 35^{o} 01' N, 40^{o} 27' E, 20 November 1958, W.C. Beckman.
SMF 16442, 5, 28.2-35.9 mm SL, Nahr al-Balikh at Jisr Shannin (Nahr Balikh at Jisr Shanine), 36^{o} 03' N, 39^{o} 06' E, 16 March 1979, R. Kinzelbach and F. Krupp.
SMF 16443, 63, 17.0-34.9 mm SL, Nahr al-Balikh at Jisr Shannin (Nahr Balikh at Jisr Shanine), 36^{o} 03' N, 39^{o} 06' E, 19 August 1980, F. Krupp and W. Schneider.

Turkey
ISBB unregistered, 4, 32.8-34.4 mm SL, Batman Suyu, tributary to the upper Tigris, near Diyarbakir, ca. 37^{o} 55' N, 40^{o} 15', E.A. Kelle.

The above list summarizes the distribution of this species in southwest Asia based on material examined. Additional localities are those cited in the introduction for L.S. Berg's two specimens which are in the Academy of Sciences, Leningrad, U.S.S.R. (Armantrout, 1980), and records for the drainage of the Little Zab River in Iraq (Al-Rawi *et al.*, 1978) which are given below after interpretation :

Al-Tabla, 20 km before Rania (Raniyah), on the highway between Kala Diza (Qal'at Dizah) and Rania (Raniyah) (ca. 36^{o} 12' N, 44^{o} 59' E).
Dokan (Dukan) Lake, Dokan (Dukan) Nahiya (35^{o} 57' N, 44^{o} 57' E).
Kirkuk Province, Altun Kupri (35^{o} 45' N, 44^{o} 09' E).

Counts and measurements follow Hubbs and Lagler (1958). Dorsal, anal, pectoral and pelvic fin ray counts are separated into unbranched, including rudimentary rays (Roman numerals), and branched rays with the last two rays in the dorsal and anal fins counted as one (Arabic numerals). Gill raker counts are for the whole, anterior, first arch. Vertebral counts include the hypural plate as one vertebra and the four Weberian vertebrae.

Results

Meristic data.

Meristic data are summarized in Table I. There are no significant differences between males and females for meristic characters. However significant differences are found in seven out of twelve characters examined for a comparison of a limited sample of ten females from the Habbaniyah stream.

Table I. – Meristic data for 30 males, 30 females and 10 Habbaniyah stream females. x = mean, SD = standard deviation. Probability values (p) are given using t-tests for comparison of males with females and for comparison of the two female samples.

Dorsal fin branched rays	7	8	9	x	SD	p
Males	-	27	3	8.1	0.31	>0.05
Females	2	25	3	8.0	0.41	>0.05
Habbaniyah females	1	9	-	7.9	0.32	

Anal fin branched rays	10	11	12	13	14	x	SD	p
Males	3	13	13	-	1	11.4	0.82	>0.05
Females	1	15	13	1	-	11.5	0.63	>0.05
Habbaniyah females	-	8	1	1	-	11.3	0.67	

Pectoral fin branched rays	11	12	13	14	x	SD	p
Males	3	9	17	1	12.5	0.73	>0.5
Females	4	6	20	-	12.5	0.73	<0.001
Habbaniyah females	6	4	-	-	11.4	0.52	

Pelvic fin branched rays	6	7	8	x	SD	p
Males	1	28	1	7.0	0.26	>0.05
Females	1	28	1	7.0	0.26	>0.05
Habbaniyah females	-	10	-	7.0	0.00	

Lateral line scales	42	43	44	45	46	47	48	49	50	51	52	53	54	55	x	SD	p
Males	1	3	-	1	6	4	3	3	3	3	1	1	1	-	47.8	3.02	>0.05
Females	-	-	3	1	4	4	-	4	8	2	3	-	-	1	48.6	2.74	<0.02 >0.01
Habbaniyah females	-	-	-	-	-	1	1	1	-	2	2	1	1	1	51.2	2.57	

Scales above lateral line	8	9	10	11	x	SD	p
Males	10	16	3	1	8.8	0.75	>0.05
Females	13	15	2	-	8.6	0.61	>0.05
Habbaniyah females	5	5	-	-	8.5	0.53	

Scales below lateral line	2	3	4	x	SD	p
Males	10	19	1	2.7	0.53	>0.05
Females	13	17	-	2.6	0.50	<0.01 >0.001
Habbaniyah females	-	9	1	3.1	0.32	

Scales between lateral line and pelvic fin	1	2	3	x	SD	p
Males	1	20	9	2.3	0.52	>0.05
Females	3	15	12	2.3	0.65	>0.05
Habbaniyah females	1	7	2	2.1	0.57	

Scales around caudal peduncle	15	16	17	18	19	20	x	SD	p
Males	2	17	7	4	-	-	16.4	0.82	>0.05
Females	-	20	6	2	1	1	16.6	1.01	<0.01 >0.001
Habbaniyah females	4	6	-	-			15.6	0.52	

Total gill rakers	7	8	9	10	11	12	13	14	x	SD	p
Males	2	6	8	7	5	1	-	1	9.5	1.53	>0.05
Females	2	5	10	8	4	-	1	-	9.4	1.30	<0.01 >0.001
Habbaniyah females	3	4	3	-	-	-	-	-	8.0	0.82	

Flank spots	6	7	8	9	10	11	x	SD	P
Males	1	6	10	7	5	1	8.4	1.19	〉0.05
Females	1	5	11	8	4	1	8.4	1.13	
Habbaniyah females	-	-	-	-	-	-	-	-	

Total vertebrae	38	39	40	41	x	SD	P
Males*	-	8	11	1	39.7	0.59	〉0.05
Females*	-	5	12	3	39.9	0.64	〈0.02 〉0.01
Habbaniyah females	2	4	4	-	39.2	0.79	

* n = 20.

Modal values are dorsal rays III/8, anal rays III/11, pectoral rays I/13, pelvic rays I/7, scales above lateral line 9, scales below lateral line 3, scales between lateral line and pelvic fin 2, scales around caudal peduncle 16, total gill rakers 9, flank spots 8, and total vertebrae 40. Counts of lateral line scales do not show strong modes.

Morphometric data.

Morphometric data are summarized in Table II. Seventeen characters are examined and there are five differences between males and females. Again the Habbaniysh stream females are quite distinct from females taken over a wide range for the species, eleven differences out of seventeen.

Scale characters.

Scale counts are summarized in Table I. The size at which the lateral line is fully developed is variable. It is usually complete in specimens over 30 mm SL. A specimen of 27.3 mm SL was the smallest one with a complete lateral line. The specimens from the Batman Suyu, Turkey, differ from other populations by having a larger number of scales in the lateral line (51-58, mean = 54.5). On the body the lateral line is decurved and parallel to the ventral body profile from the pelvic fin origin to the caudal peduncle, being 2-3 scales above this profile. On the caudal peduncle the lateral line is below the mid-line, but the scales on the caudal fin posterior to the hypural plate are perforated in the mid line. There is an evident pectoral fin axillary scale and a smaller pelvic fin axillary scale. Scales are regularly arranged over the whole body but are not strongly imbricate, particularly on the belly and on the back anterior to the dorsal fin. The scales are deciduous. Anterior flank scales are oval with a subcentral anterior focus and a moderate number of circuli. Radii are found principally on the posterior and lateral fields. Anterior field radii are usually absent although one or two radii may occasionally be found. Scale radii based on five anterior flank scales from each of five fish (40.7-50.7 mm SL) : number 5-11 (mean 7.8) primary radii, 0-13 (mean 5.9) secondary radii, and 5-23 (mean 6.8) total radii.

Table II. – Morphometric data for 30 males, 30 females and 10 Habbaniyah stream females. Abrevations and comparisons as in Table I except range is given in parentheses, P_1 - P_2 = distance between origins of paired fins, and P_2 - A = distance between pelvic fin origin and anal fin origin.

Character	Males	p	Females	p	Habbaniyah females
SL (mm)	28.2 - 48.8		27.3 - 50.7		33.6 - 46.7
	x SD	p	x SD	p	x SD
Standard length (SL)	3.9 0.17	> 0.05	3.9 0.20	< 0.001	4.3 0.19
Head length (HL)	(3.6-4.3)		(3.6-4.3)		(3.9-4.6)
SL	6.0 0.30	> 0.05	6.0 0.23	<0.01> 0.001	6.3 0.28
Head depth	(4.9-6.4)		(5.5-6.5)		(5.7-6.7)
SL	5.3 0.39	> 0.05	5.4 0.39	> 0.05	5.6 0.25
Body depth	(4.5-6.0)		(4.8-6.2)		(5.0-5.8)
SL	1.7 0.04	> 0.05	1.7 0.05	< 0.001	1.8 0.08
Predorsal length	(1.6-1.8)		(1.6-1.8)		(1.6-1.8)
HL	2.3 0.08	> 0.05	2.3 0.10	< 0.001	2.1 0.09
Head width	(2.1-2.4)		(2.0-2.5)		(2.0-2.3)
HL	3.7 0.19	<0.05>0.02	3.8 0.19	< 0.001	4.2 0.16
Snout length	(3.4-4.0)		(3.4-4.3)		(3.9-4.3)
HL	3.1 0.16	<0.05>0.02	3.2 0.17	< 0.001	2.9 0.13
Orbit width	(2.9-3.5)		(2.8-3.5)		(2.8-3.2)
HL	3.4 0.17	<0.05>0.02	3.5 0.18	> 0.05	3.5 0.14
Interorbital width	(3.1-3.8)		(3.1-3.8)		(3.4-3.7)
HL	2.3 0.13	> 0.05	2.3 0.11	> 0.05	2.3 0.05
Postorbital length	(2.0-2.5)		(2.1-2.5)		(2.2-2.4)
HL	1.2 0.05	> 0.05	1.2 0.06	> 0.05	1.2 0.07
Pectoral fin length (P_1)	(1.1-1.3)		(1.1-1.4)		(1.1-1.3)
HL	1.8 0.08	< 0.001	1.9 0.08	< 0.001	1.7 0.09
Pelvic fin length (P_2)	(1.7-2.0)		(1.7-2.0)		(1.5-1.8)
HL	*1.5 0.12	<0.01> 0.001	1.6 0.14	< 0.001	**1.4 0.06
Longest branched dorsal fin ray	(1.3-1.7)		(1.3-1.8)		(1.3-1.5)
HL	1.7 0.11	> 0.05	1.7 0.12	> 0.05	1.7 0.11
Longest branched anal fin ray	(1.5-2.0)		(1.5-1.9)		(1.5-1.9)
HL	3.6 0.87	> 0.05	3.5 0.92		-
Barbel length	(2.7-7.2)		(2.6-7.8)		
Caudal peduncle length	2.2 0.22	> 0.05	2.3 0.21	< 0.001	2.7 0.16
Caudal peduncle depth	(1.8-2.6)		(1.9-2.7)		(2.5-3.0)

P_1P_2 / P_1	1.1	0.08	> 0.05	1.1	0.07	< 0.001	1.3	0.08
	(0.9-1.3)			(1.0-1.3)			(1.2-1.4)	
P_2 - A / P_2	1.2	0.09	> 0.05	1.2	0.08	<0,01 >0.001	1.1	0.12
	(0.9-1.3)			(1.1-1.5)			(0.9-1.3)	

* n = 29
** n = 9

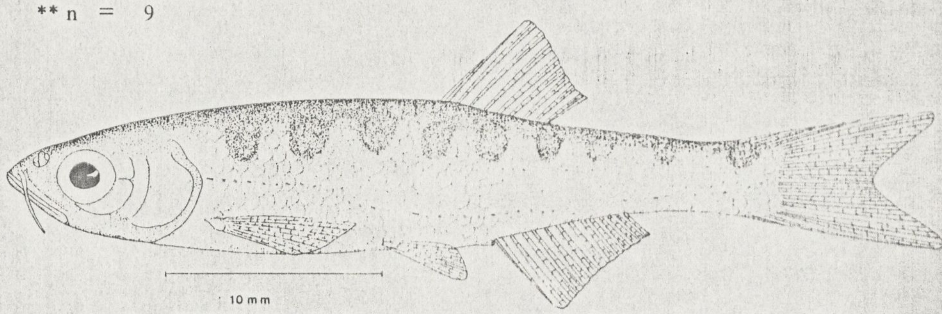

Fig. 1. – *Barilius mesopotamicus*, specimen from Jisr Shannin, Syria, (SL = 35.9 mm)

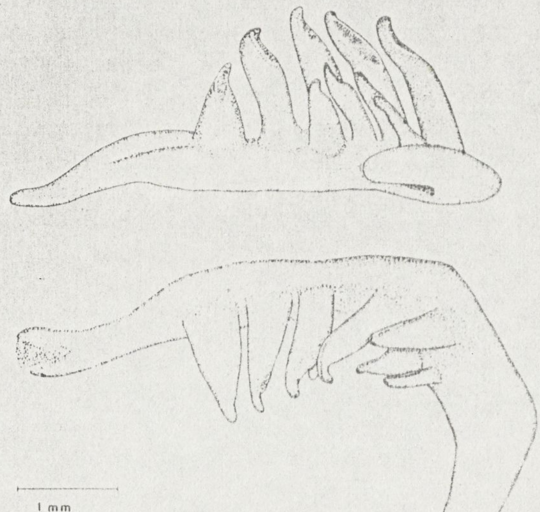

Fig. 2. – Left pharyngeal bone and teeth of *Barilius mesopotamicus*

Gut characters.

Gill raker counts are summarized in Table I. Gill rakers are short and rounded. Pharyngeal teeth are hooked at their tips and are in two rows (Fig. 2). Pharyngeal tooth counts are 4,5-5,4 (14) and 4,5-5,3 (5) or more rarely in three rows 1,3,5-5,3,1 (1). Beckman (1962) reported a count of 1,4,5-5,4,1. The peritoneum is light

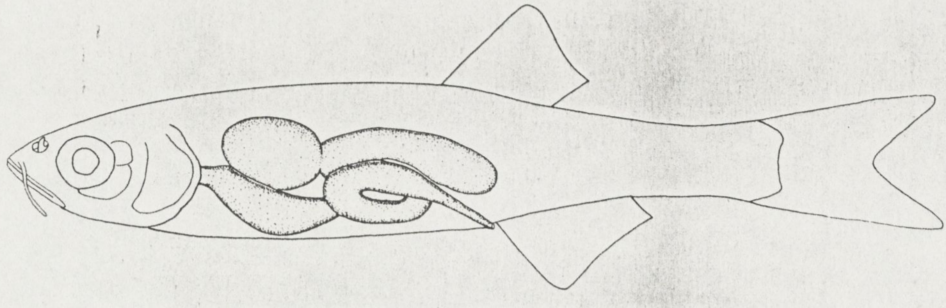

Fig. 3. – ***Barilius mesopotamicus*****,** position and shape of the gut and the swim bladder

to silvery but bears scattered melanophores which give a greyish tinge in preserved specimens when expanded. The gut is a simple S-shape (Fig. 3).

Pigmentation.

The flanks, belly and suborbital bones are silvery in life. Alcohol preserved specimens are silvery to yellowish but the silvery colouration is lost in formalin preserved specimens. The most conspicuous pigmentation in preserved specimens is a series of brown flank spots following the upper body profile. These are weakly expressed or absent in the Habbaniyah stream females. The number of flank spots is summarized in Table I. A median dorsal stripe is variably developed. Fins are lightly pigmented, most pigment being on the fin rays, not the fin membranes. The anal and paired fins are almost entirely hyaline. The caudal fin may show one or two irregular grey stripes running parallel to the posterior margin.

Other characters.

General body shape may be seen in Fig. 1. There is a small symphysial knob on the lower jaw. The mouth is slightly subterminal, oblique and elongate ; the rictus lies below the anterior half of the eye. A well developed barbel has its origin just anterior to the level of the nostril above the upper lip and lies in a groove between the upper lip and the beginning of the suborbital bone series. This barbel is absent or minute in the Habbaniyah stream females. In addition to the maxillary barbels, a second pair of barbels having their origin slightly above the posterior edge of the mouth, are present in 8 out of 259 specimens. These are usually rudimentary but may reach 10.7 % of the head length. The suborbital bones are large. The dorsal fin origin lies about mid-way between the pelvic and anal fin origins. The caudal fin is moderately forked and the margins of the dorsal and anal fins are slightly concave.

Habitat and diet.

Barilius mesopotamicus is found in small streams only a metre wide, irrigation ditches and larger flowing waters including major rivers more than 200 m wide.

Current in these waters varies from slow to fast but generally an obvious flow is apparent. All these waters are at low altitude on the mesopotamian plain and no specimens were collected in streams and rivers of the Zagros mountains. Collections were made over mud and pebble substrates in shallow streams or at river margins. The species may occur in mid-river in surface waters. Temperatures at various times of capture ranged from 12-24°C and conductivity from 0.45-10.5 millimhos. The Nahr al-Balikh dries up completely in summer unlike the other habitats sampled. In August hundreds of small *B. mesopotamicus* were found in small pools of less than 20 cm depth which remained in the dry river bed. The salinity is usually high in these small mesopotamian rivers. In March when the river was still flowing, the following values were taken : Cl^{-} = 390 mg/l and salinity 1.5 ‰. The complete stomach contents of 10 specimens were examined. They consisted entirely of terrestrial arthropods of the following taxa : Arachnidae ; Coleoptera ; Heteroptera ; Thysanoptera ; Diptera : Culicidae, Brachycera ; Hymenoptera.

Distribution.

Barilius mesopotamicus is endemic to the Tigris-Euphrates basin in Syria, Iraq, Iran and Turkey. It does not appear to be common in Turkey, at least in the upper reaches of this basin (Kuru, 1971). Its known distribution is summarized by the list of material examined. One population from the Dalaki River in Iran is outside the modern Tigris-Euphrates basin. However this distribution is presumably a relict of the late Pleistocene when the Tigris-Euphrates flowed down a drained Gulf receiving tributaries now isolated by the post-Pleistocene rise in sea level (Banister and Clarke, 1977).

Discussion

Howes (1980) has suggested that *B. mesopotamicus* is related to *Leucaspius* and should not be retained in *Barilius*. This statement is apparently based on osteological evidence but detailed reasoning has not yet been published and critical comment cannot be made. For the present it seems best to retain the species in *Barilius*. Its relationship to *Barilius* species of Africa and India has not been investigated.

The most unusual feature of this re-description is the discovery of what can only be termed an « aberrant » population in the Habbaniyah stream. The sample is small and nothing is known about the environmental conditions under which the sample was caught. Populations to the north-west and to the south-east are not dissimilar from each other. Maps indicate that the Habbaniyah stream is not isolated from the Tigris-Euphrates basin.

Accordingly these specimens are identified as *B. mesopotamicus* for the present but further examination of material from the Habbaniyah area should be undertaken to delimit the distribution, variation and continued existence of this population.

The population from Dalaki river in Iran, although isolated from populations in the Tigris-Euphrates basin, is not notably different from these other populations.

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Plate morphs in freshwater samples of *Gasterosteus aculeatus* from Arctic and Atlantic Canada: Complementary comments on a recent contribution

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Plate morphs in freshwater samples of *Gasterosteus aculeatus* from Arctic and Atlantic Canada: Complementary comments on a recent contribution

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COAD, B. W. 1983. Plate morphs in freshwater samples of *Gasterosteus aculeatus* from Arctic and Atlantic Canada: Complementary comments on a recent contribution. Can. J. Zool. **61**: 1174–1177.

Additional analyses of museum samples for plate morphs in the freshwater threespine stickleback from Arctic and Atlantic Canada confirm the scarcity of the low morph in mainland Atlantic Canada as shown by Hagen and Moodie (D. W. Hagen and G. E. E. Moodie. 1982. Can. J. Zool. 60: 1032–1042). Insular Newfoundland samples show evidence that populations containing the low morph are not uncommon and this agrees well with Hagen and Moodie's climatic explanation for plate morph distribution. This climatic explanation does not, however, account for the high frequencies of low morph populations shown here to occur in Arctic Canada. Two populations are identified which may be monomorphic for the low morph, and a monomorphic partial population is reported from an inland stream. Both these types of populations are rare in eastern North America.

COAD, B. W. 1983. Plate morphs in freshwater samples of *Gasterosteus aculeatus* from Arctic and Atlantic Canada: Complementary comments on a recent contribution. Can. J. Zool. **61**: 1174–1177.

L'examen des plaques osseuses chez des spécimens de musée d'épinoches à trois épines dulcaquicoles du Canada arctique et atlantique confirme la rareté, déjà démontrée de la forme à peu de plaques dans l'Atlantique canadien continental par Hagen et Moodie (D. W. Hagen and G. E. E. Moodie. 1982. Can. J. Zool. 60: 1032–1042). Les échantillons insulaires de Terre-Neuve démontrent que les populations d'épinoches à peu de plaques ne sont pas rares, comme le conviennent d'ailleurs Hagen et Moodie (1982) dans leur explication climatique de l'aire de répartition des formes à plaques. Par contre, cette justification climatique n'explique pas, comme on le démontre ici, que l'on retrouve très fréquemment des populations d'épinoches à peu de plaques dans l'Arctique canadien. Il existe deux populations monomorphes de la forme à peu de plaques; on signale aussi une population monomorphe à forme partiellement couverte de plaques provenant d'un ruisseau intérieur. Ces deux types de populations sont rares dans l'Est de l'Amérique du Nord.

Hagen and Moodie (1982) have examined polymorphism for plate morphs in the threespine stickleback from eastern Canada based on extensive field work in Atlantic drainages (New Brunswick, Prince Edward Island, Nova Scotia, and Gaspé, Quebec) and on museum samples for Arctic drainages. They formed the "distinct impression that freshwater populations are scarce" and I concur based on my own field work and a survey of collections in the Royal Ontario Museum, Toronto (ROM) and the National Museum of Natural Sciences, Ottawa (NMC). The Atlantic drainage samples of Hagen and Moodie (1982) were either monomorphic for the completely plated morph, or rarely monomorphic for the partially plated morph, or polymorphic for completes and partials. The low-plated morph was absent, in contrast to western Europe and western North America where lows are common. In Arctic drainages the low morph was found in a number of museum collections, but sample sizes were often small.

Table 1 summarizes plate morphs for muesum collections in NMC and ROM not examined by Hagen and Moodie (1982). I have omitted samples numbering less than 10 individuals and samples monomorphic for completes or polymorphic for completes and partials. Minimum total length for all fish examined was 34 mm since plate development is incomplete in smaller fish (Coad and Power 1974; Hagen and Moodie 1982). Fish were examined on the left side for morph type according to the definitions of Hagen and Moodie (1982).

About 45% of samples from Arctic drainages show evidence of the low morph, even though number of specimens available in any one sample is often low (combining my data with Hagen and Moodie's Table 3, making 44 samples). Where sample size is larger than 35 specimens (11 samples), 64% of samples have the low morph present. The sample from Lake Canichico in Ungava (NMC 58-356) is the only population from eastern North America which may be monomorphic for the low morph. Sample size is relatively large but this sample should be treated with caution since other samples show high frequencies of one morph combined with a very low frequency (less than 3%) of a second morph. Monomorphy can only be confirmed with large samples numbering hundreds of individuals but in some instances the habitat may not support large population numbers (see below).

Samples from Atlantic drainages show several interesting points. Power (1965, p. 54) has referred to low plate morph populations in the Nabisipi River on the north shore of the Gulf of St. Lawrence and this is confirmed here (ROM 23560). Remarkably, of 12 samples from Newfoundland, 8 show low to high frequencies of the low morph. With an earlier record by Coad and Power (1974) this brings to 10 the number of localities showing evidence of populations containing the low morph in contrast to the virtual absence reported by Hagen and Moodie (1982) who examined other areas of Atlantic Canada. One of these Newfoundland samples (NMC 66-177), from a brook draining to the sea, was almost monomorphic for lows. Only 2 of 92 individuals were partials, and these may be *semiarmatus* hybrids from contact between a true, low-plated *leiurus* population in freshwater and a marine, completely plated *trachurus* population entering freshwater on a spawning migration.

The stream near Ottawa (NMC 82-335, 82-336, 82-337, 82-358) apparently supports a population which is monomorphic for partials. One fish was scored as a low morph since it lacked a keel on its left side. A normally developed keel was present on the right side. The absence of a keel on only one side in a population showing a strongly developed keel in all other individuals may be a developmental anomaly. Sample size is relatively small but reflects the habitat size and is probably an accurate summary of this population's plate morph distribution. This is only the fourth population in eastern North America which is believed to be monomorphic for partials and is unusual on two counts, distance from the sea (ca. 400 km by air) and in being a stream rather than a lake habitat. This contrasts with Hagen and Moodie's (1982) Table 2 where all monomorphic partial populations are in lakes 10 km or less from the sea.

A trend to gradual loss of flank and keel plates is evident in several of the populations examined here and in populations of completes and in populations of completes and partials not cited in Table 1 (Coad and Power 1974; unpublished data). Some individuals which were scored as partials on the left side were low morphs on the right side, and vice versa. Keel development varied between strong, with five or more obvious plates, and weak, with only a single minute plate. Thus, while some populations are clearly divisible into three discrete morphs, others show a continuous range of variation. The factors maintaining polymorphisms and monomorphisms appear to be complex and not always attributable simply to hybridisation between

TABLE 1. Plate morphs of freshwater samples of *Gasterosteus aculeatus* from Arctic and Atlantic drainages of Canada

Catalogue No.	Locality	No. (and %) of plate morphs		
		Low	Partial	Complete
	Arctic drainages			
Baffin Island				
ROM 12147	N.W.T., Franklin District, Lake Harbour (62°51′N, 69°53′W)	167(79.1)	44(20.9)	0(0)
Ungava				
ROM 23563	Que., Nouveau-Québec, Lac Aigneau, Bastard Creek (57°14′N, 70°07′W)	71(91.0)	6(7.7)	1(1.3)
NMC 58-356	Que., Nouveau-Québec, Lake Canichico (56°50′N, 68°58′W)	104(100)	0(0)	0(0)
Hudson Bay				
ROM 9824	N.W.T., Keewatin, Tayane (60°31′N, 94°37′W)	4(28.6)	10(71.4)	0(0)
NMC 63-226	Que., Nouveau-Québec, Charr Lake (56°20′N, 76°29′W)	8(80)	2(20)	0(0)
James Bay				
ROM 22442, 25364	Ont., Kenora District, Hawley Lake (54°30′N, 84°39′W)	201(79.4)	52(20.6)	0(0)
NMC 77-1586	Que., Nouveau-Québec, Fort George River (53°50′N, 79°01′W)	1(2.6)	38(97.4)	0(0)
ROM 27823	Ont., Kenora District, Attawapisket River (52°57′N, 82°18′W)	0(0)	23(100)	0(0)
ROM 27617	Ont., Cochrane District, Moose River (51°20′N, 80°24′W)	1(9.1)	10(90.9)	0(0)
ROM 27822	Ont., Cochrane District, Moosonee (51°17′N, 80°39′W)	0(0)	12(100)	0(0)
ROM 8457	Ont., Kenora District, East Point, Algonquin Camp (?)	0(0)	13(100)	0(0)
	Atlantic drainages			
NMC 82-335, 82-336, 82-337, 82-358	Que., Gatineau Co., stream near Eardley (45°35′N, 76°05′W)	1(1.4)	71(98.6)	0(0)
ROM 23560	Que., Saguenay Co., Nabisipi River (50°16′N, 62°10′W)	33(25.8)	95(74.2)	0(0)
NMC 66-177	Nfld., White Bay North District, brook into Wild Bight (51°36′N, 55°53′W)	90(97.8)	2(2.2)	0(0)
NMC 76-452	Nfld., Humber East District, Rapid Pond (49°00′N, 57°42′W)	5(33.3)	9(60.0)	1(6.7)
NMC 81-70	Nfld., Humber East District, Humber River (48°58′N, 57°54′W)	3(13.6)	6(27.3)	13(59.1)
ROM 21027	Nfld., Fortune Bay and Hermitage District, small pond west of ROM 21020 (?)	23(13.4)	149(86.6)	0(0)
ROM 21020	Nfld., Fortune Bay and Hermitage District, Lake St. John (48°23′N, 54°51′W)	7(11.3)	55(88.7)	0(0)
ROM 20968	Nfld., St. Mary's District, North Harbour River tributary (?)	0(0)	26(100)	0(0)
ROM 20964	Nfld., Ferryland District, brook north of Trepassey (46°44′N, 53°22′W)	10(20.0)	24(48.0)	16(32.0)

low-plated *leiurus* and completely plated *trachurus* (Hagen and Moodie 1982). The factors influencing a continuous range of variation are unknown.

Hagen and Moodie (1982) suggest that selection with respect to climate or an associated variable may account for plate morph distribution worldwide. The contrast between Arctic and Atlantic mainland plate morph distributions is marked, examining their data and Table

1 herein. Low plate morphs are relatively common in the Arctic, but are rare in the Atlantic mainland. Low morphs are not uncommon on insular Newfoundland, which has a subcontinental temperature range (12–24C°) milder than the continental range (24–36C°) shown by the rest of Atlantic Canada (Hall 1974). According to Hagen and Moodie (1982) the low plate morph is at a selective advantage where the climate is warm or mild and annual flux in temperature is small. However, James Bay, eastern Hudson Bay, Keewatin, and Ungava Bay drainages have a very continental range (36–48C°) but low morphs are common. There are low morphs too on Baffin Island which does not have a warm climate. A climatic explanation for plate morph distribution is therefore equivocal but, as Hagen and Moodie (1982) point out, the local climate may be important and other, undetected factors may play a part. For example, diversity of species, and therefore potential predators on sticklebacks, is less in Newfoundland, the Quebec north shore, and the Arctic compared with mainland Atlantic Canada but this possible relationship remains to be investigated on a more detailed level.

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ABSTRACTS

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STUDIES ON THE SYSTEMATICS AND ZOOGEOGRAPHY OF THE FRESHWATER FISHES OF IRAN.

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The freshwater ichthyofauna of Iran is the most poorly known in the Middle East. Current studies on this fauna at the National Museums of Canada are based on over 500 collections made during 1976-1979 by me and during 1961-1962 by V. D. Vladykov. Several new species have been discovered including a cichlid endemic to streams draining to the Persian Gulf at the Straits of Hormuz. The relationships of this species appear to lie with the Jordan Rift endemic genus *Tristramella* or possibly *Danakilia* of Ethiopia. A new species of *Pseudophoxinus* from Persian Gulf and internal drainages in southern Iran represents the most easterly distribution of this genus. Several species known only from the original description have been re-collected or synonymised with other, common species. A general review of recent work is given.

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The Identity of *Alburnus maculatus* Keyserling, a Cyprinid Fish from Esfahan Province, Iran

Brian W. Coad

(Received December 25, 1981)

Graf Eugen Keyserling travelled through Persia in 1858 and the first half of 1859 attached to the scientific expedition of the Imperial Russian government under the direction of N. Chanikoff. Difficulties with baggage transport prevented him from bringing back specimens of fishes but he made drawings and measurements of the cyprinid species he found (Keyserling, 1861). He described a new species, *Alburnus maculatus,* from "Wasserleitung bei Gaes einige Meilen von Isphahan," a locality which I interpret as a canal (probably a qanat) near Gaz (which is at 32°48′N, 51°37′E) northwest of Esfahan. In the absence of type material and more accurate locality data the fish fauna of the Esfahan area must be examined to determine the identity of Keyserling's species.

The only other report of this species is a brief description by Saadati (1977) based on two samples comprising 25 specimens from the Esfahan endorheic drainage basin. Saadati (1977) placed these specimens in the genus *Alburnus* but noted, as did Berg (1949b), that *A. maculatus* is a primary homonym of *Alburnus maculatus* Kessler, 1859 (=*Alburnoides bipunctatus fasciatus* (Nordman, 1840) according to Berg (1949a)). Through the courtesy of Dr. R. J. Behnke, Colorado State University, Fort Collins, I have been able to re-examine Saadati's specimens and compare them with material collected by me and listed below. This latter material is deposited at the National Museum of Natural Sciences, National Museums of Canada, Ottawa (NMC).

Material. NMC 79-0244, (3, 60.6～74.6 mm SL), Shahrestan-e Bakhtiari va Chahar Mahall, spring at Shahr Kord, 32°19′N, 50°52′E, 9 June 1977, B. W. Coad and Sh. Mansoorabadi. NMC 79-0249, (1, 106.7 mm SL), Esfahan Province, stream at Dizaj, 31°55′N, 51°30′E, 9 June 1977, B. W. Coad and Sh. Mansoorabadi. NMC 79-0250, (28, 26.2～88.4 mm SL), Esfahan Province, stream tributary to Pelasegan River, 33°01′N, 50°29′E, 10 June 1977, B. W. Coad and Sh. Mansoorabadi. NMC 79-0251, (134, 22.1～83.7 mm SL), Esfahan Province, stream tributary to Pelasegan River, 32°59′N, 50°26′E, 10 June 1977, B. W. Coad and Sh. Mansoorabadi. Saadati's material: (15, 55.6～84.0 mm SL), Esfahan Province, "Paherahneh" qanat, 100 km east of Esfahan, ca. 32°43′N, 52°40′E, 29 November 1974, R. J. Behnke. (10, 43.9～74.0 mm SL), Esfahan Province, Zayandeh River at Tanderan, 32°47′N, 51°02′E, 30 November, 1974, R. J. Behnke.

Description. In the following description counts and measurements as given by Keyserling (1861) are followed by range and mean (and in innermost parentheses the mode or modes for meristic data) for 12 males and 12 females of *Leuciscus lepidus* (Heckel, 1843) examined by me from the Esfahan endorheic basin and the adjacent upper Tigris River tributaries basin.

Counts: Dorsal fin rays III, 8 (III, 8), anal fin rays III, 11 (III, 9～12; III, 10.2 (III, 10)), ventral fin rays I, 7 (I, 7～9; I, 7.9 (I, 8)), pectoral fin rays I, 14～15 (I, 13～16; I, 14.6 (I, 14)), caudal fin branched rays 17 (17), lateral line scales 52～54 (45～55; 49.9 (51, 52)), scales above lateral line 8 (9～11; 9.6 (9, 10)), scales between lateral line and ventral fin 4 (3～6; 4.5 (4)), scales between dorsal fin insertion and lateral line 7 (6～10; 7.5 (7, 8)).

Measurements: Head length in total length 5.0 (4.6～5.4, 5.1), orbit diameter in head length 3.7 (or 3.5 later in Keyserling's text) (3.2～3.8, 3.4), dorsal fin base length in head length 2.2 (or 2.0 later in text) (1.8～2.5, 2.1), anal fin base length in head length 1.7 (1.4～2.3, 1.9), body depth in total length 5.0 (4.5～5.6, 4.9), orbit diameter in interorbital width 1.0 (1.0～1.3, 1.1), pectoral fin length in head length 1.4 (1.0～1.4, 1.3), dorsal fin base length in dorsal fin ray length 1.5 (1.2～1.8, 1.5), anal fin base length in anal fin ray length 0.3 (0.8～1.2, 1.0).

Other characters cited by Keyserling for *A. maculatus* which agree with specimens of *L. lepidus* include the anal fin origin lying under the end of the dorsal fin, body depth equalling head length, lower jaw protruding somewhat, pectoral fin not reaching the much shorter ventral fins which are attached almost one eye diameter before a level with the dorsal fin origin, anal fin margin rounded, caudal fin forked to half its length, preopercle margin one third eye diameter in front of occiput, few anterior and more numerous posterior scale radii, and silvery colouration. The nape and anterior part of the back were higher than the dorsal fin origin in Keyserling's description but this character was only approached in the larger specimens seen by me.

Remarks. Only minor differences were noted between Keyserling's (1861) *A. maculatus* and *L. lepidus*. These include a higher number of scales above the lateral line in *L. lepidus* but my counts incorporate the scale overlapping the dorsal fin origin which Keyserling may not have counted. There are 3～4 rather than the 2 scales above and below the lateral line on the caudal peduncle described by Keyserling. The black spots reported by Keyserling were not found as a normal pigmentation of *L. lepidus* but some fish had heavy pigmentation around sites of parasite infestation which give the body a spotted appearance. Keyserling cites a value of 0.3 for anal fin base length in anal fin ray length but this appears to be a textual error since Keyserling's Fig. 7 may be measured to give a value of 0.8, within the range cited by me.

Keyserling (1861) gives no indication of the presence of a naked ventral keel in front of the anal fin in his *A. maculatus*. Both Saadati's material and mine lack this typical *Alburnus* character and have the rounded belly found in *Leuciscus*.

On the basis of the above observations I consider *Alburnus maculatus* Keyserling, 1861 a synonym of *Leuciscus lepidus* (Heckel, 1843).

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イラン産のコイ科 *Alburnus maculatus* Keyserling の同定

Brian W. Coad

Keyserling (1861) はイランからコイ科の *Alburnus maculatus* を新種として記載している．模式標本は存在しない．著者は Saadati (1977) の標本を再調査して自己の標本と比較し，同時に原記載を再検討した結果，*A. maculatus* は *Leuciscus lepidus* と形態的に有意な差がなく，従って *A. maculatus* Keyserling, 1861 は *L. lepidus* (Heckel, 1843) のジュニアーシノニムであるという結論に達した．

Copeia, 1983(1), pp. 280–282

THE FRESHWATER FISHES OF INDIA, PAKISTAN, BANGLADESH, BURMA AND SRI LANKA—A HANDBOOK. By K. C. Jayaram. 1981. Zoological Survey of India, Calcutta. xxii + 475 pp., 208 figs., 13 plates (2 color). Rs. 100.00 or $22.50.—This handbook was prepared to provide in a single volume a comprehensive means of identifying the freshwater fishes of the Indian subcontinent. Day's "Fishes of India" (1875–1878) was the last complete treatment of all fish taxa and a modern treatment will prove most valuable for workers in India and elsewhere.

The book considers bony fishes; cartilaginous fishes are omitted. Sixty-four families, 233 genera and 742 species are dealt with. The classification follows Greenwood et al. (1966) and Rosen and Patterson (1969) with some modifications. Brief sections cover Methods of Collection and of Preservation, Measurements, Counts and a Glossary. The bibliography comprises 409 publications. Ninety-three of these are by S. L. Hora and co-authors, 40 by Jayaram and co-authors, and 37 are by M. R. Mirza and co-authors on Pakistani fishes. Unfortunately the publications are not all referenced under genus descriptions, necessitating a search of the whole bibliography for relevant works. This greatly detracts from the utility of the Handbook. There is an index to species and genera. The text figures are of species and of anatomical structures used in identification.

The bulk of the text consists of keys to orders, families, subfamilies, genera and species, each of which has a diagnosis except species. A brief distribution is given for each species.

Ostariophysi dominate the fauna, comprising about 60% of the text with much of the remainder taken up by primarily marine families which have one or two members penetrating freshwaters. There are 46 genera of Cyprinidae with *Puntius*, 69 species, the most speciose genus, followed by *Labeo* with 26 species. There are 79 species of Cobitidae. The Siluriformes is made up of 13 families ranging from Chacidae with a single species to Sisoridae with 62 species. Jayaram's interest in catfishes is evident from the number of detailed diagrams.

The following comments are made on genera with which I have some familiarity and serve to illustrate the type of errors of commission and omission which may be found in this Handbook.

In the cyprinid genus *Labeo* (p. 116) two species described by Erich Zugmayer in 1912 from Baluchistan in Pakistan are omitted. These are *L. gedrosicus* and *L. macmahoni.* The validity of these species has not been re-evaluated and Mirza (1972, 1975), for example, accepts them without comment. Fritz Terofal of the Zoologische Sammlung Des Bayerischen Staates, Munchen informs me that Dr. Zugmayer's fish collections were destroyed 25 April 1944.

The snow trout genus *Schizocypris* (p. 70) is said to have only one species in the region. However Karaman (1969) has described *S. ladigesi* from the Indus River drainage of Afghanistan and this should have been included on geographical grounds. A third species is now known from Seistan on the border of Afghanistan and Iran [*S. altidorsalis* Bianco and Banarescu (1982)].

Under the genus *Cyprinion* (p. 130) the date of the author Heckel is given as 1842 in error for 1843. The diagnosis omits mention of the pharyngeal teeth being in three rows. The horny layer of the lower jaw is not always evident, particularly in small specimens, and the mouth may be horseshoe-shaped. The range in scale counts is greater than 33–36. The black peritoneum and elongate intestine are not mentioned. The scaleless furrow between the occiput and dorsal fin origin is not always evident. *Barbus milesi* (not *millesi*) and *Scaphiodon irregularis* are regarded as synonyms of *C. watsoni* by Karaman (1971) and Mirza (1975) while Berg (1949) retained them as valid species of *Cyprinion.* The author does not give reasons for his listing of these three species in this genus and his comment that *C. milesi* is of doubtful status is not backed up by any reference. The key is after a 1923 work but in this, as in many other keys, it is not clear whether an attempt has been made to digest more recent information. This greatly reduces the confidence in an identification made using this Handbook which is, after all, its main thesis.

In the genus *Garra* (p. 134) one species from Pakistan, *G. rossica,* is omitted (Coad, 1981). It is evident in this, and the cases cited above, that care must be exercised in making identifications, particularly in areas outside of India proper, as it is possible to be misled or driven to a variety of original papers in an attempt to confirm the initial identification.

In the key to genera of the Gobiinae (p. 350) couplets 9 and 11 are the same yet the former leads to the latter. The genus *Brachygobius* in couplet 11 would not be identified as the user would terminate his search at *Gobiopsis* in couplet 9.

The concept of additional keys to *Noemacheilus,* a difficult group, based on distribution is most useful and might well be applied to some other speciose taxa dealt with in this Handbook.

There is no attempt to summarize the information compiled in this book. As one example there are no maps, and this greatly detracts from the usefulness of the distribution data given in the text. Under *Puntius* with 69 species it is difficult to obtain an idea of the distribution of this genus and its species when localities vary from the general, such as Sri Lanka, to the particular, such as the Thungabhadra River. If distributions had been listed by drainage basins much useful data would have been distilled from the text in addition to clarifying obscure locality information.

The book would have benefited from more careful editing as spelling and dating errors are not uncommon. The figures vary greatly in quality, some excellent and others very poor line drawings, as a result of being reproduced from a number of different works. Ideally an original figure depicting a representative of each genus and characteristic portions of its anatomical structures would have been very useful. As indicated above it is evident that some genera have not been fully assessed as to possible valid species. There must be few workers who are thoroughly familiar with this rich fauna and the rest of us would have benefited from the authors own comments on genera which badly need study.

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REDUCED DORSAL SPINE NUMBERS IN TWO ISOLATED POPULATIONS OF THE BROOK STICKLEBACK *(CULAEA INCONSTANS)* FROM EASTERN CANADA

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Résumé

Les auteurs font mention de nombres réduits d'épines dorsales chez l'épinoche à cinq épines (*Culaea inconstans*) provenant de récoltes du Québec et de l'Ontario. Les poissons du lac du Beau Portage (Québec) comportent tous une ou deux épines dorsales. Les épinoches du lac Tom (Ontario) ont de deux à cinq épines et présentent, en outre, un squelette pelvien réduit, voire absent.

Abstract

Reduced dorsal spine numbers are reported for two collections of the brook stickleback *(Culaea inconstans),* from Ontario and Québec. The sample from Lac du Beau Portage, Québec, is made up entirely of fishes with one or two dorsal spines. The Ontario sample, from Tom Lake, had two to five spines and, in addition, the Tom Lake pelvic skeletons varied from complete to absent.

The brook stickleback [*Culaea inconstans* (Kirtland)] occurs in inland waters across much of Canada and the northern United States where it shows considerable meristic variation. Lawler (1958), Nelson (1969) and Moodie (1977) have shown *Culaea* to have a strong modal number of five dorsal spines with counts varying from four to seven spines. Hansen (1939) has reported two to seven dorsal spines in 10 collections numbering 2287 fish but only one two-spined specimen (0.7% of the collection) and four three-spined specimens (2.8%, 1.2% and 1.5% of collections) were recorded from collections dominated by five-spined individuals.

TABLE I

Frequency (and percent) of dorsal spine numbers in two collections of the brook stickleback, *Culaea inconstans*

Catalogue number	*Locality*	*Dorsal spine number*				
NMC80-0934	Québec, lac du Beau Portage 48°22′05″N, 71°34′20″W	1	2	3	4	5
		8	5	—	—	—
		(61.5%)	(38.5%)	—	—	—
NMC60-0121	Ontario, Tom Lake 48°55′N, 80°50′W	—	3	2	22	36
		—	4.8%	3.2%	34.9%	57.1%

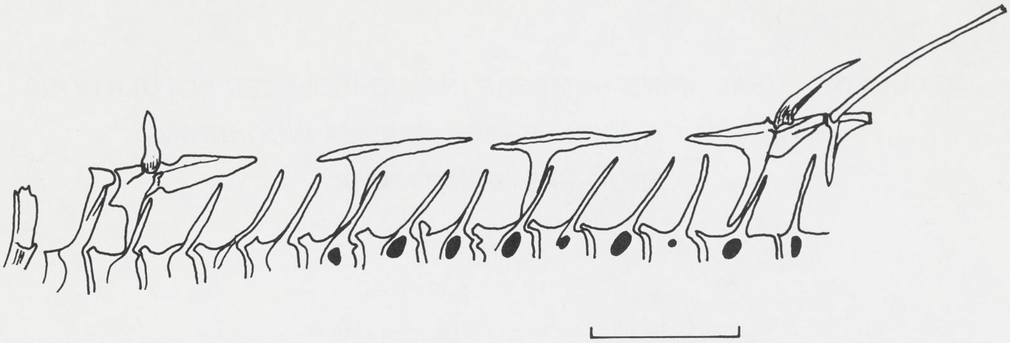

Figure 1. Lateral view of vertebrae and dorsal spine elements preceding the soft dorsal fin in a 40 mm SL *Culaea inconstans* from Lac du Beau Portage. Four basals are present over the anterior vertebrae and bear spines 1 and 4 only. Scale : 2.5 mm.

In the present study, 6983 specimens from 272 collections of *Culaea inconstans* throughout Canada (Northwest Territories, British Columbia, Alberta, Manitoba, Ontario, Québec, New Brunswick, Nova Scotia) and in the United States (New York, North Dakota) were examined for fish with less than four dorsal spines. Two collections were found and the dorsal spine counts are shown in Table I. Both collections were seined from small, internally drained marshes which were not known to have other fish species present. Spine counts made included the spine immediately preceding the soft dorsal fin and all other spine elements. Five specimens with one or two dorsal spines were stained in an alizarin preparation for closer examination. A diagram of one specimen is shown in Figure 1. All specimens examined were from the National Museum of Natural Sciences, Ottawa, Ontario (NMC).

All alizarin stained specimens had four or five basals. There was a dorsal spine present immediately in front of the soft dorsal fin in all the fish examined. In some cases this was the only dorsal spine. It was also observed that 50 of 63 specimens (79.4%) from Tom Lake lacked or had reduced pelvic skeletons, including the five specimens with low counts of two or three dorsal spines (Table II). The *Culaea* from Lac du Beau Portage had normal pelvic skeletons.

Culaea pelvic spines have been shown to be important deterrents against some predators (Reist, 1980a) but there is no experimental evidence of the effectiveness of dorsal spines in this respect. Reduction of pelvic spines, and by implication dorsal spines, is probably not simply related to presence or absence of predators. Behavioural and environmental factors may also be involved (Moodie, 1977 ; Nelson, 1977 ; Reist, 1980a, b). The available data do not permit an accurate assessment of the selective pressures operating in Lac du Beau Portage and Tom Lake.

Acknowledgments

We would like to thank André Talbot for drawing our attention to the specimens from Lac

TABLE II

Frequency (and percent) of complete, reduced and absent pelvic skeletons in relation to dorsal spine number for brook sticklebacks, *Culaea inconstans,* from Tom Lake

Pelvic skeleton	*Dorsal spine number* 2	3	4	5
Complete	— —	— —	6 (9.5)	7 (11.1)
Reduced	1 (1.6)	— —	2 (3.2)	3 (4.8)
Absent	2 (3.2)	2 (3.2)	14 (22.2)	26 (41.3)

du Beau Portage and Dr. D.E. McAllister, National Museum of Natural Sciences, Ottawa, Ontario, for providing helpful comments on the manuscript.

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A re-description and generic re-assignment of *Kosswigobarbus kosswigi* (LADIGES, 1960), a cyprinid fish from Turkey and Iran

BRIAN W. COAD[1])

Abstract

Kosswigobarbus kosswigi (LADIGES, 1960), formerly known only from the holotype, is re-described based on 5 specimens from Tigris River tributaries of Iran, 500 air kilometres southeast of the type locality in Turkey. Its characters do not appear to warrant its retention in a genus distinct from *Barbus* s. l.

LADIGES (1960) described a new species of cyprinid fish, *Cyclocheilichthys kosswigi*, based on a single, damaged specimen collected in 1939 by CURT KOSSWIG from the Batman suyu, Turkey. The Batman suyu, (suyu = stream) enters the Tigris River at 37°47½'N, 41°00'E near the town of Batman in Siirt Province. This holotype, 162.7 mm SL, is in the Zoologisches Institut und Zoologisches Museum, Universität Hamburg (ZMH1148) and was re-examined by KARAMAN (1971) who placed it alone in a new genus, *Kosswigobarbus*. Through the courtesy of Prof. Dr. H. WILKENS I have also been able to examine the holotype.

It does not appear to be closely related to the species of the south-east Asian *Cyclocheilichthys* BLEEKER, 1860 which differ in several respects such as a head with numerous sensory folds in parallel groups, a dorsal fin spine with teeth, eight branched dorsal fin rays and five branched anal fin rays. Its closest relationship may lie with those *Barbus* of south-west Asia which have six branched anal fin rays, a smooth dorsal fin spine and large scales, namely *B. apoensis* BANISTER and CLARKE, *B. canis* VALENCIENNES, *B. exulatus* BANISTER and CLARKE and *B. luteus* (HECKEL) [see KARAMAN (1971) and BANISTER and CLARKE (1977) for comparative descriptions]. I disagree with KARAMAN's referral of this species to a genus distinct from *Barbus* sensu lato on the basis of the fin ray characters, a well developed rostral flap, numerous fine pores on the head, and large lachrymal bone. These characters, while unique in combination, are found or closely approached in other *Barbus* species of south-west Asia [see also MYERS (1960) and BANISTER (1980) for comments on *Barbus* s. l. taxonomy].

I have examined one male and four female specimens from Tigris River tributaries in Iran which I refer to *Barbus kosswigi*. These localities are over 500 air kilometres southeast of the type locality. A description of this material follows to augment the descriptions of the holotype (which lacks some of its scales and has had its pharyngeal arches removed and presumably lost).

1) Anschrift des Verfassers: Dr. BRIAN W. COAD, Ichthyology Section, National Museum of Natural Sciences, Ottawa, Ontario, Canada. KlA OM8.

General body shape and structure of the mouth are as depicted by KARA-MAN (1971) except that the rostral flap is not as well developed and does not overlap the upper lip sufficiently to become markedly visible in ventral view. Lips are thick, continuous and fleshy and there is a large median lobe to the lower lip. The mouth is small, ventral and U-shaped. The gill membranes are broadly joined to the isthmus. There are two pairs of thin barbels. The dorsal fin origin lies over or slightly in advance of the ventral fin origin. The dorsal fin margin is markedly concave and the last unbranched dorsal ray is a strong spine without teeth. The caudal fin is deeply forked. The anal fin when adpressed reaches or almost reaches the caudal fin base in the female specimens but lies well short of this base in the male specimen.

The peritoneum is black and the gut is elongate and coiled. Pharyngeal tooth counts for two specimens are 2, 3, 5–4, 3, 2 and 2, 3, 5–5, 3, 2 and teeth are hooked at the tip.

Scales are regularly arranged over the body. A low sheath of scales is found at the bases of the dorsal and anal fin being most evident anteriorly. There is a pelvic axillary scale. The anal papilla is closely surrounded by scales and does not protrude. Scales from the flank below the dorsal fin bear radii on both the anterior and the posterior fields. Anterior radii are few (5–11 in five scales from one specimen) while posterior radii are numerous (35–40).

Meristic characters are as follows with number of specimens in parentheses: Dorsal fin rays III, 10 (1), IV, 10 (4), anal fin rays III, 6 (5), ventral fin rays I, 8 (5), pectoral fin rays I, 15 (1), I, 16 (3), I, 17, (1), caudal fin branched rays 17 (5), lateral line scales 29 (1), 30 (1), 32 (1), 35 (2), scales above lateral line 6 (5), scales below lateral line 5 (2), 6 (3), scales between lateral line and ventral fin 4 (5), predorsal scale rows 13 (4), 14 (1), scales around caudal peduncle 12 (1), 13 (1), 14 (1), 15 (2), gill rakers on whole first arch 10 (1), 11 (2), 12 (2), total vertebrae including four Weberian vertebrae and the hypural plate 39 (4), 40 (1). The holotype has 40 vertebrae.

Morphometric characters follow and are given as a range with a mean in parentheses. Head length in standard length 4.0–4.3 (4.1), head depth in standard length 5.0–5.5 (5.2), body depth in standard length 3.5–3.9 (3.6), predorsal length in standard length 1.8–2.0 (1.9), preventral length in standard length 1.9–2.1 (2.0), head width in head length 1.6–1.7 (1.7), snout length in head length 2.6–2.7 (2.7), eye diameter in head length 3.8–4.2 (3.9), interorbital width in head length 2.6–2.9 (2.8), postorbital length in head length 2.2–2.3 (2.2), pectoral fin length in head length 1.1–1.2 (1.2), ventral fin length in head length 1.1–1.3 (1.2), mouth width in head length 3.9–5.3 (4.6), anterior barbel length in head length 5.0–6.1 (5.4), posterior barbel length in head length 4.0–5.0 (4.5), longest dorsal fin branched ray length in head length 0.9–1.1 (1.0), longest anal fin branched ray length in head length 1.0–1.3 (1.2), length shortest dorsal fin branched ray in length longest dorsal fin branched ray 2.2–2.9 (2.5), length dorsal fin spine in head length 0.9–1.0 (0.9), pectoral fin length in pectoral-ventral fin distance 1.0–1.3 (1.1), ventral fin length in ventral-anal fin distance 1.2–1.3 (1.3), and caudal peduncle depth in caudal peduncle length 1.5–1.7 (1.6).

Pigmentation of the fins is light with scattered melanophores on both rays and membranes. Some concentration of pigment is found on the dorsal fin membranes but its extent varies individually. Upper flank scales are outlined by pigment which is most evident anteriorly on each scale.

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Abbreviations: – NMC, National Museums of Canada, Ottawa; MMTT, National Museum of Natural History, Tehran; SL, standard length; TL, total length.

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Other records. – MMTT 530, 531, 2 specimens, 97 mm TL, Gamasiab River, ca 34°23'N, ca 47°27'E, May 1972. MMTT (no catalogue number), 79 mm TL, Hamadan, Haramabad or Malayer River, 34°17'N, 48°47'E, 1 December 1974. (after Armantrout 1980).

Acknowledgements

I am indebted to the Research Council of Pahlavi (now Shiraz) University, Shiraz, Iran for funding of collection trips (research grants 35-A5-149-172 and 37-AS-251-238). Specimens were collected by K. Evans and H. Assadi and their efforts are gratefully acknowledged.

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A RE-DESCRIPTION AND GENERIC RE-ASSIGNMENT OF KOSSWIGOBARBUS KOSSWIGI (LADIGES, 1960), A CYPRINID FISH FROM TURKEY AND IRAN.

Brian W. Coad[1])

Abstract

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---

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Other records. - NMC 79-0368, 69.2 mm SL, Khuzestan, Karkheh River, 32°24½'N, 48°09'E, 28 January 1978 (damaged specimen) MMTT 530, 531, 2 specimens, 97 mm TL, Gamasiab River, ca 34°23'N, ca 47°27'E, May 1972. MMTT (no catalogue number), 79 mm TL, Hamadan, Haramabad or Malayer River, 34°17'N, 48°47'E, 1 December 1974. (after Armantrout, 1980).

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GARRA PERSICA BERG, 1913, A VALID SPECIES OF CYPRINID FISH FROM SOUTH-EASTERN IRAN

by

Brian W. COAD (1)

RÉSUMÉ. – La validité de *Garra persica*, un cyprinidé retrouvé dans les provinces du Balutchistan et d'Hormozdgan dans le sud-est de l'Iran, est réaffirmée. Cette espèce était considérée comme synonyme de *Garra rufa* (Heckel). On donne une description fondée sur des exemplaires provenant de la localité-type ainsi que sur du matériel comparatif couvrant l'aire de répartition de l'espèce, qui est étendue plus de 500 km vers l'ouest jusqu'aux drainages du golfe Persique.

SUMMARY. – The validity of *Garra persica*, a cyprinid fish from the provinces of Baluchestan and Hormozdgan in southeastern Iran, is reaffirmed. This species has been regarded as a synonym of *Garra rufa* (Heckel). A description is given based on topotypes and comparative material from the whole range of species which is extended over 500 km westward to Persian Gulf drainages.

Garra persica was briefly described as a new species by Berg (1913) from seven specimens collected by N.A. Zarudnyi in south-eastern Iran. A more detailed description was given by Berg (1914) based on the same material but a holotype was not designated. The seven specimens were identified incorrectly as *Discognathus lamta* (Hamilton, 1822) by Nikolsky (1899). Six of the specimens were listed as from the Bampur River, Baluchestan in Nikolsky (1899) and Berg (1913, 1914) but Berg (1949) cited ten specimens as the type-series from this locality under the same collection number, possibly an error. The seventh specimen was collected at Kiabad in the Zirkuh region of eastern Khorasan. This locality is obscure but may be near Zir-e Kuh, a mountain at 32°48'N, 59°50'E West of the Sistan basin as Zarudnyi's (1898) itinerary indicates he was en route to Sistan on the collection date given by Nikolsky (1899) and Berg (1913) for the specimen. *Garra persica* has not been recollected in this area.

Menon (1964), in a monograph on the genus *Garra*, placed *G. persica* in the synonymy of *G. rufa obtusa* (Heckel, 1843). Saadati (1977) provisionally recognised *G. persica* as a valid species. Saadati's two specimens and a specimen from the Oregon State University, Corvallis collections examined by Armantrout (1980) differ in a number of respects from the material collected by me, particularly in scale counts, and are excluded from the present description. Saadati (1977) and Armantrout (1980) incorrectly regard the specimen from Zirkuh as the holotype but Berg's specimens are syntypes (Berg, 1949).

(1) Ichthyology Section, National Museum of Natural Sciences, Ottawa, Ontario, Canada, KIA OM8.

The description given below is based on 12 small recently collected specimens from the type-locality and comparative material from the provinces of Hormozdgan and eastern Fars comprising 110 specimens thus extending the distribution of *G. persica* westwards to include the basins of rivers draining to the eastern Persian Gulf at the Straits of Hormoz (see Coad, 1982 for map).

Dorsal fin rays IV-7 ; anal fin rays III-4 (3 specimens), III-5 (9) ; ventral fin rays I-6 (1), I-7 (11) ; pectoral fin rays I-12 (1), I-13 (6), I-14 (4) (one specimen too small to count accurately) ; branched caudal fin rays 15 (1), 16 (10), 17 (1) ; lateral line scales to hypural fold 29 (2), 30 (1), 31 (1), 32 (2), 33 (2), 34 (2), 35 (2) ; scales above lateral line 4 (7), 5 (5) ; scales below lateral line 4 (12) ; scales between lateral line and ventral fin 3 (1), 4 (11) ; predorsal rows 11 (1), 12 (2), 13 (2), 14 (7) ; scales around caudal peduncle 12 (11), 13 (1) ; total vertebrae including urostylar centrum 34 (9), 35 (3) ; gill rakers on whole first arch 15 (in 6 specimens) ; pharyngeal teeth 2, 4, 5-5, 4, 2 (in 5 specimens).

Head length in standard length 3.7 - 4.0 (mean 3.8), body depth in standard length 4.6 - 5.2 (4.9), head depth in standard length 5.6 - 6.1 (5.9), predorsal length in standard length 1.9 - 2.1 (2.0), pectoral fin length in standard length 3.8 - 4.9 (4.4), prepelvic length in standard length 1.8 - 1.9 (1.9), head width in head length 1.4 - 1.5 (1.4), head depth in head length 1.5 - 1.6 (1.5), snout length in head length 2.3 - 2.7 (2.4), orbit diameter in head length 3.4 - 3.9 (3.6), interorbital width in head length 2.3 - 2.6 (2.5), caudal peduncle length in head length 1.4 - 1.8 (1.6), mouth width in head length, 2.4 - 3.2 (2.7), orbit diameter in interorbital width, 1.3 - 1.7 (1.4), disc length in head length 2.7 - 4.1 (3.3), disc width in head width 1.4 - 2.0 (1.6), disc length in disc width 1.4 - 1.5 (1.4), caudal peduncle depth in caudal peduncle length 1.1 - 1.7 (1.4), pectoral fin length in pectoral - ventral fin distance 1.1 - 1.6 (1.3), ventral fin length in ventral - anal fin distance 1.1 - 1.4 (1.2), anal papilla to anal fin length in ventral - anal fin distance 6.3 - 8.7 (7.3), length longest anal fin ray in longest dorsal fin ray 1.1 - 1.4 (1.2), and anal papilla to anal fin length as a percentage of ventral - anal fin distance 11.5 - 15.8 (13.9).

Dorsal fin origin well in advance of ventral fin origin. Caudal fin moderately forked, dorsal fin emarginate and anal fin rounded. Gill membranes are attached to isthmus at or behind a level with the preopercular bone. Peritoneum black and gut greatly coiled. The pharyngeal teeth bear flattened crowns. Disc and rostral fold greatly papillose. Centre of disc not as papillose as margins. Rostral fold margin weakly fringed. Scales regularly arranged except on anterior portion of isthmus where absent. Pelvic axillary scale present but not always well developed. Radii numerous on all fields, focus broken up into a network of lines. Tuberculate males have a transverse depression anterior to the nostrils. Tubercles are found between the eye and nostril, around the margins of the transverse depression, below the nostril and very weakly on anterior head surface between the eyes. Not developed elsewhere.

There is a large dark spot at or just below the beginning of the lateral line on the flank behind the postero-dorsal corner of the operculum. In life this spot has a dark blue tinge. The bases of the pectoral fins are also tinged blue. The flanks are orange-brown and the fins pink. In preserved specimens there are elongate blotches lining the posterior half of each dorsal fin membrane and fading dorsally. In some fish these blotches occupy the whole membrane and are developed dorsally. Ventrally there is a gap between these blotches and 3-5 bars which originate at the posterior edge of the base of branched ray three and succeeding rays, and extend dorsally across the ray and then along the ray and the membrane to the gap. These bars are much more heavily pigmented than the dorsal blotches. The pigmentation on the caudal fin varies with the individual. Some are blotched irregularly on both rays and membranes, in others there is a trace of a band in mid-fin extending from the dorsal to the ventral margin following the posterior outline of the fin, while others have pigment heavily concentrated only in the mid-fin clear of the margins. The ventral fin has little or no pigment and the anal fin has a very few irregular light blotches on both rays and membranes. The pectoral fin is pigmented near the base dorsally with some pigment on anterior rays and membranes.

This species is clearly distinguished from other *Garra* s.s. of Iran seen by me in having a mode of 7, as opposed to 8, branched rays in the dorsal fin and a mode of 16 branched rays in the caudal fin as opposed to 17. Comparative material of *G. persica* from Persian Gulf and Hamun- e Jaz Murian drainages had 6 dorsal fin branched rays in 2 fish, 7 (106), or 8 (1) (one specimen excluded because fin was abnormally developed) and 15 branched rays in the caudal fin in 6 fish, 16 (97), 17 (3) or 18 (1) (three specimens damaged).

Material examined. – All specimens examined are deposited at the National Museum of Natural Sciences, National Museums of Canada, Ottawa (NMC) and further details are on file. From the type-locality : NMC 79-0312, 10 specimens, 26.6 - 35.6 mm standard length (SL), Bampur River, 8 km west of Iranshahr, 27°11'N, 60°36'E, Baluchestan ; 1 December 1977, B.W. Coad, A. Tofangdar and A. Shirazi. NMC 79-0315, 23.8 mm SL, Bampur River, 2 km north of Karvandar, 27°51'N, 60°46'E, Baluchestan ; 1 December 1977, B.W. Coad, A. Tofangdar and Shirazi. NMC 79-0324, 29.6 mm SL, Bampur River at Qasemabad, 27°11'N, 60°22'E, Baluchestan ; 4 December 1977, B.W. Coad, A. Tofangdar and A. Shirazi.

Comparative material from Hormozdgan and Baluchestan : NMC 79-0138 (1 specimen), 27°32'N, 54°58 1/2'E ; NMC 79-0139 (1), ca. 27°25 1/2'N, 54°59'E ; NMC 79-0144 (1), 27°09 1/2'N, 57°04'E ; NMC 79-0145 (4), 26°55'N, 57°01 1/2'E ; NMC 79-0149 (7), 27°36'N, 56°14'E ; NMC 79-0152 (1), 28°09'N, 55°43'E ; NMC 79-0178 (25), 27°36'N, 56°15'E ; NMC 79-0180 (1), 27°19'N, 56°17 1/2'E ; NMC 79-0181 (1), 27°17 1/2'N, 56°03 1/2'E ; NMC 79-0186 (8), 27°24 1/2'N, ca. 56° 25'E ; NMC 79-0187 (9), 27°23 1/2'N, 56°26'E ; NMC 79-329 (2), 27°02'N, 61°20'E ; NMC 79-0411 (1), 27°24'N, 57°12'E ; NMC 79-0412 (9), 27°30'N, 57°34'E ; NMC 79-0416 (39), 27°27'N, 56°18'E.

Acknowledgements. – I am indebted to the Research Council of Pahlavi (now Shiraz) University, Shiraz, Iran which provided funds for field work (grants 35-A5-149-172 and 37-AS-251-238), and to Dr. Bahman Kholdebarin, former Chairman of the Biology Department for making arrangements for this field work. Drivers and field assistants H. Assadi, R.E. Lee, Sh Mansoorabadi, A. Shirazi and A. Tofangdar made the collection of the specimens possible by their energetic assistance. Dr. R.J. Behnke, Colorado State University, Fort Collins and Dr. C. Bond, Oregon State University, Corvallis kindly loaned me specimens in their care.

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Garra persica BERG, 1913, A VALID SPECIES OF CYPRINID FISH FROM SOUTH-EASTERN IRAN, BY BRIAN W. COAD(1)

RESUME.— La validité de *Garra persica*, un cyprinidé retrouvé dans les provinces du Balutchistan et d'Hormozdgan dans le sud-est de l'Iran, est réaffirmée. Cette espèce était considérée synonyme de *Garra rufa* (Heckel). On donne une description basée sur les topotypes ainsi que sur du matériel comparatif couvrant l'aire de répartition de l'espèce, qui est étendue plus de 500 km vers l'ouest jusqu'aux drainages du golfe Persique.

SUMMARY.— The validity of *Garra persica*, a cyprinid fish from the provinces of Baluchestan and Hormozdgan in southeastern Iran, is reaffirmed. This species has been regarded as a synonym of *Garra rufa* (Heckel). A description is given based on topotypes and comparative material from the whole range of the species which is extended over 500 km westward to Persian Gulf drainages.

Garra persica was briefly described as a new species by Berg (1913) from seven specimens collected by N.A. Zarudnyi in south-eastern Iran. A more detailed description was given by Berg (1914) based on the same material but a holotype was not designated. The seven specimens were identified incorrectly as *Discognathus lamta* (Hamilton, 1822) by Nikolsky

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(1899). Six of the specimens were listed as from the Bampur River, Baluchestan in Nikolsky (1899) and Berg (1913, 1914) but Berg (1949) cited ten specimens as the type-series from this locality under the same collection number, possibly in error. The seventh specimen was collected at Kiabad in the Zirkuh region of eastern Khorasan. This locality is obscure but may be near Zir-e Kuh, a mountain at 32°48'N, 59°50'E west of the Sistan basin as Zarudnyi's (1898) itinerary indicates he was en route to Sistan on the collection date given by Nikolsky (1899) and Berg (1913) for the specimen. *Garra persica* has not been re-collected in this area.

Menon (1964), in a monograph on the genus *Garra*, placed *G. persica* in the synonymy of *G. rufa obtusa* (Heckel, 1843). Saadati (1977) provisionally recognised *G. persica* as a valid species. Saadati's two specimens and a specimen from the Oregon State University, Corvallis collections examined by Armantrout (1980) differ in a number of respects from the material collected by me, particularly in scale counts, and are excluded from the present description. Saadati (1977) and Armantrout (1980) incorrectly regard the specimen from Zirkuh as the holotype but Berg's specimens are syntypes (Berg, 1949).

The description given below is based on 12 small recently collected topotypes and comparative material from the provinces of Hormozdgan and eastern Fars comprising 110 specimens thus extending the distribution of *G. persica* westwards to include the basins of rivers draining to the eastern Persian Gulf at the Straits of Hormoz (see Coad, 1982 for map).

Dorsal fin rays IV-7; anal fin rays III-4 (3 specimens), III-5 (9); ventral fin rays I-6 (1), I-7 (11); pectoral fin rays I-12 (1), I-13 (6), I-14 (4) (one specimen too small to count accurately); branched caudal fin rays 15 (1), 16 (10), 17 (1); lateral line scales to hypural fold 29 (2), 30 (1), 31 (1), 32 (2), 33 (2), 34 (2), 35 (2); scales above lateral line 4 (7), 5 (5); scales below lateral line 4 (12); scales between lateral line and ventral fin 3 (1), 4 (11); predorsal scale rows 11 (1), 12 (2), 13 (2), 14 (7); scales around caudal peduncle 12 (11), 13 (1); total vertebrae including urostylar centrum 34 (9), 35 (3); gill rakers on whole first arch 15 (in 6 specimens); pharyngeal teeth 2, 4, 5-5, 4, 2 (in 5 specimens).

Head length in standard length 3.7 - 4.0 (mean 3.8), body depth in standard length 4.6 - 5.2 (4.9), head depth in standard length 5.6 - 6.1 (5.9), predorsal length in standard length 1.9 - 2.1 (2.0), pectoral fin length in standard length 3.8 - 4.9 (4.4), prepelvic length in standard length 1.8 - 1.9 (1.9), head width in head length 1.4 - 1.5 (1.4), head depth in head length 1.5 - 1.6 (1.5), snout length in head length 2.3 - 2.7 (2.4), orbit diameter in head length 3.4 - 3.9 (3.6), interorbital width in head length 2.3 - 2.6 (2.5), caudal peduncle length in head length 1.4 - 1.8 (1.6), mouth width in head length, 2.4 - 3.2 (2.7), orbit diameter in interorbital width, 1.3 - 1.7 (1.4), disc length in head length 2.7 - 4.1 (3.3), disc width in head width 1.4 - 2.0 (1.6), disc length in disc width 1.4 - 1.5 (1.4), caudal peduncle depth in caudal peduncle length 1.1 - 1.7 (1.4), pectoral fin length in pectoral - ventral fin distance 1.1 - 1.6 (1.3), ventral fin length in ventral - anal fin distance 1.1 - 1.4 (1.2), anal papilla to anal fin length in ventral - anal fin distance 6.3 - 8.7 (7.3), length longest anal fin ray in longest dorsal fin ray 1.1 - 1.4 (1.2), and anal papilla to anal fin length as a percentage of ventral - anal fin distance 11.5 - 15.8 (13.9).

Dorsal fin origin well in advance of ventral fin origin. Caudal fin moderately forked, dorsal fin emarginate and anal fin rounded. Gill membranes are attached to isthmus at or behind a level with the preopercular bone. Peritoneum black and gut greatly coiled. The pharyngeal teeth bear flattened crowns. Disc and rostral fold greatly papillose. Centre of disc not as papillose as margins. Rostral fold margin weakly fringed. Scales regularly arranged except on anterior portion of isthmus where absent. Pelvic axillary scale present but not always well developed. Radii numerous on all fields, focus broken up into a network of lines. Tuberculate males have a transverse depression anterior to the nostrils. Tubercles are found between the eye and nostril, around the margins of the transverse depression, below the nostril and very weakly on anterior head surface between the eyes. Not developed elsewhere.

There is a large dark spot at or just below the beginning of the lateral line on the flank behind the postero-dorsal corner of the operculum. In life this spot has a dark blue tinge. The bases of the pectoral fins are also tinged blue. The flanks are orange-brown and the fins pink. In preserved specimens there are elongate blotches lining the posterior half of each dorsal fin membrance and fading dorsally. In some fish these blotches occupy the whole membrance and are developed dorsally. Ventrally there is a gap between these blotches and 3-5 bars which originate at the posterior edge of the base of branched ray three and succeeding rays, and extend dorsally across the ray and then along the ray and the membrane to the gap. These bars are much more heavily pigmented than the dorsal blotches. The pigmentation on the caudal fin varies with the individual. Some are blotched irregularly on both rays and membranes, in others there is a trace of a band in mid-fin extending from the dorsal to the ventral margin following the posterior outline of the fin, while others have pigment heavily concentrated only in the mid-fin clear of the margins. The ventral fin has little or no pigment and the anal fin has a very few irregular light blotches on both rays and membranes. The pectoral fin is pigmented near the base dorsally with some pigment on anterior rays and membranes.

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EUPHRATES AND TIGRIS, MESOPOTAMIAN ECOLOGY AND DESTINY

By Julian Rozska with contributions by J. F. Talling, F. R. S. and Dr. K. E. Bainster. Monographiae Biologicae, Volume 38, Dr. W. Junk by Publishers, The Hague, 1980. x + 122 pp., 36 figs., map.—U.S. $ 33.31.

The stated purpose of this book is to present a natural history of mesopotamia (modern Iraq) with particular reference to its two great rivers, the Euphrates and Tigris, and man's emergence as a dominating factor on the scene. This purpose is outlined in a brief introduction and the bulk of the work is divided into two sections "The land and its life" and "Mesopotamian Waters, Regime and Hydrobiology". The first section is 27 pages long, of which about 9 are taken up by photographs, tables and maps. Topics include geology, morphology, climate, soils, vegetation and crops, the land fauna, archaeology, and prehistoric and historic man. This treatment of the area known as mesopotamia forms a background for the second section on the waters of Iraq, which is 84 pages long with about 27 pages occupied by photographs, tables, graphs, maps and blank pages. Two chapters, "Water Characteristics" and "Phytoplankton" are by J. F. Talling and a third chapter on "The fishes of the Euphrates and Tigris" is by K. E. Banister. These chapters are available separately as reprints. The remaining chapters in the second section cover a brief review of other near east waters, the physical background of the Euphrates and Tigris, and the general biology of Iraq waters including vegetation, animal life, benthos and malaria. There is also a summary and an annexe dealing with the eyewitness accounts of the Mesopotamian past. There are over 5 pages of references and a short subject index. A number of recent works by Iraqi biologists on the limnology and hydrology of Iraq were not included presumably because these were not available before the book went to press.

The author admits that his book is "only a framework to be filled in years to come by local scientists" and in this lies its major fault. It is by for too short both for the price and for its subject headings, none of which are treated in depth in only about 75 pages of text. The Euphrates-Tigris basin is the major drainage between the Nile of the Ethiopian realm and the Indus of the Oriental realm and is therefore of great interest to biologists and to zoogeographers who wish to understand the affinities of the aguatic fauna of the Near East. Much more useful information could have been added from relevant published data on Syria, Turkey and Iran, and efforts to contact Iraqi biologists might have been rewarded by additional, unpublished data. However the book is a successful introduction to this part of the world and its value is enhanced by a series of ground and Landsat photographs.

Chapter 8 by K. E. Banister on fishes is of particular interest. He bases his annotated list on an interpretation of the literature and specimens in the British Museum (Natural History). This critical work is invaluable to newcomers to the literature on Mesopotamian fishes. However several papers and theses have appeared recently on the ichthyofauna of this area which were not available to Banister. These Include Saadati (1977), Al-Rawi *et al.*, (1978), Wossughi (1978), Armantrout (1980), and Coad (1980a, 1981a, 1981b). Banister clarifies the confusions which exist in several careless compilations including the classic case of the species *Euglyptosternum coum* (L.) (Siluridae), *Glyptothorax cous* (L.) (Sisoridae) and *Arius cous* Heckel (Ariidae) all of which are a single species, a sisorid catfish. In addition general comments are made on relationships of certain species to the faunas of Africa and the Indian subcontinent. The Euphrates-Tigris fauna is dominated by Ostariophysi which is unique in a large subtropical river system.

Some comments may be made on the list of primary freshwater fishes given by Banister. He is correct in pointing out that the cyprinid *phoxinellus* (*Pseudophoxinus*) *zeregi* is probably a misidentification. However *Pseudophoxinus* species are found in the Euphrates-Tigris basin and to the east and south. Saadati (1977) reported a manuscript species from Iranian Tigris tributaries although the specimens have since been lost. *Pseudophoxinus persidis* described by me (1981b) is found in endorheic and Persian Gulf drainages of southern Iran including rivers once tributary to the Euphrates-Tigris before the post-glacial rise in sea level.

It is unlikely that *Barilius mesopotamicus* belongs in the genus *Leucaspius* as suggested by Howes (1980) but rather that its relationship is with the Indian *Barilius* species. *B. mesopotamicus* has 1–2 pairs of barbels, a complete lateral line in adults, and a row of upper flank spots, characters not found in *Leucaspius*. *In addition B. mesopotamicus* females do not have the pronounced anal papillae found in *Leucaspius*.

Banister is incorrect in stating that *Mastacembelus mastacembelus* is absent from Iran and from outside the Euphrates-Tigris basin (see Coad, 1980a) although its disjunct distribution in Iran is related to the post-glacial rise in sea level which filled the Persian Gulf isolating former affluents of the system. *Salmo trutta* has been reported from an Iranian Tigris River tributary as well as Anatoli (Armantrout, 1980).

The record of *Sabanajewia aurata* from the Euphrates-Tigris basin is based on a single specimen which may have been mislabelled (Banarescu, (1973). *Leuciscus berak* (Heckel) is probably *L. cephalus orientalis*. *Chondrostoma nasus* may be a misidentification of *C. regium* (see Ladiges, 1966). The types of *Glyptothorax steindachneri* have been lost and this species may be a synonym of *G. cous* (see Coad, 1981a).

Species omitted from the list or recently described include the cobitid *Noemacheilus kermanshahensis* from Iranian Tigris tributaries, the cyprinids *Barbus kosswigi* from a Tigris tributary in Turkey (the holotype) and also from Iranian waters (my own collections), *Alburnus heckeli* Battalgil (or *A. akili* Battalgil, see Banarescu, 1977), *Capoeta macrolepis* (see Saadati, 1977), the Iranian cave fishes *Iranocypris typhlops* and *Noemacheilus smithi* (see Coad, 1980b), a second cave fish from Iraq

Caecocypris basimi (described by Banister and Bunni, 1980), and the sisorid catfish *Glyptothorax silviae* Coad, 1981.

Banister's list is restricted to primary freshwater fishes (with the addition of the trout for convenience) but this does not give a true idea of the diversity of species and families which may be encountered. My own list includes 38 families many of which are primarily marine but which do penetrate into fresh waters. These include a shark reported from Baghdad, possibly *Carcharhinus gangeticus*, the commercially important clupeid *Hilsa ilisha*, cyprinodontids of the genus *Aphanius*, several *Mugil* and *Liza* species, and a number of introduced species such as *Salmo gairdneri*, *Carassius auratus*, *Cyprinus carpio*, *Ictalurus nebulosus*, and *Gambusia affinis*.

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EUPHRATES AND TIGRIS, MESOPOTAMIAN ECOLOGY AND DESTINY.

By Julian Rzóska with contributions by J. F. Talling, F. R. S. and Dr. K. E. Banister. Monographiae Biologicae, Volume 38, Dr. W. Junk bv Publishers, The Hague, 1980. x + 122 pp., 36 figs., map.- U.S. $33.31.

The stated purpose of this book is to present a natural history of Mesopotamia (modern Iraq) with particular reference to its two great rivers, the Euphrates and Tigris, and man´s emergence as a dominating factor on the scene. This purpose is outlined in a brief introduction and the bulk of the work is divided into two sections "The land and its life" and "Mesopotamian Waters, Regime and Hydrobiology". The first section is 27 pages long, of which about 9 are taken up by photographs, tables and maps. Topics include geology, morphology, climate, soils, vegetation and crops, the land fauna, archaeology, and prehistoric and historic man. This treatment of the area known as Mesopotamia forms a background for the second section on the waters of Iraq, which is 84 pages long with about 27 pages occupied by photographs, tables, graphs, maps and blank pages. Two chapters, "Water Characteristics" and "Phytoplankton" are by J. F. Talling and a third chapter on "The fishes of the Euphrates and Tigris" is by K. E. Banister. These chapters are available separately as reprints. The remaining chapters in the second section cover a brief review of other Near East waters, the physical background of the Euphrates and Tigris, and the general biology of Iraq waters including vegetation, animal life, benthos and malaria. There is also a summary and an annexe dealing with the eyewitness accounts of the Mesopotamian past. There are over 5 pages of references and a short subject index. A number of recent works by Iraqi biologists on the limnology and hydrology of Iraq were not included presumably because these were not available before the book went to press.

The author admits that his book is "only a framework to be filled in years to come by local scientists" and in this lies its major fault. It is by far too short both for the price and for its subject headings, none of which are treated in depth in only about 75 pages of text. The Euphrates-Tigris basin is the major drainage between the Nile of the Ethiopian Realm and the Indus of the Oriental Realm and is therefore of great interest to biologists and to zoogeographers who wish to understand the affinities of the aquatic fauna of the Near East. Much more useful information could have been added from relevant published data on Syria, Turkey and Iran, and efforts to contact Iraqi biologists might have been rewarded by additional, unpublished data. However the book is a successful introduction to this part of the world and its value is enhanced by a series of ground and Landsat photographs.

Chapter 8 by K. E. Banister on fishes is of particular interest. He bases his annotated list on an interpretation of the literature and specimens in the British Museum (Natural History). This critical work is invaluable to newcomers to the literature on Mesopotamian fishes. However several papers and theses have appeared recently on the ichthyofauna of this area which were not available to Banister. These include Saadati (1977), Al-Rawi et al. (1978), Wossughi (1978), Armantrout (1980), and Coad (1980a, 1981a, 1981b). Banister clarifies the confusions which exist in several careless compilations including the classic case of the species Euglyptosternum coum (L.) (Siluridae), Glyptothorax cous (L.) (Sisoridae) and Arius cous Heckel (Ariidae) all of which are a single species, a sisorid catfish. In addition general comments are made on relationships of certain species to the faunas of Africa and the Indian subcontinent. The Euphrates-Tigris fauna is dominated by Ostariophysi which is unique in a large subtropical river system.

Some comments may be made on the list of primary freshwater fishes given by Banister. He is correct in pointing out that the cyprinid Phoxinellus (= Pseudophoxinus) zeregi is probably a misidentification. However Pseudophoxinus species are found in the Euphrates-Tigris basin and to the east and south. Saadati (1977) reported a manuscript species from Iranian Tigris tributaries although the specimens have since been lost. Pseudophoxinus persidis described by me (1981b) is found in endorheic and Persian Gulf drainages of southern Iran including rivers once tributary to the Euphrates-Tigris before the post-glacial rise in sea level.

It is unlikely that Barilius mesopotamicus belongs in the genus Leucaspius as suggested by Howes (1980) but rather that its relationship is with the Indian Barilius species. B. mesopotamicus has 1-2 pairs of barbels, a complete lateral line in adults, and a row of upper flank spots, characters not found in Leucaspius. In addition

B. mesopotamicus females do not have the pronounced anal papillae found in *Leucaspius*.

Banister is incorrect in stating that *Mastacembelus mastacembelus* is absent from Iran and from outside the Euphrates-Tigris basin (see Coad, 1980a) although its disjunct distribution in Iran is related to the post-glacial rise in sea level which filled the Persian Gulf isolating former affluents of the system. *Salmo trutta* has been reported from an Iranian Tigris River tributary as well as Anatolia (Armantrout, 1980).

The record of *Sabanajewia aurata* from the Euphrates-Tigris basin is based on a single specimen which may have been mislabelled (Banarescu, 1973). *Leuciscus berak* (Heckel) is probably *L. cephalus orientalis*. *Chondrostoma nasus* may be a misidentification of *C. regium* (see Ladiges, 1966). The types of *Glyptothorax steindachneri* have been lost and this species may be a synonym of *G. cous* (see Coad, 1981a).

Species omitted from the list or recently described include the cobitid *Noemacheilus kermanshahensis* from Iranian Tigris tributaries, the cyprinids *Barbus kosswigi* from a Tigris tributary in Turkey (the holotype) and also from Iranian waters (my own collections), *Alburnus heckeli* Battalgil (or *A. akili* Battalgil, see Banarescu, 1977), *Capoeta macrolepis* (see Saadati, 1977), the Iranian cave fishes *Iranocypris typhlops* and *Noemacheilus smithi* (see Coad, 1980b), a second cave fish from Iraq *Caecocypris basimi* (described by Banister and Bunni, 1980), and the sisorid catfish *Glyptothorax silviae* Coad, 1981.

Banister's list is restricted to primary freshwater fishes (with the addition of the trout for convenience) but this does not give a true idea of the diversity of species and families which may be encountered. My own list includes 38 families many of which are primarily marine but which do penetrate into fresh waters. These include a shark reported from Baghdad, possibly *Carcharhinus gangeticus*, the commercially important clupeid *Hilsa ilisha*, cyprinodontids of the genus *Aphanius*, several *Mugil* and *Liza* species, and a number of introduced species such as *Salmo gairdneri*, *Carassius auratus*, *Cyprinus carpio*, *Ictalurus nebulosus*, and *Gambusia affinis*.

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Acanthobrama centisquama Heckel and the validity of the genus *Mirogrex* Goren, Fishelson and Trewavas (Osteichthyes: Cyprinidae)

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Keywords: Cyprinidae, Middle East, taxonomy, zoogeography, *Acanthobrama, Mirogrex*

Abstract

The poorly known cyprinid fish *Acanthobrama centisquama* is re-described and its distribution is clarified. It is found in the Orontes basin and not waters around Damascus. The genus *Mirogrex* is synonymised with *Acanthobrama.*

Introduction

The cyprinid fish *Acanthobrama centisquama* was described by Heckel (1843: 1074, pl. IX, fig. 1) on a single specimen from Damascus. The only subsequent mention of this species was a record by Battalgil (1942) of two specimens from the Orontes (probably repeated by Kosswig & Battalgil (1943) from Antakya (= Antioch)), and a reference to a single specimen by Tortonese (1952) from the Amik Göl (= Amik Lake). These localities are in Turkey, near the northwestern border of Syria, with the city of Antakya lying near but to the southwest of the Amik Lake in the drainage of the Orontes River (= Asi Nehri). Ladiges (1960) also records this species from the Amik Lake based on a Kosswig manuscript, possibly referring to Kosswig & Battalgil (1943).

None of these authors provided a detailed re-description of this interesting species, and Goren *et al* (1973) in their revision of *Acanthobrama* left open its generic status for want of information on gill rakers and other characters.

Goren *et al.* (1973) described a new genus, *Mirogrex*, founded on *Acanthobrama terraesanctae* Steinitz and characterised by high number and slender form of the gill rakers. The purpose of the present report is to re-describe *A. centisquama* based on new material and to assess the validity of *Mirogrex* in light of this new information.

Material

Acanthobrama centisquama

NMW 55339, ? Holotype, 136.1 mm SL, Orontes, 12. V. 1839.

MNHN 1977-266, 7 specimens, 106.0–193.5 mm SL, Lac d'Antioche, Turquie. Lab. Pêches Outre-Mer.

MNHN 1977-295, 1 specimen, 159.6 mm SL, Orontes, Syrie. Lab. Pêches Outre-Mer.

Mirogrex terraesanctae

NMC 80-0837, 3 specimens, 103.6–139.6 mm SL, Yam Kinneret (= Lake or Sea of Galilee), 10. VIII. 1979.

NMC 80-1236, 2 specimens, 80.0–92.1 mm SL, Yam Kinneret, 1968. M. Goren.

Methods

Counts and measurements follow Coad (1981).

Hydrobiologia 109, 275–278 (1984).

Distribution and description of *Acanthobrama centisquama*

a) Distribution

Heckel's (1843) description of the holotype clearly states, 'We obtained only one specimen, 7 inches long, from the waters near Damascus' (translation). Subsequent records listed above in the Introduction and in the Materials indicate that this species is found in the Orontes River basin which drains northwestern Syria and the adjacent part of Turkey, in particular the Amik Lake. Further field work may prove it to be restricted to the Amik Lake, occasionally penetrating the Orontes River, much as *Mirogrex terraesanctae* is found in Yam Kinneret and the former Lake Huleh (Goren, 1974) but may also penetrate the Jordan River system (Karaman, 1972).

Although Goren *et al.* (1973) could not locate the holotype of *Acanthobrama centisquama* in Vienna, a single specimen of this species is in the type collection. This specimen lacks pharyngeal arches which are dried and stored separately and are identified as belonging to *A. centisquama*. This specimen would seem to be the holotype. It approaches 7 inches in total length as cited by Heckel but the caudal fin ray tips are broken off and lost. The old label for this specimen gives 'Orontes' as the collection locality. The type locality of 'Damascus' may well be an error in Heckel's text. This species has not been re-collected near Damascus and all the available evidence suggests strongly that it is restricted to the Orontes basin. Records of *A. centisquama* from the upper Jordan River (Tristram, 1884) and Iraq (Mahdi, 1962; Al-Nasiri & Hoda, 1976; Banister, 1980) are regarded here as errors of identification, and in the case of Iraq, uncritical compilation.

b) Description

Figures of *A. centisquama* and its scales may be found in Heckel (1843) and these are reproduced in Goren *et al* (1973) with the addition of a diagram of the pharyngeal arches. The specimens at hand conform to the general body shape and in details of the scales to these figures. Larger specimens do develop a small nuchal hump so the transition from the head to the back is not smooth. The pharyngeal arches have narrow, compressed but flattened crowns, with some slight ridging. The count is uniformly 5–5. In smaller fish the teeth are slightly hooked at the tip. This is most evident on the posterior tooth of each row. The most anterior tooth is more massive and rounded than the other teeth, particularly in the larger individuals. There is, therefore, some variation in tooth development associated with size judging from the limited material available.

The dorsal and anal fins are falcate. The origin of the dorsal fin lies posterior to the level of the pelvic fin origin. The last, dorsal, unbranched fin ray is greatly thickened, smooth and tapers markedly only near the tip. It is much thicker than in *Mirogrex* of comparable size. In all the available specimens this ray is broken near the tip but its length approaches body depth. The caudal fin is moderately forked. Pectoral fin length is variable, in some specimens of both sexes it exceeds the distance between the pectoral and pelvic fin origins. Pelvic fin length is shorter than the distance between the pelvic and anal fin origins.

The mouth is slightly subterminal and oblique with a rounded snout protruding a little. In *Mirogrex* the lower jaw protrudes slightly. The rictus does not extend beyond the anterior eye margin. The mouth angle with the horizontal is variable, ranging from 25–45°, but this may represent artefacts of preservation. The angle is generally less than that of comparable individuals of *Mirogrex*. Gill rakers are shorter than the gill filaments (but longer than in other *Acanthobrama* species – about 3.2–4.3 in orbit diameter). In both length and form they closely resemble the figure of a *Mirogrex* arch depicted in Goren *et al* (1973). The gut is S-shaped and short. The peritoneum is strongly speckled but melanophores are not contiguous.

There is a pelvic axillary scale and a naked ventral keel extending from the bases of the pelvic fins to the anus. The scales are unusual in lacking radii and having the posterior margin irregular and crenate. There are numerous fine circuli around an almost central focus.

Dorsal fin rays III8 (8 specimens), III9 (1); anal fin rays III18 (1), III19 (5), III20 (2), III21 (1); pectoral fin rays I16 (6), I17 (2), I18 (1); pelvic fin rays I8 (8), I9 (1); branched caudal fin rays 17 (9); lateral line scales 82 (1), 88 (2), 89 (1), 90 (1), 91 (1), 92 (1), 96 (2); scales above the lateral line 18 (2), 19 (3), 20 (4); scales below the lateral line 13 (5), 14 (2), 15 (2); scales between the lateral line and the pelvic fin 7 (1), 8 (1), 9 (7); scales around the caudal peduncle 28 (4), 30 (2), 31 (1), 32 (1) (one fish lacking scales and not counted); total gill rakers on first arch 26 or more (arches damaged, most counts appear to be 26 to 28); precaudal vertebrae 20 (4), 21 (5); caudal vertebrae 21 (1), 22 (3), 23 (5); total vertebrae 42 (1), 43 (7), 44 (1).

Head length (HL) in standard length (SL) 4.1–4.4 (mean 4.2); body depth in SL 3.5–4.1 (3.7); head depth in SL 5.6–6.4 (6.0); predorsal length in SL 1.9–2.1 (2.0); prepelvic length in SL 2.2–2.3 (2.3); longest anal fin ray length in SL 6.1–7.0 (6.5); head width in HL 1.9–2.2 (2.0); snout length in HL 3.4–3.9 (3.6); orbit diameter in HL 3.4–4.0 (3.7); interorbital width in HL 3.2–3.7 (3.5); postorbital length in HL 1.9–2.2 (2.1); mouth width in HL 3.9–4.9 (4.4); pectoral fin length in HL 1.1–1.3 (1.2); pelvic fin length in HL 1.3–1.5 (1.4); pectoral fin length in distance between pectoral and pelvic fin origins 1.0–1.3 (1.1); pelvic fin length in distance between pelvic and anal fin origins 1.1–1.5 (1.4); caudal peduncle depth in caudal peduncle length 1.9–2.1 (2.0). The distal portions of the dorsal fin rays were broken in all but two specimens where length longest anal fin ray in length longest dorsal fin ray was 1.8 in both cases.

The preserved specimens were mostly depigmented and showed no distinctive pigmentation patterns except a diffuse trace of a posterior lateral band on the upper flank.

The validity of the genus Mirogrex

This genus was founded on *Acanthobrama terraesanctae* Steinitz of the Jordan River basin by Goren *et al* (1973). It was distinguished from *Acanthobrama* by possession of more than 20 total gill rakers on the first arch, the slender form of these rakers and a mouth angle with the horizontal greater than 40°. The first two characters, and probably the third, are adaptations to a largely planktonic diet (Goren *et al*, 1973). A new species, *Acanthobrama hadiyahensis,* from a Red Sea drainage of Saudi Arabia was described by Coad *et al.* (1983). This species has 17–19 short gill rakers, a count intermediate between *Acanthobrama* (12–15) and *Mirogrex* (20–28) as defined by Goren *et al* (1973). This eliminates the large gap between these two genera making the range of variation almost continuous and reducing the utility of this character for generic distinction.

The re-description of *Acanthobrama centisquama* given above would seem to indicate that it should be placed in *Mirogrex* because of its high raker count (about 26–28) and the close similarity of raker length and form. Mouth angle overlaps with figures for *Acanthobrama* and *Mirogrex*, with some tendency to favour lower angles more resembling *Acanthobrama*. However similarities in these characters may represent a common response to a lacustrine environment and diet. Trophic characters, which tend to be susceptible to rapid modification, should be treated with care in the absence of other shared and derived characters. Moreover, *A. centisquama* has several unique features which serve to disinguish it from both *Mirogrex* and *Acanthobrama*. The last, unbranched dorsal fin ray is much more massive, the scales lack radii and have crenate edges and the counts of lateral line scales and total vertebrae are higher and do not overlap.

If *Mirogrex* is accepted as a genus distinct from *Acanthobrama*, then the even more distinctive *A. centisquama* is surely deserving of equal rank. All these species share several characters which serve to define and relate a small group of six species found in a restricted area of the Middle East. These characters are a thickened, smooth, last unbranched dorsal fin ray, a naked ventral keel on the belly between the anus and the pelvic fins, a single row of pharyngeal teeth on each side, an elongate anal fin with 9–21 branched rays, and scales without radii on the anterior field.

No adequate purpose would be served by recognising three genera for these six species of restricted distribution having a number of characters in common. *Mirogrex* Goren, Fishelson & Trewavas is therefore regarded as a synonym of *Acanthobrama* Heckel.

Howes (1981) synonymised *Acanthobrama* and *Mirogrex* with *Rutilus* on osteological grounds but did not examine other characters. *Rutilus* does not have a thickened, smooth, last unbranched dorsal fin ray, a naked ventral keel, or an elongate anal fin, and the scale morphology is quite distinct. *Acanthobrama* is therefore recognised as a valid genus until more detailed studies can be carried out encompassing a wide variety of characters.

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Methods

Counts and measurements follow Coad (1981).

Distribution and description of _Acanthobrama centisquama_

a) Distribution

Heckel´s (1843) description of the holotype clearly states "We obtained only one specimen, 7 inches long, from the waters near Damascus" (translation). Subsequent records listed above in the Introduction and in the Materials indicate that this species is found in the Orontes River basin which drains northwestern Syria and the adjacent part of Turkey, in particular the Amik Lake. Further field work may prove it to be restricted to the Amik Lake, occasionally penetrating the Orontes River, much as Mirogrex terraesanctae is found in Yam Kinneret and the former Lake Huleh (Goren, 1974) but may also penetrate the Jordan River system (Karaman, 1972).

Although Goren et al (1973) could not locate the holotype of Acanthobrama centisquama in Vienna, a single specimen of this species is in the type collection. This specimen lacks pharyngeal arches which are dried and stored separately and are identified as belonging to A. centisquama. This specimen would seem to be the holotype. It approaches 7 inches in total length as cited by Heckel but the caudal fin ray tips are broken off and lost. The old label for this specimen gives "Orontes" as the collection locality. The type locality of "Damascus" may well be an error in Heckel´s text. This species has not been re-collected near Damascus and all the available evidence suggests strongly that it is restricted to the Orontes basin. Records of A. centisquama from the upper Jordan River (Tristram, 1884) and Iraq (Mahdi, 1962; Al-Nasiri and Hoda, 1976; Banister, 1980) are regarded here as errors of identification, and in the case of Iraq, uncritical compilation.

b) Description

Figures of A. centisquama and its scales may be found in Heckel (1843) and these are reproduced in Goren et al. (1973) with the addition of a diagram of the pharyngeal arches. The specimens at hand conform to the general body shape and in details of the scales to these figures. Larger specimens do develop a small nuchal hump so the transition from the head to the back is not smooth. The pharyngeal arches have narrow, compressed but flattened crowns, with some slight ridging. The count is uniformly 5-5. In smaller fish the teeth are slightly hooked at the tip. This is most evident on the posterior tooth of each row. The most anterior tooth is more massive and rounded than the other teeth, particularly in the larger individuals. There is, therefore, some variation in tooth development associated with size judging from the limited material available.

The dorsal and anal fins are falcate. The origin of the dorsal fin lies posterior to the level of the pelvic fin origin. The last, dorsal, unbranched fin ray is greatly thickened, smooth and tapers markedly only near the tip. It is much thicker than in *Mirogrex* of comparable size. In all the available specimens this ray is broken near the tip but its length approaches body depth. The caudal fin is moderately forked. Pectoral fin length is variable, in some specimens of both sexes it exceeds the distance between the pectoral and pelvic fin origins. Pelvic fin length is shorter than the distance between the pelvic and anal fin origins.

The mouth is slightly subterminal and oblique with a rounded snout protruding a little. In *Mirogrex* the lower jaw protrudes slightly. The rictus does not extend beyond the anterior eye margin. The mouth angle with the horizontal is variable, ranging from 25-45*, but this may represent artefacts of preservation. The angle is generally less than that of comparable individuals of *Mirogrex*. Gill rakers are shorter than the gill filaments (but longer than in other <u>Acanthobrama</u> species - about 3.2-4.3 in orbit diameter). In both length and form they closely resemble the figure of a <u>Mirogrex</u> arch depicted in Goren et al. (1973). The gut is S-shaped and short. The peritoneum is strongly speckled but melanophores are not contiguous.

There is a pelvic axillary scale and a naked ventral keel extending from the bases of the pelvic fins to the anus. The scales are unusual in lacking radii and having the posterior margin irregular and crenate. There are numerous fine circuli around an almost central focus.

Dorsal fin rays III8 (8 specimens), III9 (1); anal fin rays III18 (1), III19 (5), III20 (2), III21 (1); pectoral fin rays I16 (6), I17 (2), I18 (1); pelvic fin rays I8 (8), I9 (1); branched caudal fin rays 17 (9); lateral line scales 82 (1), 88 (2), 89 (1), 90 (1), 91 (1), 92 (1), 96 (2); scales above the lateral line 18 (2), 19 (3), 20 (4); scales below the lateral line 13 (5), 14 (2), 15 (2); scales between the lateral line and the pelvic fin 7 (1), 8 (1), 9 (7); scales around the caudal peduncle 28 (4), 30 (2), 31 (1), 32 (1) (one fish lacking scales and not counted); total gill rakers on first arch 26 or more (arches damaged, most counts appear to be 26 to 28); precaudal vertebrae 20 (4), 21 (5); caudal vertebrae 21 (1), 22 (3), 23 (5); total vertebrae 42 (1), 43 (7), 44 (1).

Head length (HL) in standard length (SL) 4.1-4.4 (mean 4.2); body depth in SL 3.5-4.1 (3.7); head depth in SL 5.6-6.4 (6.0); predorsal length in SL 1.9-2.1 (2.0); prepelvic length in SL 2.2-2.3 (2.3);

longest anal fin ray length in SL 6.1-7.0 (6.5); head width in HL 1.9-2.2 (2.0); snout length in HL 3.4-3.9 (3.6); orbit diameter in HL 3.4-4.0 (3.7); interorbital width in HL 3.2-3.7 (3.5); postorbital length in HL 1.9-2.2 (2.1); mouth width in HL 3.9-4.9 (4.4); pectoral fin length in HL 1.1-1.3 (1.2); pelvic fin length in HL 1.3-1.5 (1.4); pectoral fin length in distance between pectoral and pelvic fin origins 1.0-1.3 (1.1); pelvic fin length in distance between pelvic and anal fin origins 1.1-1.5 (1.4); caudal peduncle depth in caudal peduncle length 1.9-2.1 (2.0). The distal portions of the dorsal fin rays were broken in all but two specimens where length longest anal fin ray in length longest dorsal fin was 1.8 in both cases.

The preserved specimens were mostly depigmented and showed no distinctive pigmentation patterns except a diffuse trace of a posterior lateral band on the upper flank.

The validity of the genus *Mirogrex*

This genus was founded on *Acanthobrama terraesanctae* Steinitz of the Jordan River basin by Goren et al. (1973). It was distinguished from *Acanthobrama* by possession of more than 20 total gill rakers on the first arch, the slender form of these rakers and a mouth angle with the horizontal greater than 40*. The first two characters, and probably the third, are adaptations to a largely planktonic diet (Goren et al. 1973). A new species of *Acanthobrama* from a Red Sea drainage of Saudi Arabia is being described by me in collaboration with R. J. Behnke and H. F. Alkahem, Colorado State University, Fort

Collins. This species has 17-19 short gill rakers, a count intermediate between Acanthobrama (12-15) and Mirogrex (20-28) as defined by Goren et al. (1973). This eliminates the large gap between these two genera making the range of variation almost continuous and reducing the utility of this character for generic distinction.

The re-description of Acanthobrama centisquama given above would seem to indicate that it should be placed in Mirogrex because of its high raker count (about 26-28) and the close similarity of raker length and form. Mouth angle overlaps with figures for Acanthobrama and Mirogrex, with some tendency to favour lower angles more resembling Acanthobrama. However similarities in these characters may represent a common response to a lacustrine environment and diet. Trophic characters, which tend to be susceptible to rapid modification, should be treated with care in the absence of other shared and derived characters. Moreover, A. centisquama has several unique features which serve to distinguish it from both Mirogrex and Acanthobrama. The last, unbranched dorsal fin ray is much more massive, the scales lack radii and have crenate edges, and the counts of lateral line scales and total vertebrae are higher and do not overlap.

If Mirogrex is accepted as a genus distinct from Acanthobrama, then the even more distinctive A. centisquama is surely deserving of equal rank. All these species share several characters which serve to define and relate a small group of six species found in a restricted area of the Middle East. These characters are a thickened, smooth, last unbranched dorsal fin ray, a naked ventral keel on the belly between the anus and the pelvic fins, a single row of pharyngeal teeth on each side, an elongate anal fin with 9-21 branched rays, and scales without radii on the anterior field.

No adequate purpose would be served by recognising three genera for these six species of restricted distribution having a number of characters in common. Mirogrex Goren, Fishelson and Trewavas is therefore regarded as a synonym of Acanthobrama Heckel.

Acknowledgements

I am indebted to Drs. M. L. Bauchot and M. Desoutter, Muséum National d'Histoire Naturelle, Paris (MNHN) and Dr. Rainer Hacker and Mr. Harald Ahnelt, Naturhistorisches Museum Wien (NMW) for loan of specimens. Dr. A. Ben-Tuvia, Zoological Museum, Hebrew University of Jerusalem and Dr. M. Goren, Department of Zoology, Tel Aviv University kindly made gifts of Acanthobrama species which are catalogued in the National Museum of Natural Sciences, Ottawa (NMC).

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CONTENTS

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INSHORE FISHES OF THE ARABIAN GULF

By Kenneth Relyea. George Allen and Unwin, London, 149 pp., 40 figs., 8 colour plates, map. U.S.$. 20.00, £ 7.95.

This book is designed as an aid to identification of fishes found in shallow waters or in fish markets of the Arabian (=Persian) Gulf. It is meant for use by informed laymen, students and biologists new to the area. The only other books which cover this part of the Indo-West Pacific region are out of print or not generally available to the non-specialist (Blegvad, 1944; White and Barwani, 1971; Kuronuma and Abe, 1972). Other works cover such a wide area with an immense diversity of species that is most confusing to those without specialist knowledge. Relyea is, therefore, to be commended for his efforts to produce a guide to the commoner species of Gulf fishes.

The book comprises a short but exhaustive glossary of terms used in the text, two generalised fish diagrams to illustrate external features useful in identification, a brief Introduction, the bulk of the text (107 pages) describing the species, a short Bibliography (27 references), and Indexes to Common and Scientific Names. The arrangement of orders and families follows Nelson (1976). There is a key to the 12 orders of fishes contained in the book, a key to the families of Chondrichthyes (including those reported from the Gulf but not in this text), and keys to families for Clupeiformes (3), Siluriformes (2), Atheriniformes (4), Scorpaeniformes (3), Pleuronectiformes (4) and Tetraodontiformes (5) but none for the order Perciformes which has 36 families. Species are identified by short descriptions of a few lines emphasising colour but including other characters when species are difficult to identify or are less colourful. There are no keys to species and less than 28 % of the species mentioned are illustrated.

Relyea has included about 264 species (some are only listed, not identified) in 67 families. A provisional list compiled by me based on literature and field work indicates that at least 121 families with over 650 nominal species have been reported from the Gulf and the adjacent Sea of Oman. It follows then that the usefulness of this book hinges on the author's choice of species to include in it. A newcomer to this ichthyofauna would have little concept of the degree of selection involved in compiling this book, and the author would have been well advised to include a list of species reported from the Gulf. A few superscripts would have served to indicate rare or deep water species, species of dubious occurrence, and taxa whose identity is uncertain. The choice is generally good although there are a number of species I would like to have seen, including *Fistularia petimba*, easily observed when skin-diving and often noted for its unusual elongate shape and tube-like snout, members of the families Stromateidae and Formionidae which are excellent food fishes and appear in markets, Spanish mackerels like *Scomberomorus commerson* which are popular food fishes and appear regularly at markets or inland cities of Iran and mackerel tunas like *Euthynnus affinis*, also a common market fish and one that occurs in coastal waters. The whale shark, *Rhiniodon typus*, the largest fish reaching perhaps 20 m in length, should have been included as specimens can be seen swimming off the coast, are caught locally and dead ones do wash up on beaches where their immense size makes them an attraction until the effects of decay overcome curiosity.

Several other points of criticism may be made. The absence of keys to the families of the order Perciformes and the rather short bibliography detract from the book's utility for serious students and scientists. There have been a number of recent revisionary works which are relevant to the Arabian Gulf fauna and to have these gathered together in this book would have been most useful at a cost of only a few additional pages. Coupled with the complete list of species suggested above, the author would then have reached more successfully his scientific readers without overwhelming the interested laymen. There are no common names in Arabic or Persian: the common names in English have no meaning to the local inhabitants while associating indigenous names with the scientific ones would have been most useful for anyone who wishes to study the fishes in the Gulf. There are several errors in spelling of scientific names, e.g., Charcharhinidae and *Charcharhinus* should be without the first " h ". Some of the descriptions, particularly in the Perciformes could have been improved on in the absence of keys, e.g., the family Siganidae is uniquely characterised by having two spines in the pelvic fin separated by three soft rays. Much more could have been written in the Introduction on such important subjects as pollution, a major cause for concern in a partially enclosed basin where oil extraction occurs and nuclear power plants with their voracious demands for cooling water are being built. Some general notes on the fisheries such as the species caught, methods, types of boats and nets would have added to the general interest of the text. Most biologists would like to have seen more information on geology, bathymetry, substrates, salinity, temperature, currents, tides, turbidity, climate, biogeography and other physical and natural features of the environment, which is difficult to obtain without extensive reading. Another topic of interest to local inhabitants and visitors is the possibility of shark attack. There have been detailed reports of fatal attacks on humans in the rivers at the head of the Gulf (Hunt, 1951) which are both fascinating and cautionary reading.

It is to be hoped that the publishers of this volume will prove amenable to an expanded and revised version in time so that the author can make available more detailed results of his studies and field experience for local naturalists and students.

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AN ATLAS OF DISTRIBUTION OF THE FRESHWATER FISH FAMILIES OF THE WORLD

By Tim M. Berra, University of Nebraska Press, Lincoln and London, 1981. xxix+197 p., 3 figs., 157 maps. U.S.$S. 12.50, (paperback).

This book contains a Foreword by R. M. McDowall, a 'Preface, Acknowledgements, and an Introduction containing short sections in 8 pages including two full page maps and two and a half pages of tables on " What is a fish," " Primary, Secondary and Peripheral Division Fish Families," " How Many Kinds of Fishes are There?," " Wallace's Line," " Distribution Patterns," " Continental Drift," and " Dispersal". Other sections include Pronunciation of Family Names, Glossary, Principal Rivers of the World, Principal Lakes of the World, Geological Time Chart, References (with separate sections on North American fishes and popular articles), and an Index. The bulk of the text (158 pages) consists of a series of maps) one for each primary and secondary division freshwater fish family and all the zoogeographically important peripheral ones with a sampling of marine families known to penetrate coastal rivers.

Each page encompasses a family distribution comprising a map 18.5 cm wide and about 8 cm deep across the top, a line diagram of a typical family member, a classification of the family following Greenwood *et al.*, (1966) and Andrews *et al.*, (1967) (includes class, subclass, superorder, order), common name of the family and pronunciation of the Latin name. A brief family distribution and description follows, the latter emphasising natural history and not meant to be taxonomically diagnostic. References are a guide for students new to the family.

A major criticism must be the layout which may have been beyond the author's control. The maps are too small and the projection used makes Holarctic family distributions difficult to see, *e.g.*, the presence of Umbridae in Washington State can be easily missed on the map and it is necessary to read the text to be aware of this distribution; and there appear to be sticklebacks on the Greenland ice-cap. The text is often short and at least half the families have map, classification and text occupying about half the page. The rest is blank, *e.g.*, the Indian and Burmese family Olyridae has only five lines of text.

For criticisms of distribution maps, which form the central thesis of this publication, I have chosen to comment on those families found in southwest Asia (an area from Pakistan and Afghanistan west to include Turkey, the Middle East and the Arabian Peninsula). Information on distributions for such areas as North America and Europe are readily available in synoptic works but Berra's book should be assessed on distributions in less well known parts of the world where information is not as readily available to students and where this book is liable to be accepted uncritically. This commentary is not exhaustive but serves to give a general impression of the kinds of inaccuracies that occur.

The family Petromyzontidae is found west of the shading on Berra's map to Trabzon in Turkey (Kux and Steiner, 1972). The scale of the map, however, makes it unclear whether Berra was aware of this distribution. The carcharhinid shark map omits the Persian Gulf and tributary rivers. Sharks are found in the Tigris River as far upstream as Baghdad (Coad, 1980a). Even more remarkable is the ommission of the distribution of the well-known *Carcharhinus gangeticus* which has as a type locality the Ganges River " 60 hours above the sea " (Misra, 1969) especially as this shark is mentioned in Berra's text. The map for Acipenseridae is misleading since it implies that sturgeons occur in the deserts between the Caspian and Aral Seas. American distributions are more detailed with gaps in ranges shown on a scale similar to the gap in Asia referred to here. The importance of the Asian gap is reflected in the degree of endemism shown by Aral Sea strugeons. The map for Salmonidae in Iran and Afghanistan is also a sweeping generalisation and Esocidae are not found in the Tedzhen, Murgab and upper Amu Darya Rivers of Afghanistan, Iran and Turkmenia (Coad, 1981b).

Misra (1947) records Engraulidae as entering freshwater at the head of the Persian Gulf. One would not expect the author to be aware of the numerous individual papers such as the one cited but since the map fails to depict the presence of the Engraulidae in the Persian Gulf it is evident that there has not been an adequate survey of synoptic works on southwest Asia (*e.g.*, Blegvad and Loppenthin, 1944; Kuronuma and Abe, 1972). A similar case is found in Scatophagidae which enter estuaries in the Persian Gulf (Mahdi, 1962) and have also been reported in the synoptic works cited.

There are a number of errors in distribution of the catfish families. The complete absence of Sisoridae from the Tigris-Euphrates basin in the map on page 79 is a serious omission. There are four species in the freshwaters of Iran, Iraq, Syria and Turkey (Coad, 1981a). There are no bagrid catfishes in the freshwaters of Israel (Goren, 1974). Silurid catfishes are known from the Tigris -Euphrates basin (Beckman, 1962; Banister, 1980), western Pakistan and the Indus basin including Afghanistan (Mirza, 1975; Coad, 1981b). Schilbeid catfishes are reported from the Indus basin also (Mirza, 1975). Heteropneustidae are found in the lower Tigris-Euphrates basin of Iran and Iraq (Coad, 1980b) although this may be an accidental introduction.

Gadidae (*Lota lota*) are known from the drainages at the southeastern corner of the Caspian Sea (Berg, 1948–1949) but this distribution is omitted from Berra's map although he cites Berg as a reference. He may have been misled by the poor map in Svetovidov (1948). Berra has also cited Wootton (1976) as a map reference for sticklebacks but the 'interesting distributions of *Gasterosteus aculeatus* in southwest Anatolia and in Syria have not been depicted on his map (see also Gruvel, 1931; Munzing, 1963).

Channidae have been known from Baluchistan, Iran since 1899 and Coad

(1978) extended the distribution westward to Kerman Province. This family is also known from Pakistan (Mirza, 1975) and Afghanistan (Coad, 1981b). Several species of Cottidae are known from the Syr Darya in the upper reaches of the Aral Sea basin (Berg, 1948–1949; Turdakov, 1963) but Berra's map omits this distribution. Similarly Percidae are to be found in rivers of the southern Caspian Sea basin in Iran and Mugilidae are found in Iranian freshwaters and the Turkish Euphrates River basin (Kuru, 1978–1979; Coad, 1980a). The distribution of the Iranian cichlid is misplaced. It should be depicted as occurring in rivers draining to the Persian Gulf at the Straits of Hormuz (Coad, 1982). The family Mastacembelidae is known from Persian Gulf drainages of Iran (Coad, 1980a), the Zhob River drainage of Pakistan on the Afghan border, and the Indus River basin (Mirza, 1975).

As a general guide to freshwater fish distributions on a worldwide basis this book is a useful contribution, especially for students, since it enables them to " place " a family at a glance. Unfortunately even for quite large areas of the world like southwest Asia and for many families there are numerous errors which reduce the utility of the book. It is to be hoped that a revised version will eventually be published incorporating larger maps, emended distributions and perhaps additional families.

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EDITORIAL NOTES AND NEWS

Reprint of Day's Fish India Supplement

We have already brought to the kind notice of our members the reprinting of the above volume by photo offset process. The reprint has been elegantly printed and only a limited number of copies are available. Members are requested to place their orders early to avoid disapointment. The cost is Rs. 25/= of U.S.$ 10.00, packing and postage being extra. Cheques should include Rs. 4/= or U.S. $ 1 to cover bank commission. Members of the Society are entitled for 10% discount. Remittance may please be sent to the Treasurer of the Society at 100, Santhome High Road, Madras 600 028.

Visit to Japan

Dr. N. H. Gopal Dutt, Associate Editor of ' Matsya,' visited Japan as a Post-doctoral Research Fellow under INSA–JSPS Scheme, from 27–9–1982 to 26–2–1983. During his stay, he worked tenaciously on the steroid histochemistry, histology and electron microscopy of the gonads of lower vertebrets including fishes. He is now compiling a monograph on the ovary of a marine teleost, *Theragra chalcogramma* (Pallas). He received the best researcher Gold Medal from professor Sakae Inoue, Chairman, Division of Comparativer Endocrinology, Gunma University, Japan.

THE FRESHWATER FISHES OF INDIA, BANGLADESH, BURMA, PAKISTAN & SRI LANKA:

By K. C. Jayaram

The Handbook on the Freshwater fishes is an uptodate compendium of all information on the piscine fauna of the entire Indian subcontinent incorporating all the desired data and correcting many deficiencies.

FRESHWATER FISHES OF IRAN

(A Myth in the Making)*

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* This refers to the improbability of finishing the damn thing in a reasonable time and not to its superior content.

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Zoogeography of the Freshwater Fishes of Iran

Brian W. Coad

Abstract

The freshwater ichthyofauna of Iran, including the Caspian Sea, is dominated by three families, the Cyprinidae, Cobitidae and Gobiidae, which together comprise about three-quarters of the species. The Cyprinidae has the greatest diversity of genera (43.7%) and species (45.2%). Twenty-four families are reported of which 15 are represented by only a single species and 20 families are represented by four species or less. The family diversity compares favourably with that of the whole Palaearctic Realm. The most widely distributed families are the Cyprinidae and Cobitidae which are found in all 19 drainage basins considered here. The large, ecologically and historically diverse Caspian and Tigris basins have the most families (15 and 11 respectively). Basins remote from these two and from the ocean are impoverished and 7 of these endorheic basins have only Cyprinidae and Cobitidae. The principal events which have resulted in the distributions described are transgressions of the Caspian Sea (with consequent isolation and speciation), drainage captures in an active zone of orogeny, the use of large rivers as highways between altitudinally diverse areas separated by deserts, marine penetrations, and the influence of man. Some distributions and dispersal routes remain unresolved and await detailed analysis of material.

Keywords: Iran, freshwater fishes, zoogeography, distribution

Introduction

"Freshwater fishes are uniquely significant in zoogeography."

P. J. Darlington, 1957.

Freshwater fishes are most useful to zoogeographical studies by the nature of their ecology. They are of necessity confined to water and true (or primary sensu Myers (1938)) freshwater fishes cannot use the sea to circumvent geographical barriers. Their movement from one drainage basin to another is slow so that their patterns of distribution reflect the geographical history of an area. They are easy to catch in large numbers without markedly decimating the population and possess numerous countable and measurable characters which allow species and lower categories to be described statistically. Drainage basin ichthyofaunas can, therefore, be defined readily and used to illustrate relationships between geographical areas.

Iran occupies a significant part of the Middle East, both in terms of land (and water) area and in terms of zoogeography. It contains elements of both Ethiopian and Oriental ichthyofaunas although it is dominantly part of the Palaearctic Realm.

This paper attempts a distributional and zoogeographic analysis of the freshwater fishes of Iran based on current knowledge and on an active programme of systematic research. The ichthyofauna of Iran is quite diverse for such an arid country but space and current knowledge does not permit a detailed treatment. All freshwater families are surveyed but only a selection of taxa in the more speciose families can be examined here.

Materials

A distributional and zoogeographical study is only as good as the foundation on which it is built. Surprisingly, the fishes of Iran have not been thoroughly surveyed and new species, and even a family new to the country, have been discovered in recent years (Greenwood, 1976; Coad, 1981a; 1981c; 1982; Bianco and Banarescu, 1982). All of the systematic studies have been carried out by foreigners excepting the unpublished thesis of Saadati (1977). Many of the older works were prepared by ichthyologists working up collections deposited in their museum by field biologists. Berg's (1949) classic work on Iranian freshwater fishes is based mainly on collections made 50 years previously. Often the primary interest of the collector was directed towards some other taxon than Pisces. Collections were fragmentary and incidental to other studies. The number of specimens available was small and although adequate to diagnose new species, was insufficient for intraspecific comparisons and for detailed distributional studies. The limited nature of available material and consequent nomenclatorial problems have necessarily restricted zoogeographical studies.

My current studies are based on over 900 collections, mostly collected by me during a three year residence in Iran, but including material made available to me by various museums and the collections examined by M. A. G. Saadati for his M.S. thesis. I am actively engaged in systematic and zoogeographical studies on this extensive material.

Problems

It is wise to preface this discussion with some of the problems which face a zoogeographer of Iranian freshwater fishes.

1. Definition of freshwater fishes

The ecology of most Iranian fishes is not known. Many species occur in waters which are fresh and such species are presumed to be intolerant of salt water such that their distribution has not depended on passage though the sea. However, some southern streams are very saline and other waters have a high mineral content yet they harbour fishes, such as members of the families Cyprinidae and Cobitidae, which are generally regarded as primary freshwater fishes. Collections along the Persian Gulf shore have not revealed that such species are regular visitors to marine waters.

The Caspian Sea is brackish, perhaps one-third the salinity of seawater away from river mouths. I have chosen to include its Iranian ichthyofauna in this discussion for the sake of completeness. A number of species, such as Cyprinus carpio, which are thought of as primary freshwater fishes are regularly fished for by anglers along the Caspian coast and they are quite tolerant of salt water (Jones et al., 1978).

In summary, the freshwater status of many fishes must be assumed from their known habits and distribution. I don't mean to unnecessarily complicate matters by pointing out that current tolerance of salinity, or lack of tolerance, may not have been the case in the geological past.

2. Introduced species

Several exotic species have been introduced deliberately and accidentally to freshwaters in Iran and there have been attempts to establish native fishes outside their natural range. These exotics and native transplants are not discussed here. A list is given in Coad (1980).

3. Systematic problems

My systematic studies, particularly at the population and subspecies levels, are not yet complete. Family and generic distributions are well known and many species are well understood but the zoogeography presented here will be fine-tuned at a later date. Also there is always the possibilty of surprises from remote areas. However I suspect that the general sweep of fish distributions will hold firm. Editorial constraints on paper length enable me to ignore some intriguing problems for which I have, as yet, inadequate data and for which conflicting views exist in the literature. There is little point in re-hashing these dissensions at this time without new data to resolve the problems.

4. Nature of the environment

Iran is a country which may be characterised as arid or semi-arid outside the narrow Caspian coastal strip. Many rivers do not have a continual flow from source to terminal basin. Populations of a species within a river may be isolated from each other for many years. Springs support fishes which can have had no contact with other springs or neighbouring streams for varying periods of time. Small gene pools isolated in this way can be expected to show differing degrees of diversion. Certain species might well prove more susceptible to genetic drift than other, more conservative species. Careful analysis of a number of characters on adequate samples may demonstrate variation due to this geographical isolation within a drainage basin. Demonstrating variation is a different matter from assessing its importance. The variability of populations may well be reduced if several years of wet conditions augment the flow of the stream or spring and populations re-establish contact. I would suggest that description of species, but more particularly subspecies, based on relatively few specimens from one locality or one drainage basin may well prove a doubtful exercise.

A few words should be interjected here about qanats. These are artificial irrigation devices simply described as horizontal wells sunk into alluvial fan material which provide a constant flow of water over many years and support fish populations. They are man-made devices and their fishes are derived from surface waters nearby by natural immigration or by deliberate introduction. The demand for water may well lower groundwater in a heavily populated area, drying up springs and streams and leaving qanats as the only habitat still supportive of fish life. I have included qanat collections in this analysis as they reflect the basin ichthyofauna.

5. Definition of drainage basins

The mountainous and arid nature of Iran has resulted in innumerable internal basins encompassing small areas and consisting of perhaps a few springs and small streams with no present or recent connection with neighbouring basins.

Practical considerations require that a larger scale be used and indeed, as presently understood, the fish fauna does not warrant excessive division of the topography. Figure 1 illustrates the 19 major basins of Iran. These are based on an examination of maps, field work, analysis of fish distributions, and a consideration of areas which are critical for an understanding of zoogeography. My final analysis of the ichthyofauna may modify the limits or number of these basins.

Results and Discussion

This section is divided into two parts. The first examines distribution on a a family by family basis with a selection of taxa in the more speciose families. It is essentially the descriptive part. The second part is based on events or areas which explain the distributions. It might be termed the zoogeographical or interpretative part.

A. Distribution

Tables 1 and 2 summarise the ichthyofauna of Iran by diversity and by basin.

It is immediately obvious that the fauna is dominated by three families, the Cyprinidae, Gobiidae and Cobitidae, which together comprise 73.6% of the species. The Ostariophysi, comprising Cyprinidae, Cobitidae and the four catfish families (8 to 11 on the list), forms a significant portion of the fauna at 63.2% of the species. The Cyprinidae has the greatest diversity of genera (43.7%) and species (45.2%).

Twenty-four families are reported, of which 15 (or 62.5%) are represented by only a single species and 20 families (or 83.3%) are represented by four species or less. The family diversity, even though many are represented by few species, compares favourably with a total of 39 freshwater families for the whole Palaearctic Realm. This is better brought out if the number of primary freshwater families for Iran (10) is compared to the Palaearctic total (15)(based with modifications on Berra (1981)).

The most widely distributed families are the Cyprinidae and Cobitidae which are found in all the 19 basins considered.

Of the remaining families, only the Cyprinodontidae, with 10 basins (52.6%), occurs in more than half the basins. Fifteen families are restricted to a single basin and 19 families are found in three or fewer basins. The basins with the most families represented are the Caspian (15 or 62.5%) and the Tigris (11 or 45.8%). The Caspian basin has 60% of its families represented by a single species while in the Tigris basin this value falls to 36.4%. Both the Caspian and Tigris basins are large, contain small streams, large rivers, and lakes, and drain to the sea or a former sea. The next three basins in order (Hormuz (7), Gulf (7), and Makran (5)) also drain to the sea but are remote from a major freshwater basin. Internal, endorheic basins are impoverished and range from 2 to 4 families. Basins at the higher end of this range are adjacent to basins draining to the "sea" and those at the lower end are small, separated by geographical barriers such as distance or mountains from a sea or major freshwater basin, and/or are water poor.

The following comments on each family amplify the summary treatment of distribution in Tables 1 and 2.

1. Petromyzontidae

This family is represented by a single endemic species, Caspiomyzon wagneri (Kessler, 1870) in the Caspian Sea basin. This lamprey species runs up rivers from the sea to spawn. It may be pertinent to note that the species was originally described in the genus Petromyzon Linnaeus, 1758 whose sole species today is found in the Atlantic Ocean and western Mediterranean Sea although absent from the eastern

Mediterranean and the Black Sea and is still in the same subfamily. Caspiomyzon Berg, 1906 differs from Petromyzon by fewer and weaker teeth and by the absence of a median depression on the anterior lingual plate (Berg, 1962; Vladykov and Kott, 1979). These differences are not substantive.

2. Acipenseridae

Sturgeons are restricted to the Caspian Sea basin of Iran and enter rivers to spawn. The four species are also found in the Black Sea basin and some extend as far as the Adriatic Sea. Only one species, Acipenser gueldenstaedti Brandt, 1833, is reported (Svetovidov, 1985) as having subspecies in the Caspian Sea but the studies on which these are based are in the older literature and these large fishes are ripe for re-examination. The sturgeon fauna is essentially derived from that of the Black Sea.

3. Anguillidae

The eel, Anguilla anguilla (Linnaeus, 1758) is found only in the Caspian Sea basin where its arrival is a recent event facilitated by construction of the Volga-Baltic waterway and the introduction of eel larvae into inland waters of the Volga River basin (Abdurakhmanov and Kuliyev, 1968).

4. Clupeidae

This is the fourth most speciose family in Iranian freshwaters. One of the species, Tenualosa ilisha (Hamilton, 1822), is a regular marine migrant into rivers of southern Iran where it spawns and must therefore be regarded as a freshwater fish. The remaining 8 species are found in the Caspian basin and comprise two genera, Alosa Cuvier, 1829 and Clupeonella

Kessler, 1877. Clupeidae is a notoriously difficult taxon to understand systematically. The Caspian and Black Sea Alosa were once placed in a separate genus, Caspialosa Berg, 1915 but are now recognised as belonging to the wider-ranging genus Alosa. A number of subspecies, "infraspecies" and "natio" have been described and their validity is open to debate. Even one of the species listed, A. curensis (Suvorov, 1904), is a poorly known and doubtful species. Of the 5 Alosa species in the Caspian Sea basin of Iran, two (including A. curensis) are endemic and the remainder are found also in the Black Sea. The genus Clupeonella is found in the Black and Caspian seas although two of the three Iranian species are endemic to the Caspian Sea.

5. Chanidae

The milkfish, Chanos chanos (Forsskal, 1775), is a marine species which can thrive in freshwater. Its known distribution in Iran is limited to a southern stream draining to the Straits of Hormuz (Coad, 1981b).

6. Cyprinidae

This family is the most speciose in Iran and includes about 32 genera. This rich fauna cannot be analysed in detail here and only certain selected species can be discussed.

However, in general, one can see that species in the Caspian Sea basin have their closest relatives in the Black Sea basin, the Aral Sea basin or in Europe. Other species, e.g. Acanthalburnus urmianus (Günther, 1899) and Alburnus atropatenae Berg, 1925, are endemics, in this case to the Reza'iyeh basin with their closest relatives in the Caspian Sea basin nearby.

Some species find their closest relatives and their main distribution to the east in the Oriental Realm, e.g Aspidoparia morar (Hamilton, 1822) of the Makran basin and species of "snow trouts" in the genera Schizothorax Heckel, 1838, Schizocypris Regan, 1914 and Schizopygopsis Steindachner, 1866 which are found mostly in the Sistan basin but also as one species in the Kavir and Tedzhen basins. These snow trouts, as their common name suggests, are typically found in high mountain areas rather than the lowland basin of Sistan.

Some species have a wide distribution encompassing both endorheic and exorheic basins. Capoeta aculeata (Valenciennes, 1844) is found in basins around the desert rim on its northern and western edges, in the Tigris River basin and in the Kor River basin but not the Gulf basin. A species in the genus Chondrostoma Agassiz, 1835 is found in the Tigris River basin and in the Kor River basin but not elsewhere in Iran. The genus Alburnoides Jeitteles, 1861 is found in the basins of the Caspian Sea, Tedzhen River, Lake Reza'iyeh, Namak, Tigris River, and Kor River. These all appear to belong to A. bipunctatus (Bloch, 1782) but the subspecific status of populations remains to be determined.

The distribution of Barilius mesopotamicus Berg, 1932 is restricted to the Tigris River basin and the Gulf basin and its relatives appear to lie to the east in the Oriental Realm without there being any other populations or species in between. Pseudophoxinus persidis Coad, 1981 is a new member of a genus which has a distribution around the Mediterranean and in the Levant. It is known only from the Kor River, Gulf and Hormuz basins.

7. Cobitidae

Loaches have proved to be a difficult taxon to work with systematically. My studies on this interesting group in Iran have been cursory thus far. Nevertheless certain trends can be recognised. Some species have a distribution restricted to a single basin and therefore throw little light on zoogeography within Iran unless their relationships are clearly understood. Others are found, or have relationships with, Black Sea basin and European species. Some appear to be related or conspecific with Tigris-Euphrates basin species while yet others seem to be close to species in the Oriental Realm. One species, Cobitis linea (Heckel, 1849), recently re-discovered by Bianco and Banarescu (1980) has an interesting distribution. It is reported from the Kor River basin and in the Hormuz basin but near to the boundary of the Gulf basin where it may eventually be found. Its putative relative is found in Anatolia.

8. Bagridae

A single species in this family, Mystus pelusius (Solander, 1771), is currently recognised from the Tigris River basin. Members of this speciose family (27 genera and over 200 species) are found also in the Oriental and Ethiopian Realms. The genus Mystus Scopoli, 1777 is Oriental and some members are known to enter estuaries and seas (Jayaram, 1981).

9. Siluridae

Two species are reported from Iran and the immediately adjacent waters of Iraq, namely Silurus glanis Linnaeus, 1758 and S. triostegus Heckel, 1843. The validity of the second species can be questioned as the characters on which it was desribed are known to be variable in Siluridae (Hora and Misra, 1943). S. glanis is known also from the Caspian Sea basin and the Lake Reza'iyeh basin and is widely distributed in Europe.

10. Sisoridae

Four species are recognised from the Tigris River basin in the genus Glyptothorax Blyth, 1860. Sisoridae were thought to be restricted to the Tigris-Euphrates basin in the Middle East but a single specimen has recently been found in the Yesil Irmak of Turkey in the Black Sea basin (Coad and Delmastro, 1985). This specimen, and studies in progress, indicate that several characters previously thought to be important in distinguishing and defining Middle East Glyptothorax show a range of variation which reduces their utility and which may call into question the recognition of four species. Sisoridae are distributed principally in the Oriental Realm where there are about 20 genera and at least 65 species (Nelson, 1984).

11. Heteropneustidae

Heteropneustes fossilis (Bloch, 1794) is the single species of this family found in the Tigris River basin of Iran. This species was first reported from Iran in the early 1960s and appeared also in Iraqi waters at the same time. Earlier works on the fishes of Iraq do not record this species which has been implicated in envenomations and is easily recognised as distinct from other catfishes. This species is found in the Oriental Realm where it is a common, freshwater food fish. It does have some tolerance of seawater (25% mortality in 10.25 p.p.t. according to Al-Daham and Bhatti (1977)). This fish may have reached freshwater at the head of the Persian Gulf in the ballast of ships from India, Pakistan or a neighbouring country.

12. Esocidae

The pike, Esox lucius Linnaeus, 1758, is found in the Caspian Sea basin. This species is common in temperate freshwaters all across the northern hemisphere.

13. Salmonidae

Salmo trutta Linnaeus, 1758 is the only native salmonid reported from Iran. It is found in the Caspian Sea basin and the immediately adjacent Lake Reza'iyeh and Namak basins. Populations in the Caspian Sea basin are usually referred to the subspecies caspius (Kessler, 1877) while the other populations have not been sufficiently well studied to make a formal distinction. Saadati (1977) presented some evidence that Lake Reza'iyeh basin fish had characters differing from typical caspius.

14. Gadidae

The burbot, Lota lota Linnaeus, 1758, is a rarely found freshwater representative of the cod family in the Caspian Sea basin of Iran. Like the pike, it has a temperate freshwater distribution around the northern hemisphere.

15. Cyprinodontidae

The tooth-carp genus Aphanius Nardo, 1827 is represented by four species in Iran. One of the species, A. ginaonis (Holly, 1929), is restricted to a hot spring and another, A. cypris (Heckel, 1843), is found only in the Tigris River basin. The distribution of A. sophiae (Heckel, 1849) and A. dispar (Rüppell, 1828) is more interesting. Aphanius species are salt-tolerant. A. dispar can be caught along the Persian Gulf shore and A. sophiae has been caught in hypersaline waters inland. A. dispar is distributed in basins draining to, or close to, the Persian Gulf and Sea of Oman while A. sophiae replaces it in inland basins. The two species do occur sympatrically in the Tigris River basin. As distance from the sea increases in a northeasterly direction, cyprinodonts are no longer found.

16. Atherinidae

A single species, Atherina boyeri Risso, 1810, is recorded from the Caspian Sea basin. This species is also found in the Black Sea, Mediterranean Sea and the Atlantic Ocean. Caspian populations are referred to a distinct subspecies.

17. Gasterosteidae

The sole representative of this family in Iran, Pungitius platygaster (Kessler, 1859), is found in the Caspian Sea basin. Elsewhere it is found in the Black and Aral seas and their basins. Recent work indicates that this species may only be subspecifically distinct from the Holarctic species Pungitius pungitius (Linnaeus, 1758) (Münzing, 1969; Ziuganov and Gomeluk, 1985).

18. Syngnathidae

The species Syngnathus abaster Risso, 1826 is found in the

Caspian Sea basin. Elsewhere it is known from inshore and freshwaters of the Black and Mediterranean seas and their basins (Lueken, 1967). This species in the Caspian Sea basin was once referred to as a subspecies of a purely Black Sea species.

19. Percidae

The three species of this family, Perca fluviatilis Linnaeus, 1758, Stizostedion lucioperca (Linnaeus, 1758) and S. marinum (Cuvier in Cuvier and Valenciennes, 1828), are found in the Caspian Sea basin. The first two species are widely distributed in freshwaters of Europe and Asia while the third species is found in the saline waters of the Caspian Sea and the northern Black Sea.

20. Cichlidae

The Iranian cichlid, Iranocichla hormuzensis Coad, 1982, is restricted to streams draining to the Straits of Hormuz in southern Iran. Its closest relatives may lie in the Levant and/or Ethiopia (Coad, 1982; Trewavas, 1983).

21. Mugilidae

A single species, Liza abu (Heckel, 1843), is found in the Tigris River basin and the adjacent Gulf basin. Mugilids have a marked tolerance for saltwater so that its distribution in these two basins may have involved a passage through the sea. However the salt tolerance of this particular species has not been investigated.

22. Gobiidae

This speciose family includes three species which have marine populations in the Indo-West Pacific but they also establish freshwater populations in rivers draining to the sea in southern Iran. The remaining species are all found in the Caspian Sea basin and include six monotypic species, seven species in the genus Benthophilus Eichwald, 1831, six species in Neogobius Iljin, 1927 and two species in Proteorhinus Smitt, 1899. Some favour marine conditions while others spend all their lives in freshwater. This fauna is is need of careful review and some species are known only from a few specimens taken in deep water. About half the species are endemic to the Caspian Sea basin while the remainder are found in the Black Sea basin, albeit sometimes distinguished subspecifically.

23. Channidae

Channa orientalis (Bloch and Schneider, 1801) is known from only a few specimens taken in the Jaz Murian basin (Coad, 1979). The species has a wide distribution in the Oriental Realm (Jayaram, 1981).

24. Mastacembelidae

Mastacembelus mastacembelus (Solander, 1794) is known from the Tigris River basin and the Gulf basin and is found only in the Middle East. Other members of the genus are found in the Ethiopian and Oriental Realms.

B. Zoogeography

The distributions discussed briefly above can be attributed to several "events" which provide the most parsimonious explanations.

1) Caspian Sea transgressions

The Caspian Sea basin is endorheic today but only became separated from the Black Sea in the early Pliocene. There have been other transgressions and the history and reasons for the connections of the Caspian to the Black Sea, and through it to the Mediterrranean Sea, may be read in Zenkevitch (1963), Briggs (1974) and Coad (1980). The Iranian Caspian ichthyofauna is variously the same and distinct at genus, species and subspecies levels as that of the Black/Mediterranean ichthyofauna. Since some species are distinct and others not, it could be argued that these represent time since entry into the basin but it could equally well be an indication of different speciation rates or a mixture of the two. I have argued above that many of the taxa once listed as distinct can now be regarded as the same. Neverthless there is a degree of endemism in such families as Gobiidae and Clupeidae and the ichthyofauna probably reflects a history of transgressions, isolation and speciation with the addition of some northern elements which may have entered the basin by the highway of the Volga River.

2) Drainage captures

Much of Iran is an active zone of orogeny and drainage or headwater captures are common (Oberlander, 1965). A number of basins have headwaters which arise close together on a high plain (e.g. Hormuz and Gulf) and transfer of species may be expected over time. A number of cyprinids, e.g. Capoeta aculeata, as well as the cyprinodontid Aphanius sophiae, have distributions encompassing several basins no doubt through headwater captures and possibly via small lakes and more extensive water courses in past, pluvial conditions. Careful study of such species may reveal the route taken if populations can be distinguished and trends in characters defined.

The endorheic Lake Reza'iyeh basin shares some species with the Caspian Sea basin and has some endemic species which, however, have their closest relatives in the Caspian Sea basin. On some maps the headwaters of these two basins are continuous! Also, past lake elvations may have been sufficient to form an outlet to the Caspian Sea (Berg, 1940).

The Kor River basin north of Shiraz has an interesting ichthyofauna, the source of which would appear to be mostly the Tigris River basin where many of the Kor River basin species are to be found. Two possible routes suggest themselves. One is by headwater capture through the Zagros Mountains to the northwest. The other involves the recent history of the Persian Gulf. As recently as 18,000 years ago the Tigris-Euphrates basin debouched into the mouth of the Gulf when the sea level fell by as much as 120 metres in the Pleistocene. Rivers of the the Gulf and Hormuz basins would then be tributary to the Tigris-Euphrates basin and could have derived their fauna directly from this source. This is almost certainly the case for Barilius mesopotamicus and Mastacembelus mastacembelus, and possibly Liza abu, which are found in the

Gulf basin but have not penetrated further inland across the Zagros mountain ridges to the Kor River basin. The Kor River basin has such species as Alburnoides bipunctatus, a Chondrostoma species, Capoeta aculeata and others which are not found in the Gulf basin. These must have entered the Kor River basin by headwater capture through the mountains and not from the Gulf basin. This explanation is complicated by such species as Pseudophoxinus persidis, Cobitis linea and others which have a distribution encompassing the Kor River basin, the Gulf and the Hormuz basins but are not found in the Tigris River basin. They may have evolved in this region but the distribution of their relatives is characterised by intervening basins which lack related species.

The distribution of the cyprinid Alburnoides bipunctatus is curious. It appears to have become distributed in several basins in Iran by headwater capture. In the south, its presence in the Kor River basin argues a Tigris River basin source. In the north, its presence in Lake Reza'iyeh basin and Namak basin (matched by Salmo trutta) argues for a Caspian Sea basin source. It is absent from the Esfahan and Kerman-Na'in basins which intervene between the north and the south. It is also present in the Tedzhen basin in the northeast which adjoins the Caspian Sea basin but is absent from the Kavir basin which intervenes between the Tedzhen and the Namak basins. A careful study of this species may be able to demonstrate that it entered Iran by two routes (Caspian to Namak, Reza'iyeh and Tigris and then from the latter to the Kor River basin and separately from the Caspian Sea basin to the

Tedzhen River basin). Alternatively the Tigris River and Kor River basins may have received their populations from western Asia and Europe without passage through the northern basins of Iran.

3) River highways

Rivers can be convenient highways for fishes. The Schizothoracinae (Schizothorax, Schizocypris, Schizopygopsis) of the Sistan basin (altitude under 500 metres) are apparently derived from the Hindu Kush mountains (altitudes over 5000 metres) via the long Helmand River which crosses the deserts to find its terminal basin in Sistan. The essentially montane Schizothoracinae were probably driven down into the lowlands by an ice age and are now relict there. The Tedzhen River basin to the north also appears to have derived its single species of Schizothoracinae in the same manner but this cyprinid has reached another basin to the west, perhaps by headwater capture. The Sistan basin is surrounded by deserts and lends itself less readily as a source of fishes to surrounding basins.

4) Marine penetrations

The distribution of certain families and species in southern Iran are the result of marine migrations by freshwater fishes which are known to have a wide tolerance of salinities. These include the clupeid Tenualosa ilisha, Chanidae, the cyprinodontid Aphanius dispar, certain Gobiidae, and possibly the mugilid species.

5) Man

The possibility that some apparently natural distributions have been confounded by man cannot be eliminated. Exotic species and native transplants have been left out of this discussion but native fishes are used in traditional ceremonies such as New Year celebrations and there is historical evidence for an extended concern with fish in Zoroastrian religious ceremonies. Fish are seen as indicators of water purity in a desert country and certainly many qanats must have acquired their fishes through the agency of man. However, given the arduous terrain and ferocious climate of Iran, I do not believe that man has seriously confused natural fish distributions. Movement of fishes, if it occurred, has probably been an intrabasin rather than an interbasin phenomenon. In recent times man may have been the major factor in the appearance of Anguillidae and Heteropneustidae in Iran.

6) Unresolved problems

Certain of the distributions cited here are not readily explainable. There are large disjunctions with the range of related species. Examples include the cyprinid Barilius mesopotamicus, Bagridae, Sisoridae and Mastacembelidae. These taxa, with a distribution centred on the Tigris-Euphrates have their closest relatives beginning to appear in the Indus River basin. The large gap between these two basins does have some rivers of moderate size which I have sampled yet there appears to be no representation of these taxa there. Berg (1940), and others such as Armantrout (1980), have argued that there was dry land in the northern Indian Ocean during Pliocene and post-Pliocene times and subsidence has given the coastal outline seen today. Elements of an Oriental ichthyofauna from an expanded Indus River and neighbouring basins could then gain access to the Tigris-Euphrates basin, the colonisation being limited by rising sea levels and desiccation of coastal streams. This does not account for the absence of these elements from the Makran, Hormuz and Gulf basins. The Gulf basin does have some elements from the Tigris-Euphrates basin, such as Barilius mesopotamicus and Mastacembelus mastacembelus, but not others (Bagridae, Sisoridae). The Hormuz basin is replete with salt domes and the rivers here are salt and probably unsuitable for colonisation by many fish species. The Makran basin is now poor in water resources and many streams only rarely flow to the sea. However one would have expected these streamns to be larger and have a more continouous flow in pluvial times. Subsequent desiccation may have reduced the fauna. The absence of Sisoridae and Bagridae (and possibly other species not dealt with here) from the Gulf basin remains unexplained. Conditions appear suitable and not dissimilar to the waters harbouring this family in the Tigris River basin but the detailed ecology of many species is so poorly known that the absence of some may well be due to factors such as river size and diversity of habitat which is unquestionably greater in the Tigris River basin.

The distribution of Pseudophoxinus persidis, Cobitis linea and Iranocichla hormuzensis has been detailed above. These species are characterised by large gaps between their range in Iran (where they are endemic) and the range of their putative relatives. These distributions are difficult to explain as they require selective loss of populations in intervening areas. Pleistocene climatic changes may have been an important factor (Bianco and Nalbant, 1980; Coad, 1982).

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Figure 1. Diagram to show the major drainage basins of Iran. (The Maharlu basin lies between the Gulf and Kor basins).

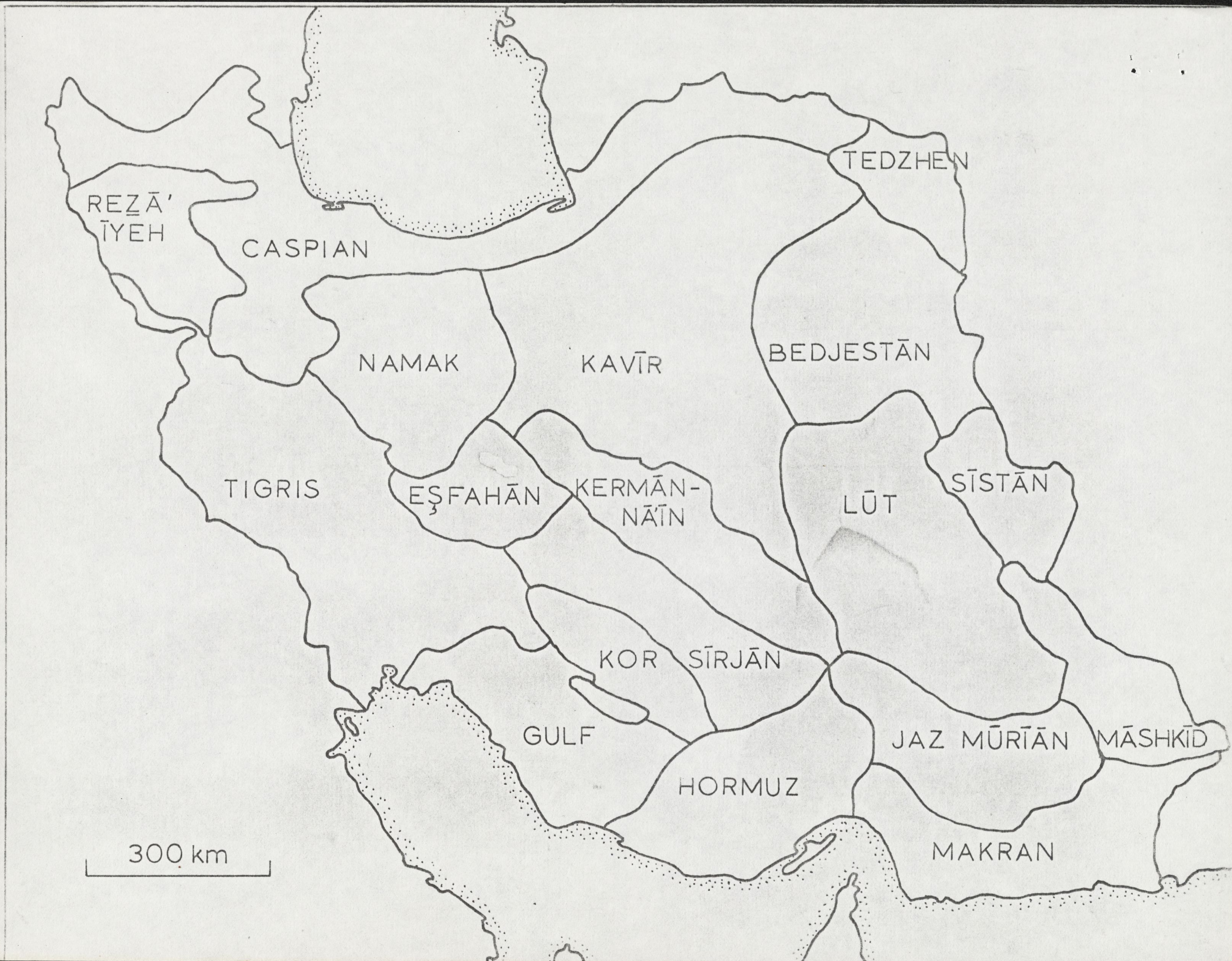
REZĀ'
ĪYEH
CASPIAN
TEDZHEN
NAMAK
KAVĪR
BEDJESTĀN
TIGRIS
EŞFAHĀN
KERMĀN-
NĀ'ĪN
LŪT
SĪSTĀN
KOR
SĪRJĀN
GULF
HORMUZ
JAZ MŪRĪĀN
MĀSHKĪD
MAKRAN
300 km

Table 1. The ichthyofauna of Iran excluding exotic species.

Family	Number of Genera	%	Number of Species	%
1. Petromyzontidae	1	1.4	1	0.6
2. Acipenseridae	2	2.8	4	2.6
3. Anguillidae	1	1.4	1	0.6
4. Clupeidae	3	4.2	9	5.8
5. Chanidae	1	1.4	1	0.6
6. Cyprinidae	31	43.7	70	45.2
7. Cobitidae	3	4.2	20	12.9
8. Bagridae	1	1.4	1	0.6
9. Siluridae	1	1.4	2	1.3
10. Sisoridae	1	1.4	4	2.6
11. Heteropneustidae	1	1.4	1	0.6
12. Esocidae	1	1.4	1	0.6
13. Salmonidae	1	1.4	1	0.6
14. Gadidae	1	1.4	1	0.6
15. Cyprinodontidae	1	1.4	4	2.6
16. Atherinidae	1	1.4	1	0.6
17. Gasterosteidae	1	1.4	1	0.6
18. Syngnathidae	1	1.4	1	0.6
19. Percidae	2	2.8	3	1.9
20. Cichlidae	1	1.4	1	0.6
21. Mugilidae	1	1.4	1	0.6
22. Gobiidae	12	16.9	24	15.5
23. Channidae	1	1.4	1	0.6
24. Mastacembelidae	1	1.4	1	0.6
Totals	71 genera		155 species	

Table 2. The ichthyofauna of Iran by drainage basin.

Family \ Basin	Caspian	Tedzhen	Bedjestan	Sistan
1. Petromyzontidae	+	–	–	–
2. Acipenseridae	+	–	–	–
3. Anguillidae	+	–	–	–
4. Clupeidae	+	–	–	–
5. Chanidae	–	–	–	–
6. Cyprinidae	+	+	+	+
7. Cobitidae	+	+	+	+
8. Bagridae	–	–	–	–
9. Siluridae	+	–	–	–
10. Sisoridae	–	–	–	–
11. Heteropneustidae	–	–	–	–
12. Esocidae	+	–	–	–
13. Salmonidae	+	–	–	–
14. Gadidae	+	–	–	–
15. Cyprinodontidae	–	–	–	–
16. Atherinidae	+	–	–	–
17. Gasterosteidae	+	–	–	–
18. Syngnathidae	+	–	–	–
19. Percidae	+	–	–	–
20. Cichlidae	–	–	–	–
21. Mugilidae	–	–	–	–
22. Gobiidae	+	–	–	–
23. Channidae	–	–	–	–
24. Mastacembelidae	–	–	–	–
Families per basin	15	2	2	2
(as a percentage)	62.5	8.3	8.3	8.3

Lut	Mashkid	Jaz Murian	Makran	Hormuz	Sirjan	Gulf
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	+?	+?	-	+?
-	-	-	-	+	-	-
+	+	+	+	+	+	+
+	+	+	+	+	+	+
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	+	+	+	+	-	+
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	+	-	-
-	-	-	-	-	-	+
-	-	-	+?	+	-	+?
-	-	+	-	-	-	-
-	-	-	-	-	-	+
2	3	4	5	7	2	7
8.3	12.5	16.7	20.8	29.2	8.3	29.2

? = probably present but not confirmed by collections.

Maharlu	Kor	Tigris	Esfahan	Kerman-Na'in	Reza'iyeh
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	+	–	–	–
–	–	–	–	–	–
+	+	+	+	+	+
+	+	+	+	+	+
–	–	+	–	–	–
–	–	+	–	–	+
–	–	+	–	–	–
–	–	+	–	–	–
–	–	–	–	–	–
–	–	–	–	–	+
–	–	–	–	–	–
+	+	+	+	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	+	–	–	–
–	–	+	–	–	–
–	–	–	–	–	–
–	–	+	–	–	–
3	3	11	3	2	4
12.5	12.5	45.8	12.5	8.3	16.7

Namak	Kavir	Basins per family (as a percentage)	
–	–	1	5.3
–	–	1	5.3
–	–	1	5.3
–	–	5	26.3
–	–	1	5.3
+	+	19	100.0
+	+	19	100.0
–	–	1	5.3
–	–	3	15.8
–	–	1	5.3
–	–	1	5.3
–	–	1	5.3
+	–	3	15.8
–	–	1	5.3
+	–	10	52.6
–	–	1	5.3
–	–	1	5.3
–	–	1	5.3
–	–	1	5.3
–	–	1	5.3
–	–	2	10.5
–	–	5	26.3
–	–	1	5.3
–	–	2	10.5
4 16.7	2 8.3		