AN ABSTRACT OF THE THESIS OF

Neil Brant Armantrout for the degree of Doctor of Philosophy

in Fisheries presented on 2 June 1980

Title: The Freshwater Fishes of Iran

Abstract Approved: Dr. Carl E. Bond Redacted for Privacy

The freshwater fish fauna of Iran is represented by 3 classes, 16 orders, 31 families, 90 genera, 269 species and 58 subspecies. This includes 8 orders, 10 families, 14 genera and 33 species with marine representatives that live at least part of the time in freshwater. Also included are one family, 7 genera, 9 species and 4 subspecies introduced into Iran. Over half the species and nearly half the genera are in the family Cyprinidae; over 75% of the genera and species are in the order Cypriniformes.

The fish fauna may be separated into three major groups. The largest and most diverse is the Sarmatian Fauna, which includes the Caspian Sea, Azerbaijan, Lake Rezaiyeh, Khorasan, Isfahan, Dashte-Kavir, and the four subbasins of the Namak Lake Basins. Of the fish found in Iran, 14 of 31 families, 48 of 90 genera, 127 of 269 species and 46 of 58 subspecies are found in the Sarmatian Fauna. Endemism is low, and mostly expressed at the subspecific level. The fauna contains marine relicts from the Sarmatian Sea and recent immigrants with

strong relationships to the fishes of Europe, the Black Sea and northern Asia. The marine relicts are absent outside the Caspian Sea Basin, where the fauna is best described as a depauperate extension of the Caspian and Aral Sea faunas.

The second major fauna is the Mesopotamian Fauna, and includes the Tigris and Euphrates River Basins, the Karun River Basin, and the Kol, Mond, Maharlu, Neyriz and Lar Basins. The fauna is transitional between the Palearctic and Oriental Regions with some Ethiopian influence and does not readily belong in either the Palearctic or Oriental Regions. Nine of the 11 families, but only 12 of 33 genera in Iran are shared with the Oriental Fauna, while 16 out of 33 genera but only 5 of 11 families are shared with the Sarmatian Fauna. Endemism is high at the specific level; 37 of 89 species, or over 40%, are endemic.

The third major fauna is the Oriental Fauna, which represents the western-most extension of the abundant and diverse fauna of Southeast Asia. It is found in the coastal Mekran drainages, and in the Bampur, Dashte-Lut, Kerman, Yazd, Seistan and Enclosed Northeastern Basins. The limited habitat is reflected in the sparse fauna; only 9 of 31 families, 16 of 90 genera, 39 of 269 species and 3 of 58 subspecies found in Iran are found in the Oriental Fauna. Endemism is high; 22 of 39 species are endemic. All nine families are common in regions to the east, while eight of the nine extend further west to the Mesopotamian Fauna.

With the exception of the marine relicts in the Sarmatian Sea and marine fishes entering freshwater along the Persian Gulf and Gulf of Oman, the Iranian fish fauna developed during the major faunal migrations of the Pliocene and Pleistocene. Receding marine waters and the formation of major river systems in Mesopotamia and northern India facilitated an east-west faunal exchange along what is now the Persian Gulf and Mekran Coasts of Iran. At the same time, the pumping action of glacial advances and retreats in the north facilitated southward movements of Palearctic fishes. While the mountain massif stretching from the Taurus Mountains in Turkey through Iran, Afghanistan, Central Asia and the Tibetan Plateau of China prevented extensive faunal exchanges, some exchanges did occur in northeastern Iran, by way of the Sefid Rud and Azerbaijan, along the Helmand River, and through the Anatolian Uplands of Turkey.

The present fish fauna in Iran is the result of colonizers able to establish themselves in the limited habitat in Iran. Species diversity and abundance are best developed in the Sefid Rud and Caspian Sea, and in the Tigris and Karun Rivers where habitat is greatest. In the internal basins, diversity and abundance are limited by the lack of suitable habitat.

The Freshwater Fishes of Iran

by

Neil Brant Armantrout

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

June 1981

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Date Thesis is Presented 2 June 1980

Typed by Neil B. Armantrout for Neil Brant Armantrout

ACKNOWLEDGEMENTS

While many people have provided support and encouragement, several deserve special acknowledgement. These include: Dr. Victor Springer, for providing access to the collections and library of the Smithsonian Institution and for assisting in acquiring samples from Iran; Wayne Kinunen, Steve Bullock, Ray RaLonde and Pete Walczak for providing fish and inventory materials from Iran; Mr. Eskandar Firouz and Mr. Robert Tuck for allowing access to the Natural History Museum in Tehran; Dr. Hassan Hosseinzadeh for allowing use of the Shilot Institution collection; Dr. Borsukov, for assistance in gaining access to the collection of the Academy of Sciences collection in Leningrad and for providing important reference material; and Dr. Alwyne Wheeler, British Museum of Natural History, for invaluable aid in obtaining reference material. A special thanks is due my parents for their constant support and encouragement.

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THE FRESHWATER FISHES OF IRAN

I. INTRODUCTION

Because of its location, classical Persia is of considerable interest to zoogeographers. Classical Persia includes what is now Iran, Afghanistan, western Pakistan, Iraq, and the Caucasus and Turkoman coasts of the Caspian Sea. Persia, together with Palestine, sits astride the major land route connecting Africa, Europe and much of the Asian Subcontinent. Oceans to the west and south, and the mountain massif to the east, act as barriers to may plants and animals, funneling migrants through the Persian-Palestinian corridor.

Despite the interest in the area, its zoogeography is surprisingly poorly known. Few comprehensive studies of any group have been made. Because of its location and the importance of its commercial fisheries, the Caspian Sea flora and fauna are the best known of any in the region. For the most part Iran and adjacent areas until recently received little attention. Earlier zoogeographers, noting the lack of information on Persian faunas, generally lumped it with the European-Palestinian faunas in the Palearctic Region.

Freshwater fish, because of their limited habitat, are an important indicator of zoogeographical relationships. Until recently there were no systematic collections of Persian fishes. Collections that had been made were limited mostly to more populated areas, a result of difficult travel in rural Iran. The lack of collections has hindered the use of freshwater fishes in determing the zoogeographical divisions and relationships for Persia.

Development of a fishery resulted from foreign interests in the commercial species in Iran, most notably the Caspian sturgeon. There is little indigenous use of fish, and little incentive for native Iranians to study fish. Past collections have been almost entirely by foreign biologists who have visited Iran, made collections, and took them to other countries for study. Only in the last 15 years has there been an attempt to inventory and evaluate fish resources on a regular basis.

The purpose of this thesis is to summarize information available on the systematics of freshwater fish in Iran and to describe the distribution of the freshwater fish, their possible origins and their movements. While the discussions will be concerned principally with Iranian freshwater fishes, of necessity the area of consideration will include all of classical Persia and Palestine.

II. MATERIAL AND METHODS

A. SOURCES OF INFORMATION

Information for this thesis was obtained from personal observations and collecting in Iran, examination of museum specimens and a review of the literature.

1. Personal Observations and Collections.

I spent four and a half years in Iran, 1966 to 1968, and again 1973 through 1974. The majority of the time I was teaching at either Pahlevi University in Shiraz, or at the University of Tabriz in Tabriz. Three months were spent with the South Shilot, the Government-owned commercial fishing monopoly, at Bandar Abbas on the Persian Gulf. About one year was spent as a fishery biologist with the Game and Fish Council of Iran. An additional three months were spent in Iran on a tourist visa collecting and examining fish.

While in Iran I had an opportunity to visit all basins, some on several occasions. I have collected fish in all basins. In addition, I have flown over most of the basins. I also had the opportunity of visiting Turkey, India, the Caucasus and Azerbaijan portions of the Soviet Union, and much of Afghanistan and Pakistan. I collected and examined many specimens of marine fishes and, prior to initiating the thesis, freshwater fishes, for which I made no notes but which helped me become familiar with the fishes of the region.

2. Collections Examined

Extensive examination was made on six lots of fish. The system of measurement used in the examination is that outlined by Berg (1948). Most of the characters, such as body proportions, pharyngeal teeth, gill rakers and scale counts, follow standard practices as used in the United States. Lengths given in the Systematics Chapter are total lengths unless otherwise indicated. The one exception is with fin ray counts. The counts are expressed by two sets of numbers, Roman numerals for unbranched rays and Arabic numberals for branched rays. Thus a formula of D IV 8 would indicate the dorsal fin had four unbranched and eight branched rays. In some instances ray counts in the literature did not separate the branched and unbranched rays and a total ray count was used. All unbranched rays were counted.

The six lots of fish on which I based much of the revision of the systematics of Iranian fishes are:

i. Fish collected together with employees of the Department of the Environment and Dr. Robert J. Behnke now in the collection of the Natural History Museum of Iran in Tehran. Half of the original collection was sent to the United States where it was to have been divided between myself and Dr. Behnke. However, the total collection was retained at Colorado State University. A graduate student, Mohammad Saadati, was sent from Iran. He examined the specimens, reporting on them in a Master's Thesis from Colorado State University (Saadati, 1977). I did not examine these specimens but did use Saadati's measurements in my analyses. I examined the half of the collection left in Tehran prior to leaving the country. These fish were not catalogued, and are indicated as MMTT (Trip) in the Systematics Chapter.

ii. Freshwater and marine fishes in the collection of the Natural History Museum of Iran (MMTT). About 1000 specimens of fish had been catalogued into the collection; many other uncatalogued specimens were examined. The material in the collection was taken from late 1969 to 1974. Prior to 1969, when intensive collecting was initiated by Peace Corps volunteers, no systematic collection existed in Iran. Material examined is indicated in the Systematics Chapter by MMTT and the catalogue number or (No Number) when not yet catalogued.

iii. I examined about 60 lots of fish in the Institute at the North Shilot compound in Bandar Phalevi. These fish dated to about 1960, and were collected by Peace Corps volunteers, Iranian workers, and some foreign visitors. The fishes were used in classes at the Institute. The fish were not catalogued and included one or more species in each lot.The material examined is indicated in the Systematics Chapter by Shilot.

iv. I was able to spend eight days examining fish at the Academy of Sciences of the U.S.S.R. in Leningrad. Many of the specimens were from earlier material collected in Iran and Mesopotamia. Because of the limited time I was able to examine only a few specimens of particular interest because of location of collecting or systematic questions I had. A longer stay had been planned, but difficulties arose because the Museum had not been notified of my coming. Material from the collection is indicated by the letter A and the catalogue number.

v. A collection of fishes was provided to Oregon State University by four former students who were in the Peace Corps in Iran, Wayne Kinunen, Steve Bullock, Ray RaLonde and Pete Walczak. Financial assistance for collecting and transmitting the specimens was provided by the Smithsonian Institution. I examined these fish, now in the Oregon State University collection, and which are indicated by the letters OS and the catalogue number.

vi. Part of the collection made by the four Peace Corps volunteers was retained at the Smithsonian Institution. I have examined these specimens, plus other specimens in the collection from the Middle East and adjoining areas. Material examined is indicated by USNM and the catalogue number.

3. Literature

An attempt was made to obtain all early publications on Persian and other Middle Eastern fishes. This proved quite difficult. Most of these papers were published in Europe in the last century and are not readily available in the United States. I was able to obtain the majority of early papers on fishes outside the Caspian Basin. The early Caspian Sea work was done by Russian biologists nearly 200 years ago; I found these papers especially difficult to acquire. I have been able to obtain most recent papers on work from the Middle East and on revisions of families and genera of Iranian fishes.

B. SYSTEMATICS

The Systematics used in this thesis was taken from Berg (1940, 1948). I have retained his names and divisions down to the Genus level unless recent work showed that a different name or system was correct.

When beginning the zoogeographical analysis of Iranian fishes, it became apparent that many discrepancies and questionable distribution patterns existed in the literature. It became necessary to review the systematics of all fishes in Iran and adjacent areas.

Two sources of information were used as the basis for this review. The first was the type descriptions in the literature I was able to obtain. The second was the specimens I examined. I first compared my specimens to the type descriptions, matching them where possible.

Next, I compared reports in the literature of collections of fish where good descriptions of the specimens were provided by the authors. Again, the comparison was with the type descriptions and with my own specimens. Of special interest were reports by authors, such as Eichwald, Kessler and Heckel, whose original papers I was not always able to obtain, but who provided descriptions of other specimens they assigned to species for which I did not have the type description.

Finally, I reviewed other literature reports, including those with only species lists or with incomplete descriptions. An attempt was made to determine the status of all forms described from the Middle East or mentioned in the literature, although in some cases too little information was provided. I then compared my preliminary analysis with other summary papers (such as Berg, 1949) and revisions of individual genera and families (for example, the series of papers by Karaman). In many cases I was not able to examine species of a species; in these instances, I reviewed all literature reports on the species, evaluating the reports and summarizing the information. Where only one or a few reports were available and I had not examined specimens, I accepted the literature reports as given even though in some instances I had reason to question the systematic position or distribution given.

After comparing my specimens to the literature I was able to obtain, there remained many specimens which did not match existing descriptions. These are indicated in the Systematics and Distribution chapters by the genus name followed by a number. A number was used rather than a name because I am still evaluating the systematic position of these specimens. Some represent new species, while others are probably subspecies. In some cases, the specimens may belong to existing species, but will require a redefinition of the species.

The Systematics used in this thesis is a preliminary revision based upon original material, type descriptions and other literature reports. The descriptions and distribution represent a comparison of all material and literature reports in each genus, for each species.

C. DISTRIBUTION

The initial step in the analysis of distribution was compilation of Table 1, indicating the basins in which each species and subspecies had been found. Next, tables were prepared for each basin (see individual basin discussions for these tables) in which all species reported from that basin are summarized. I had already made a preliminary division of the Iranian fishes (see discussion in the Distribution Chapter); this was modified on the basis of the two sets of tables indicated above.

The three major faunal divisions, the Sarmatian, Mesopotamian and Oriental, had become apparent during the first period of work in Iran. It was recognition of this division that led to this thesis. Each of three major divisions had one major basin which contained the bulk of the families, genera and species. For the Sarmatian, it was the Caspian Sea; for the Mesopotamian, the Tigris-Karun Rivers; and for the Oriental, the Mekran Coasts. The remaining basins showed relationships to these major faunas, containing similar genera and species. Comparison of the families, genera and species of the remaining basins with the three principal basins was used to assign a particular basin to a faunal region. The degree of similarity at the species and subspecies level proved to be the best indicator of probable relationships. Based on these relationships, the individual basins were organized into regions, subregions, provinces and districts.

III. PREVIOUS WORK

The groundwork for the study of freshwater fishes in Iran and adjacent areas was laid by a series of biologists and ichthyologists who collected and published during the 19th century. This was a period of increased interest in natural sciences, a period when major attempts were first made to identify and classify biological organisms.

Initial interest in the Middle East was in Palestine, a result of Biblical influences. Collections were primarily by foreign biologists who traveled to the area to make collections, or were personnel attached to foreign forces or legations in the Middle East. Travel was restricted by inaccessible terrain and by the lack of a central authority that could protect biologists. Britain, Russia and Turkey, during the 19th century, extended control over much of the area. In those areas under foreign control, considerable collecting was conducted. Iran, which remained free of foreign domination, received little attention during this period.

The first fish collection I am aware of from the Middle East was made by P. Forskäal in 1762 during the expeditions of Carsten Niebuhr to Arabia. Forskäal died on the journey, but Niebuhr later published Forskäal's records. His collections, at the Zoological Museum of Copenhagen, are of interest because of the unusual mode of preservation. Forskäal, lacking adequate containers and spirits, split his specimens and dried them, forming a fish "herbarium". Even after 200 years, the specimens are in excellent condition.

The first major freshwater collecting in the area I am aware of was by Peter Simon Pallas, a Russian, who worked in the Black and Caspian Sea Basins. He published his studies beginning in 1773.

To the east, the first look at Indian fishes was published by Marcus Elieser Bloch in his 1785-1795 edition of "Naturgeschichte der auslandischen Fische." The work was later included in J. Gottlob Schneider's "Systema Ichthyologiae." At about the same time in France Bernardine Lacépède was publishing his "Histoire Naturelle des Poissons," which covered many of the same areas.

These publications, together with other European works, beginning with Karl Linnaeus' "Systema Naturae" in 1766, provided the starting point for the study of Fishes in Persia. Many of the European publications, while not including specimens from the Middle East, contained descriptions of forms that ranged south of the Caspian Sea and into Persia.

Most of the actual collections in Iran were made by Europeans who either visited the area and returned to Europe with their collections, or who sent collections to ichthyologists in Europe who subsequently published on the collections. Only in India was there an indigenous program of collection and publication. Some of the important collections and publishers from the area are:

1. Patrick Russell, Naturalist to the Madras Government in India, published his "Fishes of Vizagapatam" in 1803.
2. George Cuvier and A. Valenciennes published a 22 volume work between 1828 and 1849 that covered most of the fish known at that time.

3. C.G. Ehrenberg, during the period of 1820 to 1825, published on collections from North Africa and Western Asia.
4. E. Eichwald, during the 1830's and 1840's, published on collections from the Caspian Basin and the Caucasus.
5. William Swainson, during the 1830's, published on marine fishes from the Indian Ocean.
6. J.J. Heckel published the first extensive report on Persian fishes from south of the Caspian. He visited the area, making collections as far south as the basin of the Persian Gulf. His studies were published in the 1840's.
7. John McClelland published the first extensive paper on fishes of Afghanistan and Kashmir. The collections were made by William Griffith of the British Expeditionary Forces. McClelland published his studies in 1842.
8. K. Kessler, a very active researcher during the period of the 1850's to 1880's. He published many papers on the fishes of the Caspian and Aral Sea Basins.
9. E. Keyserling in 1861 published the first extensive reports on collections of fish from northeast Persia and western Afghanistan.
10. F. de Filippi, during the 1860's, published several papers on fishes from Persia and other Middle Eastern countries.

11. Albert Gunther, of the British Museum of Natural History, published a series of papers on fishes from the Middle East. In 1864, he published on the fishes of Palestine; in 1874, on Tigris River fishes; in 1889, on fishes collected by the Afghan Delimitation Commission; in 1899, on the fishes of Lake Urmi (now Lake Rezaiyeh). His Catalogue of Fishes, published 1859-1870, is an important reference on fishes from the Middle East and adjoining regions.
12. Francis Day, working in India, began publishing on fishes from the area stretching from current Pakistan, Tibet, India, and into Burma in the 1860's. His "Fishes of India", which covers freshwater and marine fishes, is a monumental work, still an important reference on fishes of the Indian subcontinent.
13. Franz Steindachner, during the last 40 years of the 19th century, published several papers on the fishes of Turkey, the Middle East and Central Asia.
14. C.B. Klunzinger, in the 1870's, published extensively on fishes of the Red Sea.
15. Pieter Bleeker, by the time of his death in 1878, had published 8 of a 12 volume work on fishes, which was completed after his death. This Atlas included many forms from Asia.

16. G.A. Boulenger, in 1887, published on the fishes of Muscat. Other papers on marine and freshwater fishes of the Middle East followed.
17. L. Lortet made many original collections in the Middle East in 1883. Some of the specimens he deposited in the Lyon Museum, France, are now in the Smithsonian Institute collection.
18. J.B. Tristram, in 1884, made extensive collections in the Palestine area.
19. A. Nikolsky, from 1897 into the early 1900's, published on a series of collections made by N. Zarudny in Eastern Persia, including the first collections from many of the eastern internal basins.
20. Erich Zugmayer, 1910 through 1913, published the first papers on the Baluchistan portion of modern Pakistan.
21. A.N. Derzhavin, in 1913, made extensive collections from the Caspian shore of Iran, the Tehran area, and Azerbaijan.
22. J.T. Jenkins, in 1910, collected fish from India and Persia.

During the first 40 years of the 20th century, a number of other European collectors visited the Middle East, including E. Tortonese, D. Vinciguerra, J. Pellegrin, B. Hanko, A. Gruvel, C. Tate Regan and M. Holly.

In India, the Indian Zoological Survey made extensive collections throughout the country. A number of Scientific Societies were organized, with those in Calcutta and Bombay being particularily active. One of the early workers in the 20th Century was N. Annandale, who published on Palestinian fishes as well as those from India and the Helmand Basin.

Special note should be made of S.L. Hora, who begain publishing about 1920, and continued active study and research into the 1950s. His output included geology and zoogeography in addition to fishes throughout southern Asia. His systematic and zoogeographical publications are a major source of information for this thesis.

The single most important source of information on fishes from Persia is L.S. Berg, dominant ichthyologist in Asia and eastern Europe for the first half of the 20th Century. His work began near the turn of the century with a series of reports on fishes from several parts of Russia. In 1911-1914, he published the first report on the Fish Fauna of Russia in comprehensive form. This was further expanded and developed, being re-published in 1948 as his major work, the "Freshwater Fishes of the USSR and Adjacent Countries." The following year, he published the first summary of Persian fishes in his "Freshwater Fishes of Iran and Adjacent Areas." Other works covered fishes from throughout Asia, Europe and other parts of the world. The classification of fishes proposed by Berg in his 1940 "Classification of Fishes both Recent and Fossil," was used in this thesis.

Since the Second World War, work on the fishes of Persia and other Middle Eastern countries has grown. One major reason has been the development of native biologists with an interest in fisheries. Foreign biologists, mostly from Europe and the United States, still made major contributions, but increasingly the countries in the Middle East are developing the capability to conduct fisheries research.

In Iran, ichthyology and fisheries are not traditional fields. However, since about 1960, a number of biologists, mostly foreign trained, have begun working in Iran. Interest increased in all aspects of the natural history of Persia, including the non-commerical fisheries.

IV. PHYSICAL SETTING

Iran is located in southwestern Asia in the area referred to as the Middle East. Its southern flank forms the coastal area of the Persian Gulf and Gulf of Oman. The entire northern border is shared with the Soviet Union. On the east, Iran borders Afghanistan and Pakistan, and in the west Turkey and Iraq. (Figures 1 and 2). With a surface area of more than a million square kilometers, it is one of the largest countries in the world.

Iran is a land of mountains, with an average altitude of 1,100 M. In general, Iran is like a large bowl, with mountains along the borders rimming an inner plateau. This inner plateau is broken into a series of smaller basins by mountains (Figure 3).

Precipitation entering Iran must cross perimeter mountains. The mountains cast a rain shadow, cutting off most of the precipitation, leaving the inner plateau a largely arid desert. The heaviest rainfall occurs along the Caspian Sea coasts and in the mountains.

All major drainages begin in the mountains. Rivers draining the mountains away from the plateau drain mostly into the Caspian Sea or Persian Gulf and Gulf of Oman. Rivers draining into the inner basins all disappear into the sands or salty depressions. There are very few permanent lakes and most of those are quite saline. All internal basins have saline playas which may contain water for at least part of the year.

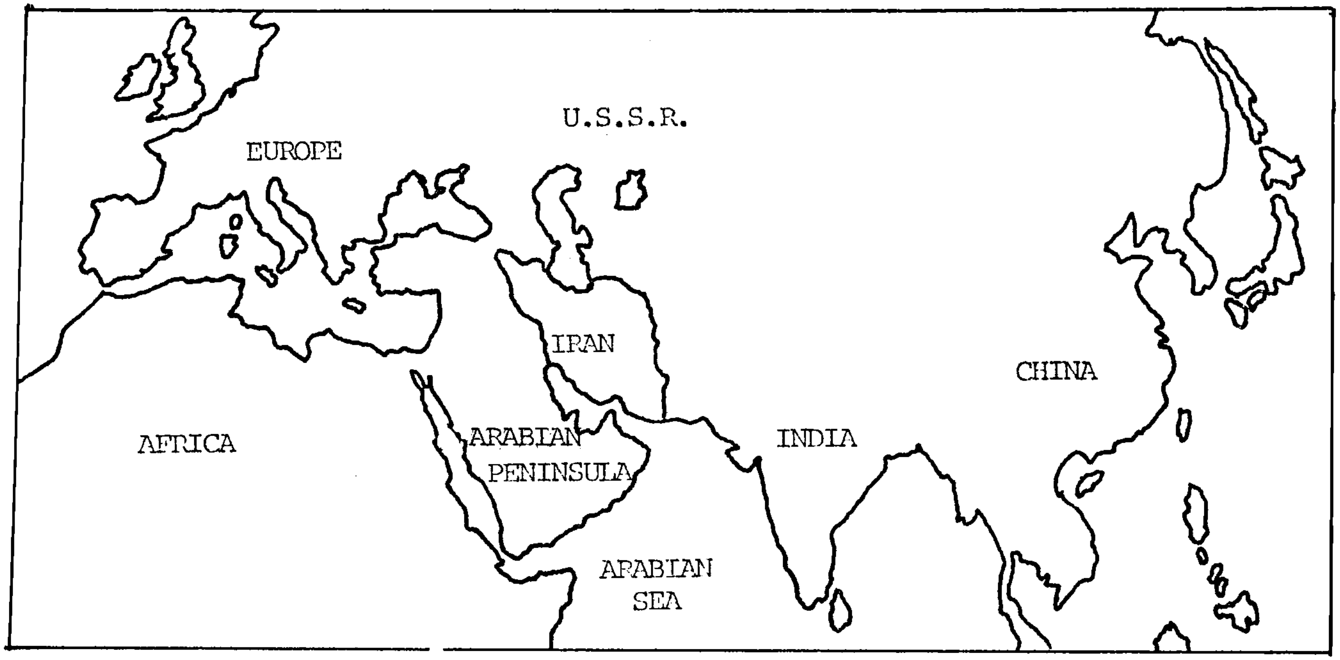

Figure 1. General location of Iran

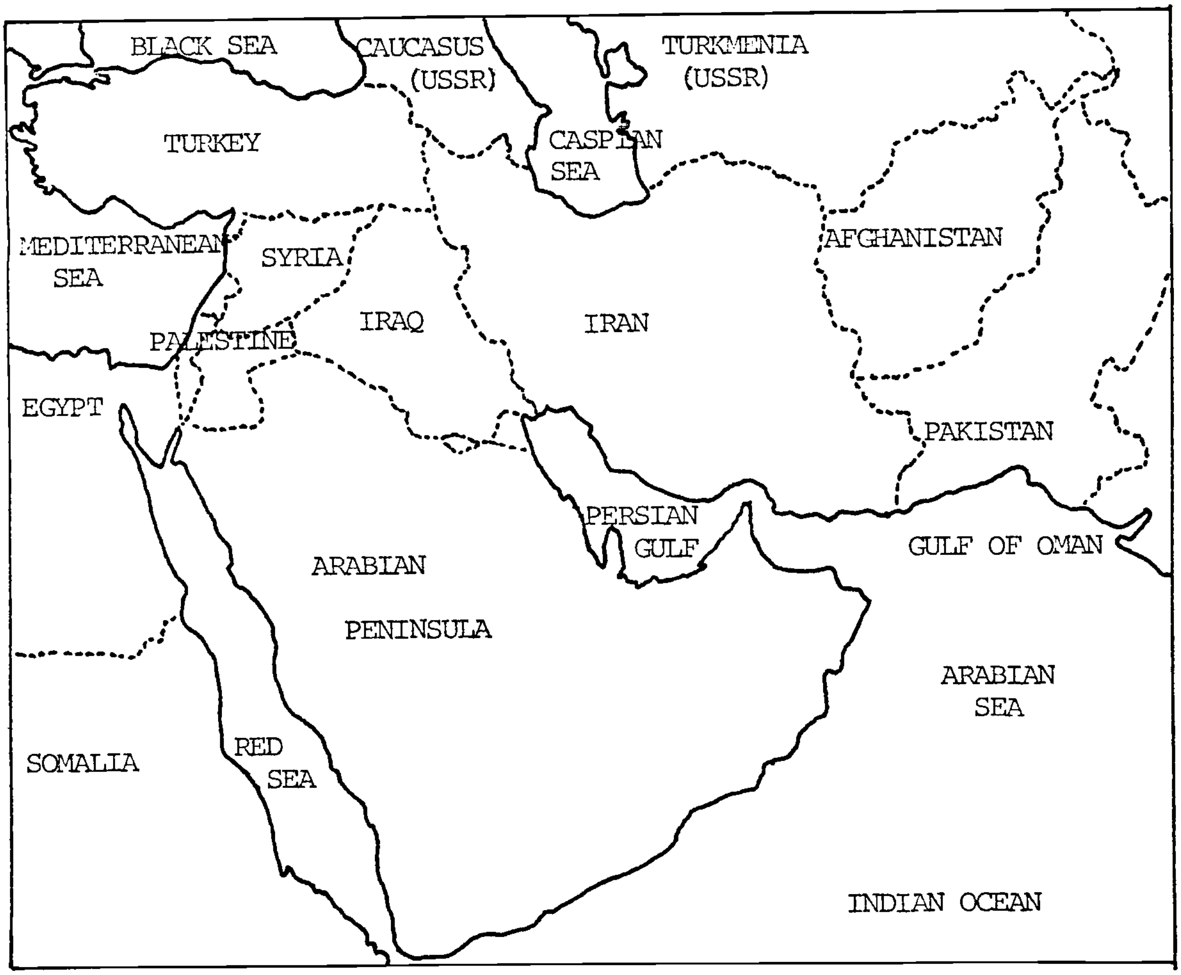

Figure 2. Iran and Adjacent Countries

Water is scarce in Iran. Even along the Caspian Sea, where as much as 250 cm of rain fall, irrigation is necessary in the dry summer months. Essentially all flowing water that can be used for irrigation is developed and diverted. Irrigation has been practiced in some basins for at least 4,500 years. As a result, few streams remain unaltered. Diversion for irrigation and domestic use, heavy livestock grazing, and removal of riparian and upslope vegetation has greatly altered the aquatic habitat. It is very possible that the distribution and abundance of fish species has been altered over the centuries as a result of the habitat modifications.

In order to supplement surface flows, the ancient Persians developed a form of irrigation called qanats that tapped subterranean aquifers. Many of these qanats now contain fish (for a discussion of qanats see Appendix I.)

The following discussions of the major mountain ranges and basins in Iran are based primarily on personal observation (see Armantrout, May, 1968). Additional information on the internal basins is from Krinsley (1970). Other sources are indicated in the discussions.

MOUNTAIN RANGES

Iran is dominated by two major mountain ranges, with several smaller ranges, principally in the central plateau.

Elburz Mountains

The Elburz Mountains run east to west across the northern part of Iran, separating the Caspian-Aral Basin to the north from the rest of Iran. The Elburz Mountains are part of the mountain chain originating in the Tien Shen Mountains of China and running through the Himalayas of India and Tibet, the Hindu Kush of Afghanistan, and the Elburz Mountains of Iran on into Europe. Highest point in the Elburz Mountains is Mt. Damavand, an extinct 5900 meter peak just northeast of Tehran.

In the northeastern corner of Iran the Elburz become little more than low hills, forming a gap in the chain through which the Tedzhan and Murgab Rivers, part of the Aral Sea Basin, drain. In the eastern part of the Elburz, a second mountain range, the Kopet Dagh, is found. While now essentially continuous with the Elburz, the Kopet Dagh had a separate developmental history (see discussion on geological history of Iran). The Kopet Dagh's northern face is quite precipitous, rising dramatically from the Russian steppes that stretch away to the north and east.

In the west, the Elburz Mountains blend into the northwestern extension of the Zagros Range and the Caucasus Mountains. This area is called Azerbaijan, and is marked by a series of separate volcanic peaks. The best known is Mt. Ararat, 5600 meters high, just over the border in Turkey.

The highest peaks and steepest terrain in the Elburz Mountains are in the central portion, which separates the Caspian Sea Basin from the internal basins to the south. It is here that the rain shadow affect of the mountains is most pronounced. The northern slopes of the Elburz Mountains receive abundant rainfall, with heavy snows in the mountains in winter. To the south, the internal basins are deserts. Rivers arising in the mountains flow either to the Caspian Sea or into the internal basins except in the west where the Sefid Rud River has cut through the mountains, forming a link between the Caspian and the internal basins.

Zagros Mountains

The Zagros Mountains form a crescent-shaped range running northwest to southeast along the western and southern flank of Iran. The highest point is Zard-e-Kuh, at 5400 meters near the center of the range. Towards the north and southeast from the center of the range the mountains become lower and less precipitous. Many peaks to 15,000 feet are present.

In the northwest, the Zagros Mountains blend into the Elburz and Caucasus Mountains. Towards the southeast, the Zagros is replaced by several smaller ranges, the most important of which is the Mekran Mountains that extend along the Gulf of Oman into Pakistan.

Most of the Zagros Mountains drain into the Tigris and Karun Rivers. Along its southern flank, streams drain into the Persian Gulf and Gulf of Oman. The interior slopes, forming the western and southern limits of the Iranian Plateau, have few streams. All streams found on the internal slopes are lost in the sands, playas and saline lakes of the internal basins.

Mekran Mountains

This mountain range extends from the end of the Zagros Mountains, between the Jaz-e-Murian Basin and the Gulf of Oman, and into Pakistan.

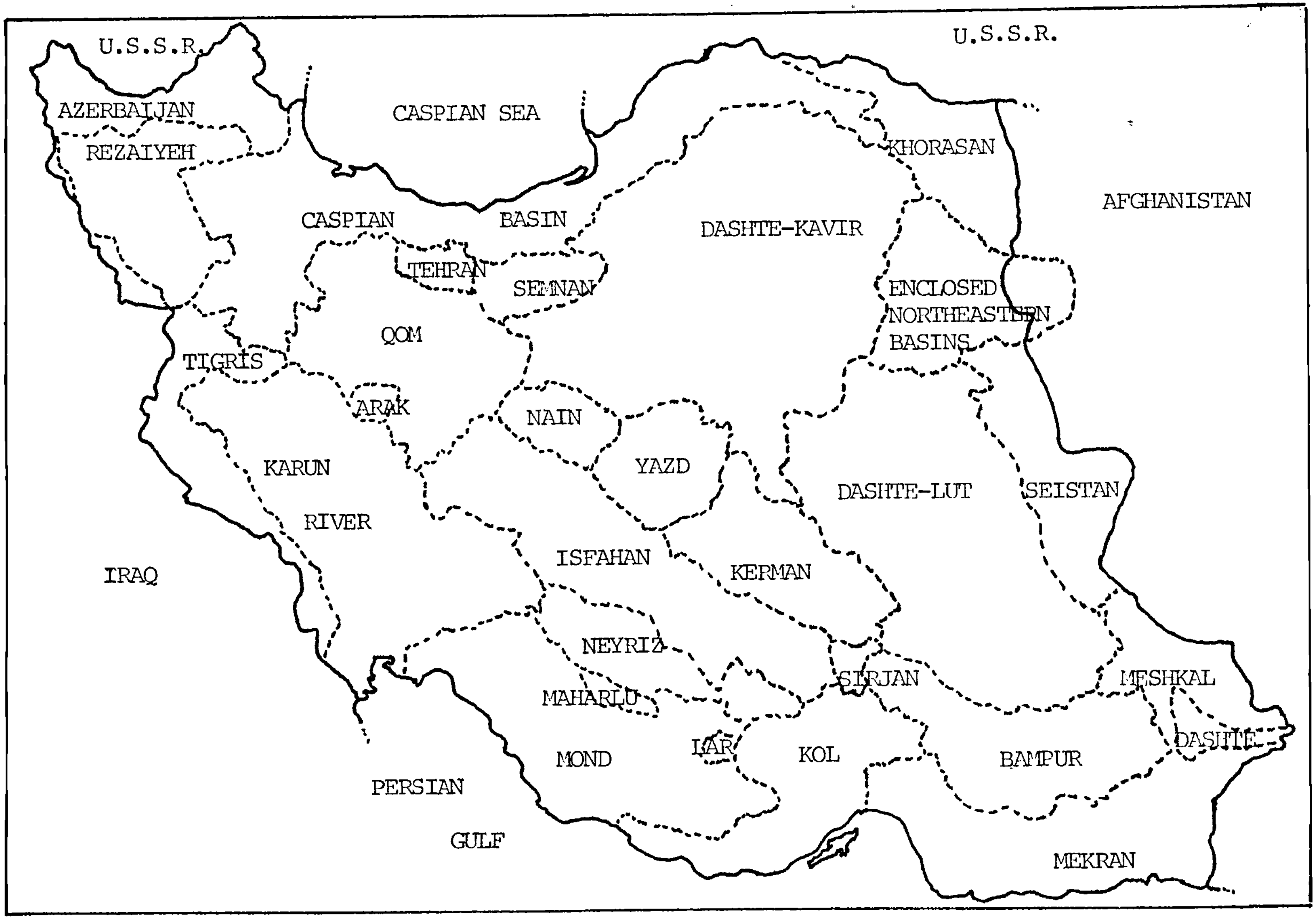

Figure 3. Major Basins of Iran

These mountains are geologically very recent. The area has many earthquakes, with a number of active volcanoes, rising to 4,300 meters. It is a stark, wild terrain which has not weathered much. The mountains are interspersed with smaller basins dotted with isolated monoliths and separated by steep, jumbled mountainous areas. Precipitation is limited and few streams are found in the area.

Eastern Mountains

A series of short mountain range run north and south along the eastern edge of Iran. They separate a number of isolated internal basins from each other, and from the Helmand and Aral Sea drainages to the east. Peaks do not exceed about 3300 meters. The area is quite arid and few streams are present.

Internal Mountains

Within the Iranian Plateau there are several basins separated from one another by isolated mountains. Some, such as the ranges that separate the Isfahan, Kerman and Yazd and Arak Basins run northwest to southeast, essentially paralleling the Zagros Mountains. Others, particularily in the central portion of the internal deserts of the Dashte-Kavir and Dashte-Lut, also run east and west. Peaks reach over 12,000 feet. The area is arid, and streams are few.

DRAINAGE BASINS

Caspian Basin (Figure 4)

The Caspian Sea is the largest inland body of water in the world. It is bordered by two countries, Iran and the Soviet Union. It was

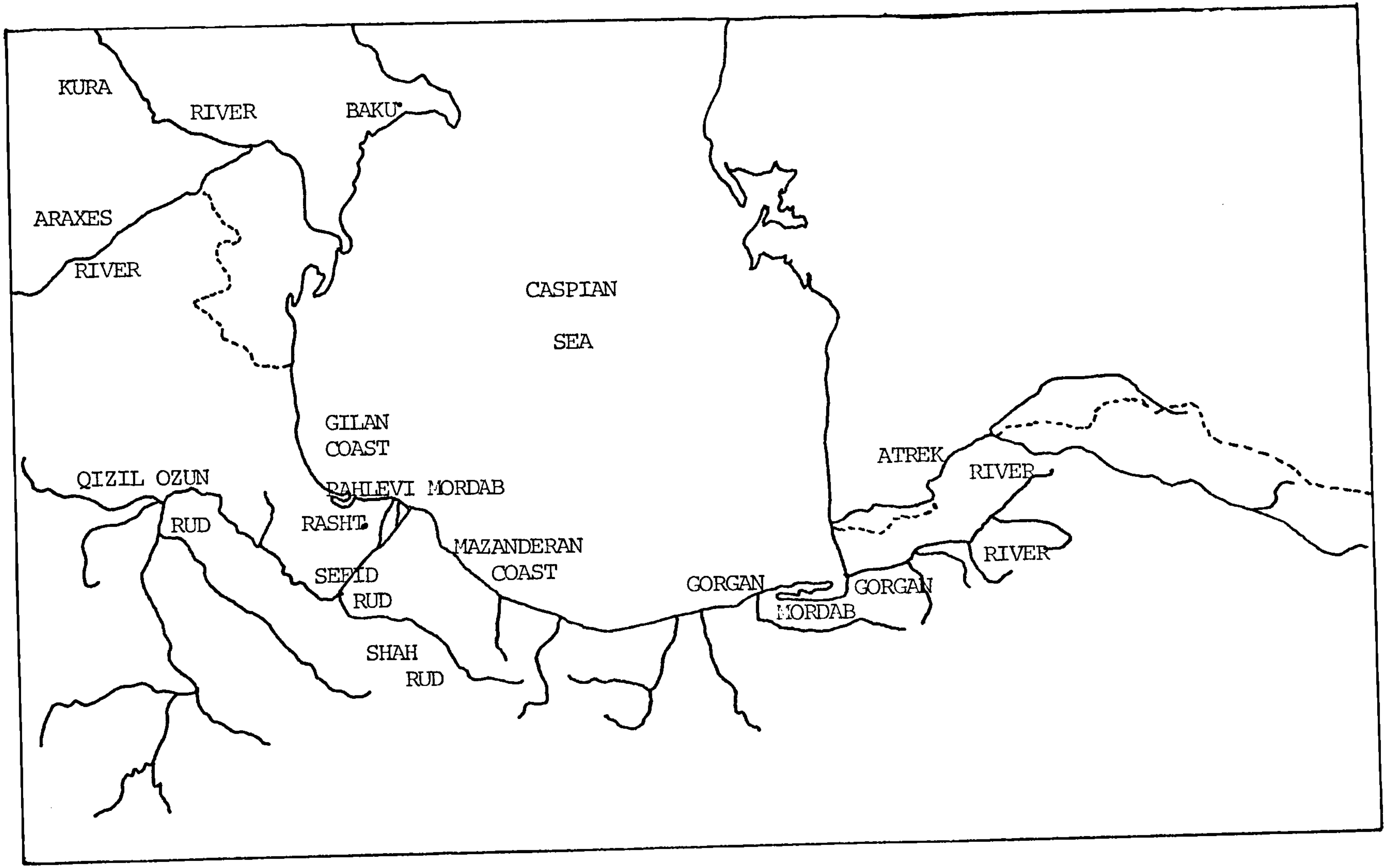

Figure 4. Caspian Sea Basin

once part of a vast ocean stretching from the Mediterranean Sea to the Indian Ocean. (See Chapter on Geologic History).

The Caspian covers about 422,000 km^2, which is roughly divided into three sections. The northern section is very shallow, the water being about 10-12 meters deep over much of the area. The water has a mean summer temperature around 25^oC, but in winter the area is covered by a thick sheet of ice. The salinity is low due to the inflow of the Volga River. It ranges from 5 to 10 0/00, being highest in the eastern areas removed from the main region of freshwater inflow.

The central and southern areas are deeper. The central area has a maximum depth of 770 meters, while the southern portion is over 1000 meters deep. Because of the much smaller inflow of fresh water, salinities are higher, 12-13 o/oo. Summer temperatures are similar to the northern area, averaging 26-27^oC. These areas do not freeze in winter; the average winter temperature in the southern area is 9^oC.

Water from the three sections is kept separate by a system of five eddies running counterclockwise; two each in the north and south and one in the central region. The currents are mainly a surface phenomenon. The deeper water circulates very slowly, and at depths below 200 meters remains a constant 5-6^oC.

Close to shore, and below 100 meters, the bottom is primarily silt, rich in detritus. The bottom in intermediate areas is largely sand and large shell deposits. In the deeper waters of the south and central regions where there is little circulation, and in the shallow waters of the northeastern corner where there is little inflow, the detritus deposits have depleted much of the available oxygen, creating a deoxygenated condition in which the sulfur-forming bacteria Microspira (Desulfevibrio) can flourish.

The Caspian depends upon rainfall and river inflow for water. About 3/4 of the inflow comes from the rivers, with the Volga contributing about 80% of this amount. Total influx from rain and the rivers is estimated to be around 450 km^2/yr. This was reduced in the 50's and 60's as a result of water withdrawals from the major rivers for agriculture and industry. This led to a drop of two meters in the surface level of the Caspian over a 30 year period. As a result of changed management of the Soviet rivers the withdrawals were decreased and the Caspian apparently has leveled off. Historically the Caspian Sea has undergone major fluctuations in depth. The surface of the Sea is currently 28 meters below sea level. (Information on the Caspian Sea taken from Armantrout, 1968b and 1968c; a major source of information is Zenkevitch, 1956).

Along the Iranian shore the mountains rise rather steeply from the sea. There is only a comparatively narrow littoral. In the northwestern corner near Astara and south along the Talesh Hills to Bandar Pahlevi the littoral is only 1-5 kilometers wide. There is a broad flat at the mouth of the Sefid Rud formed by alluvial outwash. From the mouth of the Sefid Rud eastward to about Amol, the littoral is about 4 to 8 kilometers wide. East of Amol, the littoral gradually widens as it blends into the Russian steppes stretching eastward away from the Caspian shores.

The rivers entering the Caspian Sea arise on the northern slopes of the Elburz Mountains and flow in a generally northerly direction. Within the mountains the rivers are typically alpine rivers; clear, cold, with many pools, riffles and rapids. After emerging from the mountains onto the Caspian floodplain the gradient is reduced. Towards the west, where the floodplain is narrow, the streams maintain their riffle and pool character. Towards the east the flood plain is flatter and much broader. The stream character is much different, with very slow flow between banks cut into the sediments of the plain. Most rivers flow directly into the Caspian Sea, but several empty into the two Mordabs near Bandar Pahlevi and Gorgan. The Mordabs are large lake-marsh areas cut off from the Caspian by elongate sand spits. The mordabs are quite shallow with little current. They do connect with the Caspian but only through narrow channels.

The heaviest concentration of people in Iran is along the Caspian Sea. Because of the abundant precipitation and the many perennial rivers most of the arable land is farmed, with rice, tea, oranges and cotton as principal crops. Extensive forests composed of hardwoods such as oak, beech and maple existed in the mountains above the Caspian floodplain, but these are rapidly being logged, to be replaced by farming and grazing.

Because of the heavy use, the streams are mostly in poor condition. Erosion has increased and available habitat declined. Irrigation is practiced from April to October. The dams and diversions block both upstream and downstream movements of the anadromous Caspian fishes.

Loss of habitat, poaching, heavy commercial fishing and stream blockage have led to greatly reduced populations of fish, particularily of the economically important species.

The largest tributary of the Caspian Sea is the Sefid Rud, second only to the Karun in size among Iranian rivers. It has two major forks, the Qizil Ozun flowing in from the west and the Shah Rud from the east. The two forks meet at a gap in the mountains at a place called Menjil where a major dam was constructed. The Shah Rud arises in the heart of the Elburz Mountains not far from Tehran, then runs down a deep canyon. Its floor is of varying width, with a bed of alluvial material.

The Qizil Ozun has branches originating in the northwestern part of the Zagros and in Azerbaijan. The network of headwater streams meets near the town of Mianeh, then flows generally eastward to meet the Shah Rud. Several of its headwater streams are close to headwaters of the Qom Basin, upper Karun Basin and Lake Rezaiyeh Basin.

The Sefid Rud cuts through the Elburz Mountains, the only river in the Caspian Basin to do so. Because of its close association with several other drainage basins, it is the probable pathway for many fish migrations, as will be discussed in the section on Iranian fish zoogeography.

Extensive anadromous fish runs once ran up the Sefid Rud, but these were blocked by the dam at Menjil and two subsequent dams further downstream built as part of a massive irrigation project.

The second largest Iranian Caspian drainage is the Atrek River, which enters from the east. Its headwaters flow off the Kopet Dagh Mountains in a northerly and westerly direction, with the main river flowing westerly into the Caspian Sea. Along part of its length it serves as the border between Iran and the Soviet Union. In this area the river is sometimes little more than a ditch at low flows. Some of the headwater streams are close to those of the Aral Sea and northeastern internal basin streams.

Azerbaijan (Figure 5)

Azerbaijan is the northwestern corner of Iran. Geographically, it also includes northeastern Turkey and the southern Caucasus of the Soviet Union. It is principally a mountainous upland area. Two principal rivers, the Kura and Araxes, drain Azerbaijan, the two meeting to form the main Kura River near where it empties into the Caspian Sea. Only the Araxes River drainages are found in Iran.

The Araxes River is the border between Iran and the Soviet Union along much of its length. It has headwaters in Turkey, but receives many tributaries from Iran. Along the parts of the river I saw the river was in a shallow but narrow canyon. One dam, the Araxes Dam, was a joint enterprise of Iran and the Soviet Union. Of the tributaries arising in Iran, the Qarahsu, which passes near the town of Ardebil, is the largest.

Lake Rezaiyeh (Figure 5)

Lake Rezaiyeh, also called Lake Urmi, is the largest lake in Iran. Its surface is at an average altitude of 1,300 meters. The maximum depth is 15 meters, with the mean depth only 5 meters.

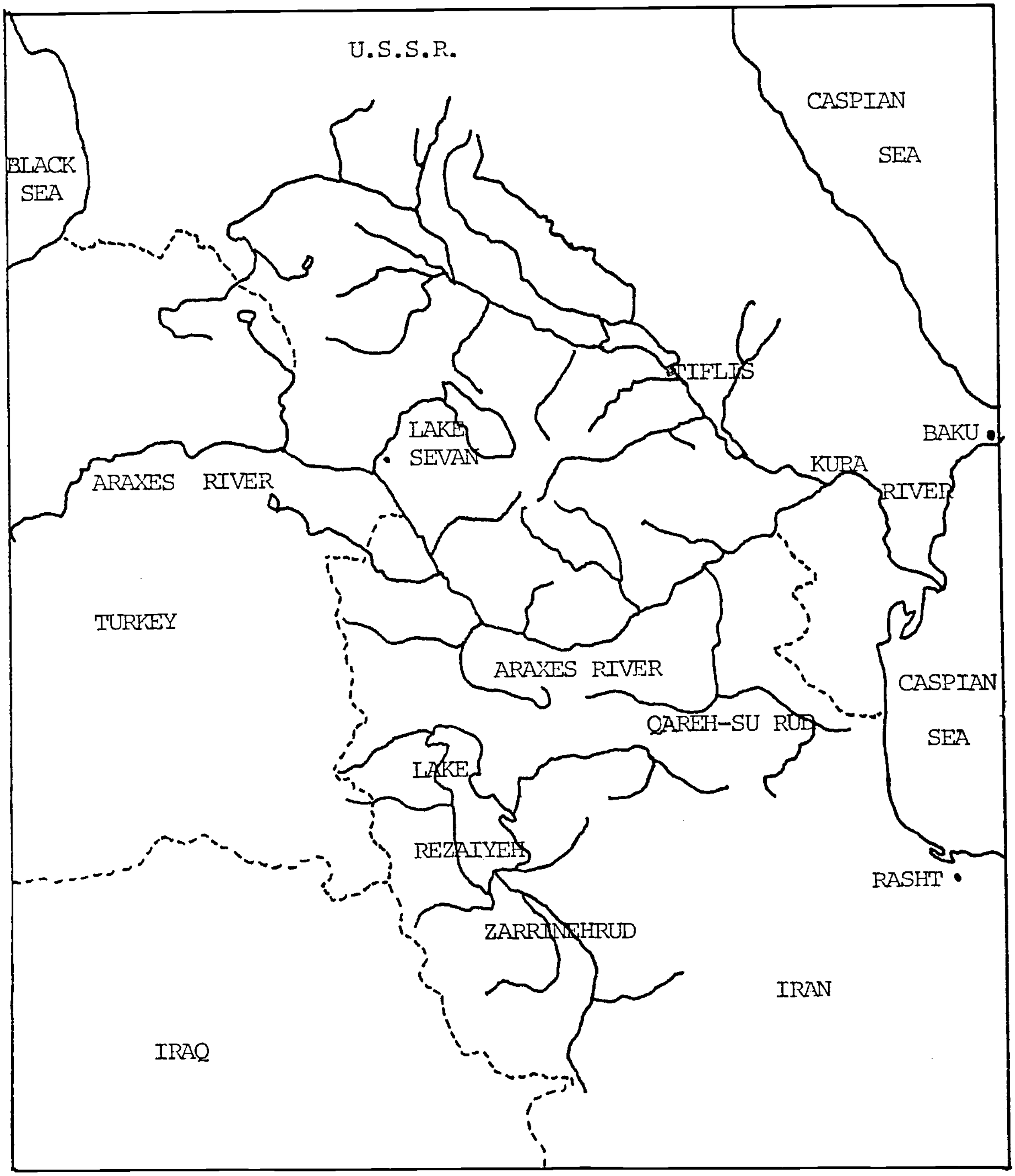

Figure 5. Azerbaijan and Lake Rezaiyeh Basins

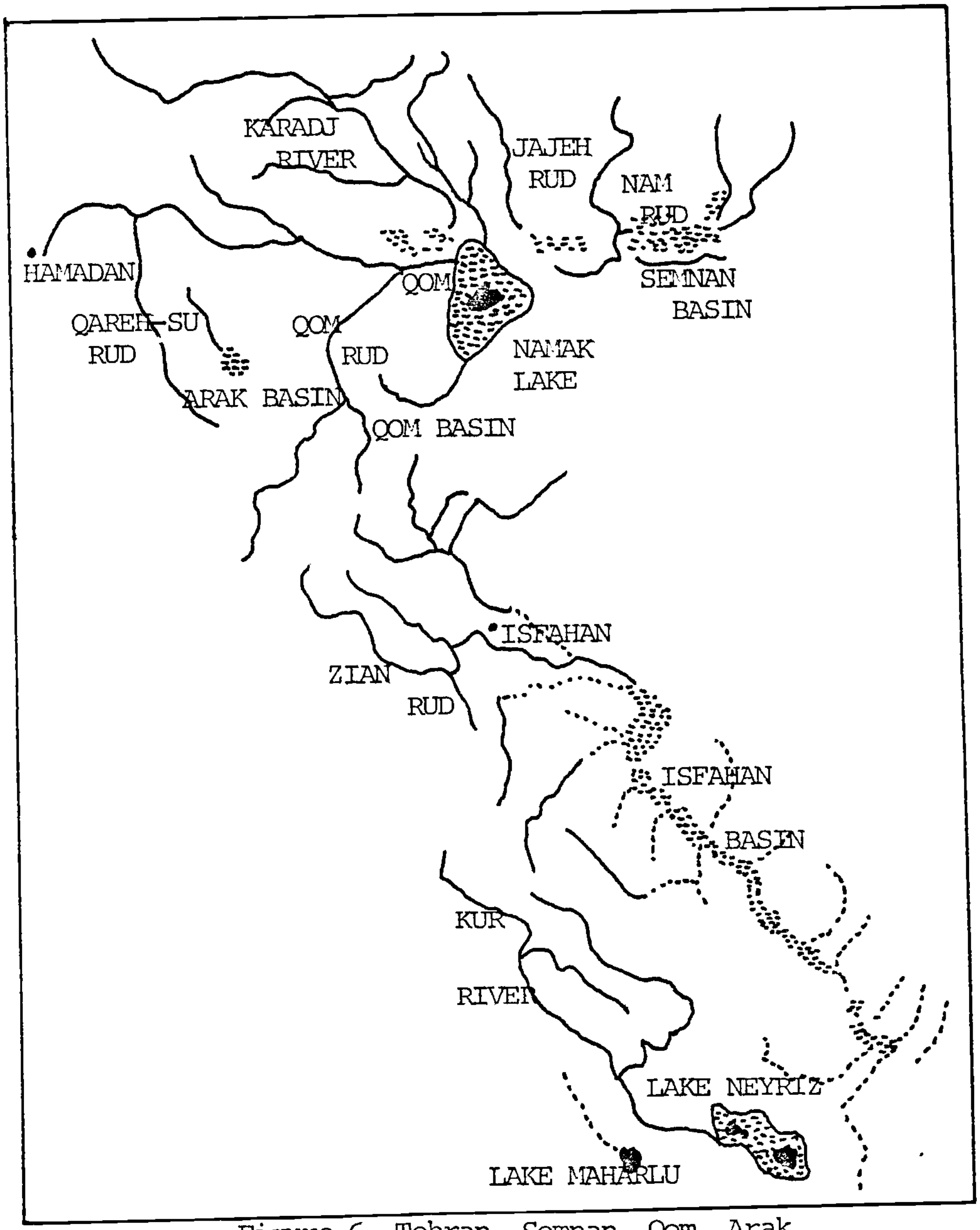

Figure 6. Tehran, Semnan, Qom, Arak, Isfahan, Neyriz and Maharlu Basins

Because of its shallowness, the surface of the lake varies widely in area, from 4,000 to 5,000 km^2, depending upon the season and amount of precipitation. It is highly saline, with a salt content of 148 0/00 and a maximum level of 300 o/oo. Several rivers, the largest of which is the Zarrinehrud, empty into Lake Rezaiyeh. During the spring runoff broad areas of freshwater are found on top of the salt water of the lake near the mouths of the rivers. There are also freshwater springs in the lake. There are no fish in the lake although it has brine shrimp, and is heavily used by birds. At one time the lake drained into the Araxes River, but the connection was severed, leaving an entirely enclosed basin.

Namak Basin (Figure 6)

The Namak Basin is a large basin in north-central Iran, south of the Elburz Mountains. It contains several subbasins. At the bottom of the basin is a large saline flat, the Daryache Namak, which is partially covered most of the year by a shallow saline lake. The size and depth of the lake fluctuates widely with the season of the year and the amount of inflow. Six rivers drain into the Namak Lake, three from the west and three from the north. Except during flood periods, all six are dry in their lower courses.

A variety of habitats are represented in the basin, from cold, steep alpine streams to slow, saline streams meandering across the arid flats. Extensive irrigation and grazing have occurred in the basin for over 3,000 years. The major streams are much modified. Most of the water is utilized for agriculture and domestic purposes, resulting in the dewatering of the lower rivers.

The Namak Basin is in a transitional position zoogeographically. Its headwaters arise in the north in the Elburz Mountains and west in Zagros Mountains. These headwaters closely adjoin headwaters of the Karun, Isfahan, Caspian and Dashte-Kavir and Dashte-Lut Basins. The divides between the basins is often quite low.

Qom Subbasin (Figure 6)

The Qom Subbasin of the Namak Basin contains the three rivers arising in the Zagros Mountains. The three, the Qom Rud, Qarehsu and Shur Rud, are all perennial. Their origins are on the upper slopes of the Zagros Mountains, where they are typical coldwater alpine streams. Most of the water is intercepted as it leaves the mountains, and only a minimal amount of saline water is found in the lower course, which are often arid.

Tehran Subbasin (Figure 6)

Several streams flow out of the Elburz Mountains between Tehran and Qazvin, but only the Karadj River has any size. It is formed by the union of two smaller streams near the town of Gachsar. A reservoir has been built near the mouth of the canyon to provide water for Tehran. The stream is a coldwater, alpine stream, with a population of native trout. The valley has been much modified for agriculture and grazing. It is also a very popular tourist spot, being only 40 km from the city of Tehran. While the Karadj, and the other smaller neighbouring streams, have a perennial flow, all the water is intercepted and used for agriculture and domestic purposes, and it is only during floods that any water reaches the Namak Lake itself.

Semnan Subbasin (Figure 6)

The remaining two major perennial streams in the Namak Basin, the Jajehrud and the Namrud, are found in the Semnan Subbasin. This subbasin, east of Tehran, also contains several smaller streams. The are, in their upper courses, typical alpine, coldwater streams, although modified by agriculture and grazing. In addition, coal mines have operated for years in the Jajehrud Basin. In the 1960s, a dam was completed on the Jajehrud as part of the Tehran water system. Water not used by the city is used for irrigation. The lower portion of both the Jajehrud and the Namrud are dry most of the year as a result of dewatering. A dam was being built on the Lar River, with a tunnel through the mountains to connect with the Jajehrud. This would bring water from the Lar River, in the Caspian Basin, into the Jajehrud to augment supplies for Tehran.

Arak Subbasin (Figure 6)

The Arak Basin is an enclosed basin within the larger Namak Basin. It has no permanent streams, although there are a number of qanats. The upper Qarehsu, or Qareh Chai, near the town of Arak, probably once connected to the basin, but the connection is now severed.

Nain Subbasin (Figure 3)

The Nain Subbasin is not strictly a part of the Namak Basin, but its past connections were with the Namak Basin. It contains no live streams but does have a number of qanats, and several large springs in mountains lying between it and the Isfahan Basin. It sits between the Namak Basin, Yazd Basin, and the Dashte-Kavir.

Isfahan Basin (Figure 6)

The Isfahan Basin is an elongate basin running along the northeastern side of the Zagros Mountains. It is separated by low hills from the Namak Basin to the north and the Neyriz Basin to the south. On the east, it is bordered by an elongate range of mountains to 4,000 meters high that separate it from the Yazd and Kerman Basins. It has a number of smaller streams which flow only during the wettest part of the year, although several do have short sections of flowing water in mountains of where springs are present. The only perennial river is the Zianrud.

The Zianrud originates in the central Zagros Mountains near the summit of the mountains. It flows in a generally northeasterly direction, emptying into the northern end of the enclosed Isfahan Basin. The basin floor contains a large playa with extensive saline marshy areas near the lower end of the Zianrud. The river has been used for irrigation and domestic purposes for centuries and is the principal water source for the city of Isfahan. It has been much modified over the centuries.

In the 1960's, a dam was built on the Zianrud to store water for the steel mill subsequently opened at Isfahan. To augment the flow in the Zianrud a tunnel was dug through a ridge near the Zard-e-Kuh Mountain. On the western side of the ridge a dam was built on a tributary of the Karun River and the water diverted through the tunnel. When I have visited the tunnel, over 50 cubic feet per second was flowing through the tunnel.

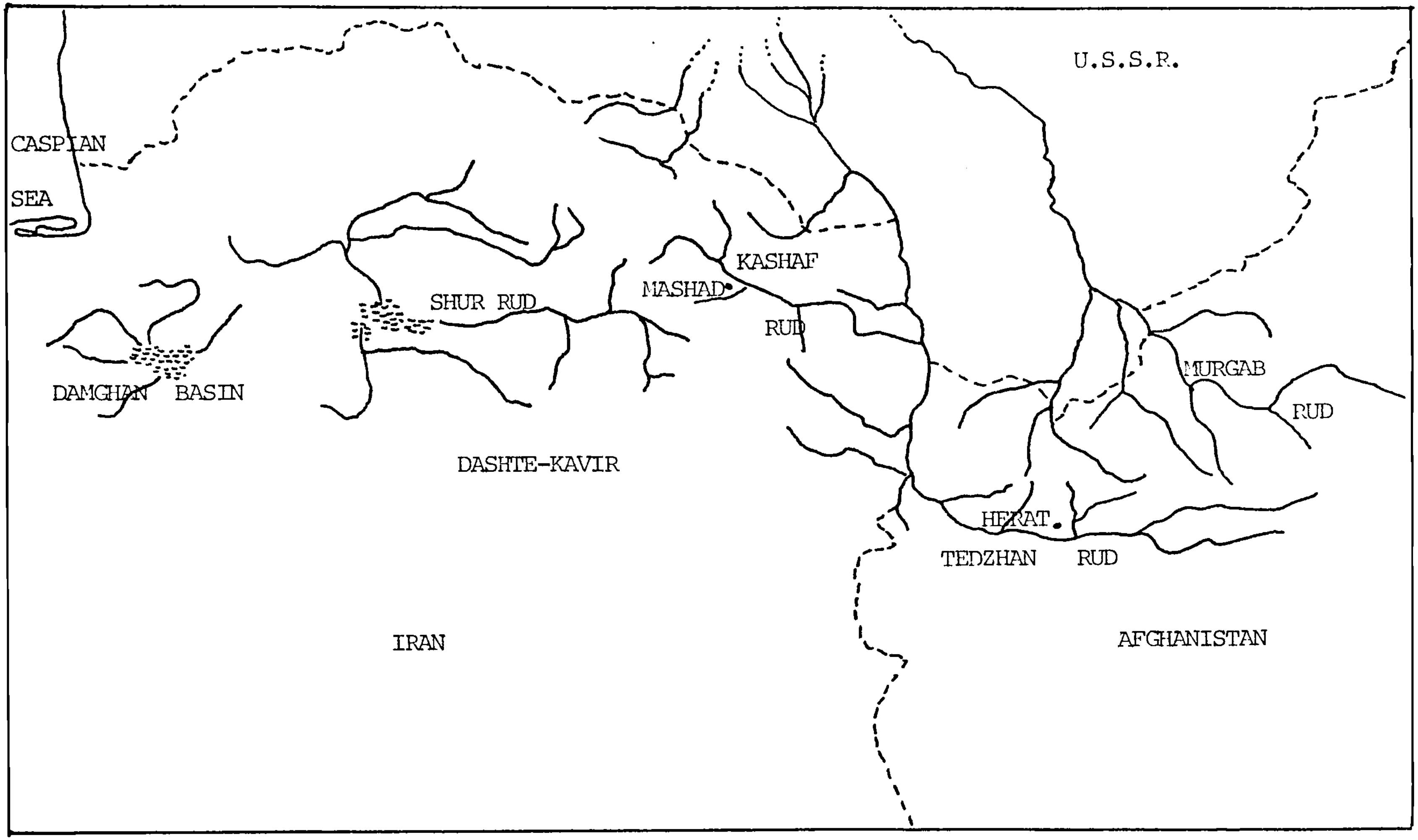

Figure 7. Dashte-Kavir, Damghan and Aral Sea Basin

Aral Sea Basin (Figure 7)

The northeastern corner of Iran is within the Aral Sea Basin. Tributaries originating in the Kopet Dagh and the Mashad Plain flow into the Tedzhan River. The Tedzhan, and the intermingled Murgab River, are part of the Aral Sea Basin, but are intercepted for irrigation or are lost in the arid steppes of Soviet Turkmanistan.

The terrain is generally flat or low hills. The streams have a low gradient, and flow mostly within cut dirt banks. Agriculture and grazing have deteriorated the watersheds. The area has some of the coldest westher in Iran, with extensive freezing. As a result of the extensive irrigation systems, the waters of the Tedzhan and the Murgab Rivers, which are quite close to each other, have become interconnected and are often treated together in zoogeographic discussions. The Jam and Kashaf are the principal Iranian tributaries.

Internal Northeast Basins (Figure 10)

In northeastern Iran, along the Afghanistan border, are a series of enclosed basins. None is large. All are surrounded by mountains of varying height, up to 3,300 meters. None has a permanent river, but all have qanats. There may be some springs present but I have not seen any. The basins are characterized by dry river channels off the surrounding mountains that flow only after precipitation. The low part of the basin is a flat playa that is covered by a shallow lake during flood periods but which is a dusty, salty flat most of the time.

These basins occupy a strategic possition between other major basins. To the north is the Tedzhan and Murgab, part of the Aral Sea Basin. East and south is the Helmand Basin. To the west is the Dashte-Kavir, and to the south and west the Dashte-Lut. Mountains to the east and west represent a more formidable barrier than the hills separating basins north to south.

Dashte-Kavir (Figure 7)

The Dashte-Kavir, located in the internal plateau of northeast Iran, is one of the two major desert basins in Iran. It contains a number of subbasins, but perennial streams are found only in the the northeastern corner. Two rivers, the Rud-e-Qarasu and Rud-e-Shur both flow into the most northeast corner. These rivers have some flow throughout the year but, when I have seen them, were highly saline with salt crystals formed on the bottom in many areas. Another stream, the outflow of the spring Cheshmeh Ali, occurs in the Damghan subbasin in the northwestern corner of the Dashte-Kavir. A number of other springs are located in the mountains along the northern tier of the Dashte-Kavir. I have not been to the southwestern corner of the Dashte-Kavir, but know of no streams. Qanats are found in many parts of the basin.

Krinsley (1970) considered the Dashte-Kavir to be a wet desert because of the periodic widespread mud flats, covered by a salt crust, that form along its western, northern and eastern ends. The stream channels, during spring runoff, discharge water across a wide delta area, forming extensive mud flats.

Helmand Basin (Figure 8)

The Helmand Basin is an enclosed basin draining all of the southern half of Afghanistan, and a limited portion of northwestern Pakistan and the central portion of Iran's eastern border. The only perennial stream is the Helmand River, originating in eastern and central Afghanistan, running in a long curve across southern Afghanistan, emptying into the Hamun-e-Helmand on the Irani-Afghani border. Smaller channels drain from Iran and western Afghanistan directly into the Hamun-e-Helmand, but have water only following precipitation.

The Hamun-e-Helmand is a lake occupying the low portion of the basin. It has been much larger. Except for the central portion, which has an average depth of 50 meters, the lake is quite shallow. As a result, a small change in depth results in wide fluctuations in the shoreline. During a drought in the mid-1970's, the lake shrank to less than 10% of its average size. Much of the shore area is occupied by reed and rush growth.

The Helmand River enters the Hamun-e-Helmand by several channels. Irrigation development has created iterconnecting ditches and canals criss-crossing the delta. The irrigation system was much more extensive, supporting a large civilization, but most of the system was destroyed 500 years ago by Tamerlane, and desert claimed much of the area.

Within the Helmand Basin are a variety of habitats from cold alpine streams to the slow, sluggish warm channels of the basin floor. Tributaries in the headwaters are in close proximity to headwaters

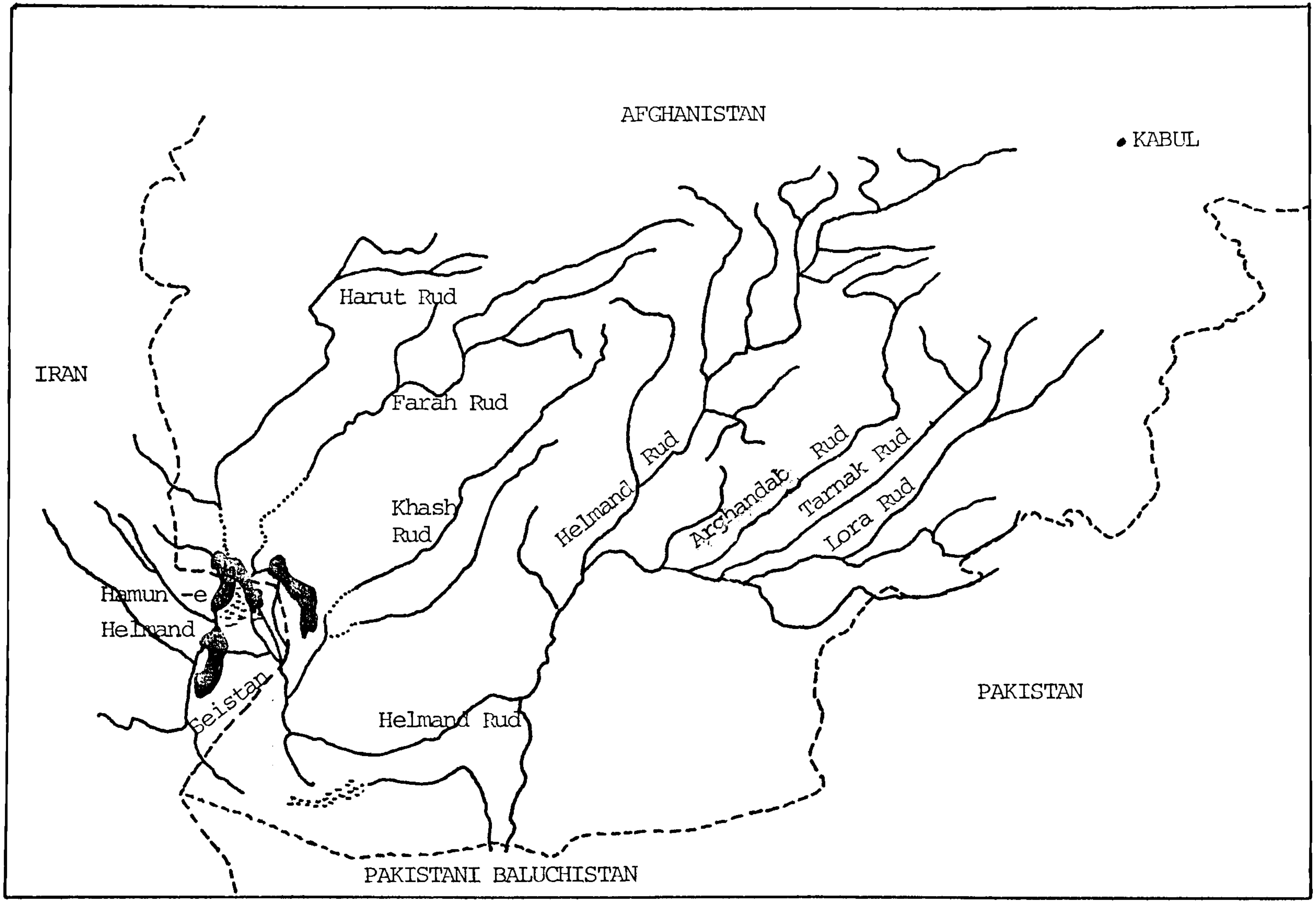

Figure 8. Helmand Basin

streams of the Indus River, Indian Ocean coastal drainages, Aral Sea drainages and the internal basins of Iran.

Mekran Drainages (Figure 9)

The Mekran Mountains are an extension of the Zagros System that run eastward along the coasts of the Arabian Sea from the Straits of Hormuz in Iran through most of western Pakistan. This area is the home of the Baluchi tribe, and is part of the Baluchistan Provinces of Iran and Pakistan. Along the range a series of rivers flow southward into the Arabian Sea. I have included in the Mekran several enclosed basins, the most important of which is the Meshkal Basin that has tributaries in Iran.

This area is steep, rugged, and active geologically, with a number of active volcanoes. It is a largely inaccessible area and little work has been done on the fishes. In Iran, I have seen fish from the Minab River, at the western end of the Mekran; from part of the Meshkal Basin and from the Sarbaz River near the Iran-Pakistan Border. The Sarbaz flows into Gwatar Bay, into which the much larger Dashte River of Pakistan empties.

Water along both the Minab and Sarbaz occurs in disconnected sections. Flow occurs along the entire channel only during floods. The Sarbaz through much of its length is in a narrow, steep canyon, but crosses the flat plain along the Persian Gulf below Bahu Kalat. The only portion of the Minab River I have seen was on the floodplain of the Persian Gulf. The Minab River is separated by a comparatively low divide from the Bampur Basin.

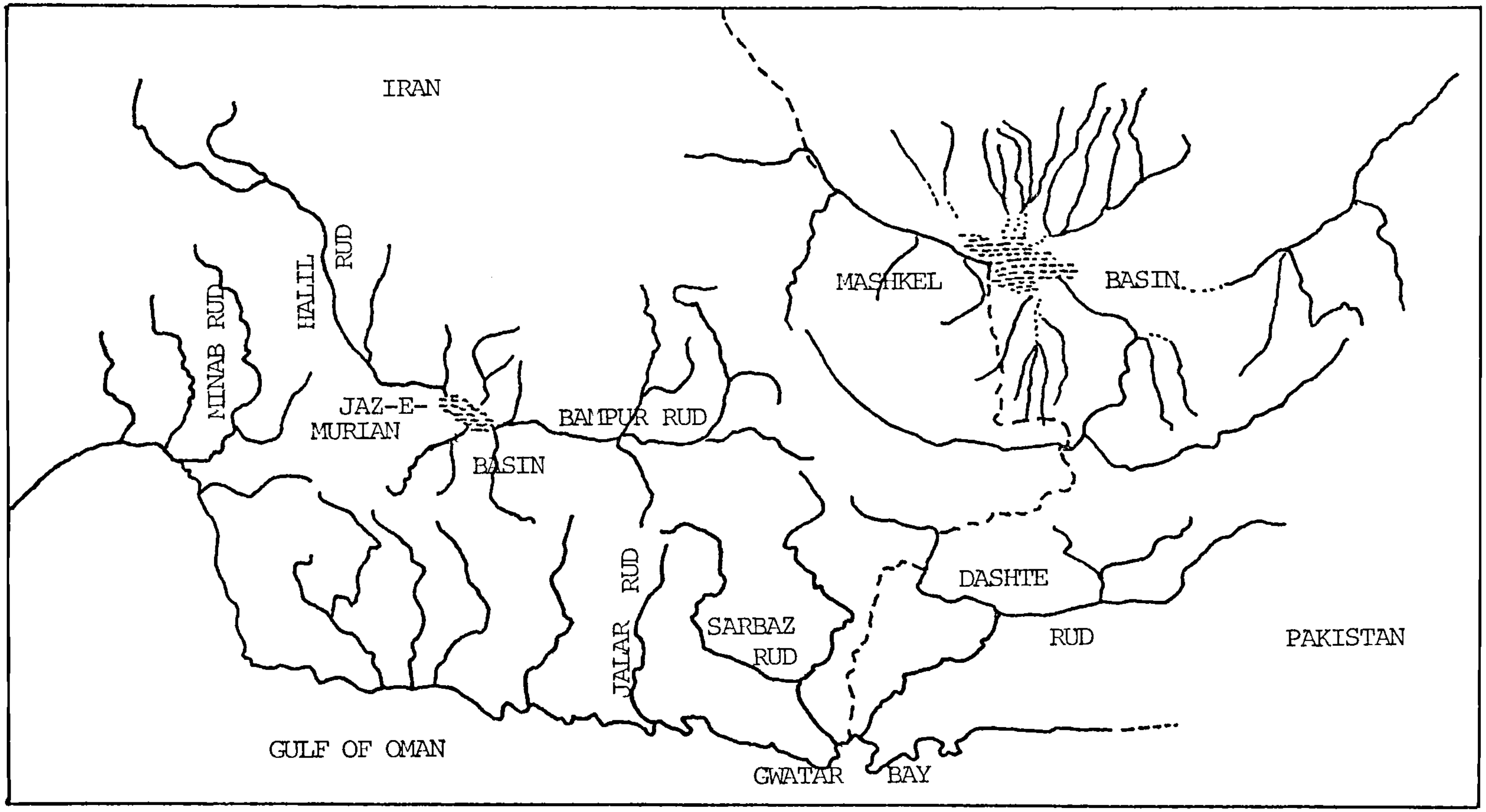

Figure 9. Bampur and Mekran Basins

Bampur Basin (Figure 9)

The Bampur Basin contains a large depression with a shallow saline lake persisting through wetter years, drying to a saline playa during dry periods. The lake area is surrounded by extensive saline mud flats that make the area almost inaccessible. The lake, and often the depression, are referred to as the Jaz-e - Murian

Two perennial rivers feed the depression. From the east flows the Bampur River. It has a series of springs in the upper part of the basin providing a stretch of flowing water soon completely diverted for irrigation. Near the town of Iranshahr, where two major forks meet, another large spring creates a flowing river. Much of the flow is diverted for irrigation. The remaining water flows only a short distance before seeping into the ground. A small dam was built on the Bampur River near Iranshahr but quickly silted in.

The second river is the Halilirud, flowing into the depression from the west. There are springs in upper streams creating perennial flow, but the water is mostly diverted for irrigation. Livestock grazing has been heavy in the basin. The lower portion of the river is a marshy area where the remaining flow is lost. Flow from the Halilirud and the Bampur Rivers reaches the depression floor only during periods of high flow.

The Bampur Basin is an enclosed basin that once drained into the Arabian Sea, and the divide separating the basin from the Arabian Sea is not very high. To the north is the Dashte-Lut Desert, and to the west, the Kol River drainage.

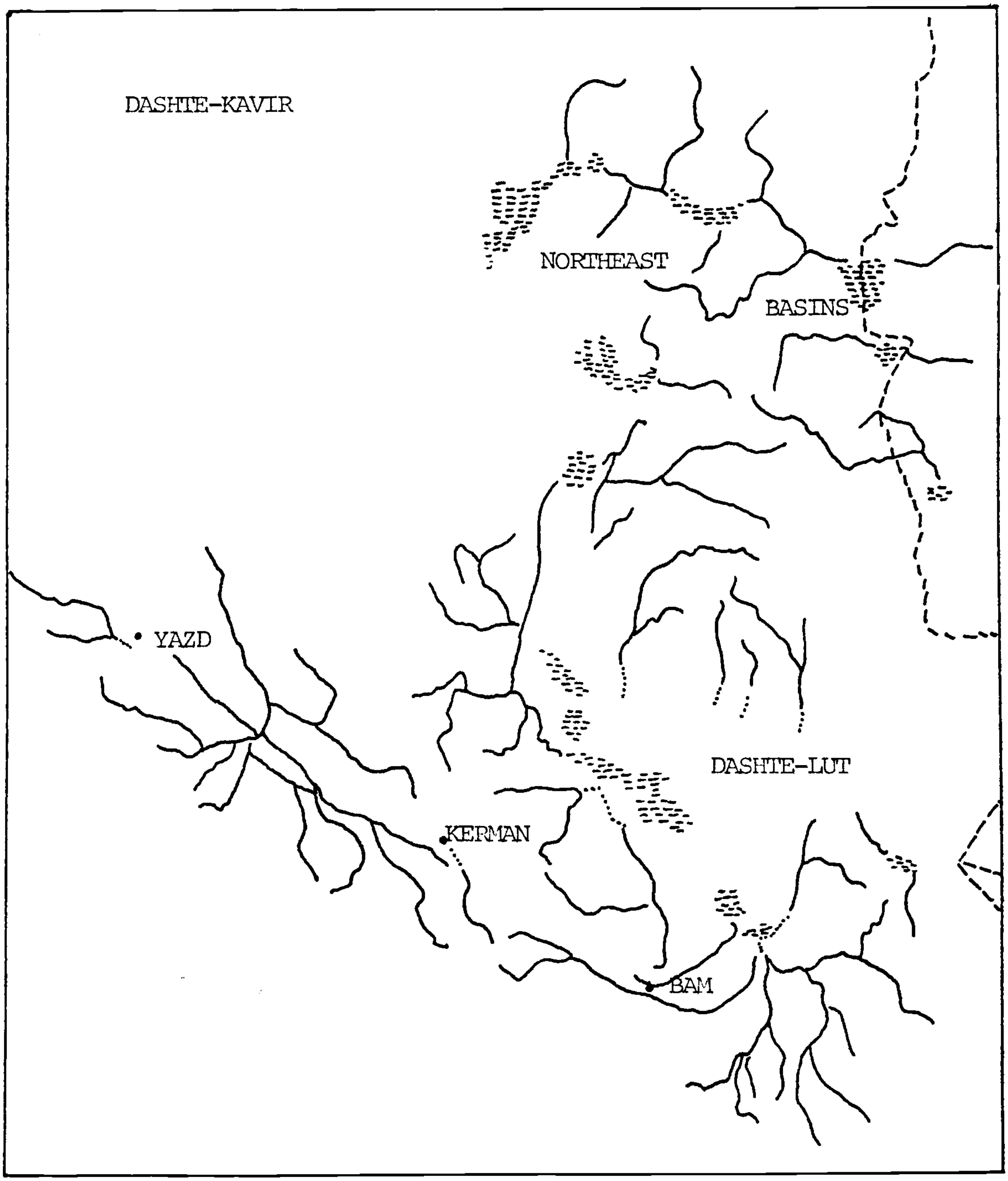

Figure 10. Northeast, Yazd, Kerman and
Dashte-Lut Basins

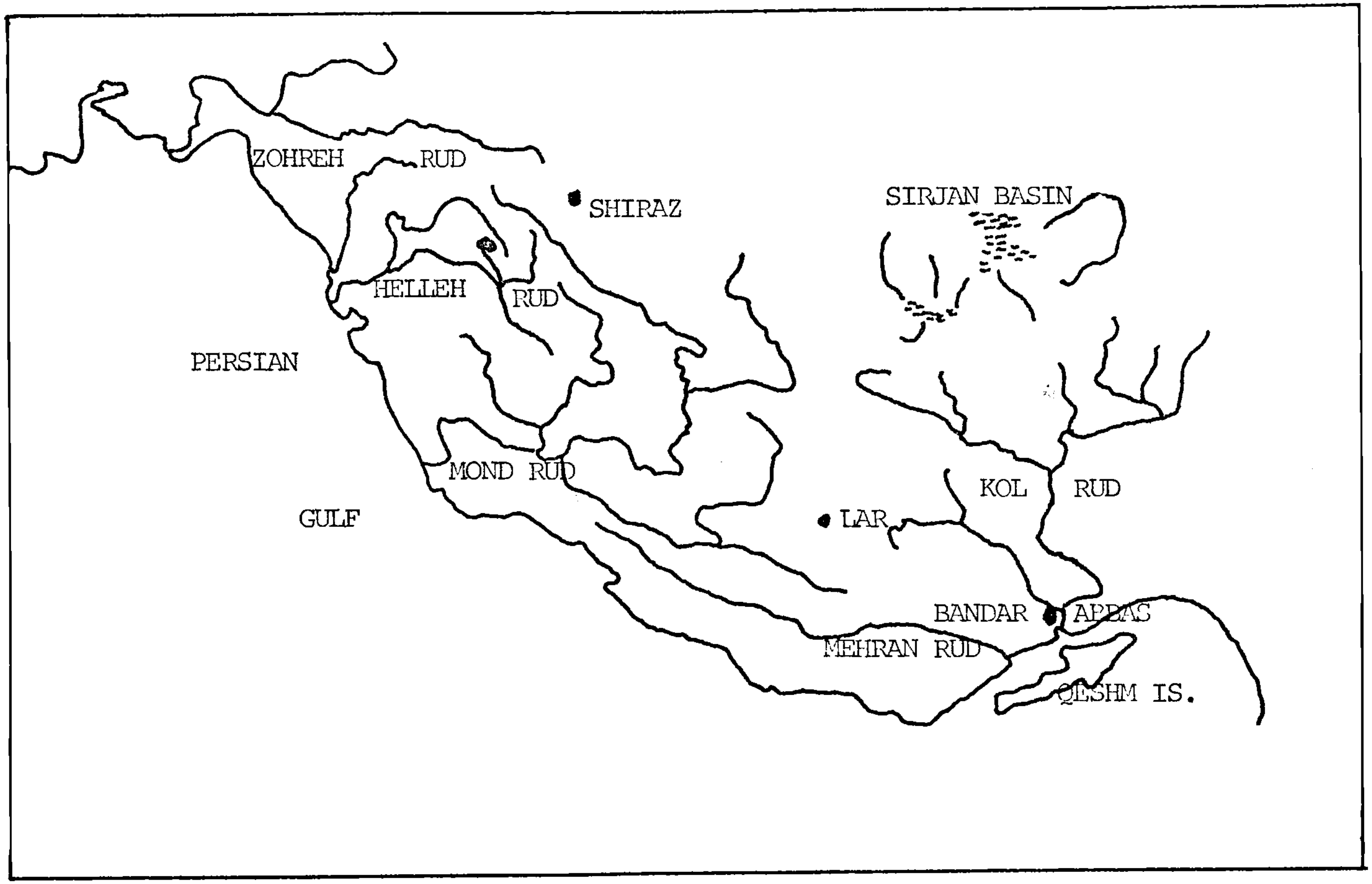

Figure 11. Kol, Sirjan, Lar and Mond Basins

<u>Sirjan Basin</u> (Figure 11)

The Sirjan Basin is a small enclosed basin containing no lakes or rivers; the only perennial water is found in qanats. It sits between the Bampur, Kerman, Isfahan and Kol River basins. While the fish fauna of the basin is extremely limited it is of interest because of the strategic location of the basin.

<u>Dashte-Lut</u> (Figure 10)

The Dashte-Lut is the second of Iran's two principal desert basins. It occupies much of central and southern Iran, and is broken into a number of separate depressions. It is separated from the Helmand Basin to the east, Kerman Basin to the west, and Dashte-Kavir to the north by a series of mountain ranges up to 11,000 feet high. The Dashte-Lut has wide areas of sand dunes up to 150 feet high, and extensive broken badlands terrain that greatly hinder movement.

Water is found mostly in qanats. There are a number of stream channels but, except for short segments, they are dry except during periods of precipitation. Some depressions contain saline playas in which water is rarely found.

<u>Kerman Basin</u> (Figure 10)

The Kerman Basin sits between the Dashte-Lut, Isfahan, Sirjan and Bampur Basins. I have seen no permanent streams in the basin. The only water is found in qanats and springs, the latter all developed for domestic and agricultural use. Stream channels are present but flow only during periods of precipitation.

Yazd Basin (Figure 10)

The Yazd Basin can be considered as part of the Kerman Basin. The two are the two principal depressions in an elongate depression situated between the Isfahan Basin and the Dashte-Kavir and Dashte-Lut. As with the Kerman Basin, the Yazd Basin contains no perennial streams but does contain dry stream channels and qanats.

Kol Basin (Figure 11)

The Kol Basin contains two streams, the Kol River and the Mehran River. Both empty into the Persian Gulf west of the city of Bandar Abbas. The Kol River is a large drainage bounded by the Mond, Sirjan, Bampur and Mekran Basins. Its upper half is in deep, steep canyons, with only limited valley floor. Much of the channel is dry, but there are sections of flowing water. Where water quality permits, the water is diverted for irrigation.

Not far from Bandar Abbas two major forks of the Kol River meet. At that point there is a large hot spring, the Ab-Garm, which creates a lengthy stretch of perennial water. The water, because of its high salinity, is not used for irrigation. At some points the salinities are so high large salt crystals have formed on the bottom of the river.

The lower section of the Kol River, and the part of the Mehran River I have seen, cross a flat floodplain along the Persian Gulf. The channels are rather narrow and deep, with some tidal influence. Some mangrove swamps are located near the mouths of the rivers but I know of no work that has been done on them.

Lar Basin (Figure 11)

The Lar Basin is a small basin between the Mond and Kol Basins whose affinities are not clear. While there is a stream channel in the valley, the only water I have seen came from qanats and at least one developed spring.

Mond Basin (Figure 11)

The Mond River drains a large basin in the upper half of the Persian Gulf. Under the basin organization in this thesis I am including two other streams, the Zohreh and the Helleh or Dalaki Rivers under the Mond Basin.

The upper part of the Mond River begins in an area of steep, rugged mountains with the headwater streams in narrow canyons with limited valley floors. Where the valley floors are of sufficient width irrigated farming has been practiced for centuries.The lower portion of the river is in a wide valley as it emerges onto the flat coastal plain of the Persian Gulf.

I have seen only limited portions of the Zohreh and Helleh Rivers. The Helleh River where I have seen it is quite similar to the Mond in its development and general condition. There is a wide, shallow lake in the Helleh Basin near the town of Kazerun. The only portion of the Zohreh I saw was near the town of Behbahan. This is part of the foothills of the Zagros Mountains, and is characterized by low but rugged hills. Oil drilling and extraction is extensively developed in the area. The Zohreh was a shallow stream channel meandering among the hills. Very little work has been done on these streams.

The Mond River Basin, as used here, sits between the Kol River Basin and the Tigris-Euphrates-Karun System. Its headwaters are separated from the Maharlu Basin only by a low divide.

Maharlu Basin (Figure 6)

The Maharlu Basin is a small enclosed basin situated between the Mond Basin, Karun Basin and the Neyriz Basin. It has one major stream channel, which is dry except during periods of precipitation. The channel drains into Lake Maharlu, a highly saline lake. The water level in the lake fluctuates widely with changes in precipitation and inflow. The valley has many springs, some quite large, and a few qanats.

Neyriz Basin (Figure 6)

The Neyriz Basin is just east of the Maharlu Basin, and is bord ered on the north and west by the Karun Basin and the Isfahan Basin, to the east by the Sirjan Basin, and to the south by the Mond and Kol River Basins.

The Basin has a large saline lake area, Lake Neyriz. There is actually one larger lake area separated into two parts at lower water levels. The lake area is also called Lake Bakhtegan. One major river, the Kur River, flows into the lake. It arises in the Zagros mountains, and flows acrossed the broad Persepolis Plain. The plain has been developed for irrigated farming for over 2,500 years. Many of the ancient dams and canal systems are still present, although salt deposits have made much of the soil infertile.

Within the basin are also located a number of springs, including a series of large springs along the edge of Lake Neyriz. Many of these have been fully developed for irrigation. A dam was recently constructed in the Gaz Fork of the Kur River for irrigation storage. A fertilizer plant is located on the Kur River near Marvdasht which polluted the river to the point we could find no fish for over a mile below the stream outfall.

Tigris-Euphrates-Karun (Figure 12)

The Tigris, Euphrates and Karun Rivers are three independent river systems that share a common outlet. The three together drain a large area encompassing most of Syria, parts of Palestine, Turkey, western Iran, Jordan, Saudia Arabia and all of Iraq. The system includes a wide variety of habitat from cold, alpine streams to the warm, sluggish waters of the Mesopotamian Plain.

While the three rivers are separate for most of their length, all three empty into the Persian Gulf through the Shatt-el-Arab. The three rivers lose their individual identity above the Shatt-el-Arab in the maze of swamps, channels, irrigation systems, and lakes that mark the lower Mesopotamian Plain.

None of the Euphrates River is within Iran. The Tigris River, which heads primarily in Turkey, receives tributaries from Iran. In Azerbaijan and southward to about the 35° N latitude, the western portion of Iran is in the Tigris Basin. Most of these streams are upper, headwater streams, with only two, the Saghir and Sirvan (or Diyala) Rivers having any size.

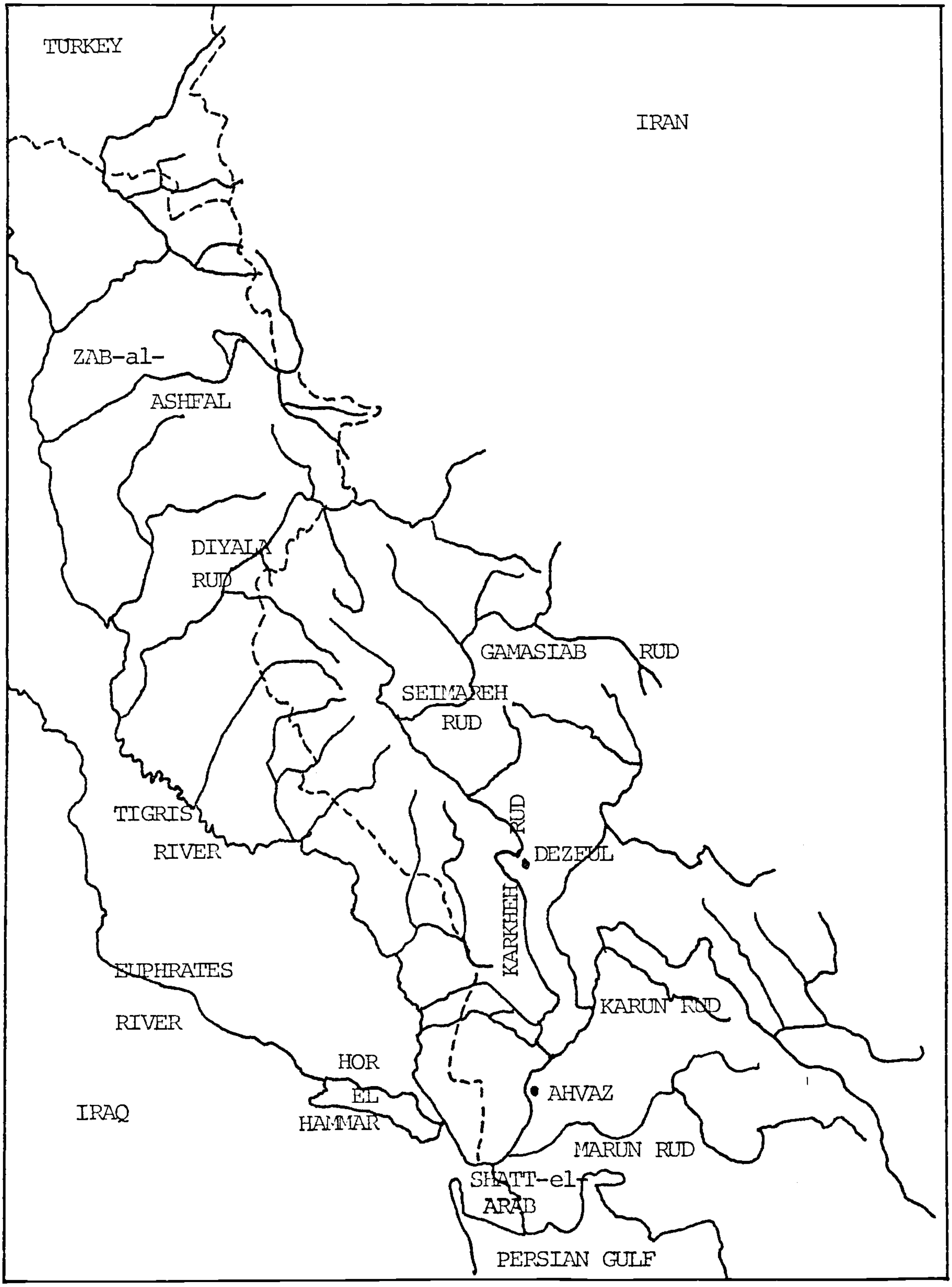

Figure 12. Tigris, Euphrates and Karun Basins

The Karun River, which is entirely within Iran, drains most of the country south of Lake Rezaiyeh Basin. The Karun is by far the largest river system in Iran both in drainage area and in flow. It is adjoined in Iran by the Lake Rezaiyeh, Arak, Qom, Isfahan, Maharlu, Caspian and Mond River Basins. The Karun System covers essentially all of the Zagros Mountains except for the portions draining into the Tigris and Isfahan Basins. This includes the eastern as well as the western face of the Zagros Mountains. This has resulted from downcutting of the river as the Zagros Mountains rose, and has led to an interesting drainage pattern. This was well described by Oberlander (1965), who studied the Karun System:

> "The Zagros Mountains are transected by a series of roughly parallel and equidistant streams that rise near the northeastern margin of the highland and pass completely through it on their way out of the Mesopotamian-Persian Gulf trough. The runoff of the eastern slope of the snow ridgepole of the asymmetric mountain sheaf follows longitudinal valleys for short distances and then turns back westward to break through it own watershed and succession of ranges to the west with but a few puzzling changes in direction, until the alluvial foredeep of Mesopotamia is reached. Thus the Zagros Hydrographic Basin overlaps the edge of the Iranian Plateau, with the divide between endorheic and exorheic drainage located along a line of subdued desert ranges inferior in elevation to the Zagros ridgepole by 700 to 1600 meters.
>
> "North of the thirtieth parallel the main drainage lines of the Zagros Highland are transverse to its structure. Eleven major streams cross the orogenic system with amazing disregard for geological barriers, and eight of the drainage basins serving this half of the highland have their longer dimension across the structural grain. Within each of these watersheds is a multitude of short tributaries whose courses are as arbitrary as those of the trunk streams.

> "Some form of anomalous transverse drainage is found in every sector of the Zagros Highland, and continues to be seen westward through the Taurus Mountains of southern Turkey, which are the structural extension of the Zagros system. However, the drainage anomaly is most remarkable in the central portion of the highland in western Iran."

Where the Karun system follows the natural faults and ridges, it flows within valleys,often quite wide. Where the streams in the system cut through the ridges and barriers, they form narrow, steep canyons with sheer rock sides up to 1500 feet high. The channel then is very narrow and velocities high.

The Karun system contains a wide network of streams and a variety of habitats. Altitude and volume of flow vary widely throughout the system. The upper headwater streams are cold, alpine, rocky waters. In the broader valleys the streams are often shallow and meandering, with the bed of alluvial material. In the canyons, the velocities are higher, even torrential, and the bed has a high proportion of rock.

Conditions in the Karun Basin have deteriorated even since I first became acquainted with it. Removal of vegetation by logging and grazing has increased the runoff and erosion throughout the basin. One noticeable result has been the increase in flooding in the Khuzistan Plain, the portion of the Mesopotamian Plain in Iran which the Karun River corsses.

V. GEOLOGICAL HISTORY OF IRAN AND ADJACENT AREAS

Geological and hydrological events in the history of Iran have had a major impact on the current distribution of fishes. In fact, the distribution of Iranian fishes can be quite closely related to the major geological events and areas of Iran. There are many opinions on the geological history of the area. I was unable to find a single good discussion of the geological history of Iran, so have tried to develop a summary of events from the literature.

Geologists generally agree that Iran has remained in the same general location since Precambrian times, 800 million years B.P. It is underlain by a shield-like basement consolidated by folding, granite intrusions and metamorphosis, similar to the Arabian Shield to the south and of which it may be a northward extension (Harrison, 1943; Stocklin, 1968; Falcon, 1967; Hargraves, 1976; Molnar and Tapponnier, 1977).

The Paleozoic sediments consist primarily of shallow marine sedimentary rock and lacunary continental rock. There is little evidence of any severe orogenic movements. Iran, covered by a shallow sea through most of the Paleozoic, was remarkably stable. Active orogeny began only during the latter part of the Permian (Stocklin, 1968; Kashfi, 1976).

Changes did not occur uniformly across Iran, with some areas undergoing orogeny and subsequent modification at an earlier stage than others. In general, two major zones can be defined. The first is the Zagros Range, running in a long, curved arc from the northwestern part of Iran to the southeast area in Baluchistan. It is separated by a long fault line from the rest of Iran, which comprise the second zone (Falcon, 1961, 1967; Stocklin, 1968; Takin, 1972; Kashfi, 1976).

The rest of the country may be divided into three general provinces. The first elongate zone, joining the Taurus Mountains in Turkey and running essentially northwest to southeast, parallels the Zagros Range. The second province is Central and East Iran, or, in Stocklin's terminology, Central Iran and the Lut Block. The third province is the Elburz, which is part of an elongate montane system from China through the Himalayan Arc, the Hindu Kush, Karakorum, Elburz, Northeast Turkey and the Little Caucasus. The Kopet Dagh in the northeast of Iran, which has a separate geological history, is not sharply divided from the Elburz. (Pumpelly, 1905; Hora, 1953; Stocklin, 1968; Takin, 1972.)

Initially, Iran was covered by an extensive shallow sea called the Tethys which developed in an unstable shelf adjoining Gondwanaland. The sea was a dominant feature through the Mesozoic and into the Tertiary, with portions persisting until today. At its height the Tethys Sea covered nearly 70° of longitude and 30° of latitude, reaching as far as the Arctic marine waters and southward to the Arabian Shield and east AFrica. To the east of the area of Tibet the Tethys ended in a more diffuse sea. Land remained exposed in India, and as some islands in the area of the Caucasus. (Furrer and Soder, 1955; Wolfart, 1967; Hallam, 1967, 1976; Sampo, 1969; Takin, 1972; Kamen-Kaye, 1972; Kashfi, 1976; Molnar and Tapponnier, 1977; Hsii, 1978).

Breakup of the Tethys Sea resulted from several events. In Iran, the most important was probably the development of the Elburz Mountain Range which separated the northern and southern portions of the Tethys. To the north, the remnants of the Tethys were termed the Sarmatian Sea, eventually giving rise to the Caspian and Aral Seas. The Sarmatian was occasionally connected to the Atlantic Ocean through the Black Sea up to the Quaternary. Interconnections of the Black, Caspian and Aral Seas have occurred on a number of occasions, depending upon the levels of the seas. The three seas are separated from each other only by a comparatively low gap. (Pumpelly, 1905; Kosswig, 1951; Hora, 1953; Steinitz, 1954; Rieben, 1955; Gansser, 1955; Butzer, 1958; Zohary, 1963,1971; Hallam, 1967; Takin, 1972; Kamen-Kaye, 1972; Novacek and Marshall, 1976; Hsii, 1978).

To the south of the Elburz, the situation is less clear. Connections persisted through what is now Iraq, Jordan and Palestine for much of the Paleozoic and Mesozoic. Marine incursions into the south were quite common, resulting both from changes in sea level and from down-faulting and subsidence along the southern margins. Only comparatively recently has the current coastline along the Persian Gulf and Indian Ocean been established. (Gansser, 1955; Falcon, 1967; Sampo, 1969; Kamen-Kaye, 1972.)

The delta of the Tigris-Euphrates at the head of the Persian Gulf was probably never much further up the drainages of the two rivers than it is now. While much alluvial material has entered the Gulf from these rivers, subsidence of the Mesopotamian Plain concurrent with the rising of the Zagros Mountains kept the delt from changing its location to any degree. Perhaps the greatest degree of seaward exnstenion after the Pliocene was when, because of reduced sea levels during glacial periods, the delta stretched to the end of the Persian Gulf in the area of the current Straits of Hormuz (Lees and Falcon, 1952; Steinitz, 1954; Kosswig, 1955; Menon, 1955; Hora, 1955; Butzer, 1958; Stocklin, 1968; CLIMAP Project Members, 1976).

Mountain building activity began in Iran in the Permian, but not until the Miocene were the great mountain belts along the margins of Iran well established. Initial orogeny was apparently in the central and eastern portions of Iran, with the mountain ranges appearing the Jurassic. However, intensive erosion and marine invasions leveled much of the formations, although the general basins persisted. This erosion continued into the Cretaceous (Gansser, 1955; Stocklin, 1968; Krinsley, 1970).

Another period of mountain building in central Iran occurred in the early Tertiary. In the Eocene, marked volcanic activity occurred, much of its submarine. This volcanic activity decreased earlier in central Iran than in adjacent areas. Again, in the

Miocene, extensive erosion occurred, filling the basins with much sediment. Final orogeny occurred in the Pliocene, tapering into the Pleistocene (Furrer and Soder, 1955, Harrison, 1943, Gansser, 1955, Krinsley, 1970, Stocklin, 1968, Seyed-Emami, 1975).

To the north, the Elburz became important in dividing the Tethys during the Cretaceous. The range persisted, but mostly as a low divide, until the Middle and Late Tertiary when it underwent extensive uplifting and folding to form the range as it is today. Volcanism was a prominent feature through much of the building process (Gansser, 1955, Stocklin, 1968).

Development of the Zagros Range has probably received more attention from geologists than any other feature in Iran because of its close association with the oil fields in the southwestern part of the country. It is separated from the rest of the country and has followed an independent metamorphosis (Takin, 1972).

A long geosuture, the Zagros Thrust Zone, runs along the eastern margin of the Zagros Pange. It originates along the southern border of Anatolia, or even further west, passes northwest to southeast along a curved arc east of the Zagros. Its passage in the southeast of Iran is not clear, but one branch seems to continue eastward through the Mekran Coasts and East Iranian ranges, so that these areas are probably more closely allied to the Baluchi-Indus ranges than the rest of Iran. A second branch, and perhaps the principal fault line, turns south, separating Muscat and Oman from the rest of Arabia. The Zagros Thrust Zone is apparently the

the northern and northeastern margins of the Arabian Shield, making this portion of Iran separate in origin (Falcon, 1967, Harrison, 1943, Takin, 1972 , Stocklin, 1968].

One point of disagreement seems to center on the extent of movements of Arabia and the impact of these movements. Several authors contend that the flexing of the African-Arabian land masses, moving counter-clockwise during the breakup of Gondwanaland, was responsible for the tectonic activity that created the Zagros (Wells, 1969, Takin, 1972, Stocklin, 1968). At the same time, others suggest that there has been a generally stable relationship between the Arabian Shield and the current Iranian land mass (Harrison, 1930, Kashfi, 1976, Falcon, 1967, Kamen-Kaye, 1972). Because of the extensive marine activity it is difficult to determine what did occur, but the consistency of fossils from drilling activities suggest a stable relationship (Hallam, 1976).

PRECAMBRIAN AND PALEOZOIC

Following summaries based on Gansser (1955), Hargraves (1976), Kamen-Kaye (1972), Kashfi (1976) and Stocklin (1968].

PRECAMBRIAN

Eurasia, as a "composite" continent, formed about 800 million years ago. The basic structure of the Iranian region was established prior to the Cambrian with a platform type basement underlying subsequent processes.

PALEOZOIC

Throughout this era, no major geological changes occurred although later orogeny had its beginning.

CAMBRIAN

Shallow waters transgressed over southwestern Persian Salt Group onto the older land mass.

DEVONIAN

Central Iran was covered by shallow marine seas, resulting in calcareous deposits; similar deposits began in other areas as late as the Upper Carboniferous. Strong Caledonic orogeny began before and during the Devonian in Central Iran and the Elburz Range. There were only slight epeirogenetic movements in the Zagros area.

CARBONIFEROUS

During the mid-Carboniferous, uplift of the Eurafrican Continent blocked the east-west and west-east faunal movements from North America and pre-Mediterranean/Tethys area.

PERMIAN

During the late Permian, the Tethys Sea invaded the Arabian Peninsula. The Tethys Sea ranged from the Caspian to the Arabian area, and to the east and north into Siberia. The Tethys Sea was largely a diffuse sea between the Atlantic and Pacific Oceans, north of the current Salt Range in India, and south as far as Oman and East Africa. In Turkey, many large islands dotted the Tethys. East-West and West-East faunal movements were again posssible between the Tethys Sea and North America.

MESOZOIC

The following summary based on Falcon (1967), Gansser (1955), Hallam (1976), Kashfi (1976), Seyed-Emami(1975), and others as indicated.

TRIASSIC

From the Triassic through to the Cretaceous, encrusting algae and molluscan fossils indicate southwest Iran was covered by a shallow sea with deeper waters to the northeast. Orogenic movements began in the north, east and central Iran in the late Triassic. The Paleozoic platform split into two portions, the Zagros and the rest of Iran. The Zagros belt became a more mobile belt with orogenic movements. The Lut block split into two: the Lut block proper on the east and the Tabas block on the west. (Stocklin, 1968)

JURASSIC

During the Jurassic, only minor folding occurred in the Elburz Range. Fold was almost non-existent in the Zagros area, but was very pronounced in the Central basins. Regional metamorphosis of this orogeny was intense in the Central basins. At this time the Kavir Basin was formed and volcanism began. The marine waters gradually receded from Central Iran, forming many intracontinental basins. Prolonged sedimentation followed the marine regressions. There may have remained a north-south connection between seas of the north and southwest Iranian basins via the Sabzevar, western Tabas and western Kerman areas. In the Late Jurassic to the Middle Cretaceous, the most intense orogenic period occurred in Central Iran. (Harrison, 1943)

CRETACEOUS

After the Middle Cretaceous, movement in the Elburz Zone had severed connections between seas to the north and south for the final time. Subsidence and marine deposition continued in the area of the Kopet Dagh. Strong erosional activities leveled much of Central Iran, with the area being invaded by a shallow sea. By the Late Cretaceous, uplifting and folding had created the continental regime found today in Central Iran. By the end of the Cretaceous, marine invasions into Central Iran ceased. South of the Zagros Thrust Line, the marine transgressions continued, with the seas sometimes being quite deep. From the Jurassic, perhaps the Triassic, to the Late Cretaceous, a tensional regime existed along the northeastern edge of the Arabian block. This suggests that sea-floor spreading may have continued between Arabia and Central Iran throughout the Mesozoic with intermittent collapse of the fault blocks along adjacent continental margins. In the Late Cretaceous, sudden changes occured, with widespread orogenic movements underway. The Tethyan Sea reached its climax in the Mesozoic, becoming fragmented as shifting land masses and continental blocks signaled the disintegration of Gondwanaland. (Harrison, 1943, Stocklin, 1968, Takin, 1972).

TERTIARY

The following summary is based on Butzer (1958), Clapp (1940), Furrer and Soder (1955), Gansser (1958), Hallam (1976), Harrison (1943), Hallam (1967), Hora (1937, 1938, 1951), Kashfi (1976), Kosswig (1955), Lees and Falcon, 1952; McLaren (1960), Por (1975), Pumpelly (1905), Sahni and Kumar (1974), Steinitz (1954), Stocklin (1968), and Takin(1972).

PALEOCENE

Southwestern Iran was covered by a shallow sea. The interior basins continued to be formed by uplifting and folding, with subsequent weathering that filled the basins with alluvial material.

EOCENE

At the start of the Eocene, there were widespread marine incursions from the southwest through Central Iran and into India. Concurrent, there was a period of widespread submarine and montane volcanic activity in a belt from Iran to India. The Elburz Range was a low and divided zone, but remained exposed. The Kopet Dagh emerged, then subsided again. The Central basins experienced considerable volcanic activity during the Lower and Middle Eocene while continuing to uplift and fold. In the southwest, orogeny resumed. The sea receded from the northeast towards the southwest, leaving behind a series of reef formations.

OLIGOCENE

During the Oligocene, major geological changes occurred throughout the area. In India, major Himalayan building began, producing displacement along a broad belt. In the west, the anti-clockwise rotation of the African-Arabian continent caused final separation of the Indo-Pacific from the Atlantic, opening the land bridge for the exchange of mammals and other forms in the Miocene. The Elburz Range in northern Iran contined to build. Inland, orogeny contined to delineate the separate basins. There were prolonged incursions of marine shallow seas into some of the basins, leaving behind extensive marine deposits. Many connections persisted between the northern and southern basins. The Zagros Area was mostly covered by seas although portions were apparently exposed. Volcanism declined but continued.

MIOCENE

The Middle and Upper Miocene were the periods of greatest Central Asian uplift, producing Himalayan Mountains and the dry Central Asian Plateau. The Tethys Sea receded in the north. The uplift of the Caucasus area produced an archipelago that, by the Middle Miocene, had separated the Sarmatian Sea. Early in the Miocene, incursions of marine waters occurred in the central and southern part of Iran, but these receded. The last connections to the east through the seas were cut, and the Mesopotamian Plain and Zagros Range exposed. Central basins showed extensive sedimentation during the period. In the Late Miocene, marine transgressions in Europe may have caused an Arctic-Sarmatian connection. In the Zagros, folding and uplifting continued. Volcanism declined further, persisting mostly along the Zagros Thrust Line and in the Elburz.

PLIOCENE

Major uplifting continued in the Central Asian Plateau, with continued formation of the Himalayan Arc and associated foothills. The Atlantic broke through at Gibraltar to connect with the Mediterranean. The Sarmatian Sea, during the latter part of the period, broke through to the Black Sea, but the connection was again broken by continued uplift. In the south and west, the African-Asian connection was again broken by marine incursions, connecting the Atlantic and Indo-Pacific. The Zagros Range experienced a period of sharp orogeny and uplift. Throughout much of Central Iran there was regional diastrophism, responsible for the greater part of the present structure. Extensive deposition occurred in the internal basins.

QUATERNARY

The following summary is based on Gansser (1955), Hora (1953, 1955), Hsii (1978), Krinsley (1970), Lees and Falcon (1952), Menon (1955), Stocklin (1968), Wright, et.al. (1967), and Pumpelly (1905).

By the end of the Pliocene, most of the orogeny was completed although all mountain ranges continued to be active. In India, the Indo-Brahm, or Siwalik, River formed, emptying into the Arabian Sea. About 250,000 B.P., these rivers split to form the Indus and Brahmaputra Rivers flowing in opposite directions, but with considerable connection for a time. In the Lower and Middle Pleistocene, the Black Sea was connected for short periods with the Caspian via the Manych Depression north of the Caucasus. Connections also occurred between the Caspian and Aral Seas for much of the time. The internal basins of Iran were subjected to extensive erosion and sedimentation. To the west, considerable shifting of water divides occurred in what is now Palestine and Jordan as a result of tectonic activity. Some subsidence occurred in lands along the Indian Ocean and Persian Gulf.

VI. CLIMATIC PATTERNS

Iran shows a variety of climates, ranging from the moist, temperate north to the hot, arid southern deserts. The general climatic patterns found today have apparently persisted from pre-Pleistocene times. These climatic patterns have had an important influence on the potential fish distribution. Much of the historical climatic change is based on Butzer (1958), while modern conditions are based on Butzer (1977) and personal observations during my four and a half years in Iran. Additional information is included from Deevey and Flint (1957), Hora (1953, 1954, 1955), Krinsley (1970), Kosswig (1951, 1955), Por (1975), Termier and Termier (1974), and Zenkevich (1957).

Most of current Iran was inundated until comparatively recently geologically. Adjacent areas to the east and northeast were exposed. The climatic history of the closest long-exposed land mass, the Indo-Tibetan area, is poorly known. The Permian was a generally warm and damp period. Following, in the Triassic and Jurassic, there was and intense period of desiccation, followed by a period of moister conditions in the Lower Jurassic, and again in the Upper Jurassic, the latter continuing into the Cretaceous.

Throughout most of the Tertiary, the climate in the middle latitudes that included Iran was warmer and wetter than at the present. Much of the area, through the Eocene, was subtropical and tropical.

In the Oligocene, rising mountain belts from the Himalayas westward began to alter climatic patterns. The rising mountain chains, together with the emergence of land masses from the seas, change the air and water circulation patterns. By the end of the Miocene, these mountains had reached sufficient height to begin creating the drier upland climate of the Tibetan and Gobi areas. The northern seas were probably colder, with ice reaching into the Sarmatian Sea. Climatic patterns, interacting with the rising mountain chains, produced a multitude of rivers flowing off the mountains and into the former internal basins and sea margins of Iran. Because of the comparatively wetter climate of the Miocene, flooding was apparently quite common, filling many of the interior lake basins. The vegetation was becoming less tropical and, by the end of the Miocene, was mainly an open woodland-savanah, with plentiful fringing forests. Hot winds from the south blew into the area, but were tempered by the cooler Tethys Sea that still covered many areas of the southern Iranian area.

By the Pliocene, climatic patterns were beginning to resemble modern patterns. India south of the Himalayas, westward into present Baluchistan, was warm. Monsoon wind patterns had developed, but were blocked by the Himalayas as they are now, causing seasonally moister periods. To the west, climatic patterns showed greater fluctuation. At the beginning of the Pliocene, western Iran and Anatolia were warm and moist, but by the beginning of the Pleistocene had cooled and become drier. The humid forests, common at the start of the Pliocene, had decreased, with the area becoming more open grassland savanahs. In the southwestern part of the current Asian landmass, the desert fauna characteristic of the Saharo-Arabian area, was already well established, essentially the same as found currently in the area (Zohary, 1971).

The Middle East, including most of Iran, was not seriously affected by the glaciation that enveloped lands to the north. Climates have remained essentially the same for the last two million years. The area was cool and dry, although there were periods when conditions were somewhat warmer and wetter. The mountain ranges to the north helped prevent incursions of the colder air from the north. Warmer air masses continued to blow in from more southernly climates (Deuser, et.al., 1976; Gates, 1976; Wright, 1976).

About 18,000 years B.P., the Mozambique Current may have turned east to parallel the West Wind Drift instead of joining the Agulhas Current as now, causing a strong anticlockwise gyre in the temperate latitudes. This may have changed climatic patterns enough to thermally isolate the Middle East. By about 12,000 B.P., the area had become warmer and wetter, remaining that way until about 5,000 B.P. The change was not enough to cause any extensive alteration in the flora or fauna, but did allow for an increase in forested areas. (Megard, 1967; Wright, et.al., 1967; CLIMAP Project Members, 1976).

By 5,000 B.P., the modern climatic pattern had become established. The Middle East area, including Iran, is in the southeast portion of the Mediterranean climatic zone. Disturbed westerly circulation is characteristic in winter, followed by a subtropical desert climate, associated with a subtropical high pressure belt, in the summer. The belt of westerlies cross Iran, reaching into the Punjab and Pamirs, and southward along the northern African coast. These westerlies retreat northward in summer, being replaced by a high pressure belt associated with the trade wind circulation.

Late September into October is an unstable transition period, with the cold, moister air of the Mediterranean air masses meeting the hot air currents from the south. This produces a period of short, sometimes intense thunderstorms. Passage of the moist air along the north brings a period of rainfall along the Caspian and in the provinces in the northwest and northeast.

Siberian air masses begin to invade by November, bringing colder, drier air. The air masses are often strong enough to push the Mediterranean depressions southward across the Zagros and along the Persian Gulf, producing a period of precipitation. By December the winter pattern has set in. A series of low pressure cold fronts moves southward from the Mediterranean or on a more northerly track from Asia. This produces cold but only limited moisture in the north, but may produce some showers to southern Iran. Temperatures in the north can become quite cold, below -50°C, with snow common all along the northern tier. Temp-ratures along the Caspian Sea are moderated by the waters of the Caspian and the lower altitude.

During April and May, the northern air masses begin retreating. The track into Iran is aminly from the west and northwest, bringing in moist air that produces the period of greatest precipitation in the northwest, northeast, and along the Caspian littoral. In the south, the hotter, drier air currents begin moving inland. Their interaction with the colder fronts to the north causes a prolonged period of hot, very windy, dusty weather in the central and southern part of Iran.

By July, the westerly jet stream has moved north. The Asiatic monsoonal low lies to the south and east, reaching into Baluchistan. The air, by the time it reaches Baluchistan, is stripped of most of its moisture, resulting in a period of hot, dry weather. Some seasonal thunderstorms do occur in Baluchistan, and rarely further north, as a result of air mass uplift over the mountains of Baluchistan. Along the shores of the Persian Gulf, temperatures become quite hot, often exceeding 120°F. The high evaporation rate causes increased salinities and high temperatures in the Persian Gulf, and creates high humidities along the Persian Gulf littoral.

This basic pattern is greatly influenced by the mountain ranges that ring the central part of Iran. The Elburz and Zagros mountains form effective rain shields, preventing most of the moisture-ladened air from the west and north from reaching into the central basins. Precipitation is quite seasonal, falling mostly in fall and spring along the northern tier, in the spring in the western Zagros, and in the spring or summer as occasional showers in the south. The heaviest concentration of precipitation occurs in the spring which, together with melting snow from higher elevations, creates a period of flooding. As a result of removal of vegetation from hillsides and floodplains these floods have in recent years become larger and more destructive. The central portion of Iran, shielded by the mountain ranges, has very little precipitation, with some areas going decades without any measureable precipitation.

Current distribution of fish in Iran has often been attributed to a much wetter past, one when rivers were much more prevalent and basins were filled with water. It appears that such conditions have not occurred for several million years, at least since the early Pliocene. While some changes have occurred in intensity of flow, the basic river and lake patterns remain much as they were at the start of the Pleistocene. Internal basins, if filled with water, have water only for a short period of time during the wettest years, but seldom have persistent freshwater lakes. Most persistent water is highly saline. Arid conditions, much as found now, have predominated, even during the glacial periods. (Krinsley, 1970). Fish distribution, then, has had to largely depend upon aquatic habitat and stream patterns not greatly different from existing conditions.

VII. FOSSIL FISHES

The fossil fishes of Iran have received little attention. Few collections have been made, and published reports limited. M.C. Arambourg (1944) has published the only extensive paper on Iranian fossil fishes. As a result, the fossil history of Iran is poorly known, although some inferences may be made from material collected in adjoining regions. The following is not a complete treatment of the available information, but is only a general summary of the patterns indicated by the available literature.

In general, the fauna of the region during the Palaeozoic and Mesozoic tended to be uniform over a wide area, with provincialism becoming more pronounced in the Upper Mesozoic and Cenozoic (for a good discussion of the Mesozoic, see Patterson, 1972). Iran, covered by the Tethyan Sea, had a fauna widespread throughout the middle latitudes, extending poleward for a considerable distance. The earliest fossils, other than fish, occur in the Cambrian, with Iranian fauna closely allied to the fauna extending eastward to China, less closely allied to the fauna of peninsular India and Europe (Valentine, 1967, Hallam, 1976).

The oldest fossil fishes reported from Iran (Golshani, et. al., 1972) were from Devonian beds near the southern city of Kerman. They represented a divergent fauna, including acanthodians (*Acanthodes*, *Homalacanthus*, and a form of *Acanthodopsis*), arthrodires (*Macropetalichthys*, Brachythoracidae, *Holonema*, and many other forms), crossopterygians (*Onychodus*, rhipidistians, Coelacanthiformes), dipneustians (*Dipterus*), and actinopterygians (Paleoniscidae).

Arambourg (1939) reported on Cretaceous fishes from Elam, which included the Mesopotamian Plain of Iran and Iraq. He found fossils of marine fishes from the Upper Cretaceous that closely resembled the Paleomediterranean fauna of the Oligocene. The fossils included a number of profundal forms.

I know of no other Mesozoic fish fossils from Iran. Hora (1954) discussed a series of Mesozoic fossils from the Maleri beds of the Godavasi Valley in India. Included were dipnoans of the genus *Ceratodus* from the Upper Triassic and the ganoid fishes *Lepidotus*, *Tetragonolepis* and *Dapedius* from the Jurassic and *Pycnodus* and *Lepisosteus* from the Cretaceous.

Hora (1938), from research on the Donargaon and Dhamni Beds of India, reports that the lepisostean and pycnodian ganoids were present in the Eocene with clupeids, cyprinoids and modern acanthopterygians. This early fauna was apparently wiped out by the major geological changes since fossils are absent from the Miocene beds. A second wave of colonization occurred in the Pliocene. By the time the Himalayan uplift was essentially completed in the Pliocene modern bony fishes had spread all over India (See Hora, 1937, 1953, 1954; Menon, 1955).

In the Siwalik beds, ganoids and dipnoans are found, together with such fishes as *Bagarius*, *Mystus*, *Rita*, and Clariidae. Jayaram, (1954), in his comments on the Siwalik beds, mentioned that the genus

Mystus, found in the Pliocene sediments, was similar to an older, Eocene form from Nigeria. In a later paper (Jayaram, 1955), he mentions the many fossil forms found in both Africa and India, indicating extensive interchange during the Cenozoic. Many of these forms, such as *Eomacrones* from the Eocene of Africa, are found in more recent sediments in India.

North of Iran, in the Caucasus Mountains, Danil'chenko (1969), found clupeids common in deposits from the Middle and Upper Eocene and into the Oligocene. These included *Sardinella* and *Pomolobus*, both of which are found in the Lower Miocene with *Alosa*, an important element in the Pliocene fauna. In the Middle Miocene, the Caspian and Caucasus area were invaded by the ocean. The autochthonous Maykop fauna of the Caucasus almost disappeared, being replaced by common genera such as *Bregmaceros*, *Palaeogadus*, *Palaeomolva*, *Vinciguerria*, *Priacanthus*, and a previously unknown species, *Sardina priska*.

Arambourg (1944), compared the marine fishes of Elam and the area near Lake Neyriz, the fauna being from the Oligocene. At Elam, 36% of the fishes were bathypelagic, 45% neritic and 19% pelagic. Near Lake Neyriz, 51% were neritic, 41% pelagic, and none were bathypelagic. These fishes were closer to the Palaeomediterranean and Atlantic than to the Indo-Pacific (see also Walters, 1957).

In general, the fossil fishes are about what would be expected, with a fairly uniform marine Tethyan fauna in the Paleozoic and Mesozoic, with a greater diversity of fishes in the Cenozoic, including some freshwater fishes. In the southern parts of Iran, which remained marine for a longer period of time, the marine fishes continued to dominate while freshwater fishes were appearing in other areas. The marine fish fossils are paralleled in distribution by the invertebrate fossils (see King, 1930, Kureshy, 1970, Kamen-Kaye, 1972, Reid, 1967, Sampo, 1969 and Sahni and Kumar, 1974). One interesting trend in the fossil freshwater fishes from India is the general appearance of forms similar to African forms, but appearing at a later time in the fossil record of India than the fossils of Africa.

In addition to fossil fishes, some fish remains and paintings have been found at prehistoric and historic sites. Those most studied have been in the Caspian Basin, with the Hotu Caves near Rasht and sites near Baku being most indicative of the situation in Iran. They indicate an active early fishery by early man on forms found in marshes and inlets. Species captured are similar to present Caspian forms. (See Fowler, 1956, Nikolsky and Radakov, 1946, discussion in Butzer, 1955).

Hora (1956) examined some fish paintings on pottery from Nal, in what is now Pakistani Baluchistan. Among the genera he was able to identify were Garra, Labeo, Crossocheilus, Tor, Noemacheilus, Botia, Glyptothorax and possibly Cyprinion. Some of these are hill stream forms. Their presence in 4,500 B.P. when the paintings were made would indicate that was a period of greater stream runoff than occurs at present in the area.

VIII. FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

For purposes of this thesis 3 classes, 16 orders, 31 families, 104 genera, 367 species and 77 subspecies from throughout the Middle East were considered. This included 8 orders, 10 families, 14 genera and 33 species of marine fishes that have frequently been reported from freshwater.

Of the fishes considered, all 3 classes, 16 orders, 31 families, 90 genera, 269 species and 58 subspecies have been reported from Iran or from waters adjacent to Iran with branches in Iran. I was able to examine specimens of 2 classes, 10 orders, 21 families, 61 genera, 174 species and 38 subspecies. I have seen in addition 1 class, 5 orders, 9 families, 11 genera, and 18 species of Iranian fishes, nearly all of which are marine, but did not make detailed studies. The only order and family of fishes in Iran I did not see was the family Channidae in the order Channiformes, represented in Iran by a single genus and species. I was also able to examine 5 genera, 11 species and 3 subspecies of fishes not from Iran but which are related to Iranian species. I was unable to examine specimens of 18 genera, 77 species and 20 subspecies, of which 7 genera and 23 species were Caspian Sea gobies.

Where possible, examination of original specimens was used in developing the following systematics listing. This included museum specimens in addition to my own collections. The specimens were compared with the available literature. When unable to examine specimens I relied upon reports in the literature. Analysis of specimens and descriptions in the literature were used to determine species and subspecies. Where possible the type descriptions formed the basis for the analysis. I tried to acquire all available literature on fishes of the region, particularily for type descriptions, but was unable to find all papers and had to rely on citations in other references for many of the species.

Distributions of species and subspecies were determined by the same process. Type localities formed the principal guide to the distribution, with localities taken from the literature and from personal observations. When I was unable to examine specimens, the distributions given represent a summation of distributions from the literature. Some changes in distribution were made for nearly all Iranian species, but the changes were usually within a basin or a faunal area, which did not affect the analysis of the zoogeographic patterns and so were not discussed.

Principal references are given for each species and subspecies. Additional references were often consulted but were not major sources of systematic or distributional information.

Following each family is a Roman numeral. This numeral is an indication of the general salt tolerance of the family, and is adapted from Darlington (1957). Four categories of tolerance are used:

(I) -Family generally restricted to freshwater;

(II) -Family shows a limited tolerance for salt water;

(III) -Family able to move freely into salt water;

(IV) -Family generally restricted to marine waters.

Locations of specimens and the system of measurement and systematic arrangement are discussed under the Materials and Methods. Location designations used in the following text are:

MMIT (Trip) - Specimens I collected now in the Museum of Natural History in Tehran, Iran;

MMIT (No Number) - Uncatalogued specimens in the Museum of Natural History, Tehran, Iran;

MMIT (Catalogue Number) - Catalogued specimens in the Museum of Natural History, Tehran, Iran;

Shilot - Uncatalogued specimens in the Shilot Institute, Bandar Pahlevi, Iran;

OS (Catalogue Number) - Specimens in the Oregon State University Collection, Corvallis, Oregon;

A (Catalogue Number) - Specimens in the Academy of Sciences of the U.S.S.R., Leningrad, U.S.S.R.;

USNM (Catalogue Number) - Specimens in the Smithsonian Institution, Washington, D.C.

SUPERCLASS I. AGNATHA

CLASS I. PETROMYZONES

ORDER I. PETROMYZONIFORMES

FAMILY I. PETROMYZONTIDAE (III)

Caspiomyzon wagneri (Kessler)

Material examined: OS (No Number), (2), 24.2 and 43.2 cm, Caspian Sea, April, 1967; MMTT 291, 292, (2), no lengths, Bandar Pahlevi.

Distribution: Volga, Ural, Astarinka, Sefid-rud, Cheshmkelya, and Babul Rivers; migrates up Volga, Kura, Ural, Terek, rivers of the Lenkoran. Found commonly in the streams along the southern shore of the Caspian Sea and in the Sea. The Caspian species is closely allied to other members of the Family Petromyzontidae, with eight genera across the Holarctic and in the Southern Hemisphere.

The species *Lampetra planeri* (Bloch, 1784), native to the Mediterranean Sea and Atlantic Ocean, sometimes penetrates the upper reaches of the Caspian Sea tributaries. It has been mentioned in Iran but I know of no collections and its presence in Iran is doubtful.

References: Berg, 1948; Nikolsky, 1954.

SUPERCLASS II. GNATHOSTOMATA

CLASS II. ELASMOBRANCHII

SUBCLASS I. SELACHII

ORDER II. LAMNIFORMES

SUBORDER I. SCYLIORHINOIDEI

FAMILY II. CARCHARHINIDAE (IV)

Carcharias lamia Risso

Material examined: I collected this species at Bandar Bushire for use in anatomy classes at Pahlevi University but have made no measurements.

Distribution: Common in the Persian Gulf; found in the Indian Ocean from Arabia through seas of India to the Pacific Islands. Ascends rivers for many miles; common in the Tigris above Baghdad.

References: Boulenger, 1892; Kennedy, 1937;Fowler, 1956.

Carcharias gangeticus (Mueller and Henle)

Material examined: I collected this species at Bandar Bushire but have made no measurements.

Distribution: Common in the Persian Gulf and along the coasts of Pakistan and India. It has been reported over 500 km above the Persian Gulf in the Tigris River. I know of shark attacks in the Karun River near Dezful which were attributed to this species.

References: Gunther, 1874; Boulenger, 1889; Steindachner, 1907; Fowler, 1956.

ORDER III. RAJIFORMES

FAMILY III. PRISTIDAE (IV)

Pristis cuspidatus Latham 1794

Pristis zysron Bleeker

Material examined: I have not seen either of these species but have examined a number of their saw-like rostra. The rostra are often offered for sale in the bazaars along the Persian Gulf, and they appear to be quite common.

Distribution: Persian Gulf; Seas of India, Malay Archipelago to Australia. Enters freshwater, sometimes for a considerable distance.

References: Latham, 1794; Day, 1878; Blegvad, 1944; Fowler, 1956.

CLASS III. TELEOSTOMI

SUBCLASS II. ACTINOPTERYGII

ORDER IV. ACIPENSERIFORMES

FAMILY IV. ACIPENSERIDAE (III)

This family has both anadromous and resident freshwater species in waters throughout the Northern Hemisphere. The Caspian sturgeon are closely allied to the European species. The same species are common to the Black, Aral and Caspian Seas, although different subspecies are recognized, a reflection of the fairly recent connections between the basins (see chapter on Geologic History).

Within the Iranian portion of the Caspian Sea the sturgeon has declined in numbers as a result of irrigation development, overfishing, and loss of habitat. The sturgeon run up the larger rivers, and are found in the Caspian Sea and the Mordabs. An active government-controlled fishery harvests the sturgeon along the Caspian coasts and near the mouths of rivers. Beginning in the mid-1960s, a hatchery program for propagating sturgeon was initiated in Iran.

The sturgeons are Peripheral fish, able to move through sea water. The closest relatives of the Persian species are found in Europe. It is not clear if the sturgeon are a recent arrival (Pleistocene or Recent), or if they were residents in the Sarmatian Sea and remained as the Sarmatian Sea broke into smaller basins.

Because of their tolerance for sea water the sturgeon may have entered either from the Mediterranean through the Black Sea or via the Volga system from the north if they were not already in the basin at the start of the Pleistocene. Even if they were present in the Sarmatian Sea, additional invasions during the Pleistocene and Recent were probable.

<u>Huso huso</u> (Linnaeus)

Material examined: OS 4290, (2), 23.4 and 23.7 cm, Bandar Pahlevi Fish Hatchery, VIII-1971.

Distribution: Black and Caspian Seas, Sea of Azov, eastern parts of the Mediterranean Sea. Anadromous, entering larger rivers to spawn. In Iran, it enters the Astara, Gorgan, Babol and Sefid-Rud Rivers and the Pahlevi and Gorgan Mordabs. The population has been greatly reduced in recent years. Quite large, reaching lengths over 10 meters.

References: Berg, 1932; Berg, 1948; Kozhin, 1957; Zenkevich, 1957; Rostami, 1961; Vladykov, 1964.

<u>Acipenser</u> L.

This genus is found throughout the Holarctic Region. It is represented in the Caspian Sea by four species.

<u>Acipenser nudiventris</u> Lovetzky

Material examined: OS 5167, 14.1 cm, Bandar Pahlevi Fish Hatchery, VIII 1971.

Distribution: Basins of the Aral, Caspian and Black Seas. Most abundant in the southern part of the Caspian Sea, where it remains mostly in the estuaries. Found in the Sefid-Rud, Araxes, Astara and

Lenkoran streams. Supports an active caviar fishery.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Zenkevitch, 1957; Rostami, 1961; Vladykov, 1964.

<u>Acipenser</u> <u>ruthenus</u> Linnaeus

Material examined: I saw specimens of this fish at the Shilot Station at Bandar Pahlevi but have studied no specimens.

Distribution: Rivers of the Black, Caspian and Baltic Sea Basins, but rare in the Baltic. In the Arctic Ocean it is found in the basin of the northern Dvina. In the Caspian Sea, found mostly in the northern part of the sea, but taken occassionally in the south.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Zenkevitch, 1957; Rostami, 1961; Vladykov, 1964.

<u>Acipenser</u> <u>guldenstadti</u> <u>persicus</u> Borodin

Material examined: OS 4255, (2), 14.7 and 15.6 cm, Bandar Pahlevi Fish Hatchery, VIII-1971; OS 5168, 17.7 cm, Bandar Pahlevi Fish Hatchery, VIII-1971.

Distribution: <u>A.</u> <u>guldenstadti</u> Brandt, 1833, is native to the basins of the Black and Caspian Seas and the Sea of Azov. It forms distinct local populations. <u>A.</u> <u>guldenstadti</u> <u>persicus</u> is found in the southern part of the Caspian Sea. It enters the rivers of the Caspian from Astara in the west to the Gorgan River in the east, including the Sefid-Rud, Shedmanrud, Tedzhan, Nalarud, Babolrud, Mirereud and Gorganrud. It supports an active caviar fishery.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Kozhin, 1957; Rostami, 1961; Vladykov, 1964; Anon., 1964.

Acipenser stellatus cyrensis Berg

Material examined: OS 4272, 36.2 cm, Bandar Pahlevi Fish Hatchery, VIII-1971.

Distribution: Basins of the Black, Caspian and Azov Seas, where several local stocks have been identified. In Iran, the fish enters rivers from the Astara Rud to the Gorgan Rud. The fish supports an active caviar fishery.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Kozhin, 1957; Rostami, 1961; Dees, 1961; Vladykov, 1964; Sokolov and Tsepkin, 1969.

ORDER V. CLUPEIFORMES

SUBORDER II. CLUPEOIDEI

FAMILY V. CLUPEIDAE (IV)

The family Clupeidae is primarily a marine family in temperate and tropical seas with a few freshwater forms. Three genera will be discussed in this thesis, two from the Caspian Sea and one from the Persian Gulf.

Caspialosa Berg

This genus is native to the Black and Caspian Seas. It is considered a remnant of the marine fauna which inhabited the Sarmatian Sea. It is very close to *Alosa*, differing primarily in the presence of vomerine teeth, absent from *Alosa*. *Alosa* is found along the Atlantic coasts of Europe and North America and in the Mediterranean Sea. Some *Alosa* do enter the Black Sea but they are rare. The interconnections of the Black and Mediterranean Seas, and the periodic connection of the Black and Caspian Seas, would have permitted interchange between *Alosa* and *Caspialosa*. Ladiges and Vogt (1965) treated *Caspialosa* as no more than a subgenus of *Alosa*. I have followed Berg (1948) and retained *Caspialosa* as a separate genus.

Caspialosa brashnikovi (Borodin)

Material examined: I have seen this species in the commercial catches at Bandar Pahlevi but have examined no specimens.

Distribution: Caspian Sea; does not enter rivers. In the winter this species is found in the southern Caspian, moving northward in the spring. Mikhailovskaya (as summarized in Berg, 1948) described seven subspecies from the southern Caspian Sea:

C. brashnikovi grimmii (Borodin, 1904): Caspian, from Gorganchay southward, Astara, Astrabad Bay, near mouth of Gorgan, Kendyrli and, in spring and summer, Kurasnovosk.

C. brashnikovi autumnalis Berg, 1915: Region of the Gasan-kuli-Chikishlyar and region of Cape Byandovan.

C. brashnikovi kisselewitschi Bulgakov, 1926: Region of Fasan-Kuli in June and July; in the spring, along the western coasts from Astara northward.

C. brashnikovi nirchi Morosov, 1928: Spawns in Krasnovodsk Bay in spring; Kendyrli Bay.

C. brashnikovi agrakhanika Michailowskaya, 1941: Winters in the southeastern part of the Caspian, spawning to the north.

C. brashnikovi sarensis Michailowskaya, 1941: Western coasts of south and central Caspian from Astara to the fishing grounds of the South Daghestan.

C. brashnikovi orientalis Michailowskaya, 1941: Krasnovodsk to Astrabad Bay; spawns in region of Baku Archipelago.

References: Berg, 1948; Nikolsky, 1954.

Caspialosa saposhnikovi (Grimm)

Material examined: None.

Distribution: North Caspian and along coasts of Daghestan, but may be found throughout the Caspian Sea. In cold winters, moves into the southern Caspian.

References: Berg, 1948; Nikolsky, 1954.

Caspialosa curensis (Suworow)

Material examined: None.

Distribution: Southern Caspian Sea, Kizilagach.

References: Berg, 1948; Ladiges and Vogt, 1965.

Caspialosa suworowi (Berg)

Material examined: MMTT 311, (length of body) 7.3 cm, Bandar Pahlevi, XII-1970; MMTT 411, (length of body) 10.7 cm, Bandar Pahlevi, III-1971.

Distribution:Found mainly in the north Caspian, but individual specimens are found throughout the Caspian Sea. Both Svetovidov (1943) and Berg (1948) suggest this is not a valid species but represents a collection of hybrids of various species. The characters cover a wide range, with specimens often intermediate between other species.

References: Berg, 1932; Svetovidov, 1943; Berg, 1948.

Caspialosa pontica kessleri (Grimm)

Material examined: I have seen this species in the laboratory but have not examined specimens.

Distribution: Winters in the southern Caspian Sea, moving northward along the western shores of the Caspian Sea in spring. It will enter the Volga River.

Berg (1948) lists C. pontica as a subspecies of C. kessleri. C. pontica was the first described, by Eichwald (1838). For this reason I have followed Ladiges and Vogt (1965) in listing C. kessleri as a subspecies of C. pontica.

References: Eichwaldi, 1841; Berg, 1948; Ladiges and Vogt, 1965.

Caspialosa pontica volgensis (Berg)

Material examined: OS 4276, (2), 21.2 and 23.3 cm, Caspian Sea in Iran, XI-1971.

Distribution: Winters in the southern Caspian Sea, migrating north in the spring, ascending the Volga River en masse.

References: Berg, 1948; Nikolsky, 1954.

Caspialosa pontica volgensis imitans Berg 1948

Material examined: OS 4259, 18.8 cm, Caspian Sea, IX-1971; MMTT 412, 12.9 cm, Bandar Pahlevi, III-1971.

Distribution: Winters in the southern Caspian Sea, migrating northward along both coasts in the spring. Mass spawning occurs in the estuaries of the Ural and Volga Rivers.

References: Berg, 1948.

Caspialosa caspia Eichwaldi

Material examined: OS 4011, (2), 21.3 and 23 cm, Caspian Sea, XI-1971; MMTT 310, (length of body) 15 cm, Bandar Pahlevi, XII-1970.

Distribution: Found throughout the Caspian Sea. Winters in the southern and central portions of the Sea, spawning in the spring and summer before the estuaries of the Volga and Ural Rivers.

C. caspia aestuarina Berg 1932 was described as a separate species on the basis of the size and form of its eggs. It is questionable whether it should be considered a separate species. In all other repects its characgers and its range are the same as *C. caspia*.

References: Eichwaldi, 1841; Berg, 1932; Berg, 1948; Nikolsky, 1954.

Caspialosa caspia persica Iljin

Material examined: MMTT 33-35, (3), (length of body) 22 cm, Bandar Pahlevi.

Distribution: Southeastern part of the Caspian Sea.

References: Berg, 1948; Nikolsky, 1954.

Caspialosa caspia knipowitschi Iljin

Material examined: USNM 37255, 30.5 cm, Astrakhan, obtained from the Imperial Academy in St. Petersburg, no date given.

Distribution: Centered in the area from east of the Sefid Rud through Astara to the northern coasts of the Apsheron Peninsula; some individuals found east through Astrabad Bay. Major spawning populations in the Mordab and the region of Sara Island.

References: Dmitriev, 1947; Berg, 1948; Nikolsky, 1954.

Clupeonella Kessler

This genus is found in the basins of the Black and Caspian Seas, is very similar to Clupea and Harengula. Like Caspialosa, it is a remnant of the Sarmatian marine fauna.

Clupeonella delicatula (Nordmann)

Material examined: OS 4249, (2), 11.575 and 10.487 cm, Caspian Sea, IV-1962.

Distribution: Black and Caspian Seas. Enters rivers in the Black Sea and northern Caspian Sea, but not in the southern Caspian. In the Caspian it is found mainly in the south in winter, moving northward in the summer.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954.

Clupeonella grimmi Kessler

Material examined: MMTT 420, (length of body) 7.2 cm, Bandar Pahlevi, II-1971.

Distribution: Pelagic species in the central and southern parts of the Caspian Sea.

References: Berg, 1948; Nikolsky, 1954.

Clupeonella engrauliformis (Borodin)

Material examined: OS 4275, (3), 10.61 to 12.34 cm, Caspian Sea, I-1971; USNM 205900, 11.2 cm, Bandar Pahlevi, I-IV-1970; USNM Acct. No. 248692, (2), 8.821 and 11 cm, Babolsar Beach, 24-VI-1963.

Distribution: Central and southern portions of the Caspian Sea.

References: Berg, 1948; Nikolsky, 1954.

Ladiges and Vogt (1965), in their listing of European fish species, give only one species, C. delicatula in the genus Clupeonella. Based on the literature and the few specimens I have seen, there appears to be considerable overlap amongst the three species, and it is quite possible there is but a single species distributed in the Black and Caspian Seas.

Hilsa ilisha (Ham. Buch.)

Material examined: I have often seen this species in the fish markets but did not examine any specimens.

Distribution: This is a marine species found throughout the Persian Gulf and the Indian Ocean through the seas of India and Indochina. It commonly enters larger rivers to reproduce, often going upriver in the Tigris-Euphrates and Karun for a considerable distance.

References: Day, 1878; Bassett-Smith, 1897; Blegvad, 1944; Fowler, 1956; Andersskog, 1966.

SUBORDER III. SALMONOIDEI

FAMILY VI. SALMONIDAE (III)

Salmo Linnaeus

This genus is widespread throughout the Holarctic Region. It has anadromous as well as resident species. The Salmo of the Middle East have received little attention and are poorly known. Recent introductions from Europe into Iran will probably lead to interbreeding with local Salmo as has happened so often in other parts of the world. The Salmo of Iran and the entire Middle East need to be studied in much more detail.

Salmo trutta caspius Kessler

Material examined: OS 4283, (3), 19.2 to 22.4 cm, Shamrud, Gilan, VI-1971; OS 4263, (2), 8.256 and 10.393 cm, Chalus River, IX-1970; OS 5034, (3), 5.088 to 5.984 cm, Shahsavar River, VI-1972; MMTT (No Number, (length of body) 19.2 cm, Regab River, 11-IX-1974; MMTT (No Number), 25.5 cm, Aldarvish River, 28-VIII-1974; MMTT (No Number), no length, Luniz River, 24-VIII-1974; MMTT (No Number), (2), 24.5 cm, Lighvan Chay, 26-VIII-1974; USNM 205915, (2), 4.663 to 5.356 cm, Bandar Pahlevi, 24-V-1970; USNM 205926, 23 cm, Bandar Pahlevi, 24-V-1970; USNM 205927, (5), 13.7 to 19.8 cm, Bandar Pahlevi, 24-V-1970; USNM 205924, 27 cm, Bandar Pahlevi, 24-V-1970.

In addition to the above, I also looked at but did not make any length measurements on the following specimens: MMTT 76-77, Naviq River, Gilan; 1-VIII-1971; MMTT 267, Bandar Pahlevi, 24-V-1970; MMTT 275-279, (5), Siyah Rud, Gilan, 7-VI-1971; MMTT 356, Shahrestaneh River, Karadj System, V-1972; MMTT 394, Lar River, 4-IX-1969; MMTT 415-416, (2), Chalus River, 23-IX-1970; MMTT 688, Lar River, 26-VII-1973; MMTT 693-697, (5), Cheshmeh Siah, Lar River, 14-VIII-1973; MMTT 698-699, (2), Qaranghu and Mardough Chay, East Azerbaijan, 11-VIII-1973; MMTT 734-741, (8), One kilometer south of the Shahrestanah and Louniz River Forks, Karadj River System, 1-X-1973; MMTT 748-752, (5), Gajareh River, 5 km southwest of Gajareh village Central Province, 29-IX-1973; MMTT 759-762, (4), Varangerud River, two kilometers south of Varangerud Village, Central Province, 29-IX-1973; MMTT 763-767, (5), Shahrastanah River, two kilometers east of the forks with the Karadj River, 10-X-1973; MMTT 775-787, (13), Lighvandari River, two kilometers from Lighvan Village, southeast of Tabriz, East Azerbaijan, 23-X-1973; MMTT 788-802, (15), Shahneshin River, three kilometers northwest of Shahneshin Village, East Azerbaijan, 26-X-1973; MMTT 803-817, (15), Lar River, eight kilometers northwest of Kamardasht, 27-X-1973; MMTT 818-835, (28), Aghlahghan River, one kilometer east of Aghlahghan Village, East Azerbaijan, 23-X-1973; MMTT 937-945, (9), Lar River near Polour, 19-VI-1974; MMTT 924-931, (8), Lar River near Polour, 19-VI-1974.

Salmo ischchan Kessler, 1877: For comparison of Iranian fishes with the Lake Sevan species, I examined one lot of fish in the Academy of Sciences of the U.S.S.R., A 37620, all over 40 cm, Lake Sevan, II-1964.

Distribution: Within Iran, this species is found in the Caspian Sea Basin, Azerbaijan, Lake Rezaiyeh Basin, Tehran Basin and the Semnan Basin.

The type species of *Salmo trutta* was described by Linnaeus, 1758, from the anadromous forms inhabiting the coastal rivers of Europe from the Iberian Peninsula northward through Scandinavia. Its range closely parallels that of the Atlantic salmon *Salmo salar* Linnaeus,1758. Within the range of the two species, they are often found in the same drainage. Within the same range, and often in the same drainages, are two resident forms of *S. trutta*, *S. trutta fario* in flowing water and *S. trutta lacustris*.

Within the Caspian Sea Basin there also appears to be two forms, a resident and a migratory form. The migratory form is anadromous, living most of its life in the Caspian Sea, returning to the rivers to spawn. There are two runs, one in the fall and one in the spring. While with the Iran Game and Fish Council I checked all streams in the Caspian Basin of Iran, finding the anadromous form in 22 of the streams of the Caspian shore. I also found resident populations of trout up to 40 cm. Because of the overlap of the anadromous and resident forms, and because of the ability of some streams to maintain runs of the anadromous form even with severe poaching, I believe the two forms are not genetically distinct and overlap with some resident offspring becoming anadromous.

A resident commercial fishery takes many of the anadromous fish in the Caspian Sea, with most of the remaining fish being captured by poachers using traps and nets that completely block the streams. The downstream migrants begin moving in March and April. About the same time, irrigation diversions are placed in all streams without any screening to protect the fish. Many of the outmigrants end up in the irrigation ditches where they are captured or die. By May, most of the streams are completely dried up in the lower one to three kilometers, preventing any fish from reaching the Caspian Sea. (A more complete discussion is found in Armantrout, 1966; Armantrout, 1967/8; Armantrout, 1968).

The actual systematic position of the Caspian salmon is not clear. While it is included with *Salmo trutta*, it has also been included with *S. salar*. Berg (1948), in his discussion on the systematics of the Caspian salmon, expressed the opinion that it was intermediate between the two species, and could not readily be assigned to either species, but retained it in *S. trutta* since that was where it was first described.

Within Iran, and throughout much of the Middle East, there are other populations of trout. All of these have been ascribed to Salmo trutta, with four subspecies now recognized, with the exception of the Lake Sevan trout assigned to the species S. ischchan Kessler, 1877, and a new species, S. platycephalus, recently described by Behnke (1968) from southcentral Turkey. The widest distribution is assigned to the subspecies S. trutta macrostigma, found in the basins of the Mediterranean Sea and the Tigris and Euphrates Rivers. S. trutta macrostigma was initially described by Dumeril, (1858) from Algeria; since then, fish from a broad arc from western North Africa through Iran have been placed in this subspecies. The Iranian specimens from Tehran were once assigned to this species but, as indicated above, belong to S. trutta caspius. Salmo trutta labrax Pallas, 1811, is found in the basin of the Black Sea and Sea of Azov, including the Caucasus and Asia Minor. Two subspecies have been described from the Aral Sea Basin, S. trutta aralensis, an anadromous form, and S. trutta oxianus, in the rivers of Afghanistan and the Hindu Kush. S. trutta aralensis was described as a separate subspecies by Berg, (1908), separating it from S. trutta oxianus, ascribed to Kessler 1874. The form given as oxianus was first reported by McClelland 1842 who named it Salmo orientalis, but the name orientalis had previously been used by Pallas, 1811, for another form of Salmo.

Outside the immediate Caspian Sea Basin of Iran there are two groups of trout. In meristic characters both of these groups are close to the Caspian Sea form. The Karadj and Semnan trouts were usually assigned to S. trutta macrostigma. While their coloration was somewhat different, with larger, brighter spots, they are very similar to the Caspian Sea forms and should be included with them. Rainbow trout (S. gairdneri) and the European brown trout (S. trutta fario) have been introduced into the Karadj and Semnan Basins and hybridization is probably occurring that will eliminate the native genotype.

The trout from the Rezaiyeh Basin are quite distinctive in their appearance. While I have seen specimens from a number of locations, I made measurements from only two specimens from Lighvan Chay. In these, the gill raker count was high, 22, with the gill rakers flat, with serrations along one or both edges. The start of the ventral fin was under the fourth branched dorsal ray. There were many large orange spots on the sides and dorsal fin, with large black spots on the back. The maxillary reached barely to the posterior margin of the eye. The length of the maxillary is equivalent to that of the Lake Sevan trout (S. ischchan) but not the typical S. trutta caspius. S. ischchan was separated from S. trutta on the basis of the shorter maxillary, which does not reach past the posterior margin of the eye as it does in S. trutta. S. ischchan is found in the Lake Sevan, which is part of the Kura River drainage, into which Lake Rezaiyeh once emptied. Tortonese (1954) found trout in the headwaters of the Araxes River, part of the Kura System, near Erzurum, Turkey, with the shorter maxillary, and with 16 gill rakers, 11 branchiostegal rays, and 27-30 pyloric caeca. The Rezaiyeh Basin once drained into the Araxes River. The shorter maxillary may be a common character in trouts within the current and former drainage of the Araxes River. With additional study, the Rezaiyeh trout may be found to be a new subspecies. It differs from the coloration, maxillary development and gill rakers from the Caspian salmon, and from the Lake Sevan trout in having spots that were markedly larger and brighter than the Lake Sevan trout. Because of the limited information I have on the Rezaiyeh Basin trout I have for the present retained them under S. trutta caspius.

Two other subspecies may also be present in Iran, while the known subspecies, caspius may be more widespread. S. trutta caspius is found in two subbasins, Karadj and Semnan, in the larger Namak Lake Basin, and may be present also in other parts of the country. Adequate habitat exists in the headwaters of the Qom Basin, but these waters have not been collected. Trout were reported in the area by the residents, but this may have been from the headwaters of the Sefid Rud which are nearby instead of from the headwaters of the Qom River. Similarily, adequate habitat exists in some parts of Khorasan, which drained into the Aral Sea rather than the Caspian Sea; S. trutta oxianus may be present in these areas, to date not collected. The other subspecies which may be present is S. trutta macrostigma of the Tigris and Euphrates Basins. Among the specimens I looked at, but did not study in detail, was a collection from the Regab River (IMIT, No Number), with a single specimen which I initially combined with the Caspian trout. Its fin ray counts (D III 8; A II 7) were lower than any of the other trout I examined from Iran; gill rakers were 15, and the lateral line 120. I made no other measurements. This is the first specimen I am aware of from the Karun System, to which the Regab River belongs, but I cannot give a firm identification.

I feel certain that additional populations of trout will be found in Iran with additional collecting. The Iranian trout, and the trout of the Middle East for that matter, badly need additional study. The separation of populations in an arid area, where there are many small populations in high mountain streams and a few more extensive populations in larger rivers, is reminiscent of the situation with the cutthroat trout in the western U.S. Like the cutthroat trout, there is considerable variability in coloration among populations, but considerable overlap in characters.

The Caspian Sea salmon is strongly allied to the northern European salmon and trout, and probably emigrated from the north during the Pleistocene. *Salmo* were present in the Sarmatian Sea. Tortonese (1954) suggests that *S. trutta macrostigma* developed from the Sarmatian trout, while *S. trutta caspius*, and the closely related *S. trutta labrax* and *S. trutta aralensis*, were later immigrants, arriving during the ice ages from the north. Continued connections to the north, with the Mediterranean Sea, and between the Black, Caspian and Aral Seas, would have permitted a regular exchange of salmonids until very recently. Probably such exchanges occurred, so that the gene pool in the Caspian Sea was continually being renewed by outside introductions. Populations in internal basins, such as the Rezaiyeh, Karadj and Semnan, and other portions of the Kura and Araxes Basins, became isolated at different times, isolating their populations so that they did not benefit from subsequent genetic exchange, leading to gradual divergence from the principal population in the Caspian Sea.

References: McClelland, 1842; Kessler, 1874; Sauvage, 1884; Alexandrovitsch, 1896; Boulenger, 1896; Kawraisky, n.d.; Regan, 1914; Hanko, 1924; Gruvel, 1931; Hora, 1934/5; Berg, 1948; Berg, 1949; Tortonese, 1954; Ladiges and Vogt, 1965; Numann, 1966; Armantrout, 1966; Armantrout, 1967/8; Armantrout, 1968A; Armantrout, 1968C; Kinunen, Bullock and Bosch, 1970; Bullock and RaLonde, 1971; Saadati, 1977.

Salmo gairdneri Richardson

This species was introduced into Iran in the 1960s. The first fish in Iran I know of were raised at a private hatchery on the Karadj River. Surplus fish from the hatchery, plus eggs flown into Iran from Europe, were used to stock a number of rivers in the Karadj, Jajerud, Caspian, Namak, Isfahan and Karun River Basins. No good records were kept of actual plantings and very few follow-up evaluations were done to see if the plantings were successful. I do not know the actual source of the eggs used, but at least part of them were obtained in Denmark.

Salvelinus fontinalis Mitchill

The owner of a private hatchery on the Jajehrud imported over a million brook trout eggs which he raised to fingerling size. Most were lost during a flood in 1968, escaping into the Jajehrud. Some fish were placed in the Jajehrud River and the Latian Reservoir on the same river. I do not know of any adults being taken or whether some fish were placed in other drainages.

Coregonus lavaretus L.

This species was planted into the Karadj Reservoir in 1968, using eggs imported from Europe and hatched in Iran. The young were quite small when planted. The fish seems to have become established but the population is quite small.

Salmo trutta fario L.

Brown trout were imported from Europe for rearing at both the Karadj and Jajehrud hatcheries. Some were planted in rivers, but I do not know which rivers, except for the Karadj and Caspian Sea Basin.

Stenodus leucichthys (Guldenstadt)

Material examined: None.

Distribution: Caspian Sea. Ascends the Volga River and, rarely, the Ural and Terek Rivers; not found in other rivers in the basin. It lives in open water, including the southern Caspian Sea. It is occasionally taken in Iranian waters. The species belongs to a genus typcial of high northern latitudes. It probably penetrated the Caspian Sea during the Ice Ages.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954.

SUBORDER IV. ESOCOIDEI

FAMILY VII. ESOCIDAE (II)

Esox lucius Linnaeus

Material examined: USNM 205941, 44 cm, Geluga, Pahlevi Mordab, 22-V-1970.

Distribution: Found throughout the Holarctic, including Europe, northern and western Asia, North America, Arctic Ocean Basin, and the basins of the Black, Caspian and Aral Seas. In Iran, it is common, particularily in the lower portion of the larger rivers and in the Pahlevi and Gorgan Mordabs. It is present in the Caspian, Azerbaijan and Lake Rezaiyeh Basins.

References: Filippi, 1865; Kessler, 1874; Steindachner, 1897; Berg, 1948; Fowler and Steinitz, 1956; Bosch, Kinunen, Bahrami and Ahdhami, 1970.

ORDER VI. CYPRINIFORMES

DIVISION I. CYPRINI

SUBORDER V. CYPRINOIDEI

FAMILY VIII. CYPRINIDAE (I)

Most of the freshwater fishes in Iran belong to the Family Cyprinidae. They are represented in all basins, and are the major group on which zoogeographic relationships are based in this thesis. The family is mostly confined to freshwater, with little tolerance for sea water. An interesting situation exists in the Caspian Sea where several genera are anadromous, living as adults in the Caspian Sea but returning to the rivers to spawn. Some, such as the genus *Rutilus*, are the base for an important commercial fishery.

SUBFAMILY I. LEUCISCINAE

This subfamily is the most primitive of the Cyprinidae (Banarescu 1968A). It is found throughout the Holarctic, and is the only subfamily that has developed an extensive fauna in the Nearctic. Within Iran, the most diverse fauna is in the Caspian Sea and related basins. This fauna is closely allied to species in Europe and northern Asia. Only a few genera have penetrated into the Mesopotamian fauna, and even fewer into the Iranian basins of the Oriental fauna.

Rutilus Rafinesque

This genus is a common genus in the Sarmatian fauna, and is found throughout the Aral, Caspian and Black Sea Basins, and in Europe. Two genera are found in the Sarmatian fauna of Iran, Rutilus rutilus and R. frisii, with indigenous subspecies in the Caspian Sea Basin. Both species are anadromous and support an extensive commercial fishery. A third species, R. tricolor, has been reported from the Tigris-Euphrates-Karun System, but this is an error and the species is actually in the genus Phoxinellus. Rutilus is found only in the Palearctic fauna.

Rutilus rutilus caspicus (Jakowlew)

Material examined: OS 4271, (2), 13.603 cm and 13.21 cm, Pahlevi Mordab, X-1971; MMTT 337, (length of body) 12.35 cm, Bandar Pahlevi, 11-IX-1969; USNM (No Number), 32 cm, taken by trawl net near Bandar Pahlevi, 15-III-1970.

Distribution: The type species, R. rutilus (Linnaeus, 1758) is found in Europe, including the upper Volga River. Related subspecies are found in the Black and Aral Seas and in Siberia. The subspecies in Iran is found throughout the Caspian Sea, entering rivers to spawn. Berg (1948) separates the northern and southern forms, but the two populations readily overlap in range. Two morphas were described from the southern Caspian:

R. rutilus caspicus kurensis Berg 1932: Bandar Pahlevi, Baku, lower Kura River, Astara, Araxes River.

R. rutilus caspicus knipowitschi Pravdin, 1927: Southeastern Caspian Sea; enters the Atrek, Gorgan and Qarasu Rivers.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Anon (Mahi Sara), 1964; Shikhshabekov, 1969.

Rutilus rutilus schelkovnikovi Derjavin

Material examined: MMTT 453, 13 cm, Araxes Dam, XII-1971.

Distribution: This subspecies was described by Derjavin from the Qarasu River, Araxes System, Iran. It is a non-migratory fish closely related to the anadromous form and probably derived from it. My specimen differed somewhat from Derjavin's description in having a lower lateral line scale count and a higher anal fin ray count. So few specimens have been collected that the range of the fish and the limits of the characteristics cannot be said to be well established. The subspecies will probably be found elsewhere in the Araxes system with additional collecting.

References: Berg, 1948.

Rutilus frisii kutum (Kamensky) 1899

Material examined: OS 4288, 19.9 cm, Caspian Sea, XI-1971; MMTT 475-477, (3), 7.2 to 8.3 cm, Chowbar River, Gilan, 10-XII-1971.

The type species, R. frisii (Nordmann, 1840), was described from the Black Sea where it is also anadromous. Two subspecies have been described from adjoining areas of Europe draining into the Mediterranean Sea. In Iran, it is found throughout the basin of the Caspian Sea, but most abundant in the south. In Iran, it enters all rivers and smaller streams to spawn.

References: Kamensky, 1899; Berg, 1932; Berg, 1948; Nikolsky, 1954; Vladykov, 1964; Ladiges and Vogt, 1965.

This fish, called a whitefish in Farsi, is the most popular food fish in Iran. It regularily attains a weight of two or three kilos and has excellent flesh. Although I have examined only the specimens above, I have seen many of this species in the markets and bazaars in northern Iran. Its habitat, like all anadromous fish in Iranian Caspian waters, has been seriously reduced. However, because it enters the river in the winter when no irrigation takes place, it has suffered less from poaching than the more vulnerable salmon and sturgeon. Its young remain only a short time in the rivers before going into the sea. The Shilot Institute in Bandar Pahlevi has been developing hatchery techniques for the fish to augment natural runs.

Rutilus frisii kutum X *Chalcalburnus chalcoides*?

Material examined: USNM 205936, 26.8 and 27.6 cm, Lake Valasht, Mazanderan, 19-II-1970; MMTT 44-45, (2), 21.5 cm, Lake Valasht, 13-V-1973; MMTT 958, 29.3 cm, Lake Valasht, 25-VII-1974; MMTT 961, (length of body) 14.08 cm, Lake Valasht, 25-VII-1974.

Distribution: In the collection of fish from Lake Valasht are a number of specimens that appear intermediate between *Rutilus* and *Chalcalburnus*. *Chalcalburnus* is native to the lake but *Rutilus*, which is an anadromous Caspian form, was absent until reportedly introduced about 1850 into the landlocked lake to provide foor for the royal family, which had a summer residence near the lake. *Rutilus* and *Chalcalburnus* are known to hybridize (Berg, 1948; Nalbandoglu, 1954).

Phoxinellus Heckel

Most species in this genus are found in Palestine and Anatolia. The genus is very similar to Rutilus, Paraphoxinus, Acanthorutilus and others. It is distinguished by a lack of scales, or with only a few scales, but this is not a reliable characteristic as nearly completely scaled forms have been collected. The last unbranched rays in both the dorsal and anal fins are smooth, pliable spines. A weak keel may be present on the ventral surface. Because of the variability of the scales, spines and keel, this genus may be easily confused with other similar genera. Its range is given as North Africa, Southern Europe and the Middle East. It is apparently present in Iran. I have had only limited experience with the genus so have generally follwed the recent revision of the genus in Karaman (1972) in the following summary.

Phoxinellus zeregi zeregi Heckel

Material examined: None.

Distribution: Kueik, Lake Tiberias, Aleppo, Syria.

References: Lortet, 1883; Pellegrin, 1923; Gruvel, 1931; Karaman, 1972.

Phoxinellus zeregi kervillei Pellegrin 1923

Material examined: None.

Distribution: Orontes system; Lake Huleh (Homs); Adana, Turkey.

References: Pellegrin, 1923; Tortonese, 1938; Steinitz, 1952; Goren, 1974; Karaman, 1972.

Phoxinellus zeregi drusensis (Pellegrin) 1933

Material examined: A 26625, (length of body) 3.6 cm, Mezra'a (Djobol Druse), Syria, n.d.

Distribution: Golan Heights, southern Syria.

References: Pellegrin, 1933; Berg, 1949; Goren, 1974.

Phoxinellus zeregi libani Lortet 1883

Material examined: A 26627, (length of body) 3.35 cm, Lake Yammi, Lebanon, n.d.; A 6738, (length of body) 3.28 cm, Lake Yammi, Lebanon, 1884; USNM 48012, (2), 4.411 and 4.960 (length of body) cm, Lebanon, n.d., TYPE SPECIMEN, obtained from Lyon Museum.

Distribution: Lebanon, Yammi (Yammoum) Sea.

References: Lortet, 1883; Pellegrin, 1923; Gruvel, 1931 Tortonese, 1938; Berg, 1949; Karaman, 1972.

Phoxinellus zeregi syriacus (Lortet) 1883

Material examined: A 26628, (length of body) 7.5 cm, Baalbek, Syria, n.d.

Distribution: Syria; Baalbek, Damascus.

References: Lortet, 1883; Pellegrin, 1923; Tortonese, 1938; Berg, 1949; Karaman, 1972.

Phoxinellus zeregi maeandri Ladiges 1960

Material examined: None.

Distribution: Southwestern Asia Minor; Afyon-Dinar-Burdur-Konya, in lakes and tributaries.

References: Ladiges, 1960; Karaman, 1972.

Phoxinellus zeregi fahirae Ladiges 1960

Material examined: None.

Distribution: Southwestern Asia Minor.

References: Ladiges, 1960; Karaman, 1972.

Phoxinellus crassus (Ladiges) 1960

Material examined: None.

Distribution: Asia Minor; Tuzgolu System. Ladiges assigned this species to Acanthorutilus but it was placed under Phoxinellus by Karaman. It is not clear from the descriptions to which genus it belongs, but I shall here follow Karaman.

References: Ladiges, 1960; Karaman, 1972.

Phoxinellus handlirschi (Pietschmann)

Material examined: None.

Distribution: Asia Minor; Egridir Lake.

References: Karaman, 1972.

Phoxinellus egridiri Karaman 1972

Material examined: None.

Distribution: Lake Egridir

References: Karaman, 1972.

Phoxinellus anatolicus (Hanko) 1924

Material examined: None.

Distribution: Turkey; Eregli, Beysehir Lake. Both this species and P. crassus have complete lateral lines and strong dorsal rays and would appear not to be Phoxinellus, but since I have not seen either species I have followed Karaman's arrangement.

References: Hanko, 1924; Ladiges, 1960; Karaman, 1972.

Phoxinellus rutiloides Tortonese 1938

Material examined: None.

Distribution: Nahr-el-Asi, Orontes Sytem. The description of this species closely approximates P. zeregi syriacus, which is not reported from the Orontes. The scale count is similar to kervillei, but the bodily proportions and fin ray counts are not the same.

References: Tortonese, 1938.

Phoxinellus tricolor (Lortet) 1883

Material examined: None.

Distribution: Palestine; the lakes near Damascus, Bahr Ateibeh, Bahret el Jijaneh, Baret Bala and Matkh Brak. Asia Minor. Tigris at Baghdad. The reported locations would place it throughout the Tigris and Euphrates River Systems.

Saadati (1977) described a form he assigned to Phoxinellus from the Bid-Sorkh River, between Sahneh and Kangavar, Karun Basin. He states it is similar to P. zeregi. However, his description is much closer to P. tricolor, the only difference being tricolor having the head length exceeding the body height while in Saadati's specimens the opposite is the case. I would suspect Saadati's specimens are tricolor.

References: Lortet, 1883; Pellegrin, 1923; Hanko, 1924; Tortonese, 1937/38; Khalaf, 1961; Saadati, 1977.

Leuciscus (Cuvier)

This genus is found throughout Europe, northern and western Asia, and the Middle East. It is a highly adaptable genus with a wide distribution. In Iran, it is found in the Sarmatian and Mesopotamian

Faunas. One species, L. cephalus, with a number of subspecies, is one of the most widely distributed specines in the Iranian fauna. It has been divided into several species at one time or another, but there is considerable overlap between the forms, so that I have retained the divisions at the subspecific rather than specific level. The systematics of this genus has been confused because of the practice in the past of assigning many similar genera to it.

Leuciscus leuciscus (Linnaeus)

Material examined: None.

Distribution: Europe, Baltic Sea Basin, Arctic Sea Basin, Caucasus, rivers of the Black Sea Basin; upper portions of rivers of the northern and western Caspian Sea. Not confirmed from Iran.

References: Berg, 1932; Berg, 1948; Ladiges and Vogt, 1965.

Leuciscus latus (Keyserling) 1861

Material examined: None.

Distribution: Murgab and Tedzhan Rivers. This species may be present in Iran but has not been reported to date. Nikolsky (1938) considered this to be a subspecies of L. lehmanii, which is found in streams to the east; the principal differences are the deeper body, and thicker body near the caudal peduncle in latus.

References: Keyserling, 1861; Nikolsky, 1938; Berg, 1948.

Leuciscus idus (Linnaeus)

Material examined: None.

Distribution: Europe from the Rhine eastward into Siberia. In the Caspian Sea Basin it is found in streams entering from the west, north and northeast, including the upper Kura. To date, it has not been reported as far south as the Araxes River. A close subspecies, *L. idus oxianus*, is found in the Aral Sea Basin.

References: Berg, 1948; Nikolsky, 1954.

Leuciscus cephalus (Linnaeus)

Material examined: None.

Distribution: This species is found essentially south of *L. leuciscus* and *L. idus*. It has several subspecies throughout Europe, Asia Minor, the Caucasus and Transcaucasus, northern Iran and Mesopotamia. As mentioned under the genus discussion, these subspecies have, at one time or another, been treated as separate species. Examination of specimens shows considerable overlap and no sharp differences between groups, so I have retained the different groups as separate subspecies rather than species.

References: Berg, 1948; Nikolsky, 1954; Ladiges, 1960; Rostami, 1963; Ladiges and Vogt, 1965.

Leuciscus cephalus orientalis Nordmann

Material examined: Shilot, no length, Karadj Reservoir, 13-X-1971; Shilot, no length, Azerbaijan (with no more information), XII-1961; Shilot, 15.7 cm, Shahi River, XI-1970; OS 4298, (3), 15.5 to 16 cm, Karadj Reservoir, X-1971; USNM 205906, 4.23 cm, Chalus River, 8-XI-1969; USNM 205929, (3), 12 to 20.1 cm, Shur Rud, Qom Basin, 31-XII-1969; MMTT 17, 24.4 cm, Araxes Dam, XII-1971; MMTT 154, 13.97 cm, Shur Rud, Qom Basin, 31-XII-1969; MMTT 446, 10.2 cm, Chalus River, 24-IX-1970; MMTT 490, 8.07 cm, Pahlevi Mordab, 10-XII-1971; MMTT 634-638, (5), 12.2 cm, Cherra Rud, Arak, 1-V-1973; MMTT 715, 21.8 cm, Karadj River, 19-IX-1973; MMTT 755, 18.25 cm, Shahrastanah River, Karadj System, 1-X-1973; MMTT 965, (length of body) 21.8 cm, Shahpour Aval Reservoir, 2-VIII-1974; MMTT (No Number), 15.4 cm, Arnar Chay, East Azerbaijan, 2-VIII-1974; MMTT (No Number), 16.5 cm, Ghareh Su River, Azerbaijan, 26-VIII-1974; MMTT (No Number), (2), 16.5 and 18.6 cm, Luniz River, Karadj River System, 24-VIII-1974; MMTT (Trip), (2), 10.5 and 15.54 cm, Gara Chay, west of Arak, 1-XII-1974; MMTT (Trip), 21.5 cm, Qom Rud at Neizar, 2-XII-1974.

Distribution: Caspian Sea Basin streams flowing in from the west and south. Caucasus. Eastern Turkey, particularily the Araxes River System. Karadj River Basin. Qom and Arak Basins. Azerbaijan. Lake Rezaiyeh Basin. This species, because of its wide distribution into several basins in the north and west of Iran is an important indicator of past connections. It appears to be an early colonizer that was able to take advantage of past interbasin connections to become established across a wide area. It is a tolerant form, being found in conditions ranging from cool, rocky streams to those with warmer water and high salinities. The adaptability certainly was important in its ability to colonize the more arid internal basins.

References: Filippi, 1864; Filippi, 1865; Sauvage, 1881/2; Gunther, 1899; Pellegrin, 1927; Berg, 1932; Berg, 1948; Svetovidov, 1948; Berg, 1949; Vladykov, 1964; Numann, 1966; Saadati, 1977.

<u>Leuciscus cephalus lepidus</u> (Heckel)

Material examined: MMTT 25, (length of body) 17 cm, Lake Zaribar, Kurdistan, 22-I-1971; MMTT 56-57, (2), 23.3 cm, Marakeh River, Luristan, 10-XI-1971; MMTT 909, 42 cm, Lake Marivan, 9-I-1974;

MMTT 912, (length of body) 21.5 cm, Dez River below Mohammad Reza Shah Pahlevi Dam, 30-I-1974; MMTT 968-969, (2), 30 cm, Lake Marivan, 6-VIII-1974; Shilot, 22.2 cm, Lake Zaribar, XI-1973.

Distribution: Basin of the Tigris, Euphrates and Karun Systems. In Iran it is found in the lakes and rivers of the Tigris and Karun River systems. _L. lepidus_ was generally described as a separate species. It differs from _L. cephalus orientalis_ in having a somewhat longer anal fin, higher scale count, and greater height of body exceeding the length of the head. The differences are not great, and individuals showing characteristics of the other subspecies can be found. I did not feel the differences warranted retaining _L. lepidus_ as a separate species so have included it as a subspecies of _cephalus._

References: Lortet, 1883; Pellegrin, 1923; Berg, 1949; Khalaf, 1961; Numann, 1966.

Leuciscus cephalus cephalopsis (Heckel) 1846

Material examined: None.

Distribution: Various forms in Turkey, northern Iraq, Syria and Palestine have been included in this subspecies. Based on the descriptions in the literature it would appear that those in Central Turkey and Eastern Turkey would probably belong to the subspecies _orientalis_ while those in the Tigris and Euphrates would be _lepidus._ Ladiges (1960) places these forms along the eastern Mediterranean into a new species, _L. borysthenicus_ (Kessler). _L. cephalus cephalopsis_ may not be a valid subspecies, but I have not seen any material so cannot give a final opinion.

References: Heckel, 1846; Richardson, 1856; Lortet, 1883; Sauvage, 1884; Pellegrin, 1923; Hanko, 1924; Gruvel, 1931; Boulenger, 1896; Berg, 1948; Ladiges, 1960.

<u>Scardinius</u> <u>erythrophthalmus</u> (Linnaeus)

Material examined: MMTT 431, 9.54 cm, "Tehran", 10-X-1970. The location is given as Tehran but it is not clear where the fish originated. It is extremely doubtful it was collected near Tehran, but quite possibly was acquired from one of the fish markets or pet markets in the city.

Distribution: Western Europe and the basins of the Baltic, Black, Caspian and Aral Seas. In Iran it is found in the Caspian Sea and its tributaries, but has not often been collected and does not seem to be very common.

References: Kessler, 1874; Berg, 1932; Berg, 1948.

<u>Aspius</u> Agassiz

This is a predatory fish that reaches a large size. It is found in Europe, Asia Minor, Mesopotamia, and the basins of the Caspian, Black and Aral Seas.

<u>Aspius</u> <u>aspius</u> <u>taeniatus</u> (Eichwald)

Material examined: MMTT 124, 22.55 cm, Araxes Reservoir, XII-1971.

Distribution: The type species is found in Central Europe east to the Ural and Emba Rivers, Asia Minor in the Black Sea Basin, and in the upper reaches of northern western drainages of the Caspian Sea. It is replaced in the lower portions of the rivers and in the southern Caspian by <u>taeniatus</u>. In Iran, <u>taeniatus</u> is found in the

Caspian Sea and in the larger rivers entering the Caspian, including the Araxes River. A very close form, A. aspius taeniatus ibliodes Kessler, 1872, is found in the Aral Sea.

References: Berg, 1932; Berg, 1948.

Aspius vorax Heckel

Material examined: MMTT 56, 31 cm, Karkheh River, XII-1971; OS 4280, head only, Khuzistan, III-1971; Shilot, 24.5 cm, Karkheh River, XII-1971.

Distribution: Tigris, Euphrates and Karun Rivers. In the Karun system it is most common in the lower part of the river, but has been found in the Karkheh, Gharasu, Gamasiab and Seymarreh.

References: Heckel, 1846; Gunther, 1874; Gruvel, 1931; Misra, 1947; Khalaf, 1961; Numann, 1966.

Tinca tinca (Linnaeus)

Material examined: USNM 205937, (3), 25 to 27 cm, Pahlevi Mordab, 22-V-1970.

Distribution: Western Europe; all rivers of the Baltic, Caspian and Black Sea Basins; Siberia; rare in Lake Baikal. In the Caspian Sea and tributaries in Iran; both Mordabs. Occasionally sold in the fish markets, but species is not abundant in Iran. The species is at the limit of its range in southern Caspian streams.

References: Berg, 1932; Berg, 1948; Bosch, Kinunen, Bahrami and Ahdhami, 1970.

Chalcalburnus Berg

This genus is most abundant in waters of Mesopotamia and associated basins. It is quite close to Alburnus. One species has become established in the Caspian Sea, where it is anadromous; it has close subspecies in the Black and Aral Seas.

<u>Chalcalburnus</u> <u>chalcoides</u> (Guldenstadt)

Material examined: MMTT 220, 10.3 cm, Valasht Lake, 13-V-1973; MMTT 224, 7.77 cm, Valasht Lake, 13-V-1973; MMTT 382, 15 cm, Nara River, Gilan, 13-VI-1971; MMTT 935, 29.4 cm, Valasht Lake, 25-VII-1974; OS 4014, (3), 13.52 to 14.45 cm, Manjil Reservoir, IV-1971; OS 4296, (2), 7.6 and 6.72 cm, Pahlevi Mordab, V-1971; OS 4015, (3), 13.9 to 14.2 cm, Pahlevi Mordab, V-1971; USNM 205896, (2), 13.3 cm, Valasht Lake, no date; USNM 205938, (length of body) 25.4 cm, Valasht Lake, 19-II-1970.

Distribution: Caspian Sea and tributaries; commonly enters the streams along the Caspian coasts. Closely related subspecies are found in the Black Sea and Aral Sea.

References: Kessler, 1874; Berg, 1932; Svetovidov, 1945; Berg, 1948; Bullock and RaLone, 1971.

<u>Chalcalburnus</u> <u>mossulensis</u> (Heckel)

Material examined: IS 4245, (2), 16.5 and 16.55 cm, Khorramabad River, XI-1971; MMTT 303, 16.8 cm, Dez Dam, III-1972.

Distribution: Tigris, Euphrates and Karun Rivers. In Iran, it has been taken in Iranian tributaries of the Tigris River and in the lower Karun River. Two specimens in the Smithsonian collection (USNM 143852, 14 and 18.6 cm, Batman Suyu, Turkey, VII-1939) were listed as <u>C. mossulensis</u> but have a high scale count, a more elongate body and shorter head. Ladiges (1960) lists a subspecies, <u>C. mossulensis delineatus</u> (Battalgil, 1942) from Diyarbakir, which is close to the

Batman Suyu location. I do not have a description of the subspecies. Both locations are in the Tigris River drainage.

References: Heckel, 1846; Kennedy, 1920; Misra, 1947; Berg, 1949; Khalaf, 1961; Saadati, 1977.

Chalcalburnus caudimacula (Heckel) 1846

Material examined: MMTT (Trip), (3), 10.63 cm, Kara-agach River at Karadeh, Mond River System, 26-XI-1974.

Distribution: Mond River Basin. This species has not been often collected and is known primarily from Heckel's type description.

References: Heckel, 1846; Berg, 1949; Saadati, 1977.

Chalcalburnus megacephalus (Heckel) 1846

Material examined: OS 4262, (2), 11.6 and 11.85 cm, Kur River, IV-1971; OS 4260, (2), 8.5 and 9.54 cm, Kur River, IV-1971; Shilot, (2), 9.44 and 9.84 cm, Kur River, IV-1971; MMTT (Trip), 7.43 cm, Kur River by Isfahan Highway, 28-XI-1974; MMTT 474, 7.9 cm, Kur River, IV-1971; MMTT 853, 19.4 cm, Dariush Kavir Dam, Kur River, 11-XII-1973.

Distribution: Kur River, Lake Neyriz Basin.

Heckel described this and two other species under Alburnus (A. megacephalus, A. iblis and A. schejtan) from "Persepolis" which is in the Neyriz Basin. Both of the other species are similar to megacephalus but differ in having smaller heads. We did not collect any fish in the Kur Basin that matched the other two species. The Smithsonian collection contains one lot described as A. iblis (USNM 48008, length of body 18.5 cm, Pergii River, Kurdistan, n.d., obtained from the Lyon Museum; this is probably part of Lortet's collection now in the Smithsonian). This specimen does not resemble either

C. megacephalus or C. mossulensis which latter is the species found in the Tigris and Karun Rivers in Iran in Kurdistan. It has a very high gill raker count (26), and a very elongate body with a small head. The eye is quite small (17% of head length), and the scale count is high (81/82). This specimen would appear to represent a new species, but more information about its location and additional specimens would be needed for a fuller treatment. See also the discussion under Alburnus heckeli.

Some Chalcalburnus were also taken from Cheshmeh Barmeh Dalak (MMTT, (Trip), (2), 13.6 cm, Cheshmeh Barmeh Dalak, 27-XI-1974) which were intermediate between C. caudimacula and C. megacephalus, but were closer to the latter. Cheshmeh Barmeh Dalak is in the Lake Maharlu Basin, intermediate in location between the Mond and Neyriz Basins.

References: Heckel, 1846; Berg, 1949; Saadati, 1977.

Chalcalburnus sellal (Heckel)

Material examined: None.

Distribution: Aleppo; Lake Tiberias, Antioch; Oronte River; Hammak. Lortet (1883) described A. sellalfrom Lake Tiberias. In his description he gives the pharyngeal teeth as 5-5, in a single row on each arch. They are hooked and slightly serrated as in Chalcalburnus but Chalcalburnus has two, not one row of teeth. Goren (1974) includes most sellal (but not Heckel's type description) under Mirogrex, which is probably a synonym of Acanthobrama from which it differs only in the gill raker development. C. sellal is sometimes given as a subspecies of C. mossulensis.

References: Heckel, 1846; Sauvage, 1881/2; Lortet, 1883; Vinciguerra, 1926; Gruvel, 1931; Berg, 1949; Goren, 1974.

Alburnus Heckel

This genus is common in Iran in the Sarmatian and Mesopotamian faunas. Its range extends throughout Europe and western Asia. Some confusion exists on the species in the genus. Many related species now included under Chalcalburnus, Acanthalburnus, Alburnoides and others were originally described under Alburnus. Part of the problem is the development of the scaleless keel before the vent that is used as a principal characteristic. In the specimens I looked at I found this to be an unreliable character, with the scaleless keel ranging from weakly developed to strongly developed. Of more value are the easily detached scales and the hooked, serrated pharyngeal teeth. Unfortunately descriptions of many species in the literature do not mention the pharyngeal teeth or the nature of the scales. This has made it difficult to evaluate reports in the literature.

Alburnus alburnus (Linnaeus)

Material examined: None.

Distribution: Europe; basins of the Baltic, Black and Caspian Seas. In the Caspian it is found only in the Volga, Ural, Emba and Kuban Rivers.

References: Berg, 1932; Berg, 1948; Ladiges and Vogt, 1965.

Alburnus charusini Herzenstein

Material examined: None.

Distribution: Delta of the Ural, basins of the Kuma, Terek, Sulak, Rubas-Chai, Dagestan, all in the Caspian Sea Basin. It is replaced in the southern part of the Caspian by the subspecies hohenackeri.

References: Berg, 1932; Berg, 1948; Ladiges and Vogt, 1965.

Alburnus charusini hohenackeri Kessler

Material examined: MMTT 281-286 (6), 11 to 11.2 cm, Araxes Dam, XII-1971.

Distribution: Basins of the Kura and Araxes Rivers, rivers of the Lenkoran District.

References: Berg, 1948.

Alburnus charusini hohenackeri persicus Petrov

Material examined: OS 4277, (2), 11.86 and 12.5 cm, Lake Valasht, V-1971; OS 5165, (4), 6.915 to 8.745 cm, Sefid Rud, XI-1961; MMTT 537-541, (5), 6 to 7 cm, Chowbar River, 10-XII-1971.

Distribution: Sefid Rud; streams of Gilan and Mazanderan coasts of Iran. Both the subspecies hohenackeri and morpha persicus are from the southwestern corner of the Caspian Sea. In the limited material I looked at I could detect no difference between the two; the original separation was based on the lower scale count, higher gill raker count, fewer dorsal rays and fewer anal rays in hohenackeri than in persicus. While average counts were lower in hohenackeri the ranges were essentially equivalent. It is probable that, with more material, hohenackeri and hohenackeri persicus will be found to be equivalent.

References: Petrov, 1930; Berg, 1948.

Alburnus filippi Kessler

Material examined: A 15518, 10.38 cm, Araxes River at Dpeulvery, 17-X-1911, identification by L.S. Berg; MMTT (No Number), (2), 9.55 cm, Arnar Chay, East Azerbaijan, 26-VIII-1974.

Distribution: Basins of the Kura and Araxes Rivers; rivers of the Lenkoran District; Sefid Rud. Readily distinguished by the low number of dorsal rays and the wide, dark streak along the side.

References: Berg, 1948.

Alburnus gaderanus (Gunther) 1899

Material examined: USNM 205904, (2), 10.3 cm, Nazlu Chay near Rezaiyeh, 22-VII-1970; MMTT 667-681, (15), (no lengths), Shahpour Aval Reservoir, 31-V-1973; MMTT 861-869, (9), 9.65 to 10.67 cm, Soufi Chay, one kilometer north of Tazekhan, northwest of Marageh, 24-X-1973; OS (No Number), (2), 8.58 and 10.18 cm, Ozband River, VIII-1962.

Distribution: Lake Rezaiyeh Basin.

Gunther (1899) described Leuciscus gaderanus (D III 8; A III 8, 1.1. 40) from Gader Chay and Nazlu Chay. I examined specimens from Nazlu Chay (USNM 205904), one with 41/43 scales in the lateral line, the second with 51 scales, and both with ray counts of D III 8, A III 10. In other respects, they correspond to the description of L. gaderanus. Saadati (1977) reported on three specimens from the Qasemul River with D III 8, A III 8-9, 1.1. 40-43. These specimens he separated from A. atropatenae on the basis of the lateral line and anal fin ray counts, but in other respects they match the description for atropatenae; these values would fit within the general range for atropatenae that I found. Of more interest was his finding that the height of the body was greater than in atropatenae; in specimens I examined the height of the body did not exceed 25% of the body length but did exceed 25% in Saadati's specimens. It is my opinion that

Saadati's specimens, Gunther's L. gaderanusand A. atropatenae are all the same species, and the correct name is Alburnus gaderanus (Gunther 1899).

References: Gunther, 1899; Berg, 1948; Saadati, 1977.

Alburnus "maculatus" Keyserling 1861

Material examined: MMTT (Trip), (2), 12.5 cm, Qom Rud at Neizar, 2-XII-1974; MMTT (Trip), (3), 10.15 cm, Pabehrahneh Village west of the summit on the Nain to Isfahan Highway, 29-XI-1974; MMTT (Trip), 9.24 cm, Zianrud, west of Isfahan, 1-XII-1974.

Distribution: Isfahan and Qom Basins. The species was described by Keyserling as maculatus but according to Saadati (1977) the name is already occupied.

References: Keyserling, 1861; Berg, 1949; Saadati, 1977.

Alburnus #1

Material examined: Shilot, 13.3 cm, Zianrud near Isfahan, X-1970.

Distribution: Zianrud, Isfahan Basin. This form differs from other Alburnus in the number of rays in the anal fin, the number of scales in the lateral line and the lower gill raker count.

Alburnus #2

Material examined: MMTT 54, 10.23 cm, Golpaygon Reservoir, 8-X-1970.

Distribution: Golpaygon Reservoir, Qom Basin. This form had the lowest anal ray count (A III 7-8) of any Alburnus in the internal basins of Iran. Gill rakers were short, very stocky, and few in number. Based on values of my specimens and values reported by Saadati

(1977) the scale counts were 39-54 in the lateral line. The bodily proportions were somewhat unusual. This may be a hybrid, but more material is needed to make any determinations.

References: Saadati, 1977.

Alburnus doriae Filippi 1864

Material examined: None.

Distribution: This species was reported by Filippi from Shiraz in 1864 but has not been taken recently.

References: Filippi, 1864; Filippi, 1865; Tortonese, 1934; Berg, 1949.

Alburnus heckeli Battalgil

Material examined: USNM 143855, (3), 6.444 to 16.25 cm, Hazer (village Elazig), VII-1942; USNM (See under Chalcalburnus iblis).

Distribution: Tigris drainage in Turkey and Iran near Iraqi border.

A discussion was given under Chalcalburnus of the specimens in the Smithsonian (USNM 48008) identified on the label as Alburnus iblis. The uncertainty on the identity of this lot is a result of the unclear situation with the pharyngeal teeth. A hook, characteristic of Alburnus, is present but not well-developed. The second lot of fish, USNM 143855, was sent by Dr. Kosswig, who labelled them as Alburnus heckeli. I have not found a description of this species in the literature. The two lots are quite similar and I think, the same species. In one characteristic these two lots are quite notable; the large number of gill rakers (26-37), much more numerous than in any comparable species.

References: Ladiges, 1960.

<u>Alburnus</u> <u>capito</u> Heckel 1846

Material examined: MMTT 436-438, (3), 7.32 to 12.15 cm, Marakeh River, Luristan, 10-XI-1971.

Distribution: Basins of the Tigris, Euphrates and Karun Rivers; Marakeh and Gamasiab Rivers in the Karun Basin.

Heckel, 1846; Khalaf, 1961; Saadati, 1977.

<u>Alburnus</u> <u>mossulensis</u> Heckel 1846

Material examined: MMTT 547-548, (2), (length of body) 7.88 to 13.24 cm, Khezre Zende spring, Kermanshah Province, 24-IV-1972; USNM 200390, (2), (length of body) 2.619 and 4.026 cm, Ab-e-Khorram-abad, Karkheh River, Luristan, n.d.; MMTT (Trip), (2), 11 cm, Haramabad River, five kilometers from Malayer, 1-XII-1974.

Distribution: Lower basins of the Tigris and Karun Rivers.

References: Heckel, 1846; Khalaf, 1961.

<u>Alburnus</u> <u>escherichii</u> Steindachner 1897

Material examined: A 26624, (2), 14.7 and 16.2 cm, Emir Gheul, near Ankara, n.d.; A 26626, 13.5 cm, Emir Gheul, near Ankara, n.d.

Distribution: Asia Minor; Tabakane-Su and Tschibuk-Tschai; Meles River. In general, it is found in the Black Sea Basin in the area of Ankara, Turkey.

Steindachner, 1897; Pellegrin, 1927; Berg, 1932.

<u>Alburnus</u> <u>kotschyi</u> Steindachner 1863

Material examined: None.

Distribution: Syria, at Arsus.

References: Steindachner, 1863; Ladiges, 1960.

Alburnus orontis Sauvage 1881/2

Material examined: None.

Distribution: Basin of the Oronte River; Lake Homs.

The three species *A. escherichii*, *A. kotschyi* and *A. orontis* are similar in lateral line counts although the bodily proportions vary. They have been variously combined or separated as species. The three forms are in different basins. They show resemblences to some of the undescribed material from Iran.

References: Sauvage, 1881/2; Sauvage, 1884; Pellegrin, 1923; Tortonese, 1937/8; Berg, 1949; Ladiges, 1960.

Alburnus caeruleus Heckel 1846

Material examined: None.

Distribution: This species was described originally from the Aleppo area and Orontes. Misra and Khalaf report it from the drainage of the Euphrates River. Gunther (as quoted in Khalaf, 1961) placed this species in *Abramis*. Khalaf reports two rows of pharyngeal teeth; if the report is accurate, this cannot be *Abramis* since that genus has but one row of pharyngeal teeth. I have not seen any material that could be assigned to this species.

References: Heckel, 1846; Gruvel, 1931; Misra, 1947; Ladiges, 1960; Khalaf, 1961.

The genus *Alburnus* needs much additional work. Only a few specimens have been collected in most areas. The confusion with similar genera have made analysis of the fauna even more difficult. The genus has its greatest diversity in the Mesopotamian fauna and in the Azerbaijan area of northwestern Iran.

Alburnoides Jeitteles

This genus is very close to Alburnus. It is found in the waters of Europe, central and western Asia. In Iran it is found primarily in the basin of the Caspian Sea and associated internal basins, and in the upper portion of the Karun River.

Alburnoides bipunctatus (Bloch)

Material examined: None.

Distribution: Europe north of the Alps; basins of the Kuma, Terek, and Sulak. Four subspecies are found in the basins of the Black and Caspian Seas.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Alburnoides bipunctatus rossicus Berg

Material examined: None.

Distribution: Basins of the Dniester, Bug, Dnieper, Don, Volga, Kuban and Kama Rivers.

References: Berg, 1948; Ladiges and Vogt, 1965.

Alburnoides bipunctatus fasciatus (Nordmann)

Material examined: None.

Distribution: Rivers of the Crimea, Asia Minor in the Black Sea Basin, West Transcaucasus and Turkestan.

References: Pellegrin, 1927; Berg, 1932; Berg, 1948; Ladiges and Vogt, 1965.

Alburnoides bipunctatus eichwaldi (Filippi) 1863

Material examined: OS 4277, 9.78 cm, Lake Valasht, V-1971; OS 4285, (3), 11.55 to 12.635 cm, Caspian Sea, V-1971; OS 4293, 8.9 cm, Latian Reservoir, V 1970; USNM 205895, (2), 4.13 and 4.34 cm, Chalus

River, four miles above mouth, 8-XI-1969; USNM 205899, 8.617 cm, Bandar Pahlevi, 10-I-1970; USNM 205930, (9), 8.7 to 10.8 cm, Karganrud, Gilan, 18-XII-1969; USNM 205909, (2), 6.854 and 8.726 cm, stream, 40 kilometers south of Tehran, 31-XII-1969; MMTT 198-209, (12), 5.72 to 11.75 cm, Lake Valasht, 13-V-1973; MMTT 447, 7.61 cm, Saveh, 31-XII-1969; MMTT 459, 8.75 cm, Chalus River, 23-IX-1970; MMTT 483, 7.97 cm, Cheshmeh Gilas, Khorasan, VI-1971; MMTT 516, 9.4 cm, Namrud, Semnan, 24-VII-1970; MMTT 559, 6.11 cm, Ghasemabad River, n.d.; USNM 564, 7.04 cm, Nessarud, Mazanderan, V-1972; MMTT 592, 6.95 cm, Lesar River, six kilometers above the mouth, 18-XII-1970; MMTT 598-607, (10), 10 cm, Mashalak River, Mazanderan, 22-XII-1970; MMTT 639, 10.3 cm, Namrud, Semnan, 24-VII-1970; MMTT 639, 10.3 cm, Cherra Rud, Arak, 1-V-1973; MMTT 692, 8.55 cm, Shafarud, Gilan, 16-V-1973; MMTT (No Number), (3), 8.5 cm, Arnar Chay, East Azerbaijan, 26-VIII-1974; MMTT (No Number), Gharah Su, Araxes River System, 26-VII-1974.

Distribution: Caspian Sea including rivers flowing into the Sea; Azerbaijan, in the basin of the Araxes River; Tehran, Semnan, Qom, Arak, Lake Rezaiyeh Basins; Aral Sea Basin in the Tedzhan and Murgab Rivers. A highly adaptable species, found in habitats ranging from open sea to rivers to springs.

Saadati (1977) reported on a specimen from the Lake Rezaiyeh Basin. I have not seen any specimens from that basin, but would expect it to be present in that basin. Saadati suggests the Rezaiyeh form may be a separate species but the measurements he gives fall within the normal range for eichwaldi.

References: Filippi, 1863; Filippi, 1865; Kessler, 1874; Steindachner, 1897; Hanko, 1924; Hora, 1934/5; Berg, 1948; Vladykov, 1964; Numann, 1966; Kinunen, 1970; Bullock and RaLonde, 1971.

Alburnoides bipunctatus armeniacus

Material examined: A 37504, 11.2 cm, Erar River, tributary of the Ardy, Araxes River system, U.S.S.R., 3-VI-1962.

Distribution: Erar River, Araxes River System.

References: I have not been able to locate the paper in which this subspecies was described; the only information I have was obtained from the specimen and its label.

Alburnoides taeniatus (Kessler) 1874

Material examined: None.

Distribution: Amu-Darya, Zeravshan, Syr-Darya, Kara-Darya, and Chu River, all in the Aral Sea Basin.

References: Kessler, 1874; Berg, 1948; Nikolsky, 1954.

Alburnoides #1

Material examined: OS 4261, (3), 6.4 to 7.38 cm, Selakhor Borujerd, Karun River Basin, V-1971.

Distribution: Karun River Basin. This is the first collection I know of from the Karun River Basin, which represents a major extension of its range. The genus has not been previously known from the Mesopotamian fauna, being restricted previously to the Sarmatian Fauna. Saadati (1977) described two other forms from the same area that he places in *Alburnoides*. The three forms are so similar that is probable that they represent a single species.

References: Saadati, 1977.

<u>Acanthalburnus</u> Berg

This genus is very similar to <u>Alburnoides</u>, the principal difference being the development of the last unbranched dorsal ray into a heavy spine. The genus probably developed in northwestern Iran; its range is restricted to Azerbaijan and the Lake Rezaiyeh Basin and adjoining portions of the Caspian Sea Basin.

<u>Acanthalburnus</u> <u>microlepis</u> (Filippi) 1863

Material examinedq MMTT 228-230, (3), 15.6 cm, Araxes Dam, XII-1971; MMTT 239, 13.9 cm, Menjil Reservoir, 2-IV-1971.

Distribution: Kura and Araxes River Systems, in rivers and lakes; in the Sefid Rud River, Caspian Sea Basin.

References: Filippi, 1863; Filippi, 1965; Berg, 1948; Karaman, 1972.

<u>Acanthalburnus</u> <u>urmianus</u> (Gunther) 1899

Material examined: MMTT 952-957, (6), 21 cm, Shahpour Aval Reservoir, 2-VIII-1974; MMTT 985-986, (2), (length of body) 18.25 cm, Shahpour Aval Reservoir, 2-VIII-1974; USNM 205904, 10.32 cm, Nazlu Chay near Rezaiyeh, 22-VIII-1970; USNM 205934, (2), (length of body) 9.32 and 14 cm, Lake Kopee, south of Lake Rezaiyeh, 24-VIII-1970; MMTT 333-336 is probably this species.

Distribution: Lake Rezaiyeh Basin.

References: Gunther, 1899; Saadati, 1977.

<u>Blicca</u> Heckel

This genus is very close to <u>Abramis</u> and <u>Alburnoides</u>. It is found in the rivers, lakes and seas of Europe and Asia; it is found in the basins of the Black, Caspian and Aral Seas. In Iran, it is found in the Caspian Sea, Araxes River and rivers of Gilan and Mazanderan.

Blicca bjoerkna (Linnaeus)

Material examined: OS 4285, (3), 7 to 9.94 cm, Caspian Sea, V-1971; USNM 248692, (2), 3.7 cm, Babolsar Beach, 24-VI-1963; MMTT 380, 381, (2), 17.7 cm, Araxes Dam, XII-1971.

Distribution: Europe; basins of the Caspian, Black and Aral Seas; Araxes River, Caspian Sea and Gilan and Mazanderan coastal rivers of Iran. Berg (1948) separated the subspecies transcaucasica for the southern Caspian but the specimens I looked at fit the type species description; it is my opinion only one form is present throughout the Caspian Sea Basin.

References: Berg, 1932; Berg, 1948; Nikolsky, 1954; Shutov, 1969.

Abramis Cuvier

This genus is found in Europe, Central Asia and the basins of the Black, Caspian and Aral Seas. In Iran, it is restricted to the Caspian Sea Basin. Three species are found in the Caspian Basin; all three are shared with the Black Sea, two are shared also with the Aral Sea. The genus is very close to the North American genus Notemigonous.

Abramis brama (Linnaeus)

Material examined: None.

Distribution: Europe, basins of the North, Baltic, White and Barents Seas; Black Sea. Replaced by the subspecies orientalis in the Caspian and Aral Seas.

References: Kessler, 1874; Berg, 1932; Berg, 1948; Ladiges, 1960; Shikhshabekov, 1969.

Abramis brama orientalis Berg 1948

Material examined: OS 4291, (3), 13.7 to 15.6 cm, Bandar Pahlevi area, Caspian Sea, III-1971.

Distribution: Basins of the Aral and Caspian Seas. In Iran, it is found in all the Caspian streams and Mordabs and in the Caspian Sea.

References: Berg, 1948; Kozhin, 1957; Vladykov, 1964.

Abramis sapa (Pallas)

Material examined: None.

Distribution: Danube, Dniester, Bug, Dnieper, Don, Kuban, Volga, Kuma, Vyatka, Ural and Terek, in the basins of the Black and Caspian Seas. In the southern Caspian Sea, it is replaced by the subspecies *bergi*.

References: Berg, 1932; Berg, 1948; Ladiges and Vogt, 1965.

Abramis sapa bergi Belyaeff

Material examined: None.

Distribution: South and central Caspian Sea, entering all the rivers. A very closely related form, *A. sapa bergi aralensis*, is described from the Aral Sea.

References: Kessler, 1874; Berg, 1948; Nikolsky, 1954.

Abramis ballerus (Linnaeus)

Material examined: None.

Distribution: Europe; Basins of the North, Baltic, Black, Azov and Caspian Seas. It has not been reported from the southern Caspian.

References: Filippi, 1865; Berg, 1948; Ladiges and Vogt, 1965.

Vimba vimba (Linnaeus)

The genus _Vimba_, which has only one species, is very close to _Abramis_. Like _Abramis_, it is anadromous in the Caspian Sea. It is found in Europe, and in the basins of the Baltic, Black, North and Caspian Seas. Several subspecies have been described.

Vimba vimba carinata (Pallas)

Material examined: None.

Distribution: Basins of the Black Sea, Sea of Azov; anadromous, entering rivers to spawn.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Vimba vimba tenella (Nordmann)

Material examined: None.

Distribution: Basin of the Black Sea, but living only in freshwater; smaller than the anadromous subspecies.

References: Steindachner, 1897; Berg, 1948; Nikolsky, 1954; Ladiges, 1960; Ladiges and Vogt, 1965.

Vimba vimba persa (Pallas)

Material examined: USNM 205903, 6.924 cm, Bandar Pahlevi, 1-IV-1970; USNM (No Number), 19.6 cm, Bandar Pahlevi, 25-V-1970.

Distribution: Basin of the Caspian Sea, entering rivers to spawn. In Iran, it is found in all rivers along the Caspian Sea; it has become established in the Sefid-Rud and Menjil Reservoir.

References: Berg, 1932; Berg, 1948; Kozhin, 1957; Anon. (Mahi Sara), 1964; Numann, 1966.

Pelecus cultratus (Linnaeus)

Material examined: None.

Distribution: This genus has one species distributed in Europe and the basins of the Baltic, Black, Aral and Caspian Seas. In Iran, it is rare, found in the Caspian Sea and tributaries.

References: Kessler, 1874; Berg, 1932; Hora, 1933; Berg, 1948; Ladiges and Vogt, 1965.

Acanthobrama Heckel

This genus is very close to Capoetobrama of the Aral Sea. Seven species have been described from North Africa, Palestine, Anatolia and Mesopotamia. Based on its association with other genera, it would be expected in Iran, but has not been reported to date. This may be because of its similarity to Alburnus-like fishes; fishes which would belong to Acanthobrama have been assigned to other genera.

Acanthobrama marmid Heckel

Material examined: None.

Distribution: Tigris at Mosul; Kuvank River at Aleppo; Karasu River in the upper Euphrates River, Erzerum District.

References: Heckel, 1846; Berg, 1948; Karaman, 1972.

Acanthobrama marmid orontis Berg 1949

Material examined: None.

Distribution: Basin of Lake Antioch and Orontes River; Turkey.

References: Berg, 1949; Karaman, 1972.

Acanthobrama mirabilis Ladiges 1960

Material examined: None.

Distribution: Western Anatolia. This species, as described by Ladiges (1960) is very close to A. marmid orontis from the same general area. The dorsal spine, as described, is closer to Acanthalburnus than to Acanthobrama.

References: Ladiges, 1960; Karaman, 1972.

Acanthobrama centisquama Heckel

Material examined: None.

Distribution: Syria; Damascus.

References: Heckel, 1846; Gruvel, 1931; Ladiges, 1960; Karaman, 1972.

Acanthobrama terrae-sanctae Steinitz 1952

Material examined: None.

Distribution: Lake Tiberius.

References: Steinitz, 1952; Karaman, 1972; Goren, 1974.

Acanthobrama terrae-sanctae oligolepis Karaman 1972

Material examined: None.

Distribution: Jordan River; Lake Huleh. Goren (1974) separated terrae-sanctae into a new genus, Mirogrex, on the basis of the more numerous gill rakers, a reflection of their planktonic diet. I have followed Karaman (1972) and left them in Acanthobrama which they resemble in all other characters.

Acanthobrama lissneri Tortonese 1952

Material examined: None.

Distribution: Lake Tiberias; near bottom of lakes, slow moving waters.

References: Tortonese, 1952; Karaman, 1972; Goren, 1974.

Acanthobrama telavivensis Goren, Fishelson and Trewavas, 1973

Material examined: None.

Distribution: Palestine; Rosh Haayin, and N. Tut.

References: Karaman, 1972; Goren, 1974.

Acanthobrama callensis (Guichenot)

Material examined: None.

Distribution: North Africa; Algeria, Tunisia. This represents a disjointed distribution for Acanthobrama. It is possible this species is Phoxinellus punicus Pellegrin, 1920, which description it matches.

References: Karaman, 1972

Capoetobrama kuschakewitschi (Kessler)

Material examined: None.

Distribution: This genus, with a single species, is found in the basin of the Aral Sea, from the lower to the upper portion of rivers.

References: Kessler, 1874; Berg, 1948.

Three genera in the region, Acanthalburnus, Acanthobrama, and Capoetobrama are distinguished by the development of the last unbranched dorsal ray into a heavy spine. In Acanthalburnus the tip of the ray is flexible, and there are two rows of pharyngeal teeth. In Acanthobrama and Capoetobrama the tip of the ray is not flexible and there is a single row of pharyngeal teeth. In the Acanthalburnus I examined the strength of the dorsal spine was variable. The distribution of the three genera is interesting; Capoetobrama is found in the Aral Sea Basin, Acanthalburnus in the southwestern Caspian and Azerbaijan, and Acanthobrama in Palestine, Turkey and the Tigris-Euphrates Basin, forming an arc of adjoining basins.

Aspidoparia Heckel

This genus is widespread in Pakistan, Indian and Southeast Asia. The species found in Mekran of Iran represents its most westward extension. Its actual affinities in Cyprinidae are unclear. It is quite similar to Barbinae, but lacks barbels; it also has two instead of three rows of pharyngeal teeth.

Aspidoparia morar (Ham. Buch.)

Material examined: USNM 205891, (2), 5.8 and 6.475 cm, Ziarat, Baluchistan, 19-IV-1970.

Distribution: India, Pakistan, Assam, Burma, Thailand, Iran. In Iran, this species is limited to the Mekran Coasts, where it has been collected from the Sarbaz River Basin.

References: Heckel, 1846; Day, 1871; Day, 1878; Vinciguerra, 1890; Zugmayer, 1913; Berg, 1949; Mirza, 1972.

Leucalburnus Berg

This genus has a disjunct distribution in Asia Minor and the Caspian Sea Basin. Its head and mouth resemble Leuciscus. It has two rows of pharyngeal teeth. It is very close to Chalcalburnus but lacks a scaleless ventral keel; the keel is like that found in Acanthobrama. It is possible this genus is more widespread. Because of its close similarities to other genera it may have been misidentified. As was discussed earlier, the development of the ventral keel I found to be an unreliable character for use in describing species and genera.

Leucalburnus satunini (Berg)

Material examined: None.

Distribution: Kura River system; Azerbaijan.

References: Ladiges, 1960; Karaman, 1972.

Leucalburnus kosswigi Karaman 1972

Material examined: None.

Distribution: Turkey; Gumuldur, 42 km south of Izmir.

References: Karaman, 1972.

Barilius Hamilton-Buchanan

This genus is found in the fresh waters of India, Ceylon, Burma, Malay Archipelago, Pakistan, Mesopotamia, the Nile and East Africa, and probably also Iran, although it has not been collected there. Barilius presents some problems on relationships. It is sometimes combined with Danio, which it closely resembles, into a separate subfamily. It is sometimes considered to be the most primitive of the living Cyprinidae, since it shows primitive characteristics and is intermediate between several groups. It has variable pharyngeal teeth, gill rakers, barbel development and lateral line development.

Barilius vagra (Ham. Buch.)

Material examined: USNM (No Number, Acct. No. 248196), 6.875 cm, Soan, below Leh, Pawalpindi, 7-V-1964.

Distribution: Pakistan, where it is found in the streams of Sind, Baluchistan; Himalayan and Sub-Himalayan Range, India; Burma. Also reported from Ceylon (Sri Lanka), but it has not been confirmed from there. It may be found in Southeast Iran; it is found in adjoining portions of Pakistan.

References: Day, 1878; Mirza, 1972.

<u>Barilius</u> <u>mesopotamicus</u> Berg 1932

Material examined: A 23955, 4.3 cm, Said-Khasan River, Gavi, tributary Kundjian, Mesopotamia, 3-IV-1914; A 23955, 4.2 cm, Mendeli, basin Tigris River, 10-IV-1914.

Distribution: Basin of the Tigris River; found in tributaries of the Tigris originating in Iran, but has not been reported from Iran to date. This species is closer to the Indian than the African forms.

References: Berg, 1932; Berg, 1949; Ladiges, 1960.

<u>Pimephales</u> <u>promelas</u> Rafinesque

This North American species was originally identified as <u>Xenocypris</u> by Numann (1966). It was identified by Dr. Robert Behnke (Personal Communication). Found in the Golpaygon Reservoir, Namak Basin, it was probably introduced with game species.

References: Numann, 1966.

<u>SUBFAMILY II. CHONDROSTOMINAE</u>

<u>Chondrostoma</u> Agassiz

This genus is found in Europe, the Middle East, Asia Minor, Iran, and Mesopotamia. A single genus is represented in the Iranian fauna, and is found in both the Caspian and Mesopotamian faunas.

<u>Chondrostoma</u> <u>nasus</u> (Linnaeus)

Material examined: None.

Distribution: Europe; rivers of the North and Baltic Sea, basin of the Danube River. Berg (1948) listed several subspecies from the basins of the Black and Aegean Seas, but Ladiges (1966), in his review of the species, combined all of the subspecies under the type species description.

References: Steindachner, 1897; Berg, 1932; Berg, 1948; Ladiges, 1960; Ladiges, 1966.

Chondrostoma nasus variabile Jakowlew

Material examined: None.

Distribution: Basins of the Don, Volga, Ural and Kama, basins of the Black and Caspian Seas.

References: Berg, 1932; Berg, 1948.

Chondrostoma colchicum (Kessler)

Material examined: None.

Distribution: Western Transcaucasia.

References: Berg, 1948; Ladiges, 1966.

Chondrostoma oxyrhynchum Kessler

Material Examined: None.

Distribution: Kuma, Terek, Sunzha, Sulak, Rubas-Chai, Samur, all on the western side of the Caspian Sea Basin.

References: Berg, 1948; Ladiges and Vogt, 1965.

Chondrostoma cyri Kessler

Material examined: MMTT 313-327, (15), 13 cm, Araxes Dam, XII-1971.

Distribution: Kura and Araxes River Basins.

References: Berg, 1948; Nikolsky, 1954.

Chondrostoma schmidti Berg

Material examined: I have not seen this species.

Distribution: Alazan', a tributary of the Kura River.

References: Berg, 1948.

Chondrostoma regium (Heckel)

Material examined: MMTT (No Number), 22.75 cm, Regab River, Kermanshah, 11-IX-1974; Shilot, 27.2 cm, Khorramabad, n.d.; USNM 200312, (4), 13.8 to 16.5 cm, Khorramabad, n.d.; OS 4301, (2), 21 adn 26.2 cm, Khorramabad, XI-1971.

Distribution: This species has been reported from throughout Palestine and Mesopotamia, including the Orontes River, Antioch, Lake Homs, Asia Minor, and the basins of the Tigris, Euphrates and Karun Rivers.

References: Heckel, 1846; Filippi, 1865; Sauvage, 188o/2; Hanko, 1924; Berg, 1949; Khalaf, 1961; Numann, 1966; Saadati, 1977.

Chondrostoma #1

Material examined: USNM 143865, (3), 13.57 to 21 cm, Diyaibekir, Beysehir, Salu, Turkey, VIII-1941.

Distribution: Beysehir Salu, Turkey. This form differs in the greater number of gill rakers (32-38, vs 27-34), length of head equal to height of body (vs height body exceeding head length), slightly lower caudal peduncle (9-10% vs 10-11% of body length), narrower mouth, less steep angle at occiput, and seven vs six pharyngeal teeth from C. regium, the only previouslv described species from the area.

Chondrostoma #2

Material examined: Shilot, (2), 14.2 cm, Gamasiab, Karun River system, n.d.; Shilot, 23 cm, Khorramabad. n.d.

Distribution: Basin of the Karun River, Gamasiab River. Differs from other Chondrostoma in the basin in quite elongate caudal peduncle, 25% of body length; gill rakers short, close together. Body shape rather elongate.

References: Saadati, 1977.

Chondrostoma #3

Material examined: MMTT 614, 12.88 cm, Taghe Bustan, a spring in Karun Basin near Kermanshah, 24-VIII-1972.

Distribution: Karun Basin, spring near Kermanshah. Differs in the small number of scales in the lateral line (51/53), small number of gill rakers (19) and low anal ray count (8 branched rays).

References: Saadati, 1977.

Chondrostoma #4

Material examined: MMTT 995, 996, (2), 24.83 and 26.7 cm, Dez River, Andimeshk to Dezful Road, 5-XI-1974.

Distribution: Lower Dez River. Close to C. regium but differs in a more elongate body (height 23-24% vs 24-26%), shorter head (18-19% vs 19-22%), smaller number of gill rakers (22-24 vs 27-34) and fewer branched rays in the dorsal fin (8 vs 9-10).

Chondrostoma #5

Material examined; MMTT 307, (length of body) 15.68 cm, Dopolan River, Karun System, Isfahan Province, 26-VII-1971; MMTT 360, 20 cm, Borujerd, Selakhor, Luristan, Karun Basin, X-1970.

Distribution: Tigris and Karun Basins. It differs from C. regium in fewer gill rakers (22 vs 27-34), shorter gill rakers, fewer rays in the dorsal fin (8 branched rays vs 9-10), larger head (21-23% vs 19-22%) and higher body (24-29 vs 24-26% of body length.

SUBFAMILY III. BARBINAE

Nearly one-third of the primary freshwater fish in Iran belong to this subfamily, the bulk of them in two genera, Barbus and Varicorhinus. The subfamily is characterized by the presence of barbels, a dorsal spine, and three rows of pharyngeal teeth. The individual genera show considerable variability. This has prompted several authors to subdivide various genera into a series of new genera. These revisions are usually based on one or several characters and not on probable phylogenetic relationships, so I have elected to retain the more traditional generic divisions. The subfamily is widespread throughout southern Asia and Africa, reaching into Europe and Central Asia. It has its greatest diversity in India and Southeast Asia, with secondary centers of diversity in Mesopotamia and Africa.

Discognathus Heckel

This genus is one of several, including Garra, Crossocheilus, and Hemigrammocapoeta which show development behind the lower lip. This development ranges from a series of ridges or papillae to a full mental sucker. Throughout their range, as a whole, they are primarily montane fishes. Within Iran, Discognathus are found in all areas south of the Sarmatian fauna. The genus is found from India through Pakistan, Afghanistan, Iran, Mesopotamia and Palestine. Discognathus and Garra are often combined into a single genus. The two differ in Discognathus having one pair of barbels and an adherent anterior mental disc margin, while in Garra there are two pairs of barbels and the anterior margin of the disc is free. Berg (1949) revised the Discognathus-Garra fishes, instituting the name Discognathichthys.The type of the genus is

Discognathus variabilis so I have retained the name Discognathus as the genus name.

Discognathus variabilis Heckel

Material examined: None.

Distribution: Hammah, Oronte, Lake Antioch, Mosul, Upper Tigris and Euphrates Rivers.

References: Keyserling, 1861; Sauvage, 1881/2; Sauvage, 1884; Pellegrin, 1923; Gruvel, 1931; Tortonese, 1937/8; Trewavas, 1941; Berg, 1949; Khalaf, 1961; Karaman, 1971.

Discognathus rossicus Nikolsky

Material examined: MMTT (Trip), (3), 7.7 cm, Salabad, 130 km south of Birjand, from a qanat, 14-XI-1974; MMTT (Trip), (2), 9.55 cm, Shusef qanat, Birjand to Zahedan Highway, 14-XI-1974; MMTT (Trip), (2), 7.5 cm, Khaneh Sharaf, qanat, Birjand to Zahedan, 14-XI-1974; MMTT (Trip), (2), 5.5 cm, Khunik Pa'in, qanat, Birjand to Zahedan, 14-XI-1974; MMTT (Trip), (3), 6.14 cm, Hormak, just south of Zabol Road, 14-XI-1974; USNM 179074, (2), 5.571 and 5.658 cm, Majan, Dashte-Lut, southwest of Birjand and west of Seistan, 20-XI-1962.

Distribution: While a very wide distribution has been given in the past for this species, stretching from Syria to Assam, this is probably the result of many forms being placed into one species. The distribution, from the specimens of this genus I have seen and an examination of the descriptions of others, is probably limited to the northwestern part of Pakistani Baluchistan, Seistan and the Helmand River, the isolated basins in eastern Iran to the north and west of Seistan, the Dashte-Lut and possibly the Bampur River Basin. In the specimens I examined from eastern Iran there is some variability in the specimens from the Seistan Basin and those collected in the isolated basins just to the north and west. At Salabad and Shusef, in the isolated basins, the head length and greatest height of the body were equal, while in those from Seistan the head was longer and its length always exceeded the height of the body.

Berg (1949) separated a subspecies nudiventris on the basis of a naked abdomen and the presence of a scaleless striae in front of the dorsal fin. These characters are quite variable, and a gradation can be found even within a population. The distribution of the two forms essentially coincides. It is my opinion that there is a single form and nudiventris does not represent a valid subspecies.

Discognathus #1

Material examined: MMTT (Trip), 6.58 cm, Iranshahr to Zaboli Road, 16-XI-1974.

Distribution: Pools in a stream channel along the Iranshahr to Zaboli Road, Bampur Basin. It differs from D. rossicus in a deeper body (31 vs 22-24%) which exceeds the length of the head; more numerous gill rakers (13-14 vs 10-12); more scales above the lateral line (8 vs 5-6 rows); and a shallower caudal peduncle (78 vs 91.5% of caudal length).

Discognathus #2

Material examined: USNM 205905, (6), 3.7 to 4.717 cm, small spring in upper Sarbaz River, 13-XI-1970.

Distribution: Upper Sarbaz River. Differs from D. rossicus in the shallower body (18-20% vs 22-24%); the range and variability of the gill rakers (8-14 vs 10-12), most with three instead of two unbranched dorsal fin rays, and the development of a crest on the caudal peduncle.

Discognathus #3

Material examined: MMTT 167, 5.7 cm, Tangeh Sarreh, Dashte River System, Baluchistan, 2-X-1971.

Distribution: Dashte River Basin, Iranian Baluchistan. Differs from D. rossicus in the lower height of the body (20 vs 22-24%), the larger number of scales in the lateral line (43 vs 30-41), and three instead of two unbranched dorsal rays. Differs from Discognathus #2, which is in an adjoining basin, by the lower head length (23 vs 25-26%), and lower number of scales in the lateral line. It differs from both Discognathus #1 and Discognathus #2 in having scales on the thorax and abdomen, and in the number of lateral line scales.

Garra Hamilton-Buchanan

Garra is a common genus, found from India and the Tibetan Plateau through southern Iran, the Arabian Peninsula, Mesopotamia and into Africa. The genus shows a high degree of variability which has made it difficult to delineate the species. This is quite evident in the case of Garra lamta, which was originally described from the Ganges River, but which has been reported for waters from the Ganges through India and the whole Middle East. Because of the variability, particularily in the scale and fin ray counts, it is usually necessary to have a series of specimens to adequately define species. The genus shows some ability to live in waters with high salinity.

Garra lamta Ham. Buch.

Material examined: None.

Distribution: Restricted to the eastern part of the Vindhya Range and the Nepal Terai. (See the discussion in Hora, 1921). Many forms have been incorrectly placed into G. lamta, as was discussed above.

References: Playfair, 1870; Gunther, 1889; Vinciguerra, 1890; Day, 1878; Jenkins, 1909; Annandale, 1913; Annandale, 1919; Hora, 1921.

Garra rufa (Heckel)

Material examined: MMTT (Trip), (3), no lengths taken, qanat at Sa'adi's Tomb near Shiraz, 27-XI-1974; Shilot, no length taken, (1), Khorramabad, X-1970; MMTT 190, 12 cm, Dez Dam, III-1972; MMTT 451, 11.76 cm, Khorramabad River, X-1970; MMTT 457, 11.58 cm, Karun River, III-1971; MMTT 466-468, (3), 6.84 cm, Gamasiab River, near Bisutun, 24-VIII-1971; MMTT 891, 12.3 cm, Qasr-Shirin River, 6-I-1974.

Distribution: Palestine, Syria, basins of the Tigris, Euphrates, Karun Rivers; Maharlu, Neyriz Basins. The species is widespread in the fauna of Mesopotamia and Palestine.

References: Heckel, 1846; Hora, 1921; Vinciguerra, 1926; Tortonese, 1937/8; Berg, 1949; Fowler and Steinitz, 1956; Khalaf, 1961; Karaman, 1971; Goren, 1974; Saadati, 1977.

Garra persica Berg

Material examined: USNM 11706, 5.3 cm, Khiabad in Zirkuh, (East Khorasan), 3-V-1898, TYPE SPECIMEN, obtained from the Soviet Academy of Sciences; USNM 11707, (2), 5.32 and 5.5 cm, Bampur River, 15-VII-1898, obtained from the Soviet Academy of Sciences; MMTT 452, 8.6 cm, Helmand River, Zahak, Seistan, 27-IV-1970; OS 4295, (length of body) 4.862 cm, Karvandar, Baluchistan, XI 1971; MMTT (Trip), (2), Karavand, upper Bampur River, 15-XI-1974.

Distribution: Eastern Persia; Seistan Basin; Bampur River Basin.

References: Annandale, 1919; Hora, 1921; Berg, 1949; Saadati, 1977.

Garra barreimiae Fowler and Steinitz 1956

Material examined: None.

Distribution: Oman, United Arab Emirates, in drainages of the Persian Gulf and Gulf of Oman. Banister and Clarke (1975) recognized two subspecies on the basis of the pelvic fin location.

References: Fowler and Steinitz, 1956; Karaman, 1971; Banister and Clarke, 1975.

Garra tibanica Trewavas

Material examined: None.

Distribution: Widespread along the coastal plain of the west and southwest Arabia; in the wadis of the Asir and Yemen Highlands; Somalia in Africa.

References: Fowler and Steinitz, 1956; Karaman, 1971; Banister and Clarke, 1975.

Garra longipinnis Banister and Clarke 1975

Material examined: None.

Distribution: Known only from the type locality, village of Saiq in Oman.

References: Banister and Clarke, 1975.

Garra arabica Hora 1921

Material examined: USNM 166888, 8.2 cm, King's garden, Yemen, southwest Arabia, 1951.

Distribution: Aden, Yemen, Southwest Arabia.

References: Hora, 1921; Fowler and Steinitz, 1956.

Garra sp. Hora 1921

Material examined:None.

Distribution: Persian Baluchistan. Hora (1921) described this species from Persian Baluchistan without naming it nor giving any more exact location. It is similar to some of the specimens I examined.

References: Hora, 1921.

Garra #1

Material examined: MMTT (Trip), (2), 8.7 cm, Fasa River, Mond Basin, along Jahrom Road, 26-XI-1974; Shilot, 7.85 cm, Well near Lar, n.d.

Distribution: Lar Basin; Mond River Basin.

Heckel (1846) described Discognathus crenulatus from the Mond Basin, but it is a synonym for G. rufa and differs in the greater number of scales, gill rakers, and in bodily proportions. The closest species is G. barreimiae, found on the opposite shore of the Persian Gulf in Arabia, which has similar gill raker counts, scale counts and fin ray counts. In bodily proportions, however, the two forms differ, with the head in barreimiae, in particular, being much larger.

References: Heckel, 1846; Fowler and Steinitz, 1956; Saadati, 1977.

Garra #2

Material examined: MMTT (Trip), (2), 6.46 cm, Gudar River, three kilometers east of Anveh, Bastak Road, 25-XI-1974.

Distribution: Gudar River, a tributary of the Persian Gulf near the Straits of Hormuz, but with headwaters near the Mond River Basin. This form is notable for the lower number of rays in the dorsal fin, III 6-7; most other Garra from Persia have 8, less often 7, branched rays. The head is quite long, 24.5 to 27% of the body length, with a steep angle at the orbit.

References: Saadati, 1977.

Garra #3

Material examined: MMTT (Trip), (2), 5.62 cm, Hajiabad, Kol River, Bandar Abbas Road, 20-XI-1974; Shilot, (2), 6.16 and 7.97 cm, Hadjiabad, Kol River, VI-1969.

Distribution: Upper Kol River, Persian Gulf Basin. Differs in having a low scale count (32-34 along the lateral line, 4-5 rows above the lateral line), low gill raker count (13-14), a long head (23-26% of body length), and a scaled abdomen and thorax.

References: Saadati, 1977.

Garra #4

Material examined: MMTT (Trip), (3), 5.5 cm, Dahaneh Nuiz, Rudan Rud, 21-XI-1974; MMTT (Trip), 6.6 cm, Galash Kard, Minab Rud, Mekran, 22-XI-1974.

Distribution: Mekran Coasts of Iran. My specimens differed quite a bit from the description given by Saadati (1977) for specimens from the same location. My dorsal fin ray counts were II 7, his III 7; my anal fin ray count was III 6, his II 5; my lateral line counts were 31-33, his 36-38.

References: Saadati, 1977.

Garra #5

Material examined: USNM 182278, (2), 12.4 cm, Arghandab River, Helmand Basin, Afghanistan, VI-1955.

Distribution: Arghandab River, Afghanistan. It is quite close to G. persica, differing only in the larger number of gill rakers (18-23 vs 18-19) and better developed upper lip with more fimbriation and a slightly shorter head.

Iranocypris typhlops Bruun and Kaiser 1949

Material examined: None.

Distribution: Kaaj-e-Ru, a spring flowing into the Ab-e-Serum, a tributary of the Karun River in Khuzistan. This is a true blind cave fish, restricted to this one location.

References: Bruun and Kaiser, 1949; Saadati, 1977.

Typhlogarra widdowsoni Trewavas 1955

Material examined: None.

Distribution: Caves north of Haditha, Iraq, near the Euphrates River. A blind cave fish, very close to Garra rufa, endemic to the region, from which it probably developed.

References: Trewavas, 1955; Khalaf, 1961; Niazi, 1965; Karaman, 1971.

Typhlogarra and Iranocypris are very close geographically, but quite different in form. Bruun and Kaiser (1949) suggest that Iranocypris, which has two pair of barbels, probably developed from Barbus but it has only two rows of pharyngeal teeth, not three as in *Barbus*. It is closer to *Garra* in its characters than to *Barbus*.

Crossocheilus Hasselt

This is a common genus in India and Pakistan, with southeastern Iran being its most westerly extension. It is close to *Discognathus* and *Varicorhinus*. It has a muscular cushion behind the chin with a free edge that resembles a mental disc.

Crossocheilus adiscus (Annandale) 1919

Material examined: MMTT 452, 8.6 cm, Helmand River, Zahak, Seistan, 27-IV-1970; USNM 205892, (4), 7.842 to 10.238 cm, Helmand River, Zahak, Seistan.

Distribution: Seistan; Hamun-i-Helmand and channels of the Helmand River.

References: Annandale, 1919; Annandale and Hora, 1920; Annandale, 1921; Berg, 1949; Karaman, 1971.

Karaman (1971) combined *C. adiscus* and *Tylognathus elegans* under a new genus, *Hemigarra*, with *adiscus* as a subspecies of *elegans*. The two are quite distant geographically - *elegans* being native to the Tigris River- and dissimilar morphologically. I consider the pairing to be artificial, based on the supposed similarity of the mental disc development, so have retained the original systematic arrangement.

Crossocheilus latius diplochilus (Heckel)

Material examined: USNM, (No Number, Acct. No. 248196), 11 cm, Soan drainage, Korang River, five miles west of Rawalpindi, Lathiar Road, 11-XI-1964.

Distribution: The type species is from northeastern India. Various subspecies have been described from Burma and into Persia. The subspecies _diplochilus_ is found in Pakistan in Baluchistan, Sind, Punjab, and Northwestern Frontier Province; from Iran, it is known for the Sarbaz River and Mekran Coastal Rivers. Reported but not confirmed from southern Afghanistan.

References: Day, 1878; Day, 1880; Vinciguerra, 1890; Zugmayer, 1913; Hora, 1923; Berg, 1949; Mirza, 1972; Mukerji, 1936.

Tylognathus _elegans_ Gunther

Material examined: None.

Distribution: Tigris River.

References: Khalaf, 1961; Karaman, 1971.

Labeo Cuvier

This genus is common in India, Burma and Pakistan. It is native to both the Meshkal and Dashte Basins of Pakistan, both of which have tirbutaries arising in Iran. The genus _Crossocheilus_ has often been confused with _Labeo_, the two being quite similar. To date the genus has not been confirmed from Iran, although I have tentatively concluded that at least two forms from Mekran and the form described by Nikolsky (1897) as _Barbus_ _bampurensis_ are _Labeo_, but would like to see more comparative material before reaching a final decision. The mouth development and the number of barbels (0 to 4) are variable, which contributes to misidentification of _Labeo_ particularily where the genus might not be expected as has been the case in Iran.

Labeo rohita (Ham. Buch.)

Material examined: None.

Distribution: Throughout the plains of Pakistan, including the Nulli-ni River in Baluchistan; India and Burma.

References: Day, 1878; Mirza, 1972.

Labeo dyocheilus (McClelland)

Material examined: None.

Distribution: The most common form of Labeo in Pakistani Baluchistan. Found mostly in sub-montane regions from Pakistan and Afghanistan eastward to Assam.

References: Day, 1878; Zugmayer, 1913; Mirza, 1972.

Labeo calbasu (Ham. Buch.)

Material examined: None.

Distribution: Throughout the plains of Pakistan, India, Burma, and Thailand. In Pakistani Baluchistan, in the Nari-Bolan Dam and Nulli-ni River.

References: Day, 1878; Mirza, 1972.

Labeo dero (Ham. Buch.)

Material examined: USNM (No Number, Acct. No. 248196), (2), 19.9 and 22.5 cm, Korang River, 2.5 kilometers east of Rawalpindi, 5-V-1964.

Distribution: Pakistan, Kashmir, India, East Punjab, West Bengal, Assam, China; in submontane regions. In Pakistan: Baluchistan, Sind, Punjab, N.W.F. Province, the Loralai River, Nari-gauge River, Bibi Nani, Krta, Kundlani of the Bolan drainage, Khuzdar, Zidi, Nulli-ni River, Panjgur, Rakshan River, Vindar River, Puralie, Las Bella.

References: Day, 1878; Day, 1880; Hora, 1923; Berg, 1949; Mirza, 1972.

Labeo gedrosicus Zugmayer 1912

Material examined: None.

Distribution: Rakshan River, Panjgur, in Pakistani Baluchistan; endemic to the Meshkal Basin.

References: Zugmayer, 1912; Zugmayer, 1913; Berg, 1949; Mirza, 1972.

Labeo macmahoni Zugmayer 1912

Material examined: None.

Distribution: Dashte River near Suntsar and Torbat; found in the Dashte and Meshkal Basins of Pakistan.

References: Zugmayer, 1912; Zugmayer, 1913; Mirza, 1972.

Hemigrammocapoeta Pellegrin

This genus is native to Asia Minor, Palestine and the upper Tigris and Euphrates River. Karaman (1971) gives Persia as part of the range for this genus, but does not indicate the source. I know of no collections of this genus from Iran. I followed Karaman's revision.

Hemigrammocapoeta nanus nanus (Heckel)

Material examined: USNM 196355, (3), 5.379 to 6.875 cm, Ammik, Lebanon, 1957.

Distribution: Palestine; Jordan, Euphrates River near Damascus, Persia? The Smithsonian specimens were given as *H. sauvagei*, which Karaman (1971) gives as a synonym of *H. nanus*. These specimens differed from Karaman's description in fin ray counts (D III 6-7 vs D II-III 7-8;

A II 4 vs A II 5) and some of the measurements. They seem to more closely resemble Tylognathoides shoemakeri, a similar genus and species from the same area, but I lack an adequate description of the latter species.

References: Lortet, 1883; Pellegrin, 1923; Tortonese, 1937/8; Berg, 1949; Karaman, 1971; Goren, 1974.

Hemigrammocapoeta nanus culiciphaga Pellegrin 1927

Material examined: None.

Distribution: Turkey;Adana; Antakya, Amik-See, Ceyhan.

References: Pellegrin, 1927; Ladiges, 1960; Karaman, 1971.

Hemigrammocapoeta kemali (Hanko) 1924

Material examined: None.

Distribution: Ak-See; Eregli, Turkey.

References: Hanko, 1924; Ladiges, 1960; Karaman, 1971.

Hemigrammocapoeta kemali klatti (Kosswig

Material examined: None.

Distribution: Egridir, Beysehir, Isparta-See, Turkey.

References: Ladiges, 1960; Karaman, 1971.

Tylognathoides Tortonese

This is a small fish to date found only in Palestine.

Tylognathoides festai Tortonese 1937/8

Material examined: None.

Distribution: Schtora-El Bekaa, Syria, drainage of the Mediterranean Sea; Nahr-el-Lytani River.

References: Tortonese, 1937/8; Karaman, 1971.

Tylognathoides shoemakeri (Ladiges)

Material examined: None.

Distribution: Amik, Lebanon.

References: Karaman, 1971.

Kosswigobarbus kosswigi (Ladiges) 1960

Material examined: None.

Distribution: Batman suyu, Turkey, in Tigris River System.

References: Ladiges, 1960; Karaman, 1971.

Varicorhinus (Ruppell)

This genus is widespread from Africa throughout the Middle East and southern Europe. It has reached the basins of the Black, Caspian and Aral Seas but has not extended very far into Europe, Central Asia or Southeast Asia. Within Iran the genus is found in all major faunal areas. It is the third most common genus in Iran. It has been particularily successful in adapting to life in isolated qanats and springs of the internal basins, and comprises a major part of the limited fauna in these basins. It is one of the most important genera used to define the faunal zoogeography of Iran.

The systematics of the genus has been confused, with various subdivisions described. The most common division separated the African and Middle Eastern species. Most recently Karaman (1969) revised the genus, separating the Middle Eastern and European species into the genus *Capoeta* and retaining the African species in *Varicorhinus*. The separation was based on denticulation of the dorsal fin ray, the development of the lower jaw, size of the suborbital and the location of the maxillary process. I have these characters to be variable, even within a single species, often changing with age. I do not think they represent a valid reason for separating the two groups so have retained the fishes in a single genus. Karaman also grouped many previously recognized species into a few species with many subspecies. The groupings are artificial, and seem to be based primarily on one or a few characters, principally lateral line counts, and do not represent phylogenetic relationships. I have elected to retain many of the original separations, accepting revisions only when it seems justified by examination of specimens or comparison of original reports in the literature.

<u>Varicorhinus</u> <u>capoeta</u> (Guldenstadt)

Material examined: MMTT (No Number), (2), 19.3 cm, Kazem Chay, near Sarab, East Azerbaijan, 28-VIII-1974; MMTT (No Number, (3), 21.1 cm, Arnar Chay, 26-VIII-1974; MMTT (No Number), (2), 18.7 cm, Ghareh Su River, 26-VIII-1974; USNM 205925, (7), (length of body) 11.4 to 15.6 cm, Ghourighol Lake, 20-VI-1970; Shilot, (2), 18.5 to 33.8 cm, Ghourighol Lake, 16-IV-1968; Shilot, (length of body) 17.5 cm, Lake Kupe, Azerbaijan, 24-VIII-1970; Shilot, 21.1 cm, Kolaneh River, West Azerbaijan, 22-VIII-1972; Shilot, (1), no length, Zarreinehrud, X-1970.

Distribution: Kura River, mainly middle and upper sections; basin of the Araxes River; Lake Rezaiyeh Basin. This genus is common throughout Azerbaijan in the basins of the Araxes and Kura Rivers, and in Iranian drainages that once connected with the Araxes River.

References: Kamensky, 1899; Gunther, 1899; Berg, 1948; Numann, 1966; Karaman, 1969.

Varicorhinus capoeta sevangi (Filippi) 1865

Material examined: USNM 37287, 26.9 cm, Goktscha Lake, n.d., obtained from the Imperial Academy of Sciences, Leningrad (St. Petersburg); USNM 37297, 39.4 cm, Goktscha Lake, n.d., obtained from the Imperial Academy of Sciences, St. Petersburg.

Distribution: Lake Sevan and Lake Goktscha in the Araxes River Basin; also reported from other parts of the Araxes and Kura Rivers.

References: Filippi, 1865; Sauvage, 1884; Kamensky, 1899; Berg, 1948.

Varicorhinus capoeta ssp. Berg

Material examined: OS 4304, (2), (length of body) 13.89 and 14.653 cm, Sefid Rud Reservoir, IV-1971; MMTT 414, 10.5 cm, Chalus River, 24-IX-1970; Shilot, 11.5 cm, Sefid Rud near Luluman, 2-6-XI-1961; Shilot, (5), 7.02 to 8.38 cm, Shafa Rud, near estuary, 9-X-1961; Shilot, no length (1), Babolsar Rud, 12-XII-1961; Shilot, 25 cm, Menjil Reservoir, IV-1971; Shilot, 14.5 cm, Shahi, XI-1970; Shilot, 30 cm, Sefid Rud, 1960s; Shilot, 7.88 cm, Haviq Rud, 29-X-1961; Shilot, 12.5 cm, Sefid Rud near Kissum, 5-XII-1961; Shilot, 8.14 cm, Lamir Rud, 10-XII-1971; Shilot, 22.3 cm, Havarud, Gilan, 12-VI-1971; Shilot, (1), no length, Kelsara Rud, Gilan, 12-VI 1971; Shilot, (2), 6.57 and 15.9 cm, Chowbar River, 10-XII-1971; Shilot, 10.51 cm, Shah Rud above Menjil, 1-II-1967.

Distribution: Caspian coastal streams in Gilan and Mazanderan. Within the specimens I examined there is some separation on the basis of gill rakers and other characters. In the specimens examined, the two groups were:

Group 1: GR 17-23, LH 21-24%, GHB 23-26%, LHB 11-12%, eye 17-20%, 1.1. 48-52, D (III)-IV 8; A (II)-III 5;

Group 2: GR 11-12, LH 23-24%, GHB 25-28%, LHB 13-15%, eye 20-27%, 1.1. 42-53, D III-IV 8; A III 5.

The subspecies in which these specimens generally fall was described by Berg (1948) as V. capoeta gracilis. V. gracilis was described by Keyserling (1861) from the Isfahan Basin, where I have collected it. It is a valid species, definitely differing from the Caspian Sea forms. V. capoeta gracilis, ascribed a range including the Caspian Sea, Isfahan, Azerbaijan and Turkey, is an artificial grouping of several forms. V. gracilis is restricted to the Isfahan and Qom Basins and a new name should be designated for the Caspian subspecies of V. capoeta.

Varicorhinus capoeta ssp. #1

Material examined: MMTT 433, 10.95 cm, Cheshmeh Gilas, Khorasan, VI-1971.

Distribution: This was taken from a spring, Cheshmeh Gilas, in Khorasan, but I do not know the exact location. It is closer to the Caspian than the Aral Sea forms of V. capoeta and may be from the Atrek or Gorgan Basins. It differs from V. capoeta in a more elongated body, longer head, and a pectoral fin resembling that found in sevangi .

Varicorhinus capoeta ssp. #2

Material examined: MMTT (Trip), (4), 13.9 to 20 cm, Nardin, a hillside spring, 7-XI-1974.

Distribution: Nardin, a developed hillside spring. It is unclear to which drainage basin this spring belongs. The fish, however, is close to the Caspian V. capoeta subspecies, differing only in fewer lateral line scales and a weaker dorsal spine with fewer serrations. If it is associated with the Caspian V. capoeta, as it appears to be, the spring is in the Gorgan River drainage.

Varicorhinus capoeta kosswigi (Karaman) 1969

Material examined: None.

Distribution: Lake Van, eastern Turkey.

References: Karaman, 1969.

Varicorhinus capoeta angorae Hanko 1924

Material examined: None.

Distribution: Ceyhan and Seychan Rivers, eastern Turkey.

References: Hanko, 1924; Karaman, 1969.

Varicorhinus capoeta heratensis (Keyserling) 1861

Material examined: MMTT (Trip), (2), 10.5 cm, Kuh Sangi Park, Mashad, qanat-fed pool, 10-XI-1974.

Distribution: Mashad, Hari-Rud at Herat; Basins of the Archman, Tedzhan and Murgab Rivers, all in the Aral Sea Basin.

References: Keyserling, 1861; Hora, 1933; Berg, 1948; Berg, 1949; Karaman, 1969; Saadati, 1977.

Varicorhinus #1

Material examined: OS 4265, (2), 13.86 and 14.7 cm, Zarreinehrud, XII-1970.

Distribution: Zarreinehrud, southern Lake Rezaiyeh Basin. This form differs from other Varicorhinus in the area in the smaller number of scales in the lateral line, larger head and taller body.

Varicorhinus aculeatus (Val.)

Material examined: MMTT (Trip), (2), 10.1 cm, Gara Chay, 36 km west of Arak, Dorud Bridge, 1-XII-1974; MMTT (Trip), (2), 11.9 cm, Malekabad, qanat, east of Arak, 2-XII-1974; MMTT (Trip), (2), 14.4 cm, Qom Rud at Neizar, Isfahan-Tehran Road, 2-XII-1974; USNM 205932, (3), 9.57 to 10.514 cm, stream 40 km south of Tehran, 31-XII-1969; MMTT 89, 20.45 cm, Shahnaz Reservoir near Hamadan, 9-IV-1972; MMTT 362, 11.88 cm, Central Province (without more information), 9-IV-1972; MMTT 637, 12.93 cm, Cherra Rud, Arak, 1-V-1973; MMTT (Trip), (2), 7.06 and 16.7 cm, Mohammadieh near Nain, qanat under the Masjid-e-Jomeh Mosque, 29-XI-1974.

Distribution: Namak Lake Basin, in the Arak, Qom, Tehran and Nain subbasins. The Tehran Basin fish have a slightly smaller head and weaker dorsal ray. Close to V. macrolepis. Day (1880) and Zugmayer (1913) list V. aculeatus from Gwadur and the highlands of Kelat and Quetta; they give the dorsal fin ray count as III 10 and the anal fin ray count as III 7, which rules out Varicorhinus; these are probably Cyprinion.

References: Day, 1880; Zugmayer, 1913; Berg, 1949; Rostami, 1963; Numann, 1966; Karaman, 1969; Saadati, 1977.

Varicorhinus buhsei (Kessler)

Material examined: MMTT 660, (length of body) 4.37 cm, Kan River, 10 km west of Tehran, 30-VII-1971; MMTT 685, (length of body) 20.5 cm, Tar River, Central Province, 7-VII-1973; MMTT 700-711, (12), 24.17 to 36 cm, Karadj River, 19-IX-1973; MMTT 746, 18.2 cm, Baragon River, one kilometer west of Baragon, 2-X-1973; MMTT 768-774, (6), 14.28 cm, Louniz River, one kilometer south of Shahrastanak Fork, 1-X-1973; MMTT (No Number), (2), 20.9 and 22.7 cm, Louniz River, Karadj System, 24 VIII-1974; OS 4300 (2), 24 and 26.6 cm, Karadj Reservoir X-1971; Shilot, (2), 11.? and 13 cm, Khamseh River, 72 km from Qazvin, III-1967; Shilot, 22.5 cm, Karadj Reservoir, n.d.; Shilot (3), 8.1 to 23.3 cm, Karadj Reservoir, 13-X-1971; USNM 205943. (6), 20.6 to 29.5 cm, Latian Reservoir, Jajehrud, 15-V-1970; USNM 205898, (2). 2.5 and 3 cm. Baragon River, 40 km northwest of Tehran, 12-III-1970; USNM 205924, (5), 3.812 to 5.137 cm, Baragon River, 40 km northwest of Tehran, 12-VIII-1970; MMTT (Trip), 11.42 cm, Gara Chay, 36 km west of Arak, Dorud Bridge, 1-XII-1974; MMTT (Trip), 17.83 cm, (2), Malekabad, qanat, east of Arak, 2-XII-1974; MMTT (Trip), 12.26 cm, Qom Rud at Neizar, Isfahan-Tehran Highway, 2-XII-1974; MMTT 638, 12.07 cm, Cherra Rud, Arak, 1-V 1973.

Distribution: Elburz front from Qazvin to the Jajehrud River; Arak, Tehran, Semnan and Qom Basins. The Arak and Qom Basin fishes differ from the Tehran and Semnan Basin fishes in having a smaller average lateral line count, a stronger, more denticulated dorsal spine, and the height of the body nearly equal to the length of the head rather than the height of the body exceeding the head length.

References: Berg, 1949; Svetovidov, 1949; Rostami, 1963; Numann, 1966; Karaman, 1969; Saadati, 1977.

Varicorhinus gracilis (Keyserling) 1861

Material examined: MMTT (Trip), (2), 11.46 cm, Malekabad, qanat, east of Arak, 2-XII-1974.

Distribution: Isfahan and Arak Basins.

References: Keyserling, 1861; Saadati, 1977.

Varicorhinus chebisiensis (Keyserling) 1861

Material examined; MMTT 622-625, (4), 22.2 cm, Shah Abbas Kabir Reservoir, Isfahan Province, 2-V-1972; MMTT 979, 18.5 cm, Lordaghan River, 5-VI-1974; Shilot, no length, Ziandehrud, Isfahan, 19-XII-1970.

Distribution: Isfahan Basin. Keyserling (1861), in his description, gives the type locality as Chebis, without any other information. Tortonese (1934) gives the location as "Persia." The specimens from the Isfahan Basin match the description given by Keyserling, who visited the area while in Persia. These specimens are similar to V. buhsei, in the basins to the north, differing in the development of the dorsal ray (weak, very weakly serrated) and in the greater number of gill rakers (13-17). It will probably be found to be a subspecies of V. buhsei (or more accurately, V. buhsei would be a subspecies of V. chebisiensis since the latter was described first) with additional study.

References: Keyserling, 1861; Tortonese, 1934.

Varicorhinus fuscus (Nikolsky) 1897

Material examined: MMTT (Trip), (2), 12.5 cm, qanat, 50 km south of Torbat Heidarieh, 11-XI-1974; MMTT (Trip), (2), 9.04 cm, Kallaj Qanat, 24-70 km south of Torbat Heidarieh, 11-XI-1974; MMTT (Trip), (2), 19.66 cm, Qanat Bedosht, Agha Reza Ali Shah Shrine near

Gonabad, 11-XI-1974; MMTT (Trip), (2), 10.68 cm, Dashte-Biaz, qanat, south of Gonabad, 11-XI-1974; MMTT (Trip), (2), 4.98 cm, Farokhabad qanat, one kilometer north of Qa'en, 12-XI-1974; MMTT (Trip), (3), 13.3 cm, Shur Rud, Qa'en to Faraki Road, 12-XI-1974; MMTT (Trip), (3), 11.56 cm, qanat between Espoden and Abbasabad, 12-XI-1974; MMTT (Trip), (2), 13.1 cm, qanats at Marah and Rabion, northeast of Birjand, 13-XI-1974; MMTT (Trip), (3), 7.95 cm, Shah Abbas qanat, Assadabad, 13-XI-1974; MMTT (Trip), (3), 8.14 cm, Mud, qanat, pool and garden, 14-XI-1974; MMTT (Trip), 14.25 cm, Sarbisheh, qanat, Birjand to Zahedan, 14-XI-1974; USNM 179075, (5), 9.71 to 20.8 cm, Majan, Southeast of Birjand.

Distribution: Eastern Iran; southeastern Khorasan, internal eastern basins, eastern slopes of the Dashte-Lut. Numann's report from the Caspian Sea is erroneous; this species has never been found in the Caspian Sea or associated basins.

Nikolsky (1897) separated gibbosa from fuscus on the basis of a deeper body and the presence of serration on the dorsal fin ray. The two species were found in the same locations. In the specimens I examined the depth of the body and fin ray serration change with age; as I reported in a presentation to the National Meeting of the American Fisheries Society in 1975 (Appendix I), the qanat fishes often show changes in body proportions and dorsal ray development with age, apparently a common trait of adaptation to living in qanats. V. gibbosa, as described by Nikolsky, probably represents larger fish of V. fuscus and not a separate species.

References: Nikolsky, 1897; Nikolsky, 1899; Berg, 1949; Numann, 1966; Karaman, 1969; Saadati, 1977.

Varicorhinus steindachneri (Kessler) 1874

Material examined: None.

Distribution: Kessler (1874) described this species from the Sarafschan River, which would place its range to the east of, and adjoining or overlapping that of V. fuscus. It is similar to fuscus, but differs in having slightly more scales on the average, and on a much greater development of the dorsal ray and its denticulation. Gunther (1889) reported this species present at Kushk and Nushi, the latter in Baluchistan.

References: Kessler, 1874; Gunther, 1889; Berg, 1933.

Varicorhinus #2

Material examined: MMTT (Trip), (3), 16 cm, Cheshmeh Ali Khan, Garmeh, 7-XI-1974; MMTT (Trip), (4), 11.8 cm, Amirabad, qanat, Jajrom to Neishabour Road, 8-XI-1974; MMTT (Trip), (3), 8.4 cm, Qaleh Tang, Jajrom to Neishabour Road, 8-XI-1974; MMTT (Trip), (4), 13.46 cm, Harsabad qanat, Jajrom to Sabzevar, 8-XI-1974; MMTT (Trip), (2), 7.5 cm, Bagh-e-Jan, qanat, south of Neishabour, 9-XI-1974.

Distribution: Northern and northeastern Dashte-Kavir, including the Damghan Basin. This form is close to V. aculeatus, to the west, differing in the type of scales, gill rakers and a more elongate body.

<u>Varicorhinus</u> <u>rostratus</u> (Keyserling) 1861

Material examined: MMTT (Trip), 13.84 cm, Hosseinabad and Gamatabad qanats, Bam, 18-XI-1974; MMTT (Trip), 22.3 cm, Mehtiabad qanat, Bam, 18-XI-1974; MMTT (Trip), 7.44 cm, Tahrud, 150 km west of Bam, 18-XI-1974; MMTT (Trip), no lengths, Jupar Shrine, qanat, 18-XI-1974; MMTT (Trip), (2), 12.4 cm, Baghin qanat, bridge south of Yazd, 19-XI-1974; MMTT (Trip), (2), 14.34 cm, Negar Ali, qanat, 19-XI-1974; MMTT (Trip), (2), 7.43 cm, Imamzadeh Sultan Sayad, qanat, Negar to Baft, 19-XI-1974; MMTT (Trip), no length, Qaleh-Askar, 30 km west of Baft, river at bridge, 19-XI-1974; MMTT (Trip), no length, Baft River, Baft, 19-XI-1974; MMTT (Trip), (2), 16 cm, Hoshun, pool of qanat, Baft-Sirjan; MMTT (Trip), (2), 14.62 cm, Hassanabad to southeast of Sirjan, qanat, 20-XI-1974; MMTT (Trip), (2), 7.55 to 12.68 cm, Farageh, qanat south of Arbaquh, 28-XI-1974; MMTT (Trip), 10.52 cm, Zarb, north of Yazd, qanat, 29-XI-1974; MMTT (Trip), (2), 9.56 to 19.13 cm, Ardakan, qanat in center of town, 29-XI-1974.

Distribution: Keyserling (1861) described this species originally from Yazd. I examined specimens from the Yazd, Kerman, Sirjan and southern Dashte-Lut Basins.

References: Keyserling, 1861.

<u>Varicorhinus</u> <u>macrolepis</u> (Heckel) 1846

Material examined: MMTT 626, 7.56 cm, Shah Abbas Kabir Reservoir, Isfahan Province, 2-V-1972; USNM 205940, (5), 10.386 to 24.5 cm, Govkaneh Marsh, Ziandeh Rud, Isfahan, 1-I-1971; MMTT (Trip), (2), 2.75 to 4.34 cm, Kur River, 28-XI-1974; OS 4279, (2), 16.9 and 19.1 cm, Khorramabad, Luristan, XI-1971; USNM 200310, (5), 13.3 to 14.3 cm, Khorramabad River, Khorramabad, n.d.; MMTT (Trip), (3), 14.14 to 18.4 cm, Haramabad River Bridge, 5 km from Malayer, 1-XII-1974; MMTT 367, 12.78 cm, Gamasiab, Kermanshah, 24-VIII-1972; USNM 143868, 44 cm Sivrice, Hazer Golu, Turkey, 15-VII-1942.

Distribution: Isfahan, Neyriz, Karun and Tigris River Basins. This species is similar to V. aculeatus but differs in the much stronger dorsal ray and the greater number of gill rakers.

References: Heckel, 1846; Keyserling, 1861; Berg, 1949; Numann, 1966; Karaman, 1969; Saadati, 1977.

Varicorhinus macrolepis ssp. #1

Material examined: MMTT 613, 15.94 cm, Teghe Bustan, spring near Kermanshah, 24-VIII-1972.

Distribution: Spring, Taghe Bustan near Kermanshah, Karun River Basin. Similar to V. macrolepis but differs in weaker dorsal ray, fewer gill rakers and taller body.

Varicorhinus amir (Heckel) 1846

Material examined: MMTT (Trip), (2), 24.3 cm, Cheshmeh Barmeh Dalak, 12 km south of Shiraz, 27-XI-1974; MMTT (Trip), 17.3 cm, Saadi's Tomb, qanat, 27-XI-1974.

Distribution: Maharlu Lake Basin. Heckel (1846) described two species from the basin; V. amir from springs near Lake Maharlu and V. saadii from Sa'adi's Tomb. The latter was described as having somewhat heavier dorsal ray and greater number of scales in the lateral line, but in other respects the two forms are the same; only a single species is present in the basin.

References: Heckel, 1846; Lortet, 1883; Tortonese, 1934.

Varicorhinus #3

Material examined: Shilot, (3), 13.7 to 21.3 cm, Bandar Bahman, Mond Basin, IV-1971; MMTT (Trip), (2), 10.1 cm, Fasa River, Jahrom Bridge, Mond Basin, 26-XI-1974; Shilot, 7.45 cm, Selakhor Borujerd, X-1970; MMTT 370, (length of body) 13.44 cm, Borujerd, Selakhor, X-1971; MMTT 646, (length of body) 7.97 cm, Karun River, III-1971.

Distribution: Basin of the Karun, Tigris and Euphrates in Mesopotamia; Mond Basin in the Persian Gulf. This species corresponds to that attributed to V. capoeta gracilis by many authors (see Berg, 1949, 1948). This is a separate species which needs to be redescribed and renamed.

References: Steindachner, 1897; Hanko, 1924; Berg, 1949; Karaman, 1969.

Varicorhinus trutta (Heckel)

Material examined: Shilot, 19 cm, Gamasiab Rud, X-1970; Shilot, 16.5 cm, Dez Rud, XII-1971; OS 4286, 18.4 cm, Gamasiab Rud, X-1970; MMTT 29-32, (4), (length of body) 22 cm, Dez Dam, III-1972; MMTT 60, (length of body) 20.7 cm, Lake Zaribar, Kurdistan, 6-IV-1972; MMTT 120, 19.75 cm, Karkheh River, XII-1971; MMTT 910, 35 cm, Marivan Lake, 9-I-1974; MMTT 933, 37.8 cm, Marivan Lake, 6-VIII-1974; MMTT (No Number), 24.35 cm, Regab River, Kermanshah, 11-IX-1974.

Distribution: Basins of the Tigris, Euphrates and Karun Rivers; reported also from Aleppo. Spotting and dorsal ray distinctive.

References: Heckel, 1846; Gunther, 1874; Gruvel, 1931; Khalaf, 1961; Numann, 1966; Karaman, 1969; Saadati, 1977.

Varicorhinus umbla (Heckel)

Material examined: Shilot, 26.8 cm, Lavan Rud, X-1970; MMTT 903-905, (3), 16.9 cm, Regab River, Kurdistan, 6-I-1974; USNM 143868, (4), 15.6 to 30 cm, Sivrice, Hazer Golu, Turkey, 15-VII-1942.

Distribution: Basin of the Tigris River.

References: Heckel, 1846; Sauvage, 1881/2; Berg, 1949; Karaman, 1969.

Varicorhinus fratercula (Heckel)

Material examined: Shilot, (length of body) 14.3 cm, Dopolan River, Isfahan Province, VII-1971; Shilot, 21.2 cm, Selakhor Borujerd, X-1970; USNM 48026, (2), 14.5 cm, Syria, n.d., obtained from Lyon Museum; USNM 48027, 23 cm, Syria, n.d., from Lyon Museum; USNM 200311, (2), 16 cm, Khorramabad River at Khorramabad, n.d.; MMTT 611, 612, (2), 16.3 cm, Dourud, Luristan, 21-II-1972; MMTT (No Number), 23 cm, Regab River, Kermanshah, 11-IX-1974.

Distribution: Palestine, Euphrates, Tigris, Karun Basins. Scaphiodon niger described by Heckel (1846) from the Kur River Basin seems to belong to this species but has not been collected recently. Three specimens from Haft Barm Ponds (MMTT 838 to 840, 21.48 to 38.5 cm, 9-XII-1973) are close to fratercula, but differ in the fewer dorsal branched rays (8 vs 9-10) and fewer gill rakers (16-18 vs 18-23); the ranges overlap.

References: Heckel, 1846; Lortet, 1883; Filippi, 1865; Pellegrin, 1923; Gruvel, 1931; Berg, 1949; Karaman, 1969.

Varicorhinus damascinus (Valenciennes)

Material examined: USNM 48028, (2), 18.3 and 19.7 cm, Syria, n.d., obtained from the Lyon Museum; USNM 196345, (3), 16.2 to 17.9 cm, Antelias, Lebanon, 18-X-1958; MMTT (Trip), (3), 22.6 cm, Haramabad River, bridge 5 km from Malayer, 1-XII-1974; MMTT 422, 423, (2), 8.15 and 8.95 cm, Gamasiab, near Bisutun, 24-VIII-1972; USNM 143870, (2), 28.1 and 28.5 cm, Hatay, Sandshak, of Alexandrette, Turkey, II-1941.

Distribution: Palestine, Syria, Turkey, basins of the Tigris, Euphrates and Karun Rivers.A variety of forms throughout the Middle East and Iran have been assigned to this species in the past, many that were properly separate species. The true V. damascinus, which still has a wide distribution, is characterized by 18-24 gill rakers, 69-80 scales in the lateral line, and a fairly strong dorsal ray with heavy serrations.

References: Lortet, 1883; Hanko, 1924; Gruvel, 1931; Pellegrin, 1923, 1927; Tortonese, 1937/8; Khalaf, 1961; Numann, 1966; Karaman, 1969; Goren, 1974; Saadati, 1977.

Varicorhinus #4

Material examined: USNM 86976, (3), 7.555 to 14.2 cm, Kuliana, Turkey, n.d.

Distribution: Kuliana, Turkey; I do not know which basin. It is notable for the large number of gill rakers (31-38) and the lack of serration in the dorsal spine.

Varicorhinus sieboldi (Steindachner) 1864

Material examined: None.

Distribution: Basin of the Black Sea; Sakarya River System.

References: Steindachner, 1864; Steindachner, 1897; Hanko, 1924; Karaman, 1960.

Varicorhinus tinca (Heckel)

Material examined: None.

Distribution: Asia Minor, in the basin of the Black Sea.

References: Heckel, 1846; Steindachner, 1897; Hanko, 1924; Pellegrin, 1927; Karaman, 1969.

Varicorhinus peregrinorum (Heckel) 1846

Material examined: None.

Distribution: Palestine; Aleppo, Antioch.

References: Heckel, 1846; Lortet, 1883; Pellegrin, 1923.

Varicorhinus pestai (Pietschmann)

Material examined: None.

Distribution: Asia Minor; Beysehir and Egridir See.

References: Ladiges, 1960; Karaman, 1969.

Varicorhinus barroisi (Lortet)

Material examined: None.

Distribution: Mediterranean drainages; Turkey in Seyhan area; Syria.

Varicorhinus #5

Material examined: USNM 205933, (5), 11.895 to 18.3 cm, Karvandar, Bampur System, Baluchistan, 26-IV-1970; Shilot, (2), (length of body) 5.6 and 7.92 cm, Kancozieh qanat, 15 km northeast of Zahedan, 13-X-1971; OS 5166, (2), 7 and 9.6 cm, Kancozieh qanat, X-1971; MMTT (Trip), 8.44 cm, upper Bampur River, near Karavand, 15-XI-1974; MMTT (Trip), 16.9 cm, small river near Eskelabad, Zahedan to Khash Road, 15-XI-1974.

Distribution: Bampur River Basin. Closely resembles both V. rostratus in the adjoining basins to the west and north, and to V. chebisiensis from the Isfahan Basin.

Varicorhinus #6.

Material examined: MMTT (Trip), 16.33 cm, Minab Rud at Galash Kard, 22-XI-1974.

Distribution: Mekran Coasts, Gulf of Oman drainages. Differs from other Baluchistan forms in greater number of gill rakers and stronger dorsal ray. It is close to the forms in the Mond River.

The genus Varicorhinus in the Middle East needs additional work. I find if difficult, with the material I have seen, to draw final conclusions. The situation is most complex in the internal basins of Iran. In general, the fishes in the internal basins fall into two groups, those with 40-60 scales and those with 70-90 scales along the lateral line. There are variations in scale count, fin ray development and morphometric features in each of these groupings. Bodily proportions show variability within groups and with age, which is common in these groups which are primarily inhabitats of qanats. Quite possibly only two or three species are present. Isolation is nearly complete for forms living in qanats and springs, which would favor development of local variability. These same fishes show relationships to fishes in the Mesopotamian and Sarmatian faunas, but, again, the local variability makes it difficult to draw sharp lines. For disucssion of qanat fishes, see Appendix I.

Cyprinion Heckel

This genus is found in the Tigris, Euphrates, Karun, southern Iran, southern Pakistan, Arabia and the Helmand Basin. It is most abundant and diverse in the basins of southeastern Iran and the Persian Gulf drainages. It is close to *Barbus* from which it probably developed. Considering the distribution of the genus, southern Iran would appear to be the location of origin of the genus.

A large-scaled form from the Lar Basin is of interest because of the small number of scales in the lateral line and the similarity to the poorly described subspecies *Barbus albus alpina* reported by Heckel (1846) from the Mond River Basin. This is form appears, from the description given by Saadati (1977) to be intermediate between *Cyprinion* and *Barbus* and may represent a transition form between the two genera. The closest species of *Barbus* in the area is *Barbus luteus*, a species which shows a very high degree of variability.

Cyprinion macrostomum (Heckel)

Material examined: OS 4246, 12.096 cm, Dez River, Khuzistan, III-1971; OS 4282, (2), 4.066, 4.442 cm, Karun River, Khuzistan, III-1971; Shilot, 21.1 cm, Khorramabad River, X-1970; USNM 200306

(3), 4.43 to 4.845 cm, Khorramabad River, n.d.; USNM 205890, (2), 5.456 and 6.024 cm, Parishan Lake, 9-VI-1970; MMTT 257, (length of body) 13.6 cm, Dez Dam, V-1972; MMTT 270, 18.48 cm, Karun River, XII-1971; MMTT 395, (length of body) 14.14 cm, Borujerd, Lurestan, X-1970; MMTT 455, 11.5 cm, Dez Dam, 7-III-1971; MMTT 488, no length, (1), Gamasiab near Bisutun, 24-VIII-1972; MMTT 521, (1), no length, Karkheh River, XII-1971; MMTT 550-553, (4), (length of body) 10.73 cm, Gamasiab, Bisutun, 8-IV-1972; MMTT 896-902, (7), (length of body) 10.15 cm, Qasr-Shirin, 6-I-1973/4; MMTT 992, 21.16 cm, Dez River, Andemeshk to Dezful Road, 5-XI-1974; MMTT 640, 8.65 cm, Karun River, III-1971; MMTT (No Number), 25.7 cm, Regab River, Kermanshah, 11-IX 1974.

Distribution: Palestine; Mesopotamia; throughout the basins of the Tigris, Euphrates and Karun Rivers. This is the only species of *Cyprinion* that has been collected in the Mesopotamian and Palestinian faunas.

References: Heckel, 1846; Sauvage, 1881/2; Gruvel, 1931; Berg, 1949; Khalaf, 1961; Kafuku, 1969; Karaman, 1971; Saadati, 1977.

Cyprinion macrostomum tenuiradius Heckel 1846

Material examined: Shilot, (2), 10.43 and 14.5 cm, 10 km above Bandar Bahman, Kara-Agach River, Mond Basin, VI-1971; OS 4243, 7.298 cm, Kara-agach River, Fars, IV-1971; MMTT (Trip), (2), 8.6 cm, Fasa River, Bridge west of Jahrom, 26-XI-1974; MMTT 419, 9.61 cm, Bandar Bahman, Kara-Agach Rud, IV-1971.

Distribution: Basins of Lake Maharlu and Neyriz; Mond River Basin, Persian Gulf. Quite close to type species and may be the same form; principal difference is the weaker dorsal ray, somewhat lower average scale and dorsal ray counts.

References: Heckel, 1846; Filippi, 1865; Berg, 1949; Karaman, 1971; Saadati, 1977.

Cyprinion #1

Material examined: MMTT 918, 919, (2), 9.86 cm, Haylay Jan River, Pol-e-Jeh Jeh, Khuzistan, 19-III-1974.

Distribution: Haylay Jan River, Pol-e-Jeh Jeh, Khuzistan, Karun or Tigris Basin. Differs from the type species in the weak dorsal ray, six branched rays in the anal fin and a taller body; probably at most a subspecies of *C. macrostomum*.

Cyprinion #2

Material examined: MMTT (Trip), (2), 7.17 cm, Abariq, 80 km west of Lar, qanat pool by a teahouse.

Distribution: Qanat, Abariq, Mond Basin. Head short, (18% of body length) and abdomen and thorax naked. Belongs to *C. macrostomum*.

Cyprinion #3

Material examined: MMTT (Trip), (3), 6.3 cm, Mansurabad, qanat, by road near Jahrom.

Distribution: Mansurabad, qanat, near Jahrom, Mond River Basin. Distinguished by the naked abdomen and thorax and the high scale count.Belongs to *C. macrostomum*.

Cyprinion #4

Material examined: Shilot, 11.5 cm, Well in Lar Region, III-1969; MMTT (Trip), (2), 14.42 cm, Bedasht, pool of spring, Bastak to Lar Road, 25-XI-1974; MMTT (Trip), (2), 12.05 cm, Cheshmeh Abba Su, northwest edge of Lar (spring, well or qanat), 25-XI-1974.

Distribution: Lar Basin. Differs from other _Cyprinion_ in the lateral line (39-44), the most of any _Cyprinion_ of which I am aware.

References: Saadati, 1977.

Cyprinion #5

Material examined: None.

Distribution: Lar Basin. As reported by Saadati (1977), this form has a very low number of scales (26-27) in the lateral line and two pair of barbels. This form corresponds to one described by Heckel (1846) as _Barbus albus alpina_, although Heckel's description is too fragmentary to make a firm comparison.

References: Heckel, 1846; Saadati, 1977.

Cyprinion #6

Material examined: None.

Distribution: "near Jeddah". D IV 12, A III 6-7, GR 10-12, l.l. 32-34. As described, this form would fit either _C. macrostomum_ or _C. macrostomum tenuiradius_.

References: Banister and Clarke, 1975.

Cyprinion #7

Material examined: None.

Distribution: Wadi Hediyah, close to Medina and not far from Jeddah. D IV 11, A III 7, GR 12, l.l. 35-36. As described, this form corresponds to C. macrostomum.

References: Banister and Clarke, 1975.

Cyprinion watsoni Group

This group includes a variety of forms from southern Persia, Arabia, Afghanistan and Pakistan which have been variously described under Scaphiodon, Varicorhinus, Cirrhina, Barbus and other genera. It is difficult to separate the various forms, partly because of the natural variability and partly because of overlapping ranges. Scales in the lateral line generally run 31-41. The dorsal fin ray counts are III-IV 9-12; anal fin II-III 6-7. The dorsal fin ray ranges from weak to very strong, always serrated, with serration varying from very weak to very strong, and covering one-half to all of the ray. Scales on the ventral surface may be present to the isthmus and arranged in a regular fashion, partially unscaled to completely unscaled. Scales are often reduced in size and imbedded in the skin, giving the appearance of a naked skin. The striae on the back, between the occiput and the start of the dorsal fin varies from absent to well-developed. Scales are often irregular in the area of the striae; this character was used by Day (1876) to distinguish the species C. irregulare, but, since this character is found in many populations, it is not a valid distinguishing characteristic and the species C. irregulare an artificial one. In general, I have adpoted the revision of the genus made by Mirza (1969).

Cyprinion watsoni (Day) 1872

Material examined: MMTT (Trip), (2), 7.78 cm, Khanuj Qanat, Halilirud, Bampur Basin; Shilot, 5.86 cm, Hadjiabad, Kol River Basin, IV-1967; MMTT (Trip), (4), 11.55 cm, Hadjiabad, Gustaieh Qanat, 20-XI-1974; MMTT (Trip), (2), 10.7 cm, Kol River, Hadjiabad Bridge, 20-XI-1974; MMTT (Trip), (3), 8.85 cm, Hosseinabad qanat, 220 km north of Bandar Abbas, 20-XI-1974; MMTT (Trip), (2), 11.44 cm, Guhareh qanat, north of Bandar Abbas; USNM 205894, 3.3 cm, Small spring, upper Sarbaz River, 13-XI-1970; USNM 205910, (3), 3.72 to 5.196 cm, Ziarat, Baluchistan, 19-IV-1970; USNM 205916, 3.75 cm, Ziarat, Baluchistan, 19-IV-1970; Shilot, (3), 6.66 to 9.83 cm, Khodar Village, middle Sarbaz River, 13-X-1971; A 8278, 10.4 cm, Sind, 1889; A 8279, 8.4 cm, Sind, 1889; MMTT (Trip), (2), 9.3 cm, Rushqah qanat, Iranshahr, 16-XI-1974; MMTT (Trip), (2), 5.83 cm, Karvandar, Bampur Basin, 15-XI-1974; MMTT (Trip), 8.93 cm, Zaboli Road, Bampur Basin, springs near top, saline pools, 16-XI-1974; MMTT (Trip), 12.42 cm, Zaboli, Nukaba and Shashki qanats, 16-XI-1974; MMTT, 7.66 cm, Bazman qanat, 17-XI-1974; MMTT (Trip), (2), 16.95 cm, Bam, Hosseinabad and Gamatabad qanats, 18-XI-1974; MMTT, (Trip), 11.4 cm, Mehtiabad qanat, Bam, 18-XI-1974.

Distribution: South Central Iran in the Dashte Lut Basin, Bampur River Basin, Kol Basin; southern Pakistan, Arabian Peninsula.

References: Day, 1872; Day, 1878; Day, 1880; Zugmayer, 1912; Zugmayer, 1913; Hora, 1923; Berg, 1933; Berg, 1949; Nikolsky, 1899; Mirza, 1969; Karaman, 1971; Banister and Clarke, 1975.

<u>Cyprinion microphthalmum</u> (Day) 1880

Material examined: MMTT 161, 10.04 cm, Tangeh Sarrah, Baluchistan, 2-X-1971; OS 4254, (6), 6.603 to 9.543, Karvandar, Bampur River, XI-1971; MMTT (Trip), (3), 9.14 cm, Dahaneh Nuiz, Rudan River, 21-XI-1974; MMTT (Trip), (6), 8.12 to 14.2 cm, Galash Kard, Minab Rud, 22-XI-1974.

Distribution: Helmand Basin; Bampur Basin; Mekran, coastal streams; Coastal streams of Pakistan; Arabian Peninsula.

References: Day, 1880; Gunther, 1889; Nikolsky, 1899; Regan,1906; Zugmayer, 1912; Zugmayer, 1913; Annandale and Hora, 1920; Annandale, 1921; Jenkins, 1910; Berg, 1933; Berg, 1949; Mirza, 1969; Mirza, 1972; Banister and Clarke, 1975.

Cyprinion milesi (Day) 1880

Material examined: USNM 182275, (3), 14.5 to 18 cm, Archandab River, Afghanistan, 10-VI-1955.

Distribution: Southern Afghanistan; Western Pakistan. Nikolsky (1897) described *Barbus bampurensis* from the Bampur Basin which is often listed as a synonym for *C. milesi*. The description does not match *Cyprinion* nor *Barbus*; I suspect it is *Labeo*, although no specimens have been collected since from the basin that match the description so it is difficult to tell. however, the distribution does not include the Bampur Basin for *C. milesi*.

References: Day, 1880; Nikolsky, 1897; Zugmayer, 1912; Zugmayer, 1913; Berg, 1933; Berg, 1949; Mirza, 1969; Mirza, 1972.

Barbus Cuvier

This is the second most abundant genus in Iran. It is widespread throughout Asia, the Middle East, Africa and southern Europe. There is considerable variability in the scales, dorsal fin ray development and bodily proportions. The genus is one of the oldest of Cyprinids. It shows considerable differences throughout its range. The African species tend to be more abundant but show less variability, with the larger-scaled species being most common. In India and elsewhere in Asia the genus shows a greater variability between species but with fewer species.

In Iran, the genus shows more interesting distributional patterns. It is common in the Caspian Sea, tributaries and associated basins. It is very abundant, with a diverse fauna, in the Mesopotamian fauna. It is also found in the Persian Gulf Basin in the Mond Basin. It is totally absent from the coastal drainages to the southeast, and from many of the interior basins. It does not show up in the qanat fauna, indicating an inability to adapt to the isolated existence required for survival in the arid internal basins. In this habitat, it is superceded by Varicorhinus. In the southeast, it is replaced by Cyprinion, which probably derived from Barbus.

Mention should be made of the recent revision of the barbel fishes of Europe, Africa and the Middle East by Karaman (1971). He separated Barbus into six separate genera. I have found the groupings to be rather artificial. The specimens I examined do not fit into his groupings. Because of the variability within species, a result of natural variability and changes in bodily proportions and dorsal ray development with aging, the species overlapped between his genera as described. Some of the revisions in species do not match my specimens, and seem to be more dictated by the systematics than by an attempt to describe actual separations. Omitted, too, were the multitude of species that comprise the Indian fauna, which are closely related to the Mesopotamian fauna. While it is possible that the genus may be subdivided into more than one genus, I could not accept Karaman's revision so have retained all specimens in *Barbus*, using my own specimens and other literature sources to determine species in most instances.

Barbus mursa (Guldenstadt)

Material examined: OS 4297, (2), 17.5 and 17.9 cm, Shahsavar Rud, IX-1971; MMTT 383, 14.2 cm, Lesar Rud, Gilan, 6-IX-1971; MMTT (No Number), 8.58 cm, Arnar Chay, 26-VIII-1974; A 14875, no length, Balik-Chay, Ghareh Su, near Ardebil, 1910; Shilot, 24.5 cm, Azhur, 1962.

Distribution: Streams of the southwestern Caspian coasts; basins of the Kura and Araxes Rivers.

References: Kamensky, 1899; Sauvage, 1884; Berg, 1948; Karaman, 1971.

Barbus mursa miliaris Filippi

Material examined: USNM 205901, 13.05 cm, Nam Rud, Firouzrud, Semnan, 23-VII-1970; MMTT 413, 11.06 cm, Nam Rud, Firouz Rud, Semnan, 23-VII-1970; MMTT 921, 6.25 cm, Cheshmeh Manqur near Mahmoudabad, Semnan, 23-IV-1974.

Distribution: Southern drainages of the Elburz Mountains. The species *miliaris* is very close to *mursa*, from which it probably developed, and is not more than a subspecies of *mursa*.

Filippi, 1863; Filippi, 1965; Kennedy, 1920; Berg, 1949; Rostami, 1963; Vladykov, 1964; Numann, 1966; Karaman, 1971.

Barbus #1

Material examined: MMTT 432, 7.06 cm, Zarrinehrud, below Nowruzlu Dam, n.d.; MMTT 682, (length of body) 11.15 cm, Shahpour Aval Reservoir, two kilometers east of Mahabad, n.d.; MMTT 870-880, (11), 10.1 to 15.68 cm, Soufichay Rud, one kilometer north of Tazekhan, northwest of Marageh, 24-X-1973; MMTT 962, (length of body) 17.77 cm, Shahpour Aval Reservoir, 3-VIII-1973; MMTT (No Number), (2), 13.8 cm, Kazem Chay, near Sarab, East Azerbaijan, 28-VIII-1974; Shilot, 9.05 cm, Zarrinehrud, VIII-1970; USNM 205931, (2), 14.1 cm, Kolaneh (Barandar), 23 km south of Rezaiyeh, 22-VIII-1970.

Distribution: Basin of Lake Rezaiyeh. This form is similar to both *mursa* and *mursa miliaris*, and probably represents a subspecies of *mursa* endemic to the Rezaiyeh Basin. The specimens described by Gunther (1899) as *Barbus caucasicus* appear to belong to this form.

References: Gunther, 1899; Saadati, 1977.

Barbus cyri Filippi 1865

Material examined: Shilot, 9.44 cm, Lamir Rud, 10-XII-1971; OS 4289, 11 and 15 cm, Lesar Rud, IX-1971; MMTT 293, 12.66 cm, Karganrud 14-VI-1971; MMTT 297, (length of body) 14.62 cm, Haviq Rud, 7-VIII-1971; MMTT 442, 13.86 cm, Azerbaijan, X-1970; MMTT (No Number), 10.03 cm, Arnar Chay, 26-VIII-1974; MMTT (No Number, 10.5 cm, Ghareh Su Rud, 26-VIII-1974; MMTT 234, 17.9 cm, Araxes Dam, XII-1971.

Distribution: Tributaries of the southwestern Caspian Sea, including the basins of the Kura and Araxes Rivers. The Lamir Rud specimens showed some variability from the rest in the size of the eye (21 vs 11-17%), shape of snout, fewer scales in the lateral line

(52-53 vs 56-65) and the height of the dorsal fin. It more closely resembles *B. tauricus* from the Black Sea than the typical *B. cyri*. Gunther's (1899) report from the Rezaiyeh Basin appears to be a misidentification; his description does not match *B. cyri*, and no other specimens have been reported from that basin.

One other specimen (MMTT 70, 23.4 cm, Araxes Dam, 6-XII-1971) probably belongs to this species, but had a longer head (24% of body length) and more gill rakers (16) than the typical *B. cyri*.

References: Filippi, 1865; Sauvage, 1882; Kamensky, 1899; Gunther, 1899; Berg, 1948; Numann, 1966; Karaman, 1971.

Barbus capito (Guldenstadt)

Material examined: USNM 205935, 32.1 cm, Nahang Roja Rud, Pahlevi Mordab, III-1970; OS 4253, (2), 19.2 and 19.6 cm, Caspian Sea, VIII-1962; MMTT 375, 17.8 cm, Karganrud, VII-1971; MMTT 384, 15.5 cm, Lesar Rud, Gilan, 6-IX-1971; MMTT 462, 463, (2), 10.1 cm, Menjil Reservoir, 12-IV-1971.

Distribution: Caspian Sea Basin; rivers entering the southern part of the Caspian Sea, including streams all along the Iranian coasts.

References: Kamensky, 1899; Berg, 1948; Nikolsky, 1954; Numann, 1966; Karaman, 1971.

Barkus capito concocephalus Kessler

Material examined: None.

Distribution: Rivers of the Aral Sea.

References: Kessler, 1874; Berg, 1948.

Barbus goktschaicus Kessler

Material examined: None.

Distribution: Basin of Lake Sevan, Araxes Drainage.

References: Kamensky, 1899; Berg, 1948; Nikolsky, 1954; Karaman, 1971.

Barbus brachycephalus Kessler

Material examined: None.

Distribution: Basins of the Aral and Caspian Seas; enters larger rivers along the Caspian coasts of Iran.

References: Kessler, 1874; Kamensky, 1899; Berg, 1948; Karaman, 1971.

Barbus tauricus Kessler

Material examined: None.

Distribution: Freshwater streams of the Black Sea Basin.

References: Kamensky, 1899; Berg, 1948; Ladiges, 1960; Karaman, 1971.

Barbus tauricus kubanicus Berg

Material examined: None.

Distribution: Kuban River

References: Berg, 1948; Karaman, 1971.

Barbus tauricus pergamonensis Karaman 1971

Material examined: None.

Distribution: Bergama, Turkey.

References: Karaman, 1971.

Barbus tauricus escherichii Steindachner 1897

Material examined: None.

Distribution: Rivers entering the Black Sea from Asia Minor.

References: Steindachner, 1897; Hanko, 1924; Pellegrin, 1927; Berg, 1948; Karaman, 1971.

Barbus ercisianus Karaman 1971

Material examined: None.

Distribution: Lake Van, eastern Turkey.

References: Karaman, 1971.

Barbus albus Heckel

Material examined: None.

Distribution: Heckel (1843) described this species from the Oronte River and from Orfa, upper Euphrates River, apparently in what is now Syria. It has not been collected since. Heckel (1846) also described a subspecies *alpina* from the Kara-Agach, Mond River Basin, mainly on the basis of the colors, the body form being somewhat thicker, and the rougher scales. *B. albus* is very close to *B. luteus* and may be a divergent specimen of that species. In Lake Parishan I found one specimen which corresponds quite closely to *albus*, with 21-24 lateral line scales, 9 gill rakers, D IV 10, A III 7, and one pair of barbels. It co-existed with a rather diverse population of other *B. luteus*, some of which approached Heckel's description of *B. albus*. As mentioned earlier, Saadati (1977) reported on an unusual form of *Cyprinion* which seemed to conform to Heckel's description of *B. albus alpina*.

References: Heckel, 1846; Filippi, 1865; Sauvage, 1882, 1884; Gruvel, 1931; Tortonese, 1934.

Barbus luteus (Heckel)

Material examined: MMTT 38, 39, (2), 17.1 cm, Karkheh River, Khuzistan, XII-1971; MMTT 503-506, (4), (length of body) 7.7 to 7.9 cm, Dez Dam, III-1972; MMTT 837, 843-850, (9), 19.9 to 31 cm, Parishan Lake, 7-XII-1973; MMTT 911, 23.84 cm, Dez Dam, 25 km below the Mohammad Reza Shah Pahlevi Dam, 30-I-1973; MMTT 993, 16 cm, Dez River, Andimeshk to Dezful, 5-XI-1974; Shilot, 18.3 cm, Khorramabad, X-1970; Shilot, 20.7 cm, Lake Parishan, 25-II-1962; OS 4304, 21.4 cm, Lake Parishan, II-1962; OS 4299, 27 cm, Karun River, Khuzistan, III-1971; Shilot, 17.5 cm, Fars (without more exact location), 1966.

Distribution: Palestine; throughout the Tigris, Euphrates and Karun River Systems; Mond River Basin, Persian Gulf Basin. A widespread species with considerable variability in morphometric features and barbels. Distinctive because of the low number of scales in the lateral line and the strong, unserrated dorsal ray.

References: Sauvage, 1882, 1884; Gunther, 1874; Kennedy, 1920, 1937; Gruvel, 1931; Kisra, 1947; Berg, 1949; Khalaf, 1961; Andersskog, 1966; Numann, 1966.

Barbus arabicus Trewavas 1941

Material examined: None.

Distribution: Arabian Peninsula. From the description, the species is very close to B. canis, found in Palestine, and to B. macronema, found in Ethiopia. These three, plus B. apoensis and B. exulatus, are all similar in scale counts,form, and gill rakers.

References: Trewavas, 1941; Karaman, 1971; Banister and Clarke, 1975.

Barbus apoensis Banister and Clarke 1975

Material examined: None.

Distribution: Southwestern Arabian Peninsula, southeast of Mecca.

References: Banister and Clarke, 1975.

Barbus exulatus Banister and Clarke 1975

Material examined: None.

Distribution: Yemen.

References: Banister and Clark, 1975.

Barbus tor (Ham. Buch.)

Material examined: None.

Distribution: Loralai (Sehan an Anambar Rivers); Nari-Gauge; Kirta, Mundlani (Bolan Drainage); Ziarat Pir Umer (Kolachi Drainage); Gaj, Nuzarani-ni and Nulli-ni Rivers, all in western Pakistan. This species has been reported from throughout Pakistan, India and Burma, and probably represents a grouping of forms rather than a single species. It has been found in Pakistani Baluchistan but, to date, not in Iranian Baluchistan.

References: Day, 1871; Day, 1878; Day, 1880; Zugmayer, 1913; Hora, 1923; Mirza, 1972.

Barbus sharpeyi Gunther 1874

Material examined: MMTT 22,23, (2), no lengths, Karkheh River, Khuzistan, XI-1971; Shilot, 25.3 cm, Dez River, XII-1971.

Distribution: Basin of the Tigris, Euphrates and Karun Rivers.

References: Gunther, 1874, 1896; Berg, 1949; Karaman, 1971.

Barbus canis Cuv. Val.

Material examined: None.

Distribution: Palestine, Jordan, Lake Tiberias, Lake Holu, Lake Antioch, Oronte. Karaman (1971) combins B. canis and B. chantrei into a single species. From the literature reports , they differ in the length of the head, form of the mouth and form of the dorsal ray.

References: Lortet, 1883; Vinciguerra, 1926; Gruvel, 1931; Tortonese, 1938; Berg, 1949; Karaman, 1971; Goren, 1974.

Barbus chantrei (Sauvage) 1882

Material examined: MMTT (No Number), (2), 20.6 and 22.6 cm, Regab River, Kermanshah Province, 11-IX-1974.

Distribution: Antioch, Oronte, Lake Homs, Aleppo; Karun Basin.

References: Sauvage, 1882, 1884; Berg, 1949; Ladiges, 1960; Karaman, 1971.

Barbus grypus Heckel

Material examined: MMTT 24, 30.5 cm, Khuzistan, n.d.; MMTT 27, 28.5 cm, Karkheh River, Khuzistan, XII-1971; MMTT 836, 43.5 cm, Lake Parishan, 7-XII-1973; MMTT 891, (1), no length, Qasr-Shirin River, Alwand, 6-I-1973; MMTT (No Number), 30.5 cm, Regab River, Kermanshah Province, 11-IX-1974.

Distribution: Basins of the Tigris, Euphrates and Karun Rivers.

References: Gunther, 1874; Sauvage, 1882, 1884; Gruvel, 1931; Misra, 1947; Berg, 1949; Khalaf, 1961; Karaman, 1971.

Barbus pectoralis Heckel

Material examined: None.

Distribution: Oronte, Lake Homs, Aleppo, Smyrna, Palestine, Asia Minor.

References: Boulenger, 1896; Pellegrin, 1923; Berg, 1949; Karaman, 1971.

Barbus orontis (Sauvage) 1882

Material examined: None.

Distribution: Oronte, Antioch, Lake Tiberias. The descriptions of B. orontis and B. pectoralis are very similar, the principle differences being the development of the dorsal ray, size of head and size of eyes. They have concurrent distributions and may be the same species.

References: Sauvage, 1882, 1884; Vinciguerra, 1926; Gruvel, 1931; Berg, 1949; Karaman, 1971.

Barbus barbulus Heckel 1846

Material examined: MMTT (No Number), (2), 27 cm, Regab River, Kermanshah Province, 11-IX-1974; Shilot, 22.2 cm, 12 km above Bandar Bahman, Kara-Agach River, Mond Basin, IV-1971; Shilot, 21.5 cm, Karkheh River, XII-1971.

Distribution: Palestine, Tigris, Euphrates and Karun Rivers; Kara-Agach River, Mond Basin.

References: Heckel, 1846; Sauvage, 1882, 1884; Pellegrin, 1923; Tortonese, 1938; Gruvel, 1931; Berg, 1949; Khalaf, 1961; Saadati, 1977.

Barbus longiceps Cuv. Val.

Material examined: Shilot, 23 cm, Karkheh River, XII-1971; MMTT 59, 61, 62, (3), (length of body) 21.3 to 25 cm, Karkheh River, Khuzistan, XII-1971; MMTT 913, 33 cm, Dez River, 25 km below Mohammad Reza Shah Pahlevi Dam, 30-I-1973; MMTT 991, 19.8 cm, Dez River, Andimeshk to Dezful, 5-XI-1974; Shilot, 28.5 cm, Karkheh River, XII-1971.

Distribution: Palestine, Tigris, Euphrates, Karun River Systems. B. longiceps and B. barbulus are very close and probably the same species.

References: Heckel, 1846; Gunther, 1874; Sauvage, 1882, 1884; Lortet, 1883; Pellegrin, 1923; Gruvel, 1931; Light, 1917; Berg, 1949; Khalaf, 1961; Vesey-Fitzgerald and LaMonte, 1949; Numann, 1966; Karaman, 1971; Goren, 1974.

Barbus lacerta Heckel

Material examined: None.

Distribution: Aleppo, Oronte, Antioch.

References: Heckel, 1846; Sauvage, 1882, 1884; Berg, 1949, Ladiges, 1960.

Barbus xanthopterus (Heckel)

Material examined: None.

Distribution: Basins of the Tigris, Euphrates and Karun Systems. In the Mesopotamian fauna are three species that are quite close to one another: B. barbulus (1.1. 50-57, GR 12-21, ray strong, strongly serrated); B. longiceps (1.1. 51-65, GR 13-21, ray strong, serrated); and B. xanthopterus (1.1. 58-65, GR 10-13, ray strong and serrated).

There are some differences in lip development and form of body, but these vary within a species and with age. While I have not seen many of these fishes, I suspect they represent a single species.

<u>Barbus</u> #2

Material examined: USNM (No Number, Acct. No. 303854), (5), 4.226 to 5.338 cm, Lake Arzhan, Dalaki River, Persian Gulf Basin, 15-IX-1972.

Distribution: Lake Arzhan, Dalaki River, Persian Gulf Basin. Close to *B. barbulus*, which is present in the adjoining Mond Basin, but differs in the weak dorsal ray and greater number of scales along the lateral line. There is only one pair of barbels and the eyes are large, but this may be due to the relatively small size of the fish.

<u>Barbus</u> #3

Material examined: USNM (No Number, Acct. No. 303854), (4), 7 to 12.319 cm, Springfed pool east of Sang Kar (Kur or Mond Basin), IX-1972.

Distribution: Kur or Mond Basin. Body form resembles *Varicorhinus* but the mouth as in *Barbus*; one pair of barbels present.

Barbus kosswigi Karaman 1971

Material examined: MMTT 530, 531, (2), 9.7 cm, Gamasiab, near Bisutun, V-1972; MMTT (Trip), 7.9 cm, Haramabad River, bridge five km from Malayer, 1-XII-1974.

Distribution: Tigris and Karun Rivers. The description given by Karaman (1971) has a somewhat weaker dorsal ray, but otherwise the Karun specimens agree with the type.

References: Karaman, 1971; Saadati, 1977.

Barbus esocinus (Heckel)

Material examined; MMTT 63, 64, (2), 32.3 cm, Karkheh River, Khuzistan, XII-1971; MMTT 914, 32.5 cm, Dez River, 25 km below Mohammad Reza Shah Pahlevi Dam, 30-I-1973.

Distribution: Tigris and Karun Rivers.

References: Misra, 1947; Berg, 1949; Khalaf, 1961; Karaman, 1971.

Barbus #4

Material examined: USNM 200308, (2), 4.626 cm, Khorramabad River, n.d.

Distribution: Khorramabad River, Karun Basin. Lateral line has 72-73 scales, similar to counts in both B. kosswigi and B. esocinus. It has one pair of barbels and a weakly developed dorsal ray, but these are immature fish (body lengths 3.66 and 4.626 cm), so these two characters are not decisive. However, these two specimens have 17-20 gill rakers, considerably more than in kosswigi (6-9) or esocinus (9-11).

Barbus subquincunciatus Gunther

Material examined: Shilot, 42.1 cm, between Sanandaj and Kermanshah, 29-XI-1973.

Distribution: Tigris, Euphrates and Karun River Basins. This is a highly distinctive species; the dorsal ray is very strong, serrated to the top, and the body is covered with large (as the eye) dark spots.

References: Gunther, 1874; Sauvage, 1884; Kennedy, 1920, 1937; Berg, 1949; Khalaf, 1961; Karaman, 1971.

Barbus belayewi Menon

Material examined: None.

Distribution: Tigris River at Baghdad.

References: Khalaf, 1961.

Barbus euphrati (Sauvage) 1884

Material examined: None.

Distribution: Euphrates River.

References: Sauvage, 1884; Ladiges, 1960.

The preceding four species, B. esocinus, B. subquincunciatus, B. belayewi and B. euphrati, are quite similar in scale counts and dorsal ray development. There are some differences (barbel development, colors, bodily proportions) but considerable overlap.

SUBFAMILY IV. GOBIONINAE

Gobio Cuvier

The subfamily Gobioninae is very common in the waters of eastern Asia. The single genus, Gobio, in Iran, is found also in Europe, Central Asia, western Siberia and the Amur Basin. Iran represents the most southwestern extension of both the genus and subfamily. In Iran the genus is confirmed only from the Aral and Caspian Sea Basins and associated basins. One specimen I examined was listed as from "Zarrienehrud near Isfahan." The Zarrienehrud is in the Lake Rezaiyeh Basin not near Isfahan; the Zianrud is the river near Isfahan. It is not clear where this form originated. The Isfahan location would be a new, major extension of the range of the subfamily and genus.

Gobio gobio (Linnaeus)

Material examined: I have not seen this species.

Distribution: Throughout most of Europe; different subspecies in the basins of the Black, Caspian and Aral Seas; Siberia and to the north.

References: Kessler, 1874; Gunther, 1889; Berg, 1933; Berg, 1948; Nikolsky, 1954.

Gobio gobio lepidolaemus Kessler

Material examined: MMTT (Trip), 10.05 cm, Kuh-Sangi Park, Mashad, 10-XI-1974.

Distribution: Central Asia; Basin of the Aral Sea, in the Tedzhan, Murgab, Amu-Darya, Kashka-Darya, Zeravshan and Syr-Darya Rivers.

References: Keyserling, 1861; Berg, 1948; Saadati, 1977.

Gobio ciscaucasicus Berg

Material examined: None.

Distribution: Basins of the Kuban, Kuma, Terek, Sulak and Samur Rivers.

References: Berg, 1948; Ladiges and Vogt, 1965.

Gobio persa Gunther 1899

Material examined: None.

Distribution: Basin of Lake Rezaiyeh; basins of the Kura and Araxes River.

References: Gunther, 1899; Berg, 1948; Vladykov, 1964; Saadati, 1977.

Gobio #1

Material examined: Shilot, 5.19 cm, "Zarreinehrud near Isfahan," X-1970.

Distribution: Unclear; Zarreinehrud is in the Lake Rezaiyeh Basin, while the river near Isfahan is the Zianrud or Zayandehrud. The specimen is similar to G. persa, but differs in having a very elongate body, large head, very narrow caudal peduncle (height almost three in length), and a somewhat higher average scale count.

SUBFAMILY V. SCHIZOTHORACINAE

This subfamily is close to Barbinae. It has its greatest diversity in the uplands of Central Asia, Tibet and the nothern slopes of the Himalayan Mountains. Some species have penetrated to the southern slopes of the Himalayas and Hindu Kush, but these are mostly montane forms and have not become established in lowland areas. In Iran they are confined to the northern and eastern parts of the country. Iran represents the most southern and western extension of the subfamily.

Schizothorax Heckel

This genus is found from the Mekong and Yangtzekian Rivers in the east through Central Asia to northern and eastern Persia. Its westernmost extension is the Damghan subbasin in northern Iran. It has small scales, and its eggs contain a highly toxic poison.

A horny mandibular sheath is present in some specimens of this genus but its appearance is sporadic. Such specimens are sometimes referred to as morpha oreiniformis. Strong labial development is commonly observed. The original species described by Heckel (1838) were S. plagiostomus and S. sinuatus, since combined into a single species, S. plagiostomus. This species possesses the labial sucker. McClelland (1842), and many subsequent ichthyologists, separated the forms with labial suckers into the genus Oreinus, distinguishing them from Schizothorax, which lacks the labial sucker. Mirza (1972), discussed the nomenclature of these forms, showing that, if a division were to be made, the correct name for the forms with the labial sucker would be Schizothorax, since the labial sucker is present in S. plagiostomus. For the forms lacking the labial sucker, he adopted the name Schizothoraichthys, proposed originally by Misra (1949). In other respects, the two forms are quite similar. Berg suggests (1948, 1949), that the difference of the presence or absence of the labial sucker is not a reliable character for separating forms because it may vary even within a species. I have decided to follow Berg, electing to retain the species under a single genus, the original Schizothorax.

Schizothorax pelzami (Kessler)

Material examined: MMTT 85,86, (2), 19.5 cm, Cheshmeh Ali, near Damghan, 5-IV-1972; MMTT 332, no length, (1), Akhland River, Mashad, 26-V-1971; MMTT (Trip), (3), 26.5 cm, Cheshmeh Ali, near Damghan, 5-XI-1974; MMTT (Trip), (3), 12.5 cm, Cheshmeh Bedash, near Shahrud, 6-XI-1974; MMTT (Trip), (2), 17.75 cm, Bagh-e-Jan, qanat, south of Neishabour, 9-XI-1974; MMT (Trip), 10.25 cm, Nazerabad, four km north of Bagh-e-Shah, Neishabour to Mashad Road, 9-XI-1974; MMTT (Trip), 11.15 cm, Kuh Sangi Park, Mashad, 10-XI-1974; MMTT 399-401, (3), 19.6 cm, Shakuruk Road, Khorasan, 28-V-1971; OS 4284, 26.8 cm, Sharak Road, Khorasan, VII-1971.

Distribution: Basins of the Murghab and Tedzhan Rivers; in northeastern Iran, found in the Mashad Area, the northern Dashte-Kavir, in the Neishabour area and in the Damghan Subbasin. The type was taken from "Shahrud" south of Astrabad. This is probably the Shahrud in the Damghan Basin. There are two towns named Astrabad, one in the east and one in the west (now called Bandar Pahlevi or Enzeli). One fork of the Sefid Rud is named the Shahrud. The pairing of names led to reports that this species was found in the western Caspian Sea Basin. In fact, the genus Schizothorax is completely absent from the Caspian fauna.

Karaman, (1969) described a new subspecies, S. pelzami iranicus, from "Tehran." This was probably taken from Cheshmeh Ali near Damghan the western most extension of the genus and in the basin adjoining the Semnan and Tehran Basins on the east not far from Tehran. The spring Cheshmeh Ali is probably also the type locality of the species S. pelzami. His description does not differ from the typical pelzami; even if a new subspecies were to be recognized, the name would need to apply to fishes elsewhere in the range since the subspecies he proposes probably comes from the type locality of the species. I do not think the subspecies is valid.

Among the specimens I examined there was noticeable variability. In the northern Dashte-Kavir (Neishabour, Damghan) the dorsal ray was noticeably stronger than in forms from the Tedzhan and Murghab. In the Neishabour area fishes, the gill raker count was somewhat lower. The fishes from "Shakuruk Road" and "Sharak Road" (I cannot locate the sites), had a noticeably lower, elongate body. In these arid areas, most of the populations are isolated in qanats or springs, or in short perennial portions of rivers, so some population variability would be expected.

References: Gunther, 1889; Nikolsky, 1897, 1899; Berg, 1933, 1948, 1949; Hora, 1933; Karaman, 1969; Saadati, 1977.

<u>Schizothorax</u> <u>intermedius</u> McClelland 1842

Material examined: None.

Distribution: Afghanistan and Pakistan, in the Indus River drainage. McClelland described this species from the Indus Basin. Day (1876) listed specimens from Yarkand, out of the Indus Basin, as <u>intermedius</u>. Other authors, following Day, described a variety of forms under <u>intermedius</u>. Hora (1935) showed that Day's specimens were clearly not <u>intermedius</u>. However, the wide distribution for this species persisted in the literature. Berg (1948), for example, included three morphas under <u>intermedius</u> covering a diverse fauna from the Indus, Helmand and Aral Sea Basins. While I have not seen specimens from most areas, after reviewing the literature, I have accepted Hora's analysis and restricted <u>intermedius</u> to the Indus Basin, the forms in the Helmand and Aral Sea Basins belonging to other species.

References: McClelland, 1842; Day, 1871; Day, 1876, Hora, 1935; Berg, 1948.

<u>Schizothorax</u> <u>labiatus</u> (McClelland) 1842

Material examined: None.

Distribution: Basins of the Indus and Helmand Rivers, Afghanistan and Iran. Not confirmed from the Seistan area of Iran, but present elsewhere in the Helmand Basin.

References: McClelland, 1842; Day, 1871; Mukerji, 1936; Vijayalakshmanan, 1949; Mirza, 1972; Mirza and Hameed, 1975.

Schizothorax plagiostomus Heckel

Material examined: None.

Distribution: Afghanistan and Pakistan, basins of the Indus and Helmand Rivers. Reported from the Helmand Delta, Seistan, Iran.

References: McClelland, 1842; Day, 1871, 1876, 1878; Hora, 1933, 1935; Zugmayer, 1910; Mukerji, 1936; Vijayalakshmanan, 1949; Mirza, 1972; Mirza and Hameed, 1975.

Schizothorax zarudnyi (Nikolsky) 1897

Material examined: MMTT 266, 24 cm, Helmand River, Zahak Dam, 25-IV-1970; MMTT (Trip), 35.3 cm, Helmand Delta, purchased in the market in Zahedan, 15-XI-1974; USNM 205939, (2), 28.8 and 30.1 cm, Zahak, Helmand Delta, 27-IV-1970; Shilot, 30 cm, Hamun-e-Helmand, Summer, 1969.

Distribution: Helmand River Basin; most specimens taken in the Seistan Area.

References: Nikolsky, 1897; 1899; Keyserling, 1861; Annandale and Hora, 1920; Annandale, 1921; Berg, 1949; Fowler and Steinitz, 1956.

Schizothorax esocinus Heckel

Material examined: None.

Distribution: Basins of the Helmand and Kabul River; in the upper tributaries of the Indus River.

References: McClelland, 1842; Day, 1871, 1876, 1878; Zugmayer, 1910; Vinciguerra, 1916; Mukerji, 1936; Mirza and Hameed, 1975.

Schizothorax schumacheri Fowler and Steinitz 1956

Material examined: None.

Distribution: Reported from Seistan. The description closely matches the description of S. plagiostomus from the same location and is probably a synonym. Fowler and Steinitz, 1956.

Schizocypris Regan

The members of this genus are primarily montane forms associated with the Indus River System.

Schizocypris brucei Regan 1914

Material examined: USNM 182282, (2), 19.0 and 19.5 cm, Helmand River, Lashka-Dah, Afghanistan; USNM 182276, (3), 16.1 to 19.0 cm, Arghandab Reservoir, Afghanistan, 10-VI-1958.

Distribution: Waziristan Mountains of Pakistan and Afghanistan; Basins of the Indus and Helmand Rivers; in Iran, in the delta of the Helmand River in Seistan.

Karaman (1969) separated S. ladigesi on the basis of the presence of a horny coating on the lower jaw, scales on other than the sides of the body and larger dorsal fin. However, these characters are quite variable in a population and do not justify erection of a new species.

References: Regan, 1914; Annandale, 1921; Annandale and Hora, 1920; Berg, 1949; Karaman, 1969; Mirza, 1972; Mirza and Hameed, 1975.

Schizopygopsis Steindachner

This genus has about 20 species in the mountainous areas of Central Asia. The only species reported in Iran is confined to the Helmand Basin.

Schizopygopsis stoliczkai Steindachner 1866

Material examined: USNM 165047, (length of body) 4.151 cm, Helmand River, Seistan, n.d.; A 25854, 13.8 cm, Seistan, 16-V-1933; A 26319, (2), 8.3 and 8.5 cm, Amchur River, near Yashil-Kul, Pamirs, 1901.

Distribution: This species has been reported from the headwaters of the Indus, Yarkand and Oxus Rivers; from the Amu-Darya; Basin of the Brahmaputra; Basin of the Helmand River, including the Seistan Delta. This is primarily a montane form. There is considerable variability and a wide distribution of the species, suggesting that more than one form may be included under the species as defined. A subspecies, sewerzowi, was separated on the basis of a smaller size, larger eye and a somewhat deeper body and more oblique mouth, but several authors have reported that these characters can be found in a continuous series and the subspecies is not valid. The material in lot A 26319 were given as subspecies sewerzoi on the label. The material from the Smithsonian collection, USNM 165047, was from Hora, who identified it as S. stoliczkai. However, it does not match the description of the species as found in the literature.

References: Steindachner, 1866; Heckel, 1846; Day, 1871, 1876, 1878; Zugmayer, 1910; Vinciguerra, 1916; Annandale and Hora, 1920; Annandale, 1921; Mukerji, 1936; Berg, 1948, 1949; Mirza, 1972; Mirza and Hameed, 1975.

SUBFAMILY VI. RHODEINAE

Rhodeus sericeus amarus (Bloch)

Material examined: OS 4269, (2), 4.546 and over 4.7 cm, Shafarud, Caspian Sea Basin, XI-1971.

Distribution: The genus is found in Europe and the basins of the Black and Caspian Seas. One subspecies is found in Iran, and is restricted to the Caspian Sea coasts of Gilan and Mazanderan.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

SUBFAMILY VII. CYPRININAE

This subfamily is widespread in Europe and Asia; one member of the subfamily, *Cyprinus carpio* has been introduced worldwide.

Cyprinus carpio Linnaeus

Material examined: I have seen many of this species throughout Iran and other countries but have not made measurements on any specimens.

Distribution: Its native range included the basins of the Black, Caspian and Aral Seas, rivers of the Pacific Ocean Basin and East Asia from the Amur River north to the Yunnan and to Burma in the south. It has been widely introduced throughout central and western Iran.

References: Kessler, 1874; Regan, 1914; Hora, 1933; Fowler, 1956; Khalaf, 1961; Sterba, 1966; Numann, 1966.

Carassius (L.)

Two species of this genus *C. carassius* (Linnaeus, 1758) and *C. auratus gibelio* (Bloch, 1783) have been introduced into Iran. According to Berg (1948), *C. carassius* is native to the Volga Basin but did not penetrate to the Caspian Sea nor Iran. *C. auratus gibelio* is found in the Amur Basin, Siberia, Aral Basin and Europe, but not the Caspian Sea Basin, (Berg, 1948).

Hypothalmichthys molitrix (Valenciennes)

This species, which is endemic to the Amur Basin and China, is reportedly established in the Pahlevi Mordab, arriving either through release from a private Iranian fish farm or from the Soviet Union.

References: Berg, 1948; Saadati, 1977.

Ctenopharyngodon idellus (Valenciennes)

This species, native to the Amur Basin and China, has been introduced into Iran. A population was established in the Pahlevi Mordab in the early 1950s as a method of controlling vegetation, but apparently never established a breeding population, although a few large individuals were reported in the mid-1960s. It was also introduced in the 1970s into Khuzistan to control vegetation in the irrigation ditches. Introductions were supposed to be restricted to ditches where the fish would not escape into the Karun or Tigris Rivers, but with the very extensive flooding that occurs annually, it is probable that some of the fish will escape. Conditions are favorable to establishing a breeding population.

References: Berg, 1948.

FAMILY VIX COBITIDAE (I)

The loaches are represented in Iran by several genera, one of which, Noemacheilus, is the most common genus in Iran. The family is found in Asia, Europe and Northeastern Africa, being most diverse and abundant in southeastern Asia. They are small fishes, and are most often taken over rocky or gravelly bottoms. Many of them have adapted to living in qanats and isolated springs.

Cobitis L.

Several species of this genus are found in Europe, Asia and Morocco. In Iran, it is well established in the Caspian Sea Basin; its presence elsewhere in Iran is less definite. Heckel (1846) described *C. linea* from the Kur River; it has not been reported from that location since. Saadati (1977) also reported specimens from "Qara-Chai River at Khosroabad near Hamadan," which he indicates is in the Karun Basin. There is a Qara-Chai near Hamadan, in the Qom Basin. It is not clear in which basin this fish is located. Either location would be a new distributional record.

Cobitis taenia Linnaeus

Material examined: USNM 205893, (3), 4.8 to 5.298 cm, Pahlevi Mordab, III-1970; MMTT 417, 418, (2), 5.63 cm, Sefid Rud, n.d.; MMTT 421, 6.2 cm, Chowbar Rud, n.d.; MMTT 533, 7.65 cm, Ghasemabad River, Mazanderan, V-1972.

Distribution: Widely distributed in Europe, basins of the Arctic Ocean and Siberia; basin of the Caspian Sea. Saadati (1977) assigned his specimen from "Qara-Chi River at Khosroabad near Hamadan" to this species. As discussed above, this may be in the Qom Basin, not the Karun River Basin as Saadati suggests.

References: Kessler, 1874; Berg, 1948; Svetovidov, 1949; Banarescu and Nalbant, 1964; Saadati, 1977.

Cobitis aurata (Filippi) 1865

Material examined: USNM 205902, 7.025 cm, Pahlevi Mordab, III-1970.

Distribution: Basins of the Black and Caspian Seas. Banarescu and Nalbant (1964) report finding this species in the lower Euphrates.

References: Filippi, 1865; Banarescu and Nalbant, 1964; Banarescu and Nalbant, 1966.

Cobitis aurata aralensis Kessler

Material examined: None.

Distribution: Aral Sea Basin; Syr-Darya, Chu River, Zeravshan, Amu-Darya.

References: Berg, 1948.

Cobitis caucasica Berg

Material examined: None.

Distribution: Terek, Sular, Shura-ozen, all in basin of upper Kuban River.

References: Berg, 1948; Ladiges and Vogt, 1965.

Cobitis caspia Eichwald

Material examined: USNM 205902, 7.142 cm, Pahlevi Mordab, III-1970; MMTT 520, 7.7 cm, Chowbar River, Gilan, 9-XII-1971.

Distribution: Basins of the Caspian Sea tributaries; Mordabs.

References: Eichwald, 1841; Berg, 1948; Ladiges and Vogt, 1965.

Cobitis linea (Heckel) 1846

Material examined: None.

Distribution: Given as Pulwar River, tributary of the Kur River, near Persepolis, in the Neyriz Basin. Banarescu and Nalbant (1966) examined the type and holotype specimens and reported they were in very poor condition; they retained the species in Cobitis.

References: Heckel, 1846; Banarescu and Nalbant, 1966.

Cobitis simplicispina Hanko 1924

Material examined: None.

Distribution: Kotschke-Kissik, Eregli; Anatolia, Turkey, Basin of the Black Sea.

References: Hanko, 1924; Tortonese, 1938; Banarescu and Nalbant, 1964.

Noemacheilus Hasselt

This genus is found in Asia, Europe and Northeastern Africa. In Iran it is found in most basins, and is the most common genus in terms of the number of species present. The genus covers a diverse group of fishes over a wide area, but has resisted effots to reduce it to several smaller genera. The body may be naked or partially to completely scaled. A dermal crest may be present on the caudal peduncle or it may be absent. A dentiform process may be present or absent on the upper jaw. Sometimes variability will occur in a single population. Because of this variability, transition stages are common. The variability has probably contributed to some of the rather unusual distributions reported in the literature where populations from distant locations have been assigned to the same species. The most common spelling of the genus name has been _Nemachilus_, following Gunther (1859-1870). Hasselt, in describing the genus, spelled the name _Noemacheilus_. Following Mirza (1972) and other recent authors I am adopting the original spelling.

Noemacheilus stoliczkai (Steindachner) 1866

Material examined: A 28926, (2), 6 and 6.36 cm, Kara-Su, 1914, Mitrodolkovy; A 25224, (2), 8.48 and 10.46 cm, Issyik-Kul, 110-VI-1930; A 26891, 17.73 cm, Pamirs, Lake Yashzab-Kul, River Yahgur-Tuch System, VI-1935; A 21083, 13.3 cm, Aligura River, Doina, Pamirs, 21-VI-1913; A 20718, 8 cm, River Khorog, Pamirs, VII-1918; A 12494, 11 cm, Ba-Chu River, basin Boschboy, VIII-1900.

Distribution: Western Tibet, in the basin of the Indus River; probably also in the upper reaches of the Oxus River. A very wide range has been assigned to this species. Herzenstein (1888) divided this species into several subspecies, a division followed by Berg (1948). The material I examined from the Academy of Sciences in Leningrad reflected this subdivision, including material assigned to _N. stoliczkai_ (A 28926, A 25224), subspecies _tenius_ (A 26891, A 21083, A 20718), and _N. stenurus_ (A. 12494) which is usually given as a synonym of _N. stoliczkai_. Hora (122, 1936), in his discussions of the species, indicates that at least six, possibly up to ten species, have been included under this species name. None of the specimens I examined I would consider close to the species description given by Steindachner (1866) when he described the type species. I concur with Hora (1936) in his more limited distribution of _N. stoliczkai_.

References: Steindachner, 1866; Day, 1872, 1876, 1878; Zugmayer, 1910; Vinciguerra, 1916; Annandale, 1921; Hora, 1922, 1936; Berg, 1948; Vijayalakshmanan, 1949.

Noemacheilus rhadinaeus Regan 1906

Material examined: A 24413, 9.1 cm, Djellalabad, Helmand Delta, XI-1918.

Distribution: Basin of the Helmand River; Zhob District, Pakistan; Pakistani Baluchistan.

References: Regan, 1906; Zugmayer, 1913; Annandale and Hora, 1920; Berg, 1949; Banarescu and Nalbant, 1966; Mirza, 1972.

<u>Noemacheilus</u> <u>ghazniensis</u> Banarescu and Nalbant 1966

Material examined: None.

Distribution: Ab-i-Istadah Lake in the Helmand Drainage.

References: Banarescu and Nalbant, 1966.

<u>Noemacheilus</u> <u>lindbergi</u> <u>haarlovi</u> Banarescu and Nalbant 1966

Material examined: None.

Distribution: Helmand Basin, specimen from Kandahar in southern Afghanistan.

References: Banarescu and Nalbant, 1966.

<u>Noemacheilus</u> <u>brahui</u> Zugmayer 1912

Material examined: None.

Distribution: Sariab and Jungl Bagh streams, Pishin Lora River; Quetta, Kalat. Not confirmed from the adjoining Helmand Basin.

References: Zugmayer, 1912; Mirza, 1972; Banarescu and Nalbant, 1966.

<u>Noemacheilus</u> <u>farwelli</u> Hora 1935

Material examined: None.

Distribution: Helmand Basin.

References: Hora, 1935; Vijayalakshmanan, 1949; Banarescu and Nalbant, 1966.

<u>Noemacheilus</u> <u>kessleri</u> Gunther 1889

Material examined: None.

Distribution: Basin of the Helmand River; Lora River system in

Pakistani Baluchistan; Kushka River, tributary of the Murghab. Nikolsky (1899) reported this species from "Kelat-Marg in the area of Zirkuh," which is in the Sarbaz River drainage, and is separated from the rest of the range. He did not give a description of the specimen, and it has not been reported from that location by anyone else.

References: Gunther, 1889; Nikolsky, 1899; Annandale and Hora, 1920; Hora, 1933; Berg, 1933, 1948, 1949; Banarescu and Nalbant, 1966; Mirza, 1972.

Noemacheilus prashari Hora 1933

Material examined: None.

Distribution: From a spring near Kohat City; range overlaps that of *N. kessleri* and it may be, as Berg (1949) suggests, a synonym or at most a subspecies.

References: Hora, 1933; Berg, 1949.

Noemacheilus prashari lindbergi Banarescu and Mirza

Material examined: None.

Distribution: Loralai drainage; Panjgur, Rakhshan drainage, in Mashkel Basin; Sasol, Kolachi drainage, basin of the Indus River.

References: Mirza, 1972; Banarescu and Nalbant, 1966.

Noemacheilus montanus McClelland

Material examined: None.

Distribution: Himalayas; Simla. Berg (1949) list *N. bampurensis* as a synonym of *N. montanus* and gave the Bampur Basin as part of the distribution, but *N. bampurensis* differs considerably from the description of *N. montanus* and is, I believe, a different species.

References: Day, 1872, 1878; Berg, 1949.

Noemacheilus baluchiorum Zugmayer 1912

Material examined: None.

Distribution: Rakshan drainage, Mashkel Basin, on Pakistani-Iranian border; reported also from the Beji Drainage, a tributary of the Indus River. Banarescu and Nalbant (1966) report this species from the Helmand Basin, but the specimens they describe differ considerably in bodily proportions and development of the caudal peduncle from the type description.

References: Zugmayer, 1912, 1913; Hora, 1933; Banarescu and Nalbant, 1966; Mirza and Nalbant, 1970; Mirza, 1972.

Noemacheilus sargadensis Nikolsky 1899

Material examined: MMTT 171, 5.7 cm, Tangeh Sarrah, Baluchistan, 2-X-1971.

Distribution: This specimen is from Tangeh Sarrah, between Zahedan and Seistan. Nikolsky described the type from Sargad in eastern Persia, although it is not clear where that is. Berg (1949) mentions the species from Sarxad area in Kerman, and in Kuh-e-Taftan, which is a volcanic area south of Zahedan.

References: Nikolsky, 1899; Berg, 1949; 1948;Banarescu and Nalbant, 1966; Saadati, 1977.

Noemacheilus sargadensis turcmenicus Berg

Material examined: MMTT (Trip), 6.23 cm, Shah Abbas Qanat, Assadabad, 13-XI-1974.

Distribution: Basin of the Murghab River; Isolated basins of northeastern Iran between the Tedzhan -Murgab Rivers and the Helmand.

References: Berg 1932, 1948; Nikolsky, 1947; Saadati, 1977.

Noemacheilus sargadensis bampurensis Nikolsky 1899

Material examined: MMTT (Trip), 3.92 cm, Karavandar, Upper Bampur, 15-XI-1974; MMTT (Trip), 6.63 cm, Hoseeinabad and Gamatabad qanats, Bam, 18-XI-1974; MMTT (Trip), 4.64 cm, Mehtiabad qanat, Bam, 18-XI-1974; MMTT (Trip), 5.94 cm, Tahrud, 150 km west of Bam, 18-XI-1974; MMTT (Trip), 6.77 cm, qanat at Imamzadeh Sultan Sayad, Nezar to Baft, 19-XI-1974; MMTT (Trip), 4.7 cm, Baft River, Baft, 19-XI-1974; MMTT (Trip), 4.68 cm, Dahaneh Nuiz Rudan Rud, 21-XI-1974.

Distribution: Bampur Basin; southern Lut Basin. The type of N. sargadensis and the two subspecies turcmenicus and bampurensis show considerab le variability and overlap and it is probable there is just a single species covering the internal basins of eastern Iran. Banarescu and Nalbant (1966) described a collection from the Karun River System which they assigned to bampurensis. Their description differs considerably from bampurensis but is quite close to another form recently described from the area, to be discussed later. I believe their report of this subspecies in the Karun System is the result of a misidentification.

References: Nikolsky, 1899; Banarescu and Nalbant, 1966; Saadati, 1977.

Noemacheilus #1

Material examined: MMTT (Trip), 6.88 cm, Hoshun, qanat pool, Baft to Sirjan Road, Sirjan Basin, 19-XI-1974.

Distribution: Qanat in the isolated Sirjan Basin. Notable for a very low, elongate body, shape of mouth and elongate barbels.

References: Saadati, 1977.

<u>Noemacheilus</u> #2

Material examined: MMTT (Trip), 4.54 cm, Kol River, Hadjiabad, 20-XI-1974.

Distribution: Upper Kol River, Persian Gulf Basin. Close to *sargadensis* , but differs in a narrower caudal peduncle and some scales present on the caudal peduncle; at most, it would represent a separate subspecies.

References: Saadati, 1977.

<u>Noemacheilus</u> #3

Material examined: MMTT (Trip), 4.94 cm, Galash Kard, Minab Rud, 22-XI-1974.

Distribution: Minab Rud, Mekran Coast, Arabian Sea Basin. Notable because of the presence of minute scales, nostrils far back on the head, near the eye, and no dermal crest on the caudal peduncle.

Noemacheilus angorae Steindachner 1897

Material examined: USNM 143863, 7.08 cm, Ankara, Turkey, VII-1940.

Distribution: Ankara, Sakarya, Kizil-Irmak; Menderes; drainages of Tuz-Golu.

References: Steindachner, 1897; Hanko, 1924; Pellegrin, 1927; Gruvel, 1931; Banarescu and Nalbant, 1964; Banarescu 1968.

Noemacheilus angorae jordanicus Banarescu and Nalbant 1966

Material examined: None.

Distribution: Palestine.

References: Banarescu and Nalbant, 1966; Goren, 1974.

Noemacheilus angorae bergianus Derjavin

Material examined: MMTT (No Number), 5.34 cm, Ghareh Su, East Azerbaijan, 26-VIII-1974; MMTT (No Number), 6.93 cm, Kazem Chay, near Sarab, East Azerbaijan, 28-VIII-1974.

Distribution: Southern Caspian, basins of the Sefid-Rud and Araxes Rivers; Lake Rezaiyeh Basin.

References: Berg, 1948; Banarescu and Nalbant, 1966; Saadat, 1977.

Noemacheilus brandti Kessler

Material examined: MMTT (No Number), 8.62 cm, Arnar Chay, 26-VIII-1974.

Distribution: Basins of the Kura and Araxes Rivers; Basin of Lake Rezaiyeh.

References: Berg, 1948; Numann, 1966; Saadati, 1977.

Noemacheilus barbatulus (Linnaeus)

Material examined: None.

Distribution: Most of Europe; basins of the Baltic and Black Seas; some streams in the basin of the Caspian Sea.

References: Berg, 1948; Ladiges and Vogt, 1965.

Noemacheilus barbatulus caucasicus Berg

Material examined: None.

Distribution: Argun River, basin of the Terek; from the description, it would appear this is the same as N. merga.

References: Berg, 1948.

Noemacheilus merga (Krynicki)

Material examined: None.

Distribution: Basins of the Kuban, Kuma, Terek, Sulak, Shura-ozen, and Samur, in the Caspian Sea Basin.

References: Berg, 1948.

Noemacheilus #4

Material examined: OS 4272, (2), 5.866 and 6.126 cm, Jajehrud, I-1971; USNM 205921, (6), 3.02 to 4.12 cm, Baragon River, Karadj System, 12-XII-1970.

Distribution: Tehran, Semnan and Qom Basins. Close to N. angorae and probably a subspecies. If differs from N. angorae in the development of the caudal peduncle, height of body, location of the dorsal fin, larger eye and coloration. Differs from N. bergianus in a taller caudal peduncle (less than three vs more than three, height in length) and in the location of the dorsal fin.

References: Saadati, 1977.

Noemacheilus #5

Material examined: MMTT 460, 461, (2), (length of body) 5.3 cm, Siyahrud, Gilan, 7-VI-1971; MMTT 856, 7 cm, Shafarud, Gilan, 17-V-1973.

Distribution: Gilan coastal streams, Caspian Basin. Originally I keyed this to N. bergianus, which it resembles, but it differs in bodily proportions and fin developments. The ventral fin reaches past the vent. The height of the caudal peduncle is two in its length. It differs from any other form in the area in its head length and the body height proportions and in its fin development.

Noemacheilus cristatus Berg

Material examined: USNM 55906, 6.065 cm, Astrabad, 1896; A 35025, 6.5 cm, Neighbourhood of Gorgan, 21-V-1942.

Distribution: Rivers of Turkmenia flowing down the Kopet Dagh, in the basins of the Caspian and Aral Seas, including the Atrek, Gorgan, Tedzhan and Murghab Rivers.

References: Berg, 1948, 1949; Banarescu and Nalbant, 1966.

Noemacheilus longicauda (Kessler)

Material examined: A 25741, 7.3 cm, 20 km southwest of Stalinbad, 18-V-1930; A 28904, 5.8 cm, Tedzhan River, 21-XI-1933.

Distribution: Rivers of the Aral Sea.

References: Kessler, 1874; Berg, 1948, 1949.

Noemacheilus malapterurus (Valenciennes)

Material examined: MMTT (Trip), (2), 5.8 and 6.3 cm, Gara Chai, 36 km west of Arak, Dorud Bridge, 1-XII-1974; OS 5164, 7.374 cm, Namrud, Firouzkuh, VIII-1970; USNM 205922, (4), 5.905 to 14.7 cm, Baragon River, Karadj River, 12-III-1970.

Distribution: Tehran, Semnan and Qom Basins; probably also the Sefid-Rud and Caspian Sea Basins. Distribution and systematics of this species have been confused. Both cristatus and longicauda have been included as subspecies of malapterurus. The three are quite similar and may represent a single species; if so, the distribution would be quite broad, covering the Caspian, Aral and Namak Basins of Iran and adjoining countries to the east and north. Berg (1949) included N. macmahoni from the Helmand Basin as a synonym of malapterurus, but macmahoni is a synonym of rhadinaeus, not malapterurus, which is not found in the Helmand Basin. It has also been reported from "Syria" without more exact location, but has never been reported from there since.

References: Heckel, 1846; Berg, 1948, 1949; Svetovidov, 1949; Banarescu and Nalbant, 1964; Vladykov, 1964; Numann, 1966.

Noemacheilus tigris (Heckel)

Material examined: A 24098, (length of body) 4.05 cm, Kulikan, Dezful Area, 24-VIII-1904.

Distribution: Basins of the Tigris, Euphrates and Karun Rivers; Palestine.

References: Lortet, 1883; Tortonese, 1937/8; Berg, 1948, 1949; Banarescu and Nalbant, 1964; Banarescu and Nalbant, 1966; Banarescu, 1968; Goren, 1974; Saadati, 1977.

Noemacheilus tigris seyhanensis Banarescu 1968

Material examined: None.

Distribution: Asia Minor, Turkey, Ceyhan.

References: Banarescu, 1968.

Noemacheilus tigris cyri Berg

Material examined: A 16885, 5.34 cm, Kapske, Upper Kura, 31-X-1902; A 21332, 6.5 cm, Upper Kura, 8-VII-1890.

Distribution: Upper Kura River.

References: Berg, 1948.

Noemacheilus lendli Hanko 1924

Material examined: USNM 163539, 6.228 cm, Lake Emir, 18 km south of Ankara, 20-VIII-1953.

Distribution: Turkey; Asia Minor, Ankara Area, Basin of the Black Sea.

References: Hanko, 1924; Pellegrin, 1927; Berg, 1948; Banarescu and Nalbant, 1964.

Noemacheilus persa (Heckel) 1846

Material examined: MMTT (Trip), (3), 5.1 to 7.86 cm, Kur River, 80 km from Shiraz, 28-XI-1974.

Distribution: Endemic to the Lake Neyriz Basin. The report by Gunther (1899) and subsequent authors for the Lake Rezaiyeh Basin is probably due to a misidentification; the description given by Gunther matches N. brandti, present in the Lake Rezaiyeh Basin, but does not match N. persa.

References: Heckel, 1846; Gunther, 1899; Saadati, 1977.

Noemacheilus smithi Greenwood

Material examined: None.

Distribution: A blind cave fish found to date only from Lavan Village in the Tigris Basin.

References: Saadati, 1977.

Noemacheilus insignis Gunther

Material examined: None.

Distribution: Dead Sea Basin, northern end, Nahr-el-Kelt, Jericho.

References: Lortet, 1883.

Noemacheilus insignis tortonesei Banarescu and Nalbant 1966

Material examined: None.

Distribution: Eastern part of the Jordan River System.

References: Tortonese, 1938; Banarescu and Nalbant, 1966.

Noemacheilus insignis euphraticus Banarescu and Nalbant 1964

Material examined: MMTT (Trip), 6.05 cm, Haramabad River five km from Malayer, 1-XII-1974.

Distribution: Eastern and southern Anatolia; Basins of the Tigris, Euphrates and Karun Rivers.

References: Banarescu and Nalbant, 1964.

Noemacheilus panthera (Heckel)

Material examined: None.

Distribution: Widely distributed in the Middle East; reported in Palestine, Tigris, Euphrates and probably the Karun Rivers. Khalaf (1961) assigned forms from the Tigris and Karun Rivers to N. frenatus, but in all characters he gives his description matches N. panthera.

References: Heckel, 1846; Pellegrin, 1923; Gruvel, 1931; Tortonese, 1938; Khalaf, 1961; Banarescu and Nalbant, 1964; Goren, 1974; Saadati, 1977.

Noemacheilus argyrogramma (Heckel) 1846

Material examined: None.

Distribution: Palestine, Asia Minor, Basin Upper Euphrates River. Saadati (1977) reported this species from the Tigris Basin in Iran, but his description differs in several respects from the type: dorsal ray 9-10 vs 8-9; lower caudal peduncle (2 vs 1.5 in length), length of snout (44-47% vs 34-40% of head length); other measurements needed for comparison were not given.

References: Heckel, 1846; Sauvage, 1882; Pellegrin, 1923; Khalaf, 1961; Banarescu and Nalbant, 1964; Banarescu, 1968; Saadati, 1977.

Noemacheilus kermanshahensis Banarescu and Nalbant 1966

Material examined: None.

Distribution: Karun River, basin of the Seymareh River.

References: Banarescu and Nalbant, 1966; Saadati, 1977.

Noemacheilus tschaiyssuensis Banarescu and Nalbant 1964

Material examined: None.

Distribution: Asia Minor; Tshaiy-Su, Ceyhan.

References: Banarescu and Nalbant, 1964.

Noemacheilus galileus (Gunther)

Material examined: None.

Distribution: Lake Tiberius.

References: Gunther, 1864; Lortet, 1883.

Noemacheilus leontinae Lortet 1883

Material examined: None.

Distribution: Lake Tiberius.

References: Lortet, 1883.

Noemacheilus #6

Material examined: MMTT 524-529, (6), 5.2 cm, Gamasiab, Bisutun, 28-VIII-1972.

Distribution: Basin of the Karun River. Body scaled, with no dermal crest. Origin of dorsal fin in middle of body. Height of caudal peduncle 1.3 (2.2 in immature specimens) in length. Caudal moderately emarginate.

References: Saadati, 1977.

Noemacheilus #7

Material examined: OS (No Number), 5.93 cm, Luristan, Khorramabad, III-1971.

Distribution: Khorramabad River, basin of the Karun River. No scales, no dermal crest. Dentiform process well-developed. Pectoral fin long, almost reaching vent. Height of caudal peduncle 1.8 in length. Saadati (1977) reported a very similar form from the Qara-Su in the Karun Basin; principal difference is the origin of the dorsal fin, in his form it is closer to the caudal fin than the end of the snout, in mine the origin is near the middle of the body, but closer to the end of the snout.

References: Saadati, 1977.

Noemacheilus #8

Material examined: None.

Distribtuion: Seymarreh River.

Reference; Saadati, 1977.

Noemacheilus #9.

Material examined: None.

Distribution: Lower Tigris and Euphrates Rivers. I am including in this species two reports from the same area that appear to be the same form but which were identified as other species. As mentioned earlier, Banarescu and Nalbant (1966) reported on specimens they gave as N. bampurensis but which did not match the description of that species. Khalaf, (1961) reporting on specimens from Sinjar in Iraq, identified them as N. angorae, as species never found in the basin and which, from his description, appears to be misidentified. The descriptions given by both Banarescu and Nalbant and Khalaf, however, are quite similar, are from the same general area, and seem to represent the same, unnamed species.

References: Khalaf, 1961; Banarescu and Nalbant, 1966.

Turcinoemacheilus kosswigi Banarescu and Nalbant 1964

Material examined: None.

Distribution: Southeastern Anatolia, Basin of the Tigris River. This genus, with one species, was separated primarily on the origin of the ventral fin, which is in front of the origin of the dorsal fin, while the opposite is generally the case in *Noemacheilus*. Of more interest, I believe, is the very low, elongate and flattened body and head.

References: Banarescu and Nalbant, 1964.

Misgurnus fossilis (Linnaeus)

Material examined: None.

Distribution: Europe; Basins of the North and Baltic Seas; Black Sea Basin from the Danube and Don Rivers; Volga River; Caucasus, Transcaucasus, Turkestan. In the packing list of Iranian fish sent to Oregon State University there is a listing for this species from "Ghaleh Rudkhan" collected and identified by V. Vladykov. I was not able to find the specimen in the material sent. If this specimen were from Iran and the identification confirmed, it would represent the first collection from Iranian waters.

References: Berg, 1948.

DIVISION II. SILURI

SUBORDER VI. SILUROIDEI

FAMILY X. TACHYSURIDAE (IV)

Tachysurus thalassinus (Ruppell)

Material examined: I have seen several specimens of this species but have made no measurements; MMTT has specimens from Chahbahar, lower Sarbaz River.

Distribution: Seas of Africa, through the Red Sea, Persian Gulf, seas of India to the Malay Archipelago and beyond. Ascends tidal rivers. Found in the Tigris-Euphrates-Karun Delta and the streams of the Mekran Coast of Iran. Sometimes placed in the family Ariidae.

References:Day, 1878; Basset-Smith, 1897; Blegvad, 1944; Chandy, 1953; Misra, 1947; Fowler, 1956.

FAMILY XI. SILURIDAE (II)

Silurus Linnaeus

This genus is found primarily in Asia, with two species reaching into Europe. They are common in the Sarmatian and Mesopotamian faunas of Iran, but are little sought after because of the lack of visible scales, Islam prohibiting the eating of scaleless fishes.

Silurus glanis Linnaeus

Material examined: MMTT 68, 39.2 cm, Araxes Dam, XII-1971; MMTT, 72, 73, (2), 32.5 cm, Nowruzlu Dam, Zarrineh Rud, 15-VI-1971; MMTT 951, no length, Shahpour Aval Reservoir, 2-VIII-1974; OS 4278, (2), 26 and 31.465 cm, Zarrinehrud, Azerbaijan, II-1971.

Distribution: Rivers of Europe; Basins of the Baltic, Black, Caspian and Aral Seas. In Iran, found throughout the Caspian Sea Basin, Azerbaijan and the Lake Rezaiyeh Basin. Very common.

References: Kessler, 1874; Steindachner, 1897; Gunther, 1899; Berg, 1948; Nikolsky, 1954; Fowler, 1956.

<u>Silurus</u> <u>triostegus</u> Heckel

Material examined: None.

Distribution: Most of the Tigris and Euphrates Rivers in Syria and Iraq. It would be expected in Iran but has not been reported there to date. This species is sometimes included as a synonym of <u>S.</u> <u>asotus</u> (Linnaeus, 1758), a species widespread in the Palearctic. This and the following species are sometimes placed in a separate genus, <u>Parasilurus</u>; I have followed Haig (1950) who revised the genus and placed these two species under <u>Silurus</u>.

References: Gunther, 1874; Berg, 1949; Khalaf, 1961.

<u>Silurus</u> <u>chantrei</u> Sauvage 1882

Material examined: None.

Distribution: Sauvage (1992, 1884) gives the location as "Kura at Tiflis" but it has never been reported there by others. Berg (1949), without explanation, indicates the actual location of the collection was probably Syria or the Tigris Basin; it has not ben taken by others at these locations either. Based on its description and comparison to similar forms, the Mesopotamian fauna would be the more likely location.

References: Sauvage, 1882, 1884; Berg, 1949, Haig, 1950.

Wallago attua (Bloch)

Material examined: None.

Distribution: India, Ceylon, Burma, Pakistan; in Pakistan, found in Baluchistan. The report by Zugmayer (1913) is incorrect (Mirza, 1972).

References: Day, 1878; 1880; Vinciquerra, 1890; Zugmayer, 1913; Berg, 1949; Haig, 1950; Mirza, 1972.

FAMILY XII. BAGRIDAE (II)

Mystus Scopoli

This family is common in Asia and Africa. They have the unusual behaviour of feeding in an upside-down position. Only one genus, Mystus, is found in Iran. It is commonly listed as Macrones instead of Mystus.

Mystus pelusius (Solander)

Material examined: USNM 48018, 15 cm, Lake Antioch, n.d., received from the Lyon Museum.

Distribution: Lake Antioch; Oronte; Palestine.

References: Sauvage, 1882; Pellegrin, 1923; Gruvel, 1931; Berg, 1949; Jayaram, 1954.

Mystus pelusius colvillii (Gunther) 1874

Material examined: MMTT 152, 20 cm, Karun River, III-1971; OS (No Number), 15.7 cm, Karun River, Khuzistan, III-1971.

Distribution: Lower Tigris, Euphrates and Karun Rivers.

References: Gunther, 1874; Jayaram, 1954; Jayaram, 1955; Khalaf, 1961.

Mystus cavasius (Ham. Buch.)

Material examined: A 6521, (length of body) 10.75 cm, Kistna, India, 1882.

Distribution: India, Assam, Burma, Sind, Punjab, NWF Province, Pakistan. Very close to M. pelusius.

References: Day, 1878; Zugmayer, 1913; Mirza, 1972.

FAMILY XIII. SISORIDAE (II)

This family is found in India, Southeast Asia and the Middle East. One species has also been reported from the headwaters of the southern Aral Sea Basin. It is quite similar to Bagridae.

Glyptothorax Blyth

This is the only genus found in Iran. The genus is composed mostly of small, hill-dwelling species that thrive in swift waters. The thorax is covered by an adhesive apparatus composed of longitudinal plaits of skin. Both Glyptothorax and Glyptosternum have been used as the genus name, but Glyptothorax has precedence.

Glyptothorax armeniacum (Berg)

Material examined: None.

Distribution: The distribution is unclear. The type specimen was from "Muchlasi-Darasi, near Chuta, 42 km southeast of Erzerum," (Berg, 1931). However, 42 km southeast of Erzerum is in the Araxes River Basin, not in the Euphrates Basin as Berg states. Since no other member of the family has ever been found in the Black or Caspian Sea Basins, it is probable the type was taken from the Euphrates headwaters near Erzerum, but not in the exact location as given.

References: Berg, 1931, 1948, 1949; Ladiges, 1964.

Glyptothorax steindachneri (Pietschmann)

Material examined: None.

Distribution: Tigris River at Mosul.

References: Berg, 1931, 1949; Ladiges, 1964.

Glyptothorax kurdistanicum (Berg) 1931

Material examined: MMTT 406, 11.33 cm, Khorramabad, X-1970; MMTT 997, 28.6 cm, Dez River, Andimeshk to Dezful, 5-XI-1974; Shilot, 13.5 cm, Khorramabad River, X-1970.

Distribution: Basin of the Karun River. While I have not seen *steindachneri*, the specimens of *kurdistanicum* I examined were quite close to that species. The distributions are adjoining, and they are probably all part of a single species.

References: Berg, 1931, 1949.

FAMILY XIV. CLARIIDAE (II)

This family is composed of many species in the freshwaters of Asia and Africa. The air bladder is represented by two sacs that connect by a duct to the esophagus and which can function for air breathing. Two genera are found in the Middle East, *Clarias* and *Heteropneustes*.

Clarias lazera Cuv. Val.

Material examined: None.

Distribution: Palestine.

References: Sauvage, 1882, 1884; Lortet, 1883; Vinciguerra, 1926; Gruvel, 1931; Goren, 1974.

Heteropneustes fossilis (Bloch)

Material examined: A 8255, 21 cm, Oriental India, n.d.; A 29053, 19.77 cm, Calcutta Market, n.d.

Distribution: Freshwaters of Pakistan, India, Burma and China. Khalaf (1961) made the first report of this species from the Middle East, from Iraq. Unfortunately, he does not describe his specimens but quotes Day's description (1878) instead. Two closely related forms were among the material I examined, but I do not know how they relate to Khalaf's specimens.

References: Day, 1878; Vinciguerra, 1890; Hora, 1935; Khalaf, 1961.

Heteropneustes #1

Material examined: MMTT 78, 26.4 cm, Karun River, 3-VIII-1971; OS (No Number), (2), 17.8 and 21.8 cm, Karun River, Khuzistan, III-1971; Shilot, 19.1 cm, Dez River, 1971.

Distribution: Lower Karun River Basin, Iran. Differs from H. fossilis in the size and form of the mouth, development of the barbels and fin ray counts.

Heteropneustes #2

Material examined: USNM (No Number), (3), 4.915 to 7.895 cm, Marsh, west of Susangir, Iran-Iraq Border, n.d.

Distribution: Marshes of the lower Karun River delta. Notable for its elongate head, which is only 3/4 of its length, very low body, length of barbels and fin ray counts.

ORDER VII. ANGUILLIFORMES

FAMILY XV. MURAENESOCIDAE (IV)

Muraenesox cinereus (Forskäål)

Material examined: I have seen but not studied this species.

Distribution: Red Sea, Persian Gulf, through the seas of India to the Malay Archipelago, Philippines, China, and Japan. Enters brackish and freshwater.

References: Day, 1878; Blegvad, 1944; Fowler, 1956.

ORDER VIII. GADIFORMES

FAMILY XVI. GADIDAE (IV)

Lota lota (Linnaeus)

Material examined: I have seen many examples of this species but have not studied any of them.

Distribution: Europe, Northern Asia, Rivers of the northern Caspian Sea and in the Caspian Sea; occasionally found in the lower Kura and Sefid Rud Rivers. The order and family to which this species belongs are primarily marine fishes of the nothern and southern hemispheres. This species is widespread in the Holarctic, being found in Asia, Europe and North America.

References: Berg, 1948; Nikolsky, 1954; Vesery-Fitzgerald and LaMonte, 1949.

ORDER IX. GASTEROSTEIFORMES

FAMILY XVII. GASTEROSTEIDAE (III)

These are primarily small fishes of the freshwater and brackish marine waters of temperate latitudes. A single species is found in the freshwaters of Iran. This species, *Pungitius platygaster*, is located in the Caspian Sea, and is shared with the Black Sea. A subspecies is found in the Aral Sea. Other species of the genus are found in the waters of Europe, northern Asia and North America.

Pungitius platygaster (Kessler)

Material examined: USNM 205923, 4.371 cm, Pahlevi Mordab, 23-V-1970.

Distribution: Basins of the Black and Caspian Seas; subspecies found in the Aral Sea.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

ORDER X. SYNGNATHIFORMES

FAMILY XVIII. SYNGNATHIDAE (IV)

Syngnathus nigrolineatus caspius Eichwald

Material examined: MMTT 425, 426, (2), no lengths, Bandar Pahlevi, 24-V-1970; OS 4268, (3), 5.93 to 6.5 cm, Pahlevi Mordab, VIII-1971.

Distribution: The order to which this species belongs is composed primarily of marine fishes of tropical and temperate seas. The type species, S. nigrolineatus was described from the Black Sea. The subspecies caspius is found throughout the Caspian Sea Basin.

References: Eichwald, 1841; Berg, 1948; Zenkevich, 1957.

ORDER XI. CYPRINODONTIFORMES

FAMILY XIX. CYPRINODONTIDAE (III)

This family is widespread in Asia, Africa and North America. They are highly tolerant of saline conditions. In Iran, they are found in most basins in the southern and western regions of the country.

Aphanius Nardo

This genus is found throughout the shores of the Mediterranean Sea, Red Sea and Persian Gulf and in the rivers currently or formerly draining into these seas. It is the only genus found in Iran. We found specimens in water so saline salt crystals covered the bottom of the pools, and in hot springs over 40°C. The systematics of the genus are unclear, particularily in southern Iran where there have been a number of populations from isolated springs described as separate species. The genus shows sexual dimorphism.

Aphanius mento (Heckel)

Material examined: None.

Distribution: Palestine; Mosul; Oronte; Damascus; Asia Minor. The specimens in the Academy of Sciences, Leningrad, from Basra, assigned by Berg (1949) to this species are closer to A. sophiae. Dr.Behnke (reported in Saadati, 1977) described specimens collected in the Isfahan Basin by Woodward-Clyde Consultants that he assigned to this species.

References: Heckel, 1846; Lortet, 1883; Pellegrin, 1923; Hanko, 1924; Gaillard, 1895; Garman, 1895; Tortonese, 1938; Berg, 1949; Goren, 1974; Saadati, 1977.

Aphanius chantrei Gaillard 1895

Material examined: None.

Distribution: The type was described from Asia Minor. Other authors have extended the distribution to the Dead Sea and Persia, but it is probable they were confusing this species with other species. The length of the teeth seem to be the principal reason for separating this species from A. mento, with which it agrees in other respects, and which shares an overlapping range.

References: Gaillard, 1895; Hanko, 1924; Tortonese, 1938.

In 1846 Heckel described three species of Aphanius from the Maharlu Basin, the first being A. sophiae. Since then, specimens from throughout Persia and the Tigris-Euphrates Basins have been assigned to this species. There are differences between populations within this range. I have not seen enough material to confidently separate the various forms, but shall mention some of these forms that differ from the type description but which have been assigned at one time or another to A. sophiae.

Aphanius sophiae (Heckel) 1846

Material examined: A 25425, (2), 3.26 cm, Basra, Mesopotamia, 25-II-1914; A 25413, (2), 3.45 cm and 4.4 cm, Basra, Syria, 28-II-1914.

Distribution: The type was described from springs near Persepolis in the Neyriz Basin; the species is found in the isolated basins of southwestern Iran and the Tigris and Euphrates Rivers.

References: Heckel, 1846; Garman, 1895; Gaillard, 1895; Jenkins, 1910; Pellegrin, 1923; Hanko, 1924; Gruvel, 1931; Berg, 1949; Fowler and Steinitz, 1956; Villwock, 1960; Khalaf, 1961.

Aphanius punctatus (Heckel) 1846

Material examined: None.

Distribution: Heckel (1846) described this species from the springs at Sa'adi's Tomb; we did not find it at that location when we made collections in 1974. Heckel's cystallodon was taken from the same basin from a spring near Lake Maharlu. The species described by Jenkins (1910) as *persicus* was also from a spring adjoining lake Maharlu. Jenkins described *A. blanfordii* from "east of Shiraz," but it is not clear where this site is located since the city of Shiraz is on the eastern edge of the Maharlu Basin and the next waters to the east of Shiraz with any *Aphanius* is the Kur River Basin, Lake Neyriz Basin. The description given by Jenkins is close to *punctatus*.

References: Heckel, 1846; Garman, 1895; Jenkins, 1910; Tortonese, 1934.

Aphanius danfordii Boulenger 1890

Material examined: None.

Distribution: Asia Minor at Albistan. A note in Boulenger (1890) says *A. dispar* was taken at the same location. From the description, this species is quite close to *A. sophiae*, but the distribution of the two species is quite disjointed.

References: Boulenger, 1890.

Aphanius #1

Material examined: MMTT 687, (2), (length of body) 2.57 and 2.78 cm, Cheshmeh Ab-garm, Lake Neyriz Basin, 1-VI-1973.

Distribution: Hot springs adjoining Lake Bakhtegan, Lake Neyriz Basin. Similar to *A. sophiae* described from the same basin, but differs in having more unbranched dorsal rays (III vs I) and fewer branched rays (9 vs 11-13); in the latter character, this form is closer to the description of *A. punctatus*.

<u>Aphanius dispar</u> (Ruppell)

Material examined: A 25401, 3.32 cm, Basra, Mesopotamia, 28-II-1914; A 2575, 7.1 cm, Kaseir on the Red Sea, 1787, collected by Klunzinger; USNM 147951, (2), 3.315 and 3.75 cm, Bahrain, 12-VI-1948; USNM 147952, 4.6 cm, Al Bainey Island, 8-VI-1948; MMTT (Trip), (2), 4.9 cm, Gudar River, Bastak to Lar Road, three km east of Anveh, 25-XI-1974; MMTT (Trip), (4), 4.64 cm, Mehran River, four km below Bastak, 24-XI-1974.

Distribution: Coastal areas and tributaries of the Persian Gulf and Red Sea. Highly tolerant of saline waters. The fins are longer in the male than in the female according to Lortet (1883), but in the specimens I looked at the opposite was the case. In some, both the anal and ventral fins fell far short of the base of the caudal; in others, the anal reached almost to the base of the caudal, while the ventral fin reached only to the vent. In females, the anal, ventral and dorsal fins were rounded; in the male, the dorsal and anal were rounded, but the ventral fin pointed. The dorsal fin origin was in the middle of the body, or midway between the head and base of the caudal. There seems to be some confusion on fin lengths and whether the pectoral is pointed in the males or females; the specimens I looked at matched the description given by Garman (1895) in his revision of the genus, but were the reverse of Lortet's description.

References: Day, 1878; Garman, 1895; Gaillard, 1895; Lortet, 1883; Holly, 1929; Tortonese, 1938; Blegvad, 1944; Mendelsohn, 1947; Fowler, 1956; Khalaf, 1961.

Aphanius dispar richardsoni (Boulenger)

Material examined: None.

Distribution: Dead Sea Basin, Palestine, southern Syria. This subspecies was described from the basin of the Dead Sea. It has been reported variously from other localities. In general, it corresponds well with the type of A. dispar and is probably not a separate form. The principal difference given is a more elongate body, which is found in other populations of A. dispar.

References: Richardon, 1856; Gaillard, 1895; Garman, 1895; Tortonese, 1938; Berg, 1949; Goren, 1974.

Aphanius dispar stoliczkanus (Day)

Material examined: A 11713, (2), 3.53 and 3.96 cm, Bampur River, Kerman, 1898, part of Zarudny's collection; A 8305, (1), no length, Cutch, 1889; Shilot, (2), 4.9 and 7.29 cm, Qeshm Island, IV-1971; OS (No Number), 5.476 cm, Qeshm Island, saline springs, III-1971.

Distribution: Bampur Basin (taken by Zarudny, but not collected there since); Panjgur, Dashte and Las Bela Basins, Pakistan; Coastal streams in the Mekran of Iran; Qeshm Island, saline springs.

References: Day, 1878; Nikolsky, 1899; Zugmayer, 1913 Berg, 1949; Mirza, 1972.

Aphanius ginaonis (Holly) 1929

Material examined: MMTT (Trip), (3), 3.47 cm, Ab-Genu, hot spring north of Bandar Abbas, 20-XI-1974.

Distribution: Restricted to the Ab-Genu hot spring, Kol River Basin, north of Bandar Abbas. Berg (1949) included this species as a synonym of A. dispar stoliczkanus, but it is clearly a different species, differing in the number of dorsal fin rays (4-6 branched rays vs 7-8), length of head (32-35% vs 25-28%) and the very posterior origin of the dorsal fin. The spring it lives in is quite hot, well over 50°C in the middle; the fish lived in the cooler, quieter waters along the sides but would dart into the hotter water.

References: Holly, 1929; Berg, 1949; Saadati, 1977.

Aphanius #2

Material examined: MMTT (Trip), 4.54 cm, Sarageh River, 55 km north of Bandar Abbas, 20-XI-1974.

Distribution: Kol River Basin, about 25-30 km upstream from the Ab-Genu hot spring. Water here is highly saline, with salt crystals on the bottom of the stream channel. Quite close to *A. dispar* and is probably a subspecies of that species. Notable for the low body (26% of body length), length of head (29% of body length), 14 teeth on the lower jaw, D I 7, A II 9, and truncate caudal fin.

Aphanius #3

Material examined: MMTT (Trip), Galash Kard Lake, Minab Basin of Mekran Coasts, 4.12 cm.

Distribution: Mekran Coasts, Minab River. D I 9, A I 9, 14 teeth in lower jaw; fin rays and teeth differ from described subspecies of *A. dispar*; quite similar to the form from the Kol River.

Aphanius #4

Material examined: USNM 147834, (2), 6.4 and 6.879 cm, El Azzizia, Persian Gulf, 28-VII-1948.

Distribution: El Azzizia, Persian Gulf; I have not been able to locate this site, but other specimens collected about the same time from the Persian Gulf were from Bahrain and neighbouring areas. The teeth and fin ray counts are like _A. sophiae_ (teeth 14-16, shaped like _sophiae_ , D I 11-13; A I 8-9); in other respects, like _A. dispar_.

Aphanius #5

Material examined: None.

Distribution: Rud-e-Shur, Qom Basin. Barry Nehring (as reported by Saadati, 1977) reported taking _Aphanius_ from the Qom Basin. If confirmed, this would represent the first report of this genus from the Sarmatian Fauna. No description of this form is available.

References: Saadati, 1977.

FAMILY XX. POECILIIDAE (III)

Two subspecies of this family were introduced into Iran from the United States in the 1960s as part of an anti-malaria campaign. I have seen specimens from the Caspian, Karun and southern Iranian Basins. It is well-established in all faunal regions of Iran. The two subspecies in Iran are _Gambusia affinis affinis_ (Baird and Girard) and _G. affinis holbrooki_ Girard

ORDER XII MUGILIFORMES

FAMILY XXI. MUGILIDAE (IV)

The mullets are coastal fishes of marine, less often freshwater, tropical and subtropical seas. One genus, _Mugil_, is found in Iran. Several marine species enter freshwater streams along the coasts of the Persian Gulf and Gulf of Oman. _Mugl_ is found also in the Caspian Sea, but is not native, having been introduced in this century to provide additional species for commercial fishing. The only native freshwater species are found in the waters of the Tigris, Euphrates and Karun Rivers.

<u>Mugil</u> <u>auratus</u> Risso

Material examined: USNM 205889, 5.67 cm, Bandar Pahlevi, I-1970; OS 4267, 9.713 cm, Bandar Pahlevi, I-1966.

Distribution: Native to the Mediterranean Sea, Black Sea Basin, Atlantic Ocean from England to South Africa. Introduced into the Caspian Sea where it has become abundant, forming an important commercial fishery.

References: Berg, 1948; Nikolsky, 1954; Zenkevich, 1957.

<u>Mugil</u> <u>saliens</u> Risso

Material Examined: I have seen but not studied this species.

Distribution: Native to the Mediterranean Sea, Atlantic Ocean and Black Sea; enters rivers. It has been introduced into the Caspian Sea; taken in the commercial but in limited numbers.

References: Berg, 1948; Kozhin, 1957; Zenkevich, 1957.

<u>Mugil</u> <u>cephalus</u> Cuv.

Material examined: I have seen but not studied this species.

Distribution: Black, Mediterranean, Red Seas; throughout much of the southern Atlantic and Indian Oceans; Persian Gulf. Along the coasts of the Gulf of Oman it enters rivers. It was transplanted from the Black Sea into the Caspian Sea.

References: Day, 1878; Berg, 1948; Mirza, 1972.

Mugil abu Heckel 1846

Material examined: I have not seen this species.

Distribution: The type was collected at Mosul from the upper Tigris River. It has been reported at various locations from the Tigris, Euphrates and Karun Rivers, but this may include confusion with the subspecies M. abu zarudnyi.

References: Heckel, 1846; Gruvel, 1931; Berg, 1949.

Mugil abu zarudnyi Berg 1949

Material examined: A 24336, (2), 8.85 cm, Ser-i-Pul, 30 km from Malamir, upper Karun River, TYPE SPECIMEN, 17-III-1904; A 31226, 15.5 cm, Doroga, Dezful-Ahwaz, near Sol-Kheirafa, 60 km from Ahwaz, Karkheh River System, 21-V-1943; Shilot, 20 cm, Dez River, XII-1971; MMTT 338-340, (3), 17.4 cm, Dez River, XII-1971.

Distribution: Karun River; lower Tigris and Euphrates Rivers. The specimens I looked at showed considerable variability. It may be that with more material it will be found that zarudnyi is not a valid subspecies and that a single, variable species is found throughout the Tigris, Euphrates and Karun Rivers.

References: Berg, 1949; Khalaf, 1961.

Mugil #1

Material examined: MMTT 851, 852, (2), 21 cm, Parishan Lake, 7-XII-1973.

Distribution: Parishan Lake, Karun River Basin. Differs from M. abu in the Karun Basin in the fin development, smaller eyes and the formation of the scales on the head.

Mugil dussumieri Cuv.

Material examined: A 8155, no length, (1), Madras, India, 1889.

Distribution: Northern Indian Ocean, from the Persian Gulf to the seas of Australia and the Philippines. In the Persian Gulf, it enters fresh water.

References: Day, 1878; Kennedy, 1937; Tortonese, 1934; Blegvad, 1944; Randall, Allen and Smith-Vaniz, 1978.

Mugil oligolepis Bleeker

Material examined: None.

Distribution: Seas of India to the Malay Archipelago. Khalaf (1961) reported this species from the Shatt-el-Arab.

References: Day, 1878; Khalaf, 1961.

Mugil waigiensis Quoy and Gaimard

Material examined: MMTT 410, (1), no length, Konarak, X-1971.

Distribution: From the Red Sea through the seas of the northern Indian Ocean to China and beyond. Ascends rivers. *M. waigiensis* and *M. oligolepis* are very similar, and, in fact, may be the same species, differing principally in the higher body, thinner lips and fin coloration in *M. oligolepis*. Khalaf, in his description of his specimen he assigned to *oligolepis* indicated they had thick lips and black on the fins as in *waigiensis*, but that the height was as in *oligolepis*. While *waigiensis* has been reported previously in the Persian Gulf, and is known to ascend rivers, *oligolepis* has only been reported further to the east and has not been previously reported to enter rivers.

References: Day, 1878; Khalaf, 1961.

Mugil speigleri Bleeker

Material examined: OS 4281, 30.1 cm, Kolani, Sarbaz River, X-1971.

Distribution: Seas of northern Indian Ocean from Persia to the Malay Archipelago. Mekran coasts of Iran and Pakistan where it enters rivers.

References: Day, 1878; Zugmayer, 1913; Mirza, 1972.

FAMILY XXII. ATHERINIDAE (IV)

These are small coastal fishes found in the tropical and subtropical seas. Less often they are taken in freshwater. The only genus in Iran is *Atherina*, found in the Caspian Sea.

Atherina mochon pontica caspia Eichwald

Material examined: OS 4266, (2), 10.904 and 11.976 cm, Bandar Pahlevi, XII-1969.

Distribution: The type species is found in the Black Sea. The form *A. mochon pontica caspia* is found in the Caspian Sea Basin along all shores; it enters freshwater streams in the Lenkoran Coasts.

References: Eichwald, 1841; Berg, 1948; Nikolsky, 1954.

ORDER XIII. CHANNIFORMES

FAMILY XXIII. CHANNIDAE (I)

This family is common in southern Asia and the Indo-Malay Archipelago, China and eastern Asia, and in Africa. Only one genus, *Ophiocephalus*, has been collected in Iran, in the Bampur River Basin. The family would be expected also along the Mekran Coasts but has not been taken there to date.

Ophiocephalus gachua Ham. Buch.

Material examined: None.

Distribution: Throughout the submontane regions of Pakistan, India, Burma, Ceylon, Indochina; in Pakistan, from the Kalat District, Turbat, Kundlani, Dashte Basin in Mekran District; in Iran, reported only from the Bampur Basin.

References: McClelland, 1842; Day, 1878, 1880; Nikolsky, 1899; Zugmayer, 1913; Hora, 1923; Berg, 1949; Mirza, 1972; Coad, 1977.

ORDER XIV. PERCIFORMES

SUBORDER VII. PERCOIDEI

FAMILY XXIV. PERCIDAE (III)

Members of this family are freshwater fishes of the northern hemisphere, found in Europe, Asia and North America. In Iran there are three genera, all found only in the Caspian Sea Basin. All three are allied with the fishes of Europe, northern Asia and the Black Sea. In the Caspian Sea they are important commercial species and have been subjected to heavy fishing pressure.

Stizostedion Rafinesque

This genus contains several species in Europe, Asia and North America. In Iran, it is confined to the Caspian Sea Basin.

Stizostedion lucioperca (Linnaeus)

Material examined: MMTT 331, (1), no length, Bandar Pahlevi, 24-V-1970; OS 4012, 31.35 cm, Nahan Roga River, Pahlevi Mordab, IV-1971; USNM (No Number), (3), 21.4 to 40 cm, Bandar Pahlevi, 25-V-1970. I have seen this species often in commercial catches and in catches by local fishermen, especially in the Pahlevi Mordab.

Distribution: Aegean, Black and Caspian Sea Basins; Europe; in Iran, found in the Caspian Sea, the Mordabs and the larger rivers.

References: Kessler, 1874; Berg, 1948; Kozhin, 1957; Zhadin and Gerd, 1961; Sterba, 1966.

Stizostedion marina (Cuvier)

Material examined: None.

Distribution: Northwestern Black Sea, Caspian Sea. In the Caspian Sea it never enters rivers; it is spread mainly along the eastern coasts. When spawning, the greatest numbers are along the shores of Turkmenia, next to Azerbaijan and at Mangyshlak. Occasionally taken in commercial catches in Iran, but I have seen only a few in the catches I have examined.

References: Eichwald, 1841; Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Perca Linnaeus

This genus is widely distributed in Europe, northern Asia and North America. It is a very popular food fish.

Perca fluviatilis Linnaeus

Material examined: USNM 205928, (3), 11.076 to 18 cm, Ab-Kenar, Pahlevi Mordab, 19-II-1970; USNM (no Number), (2), 12 and 13.9 cm, Bandar Pahlevi, 24-V-1970; OS 4302, (2), 16.7 and 20.1 cm, Pahlevi Mordab, IV-1967; MMTT 371, 15.72 cm, Pahlevi Mordab, 19-II-1970. I have seen many more examples of this species in commercial and private catches.

Distribution: Europe; Caspian, Aral, Baltic and White Seas; in the Caspian, eters rivers. Black Sea Basin. A subspecies is found in North America.

References: Kessler, 1874; Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Acerina Cuvier

This genus contains three species in Europe and Asia. Lhe most widely distributed species is A. cernua, which is found throughout much of Asia and Europe.

Acerina cernua (Linnaeus)

Material examined: None.

Distribution: Europe, Baltic Sea, Siberia, Rivers of the northern Caspian and Black Seas, Aral Sea Basin. Rarely encountered in Iranian waters.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

FAMILY XXV. CICHLIDAE (III)

This family is found in fresh and saline waters of Africa, America, Western Asia and India. It has not been previously reported from Iran, although present in Palestine and India. The first collections were taken by biologists from the Department of the Environment from the "Salt River, Fars', without more exact location. In addition, we collected this family from the Kol River, in the Persian Gulf Basin, 1974. I examined the specimens we took that were left in Tehran. Saadati (1977) discussed those specimens we shipped to the United States. The two collections are similar but sufficiently different to be considered separate species or subspecies. The Iranian forms are sufficiently different from known members of the family to be considered a separate genus. They are closer to the Palestinian and African species than to the Indian species. The cichlids in India are represented by a single genus, Etroplus, which is quite different from other genera of the family. It is located at the lower portion of the Indian Peninsula, and probably represents an isolated population of the family long separated from other members of the family. In Palestine there are nine species, three of which are found also in Africa.

I am aware of a fairly recent revision of the cichlids but have not been able to obtain the reference so will use the systematic arrangement in use preceding the revision. The species remained the same but the genera have been reorganized.

Tilapia Smith

This genus is found in the waters of Africa and Palestine.

Tilapia galilaea (Artedi)

Material examined: USNM 48016, 9.2 cm, Lake Tiberias, n.d., TYPE SPECIMEN, obtained from Lyon Museum, of Chromis microstomus, Lortet 1883, a synonym.

Distribution: Lake Tiberias.

References: Lortet, 1883; Vinciguerra, 1926; Gruvel, 1931; Tortonese, 1938; Trewavas, 1942; Ben-Tuvia, 1960; Goren, 1974.

Tilapia nilotica (Linnaeus)

Material examined: A 6698, 10.66 cm, Hasselgu, 1883.

Distribution: East and west Africa; Lake Tiberias; coastal streams of Palestine.

References: Steindachner, 1864; Lortet, 1883; Vinciguerra, 1926; Gruvel, 1931; Tortonese, 1938; Trewavas, 1942; Ben-Tuvia, 1960; Goren, 1974.

Tilapia aurea (Steindachner) 1864

Material examined: None.

Distribution: Lower Nile, Lake Chad, West Africa, Palestine.

References: Steindachner, 1864; Lortet, 1883; Tortonese, 1938; Steinitz, 1951; Goren, 1974.

Tilapia zillii (Gervais)

Material examined: None.

Distribution: Africa north of the equator, Jordan River, Lake Tiberias, coastal streams of Palestine.

References: Gunther, 1864; Lortet, 1883; Vinciguerra, 1926; Tortonese, 1938; Trewavas, 1942; Goren, 1974.

Haplochromis flavii-josephi (Lortet) 1883

Material examined: USNM 48022, 7.819 cm, Syria, n.d., TYPE SPECIMEN, from Lyon Museum.

Distribution: This monospecific genus is endemic to the Jordan River System, Palestine.

References: Lortet, 1883; Regan, 1922; Vinciguerra, 1926; Tortonese, 1938; Trewavas, 1942; Goren, 1974.

Tristramella Trewavas

Tristramella sacra (Gunther) 1864

Material examined: None.

Distribution: Endemic to Lake Huleh.

References: Gunther, 1864; Lortet, 1883; Annandale, 1913;

Trewavas, 1942; Ben-Tuvia, 1960; Goren, 1974.

Tristramella simonis (Gunther) 1864

Material examined: None.

Distribution: Lake Tiberias

References: Gunther, 1864; Lortet, 1883; Vinciguerra, 1926; Trewavas, 1942; Ben-Tuvia, 1960; Goren, 1974.

Tristramella simonis intermedia Steinitz and Ben-Tuvia

Material examined: None.

Distribution: Lake Huleh.

References; Trewavas, 1942; Ben-Tuvia, 1960.

Tristramella magdalenae (Lortet) 1883

Material examined: USNM 48023, 12 cm, Syria, no.d, TYPE SPECIMEN, from Lyon Museum.

Distribution: Syria, near Damascus. This species is sometimes included as a synonym of T. simonis.

References: Lortet, 1883; Pellegrin, 1923; Vinciguerra, 1926; Gruvel, 1931; Trewavas, 1942; Ladiges, 1964.

Etroplus Cuvier

This genus is restricted to southern India. It differs from other cichlids in a number of characters, but the most readily apparent is the number of spinous anal rays (12-16); most cichlids have three spinous anal rays. Day (1878) described three species of this genus.

Etroplus canarensis Day 1878

Material examined: None.

Distribution: South Canara.

References: Day, 1878.

<u>Etroplus maculatus</u> (Bloch)

Material examined: None.

Distribution: Coasts of South Canara, Malabar, Ceylon, Madras.

References: Day, 1878.

<u>Etroplus suratensis</u> (Bloch)

Material examined: None.

Distribution: Coasts of South Canara, Malabar, Ceylon and Madras to Orissa.

References: Day, 1878.

<u>Cichlidae</u> #1

Material examined: MMTT (Trip), 7.23 cm, Sarazeh River, 55 km north of Bandar Abbas, Kol River Basin, 20-XI-1974; MMTT (Trip), (3), 10.5 cm, Bastak, Mehran River, four km from Bastak, 25-XI-1974; MMTT (Trip), (2), 10.13 cm, Gudar River, Bastak to Lar Road, 25-XI-1974.

Distribution: Kol and Mehran River Basins, both entering the Persian Gulf near Bandar Abbas. D XIII-XVII 7-10, A III 6-8, GR 14-18, 1.1. 28-33, three rows of teeth on the upper jaw, four on the lower, teeth bicuspid or tricuspid, branchiostegals attached below the vertical from the rear of the eye. Scales not typically cycloid as in western African cichlids; closer to ctenoid but without any projecting teeth on the surface.

References: Saadati, 1977.

Cichlidae #2

Material examined: MMTT 409, 484-486, (4), 5.6 to 13.1 cm, Salt River, Fars (without more exact location), IV-1972.

Distribution: Salt River, Fars. This could be in the upper Kol River Basin, Lake Neyriz Basin or the upper Mond Basin. D XV 10-11, A III 6, l.l. 27-28, GR 14-18, scales irregular, with the largest along the midline, becoming smaller and irregular dorsally; a scaleless striae before the dorsal fin, abdomen naked. The lateral line is disjointed and quite irregular. Head larger than Cichlidae #1 (38-45% vs 35-39% of body length), caudal peduncle shorter and deeper (least height body 16-17% vs 13-15%), dorsal rays more numerous (10-11 vs 7-10), scale arrangement quite different, and coloration much different.

SUBORDER VIII. GOBIODEI

FAMILY XXVI. GOBIIDAE (IV)

Members of this family are found in fresh and marine waters in tropical and temperate latitudes. In southern Iran, four genera found in the Persian Gulf and Gulf of Oman penetrate into fresh water. The gobies comprise a sizeable percentage of the fish fauna of the Caspian Sea. All but one of the 10 genera and 32 species in the Caspian Sea is endemic or shared with the Black Sea. The goby fauna in the Caspian Sea is a relict of the Tethys which has become adapted to the less saline Caspian waters. Most species remain in the sea, but a few do enter rivers. They often form separate populations. I have followed Berg's (1948) systematics of the Caspian Sea forms.

Pomatoschistus caucasicus (Kawraisky) 1899

Material examined: None.

Distribution: This species is found in the Black Sea, Sea of Azov and Caspian Sea; it will enter freshwater.

References: Kawraisky, 1899; Berg, 1948; Ladiges and Vogt, 1965.

Knipowitschia Iljin

This genus is found in the Black and Caspian Seas.

Knipowitschia longicaudata (Kessler)

Material examined: None.

Distribution: Brackish portions of the Black Sea, Sea of Azov and Caspian Seas; enters freshwater. Ladiges and Vogt (1965) place this species in *Pomatoschistus* but do not discuss the reasons; I have left it in *Knipowitschia*.

References: Berg, 1948; Ladiges and Vogt, 1965.

Knipowitschia iljini Berg 1931

Material examined: None.

Distribution: Central portion of the Caspian Sea.

References: Berg, 1931; Berg, 1948.

Neogobius Iljin

This genus is found in the Black and Caspian Seas. Species in this genus are often found in rivers and streams.

Neogobius melanostomus affinis (Eichwald)

Material examined: USNM 205920, (3), 9.228 to 11.284 cm., Karganrud, Gilan, 17-VI-1970; MMTT 439, (1), no length, Navarus, Gilan, 13-VI-1971; MMTT 443-444, (2), no length, Chalus River, Mazanderan, 24-IX-1970.

Distribution: The type species is found in the Black Sea. The subspecies affinis is found in the Caspian Sea and its rivers along the Lenkoran and southern Caspian coasts.

References: Eichwald, 1941; Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Neogobius ratan goebeli (Kessler) 1874

Material examined: None.

Distribution: The type species is in the Black Sea. The subspecies goebeli is found in the Caspian Sea in the Baku region.

References: Kessler, 1874; Berg, 1948.

Neogobius cephalarges constructor (Nordamnn)

Material examined: MMTT 299, (length of body) 9.6 cm, Naviq River, Gilan, 7-VIII-1971; OS 4305, (2), 8.058 and 8.9 cm, Shasderud Khaneh, XII-1961; MMTT 265, 14.7 cm, Shafarud, Gilan, 3-VI-1971; MMTT 440, 441, (2), 8.6 cm, Karganrud, Gilan, 22-XII-1969; MMTT 691, 6.24 cm, Shafarud, Gilan, 16-V-1973.

Distrubtion: The type species is found in the Black Sea. The subspecies constructor is found in the West Transcaucasia, Black and Caspian Seas, and possibly the rivers of Asia Minor; in Iran, it is found in streams along the western and southern shores. Berg (1948) lists Gobius platyrostris cyrius Iljin as a synonym, but both Ladiges (1964) and Svetovidov (1949) list is as a separate species in the Black Sea; neither has a discussion of this species so I have left it as given by Berg.

References: Berg, 1948; Svetovidov, 1949; Ladiges, 1964; Ladiges and Vogt, 1965.

Neogobius kessleri (Gunther)

Material examined: USNM 205907, 6.294 cm, Karganrud, Gilan, 17-VII-1970.

Distribution: Basins of the Black and Caspian Seas. In Iran, it is found in streams along the Gilan Coasts.

References: Berg, 1948; Ladiges and Vogt, 1965; Faridpak, 1966.

Neogobius fluviatilis pallasi (Berg)

Material examined: OS 4292, (2), 11.353 and 11.79 cm, Caspian Sea, VIII-1971; OS 4273, (2), 6.464 and 8.266 cm, Caspian Sea, V-1971; USNM 205917, 7.675 cm, Bandar Pahlevi, 1-IV-1970; OS 4264, (2), 10.024 and 11.638 cm, Bandar Pahlevi, VIII-1971.

Distribution: Type species is found in the Black Sea. The subspecies pallasi is found in the Caspian Sea in the coastal areas of Gilan.

References: Berg, 1948; Nikolsky, 1954; Ladiges and Vogt, 1965.

Neogobius bogdanowi (Kessler) 1874

Material examined: None.

Distribution: Caspian Sea.

References: Kessler, 1874; Berg, 1948.

Neogobius bathybius (Kessler)

Material examined: None.

Distribution: Caspian Sea; south of Baku, oppsoite Svinoi Island, North Caspian.

References: Berg, 1948.

Neogobius caspius (Eichwald)

Material examined: OS 4287, (2), 12.276 and 14.1 cm, Bandar Pahlevi, I-1968.

Distribution: All of the Caspian Sea; does not enter fresh water.

References: Eichwald, 1841; Berg, 1948.

Neogobius syrman eurystomus (Kessler)

Material examined: None.

Distribution: North Caspian, shores of Mangyshlak, Krasnovodks, Baku. Type species is found in the Black Sea.

References: Berg, 1948.

Mesogobius Bleeker

This genus is found in the Black Sea and Caspian Sea. It is very similar to Neogobius.

Mesogobius nonultimus (Iljin)

Material examined: None.

Distribution: Caspian Sea; very rare.

References: Berg, 1948; Faridpak, 1966.

Mesogobius gymnotrachelus macrophthalmus (Kessler)

Material examined: MMTT 158, (1), no length, Bandar Pahlevi, n.d.

Distribution: The type species is found in the Black Sea. The subspecies macrophthalmus is found in the Caspian Sea Basin. Berg (1948) gives the scale count of macrophthalmus as 47-49. The specimen from Bandar Pahlevi had 55/58 scales, in which it is much closer to the type M. gymnotrachelus, which it resembles in other respects.

References: Berg, 1948.

Mesogobius nigronotatus (Kessler)

Material examined: None.

Distribution: Caspian Sea near Mangyshlak; rare.

References: Berg, 1948

Proterorhinus Smitt

This genus is found in the Black and Caspian Seas. It is quite similar to Neogobius.

Proterorhinus marmoratus (Pallas)

Material examined: USNM 205908, (2), 4.237 and 5.36 cm, Bandar Pahlevi, I-IV-1970.

Distribution: Black and Caspian Seas; enters rivers. In the Caspian Sea, along the western and southern shores.

References: Berg, 1948; Ladiges, 1964.

Proterorhinus semipellucidus (Kessler)

Material examined: None.

Distribution: Astrabad Bay, Caspian Sea. In the packing list of material sent to Oregon State University this speices was listed but I was unable to locate it.

References: Berg, 1948.

Caspiosoma caspium (Kessler)

Material examined: None.

Distribution: Black and Caspian Seas; in the Caspian Sea, mainly in the central and northern portions.

References: Berg, 1948; Ladiges and Vogt, 1965.

Asra turcomana Iljin

Material examined: None.

Distribution: Southern Caspian Sea; very rare.

References: Berg, 1948.

Benthophiloides brauneri Beling and Iljin

Material examined: None.

Distribution: Black Sea; Caspian Sea near the Apsheron Peninsula.

References: Berg, 1948; Ladiges and Vogt, 1965.

Benthophilus Eichwald

This genus is common in the Caspian and Black Seas.

Benthophilus macrocephalus (Pallas)

Material examined: None.

Distribution: Black Sea; Caspian Sea. In the Caspian Sea, along the southern shores, and probably in the Mordabs.

References: Eichwald, 1841; Berg, 1948; Ladiges and Vogt, 1965.

Benthophilus ctenolepidus Kessler

Material examined: None.

Distribution: Southern and central Caspian Sea.

References: Berg, 1948.

Benthophilus stellatus leobergius Iljin

Material examined: None.

Distribution: Caspian Sea; more abundant in freshened areas; apparently does not enter rivers. Type species is found in the Black Sea.

References: Berg, 1948; Ladiges and Vogt, 1965.

Benthophilus spinosus Kessler

Material examined: None.

Distribution: Caspian Sea; region of Mangyshlak-Kulaly; Baku.

References: Berg, 1948.

Benthophilus leptocephalus Kessler

Material examined: None.

Distribution: Southern Caspian Sea; rare.

References: Berg, 1948.

Benthophilus baeri Kessler

Material examined: None.

Distribution: Southern part of the Caspian Sea.

References: Berg, 1948.

Benthopilus granulosus Kessler

Material examined: None.

Distribution: Throughout the Caspian Sea.

References: Berg, 1948.

Benthophilus leptorhynchus Kessler

Material examined: None.

Distribution: Middle portions of the Caspian Sea.

References: Berg, 1948.

Benthophilus grimmi Kessler

Material examined: None.

Distribution: Central and southern portions of the Casipan Sea. A subspecies, B. grimmi kessleri Berg was described from the same locations, and is separated by the presence of a row of larger scutes of a characteristic shape on the sides.

References: Berg, 1948.

Anatirostrum profundorum (Berg)

Material examined: None.

Distribution: Caspian Sea; deep water. This genus is quite close to *Benthophilus*.

References: Berg, 1948.

"*Gobius*" *giuris* Ham. Buch.

Material examined: OS (No Number), 21.6 cm, Sarbaz River, at Bahu Kalat, X-1971.

Distribution: East Coast of Africa, through the Persian Gulf, seas of India and Ceylon to Bruma, Malay Archipelago and beyond. Often found in freshwater. There appears to be two forms, the smaller being found entirely in the ocean. Commonly found in the streams along the coasts of Pakistan, Baluchistan and the Mekran Coasts of Iran. The genus given by Mirza (1974) is *Glossogobius*; the name *Gobius* is certainly superceded, but I do not have adequate reference material to know if the name listed by Mirza is accurate.

References: Day, 1878; Zugmayer, 1913; Mirza, 1974.

Gobius #1

Material examined: Shilot, 21 cm, Sarbaz River, Koanee, X-1971.

Distribution: Kolanee, in freshwater, Sarbaz River, Mekran coasts of Iran. Similar to *G. giuris*, but differs in fin ray counts (D VI, I 10 vs VI, I 8-9), head development and coloration. Sensory canals on head better developed than in *giuris*.

Trypauchen vagina (Bl. Schn.)

Material examined: I have seen but not studied this species.

Distribution: Persian Gulf; Northern Indian Ocean through the seas of India to the Malay Archipelago. Enters freshwater in the Tigris-Euphrates-Karun Delta.

References: Day, 1878; Blegvad, 1944; Khalaf, 1961.

Scartelaos tenuis (Day) 1878

Material examined: None.

Distribution: Persian Gulf, Arabian Sea; waters of Pakistan; does not extend east as far as Bombay. Lives in shallow coastal areas, on mud flats. Enters freshwater.

References: Day, 1878; Blegvad, 1944; Svetovidov, 1949; Khalaf, 1961.

Boleophthalmus Cuv. Val.

This genus is found in marine waters from the Persian Gulf eastward through the seas of India to Southeast Asia. Some species enter frehswater, traveling upstream a considerable distance.

Boleophthalmus dussumieri Val

Material examined: None.

Distribution: From Bombay along the coasts of India, Pakistan and Iran. Enters rivers in Baluchistan, the coastal Mekran coasts, and the Tigris-Euphrates-Karun System, where it sometimes travels a considerable distance upstream. B. dentatus (Day 1878) is the male of B. dussumieri, the female of which was used in describing the species. The male has a longer dorsal fin, with both dorsal fins coming together, with canines in the upper jaw large. B. chaimiri

(Holly 1929) differs in the presence of 13 small teeth on the upper jaw, whereas B. dentatus and B. dussumieri there are 25. But the teeth number varies with age; in adults, up to 25 teeth are found on each side of the jaw, but in the young only 12-17. Holly's specimens were 99 mm in length, and had 13 teeth, while Berg (1949) reported teeth in his specimens 160-190 mm in length numbered 25.

References: Day, 1878; Zugmayer, 1913; Holly, 1929; Misra, 1947; Berg, 1949; Svetovidov, 1949; Fowler and STeinitz, 1956; Khalaf, 1961; Mirza, 1972.

Boleophthalmus boddaerti (Pallas)

Material examined: OS (No Number), 7.829 cm, Sarbaz River at Bahu Kalat, X-1971.

Distribution: Coastal areas of Pakistan, India, Bombay, Burma, Thailand, Malaysia, Malay Archipelago. Enters streams in the Mekran Coasts of Iran and Pakistan.

References: Day, 1878; Zugmayer, 1913; Mirza, 1972.

FAMILY XXVII. PERIOPHTHALMIDAE (IV)

These fishes are primarily coastal marine fishes found from Africa through Southeast Asia. They live in colonies on mudflats along the sea or the lower end of rivers. They live in burrows in the ground, but are often found on land. They can hop across the surface of land or water at a rather rapid rate. While I have not studied any specimens, I have often seen these fishes in the field and made collections for the Pahlevi University Collection.

Periophthalmus koelreuteri (Pallas)

Material examined: I have seen but not studied this species.

Distribution: Red Sea, Persian Gulf, Arabian Sea, Indian waters, Pakistan, Indian ocean through the Malay Archipelago. Quite common around Bandar Abbas where I often watched their colonies.

References: Day, 1878; Holly, 1929; Blegvad, 1944; Mirza, 1972.

Periophthalmus waltoni Koumans

Material examined: I have seen but not studied this species.

Distribution: Persian Gulf; enters rivers, including the lower Tigris-Euphrates-Karun Rivers.

References: Blegvad, 1944; Svetovidov, 1949; Khalaf, 1961.

SUBORDER IX. STROMATEOIDEI

FAMILY XXVIII. STROMATEIDAE (IV)

Chondroplites chinensis (Euphrasen)

Material examined: I have seen but not studied this species.

Distribution: Persian Gulf, Indian Ocean through the seas of India and the Malay Archipelago to China. Enters the lower Tigris, Euphrates and Karun Rivers.

References: Day, 1878; Misra, 1947; Khalaf, 1961.

Pampus argenteus (Euphrasen)

Material examined: I have seen but not studied this species.

Distribution: Persian Gulf; seas of India, Malay Archipelago and beyond. Enters freshwater in the Tigris, Euphrates and Karun Rivers.

References: Day, 1878; Bassett-Smith, 1897; Blegvad, 1944; Misra, 1947; Khalaf, 1961; Andersskog, 1966.

ORDER XV. PLEURONECTIFORMES

FAMILY XXIX. PLEURONECTIDAE (IV)

Pleuronectes flesus Linnaeus

Material examined: I have seen but not studied this species.

Distribution: Black Sea and Sea of Azov, where it enters rivers, sometimes traveling far upstream. Introduced into the Caspian Sea in 1902 and 1931; found mainly along the coasts of Iran where it is taken in the commercial fishery.

References: Berg, 1948; Nikolsky, 1954; Zenkevitch, 1957.

FAMILY XXX. SOLEIDAE (IV)

Synaptura orientalis (Bl. Schn.)

Material examined: I have seen but not studied this species.

Distribution: Indian Ocean from the Persian Gulf through the seas of India to the Malay Archipelago and China. Enters the Tigris and Euphrates Delta, spending the summer in the Hor-el-Hammar Lakes, returning to the Persian Gulf in the fall.

References: Day, 1878; Norman, 1928; Spence and Prater, 1931 Blegvad, 1944; Misra, 1947; Fowler, 1956; Khalaf, 1961; Andersskog, 1966.

ORDER XVI. MASTACEMBELIFORMES

FAMILY XXXI. MASTACEMBELIDAE (II)

This family is composed of snake-like freshwater fishes found in Africa, the Middle East, India and Southeast Asia.

Mastacembelus Cuv. Val.

One of two genera in this family, *Mastacembelus*, is the only genus found in Iranian waters.

Mastacembelus simack (Walbaum)

Material examined: MMTT (Trip), (2), 24.7 and 26.3 cm, Fasa River, Mond Drainage, near Jahrom, 26-XI-1974; MMTT 74, 75, (2), 22.4 and 30.3 cm, Lake Zaribar, 22-I-1971; MMTT 906, 907, (2), Lake Marivan (Zaribar), 9-I-1974; MMTT (No Number), 13.3 cm, Lake Marivan, 25-VI-1974; Shilot, 12 cm, Lake Marivan, 22-I-1971.

Distribution: Palestine, Tigris, Euphrates and Karun Rivers.

References: Heckel, 1846; Gunther, 1874; Boulenger, 1912; Kennedy, 1937; Berg, 1949; Khalaf, 1961; Ladiges, 1964.

Mastacembelus armatus (Lacépède)

Material examined: USNM 248196, 16 cm, Leh drainage, Nurpur, West Pakistan, 7-V-1964.

Distribution: Mekran coasts of Iran, along all coasts of Pakistan; rivers of India and Indochina.

References: Day, 1878, 1880; Vinciguerra, 1890; Boulenger, 1912; Zugmayer, 1913; Berg, 1949; Mirza, 1972.

IX. DISTRIBUTION OF FISHES IN IRAN

Under the zoogeographical pattern developed by Sclater in 1857, and subsequently refined by other authors, Iran is generally placed in the Palearctic fauna. It is separated from the Ethiopian, or African fauna, by the deserts of the Middle East. In the east, the Oriental fauna, which includes India and much of Pakistan, is thought to end at the Indus River Basin.

Lack of knowledge of the Iranian fish fauna has presented problems in zoogeographichal placement. Commercial fishing activities in the Caspian Sea Basin and associated studies firmly established its association with the Black and Aral Seas and with the European fauna. Other areas of the country, particularily in the central basins and the southeastern part of the country, little information was available to use in defining zoogeographical relationships.

The best division of the Iranian fishes into zoogeographical units was made by Berg (1948), in his divisions of the Holarctic Fauna (Table 1). He separated out three regions, the Circumpolar, Meseurasian and Sonoran. Under the Meseurasian, Berg listed two subregions, the Mediterranean and the Asiatic Upland. The Mediterranean was further divided into the Provinces and Districts shown in Table 1.

More recently, Banarescu (1969) reorganized the faunal regions and provinces into eight divisions (Table 2). Under Banarescu's schema, Iran falls into two regions, the Ponto-Caspian Province of the

TABLE 1. ZOOGEOGRAPHIC DIVISIONS

BERG (1948)

- Meseurasian Section
  - Mediterranean Subregion
    1. Baltic Province
       - a. Western (Rhine) District
       - b. Eastern (Neva) District
    2. Mediterranean Province
       - a. Iberian District
       - b. African Minor District
       - c. Transitional Po-Rhone District
       - d. Italo-Hellenic District
    3. West Balkanian Province
    4. Central Anatolian Province
    5. Iranian Province
       - a. Teheran District
       - b. Turkmenian District
       - c. Seistan District
       - d. Farsi District
    6. Pontic-Caspian-Aral Province
       - a. Pontic (Black Sea) District
         - i. Danube-Kuban Subdistrict
         - ii. North Aegean Subdistrict
         - iii. Cochic-Anatolian Subdistrict
       - b. Caspian District
         - i. Volga Subdistrict
         - ii. Kura-Persian Subdistrict
       - c. Aral District
         - i. Aral Subdistrict
         - ii. Issyk-kul Subdistrict
    7. Turkestan Province

TABLE 2. ZOOGEOGRAPHIC DIVISIONS

BANARESCU (1960)

- Holarctic Region
    - Arctic Subregion
    - Baikal Subregion
    - Western Mongolia Subregion
    - Euro-Mediterranean Subregion
        - Atlanto-Baltic Province
        - Ponto-Caspian Province
        - Turkestan Province
        - Central Anatolia Province
        - Iberian Province
        - African Minor Province
    - Northeast America Subregion
    - Northwest America Subregion
- Sino-Indian Region
    - East Asia Subregion
    - Indo-Malay Subregion
    - Western Asia Subregion
    - Central Asia Subregion
- Ethiopian Region
    - East Africa Subregion
    - South Africa Subregion
    - Central Africa Subregion
- Neotropical Region
- Madagascar Region

Holarctic Region and the Western Asian Subregion of the Sino-Indian Region. Under Banarescu, two faunas are recognized in Iran. Berg, in his arrangement, recognized five separate faunas in two provinces.

Based on my own experience in Iran, I initially divided the Iranian freshwater fish into four groups: Caspian, Central and Southwestern, Seistan-Baluchistan, and the Northeast Faunas. This discussion was included in the draft of a short training manual on Iranian fisheries biology prepared for the Iran Game and Fish Council in 1968.

After additional work on Iranian fishes, I made a preliminary division of the fishes based on individual basins. This division was presented in a paper on qanat fishes given at the National Meeting of the American Fisheries Society in 1975 (Appendix I). I had not completed my analysis of my specimens at the time, so based the division primarily on the initial analysis of the qanat fishes. The divisions I suggested in that paper are summarized in Table 3.

Since presentation of the paper in 1975, I made the revision of the systematics of Iranian fishes summarized in the preceding chapter. A general analysis indicated three major groups of fish were present, with the interior basins generally representing depauperate extensions of the more diverse faunas to the north, east and west. I adopted Berg's general schema for my division of Iranian freshwater fishes as summarized in Table 4.

Under this division, the Iranian fish fauna falls into three major faunas in two regions. The Sarmatian Province occupies the basin of the former Sarmatian Sea plus former connecting basins.

TABLE 3. IRANIAN ZOOGEOGRAPHIC DIVISIONS

ARMANTROUT (1975)

Caspian Region
- Caspian Sea
- Turkoman
- Enclosed Northeast Basins
- Azerbaijan
- Lake Rezaiyeh

Indian Region
- Seistan
- Bampur, or Jaz-e-Murian
- Mekran, or Baluchistan

Mesopotamian Region
- Shiraz
  - Maharlu
  - Kur
  - Mond
- Karun

Central Basin Region
- Kavir
  - Damghan
  - Great Kavir
- Lut
- Isfahan
- Qom

TABLE 4.

ZOOGEOGRAPHICAL DIVISION OF IRANIAN FRESHWATER FISH

- Holarctic Region
  - Meseurasian Section
    - Mediterranean Subregion
      - Sarmatian (Pontico-Caspian-Aral) Province
        - Caspian District
          - Persian Subdistrict
          - Azerbaijan Subdistrict
            - Lake Rezaiyeh Basin
          - Namak Lake Subdistrict
            - Qom Basin
            - Tehran Basin
            - Semnan Basin
            - Arak Basin
          - Isfahan Subdistrict
        - Aral District
      - Mesopotamian Province
        - Palestine District
        - Tigris-Euphrates District
          - Asia Minor Subdistrict
          - Tigris-Euphrates Subdistrict
          - Karun Subdistrict
          - Neyriz Subdistrict
          - Maharlu Subdistrict
        - Persian Gulf District
          - Mond Subdistrict
          - Lar Subdistrict
          - Kol Subdistrict
          - Arabian Subdistrict

- Oriental Region
  - Baluchistan Subregion
    - Mekran Province
    - Baluchistan Province
      - Bampur District
      - Dashte-Lut District
        - Dashte-Lut Subdistrict
        - Kerman Subdistrict
        - Yazd Subdistrict
  - Seistan Subregion
    - Helmand Province
      - Seistan District
      - Enclosed Northeastern Basins District

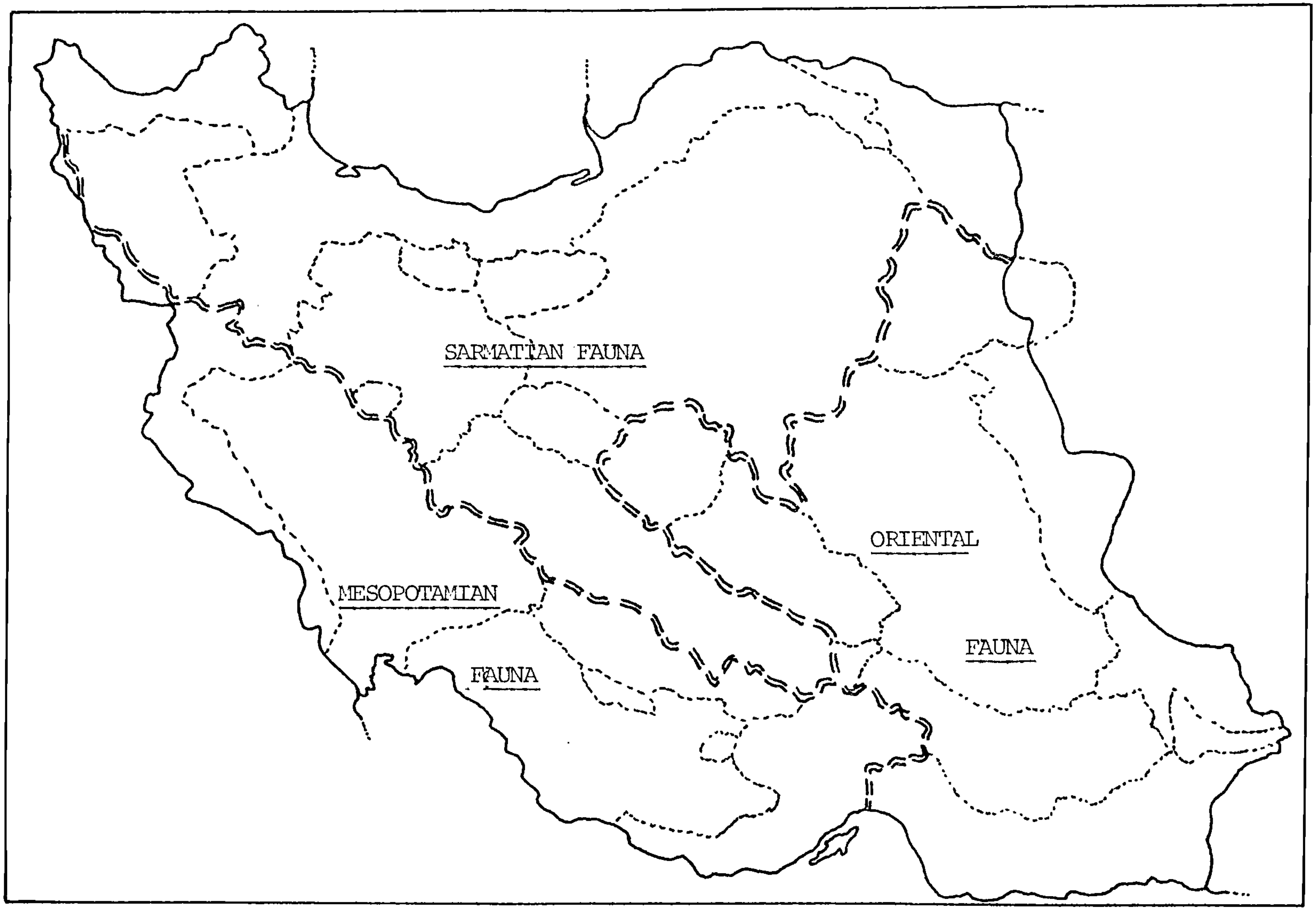

Figure 13. Three Major Faunas of Iran

TABLE 5

DISTRIBUTION OF THE FRESHWATER FISHES

OF IRAN AND ADJACENT AREAS

The following Table summarizes the distribution of freshwater fish and marine fishes commonly reported from freshwater in Iran and adjacent areas. The following is a key to the symbols in the Table:

1-Restricted to freshwater;

2-Species shows some tolerance for saline water;

3-Species shows a high degree of tolerance for saline water;

4-Species permanent residents in freshwater but whose origins and closest relatives are marine;

M-Marine species, able to spend time in fresh water;

A-Anadromous

I-Introduced;

Sbcl.-Subclass;

SbO.-Suborder;

Fam.-Family;

G.-Genus

S.-Species

SSP.-Subspecies

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Superclass I. Agnatha																																			
Class 1. Petromyzones																																			
Order 1. Petromyzoniformes																																			
Fam. 1. Petromyzontidae																																			
G-1. Caspiomyzon																																			
S-1. C. wagneri																					A														
Superclass II. Gnathostomata																																			
Class 2. Elasmobranchii																																			
Sbcl. 1. Selachii																																			
Order 2. Lamniformes																																			
Fam. 2. Carcharhinidae																																			
G-2. Carcharias																																			
S-2. C. lamia				M	M	M																										M		M	M
S-3. C. gangeticus				M	M																											M		M	
Order 3. Rajiformes																																			
Fam. 3. Pristidae																																			
G-3. Pristis																																			
S-4. P. cuspidatus				M	M																											M		M	M
S-5. P. zysron				M	M																											M		M	M

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Class 3. Teleostomi																																			
Sbcl. 2. Actinopterygii																																			
Order 4. Acipenseriformes																																			
Fam. 4. Acipenseridae																																			
G-4. Huso																																			
S-6. H. huso																			A	A	A														
G-5. Acipenser																																			
S-7. A. nudiventris																				A	A	A													
S-8. A. ruthenus																			A	A	A														
S-9. A. guldenstadti																				A	A														
SSP. 1. A. g. persicus																					A														
S-10. A. stellatus cyrensis																				A	A														
Order 5. Clupeiformes																																			
SbO 2. Clupeoidei																																			
Fam. 5. Clupeidae																																			
G-6. Caspialosa																																			
S-11. C. brashnikovi																					4														
SSP 2. C.b. grimmi																					4														
SSP 3. C.b. autumnalis																					4														
SSP 4. C.b.kisselewitschi																					4														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SSP 5. <u>C.b. nirchi</u>																					4														
SSP 6. <u>C.b. agrakhanika</u>																					4														
SSP 7. <u>C.b. sarensis</u>																					4														
SSP 8. <u>C.b. orientalis</u>																					4														
S-12. <u>C. saposhnikovi</u>																					4														
S-13. <u>C. curensis</u>																					4														
S-14. <u>C. suworowi</u>																					4														
S-15. <u>C. pontica</u>																				4															
SSP 9. <u>C.p. kessleri</u>																					4														
SSP 10. <u>C.p. volgensis</u>																					4														
Morpha 1. <u>C.p.v. imitans</u>																					4														
S-16. <u>C. caspia</u>																					4														
SSP 11. <u>C.c. aestuarina</u>																					4														
SSP 12. <u>C.c. persica</u>																					4														
SSP 13. <u>C.c. knipowitschi</u>																					4														
G-7. <u>Clupeonella</u>																																			
S-17. <u>C. delicatula</u>																				4	4														
S-18. <u>C. grimmi</u>																					4														
S-19. <u>C. engrauliformis</u>																					4														
G-8. <u>Hilsa</u>																																			
S-20. <u>H. ilisha</u>				M	M																										M	M		M	M

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SbO 3. Salmonoidei																																			
Fam. 6. Salmonidae																																			
G-9. <u>Salmo</u>																																			
S-21. <u>S. trutta</u>	3		3	3	3										3	3	3	3	3	3	3	3													
SSP 14. <u>S.t. caspius</u>															3	3	3	3			3														
SSP 15. <u>S.t. fario</u>															I	I					I														
S-22. <u>S. ischchan</u>																		3																	
S-23. <u>S. gairdneri</u>					I							I			I	I	I	I			I														
G-10. <u>Salvelinus</u>																																			
S-24. <u>S. fontinalis</u>															I																				
G-11. <u>Coregonus</u>																																			
S-25. <u>C. lavaretus</u>															I	I																			
G-12. <u>Stenodus</u>																																			
S-26. <u>S. leucichthys</u>																					3														
SbO 4. Esocoidei																																			
Fam. 7. Esocidae																																			
G-13. <u>Esox</u>																																			
S-27. <u>E. lucius</u>																	2	2	2	2	2	2													
Order 6. Cypriniformes																																			
Div. 1. Cyprini																																			
SbO. 5. Cyprinoidei																																			

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	MAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Fam. 8. Cyprinidae																																			
Subfam. 1. Leuciscinae																																			
G-14. Rutilus																																			
S-28. R. rutilus																		2	2	2	2	2													
SSP 16. R.r. caspicus																		A			A														
Morpha 2. R.r.c. kurensis																		A			A														
Morpha 3. R.r.c. knipowitschi																		A			A														
SSP 17. R. r. schelkovnikovi																		1																	
S-29. R. frisii																			A	A	A														
SSP 18. R.f. kutum																					A														
G-15. Phoxinellus																																			
S-30. P. zeregi zeregi		1																																	
SSP 19. P.z. kervillei		1	1																																
SSP 20. P.z. drusensis		1																																	
SSP 21. P.z. libani		1																																	
SSP 22. P.z. syriacus		1	1	1																															
SSP 23. P.z. maeandri		1																																	
SSP 24. P.z. fahirae		1																																	
S-31. P. crassus			1																																
S-32. P. handirschi			1																																

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
S-33. P. egridiri			1								
S-34. P. anatolicus			1								
S-35. P. rutiloides		1									
S-36. P. tricolor		1		1	?						
G-16. Leuciscus											
S-37. L. leuciscus											
S-38. L. latus											
S-39. L. idus											
S-40. L. cephalus		1	1	1	1						
SSP 25. L.c. orientalis											
SSP 26. L.c. lepidus				1	1						
SSP 27. L.c. cephalopsis		?	?	?							
G-17. Scardinius											
S-41. S. erythrophthalmus											
G-18. Aspius											
S-42. A. aspius											
SSP 28. A.a. taeniatus											
Morpha 4. A.a.t. ibliodes											
S-43. A. vorax				1	1						
G-19. Tinca											
S-44. T. tinca											

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
S-33. P. egridiri													
S-34. P. anatolicus													
S-35. P. rutiloides													
S-36. P. tricolor													
G-16. Leuciscus													
S-37. L. leuciscus								1	1	1			
S-38. L. latus											1	1	
S-39. L. idus								1		1	1		
S-40. L. cephalus		1	1		1	1	1	1	1	1			
SSP 25. L.c. orientalis		1	1		1	1	1		1	1			
SSP 26. L.c. lepidus													
SSP 27. L.c. cephalopsis													
G-17. Scardinius													
S-41. S. erythrophthalmus								1	1	1	1		
G-18. Aspius													
S-42. A. aspius							1	1	1	1	1		
SSP 28. A.a. taeniatus							1			1	1		
Morpha 4. A.a.t. ibliodes											1		
S-43. A. vorax													
G-19. Tinca													
S-44. T. tinca							1	1	1	1			

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-33. P. egridiri											
S-34. P. anatolicus											
S-35. P. rutiloides											
S-36. P. tricolor											
G-16. Leuciscus											
S-37. L. leuciscus											
S-38. L. latus											
S-39. L. idus											
S-40. L. cephalus											
SSP 25. L.c. orientalis											
SSP 26. L.c. lepidus											
SSP 27. L.c. cephalopsis											
G-17. Scardinius											
S-41. S. erythrophthalmus											
G-18. Aspius											
S-42. A. aspius											
SSP 28. A.a. taeniatus											
Morpha 4. A.a.t. ibliodes											
S-43. A. vorax											
G-19. Tinca											
S-44. T. tinca											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
G-20. Chalcalburnus																																			
S-45. C. chalcoides																		1			1														
S-46. C. mossulensis				1	1																														
SSP 29. C.m. delineatus				1																															
S-47. C. caudimacula							1																												
S-48. C. megacephalus										1	1																								
S-49. C. sellal		1																																	
G-21. Alburnus																																			
S-50. A. alburnus																			1	1	1														
S-51. A. charusini																		1			1														
SSP 30. A.charusini hohenackeri																		1			1														
Morpha 5. A.c.h. persicus																					1														
S-52. A. filippi																		1			1														
S-53. A. gaderanus																	1																		
S-54. A. "maculatus"												1		1																					
S-55. Alburnus #1												1																							
S-56. Alburnus #2														1																					
S-57. A. doriae										1																									
S-58. A. heckeli/iblis				1							?																								
S-59. A. capito				1	1																														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-60. A. mossulensis				1	1																														
S-61. A. escherichii																				1															
S-62. A. kotschyi				1																															
S-63. A. orontis		1																																	
S-64. A. caeruleus		1		1																															
G-22. Alburnoides																																			
S-65. A. bipunctatus														1	1	1	1	1	1	1	1	1	1												
SSP 31. A.b. rossicus																				1	1														
SSP 32. A.b. fasciatus																				1															
SSP 33. A.b. eichwaldi														1	1	1	1	1			1		1												
SSP 34. A.b. armeniacus																		1																	
S-66. A. taeniatus																						1													
S-67. Alburnoides #1					1																														
G-23. Acanthalburnus																																			
S-68. A. microlepis																		1			1														
S-69. A. urmianus																	1																		
G-24. Blicca																																			
S-70. B. bjoerkna																		1	1	1	1	1													
G-25. Abramis																																			
S-71. A. brama																		1	1	1	1	1													
SSP 35. A.b. orientalis																		1			1	1													
S-72. A. sapa																		1	1	1	1	1													
SSP 36. A.s. bergi																		1			1	1													

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	MAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
Morpha 6. A.s.b. aralensis											
S-73. A. ballerus											
G-26. Vimba											
S-74. V. vimba											
SSP 37. V.v. carinata											
SSP 38. V.v. tenella											
SSP 39. V.v. persa											
G-27. Pelecus											
S-75. P. cultratus											
G-28. Acanthobrama											
S-76. A. marmid				1							
SSP 40. A.m. orontis		1	1								
S-77. A. mirabilis			1								
S-78. A. centisquama		1									
S-79. A. terrae-sanctae		1									
SSP 41. A.t. oligolepis		1									
S-80. A. lissneri		1									
S-81. A. telavivensis		1									
S-82. A. callensis	1										
G-29. Capoetobrama											
S-83. C. kuschakewitschi											

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
Morpha 6. A.s.b. aralensis											1		
S-73. A. ballerus								1	1	1			
G-26. Vimba													
S-74. V. vimba								1	1	1			
SSP 37. V.v. carinata									1				
SSP 38. V.v. tenella									1				
SSP 39. V.v. persa										1			
G-27. Pelecus													
S-75. P. cultratus								1	1	1	1		
G-28. Acanthobrama													
S-76. A. marmid													
SSP 40. A.m. orontis													
S-77. A. mirabilis													
S-78. A. centisquama													
S-79. A. terrae-sanctae													
SSP 41. A.t. oligolepis													
S-80. A. lissneri													
S-81. A. telavivensis													
S-82. A. callensis													
G-29. Capoetobrama													
S-83. C. kuschakewitschi											1		

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Morpha 6. A.s.b. aralensis											
S-73. A. ballerus											
G-26. Vimba											
S-74. V. vimba											
SSP 37. V.v. carinata											
SSP 38. V.v. tenella											
SSP 39. V.v. persa											
G-27. Pelecus											
S-75. P. cultratus											
G-28. Acanthobrama											
S-76. A. marmid											
SSP 40. A.m. orontis											
S-77. A. mirabilis											
S-78. A. centisquama											
S-79. A. terrae-sanctae											
SSP 41. A.t. oligolepis											
S-80. A. lissneri											
S-81. A. telavivensis											
S-82. A. callensis											
G-29. Capoetobrama											
S-83. C. kuschakewitschi											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
G-30. Aspidoparia											
S-84. A. morar											
G-31. Leucalburnus											
S-85. L. satunini											
S-86. L. kosswigi											
G-32. Barilius											
S-87. B. vagra											
S-88. B. mesopotamicus				1							
G-33. Pimephales											
S-89. P. promelas											
Subfam. Chondrostominae											
G-34. Chondrostoma											
S-90. C. nasus											
SSP 42. C.n. variabile											
S-91. C. colchicum											
S-92. C. oxyrhynchum											
S-93. C. cyri											
S-94. C. schmidti											
S-95. C. regium		1	1	1	1						
S-96. Chondrostoma #1				1							
S-97. Chondrostoma #2					1						

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
G-30. Aspidoparia													
S-84. A. morar													
G-31. Leucalburnus													
S-85. L. satunini							1						
S-86. L. kosswigi									1				
G-32. Barilius													
S-87. B. vagra													
S-88. B. mesopotamicus													
G-33. Pimephales													
S-89. P. promelas			I										
Subfam. Chondrostominae													
G-34. Chondrostoma													
S-90. C. nasus								1	1	1			
SSP 42. C.n. variabile									1	1			
S-91. C. colchicum							1						
S-92. C. oxyrhynchum										1			
S-93. C. cyri							1						
S-94. C. schmidti							1						
S-95. C. regium													
S-96. Chondrostoma #1													
S-97. Chondrostoma #2													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
G-30. Aspidoparia											
S-84. A. morar							1	1	1	1	1
G-31. Leucalburnus											
S-85. L. satunini											
S-86. L. kosswigi											
G-32. Barilius											
S-87. B. vagra								1		1	1
S-88. B. mesopotamicus											
G-33. Pimephales											
S-89. P. promelas											
Subfam. Chondrostominae											
G-34. Chondrostoma											
S-90. C. nasus											
SSP 42. C.n. variabile											
S-91. C. colchicum											
S-92. C. oxyrhynchum											
S-93. C. cyri											
S-94. C. schmidti											
S-95. C. regium											
S-96. Chondrostoma #1											
S-97. Chondrostoma #2											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	HOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
S-98. Chondrostoma #3					1						
S-99. Chondrostoma #4					1						
S-100. Chondrostoma #5					1						
Subfam. 3. Barbinae											
G-35. Discognathus											
S-101. D. variabilis		1		1							
S-102. D. rossicus											
S-103. Discognathus #1											
S-104. Discognathus #2											
S-105. Discognathus #3											
G-36. Garra											
S-106. G. lamta											
S-107. G. rufa		2		2	2		2			2	2
S-108. G. persica											
S-109. G. barreimiae						2					
S-110. G. tibanica						2					
S-111. G. longipinnis						2					
S-112. G. arabica						2					
S-113. Garra sp. Hora											
S-114. Garra #1							2				
S-115. Garra #2									3		
S-116. Garra #3									3		

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
S-98. Chondrostoma #3													
S-99. Chondrostoma #4													
S-100. Chondrostoma #5													
Subfam. 3. Barbinae													
G-35. Discognathus													
S-101. D. variabilis													
S-102. D. rossicus													
S-103. Discognathus #1													
S-104. Discognathus #2													
S-105. Discognathus #3													
G-36. Garra													
S-106. G. lamta													
S-107. G. rufa													
S-108. G. persica												2	
S-109. G. barreimiae													
S-110. G. tibanica													
S-111. G. longipinnis													
S-112. G. arabica													
S-113. Garra sp. Hora													
S-114. Garra #1													
S-115. Garra #2													
S-116. Garra #3													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-98. Chondrostoma #3											
S-99. Chondrostoma #4											
S-100. Chondrostoma #5											
Subfam. 3. Barbinae											
G-35. Discognathus											
S-101. D. variabilis											
S-102. D. rossicus	1	1			1	1		1			
S-103. Discognathus #1						2					
S-104. Discognathus #2							1				
S-105. Discognathus #3							1				
G-36. Garra											
S-106. G. lamta										2	
S-107. G. rufa											
S-108. G. persica	2	2				2					
S-109. G. barreimiae											
S-110. G. tibanica											
S-111. G. longipinnis											
S-112. G. arabica											
S-113. Garra sp. Hora							1				
S-114. Garra #1											
S-115. Garra #2											
S-116. Garra #3											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-117. *Garra #4*																															2				
S-118. *Garra #5*																										2									
G-37. *Iranocypris*																																			
S-119. *I. typhlops*					1																														
G-38. *Typhlogarra*																																			
S-120. *T. widdowsoni*				1																															
G-39. *Crossocheilus*																																			
S-121. *C. adiscus*																										1									
S-122. *C. latius diplochilus*																															1	1	1		
G-40. *Tylognathus*																																			
S-123. *T. elegans*				1																															
G-41. *Labeo*																																			
S-124. *L. rohita*																																1	1	1	1
S-125. *L. dyocheilus*																																1	1	1	1
S-126. *L. calbasu*																																1	1	1	1
S-127. *L. dero*																																1	1	1	1
S-128. *L. gedirosicus*																																1			
S-129. *L. macmahoni*																																1			
G-42. *Hemigrammocapoeta*																																			
S-130. *H. nanus nanus*		1		1																															
SSP 43. *H.n.culiciphaga*			1																																

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	ZAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-131. H. kemali			1																																
SSP 44. H.k. klatti			1																																
G-43. Tylognathoides																																			
S-132. T. festai		1																																	
S-133. T. shoemakeri		1																																	
G-44. Kosswigobarbus																																			
S-134. K. kosswigi				1																															
G-45. Varicorhinus																																			
S-135. V. capoeta																	1	1																	
SSP 45. V.c. sevangi																		1																	
SSP 46. V.capoeta ssp. Berg																					1														
SSP 47. V. capoeta #1																					1														
SSP 48. V. capoeta #2																					1														
SSP 49. V.c. kosswigi																		1																	
SSP 50. V.c. angorae																				1															
SSP 51. V.c. heratensis																						1	1												
S-136. Varicorhinus #1																	1																		
S-137. V. aculeatus													1	1		1																			
S-138. V. buhsei													1	1	1	1																			
S-139. V. gracilis												1	1																						
S-140. V. chebisiensis												1																							

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-141. V. fuscus																								1	1				1						
S-142. V. steindachner																						1													
S-143. Varicorhinus #2																								1											
S-144. V. rostratus																											1	1	1						
S-145. V. macrolepis				1	1						1	1																							
SSP 52. V. macrolepis #1					1																														
S-146. V. amir										1																									
S-147. Varicorhinus #3				1	1		1																												
S-148. V. trutta				1	1																														
S-149. V. umbla				1																															
S-150. V. fratercula		1		1	1						1																								
S-151. V. damascinus		1	1	1	1																														
S-152. Varicorhinus #4				?																															
S-153. V. sieboldi																				1															
S-154. V. tinca																				1															
S-155. V. peregrinorum		1																																	
S-156. V. pestai			1																																
S-157. V. barroisi		1	1																																
S-158. Varicorhinus #5																														1					
S-159. Varicorhinus #6																															1				
G-46. Cyprinion																																			
S-160. C. macrostomum		1		1	1																														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

SYSTEMATICS	MESOPOTAMIAN: AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
SSP 53. C.m. tenuiradius							1			1	1
S-161. Cyprinion #1					1						
S-162. Cyprinion #2							1				
S-163. Cyprinion #3							1				
S-164. Cyprinion #4								1			
S-165. Cyprinion #5								1			
S-166. Cyprinion #6						1					
S-167. Cyprinion #7						1					
S-168. C. watsoni						1			1		
S-169. C. microphthalmum						1					
S-170. C. milesi											
G-47. Barbus											
S-171. B. mursa											
SSP 54. C.m. miliaris											
S-172. Barbus #1											
S-173. B. cyri											
S-174. B. capito											
SSP-55. B.c. concocephalus											
S-175. B. goktshaicus											
S-176. B. brachycephalus											
S-177. B. tauricus											
SSP 56. B.t. kubanicus											

SYSTEMATICS	SARMATIAN: ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
SSP 53. C.m. tenuiradius													
S-161. Cyprinion #1													
S-162. Cyprinion #2													
S-163. Cyprinion #3													
S-164. Cyprinion #4													
S-165. Cyprinion #5													
S-166. Cyprinion #6													
S-167. Cyprinion #7													
S-168. C. watsoni													
S-169. C. microphthalmum													
S-170. C. milesi													
G-47. Barbus													
S-171. B. mursa							1			1			
SSP 54. C.m. miliaris			1	1	1								
S-172. Barbus #1						1							
S-173. B. cyri							1			1			
S-174. B. capito										1			
SSP-55. B.c. concocephalus													
S-175. B. goktshaicus							1						
S-176. B. brachycephalus										1	1		
S-177. B. tauricus									1				
SSP 56. B.t. kubanicus									1				

SYSTEMATICS	ORIENTAL: N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SSP 53. C.m. tenuiradius											
S-161. Cyprinion #1											
S-162. Cyprinion #2											
S-163. Cyprinion #3											
S-164. Cyprinion #4											
S-165. Cyprinion #5											
S-166. Cyprinion #6											
S-167. Cyprinion #7											
S-168. C. watsoni					1	1	1	1			
S-169. C. microphthalmum		1				1	1	1			
S-170. C. milesi		1						1			
G-47. Barbus											
S-171. B. mursa											
SSP 54. C.m. miliaris											
S-172. Barbus #1											
S-173. B. cyri											
S-174. B. capito											
SSP-55. B.c. concocephalus											
S-175. B. goktshaicus											
S-176. B. brachycephalus											
S-177. B. tauricus											
SSP 56. B.t. kubanicus											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SSP 57. B. tauricus pergamonensis																				1															
SSP 58. B.t. escherichii																				1															
S-178. B. ercisianus																		1																	
S-179. B. albus		1		1																															
SSP 59. B.a. alpina							1																												
S-180. B. luteus		1		1	1		1																												
S-181. B. arabicus						1																													
S-182. B. apoensis						1																													
S-183. B. exulatus						1																													
S-184. B. tor																																1	1	1	1
S-185. B. sharpeyi				1	1																														
S-186. B. canis		1																																	
S-187. B. chantrei		1			1																														
S-188. B. grypus				1	1																														
S-189. B. pectoralis		1	1																																
S-190. B. orontis		1																																	
S-191. B. barbulus		1		1	1		1																												
S-192. B. longiceps		1		1	1																														
S-193. B. lacerta		1																																	
S-194. B. xanthopterus				1	1																														
S-195. Barbus #2							1																												

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

SYSTEMATICS	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-196. Barbus #3							?				1																								
S-197. B. kosswigi				1	1																														
S-198. B. esocinus				1	1																														
S-199. Barbus #4					1																														
S-200. B. subquincunciatus				1	1																														
S-201. B. belayewi				1																															
S-202. B. euphrati				1																															
Subfam. 4. Gobioninae																																			
G-48. Gobio																																			
S-203. G. gobio																		1	1	1	1	1													
SSP 60. G. gobio lepidolaemus																						1	1												
S-204. G. ciscaucasicus																		1			1														
S-205. G. persa																	1	1																	
S-206. Gobio #1												?					?																		
Subfam. 5. Schizothoracinae																																			
G-49. Schizothorax																																			
S-207. S. pelzami																						1	1	1											
S-208. S. intermedius																																	1		
S-209. S. labiatus																										1							1		
S-210. S. plagiostomus																										1							1		

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-211. S. zarudnyi																										1									
S-212. S. esocinus																										1							1		
S-213. S. schumacheri																										1									
G-50. Schizocypris																																			
S-214. S. brucei																										1							1		
G-51. Schizopygopsis																																			
S-215. S. stoliczkai																						1				1							1	1	
Subfam. Rhodeinae																																			
G-52. Rhodeus																																			
S-216. R. sericeus amarus																			1	1	1														
Subfam. Cyprininae																																			
G-53. Cyprinus																																			
S-217. C. carpio		I	I	I	I													1	1	1	1	1													
G-54. Carassius																																			
S-218. C. carassius					I											I					I														
S-219. C. auratus gibelio																I					I														
G-55. Hypothalmichthys																																			
S-220. H. molitrix																					I														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
G-56. Ctenopharyngodon																																			
S-221. C. idellus					I																I														
Family 9. Cobitidae																																			
G-57. Cobitis																																			
S-222. C. taenia					?									?					1		1														
S-223. C. aurata				?																1	1														
SSP 61. C.a. aralensis																						1													
S-224. C. caucasica																		1																	
S-225. C. caspia																					1														
S-226. C. linea											1																								
S-227. C. simplicispina																				1															
G-58. Noemacheilus																																			
S-228. N. stoliczkai																						?											1		
S-229. N. rhadinaeus																										1						1			
S-230. N. ghazniensis																										1									
S-231. N. lindbergi haarlovi																										1									
S-232. N. brahui																										?						1			
S-233. N. farwelli																										1									
S-234. N. kessleri																						1				1					1	1			
S-235. N. prashari																																1			

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

SYSTEMATICS	MESOPOTAMIAN										
	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
SSP 62. N. prashari lindbergi											
S-236. N. montanus											
S-237. N. baluchiorum											
S-238. N. sargadensis											
SSP 63. N.s. turcmenicus											
SSP 64. N.s. bampurensis											
S-239. Noemacheilus #1											
S-240. Noemacheilus #2									1		
S-241. Noemacheilus #3											
S-242. N. angorae											
SSP 65. N.a. jordanicus		1									
SSP 66. N.a. bergianus											
S-243. N. brandti											
S-244. N. barbatulus											
SSP 67. N.b. caucasicus											
S-245. N. merga											
S-246. Noemacheilus #4											
S-247. Noemacheilus #5											
S-248. N. cristatus											
S-249. N. longicauda											
S-250. N. malapterurus											

SYSTEMATICS	SARMATIAN												
	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
SSP 62. N. prashari lindbergi													
S-236. N. montanus													
S-237. N. baluchiorum													
S-238. N. sargadensis													
SSP 63. N.s. turcmenicus												1	
SSP 64. N.s. bampurensis													
S-239. Noemacheilus #1													
S-240. Noemacheilus #2													
S-241. Noemacheilus #3													
S-242. N. angorae									1				
SSP 65. N.a. jordanicus													
SSP 66. N.a. bergianus						1	1			1			
S-243. N. brandti						1	1						
S-244. N. barbatulus								1	1	1			
SSP 67. N.b. caucasicus										1			
S-245. N. merga										1			
S-246. Noemacheilus #4			1	1	1								
S-247. Noemacheilus #5										1			
S-248. N. cristatus										1	1	1	
S-249. N. longicauda											1	1	
S-250. N. malapterurus			1	1	1					1			

SYSTEMATICS	ORIENTAL										
	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SSP 62. N. prashari lindbergi							1	1	1		
S-236. N. montanus									1		
S-237. N. baluchiorum							1	1	1		
S-238. N. sargadensis			1	1		1					
SSP 63. N.s. turcmenicus	1										
SSP 64. N.s. bampurensis					1	1					
S-239. Noemacheilus #1						1					
S-240. Noemacheilus #2											
S-241. Noemacheilus #3							1				
S-242. N. angorae											
SSP 65. N.a. jordanicus											
SSP 66. N.a. bergianus											
S-243. N. brandti											
S-244. N. barbatulus											
SSP 67. N.b. caucasicus											
S-245. N. merga											
S-246. Noemacheilus #4											
S-247. Noemacheilus #5											
S-248. N. cristatus											
S-249. N. longicauda											
S-250. N. malapterurus											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
S-251. *N. tigris*		1		1	1						
SSP 68. *N.t. seyhanensis*			1								
SSP 69. *N.t. cyri*											
S-252. *N. lendli*											
S-253. *N. persa*											1
S-254. *N. smithi*				1							
S-255. *N. insignis*		1									
SSP 70. *N.i. tortonesei*		1									
SSP 71. *N.i. euphraticus*			1	1	1						
S-256. *N. panthera*		1		1	1						
S-257. *N. argyrogramma*		1	1	1							
S-258. *N. kermanshahensis*					1						
S-259. *N. tschaiyssuensis*			1								
S-260. *N. galileus*		1									
S-261. *N. leontinae*		1									
S-262. *Noemacheilus* #6					1						
S-263. *Noemacheilus* #7					1						
S-264. *Noemacheilus* #8					1						
S-265. *Noemacheilus* #9				1							
G-59. *Turcinoemacheilus*											
S-266. *T. kosswigi*				1							
G-60. *Misgurnus*											
S-267. *M. fossilis*											

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
S-251. *N. tigris*													
SSP 68. *N.t. seyhanensis*													
SSP 69. *N.t. cyri*							1						
S-252. *N. lendli*									1				
S-253. *N. persa*													
S-254. *N. smithi*													
S-255. *N. insignis*													
SSP 70. *N.i. tortonesei*													
SSP 71. *N.i. euphraticus*													
S-256. *N. panthera*													
S-257. *N. argyrogramma*													
S-258. *N. kermanshahensis*													
S-259. *N. tschaiyssuensis*													
S-260. *N. galileus*													
S-261. *N. leontinae*													
S-262. *Noemacheilus* #6													
S-263. *Noemacheilus* #7													
S-264. *Noemacheilus* #8													
S-265. *Noemacheilus* #9													
G-59. *Turcinoemacheilus*													
S-266. *T. kosswigi*													
G-60. *Misgurnus*													
S-267. *M. fossilis*								1	1	1			

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-251. *N. tigris*											
SSP 68. *N.t. seyhanensis*											
SSP 69. *N.t. cyri*											
S-252. *N. lendli*											
S-253. *N. persa*											
S-254. *N. smithi*											
S-255. *N. insignis*											
SSP 70. *N.i. tortonesei*											
SSP 71. *N.i. euphraticus*											
S-256. *N. panthera*											
S-257. *N. argyrogramma*											
S-258. *N. kermanshahensis*											
S-259. *N. tschaiyssuensis*											
S-260. *N. galileus*											
S-261. *N. leontinae*											
S-262. *Noemacheilus* #6											
S-263. *Noemacheilus* #7											
S-264. *Noemacheilus* #8											
S-265. *Noemacheilus* #9											
G-59. *Turcinoemacheilus*											
S-266. *T. kosswigi*											
G-60. *Misgurnus*											
S-267. *M. fossilis*											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Div. 2. Siluri																																			
SubO. 6. Siluroidei																																			
Family 10. Tachysuridae																																			
G-61. Tachysurus																																			
S-268. T. thalassinus	M			M	M	M																									M	M		M	M
Family 11. Siluridae																																			
G-62. Silurus																																			
S-269. S. glanis																	2	2	2	2	2	2													
S-270. S. chantrei				2														?																	
S-271. S. triostegus				2																															
G-63. Wallago																																			
S-272. W. attua																																2	2	2	2
Family 12. Bagridae																																			
G-64. Mystus																																			
S-273. M. pelusius		2																																	
SSP 72. M.p. colvillii				2	2																														
S-274. M. cavasius																																2		2	2
Family 13. Sisoridae																																			
G-65. Glyptothorax																																			

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

SYSTEMATICS	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-275. G. armeniacum				2														?																	
S-276. G. steindachneri				2																															
S-277. G. kurdistanicum					2																														
Family 14. Clariidae																																			
G-66. Clarias																																			
S-278. C. lazera		2																																	
G-67. Heteropneustes																																			
S-279. H. fossilis				2																												2	2	2	2
S-280. Heteropneustes #1					2																														
S-281. Heteropneustes #2					2																														
Order 7. Anguilliformes																																			
Family 15. Muraenesocidae																																			
G-68. Muraenesox																																			
S-282. M. cinereus	M			M	M	M																										M	M	M	M
Order 8. Gadiformes																																			
Family 16. Gadidae																																			
G-69. Lota																																			
S-283. L. lota																		4	4		4														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

SYSTEMATICS	MESOPOTAMIAN										
	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
Order 9. Gasterosteiformes											
Family 17. Gasterosteidae											
G-70. Pungitius											
S-284. P. platygaster											
Order 10. Syngnathiformes											
Family 18. Syngnathidae											
G-71. Syngnathus											
S-285. S. nigrolineatus caspius											
Order 11. Cyprinodontiformes											
Family 19. Cyprindontidae											
G-72. Aphanius											
S-286. A. mento		3	3	3							
S-287. A. chantrei		?	3								
S-288. A. sophiae				3	3						3
S-289. A. punctatus										3	
S-290. A. danfordii			3								
S-291. Aphanius #1											3
S-292. A. dispar	3			3	3	3	3				
SSP 73. A. dispar richardsoni		3									

SYSTEMATICS	SARMATIAN												
	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
Order 9. Gasterosteiformes													
Family 17. Gasterosteidae													
G-70. Pungitius													
S-284. P. platygaster							3	3	3	3	3		
Order 10. Syngnathiformes													
Family 18. Syngnathidae													
G-71. Syngnathus													
S-285. S. nigrolineatus caspius									4	4			
Order 11. Cyprinodontiformes													
Family 19. Cyprindontidae													
G-72. Aphanius													
S-286. A. mento	3												
S-287. A. chantrei													
S-288. A. sophiae													
S-289. A. punctatus													
S-290. A. danfordii													
S-291. Aphanius #1													
S-292. A. dispar													
SSP 73. A. dispar richardsoni													

SYSTEMATICS	ORIENTAL										
	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
Order 9. Gasterosteiformes											
Family 17. Gasterosteidae											
G-70. Pungitius											
S-284. P. platygaster											
Order 10. Syngnathiformes											
Family 18. Syngnathidae											
G-71. Syngnathus											
S-285. S. nigrolineatus caspius											
Order 11. Cyprinodontiformes											
Family 19. Cyprindontidae											
G-72. Aphanius											
S-286. A. mento											
S-287. A. chantrei											
S-288. A. sophiae											
S-289. A. punctatus											
S-290. A. danfordii											
S-291. Aphanius #1											
S-292. A. dispar											
SSP 73. A. dispar richardsoni											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
SSP 74. A. dispar stoliczkanus											
S-293. A. ginaonis									3		
S-294. Aphanius #2									3		
S-295. Aphanius #3											
S-295. Aphanius #4						3					
S-296. Aphanius #5											
Family 20. Poeciliidae											
G-73. Gambusia											
S-297. G. affinis affinis					I		I	I	I	I	I
SSP 75. G.a. holbrooki					I		I	I	I	I	I
Order 12. Mugiliformes											
Family 21. Mugilidae											
G-74. Mugil											
S-298. M. auratus											
S-299. M. saliens											
S-300. M. cephalus						M					
S-301. M. abu				4	4						
SSP 76. M.a. zarudnyi				4	4						
S-302. Mugil #1					4						

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
SSP 74. A. dispar stoliczkanus													
S-293. A. ginaonis													
S-294. Aphanius #2													
S-295. Aphanius #3													
S-295. Aphanius #4													
S-296. Aphanius #5			?										
Family 20. Poeciliidae													
G-73. Gambusia													
S-297. G. affinis affinis										I			
SSP 75. G.a. holbrooki										I			
Order 12. Mugiliformes													
Family 21. Mugilidae													
G-74. Mugil													
S-298. M. auratus								M	M	I			
S-299. M. saliens								M	M	I			
S-300. M. cephalus								M	M	I			
S-301. M. abu													
SSP 76. M.a. zarudnyi													
S-302. Mugil #1													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SSP 74. A. dispar stoliczkanus						3	3	3			
S-293. A. ginaonis											
S-294. Aphanius #2											
S-295. Aphanius #3							3				
S-295. Aphanius #4											
S-296. Aphanius #5											
Family 20. Poeciliidae											
G-73. Gambusia											
S-297. G. affinis affinis											
SSP 75. G.a. holbrooki											
Order 12. Mugiliformes											
Family 21. Mugilidae											
G-74. Mugil											
S-298. M. auratus											
S-299. M. saliens											
S-300. M. cephalus							M	M	M	M	M
S-301. M. abu											
SSP 76. M.a. zarudnyi											
S-302. Mugil #1											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-303. M. dussumieri				M	M																										M	M	M	M	M
S-304. M. oligolepis				M																												M	M	M	M
S-305. M. waigiensis				M	M	M																									M	M	M	M	M
S-306. M. speigleri																															M	M	M	M	M
Family 22. Atherinidae																																			
G-75. Atherina																																			
S-307. A. mochon pontica caspia																					4														
Order 13. Channiformes																																			
Family 23. Channidae																																			
G-76. Ophiocephalus																																			
S-308. O. gachua																														1	1	1	1	1	1
Order 14. Perciformes																																			
Suborder 7. Percoidei																																			
Family 24. Percidae																																			
G-77. Stizostedion																																			
S-309. S. lucioperca																		3	3	3	3														
S-310. S. marina																				3	3														
G-78. Perca																																			
S-311. P. fluviatilis																		3	3	3	3	3													

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
G-79. *Acerina*											
S-312. *A. cernua*											
Family 25. Cichlidae											
G-80. *Tilapia*											
S-313. *T. galilaea*		3									
S-314. *T. nilotica*	3	3									
S-315. *T. aurea*	3	3									
S-316. *T. zillii*	3	3									
G-81. *Haplochromis*											
S-317. *H. flavii-josephi*		3									
G-82. *Tristramella*											
S-318. *T. sacra*		3									
S-319. *T. simonis*		3									
SSP-77. *T.s. intermedia*		3									
S-320. *T. magdalenae*		3									
G-83. *Etroplus*											
S-321. *E. canarensis*											
S-322. *E. maculatus*											
S-323. *E. auratensis*											
G-84. Cichlidae #1											
S-324. Species #1									3		

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
G-79. *Acerina*													
S-312. *A. cernua*								3	3	3	3		
Family 25. Cichlidae													
G-80. *Tilapia*													
S-313. *T. galilaea*													
S-314. *T. nilotica*													
S-315. *T. aurea*													
S-316. *T. zillii*													
G-81. *Haplochromis*													
S-317. *H. flavii-josephi*													
G-82. *Tristramella*													
S-318. *T. sacra*													
S-319. *T. simonis*													
SSP-77. *T.s. intermedia*													
S-320. *T. magdalenae*													
G-83. *Etroplus*													
S-321. *E. canarensis*													
S-322. *E. maculatus*													
S-323. *E. auratensis*													
G-84. Cichlidae #1													
S-324. Species #1													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
G-79. *Acerina*											
S-312. *A. cernua*											
Family 25. Cichlidae											
G-80. *Tilapia*											
S-313. *T. galilaea*											
S-314. *T. nilotica*											
S-315. *T. aurea*											
S-316. *T. zillii*											
G-81. *Haplochromis*											
S-317. *H. flavii-josephi*											
G-82. *Tristramella*											
S-318. *T. sacra*											
S-319. *T. simonis*											
SSP-77. *T.s. intermedia*											
S-320. *T. magdalenae*											
G-83. *Etroplus*											
S-321. *E. canarensis*										3	
S-322. *E. maculatus*										3	
S-323. *E. auratensis*										3	
G-84. Cichlidae #1											
S-324. Species #1											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN													ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-325. Species #2							?		?		?																								
Suborder 8. Gobiodei																																			
Family 26 Gobiidae																																			
G-85. Pomatoschistus																																			
S-326. P. caucasicus																				4	4														
G-86. Knipowitschia																																			
S-327. K. longicaudata																				4	4														
S-328. K. iljini																					4														
G-87. Neogobius																																			
S-329. N. melanostomus affinis																					4														
S-330. N. ratan goebeli																					4														
S-331. N. cephalarges constructor																		4			4														
S-332. N. kessleri																				4	4														
S-333. N. fluviatilis pallasi																					4														
S-334. N. bogdanowi																					4														
S-335. N. bathybius																					4														
S-336. N. caspius																					4														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

	MESOPOTAMIAN											SARMATIAN												ORIENTAL										
SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-337. *N. syrman eurystomus*																					4														
G-88. *Mesogobius*																																			
S-338. *M. nonultimus*																					4														
S-339. *M. gymnotrachelus macrophthalmus*																					4														
S-340. *M. nigronotatus*																					4														
G-89. *Proterorhinus*																																			
S-341. *P. semipellucidus*																					4														
S-342. *P. marmoratus*																				4	4														
G-90. *Caspiosoma*																																			
S-343. *C. caspium*																				4	4														
G-91. *Asra*																																			
S-344. *A. turcomana*																					4														
G-92. *Benthophiloides*																																			
S-345. *B. brauneri*																				4	4														
G-93. *Benthophilus*																																			
S-346. *B. macrocephalus*																				4	4														
S-347. *B. ctenolepidus*																					4														
S-348. *B. stellatus leobergius*																					4														
S-349. *B. spinosus*																					4														

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
S-350. *B. leptocephalus*											
S-351. *B. baeri*											
S-352. *B. granulosus*											
S-353. *B. leptorhynchus*											
S-354. *B. grimmi*											
G-94. *Antirostrum*											
S-355. *A. profundorum*											
G-95. *"Gobius"*											
S-356. *G. giuris*	M										
S-357. *Gobius #1*											
G-96. *Trypauchen*											
S-358. *T. vagina*				M	M						
G-97. *Scartelaos*											
S-359. *S. tenuis*	M			M							
G-98. *Boleophthalmus*											
S-360. *B. dussumieri*				M	M						
S-361. *B. boddaerti*											
Family 27. Periophthalmidae											
G-99. *Periophthalmus*											
S-362. *P. koelreuteri*	M			M	M	M			M		
S-363. *P. waltoni*				M	M	M			M		

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
S-350. *B. leptocephalus*										4			
S-351. *B. baeri*										4			
S-352. *B. granulosus*										4			
S-353. *B. leptorhynchus*										4			
S-354. *B. grimmi*										4			
G-94. *Antirostrum*													
S-355. *A. profundorum*										4			
G-95. *"Gobius"*													
S-356. *G. giuris*													
S-357. *Gobius #1*													
G-96. *Trypauchen*													
S-358. *T. vagina*													
G-97. *Scartelaos*													
S-359. *S. tenuis*													
G-98. *Boleophthalmus*													
S-360. *B. dussumieri*													
S-361. *B. boddaerti*													
Family 27. Periophthalmidae													
G-99. *Periophthalmus*													
S-362. *P. koelreuteri*													
S-363. *P. waltoni*													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
S-350. *B. leptocephalus*											
S-351. *B. baeri*											
S-352. *B. granulosus*											
S-353. *B. leptorhynchus*											
S-354. *B. grimmi*											
G-94. *Antirostrum*											
S-355. *A. profundorum*											
G-95. *"Gobius"*											
S-356. *G. giuris*							M	M	M	M	M
S-357. *Gobius #1*							M				
G-96. *Trypauchen*											
S-358. *T. vagina*								M		M	M
G-97. *Scartelaos*											
S-359. *S. tenuis*							M	M	M	M	M
G-98. *Boleophthalmus*											
S-360. *B. dussumieri*							M	M	M	M	
S-361. *B. boddaerti*							M	M	M	M	M
Family 27. Periophthalmidae											
G-99. *Periophthalmus*											
S-362. *P. koelreuteri*							M	M	M	M	M
S-363. *P. waltoni*											

TABLE 5. DISTRIBUTION OF THE FRESHWATER FISHES OF IRAN AND ADJACENT AREAS

MESOPOTAMIAN

SYSTEMATICS	AFRICA	PALESTINE	ASIA MINOR	TIGRIS-EUPHRATES	KARUN BASIN	ARABIA	MOND BASIN	LAR BASIN	KOL BASIN	MAHARLU BASIN	NEYRIZ BASIN
SubO. 9. Stromateoidei											
Family 28. Stromateidae											
G-100. Chondroplites											
S-364. C. chinensis				M	M						
G-101. Pampus											
S-365. P. argenteus				M	M						
Order 15. Pleuronectiformes											
Family 29. Pleuronectidae											
G-102. Pleuronectes											
S-366. P. flesus											
Family 30. Soleidae											
G-103. Synaptura											
S-367. S. orientalis				M	M						
Order 16. Mastacembeliformes											
Family 31. Mastacembelidae											
G-104. Mastacembelus											
S-368. M. simack		2		2	2		2				
S-369. M. armatus											

SARMATIAN

SYSTEMATICS	ISFAHAN	ARAK BASIN	QOM BASIN	SEMNAN BASIN	TEHRAN BASIN	REZAIYEH BASIN	AZERBAIJAN	EUROPE	BLACK SEA BASIN	CASPIAN SEA BASIN	ARAL SEA BASIN	KHORASAN	DASHTE-KAVIR
SubO. 9. Stromateoidei													
Family 28. Stromateidae													
G-100. Chondroplites													
S-364. C. chinensis													
G-101. Pampus													
S-365. P. argenteus													
Order 15. Pleuronectiformes													
Family 29. Pleuronectidae													
G-102. Pleuronectes													
S-366. P. flesus								M	M	I			
Family 30. Soleidae													
G-103. Synaptura													
S-367. S. orientalis													
Order 16. Mastacembeliformes													
Family 31. Mastacembelidae													
G-104. Mastacembelus													
S-368. M. simack													
S-369. M. armatus													

ORIENTAL

SYSTEMATICS	N.E. BASINS	HELMAND	YAZD	KERMAN	DASHTE-LUT	BAMPUR BASIN	MEKRAN	PAKISTAN COAST	INDUS BASIN	INDIA	S.E. ASIA
SubO. 9. Stromateoidei											
Family 28. Stromateidae											
G-100. Chondroplites											
S-364. C. chinensis								M		M	M
G-101. Pampus											
S-365. P. argenteus								M		M	M
Order 15. Pleuronectiformes											
Family 29. Pleuronectidae											
G-102. Pleuronectes											
S-366. P. flesus											
Family 30. Soleidae											
G-103. Synaptura											
S-367. S. orientalis								M		M	M
Order 16. Mastacembeliformes											
Family 31. Mastacembelidae											
G-104. Mastacembelus											
S-368. M. simack											
S-369. M. armatus							2	2	2	2	2

The Mesopotamian Province occupies the western and southern parts of Iran. The eastern and southern border areas plus many of the internal basins are part of the Oriental Region. The inland basins represent a depauperate extension of the more diverse faunas found in the Caspian Sea, Tigris-Euphrates-Karun and Mekran Basins. The major faunal divisions are shown in Figure 13.

Distribution of the freshwater fishes of Iran is summarized in Table 5. More detailed information on the distribution of any particular species may be found in the Systematics Chapter.

A summary of the faunal diversity by family and selected lower classifications is shown in Table 6. Twenty one families of native freshwater fish, excluding the temporary marine residents, have been reported from Iran. Fourteen of the twenty one families are found in the Caspian Sea. Only five of these families are shared with other Iranian faunas. One of the five, Cyprinodontidae, I would still consider as an unconfirmed native family. Two reports have been received of cyprinodonts in the Sarmatian Fauna, one from the Isfahan and one from the Qom Basin. The Qom Basin report included no identification nor description. The cyprinodont from the Isfahan Basin was identified by Dr. Robert J. Behnke but is, I believe, a recent invader. Principal overlap of faunas between the Sarmatian and the Mesopotamian and Oriental faunas is the two families Cyprinidae and Cobitidae.

Table 7 shows the relationships with a number of basins and faunal regions. As is evident from the table, the greatest similarities are with the Black Sea Basin, Europe, and Aral Sea Basins. The

TABLE 6 . COMPARISON OF FAUNAL DIVERSITY

OF IRANIAN FRESHWATER FISHES

SYSTEMATICS	SARMATIAN			MESOPOTAMIAN			ORIENTAL		
	GEN.	SP.	SSP	GEN.	SP.	SSP	GEN.	SP.	SSP
Petromyzontidae	1	1							
Acipenseridae	2	5							
Clupeidae	2	9	13						
Salmonidae	2	2		1	1				
Esocidae	1	1							
Cyprinidae									
Leuciscinae	14	29	22	8	18	2	2	2	
Chondrostominae	1	4		1	6				
Barbinae	1	1		6	9		3	9	
Barbus		7	1		17	1			
Varicorhinus		11	8		9			4	
Cyprinion					7	1		3	
Gobioninae	1	4	1						
Schizothoracinae	1	1					3	9	
Rhodeinae	1	1							
Cyprininae	1	1							
Cobitidae	1	1		1	1				
Cobitis		4			2				
Noemacheilus		10	2		12	1		11	2
Siluridae	1	1		1	2				
Bagridae				1	1		1	1	
Sisoridae				1	3				
Clariidae				1	1		1	1	
Gadidae	1	1							
Gasterosteidae	1	1							
Syngnathidae	1	1							
Cyprinodontidae	1	1		1	8		1	2	
Mugilidae				1	2				
Channidae							1	1	
Percidae	3	4							
Cichlidae				1	2				
Gobiidae	10	30							
Mastacembelidae				1	1		1	1	

Gen.=Genus
Sp.= Species
SSP= Subspecies

TABLE 7

NATIVE FRESHWATER FISH FAUNA

OF THE SARMATIAN OF IRAN

SHARED WITH OTHER BASINS AND REGIONS

FAUNA	CLASS	ORDER	FAMILY	GENUS	SPECIES	SUBSPECIES
Sarmatian of Iran	2	9	14	48	127	46
Black Sea Basin	2	8	12	36	54	4
Europe	2	8	12	29	33	0
Aral Sea Basin	2	6	8	23	28	6
Mesopotamian of Iran	1	4	5	16	5	0
Oriental of Iran	1	2	4	4	1	0
Endemic	0	0	0	5	47	37

fauna shared with the Oriental Region includes schizothoracins and the genus Garra, which are restricted in the Sarmatian fauna of Iran to the northeastern corner.

Eleven families, as shown in Tables 6 and 8, are found in the Mesopotamian fauna. Eight of the eleven families are shared with the Oriental fauna, and five families, including the cyprinodonts, are shared with the Sarmatian. However, a greater number of genera and species are shared by the Mesopotamian fauna with the Sarmatian fauna than with the Oriental fauna.

All nine of the families reported in the Oriental fauna of Iran, as shown in Tables 6 and 9, are common with the Indo-Asian fauna to the east. Eight of the nine are found further to the west in the Mesopotamian fauna; only the channids do not reach to the Mesopotamian fauna.

All three faunas in Iran show a high degree of endemism. Over one-third of the species and over half of the subspecies are endemic to Iranian waters. It is possible, with additional collecting and analysis, the percentage will prove to be even higher, particularily within the internal basins.

In the following pages, the fish fauna of individual basins will be discussed in more detail. Accompanying the discussions are a series of tables summarizing the fish present and the sharing of fauna with other basins. Fauna shared at the genus, species and subspecies levels are indicated in the tables. Where a genus is found in another faunal region, the individual basins are not indicated; only the region.

TABLE 8

NATIVE FRESHWATER FISH FAUNA

OF THE MESOPOTAMIAN OF IRAN

SHARED WITH OTHER BASINS AND REGIONS

FAUNA	CLASS	ORDER	FAMILY	GENUS	SPECIES	SUBSPECIES
Mesopotamian of Iran	1	6	11	33	89	11
Sarmatian of Iran	1	4	5	16	5	0
Black Sea Basin	1	4	5	13	3	0
Caspian Sea Basin	1	3	4	14	4	0
Europe	1	4	5	13	2	0
Africa	1	3	7	9	1	0
Oriental of Iran	1	3	8	12	3	0
Indo-S.E. Asia	1	3	9	10	1	0
Endemic	0	0	0	5	37	5

TABLE 9

NATIVE FRESHWATER FISH FAUNA

OF THE ORIENTAL OF IRAN

SHARED WITH OTHER BASINS AND REGIONS

FAUNA	CLASS	ORDER	FAMILY	GENUS	SPECIES	SUBSPECIES
Oriental of Iran	1	4	9	16	39	3
Mesopotamian of Iran	1	3	8	12	3	0
Sarmatian of Iran	1	2	4	4	1	0
Aral Sea Basin	1	1	3	6	5	1
Caspian Sea Basin	1	1	3	3	0	0
Africa	1	2	5	3	5	0
Indo-S.E. Asia	1	4	9	13	12	0
Endemic	0	0	0	0	22	1

In the following discussions of the fish fauna of the individual basins, the following symbols were used in the accompanying tables:

STATUS

I = Introduced

A = Anadromous

1 = Fish with little or no tolerance for saline waters

2 = Fish with some tolerance for saline waters

3 = Fish showing a high degree of tolerance for saline water

4 = Freshwater fishes closely related to marine fishes

M = Marine fishes, often entering freshwater

SHARED FAUNA

Fauna, at the genus, species or subspecies level, found in other basins.

S = Sarmatian

M = Mesopotamian

O = Oriental

E = Endemic

1 = Africa

2 = Palestine

3 = Asia Minor

4 = Tigris-Euphrates Basin

5 = Karun Basin

6 = Arabia

7 = Mond Basin

8 = Lar Basin

9- Kol Basin

10- Maharlu Basin

11- Neyriz Basin

12- Isfahan Basin

13- Arak Basin

14- Qom Basin

15- Semnan Basin

16- Tehran Basin

17- Lake Rezaiyeh Basin

18- Azerbaijan

19- Europe

20- Black Sea Basin

21- Caspian Sea Basin

22- Aral Sea Basin

23- Khorasan

24- Dashte-Kavir

25- Enclosed Northeast Basins

26- Helmand Basin

27- Yazd Basin

28- Kerman Basin

29- Dashte-Lut

30- Bampur Basin

31- Mekran

32- Pakistan Coastal Areas

33- Indus River Basin

34- India

35- Southeast Asia

HOLARCTIC REGION

SARMATIAN PROVINCE

Caspian District

Persian Subdistrict (Table 10)

The Caspian Sea Basin fish fauna is the richest and best known of the Iranian fish faunas. Until after World War II, the Soviet Union operated the commercial fishery in Iranian waters. They conducted fish research from their Stations in Iran, adding the knowledge to the extensive work being done in the Soviet Union. Several major works, such as those by Berg (1948), Zenkevich (1957), Slastenenko (1959) and other Soviet authors give a detailed description of the Caspian Basin fauna.

In Iran, two classes, eleven orders, seventeen families, fifty four genera, one hundred eight species and thirty nine subspecies have been reported. Three of the orders and families, the mugilids, cyprinodonts and pleuronectids, were introduced. The flatfish Pleuronectes flesus and three species of mullets (Mugil sp.) were introduced in this century to increase the available commercial fish species. The cyprinodont Gambusia was introduced some time in the 1960s for mosquito control. The trout, Salmo gairdneri was introduced into several Caspian Basin streams, taking successfully in some headwater areas. An attempt was made to induce a steelhead run in the Chalus River, but there has been no reports of any adult returns. (For discussions of individual species see Systematics Chapter).

Two major divisions of fish may be described on the basis of origins. One is the remnant marine Tertiary fauna, the other developed from recent freshwater immigrants from adjoining areas.

The Caspian Sea was once part of the Sarmatian Sea, a remnant of the earlier Tethys Sea that covered the region (for more detail and citations, see chapter on Geologic History). During periods of desiccation during the Late Tertiary and Recent periods, the Caspian Sea was alternately isolated and connected to the Black and Aral Seas. A low depression, the Kumo-Manych Depression north of the Caucasus Mountains, provided a ready access between the Black and Caspian Seas when water levels rose. Similarily, the Usboi Depression north of the Kopet Dagh provided an exchange route between the Caspian and Aral Seas during high water periods.

The principal invasion route for recent freshwater immigrants was from the north. The very extensive Volga River Basin borders, and in a few points actually connects, with drainages flowing into the North and Baltic Seas, and the Don River. Wetter periods, plus the influence of the ice sheets during the ice age, would have made access from the north into the Caspian Sea Basin easier. A less well established but possible migration route existed in Azerbaijan where headwaters of the Kura and Araxes Rivers were very close to headwaters of the Tigris and Euphrates and Black Sea drainages.

The close relationship between the Black and Caspian Seas is evident in the high degree of relationship between the fish faunas. All major orders, and over half the genera, are shared between the two seas. Both basins receive their principal freshwater inflow from the same general regions of Eastern Europe, and both have tributaries close to the headwaters of the Tigris and Euphrates River systems. The

Black Sea, because of its continued connections with the Mediterranean Sea, is more saline, and possesses a much more diverse marine fauna.

The Aral Sea and Caspian Sea show more differences. The Aral Sea is smaller and less saline than the Caspian Sea, and lacks the diverse marine relict fauna. Unlike the Black and Caspian Seas, the Aral Sea has its principal tributaries from the south and east, not from the north. This is evident from the Central Asian groups, most notably the Schizothoracinae, that have been established in the Aral Sea Basin but are absent from the Caspian Sea Basin. (See Table 7)

Nearly a fourth of the genera and a third of the species and subspecies in the Caspian Sea belong to two families, the gobies and the clupeids. These are both relict faunas of the Sarmatian Sea. Both families are absent from the Aral Sea, but closely related species and subspecies are found in the Black Sea. Within the Caspian Sea, endemism is quite high, but is most often expressed at the subspecific level rather than the specific or genera level. The tendency has been to develop isolated breeding populations, particularily among the clupeids, which has contributed to the high degree of endemism.

The sturgeons in the Caspian Sea are related to those in the Black and Aral Seas at the generic and specific levels. The sturgeons are probably of marine origin during the Sarmatian Sea's existence, but may have penetrated more recently.

The Caspian salmon has presented problems for those trying to determine its origins. It shows resemblences to both the European searun brown trout (Salmo trutta) and the Atlantic salmon (S. salar) (See the detailed discussion of the problem in the chapter on Systematics). For many years, its origins were thought to parallel those of the Caspian seal, with both being considered of recent origin. McLaren (1960) showed recently that the Caspian Seal has been a long-term resident of the Caspian Sea, being present as far back as the Tethys Sea. Kosswig (1955, 1969) suggests that the presence of a closely related subspecies (S. trutta macrostigma) in the Tigris-Euphrates implies a Sarmatian Sea origin, since the Tigris and Euphrates have been separated from the the basins to the north since the termination of the Sarmatian Sea. A closely related genus, Stenodus, found together with Salmo in the rivers of the North and Baltic Sea, has also penetrated into the Caspian Sea. Unlike Salmo, however, Stenodus has colonized mostly in the northern part of the Caspian Sea and is seldom taken in the southern part of the Sea. Salmo, on the other hand, has colonized all accessible suitable habitat in the Caspian Sea Basin itself, and has become established in the isolated basins south of the Elbourz Mountains and in Azerbaijan.

It is probable that more than one invasion of Salmo occurred. It appears from current distribution patterns that Salmo trutta was present in the Sarmatian Sea. As a result of changing conditions, due to wetter periods and glaciation, subsequent invasions of Salmo, both S. trutta and probably S. salar, reached the Caspian Basin, interbredding with resident populations. More isolated populations in the interior and northeastern basins, once isolated from the continued influx of new genetic material, began to diverge, showing the high variety of coloration and some meristic characters now found. The situation is in many respects analogous to the cutthroat trout of western North America. The *Stenodus*, by comparison, was a late arrival, and has only recently become established in the Caspian Sea Basin.

Among the cyprinids, the greatest variety, 14 genera and 23 species and subspecies, are in the Subfamily Leuciscinae. This Subfamily is best developed in the Holarctic Region. The genera, and many of the species, in Iran are closely aligned to the fauna of Europe.

Noteworthy is the complete absence of Schizothoracinae, a very common subfamily east and south of the Caspian. The Barbinae, the most abundant and diverse fauna elsewhere in Iran, is represent by only two genera and five species. Three other subfamilies, Gobioninae, Rhodeinae, and Cyprininae are native only to the Caspian Sea Basin and Azerbaijan, although Cyprininae have been introduced in other parts of Iran.

The Family Cobitidae is respented by two genera, *Cobitis* and *Noemacheilus*. *Misgurnus* may be present, as discussed in the chapter on Systematics. *Cobitis* is principally a Palearctic species, common in Europe and northern Asia. *Noemacheilus* is the most common genus in Iran, and is represented in the Caspian fauna by six species, two of which are endemic.

The Perciformes are recent arrivals in the Caspian Sea Basin, being represented by species widespread in the Palearctic. Two genera, *Atherina* and *Syngnathus*, are very recent arrivals, probably entering the Caspian Sea from the Black Sea. The Perciforms, with the exception of the endemic gobies, show little or no differentiation.

The cyprinids, cobitids and non-goby perciforms represent the recently arrived fish fauna. Their origins appear to be in Europe and northern Asia where the closest relatives are found. Much of Europe was covered by ice during the last glacial period. Siberia, and at least the southern part of the Caspian Sea, remained ice-free. While Siberia was probably a reservoir for species that were eradicated from Europe by the ice, the Caspian did not appear to act in a similar capacity. The Caspian Sea was much larger during this period, and connections maintained with the Black Sea that would have kept the sea more saline than at present and thus inhospitable to freshwater species. It was after the connections with the Black Sea were severed and the glacials began to recede that conditions favored development of the northern fish fauna in the Caspian Sea Basin. The ice and altered drainages in the north favored colonization by northern species. Even now, the diversity of this fauna remains much greater in the northern part of the basin, particularily in the Volga River, than in the southern. (See chapters of Geologic and Hydrologic History; Berg, 1948, Zenkevitch, 1957, Kosswig, 1955, 1969, and references cited in above chapters).

The invading freshwater fauna combined with the existing marine relicts, composed of species able to adjust to the lower salinities. Like the marine relicts, this recent freshwater fauna showed a rather high degree of endemism, again at the specific and subspecific level. Many of the new species moved quickly into the rivers draining into the Caspian Sea, and began differentiating from similar species in other, separate parts of the basin.

TABLE 10. CASPIAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SHARED FAUNA SSP
Class Petromyzones				
Order Petromyzoniformes				
Family Petromyzontidae				
Caspiomyzon wagneri	A	E		
Class Teleostomi				
Order Acipenseriformes				
Family Acipenseridae				
Huso huso	A		19,20	
Acipenser nudiventris	A	19	19,22	
A. ruthenus	A	19	19,20	
A. guldenstadti persicus	A	19	20	E
A. stellatus cyrensis	A	19	20	E
Order Clupeiformes				
Suborder Clupeoidei				
Family Clupeidae				
Caspialosa brashnikovi	4	20	E	
C. brashnikovi grimmi	4	20	E	
C. brashnikovi autumnalis	4	20	E	
C. brashnikovi kisselwitschi	4	20	E	
C. brashnikovi nirchi	4	20	E	
C. brashnikovi surensis	4	20	E	
C. brashnikovi agrakhanika	4	20	E	
C. brashnikovi orientalis	4	20	E	
C. saposhnikovi	4	20	E	
C. curensis	4	20	E	
C. suworowi	4	20	E	
C. pontica kessleri	4	20	20	E
C. pontica volgensis	4	20	20	E
C. pontica volgensis imitans	4	20	20	E
C. caspia	4	20	E	
C. caspia aestuarina	4	20	E	
C. caspia persica	4	20	E	
C. caspia knipowitschi	4	20	E	
Clupeonella delicatula	4	20	20	
C. grimmi	4	20	E	
C. engrauliformis	4	20	E	
Suborder Salmonoidei				
Family Salmonidae				
Salmo trutta caspius	A,3	M,19	1,3,4,19,20 22,5	15,16, 17,18
S. trutta fario	I			
S. gairdneri	I			

TABLE 10. CASPIAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SSP.
Stenodus leucichthys	3	19	19	E
Suborder Esocoidei				
Family Esocidae				
Esox lucius	2		17,18,19,20 22	
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Rutilus rutilus caspicus	A		19,20,22	18
R. rutilus caspicus knipowitschi	A		19,20,22	18
R. rutilus caspicus kurensis	A		19,20,22	18
R. frisii kutum	A	22	19,20	E
Leuciscus leuciscus	1	M, 13,14, 16,17,18	19,20 19,22	
L. idus	1	M,13,14, 16,17,18, 20,23		
L. cephalus orientalis	1	22,23	2,3,4,5,19,	13,14,16, 17,18,20
Scardinius erythrophthalmus	1		19,20,22	
Aspius aspius taeniatus	1	M,	18,19,20,22	18,22
Tinca tinca	1		18,19,20	
Chalcalburnus chalcoides	1	M	18	
Alburnus alburnus	1	M,12,14 17,18	19,20	
A. charusini hohenackeri	1	M,12,14, 17,19,20	18	
A. charusini hohenackeri persicus	1	M,12,14, 17,19,20	18	E(Morpha)
A. filippi	1	M,12,14, 17,19,20	18	
Alburnoides bipunctatus eichwaldi	1	M	13,14,15,16, 17,18,23	19,20, 22
Acanthalburnus microlepis	1	17	18	
Blicca bjoerkna	1		18,19,20,22	
Abramis brama orientalis	1		19,20	18,22
A. sapa bergi	1		19,20	18,20
A. ballerus	1	18,22	19,20	

TABLE 10. CASPIAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SSP.
Vimba vimba persa	1		19,20	E
Pelecus cultratus	1		19,20,22	
Subfamily Chondrostominae				
Chondrostoma nasus variabile	1	M,18	19,20	20
C. oxyrhynchum	1	M,18,19,20	E	
Subfamily Barbinae				
Varicorhinus capoeta ssp. Berg	1	M,O,12,13, 14,15,16, 19,20,	17,18,22,23	E
V. capoeta #1	1	M,O,12,13 14,15,16, 19,20	17,18,22,23	E
V. capoeta #2	1	M,O,12,13 14,15,16 19,20	17,18,22,23	E
Barbus mursa	1	M,O,17,19 20,22	15,16,18	18
B. cyri	1	M,O,15,16 17,19,20,22	18	
B. capito	1	M,O,15,16, 17,18,19, 20,22	E	
B. brachycephalus	1	M,O,15,16, 17,18,19, 20	22	
Subfamily Gobioninae				
Gobio gobio	1	12?,17	18,19,20,22 23	
G. ciscaucasicus	1	12?,17, 19,20,22,23	18	
Subfamily Rhodeinae				
Rhodeus sericeus amarus	1		19,20	
Subfamily Cyprininae				
Cyprinus carpio	1		18,19,20,22	
Carassius carassius	I			
C. auratus gibelio	I			
Hypothalmichthys molitrix	I			
Ctenopharyngodon idellus	I			

TABLE 10. CASPIAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Family Cobitidae				
Cobitis taenia	1	M,14?,18, 20,22	5?,14?,19	
C. aurata	1	M,14?,18, 19,22	20,4?	
C. caspia	1	M,4?,5?, 14?,18,19, 20,22	E	
Noemacheilus angorae bergianus	1	O,M,14,15, 16,19,22,23	20,2	17,18
N. barbatulus caucasicus	1	O,M,14,15, 16,17,18, 22,23	19,20	E
N. merga	1	O,M,14,15, 16,17,18,19, 20,22,23	E	
Noemacheilus #5	1	O,M,14,15, 16,17,18,19, 20,22,23	E	
N. cristatus	1	O,M,14,15, 16,17,18, 19,20	22,23	
N. malapterurus	1	O,M,17,18, 19,20,22,23	14,15,16	
Misgurnus fossilis	1		19,20	
Suborder Siluroidei				
Family Siluridae				
Silurus glanis	2	M	17,18,19,20, 22	
Order Gadiformes				
Family Gadidae				
Lota lota	4		18,19	
Order Gasterosteidae				
Family Gasterosteidae				
Pungitius platygaster	3		18,19,20,22	
Order Syngnathiformes				
Family Syngnathidae				
Syngnathus nigrolineatus caspius	4		20	E

TABLE 10. CASPIAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Order Cyprinodontiformes				
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			
Order Mugiliformes				
Family Mugilidae				
Mugil auratus	I			
M. saliens	I			
M. cephalus	I			
Family Atherinidae				
Atherina mochon pontica caspia	4		20	E
Order Perciformes				
Suborder Percoidei				
Family Percidae				
Stizostedion lucioperca	3		18,19,20	
S. marina	3		20	
Perca fluviatilis	3		18,19,20,22	
Acerina cernua	3		19,20,22	
Suborder Gobioidei				
Family Gobiidae				
Pomatoschistus caucasicus	4		20	
Knipowitschia longicaudata	4		20	
K. iljini	4	20	E	
Neogobius melanostomus affinis	4	20	20	E
N. ratan goebeli	4	20	20	E
N. cephalarges constructor	4	20	18,20	18
N.kessleri	4	20	20	
N. fluviatilis pallasi	4	20	20	E
N. bogdanowi	4	20	E	
N. bathybius	4	20	E	
N. caspius	4	20	E	
N. syrman eurystomus	4	20	20	E
Mesogobius nonultimus	4	20	E	
M. gymnotrachelus macrophthalmus	4	20	20	E
M. nigronotatus	4	20	E	

TABLE 10. CASPIAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Proterorhinus marmoratus	4	20	20	
P. semipellucidus	4	20	E	
Caspiosoma caspium	4	20	20	
Asra turcomana	4	E		
Benthophiloides brauneri	4	20	20	
Benthophilus macrocephalus	4	20	20	
B. ctenolepidus	4	20	E	
B. stellatus leobergius	4	20	20	E
B. spinosus	4	20	E	
B. leptocephalus	4	20	E	
B. baeri	4	20	E	
B. granulosus	4	20	E	
B. leptorhynchus	4	20	E	
B. grimmi	4	20	E	
Anatirostrum profundorum	4	E		
Order Pleuronectiformes				
Family Pleuronectidae				
Pleuronectes flesus	I			

Of particular note is the rather diverse anadromous fish fauna in the Caspian Sea. The salmonids, lamprey, sturgeons, perciforms and several cyprinids are anadromous. While common in some groups, such as the salmonids and sturgeons, anadromous behaviour is unusual in cyprinids.

The Caspian Basin fauna is closely allied to the Palearctic fauna (see Tables 7 and 11). Only two families, Cyprinidae and Cobitidae, are found in the other two faunal regions in Iran, although a third family, Siluridae, is present in the Oriental and Mesopotamian faunas, but is absent from the Iranian portion of the Oriental fauna although found in countries to the east. Only one order, two families and three genera are shared with the Oriental fauna. Two of the genera, Varicorhinus and Noemacheilus are widespread throughout Iran.

Two orders and four families are shared with the Mesopotamian fauna of Iran. The majority of the species are in the subfamilies Barbinae and Leuciscinae, family Cyprinidae. The three genera, Barbus, Varicorhinus and Noemacheilus, are quite diverse in both faunas, but there is almost no sharing of fauna below the generic level.

Endemism is quite high in the Caspian Basin below the generic level. Twenty nine species and twenty seven subspecies are endemic to the Caspian Sea; the numbers increase to thirty four species and thirty one subspecies if the Kura and Araxes River Basins are included. Most of the endemism is in the clupeids and gobies, the two marine relict groups.

TABLE 11. FAUNAL ASSOCIATIONS, CASPIAN BASIN FISHES

SYSTEMATIC LEVEL	TOTAL FOR CASPIAN BASIN	ENDEMICS		MESOPOTAMIA	ORIENTAL	INTRODUCED
		CASPIAN ONLY	WITH AZERBAIJAN			
Class	2	0	0	1	1	0
Order	11	0	0	2	1	1
Family	17	0	0	4	2	3
Genus	54	3	3	10	3	6
Species	108	29	34	2(4)*	0	9
Subspecies	39	27	31	0	0	4

*Two Caspian Sea species of <u>Cobitis</u> have been reported from the Mesopotamian Fauna, but the reports need to be confirmed.

Azerbaijan Subdistrict (TABLE 12)

Azerbaijan occupies the northwestern corner or Iran plus parts of the Soviet Union and Turkey. In Iran, it is drained by the Araxes River and includes now isolated basins that formerly connected to the Araxes River. Throughout Azerbaijan, most of the area is in the Kura River Basin, of which the Araxes River is a part. The area is between the Caspian and Black Seas, with the headwaters of the Kura River only a short distance from the Black Sea. Some headwaters of the Araxes River closely adjoin the headwaters of the Tigris and Euphrates Rivers. There are within the drainages of the Kura and Araxes a number of isolated lake systems, the best known of which is Lake Sevan.

A number of Black Sea species are found in Azerbaijan, but these are currently confined primarily to the upper Kura River. Since they are well outside Iran, they were not considered.

Within Iranian Azerbaijan all genera and most species are the same or closely related to genera and species in the Caspian Sea. The biggest difference between the two faunas is the total absence from Azerbaijan of clupeids, gobies, sturgeons, and other species of marine origin. The fauna is principally cyprinids.

The trout, Salmo trutta caspius, is found in the main river, and in smaller tributary streams in the basin where conditions permit. Derived subspecies are found in the isolated lakes, primarily in the Soviet Union. The rainbow trout, S. gairdneri, has been introduced.

Leuciscinae forms the most abundant subfamily of cyprinids, and includes resident Rutilus in addition to the migratory forms; the widespread Leuciscus cephalus orientalis and Alburnoides bipunctatus eichwaldi, and an endemic subspecies of Alburnoides. The Barbinae are represented by two genera and five species, two of which are endemic.

The Azerbaijan fish fauna is best described as a depauperate extension of the Caspian Sea fauna. The species present are the more aggressive species, several of which show anadromous traits. Within the Azerbaijan Subdistrict as a whole, there is a high degree of endemism, but this is found higher in the drainages, in Turkey and the USSR, while in Iran, which is much closer to the Caspian Sea, the level of endemism is quite low. Six species and four subspecies are endemic; two other species are shared only with the Lake Rezaiyeh Basin.

As is summarized in Table 13, five orders, nine families and twenty six genera are present, all shared with the Caspian Sea. Twenty six of the thirty seven native species are found also in the Caspian Sea.

Three orders, four families and eleven genera are shared with the Mesopotamian fauna. These are primarily found in the Cypriniformes, with the diverse Barbus, Varicorhinus and Noemacheilus and several genera of Leuciscinae providing much of the overlap of faunas.

Only two orders, two families and three genera, Varicorhinus, Barbus, and Noemacheilus, are shared with the Oriental fauna.

Colonization of the Azerbaijan Basin in Iran was from the Caspian Sea through the Kura River. The origins of the fish fauna and its history parallels that of the Caspian Sea fish fauna.

TABLE 12. AZERBAIJAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Order Clupeiformes				
Suborder Salmonoidei				
Family Salmonidae				
Salmo trutta caspius	3		M,19,20,22	15,16,17, 21
S. gairdneri	I			
Suborder Esocoidei				
Family Esocidae				
Esox lucius	2		17,19,20, 21,22	
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Rutilus rutilus caspicus kurensis	A		19,20,22	21
R. rutilus caspicus knipowitschi	A		19,20,22	21
R. rutilus shelkavikovi	1		19,20,21,22	E
Leuciscus cephalus orientalis	1	22,23	M,19,20	13,14,16, 17,21
Aspius aspius taeniatus	1	M	19,20,21,22	
Tinca tinca	1		19,20,21	
Chalcalburnus chalcoides	1	M	21	
Alburnus charusini hohenackeri	1	M,12,14, 17,19,20	21	21
A. filippi	1	M,12,14, 17,19,20	21	
Alburnoides bipunctatus eichwaldi	1	M,	19,20,22	13,14,15, 16,17,21, 23
A. bipunctatus armeniacus	1	M	13,14,15,16, 17,19,20,21, 22,23	E
Acanthalburnus microlepis	1	17	21	
Blicca bjoerkna	1		19,20,21,22	
Abramis brama orientalis	1		19,20	21,22
A. sapa bergi	1		19,20	21,22
Leucalburnus satunini	1	20	E	

TABLE 12. AZERBAIJAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Subfamily Chondrostominae				
Chondrostoma colchicum	1	M,19,20,21	E	
C. cyri	1	M,19,20,21	E	
C. schmidti	1	M,19,20,21	E	
Subfamily Barbinae				
Varicorhinus capoeta	1	M,O,12,13, 14,15,16, 17,19,20,21 22,23	20,21,22, 23	17
V. capoeta sevangi	1	M,O,12,13, 14,15,16 17,19,20,21	20,21,22,23	E
V. capoeta kosswigi	1	M,O,12,13, 14,15,16, 17,19	20,21,22,23	E
Barbus mursa	1	M,O,14,15, 16,17,19, 20,22	14,15,16	21
B. cyri	1	M,O,14,15, 16,17,19, 20,22	21	
B. goktshaicus	1	M,O,14,15, 16,17,19, 20,21,22	E	
Subfamily Gobioninae				
Gobio gobio	1	12?,17	19,20,21,22	22,23
G. ciscaucasicus	1	12?,17,19, 20,22,23	21	
G. persa	1	12?,19,20, 21,22,23	17	
Subfamily Cyprininae				
Cyprinus carpio	1		19,20,21,22	
Family Cobitidae				
Cobitis caucasica	1	M,14?,19, 20,21,22,23	E	
Noemacheilus brandti	1	M,O,14,15, 16,19,20,21, 22,23	17	
N. angorae bergianus	1	M,O,14,15, 16,19,20, 22,23	2,20	17,21

TABLE 12. AZERBAIJAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Noemacheilus tigris cyri	1	M,O,14,15, 16,17,19,20, 21,22,23	2,3,4,5	E
Suborder Siluroidei				
Family Siluridae				
Silurus glanis	2	M	17,19,20, 21,22,23	
Order Gadiformes				
Family Gadidae				
Lota lota	4		19,21	
Order Gasterosteiformes				
Family Gasterosteidae				
Pungitius platygaster	3		19,20,21, 22,23	
Order Perciformes				
Suborder Percoidei				
Family Percidae				
Stizostedion lucioperca	3		19,20,21	
Perca fluviatilis	3		19,20,21,22	
Suborder Gobiodei				
Family Gobiidae				
Neogobius cephalarges constructor	4		20	21

TABLE 13. FAUNAL ASSOCIATIONS

AZERBAIJAN BASIN FISH FAUNA

SYSTEMATIC LEVEL	AZERBAIJAN FAUNA	ENDEMIC FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	5	0	5	3	2
Family	9	0	9	4	2
Genus	26	0	26	11	3
Species	38*	6	26	4	0
Subspecies	16	4	10	0	0

*Includes one introduced species, Salmo gairdneri

Lake Rezaiyeh Basin (TABLE 14)

The Lake Rezaiyeh, or Lake Urmi as it was known and may be renamed, is an isolated lake basin that once flowed into the Araxes River. The former channel, on the northern edge of the lake, is still visible. The lake itself is saline, but receives a number of freshwater rivers, the largest of which flow from the south. While the salinity of the lake forms a barrier to movements of fish between rivers, during the periods of highest runoff a freshwater layer forms on Lake Rezaiyeh that permits fish to move outward from the rivers and would facilitate exchanges among rivers.

The Lake Rezaiyeh Basin fish fauna parallels that of the Azerbaijan fauna, but shows a high degree of incipient endemism. The fauna in the basin entered from the Araxes River while a connection persisted, but has begun to diverge now that the basin is isolated.

The trout, Salmo trutta caspius, is present in several of the mountain streams, but the different populations show considerable variability in coloration and spotting patterns, some having marked bright colors and large, colorful spots. In addition to the native trout, the rainbow trout, S. gairdneri, has also been introduced into the basin.

Only four species of Leuciscinae are present, all four in genera common in the Caspian and Araxes Rivers. Two of the species are endemic, while the other two are the widespread subspecies Leuciscus cephalus orientalis and Alburnoides bipunctatus eichwaldi. Only one species each of Barbus and Varicorhinus are present, but both are endemic.

TABLE 14. REZAIYEH BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Clupeiformes				
Suborder Salmonoidei				
Family Salmonidae				
Salmo trutta caspius	3	19	M,15,16,17, 18,19,20,22	15,16, 18,21
S. gairdneri	I			
Suborder Esocoidei				
Family Esocidae				
Esox lucius	2		18,19,20,21 22	
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Leuciscus cephalus orientalis	1	M,19,20,21 22,23	2,3,4,5 19	13,14, 16,18,20, 21
Alburnus gaderanus	1	M,12,14,18 19,20,21	E	
Alburnoides bipunctatus eichwaldi	1	M	19	13,14,15, 16,17,18, 20,21,22, 23
Acanthalburnus urmianus	1	18,21	E	
Subfamily Barbinae				
Varicorhinus capoeta	1	M,O,12,13 14,15,16, 19	18,20,21, 22,23	18
Varicorhinus #1	1	M,O,12,13,14, 15,16,18,19, 20,21,22,23	E	
Barbus #1	1	M,O,14,15,16, 18,19,20,21, 22,23	E	
Subfamily Gobioninae				
Gobio persa	1	12?,19,20,21 22,23	18	
Gobio #1	1	18,19,20,21 22,23	12?, E?	

TABLE 14. REZAIYEH BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Family Cobitidae				
Noemacheilus brandti	1	M,O,14,15, 16,19,20, 21,22,23	18	
N. angorae bergianus	1	M,O,14,15, 16,20,22,23	2,19	18,21
Suborder Siluroidei				
Family Siluridae				
Silurus glanis	2	M	18,19,20,21, 22.	

TABLE 15. FAUNAL ASSOCIATIONS

REZAIYEH BASIN FISH FAUNA

SYSTEMATIC LEVEL	REZAIYEH BASIN	ENDEMIC FAUNA	AZERBAIJAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	2	0	2	2	1
Family	5	0	5	4	2
Genus	11	0	11	8	3
Species	15*	5*	9	3	0
Subspecies	4	0	4	0	0

*Totals include the *Gobio* which is either from this basin or the Isfahan Basin; see *Gobio* #1 in Systematics Chapter for a discussion of the problem. Total for Basin, but not for Endemic Fauna, includes the introduced *Salmo gairdneri*

The Lake Rezaiyeh Basin contains a limited fauna, with eleven genera and fifteen species. One of the species, the rainbow trout, is introduced. One species is questionable. As was discussed in the Systematics Chapter, Gobio #1 may be present in the Lake Rezaiyeh Basin, or it may be in the Isfahan Basin. A third of the species, as shown in Table 15, are endemic.

The fauna shared with other regions parallels the situation in the Azerbaijan fauna. Barbus, Varicorhinus and Noemacheilus provide the only overlap with the Oriental fauna, and the principal overlap with the Mesopotamian fauna.

Only a limited portion of the Lake Rezaiyeh Basin has been collected. In particular, the mountainous regions to the south and west are poorly known. It would not be surprising if other genera and species were found, some of which would certainly be endemic. Of particular interest would be the trouts, which, in the limited material I have seen, show considerable variability.

Namak Subdistrict

This subdistrict contains four separate basins, each somewhat isolated from the other, but part of the larger basin which centers on the large Namak Lake. The entire Namak Basin once connected to the Caspian Sea, but is now separated by a low divide.

Tehran Basin (Table 16)

The Tehran Basin receives several drainages flowing southward from the Elburz Mountains from Qazvin in the west to Tehran. The Karadj River is the only large drainage in the basin. All the streams

TABLE 16. TEHRAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Clupeiformes				
Family Salmonidae				
Salmo trutta caspius	3		M,19,20,22	15,17,18, 21
S. trutta fario	I			
S. gairdneri	I			
Coregonus lavaretus	I			
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Leuciscus cephalus orientalis	1	M,19,22,23	M,19	13,14,17, 18,20,21
Alburnoides bipunctatus eichwaldi	1	M,22	19,20,22	13,14,15, 17,18,21, 23
Subfamily Barbinae				
Varicorhinus aculeatus	1	M,O,12,15, 17,18,19, 20,21,22,23	13,14	
V. buhsei	1	M,O,12,17, 18,19,20,21, 22,23	13,14,15	
Barbus mursa miliaris	1	M,O,17,19, 20,22,23	18,21	14,15
Subfamily Cyprininae				
Carassius carassius	I			
C. auratus gibelio	I			
Family Cobitidae				
Noemacheilus #4	1	M,O,17,18, 19,20,21, 22,23	14,15	
N. malapterurus	1	M,O,17,18, 19,20,22,23	14,15,21	

are intercepted as they leave the mountains, have been much modified for domestic and agricultural purposes.

In the west, the Tehran Basin is separated by only low divides from part of the Sefid Rud drainage. It is also closely associated with the Shur Rud, part of the Qom Basin, in the west as well as through the Namak Lake area. Connections with the Caspian Basin through the Sefid Rud and with the Qom Basin in recent times would be easy to postulate on the basis of the low separating divides and the close proximity of the drainages.

The Tehran Basin fish fauna is an extension of the Caspian Sea fauna, although there is considerable divergence at the specific and subspecific level, although the Basin contains no endemic species. Four species and one subspecies, however, are shared with only the other basins in the Namak Subdistrict.

Because of its proximity to the capitol city of Tehran, the Karadj River has received several introductions. The European brown trout, Salmo trutta fario, rainbow trout, S. gairdneri, and the whitefish, Coregonus lavaretus, were all introduced into the Karadj River system. The goldfish, Carassius auratus gibelio, has been introduced a number of places in the basin.

Only two Leuciscinae, the widespread Leuciscus cephalus orientalis and Alburnoides bipunctatus eichwaldi, are present. Alburnus, common elsewhere in the Namak Subdistrict, has not been collected in the Tehran Basin.

Two species of Varicorhinus, both endemic to the Namak Subdistrict, are present. The one species of Barbus is represented by a subspecies

TABLE 17. FAUNAL ASSOCIATIONS

TEHRAN BASIN FISH FAUNA

SYSTEMATIC LEVEL	TEHRAN FAUNA	NAMAK FAUNA	INTRODUCED FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	2	2	0	2	2	1
Family	3	3	0	3	3	2
Genus	8	8	4	6	6	3
Species	13	8	5	5	2	0
Subspecies	5	4	2	3	0	0

endemic to the Namak Lake Subdistrict of a common Caspian species. Two species of Noemacheilus are present, one an undescribed subspecies or species, the other a widespread Caspian species.

The Tehran Basin fish fauna (Table 17) may be considered a depauperate extension of the Caspian Sea fauna, composed of resistant, early colonizers. Connections with other subbasins in the Namak Subdistrict allowed continued exchange of fishes even after the connection with the Caspian Sea was severed. As a result, while there are a number of endemic species in the Namak Basin, there are none in the Tehran Subbasin.

Fauna shared with the Oriental fauna is the same as for the Caspian Basin. However, the closer association with the Mesopotamian fauna is evident in the two orders, three families and six genera shared with the Mesopotamian fauna, the same numbers as for the Tehran fauna shared with the Caspian Sea. However, only two species and no subspecies are shared between the Tehran and Mesopotamian faunas.

As a result of its close proximity to the capitol of Tehran, the Karadj River has received several introductions. Half of the eight genera and five of the thirteen species are introduced. .

Semnan Basin (Table 18)

The Semnan Basin is a small basin east of Tehran. The native species present are all found in the Tehran Basin, but several species found in the Tehran Basin are absent. Most notable is the absence of Leuciscus, found in all other basins of the Caspian District.

TABLE 18. SEMNAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Clupeiformes				
Family Salmonidae				
Salmo trutta caspius	3		M,19,20,22	16,17,18 21
S. trutta fario	I			
S. gairdneri	I			
Salvelinus fontinalis	I			
Coregonus lavaretus	I			
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Alburnoides bipunctatus eichwaldi	1	M,22	19,20,22	13,14,16 17,18,21 23
Subfamily Barbinae				
Varicorhinus buhsei	1	M,17,18,O, 19,20,21, 22,23,12	13,14,16	
Barbus mursa miliaris	1	M,17,19, 20,22,O	18,21	14,16
Family Cobitidae				
Noemacheilus #4	1	M,O,17,18, 19,20,21, 22,23	14,16	
N. malapterurus	1	M,O,17,18, 19,20,22,23	14,16,21	

Two rivers, the Jajehrud and the Namrud, feed the basin. A hatchery was built on the Jajehrud where several species of salmonids were raised. A flood released three species into the Jajehrud with at least a few individuals of the species being reported a year later. However, the dewatering of the river made conditions unfavorable for fish and it is possible none of the introduced species became established.

A project has been initiated that will create a tunnel through the mountains to connect the Jajehrud with the Haraz River in the Caspian Sea Basin to transport water into the Jajehrud to augment the water supply for Tehran. If this project is operational, additional exchanges of fishes with the Caspian Basin will probably occur.

The Semnan fish fauna is an extension of the Caspian Basin fish fauna. Invasion was through the Tehran Basin to the west. Most species found in the Tehran Basin also penetrated into the Semnan Basin. The Semnan Basin is separated from the Damghan Basin to the east by only a low divide, but the fishes in the two basins show different origins - most notably, the presence in the Damghan Basin of Schizothoracinae - with no indication that exchanges ever occurred between these two adjoining basins.

The Semnan Basin fauna is characteristic of the Namak Basin as a whole, with the exception of the introduced species. As with the rest of the basin, it has only a limited relationship with the Oriental fauna, even though it adjoins that fauna, but a greater relationship with the Mesopotamian fauna (Table 19).

TABLE 19. FAUNAL ASSOCIATIONS

SEMNAN BASIN FISH FAUNA

SYSTEMATICS LEVEL	SEMNAN FAUNA	INTRODUCED FAUNA	NAMAK FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	2	0	2	2	2	1
Family	3	0	3	3	3	2
Genus	7	2	5	5	5	3
Species	9	3	6	4	1	0
Subspecies	4	1	3	2	0	0

Qom Basin (Table 20)

The Qom Basin is a large, enclosed basin with borders closely adjoining other basins. It contains two major rivers, the Shur Rud and the Qare-Su or Qom Rud. Both have their headwaters in the Zagros Mountains to the west, flowing eastward to empty into the Namak Lake. Collecting in the Basin has been limited. There seems to be some confusion on actual collection sites in the upper portions of the basin. In the west and northwest, the headwaters of the Qom Rud streams are quite close to the headwaters of Sefid Rud and Karun Rud Rivers. The break between drainages is not always clear.

Three species which may be present in the basin I have indicated as questionable because of the uncertainty of collection locations. *Alburnoides* and *Cobitis* were reported from the Karun drainage from the Qare-Su "near Hamadan". The Qare-Su near Hamadan is in the Qom, not the Karun. *Alburnoides* is already present in the Qom Basin and would be expected from the Qare-Su. *Cobitis* has never been reported from the Namak Subdistrict, although it is common in the Caspian and Azerbaijan faunas from which the Namak Subdistrict fauna was derived. *Cobitis* has been reported from the Neyriz Basin (Heckel's 1846 report being the only report), and more recently from the lower Euphrates, so may be present in the Karun System although it has never previously been reported. While *Alburnoides* has not been previously reported from the Mesopotamian fauna, I have seen some specimens from the Karun that seemed to belong to this genus. For the present, I am including the two reports, *Cobitis* and *Alburnoides* as belonging to the Qom Basin fauna on the basis of their reported collection site of the Qare-Su

River "near Hamadan," but with a question mark.

Barry Nehring, an employee of the Department of Conservation indicated he found Apnanius is the Qom Basin. This genus has never been found in the Sarmatian Fauna, and its presence in the Qom Basin would represent a major extension of its range. This report needs to be confirmed.

The eight species of Leuciscus, Alburnoides, Varicorhinus, Barbus, and Noemacheilus found in the basin are species commonly found in the Namak Basin, with the exception of V. gracilis. V. gracilis, and the species Alburnus "maculatus" are shared not with other basins in the Caspian District, but with the Isfahan Basin to the south. A. "maculatus" and a second undescribed species of Alburnus endemic to the Qom Basin represent the only Alburnus reported from the Namak Subdistrict.

Notable is the absence of Salmonidae from any collections to date. This may be due to lack of collections from suitable habitat. While in Hamadan, I received reports of salmonids in nearby mountain streams, but was not able to make any collections. The Sefid Rud River also has headwaters not far from Hamadan and it may be the reports were for those streams.

The Qom Basin shows its strongest relationships with the Caspian Basin fauna. However, the sharing of two species in two genera with the Isfahan indicates exchanges have occurred with that basin. The shared Alburnus suggests that this genus may have moved into the Qom Basin from the south rather than from the north, which would help explain the otherwise puzzling absence of that genus from the Tehran and Semnan Basins.

It is quite probable that additional species or genera will be found in the basin with additional collecting. While a variety of habitats, from warm, saline streams to cold mountain streams to isolated springs are found in the basin, most collecting has been in the quieter, warmer waters near roads and population centers.

One species, Pimephales promelas, was collected by Dr. Numann from the basin; it was probably introduced with eggs of game fish brought from the United States. Saadati (1977) indicates that bass and perch were introduced into the Golpaygon Reservoir near Hamadan, and the Pimephales promelas may have been introduced at that time. I know of no collections of bass nor perch from Persian waters, nor of any other reports of their introduction other than Saadati's discussion.

The Qom Basin fish are part of the Namak Subdistrict Fauna, with strong relationships with the Caspian Sea Basin. While a greater number of orders and families are reported shared with the Mesopotamian than with the Caspian Fauna (Table 21), this is because of the uncertain report of Aphanius in the basin. The greater shared fauna with the Oriental fauna than reported for the other subbasins in the Namak Basin is also due to the Aphanius report. Some overlap also occurs with the Isfahan Basin to the south, suggesting past connections with that basin.

The small, isolated basin near Na'in, located on the southwestern part of the Dashte-Kavir Basin, contains the same species of Varicorhinus as the Qom Basin and is here included with the Qom Basin.

TABLE 20. QOM BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA: GENUS	SHARED FAUNA: SPECIES	SHARED FAUNA: SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Leuciscus cephalus orientalis	1	M,22,23	19,M	13,16,17, 18,20,21
Alburnus "maculatus"	1	M,17,18, 19,20,21	12	
Alburnus #2	1	M,12,17, 18,19,20, 21	E	
Alburnoides bipunctatus eichwaldi	1	M,22	19,20,22	13,15,16, 17,18,21 23
Pimephales promelas	I			
Subfamily Barbinae				
Varicorhinus aculeatus	1	M,O,12,14, 15,16,17, 18,19,20,21, 22,23	13,16	
V. buhsei	1	M,O,12,17, 18,19,20,21, 22,23	13,15,16	
Barbus mursa miliaris	1	M,O,17,19, 20,22	18,21	15,16
Family Cobitidae				
Cobitis taenia?	1	M,18,20,22	19,21,5?	
Noemacheilus #4	1	M,O,17,18, 19,20,21,22, 23	15,16	
N. malapterurus	1	M,O,17,19, 20,22,23	15,16,18,21	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius #5	3	M,O	E?	

TABLE 21. FAUNAL ASSOCIATIONS

QOM BASIN FISH FAUNA

SYSTEMATIC LEVEL	QOM BASIN	NAMAK FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	2	1	1	2	2
Family	3	2	2	3	3
Genus	9*	6	7	8	4
Species	12*	8	5	1	0
Subspecies	3	3	2	0	0

* Includes the introduced *Pimephales promelas* and the unconfirmed *Aphanius*, the latter native to the Mesopotamian and Oriental Faunas.

Arak Basin (Table 22)

The Arak Basin is a small enclosed basin in the southwestern part of the Namak Subdistrict. No permanent streams are found in the basin but there are a number of qanats. The basin once emptied into the Qare-Su River of the Qom Basin.

Four species of fish are found in the Arak Basin. Three are also found in the Qom and Tehran Basins of the Namak Subdistrict. Only two genera, Leuciscus and Varicorhinus, are represented. The Leuciscus present is the widespread L. cephalus orientalis. Two of the Varicorhinus are endemic to the Namak Subdistrict, and are present in other basins.The fourth species, V. gracilis, is shared with the Isfahan Basin to the south.

As is shown in Table 23, the Arak Basin fauna is essentially the same as the rest of the Namak Subdistrict in is relationships with other regions. Its fauna suggests more than one previous association; three of the species are common elsewhere in the Namak Subdistrict, while the fourth is shared with the Isfahan Basin to the south.

Isfahan Subdistrict (Table 24)

The Isfahan Subdistrict is comprised of the elongate Isfahan Basin. While many drainages are present, the only perennial river is the Zianrud. Most drainages arise in the west in the central portion of the Zagros Mountains, which separates the Isfahan Basin from the Karun Basin to the west. On the east, the basin is separated from the Yazd and Kerman Basins by an elongate mountain ridge. On the

TABLE 22. ARAK BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Leuciscus cephalus orientalis	1	M,22,23	M,19	14,16,17, 18,20,21
Varicorhinus aculeatus	1	M,O,12,15, 17,18,19, 20,21,22,23	14,16	
V. buhsei	1	M,O,12,17, 18,19,20, 21,22,23	14,15,16	
V. gracilis	1	M,O,14,15, 16,17,18, 19,20,21, 22,23	12	

TABLE 23. FAUNAL ASSOCIATIONS

ARAK BASIN FISH FAUNA

SYSTEMATIC LEVEL	ARAK FAUNA	NAMAK FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA
Order	1	1	1	1	1
Family	1	1	1	1	1
Genus	2	2	2	2	1
Species	4	3	1	1	0
Subspecies	1	1	1	0	0

TABLE 24. ISFAHAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Clupeiformes				
Family Salmonidae				
Salmo gairdneri	I			
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Alburnus "maculatus"	1	M,15,16,17 18,19,20,21	14	
Alburnus #1	1	M,14,15,16 17,18,19 20,21	E	
Subfamily Barbinae				
Varicorhinus gracilis	1	M,O,14,15, 16,17,18, 19,20,21, 22,23	13	
V. chebisiensis	1	M,O,13,14, 15,16,17, 18,19,20 21,22,23	E	
V. macrolepis	1	M,O,S;2,3, 7,8,9,10, 13,14,15,16, 17,18,19,20, 21,22,23	4,5,11,12	
Subfamily Gobioninae				
Gobio #1?	1	S,17,18,19, 20,21,22,23	E?	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius mento	3	M,O	2,3,4	

south, it is adjoined by the Neyriz and Sirjan Basins, being separated by low ridges. To the north, the Isfahan Basin is bordered by the Qom and Arak Basin.

The basin's fauna is somewhat enigmatic, but shows its strongest relationships to the Caspian Sea fauna. Five genera and two species are shared with the Namak Basin. In contrast, four genera and two species are shared with the Karun fauna. Two, and perhaps three, species are endemic. At least one genus, Salmo, is introduced. The rainbow trout, Salmo gairdneri was introduced into the Zianrud River, where it established a reproducing population. (Table 25)

One species is uncertain. One specimen in the Natural History Museum in Tehran was an undescribed species of Gobio listed as being from the "Zarrinehrud near Isfahan." As was discussed for Gobio #1 in the Systematics Chapter, the Zarrinehrud is in the Lake Rezaiyeh Basin, not the Isfahan Basin. Gobio has never been reported south of the Caspian Sea Basin, and I would suspect the specimen was from the Rezaiyeh Basin, but the actual location will require collection of additional specimens.

Aphanius mento, a Tigris-Euphrates species, was reported by Saadati (1977) as having been collected from the Isfahan Basin. This genus and species has never been found in the Isfahan Basin before. It is probable this species is a recent immigrant. A tunnel was opened in the 1960's near Kuh Range that connected the headwaters of the Karun River and the upper Zianrud. The flow through the tunnel at the time I was there exceeded 50 cubic feet per second,

TABLE 25. FAUNAL ASSOCIATIONS

ISFAHAN BASIN FISH FAUNA

SYSTEMATIC LEVEL	ISFAHAN FAUNA	ENDEMIC FAUNA	NAMAK FAUNA	KARUN FAUNA	ORIENTAL FAUNA	INTRODUCED FAUNA
Order	3	0	3	3	2	1
Family	3	0	3	3	2	1
Genus	5*	0	5	4	2	1
Species	8*	3*	3	2	0	1

*Includes Gobio #1, which may be in this or the Lake Rezaiyeh Basin.

more than adequate to transport fish. Because of the drop in elevation at the tunnel, fish could easily move from the Karun River into the Zianrud but not in the reverse direction. In addition, the reservoir built on the Zianrud would provide a large, quiet water habitat such as Aphanius does well in. I would anticipate further specimens of Karun River Fishes appearing in future collections from the Isfahan Basin.

The Isfahan Basin appears to have received invasions of fish from more than one source, in addition to any recent invasions from the Karun River through the tunnel. One species of Alburnus and one of Varicorhinus are shared with the Namak Basin; two other endemic species, Alburnus #1 and V. chebisiensis, are very similar to Namak Basin species. Varicorhinus macrolepis, on the other hand, is found in both the Karun and Neyriz Basins. The most consistent relationship is with the Namak Basin, suggesting past regular connections. While the faunal associations are not clear, it may never be possible to determine the native fish fauna of the Isfahan Basin nor its true associations because of the potential influence of the Karun River species that may invade through the tunnel.

Aral District

Khorasan Subdistrict (Table 26)

The Khorasan Subdistrict is primarily within the drainage basins of the Tedzhan and Murgab Rivers. Both of these rivers are tributaries of the Aral Sea, although water from the rivers reaches the Aral Sea only during periods of heavy flooding. Much of the

TABLE 26. KHORASAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SHARED FAUNA SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Leuciscus latus	1	M,13,14,16, 17,18,19, 20,21	22	
Alburnoides bipunctatus eichwaldi	1	M,22	19,20	14,15,16, 17,18,21
Subfamily Barbinae				
Garra persica	2	M,O	25,26,30	
Varicorhinus capoeta heratensis	1	M,O,12,13, 14,15,16,19,	17,18,20, 21	22
Subfamily Gobioninae				
Gobio gobio lepidolaemus	1	12?,17	18,19,20, 21	22
Subfamily Schizothoracinae				
Schizothorax pelzami	1	O	22,24	
Family Cobitidae				
Noemacheilus sargadensis turcmenicus	1	O,M,14,15, 16,17,18,19, 20,21,22	28,29,30	25
N. cristatus	1	O,M,14,15, 16,17,18,19, 20	21,22	
N. longicauda	1	O,M,14,15, 16,17,18,19, 20,21	22	

basin is characterized by rolling hills lying between the Kopet Dagh and Elburz Mountains in Iran and the Hindu Kush in Afghanistan. Tributaries from both mountain ranges contribute to the Tedzhan and Murgab Rivers.

While fairly accessible, the area has seldom been collected by ichthyologists. Some habitats in the Subdistrict, most notably the montane areas, have not been collected. The absence of any Salmonidae from the material I examined may be due to the lack of collection rather than absence from the Subdistrict.

Only two genera and species in the subfamily Leuciscinae are present, one a species of *Leuciscus* endemic in the Aral Sea Basin, and the widespread *Alburnoides bipunctatus eichwaldi*. Other genera such as *Abramis*, common in the basin, have not been taken in the Khorasan Subdistrict.

Two genera of Barbinae are present, *Varicorhinus capoeta heratensis*, a subspecies of a common species in the Caspian Sea Basin; and *Garra persica*, and Oriental species. The presence of *Garra* is interesting, since this genus is more characteristic of the Mesopotamian and Oriental faunas. Khorasan represents the most northerly extension of this genus, and the only report I am aware of from the Sarmatian fauna. *G. persica* is found in the enclosed Northeastern Basins and the Helmand, both to the south and most certainly the origin of the species found in Khorasan.

The same route was probably taken also by the cobitid *Noemacheilus sargadensis turcmenicus*. This is the most northerly

TABLE 27. FAUNAL ASSOCIATIONS

KHORASAN BASIN FISH FAUNA

SYSTEMATIC LEVEL	KHORASAN FAUNA	ARAL FAUNA	CASPIAN FAUNA	ORIENTAL FAUNA	MESOPOTAMIAN FAUNA
Order	1	1	1	1	1
Family	2	2	2	2	2
Genus	7	6	5	4	5
Species	9	7	4	3	0
Subspecies	4	2	1	1	0

extension of a species found throughout the internal basins of eastern Iran from the Bampur Basin northward. The other two species of Noemacheilus collected in the Khorasan Subdistrict are common forms in the Aral Sea Basin.

Notably absent is the genus Barbus, common in the Caspian Sea and present elsewhere in the Aral Sea Basin. The subfamily Schizothoracinae, a subfamily typical of Central Asia and the Indus River Basin, is present, represented by a single species endemic to northeastern Iran.

The other subfamily represented is Gobioninae, with a single subspecies in the Aral Sea Basin of a common Caspian species.

The Khorasan Subdistrict fauna is fairly characteristic of the Aral Sea Basin (Table 27). With the exception of the Garra, the families and genera are typical of the Aral Sea Basin. Two, and possibly three, species entered the Subdistrict from the south. While mountains divide the Sarmatian Fauna in the north from the Oriental and Mesopotamian Faunas to the south, the divide is at its lowest point in the Khorasan Subdistrict. This is postulated as a migration route for fish in the past; the mixture of Aral Sea Basin and more southern fishes in Khorasan would support this idea.

Dashte-Kavir Subdistrict (Table 28)

The Dashte-Kavir Subdistrict encompasses the Dashte-Kavir desert, and includes the Damghan Basin. The Subdistrict is arid, with only two rivers, the Qara-Su and Shur Ruds, both intermittent and quite saline. There are several qanats and springs, some quite large, primarily in the north along the base of the southern slopes of the

TABLE 28. DASHTE-KAVIR BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Varicorhinus fuscus	1	M,O,12,13, 14,15,16,17 18,19,20,21, 22,23	25	
Varicorhinus #2	1	M,O,12,13, 14,15,16,17, 18,19,20,21, 22,23	E	
Subfamily Schizothoracinae				
Schizothorax pelzami	1	O,22	22,23	

TABLE 29. FAUNAL ASSOCIATIONS

DASHTE-KAVIR BASIN FISH FAUNA

SYSTEMATIC LEVEL	DASHTE-KAVIR FAUNA	ARAL FAUNA	CASPIAN FAUNA	ORIENTAL FAUNA	MESOPOTAMIAN FAUNA
Order	1	1	1	1	1
Family	1	1	1	1	1
Genus	2	2	1	2	1
Species	3	2	0	1	0

of the Elburz Mountains. Fish are found primarily in the springs and qanats. Three species of fish are present, representing two genera.

One species is the Schizothoracinae, _Schizothorax pelzami_, which reaches westward to the Damghan Basin, achieves its western-most extension. The subfamily is characteristic of Central Asia and the Indus River Basin. While the Damghan Basin, at the western end of the Dashte-Kavir, is separated from the Semnan Basin by only a low divide, the _Schizothorax_ did not reach beyond the Damghan Basin.

The other two species are both in the genus _Varicorhinus_, in the subfamily Barbinae. _V. fuscus_ is found in the adjoining basins to the east, where it is a common occupant of qanats. The second form is an undescribed species or subspecies endemic to the Dashte-Kavir.

The relationship of the Dashte-Kavir fauna is summarized in Table 29. Assigning the basin to a particular fauna was difficult. Only three species are present, a reflection of the arid conditions, and none give a clear indication of associations. The _Schizothorax_ is shared with the Khorasan fauna, in the Aral Sea Basin. The _Varicorhinus fuscus_, on the other hand, is found in the enclosed Northeastern Basin, part of the Oriental fauna. The third form, the undescribed _Varicorhinus_, is similar to _V. fuscus_ and probably differentiated from it. On the basis of the _Schizothorax_ and the topography, I have put the basin in the Sarmatian fauna.

MESOPOTAMIAN PROVINCE

This Province covers much of the Middle East, including all of Turkey south of the Taurus Mountains, Iraq, Syria, Jordan, Palestine, Saudi Arabia, and southern and western Iran. It contains a variety of habitats, including cold mountain streams, isolated desert springs, large, deep rivers, and estuaries. It occupies a strategic location on the land bridge between Africa and Eurasia.

The fish fauna is a mixture of three Regions, the Holarctic, Ethiopian and Oriental, and does not readily fit into a single Region. I have retained it in the Palearctic mostly for historical reasons, although it might better fit into the Oriental Region. It is characterized by a high degree of endemism. In a sense, the Province has received immigrants from several directions, developing its own characteristic fauna, which retains relationships to other faunas, but is really a transitional fauna not closely aligned to any particular region.

As was shown in Table 8, the Mesopotamian fauna in Iran includes six orders, eleven families, thirty three genera and eighty nine species. The greatest number of families, nine, are shared with the Oriental fauna. Seven of the families are shared with Africa. Only five families, including the probably recent immigrant Aphanius, are shared with the Sarmatian fauna of Iran. At the genus level, however, the association between the Mesopotamian and Sarmatian faunas are stronger, with sixteen shared genera, as opposed to twelve shared with the Oriental and nine with the African faunas.

Few species are shared with other faunas; the five common to the Sarmatian and Mesopotamian is the highest number. Thirty seven of the species, over 40%, are endemic to the Mesopotamian fauna of Iran.

Palestine District

Only a few comments will be made on the Palestinian fauna. It is closely aligned to the fauna found in the Tigris-Euphrates River, with which it was once connected. A greater number of African species, such as the cichlids, are found in the Palestine District than any other part of the Mesopotamian fauna. Because of recent connections between Palestine and Africa, several immigrants have become established which were not able to move further north or east.

Tigris-Euphrates District

This District includes the Tigris and Euphrates Rivers, and all streams flowing into them, including the Karun River in Iran, plus other basins which, at one time, connected to the Tigris and Euphrates.

Asia Minor Subdistrict

This subdistrict occupies south and west Turkey. It has been influenced by immigrants from three directions; from the Black Sea Basin to the north, from Palestine, and from the Tigris and Euphrates System. The demarcation between Asia Minor and the Palestinian fauna is not sharp. A number of species have been able to move northward along the coasts of the Mediterranean Sea and into the rivers of the Asia Minor. The headwaters of the Euphrates are adjoining the Asia Minor streams on the east.

<u>Tigris-Euphrates Subdistrict</u> (Table 30)

The Tigris-Euphrates Subdistrict encompasses the basins of the Tigris and Euphrates Rivers. These two rivers have headwaters in Iran, Turkey, Syria, Jordan, Saudi Arabia and Iraq. The two rivers join near their mouths in the Mesopotamian Plain, where they form an extensive estuarine delta with interlocking channels, swamps, and lakes. The extensive delta area contributes to the variety of marine species found in the lower part of the two rivers.

Of the 10 orders, 19 families and 43 genera of fish in the Subdistrict, 4 orders,11 families and 14 genera are marine. The remainder of the families and genera are primarily freshwater although some, such as the cyprinodonts, show a high degree of tolerance for saline waters.(Tables 31, 32)

One species of trout is native to the Subdistrict, <u>Salmo trutta macrostigma</u>. It is a subspecies of a species widely distributed in Europe, northern Africa and elswhere in the Middle East. It is found in mountainous headwaters of the Tigris and Euphrates Rivers. Although not reported from Iran, it is quite possible this species may be present in suitable habitat along the borders with Turkey and northern Iraq.

The most abundant group is the Barbinae, represented by nine genera and twenty-five species. Almost half of the species are in the genus <u>Barbus</u>, which shows considerable diversity throughout the system. The next most abundant genus is <u>Varicorhinus</u>, represented by seven species, two of which are undescribed.Two of the nine genera, the widespread <u>Barbus</u> and <u>Varicorhinus</u>, are shared with the Sarmatian

TABLE 30. TIGRIS-EUPHRATES BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SHARED FAUNA SSP
Class Elasmobranchii				
Order Lamniformes				
Family Carcharhinidae				
Carcharias lamia	M		5,6,32,34,35	
C. gangeticus	M		5,32,34	
Order Rajiformes				
Family Pristidae				
Pristis cuspidatus	M		5,32,34,35	
P. zysron	M		5,32,34,35	
Class Teleostomi				
Order Clupeiformes				
Suborder Clupeoidei				
Family Clupeidae				
Hilsa ilisha	M		5,31,32,34,35	
Suborder Salmonoidei				
Family Salmonidae				
Salmo trutta macrostigma	3	S	15,16,17,18, 19,20,21,22	1,3,5
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Phoxinellus zeregi syriacus	1	5	2,3,	2,3
P. tricolor	1	2,3	2,5	
Leuciscus cephalus lepidus	1	S	2,3	5
L. cephalus cephalopsis	1	S	5	2,3
Aspius vorax	1	S	5	
Chalcalburnus mossulensis	1 1	S,2,7, 10,11	5	
C. mossulensis delineatus	1	S,2,7, 10,11	5	E
Alburnus heckeli	1	S,5,10,2	11?	
A. capito	1	S,2,10, 11	5	
A. mossulensis	1	S,2,10, 11	5	
A. kotschyi	1	S,2,5, 10,11	E	
A. caeruleus	1	S,5,10, 11	2	

TABLE 30. TIGRIS-EUPHRATES BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Acanthobrama marmid	1	1,2,3	2,3	E
Barilius mesopotamicus	1	O	E	
Subfamily Chondrostominae				
Chondrostoma regium	1	S,5	2,3,5	
Chondrostoma #1	1	S,2,3,5	E	
Subfamily Barbinae				
Discognathus variabilis	1	O	2	
Garra rufa	1	0,6	2,5,10,11	
Typhlogarra widdowsoni	1	E		
Tylognathus elegans	1	E		
Hemigrammocapoeta nanus nanus	1	2	2,3	2
Kosswigobarbus kosswigi	1	E		
Varicorhinus macrolepis	1	S,O,1,2, 3,7,8,10	5,11,12	
Varicorhinus #3	1	S,0,1,2,3 10,11	5,7	
V. trutta	1	S,0,1,2,3 7,10,11	5	
V. umbla	1	S,0,1,2,3 5,7,10,11	E	
V. fratercula	1	S,0,1,3, 7,10	2,5,11	
V. damascinus	1	S,0,1,7, 10,11	2,3,5	
Varicorhinus #4	1	S,0,1,2,3 5,7,10,11	E	
Cyprinion macrostomum	1	O,6,8,9	7,10,11	2,5
Barbus albus	1	S,O,1,3,5 6,11	7	2
B. luteus	1	S,0,1,3,6 11	2,5,7	
B. sharpeyi	1	S,0,1,2,3 6,7,11	5	
B. grypus	1	S,0,1,2,3 6,7,11	5	
B. barbulus	1	S,0,1,3,6 11	2,5,7	
B. longiceps	1	S,0,1,3,6 7,11	2,5	
B. xanthopterus	1	S,0,1,2,3 6,7,11	5	

TABLE 30. TIGRIS-EUPHRATES BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Barbus kosswigi	1	S,0,1,2,3 6,7,11	5	
B. esocinus	1	S,0,1,2,3 6,7,11	5	
B. subquincunciatus	1	S,0,1,2,3 6,7,11	5	
B. belayewi	1	S,0,1,2,3 5,6,7,11	E	
B. euphrati	1	S,0,1,2,3 5,6,7,11	E	
Subfamily Cyprininae				
Cyprinus carpio	I			
Ctenopharyngodon idellus	I			
Family Cobitidae				
Cobitis aurata?	1	S,5?,11	20,21	
Noemacheilus tigris	1	S,0,9,11	3,18	2,5
N. smithi	1	S,0,2,3 5,9,11	E	
N. insignis euphraticus	1	S,0,9,11	2	3,5
N. panthera	1,	S,0,3,9,11	2,5	
N. argyrogramma	1	S,0,5,9,11	2,3	
Noemacheilus #9	1	S,0,2,3,5 9,11	E	
Turcinoemacheilus kosswigi	1	E		
Suborder Siluroidei				
Family Tachysuridae				
Tachysurus thalassinus	M		1,5,6,31 32,34,35	
Family Siluridae				
Silurus chantrei	2	S	E	
S. triostegus	2	S	E	
Family Bagridae				
Mystus pelusius colvillii	2	O	2	5
Family Sisoridae				
Glyptothorax armeniacum	2	0,5	E	
G. steindachneri	2	0,5	E	
Family Clariidae				
Heteropneustes fossilis	2	0	32,33,34,35 5	

TABLE 30. TIGRIS-EUPHRATES BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Anguilliformes				
Family Muraenesocidae				
Muraenesox cinereus	M		1,5,6,32, 33,34,35	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius mento	3	0,5,6,7 9,10,11,1	2,3,12	
A. sophiae	3	0,1,2,3,6 7,9,10,	5,11	
A. dispar	3	0,3,9,10 11	2,30,31,32	1,5,6,7
Order Mugiliformes				
Family Mugilidae				
Mugil abu	4		5	
M. abu zarudnyi	4		5	5
M. dussumieri	M		5,31,32,33, 34,35	
M. oligolepis	M		32,33,34,35	
M. waigiensis	M		31,32,33 34,35,5,6	
Order Perciformes				
Suborder Gobiodei				
Family Gobiidae				
Trypauchen vagina	M		5,32,34,35	
Scartelaos tenuis	M		1,31,32,33 34,35	
Boleophthalmus dussumieri	M		5,31,32,33,34	
Family Periophthalmidae				
Periophthalmus koelreuteri	M		1,5,6,9,31 32,33,34,35	
P. waltoni	M		5,6,9	
Suborder Stromateoidei				
Family Stromateoidei				
Chondroplites chinensis	M		5,32,34,35	
Pampus argenteus	M		5,32,34,35	

TABLE 30. TIGRIS-EUPHRATES BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Pleuronectiformes				
Family Soleidae				
Synaptura orientalis	M		5,32,34,35	
Order Mastacembeliformes				
Family Mastacembelidae				
Mastacembelus simack	2	0	2,5,7	

Fauna. These two genera, plus the genus Cyprinion, are found also in the Oriental Fauna. The remaining six genera, plus all of the species in the subfamily, are endemic to the Tigris-Euphrates District, with seven of the twenty-five species so far being reported only from the Tigris-Euphrates Subdistrict.

The subfamily Leuciscinae, most characteristic of the Holarctic fauna among the cyprinids, is represented by seven genera and eleven species. Three of the seven genera are endemic to the Tigris-Euphrates District; three are shared with the Sarmatian fauna, and one with the Oriental fauna.

Three genera of cobitids, one endemic to the Subdistrict, have been reported from the Subdistrict. A specimen of Cobitis auratus was reported from the lower Tigris-Euphrates, but this is a considerable distance from its previously reported distribution in the Black and Caspian Seas. It has never been reported before from the Subdistrict; in fact, the only report of a Cobitis from the Mesopotamian Province was Heckel's 1846 report of C. linea from the Neyriz Basin. I feel this distribution needs confirmation before it is accepted since the location and the habitat are so uncharacteristic of the genus and species.

Six species of the cobitid Noemacheilus are present, including one undescribed species. All are found only in the Tigris-Euphrates District with the exception of N. tigris, with a subspecies reported from the closely adjoining Azerbaijan Subdistrict.

Of particular interest is the presence of five families of Siluroidei. One of the families, Tachysuridae, is marine. The other four are freshwater, with species in both the Ethiopian and Oriental Regions. Only one of the four, Siluridae, extends into the Sarmatian Fauna. The genera present are are mostly found in the Oriental fauna, with at least one species, *Heteropneustes fossilis*, a common Oriental species. The Siluroidei is represented by only a few species, not the highly diverse fauna characteristic of Southeast Asia, suggesting colonization by a few agressive species.

One genus of marine fishes, *Mugil*, has become established in freshwater, *M. abu*. It is widespread in the larger rivers. At least three other *Mugil* species have been reported from the rivers, but they are not permanent residents.

Two other orders common in the Oriental Region are also represented in the Tigris-Euphrates Subdistrict. *Mastacembelus simack* of the order Mastacembeliformes, is the only species of this order and genus present in the Subdistrict, although it is more abundant in the Oriental Region. The second order, Cyprinodontiformes, is represented by three species in the genus *Aphanius*. Two are restricted to the Tigris-Euphrates District, while the third is found in that District and the Persian Gulf District.

The Tigris-Euphrates Subdistrict fauna shows four elements, the marine fishes, Oriental Region, Ethiopian Region and Sarmatian fauna. Of these, the marine and Oriental show the strongest influences, in the diversity of families present. The most abundant group is the Barbinae, characteristic of the Oriental and Ethiopian Regions.

As discussed under the Mesopotamian Province, it is not easy to place the fauna, although the relationships appear to be closer to the Oriental Region than to the Palearctic. As was discussed under the Geologic History Chapter, the Persian Gulf was at one time much reduced in size and the Tigris-Euphrates-Karun Rivers emptied into the Arabian Sea at the Straits of Hormuz. The large Indo-Brahmaputra River in northern India also emptied into the Arabian Sea. It is possible that, during this period, which occurred in the Pleistocene and Recent times, more agressive fishes, particularily those with some resistance to salinities such is found in the Siluroidei, were able to colonize the Tigris-Euphrates-Karun Rivers. Only limited colonization occurred before the route was blocked by rising ocean levels. An alternate invasion route for some species was from Africa, but the comparison of faunas suggest the east to west route was the more active. Once established in the Mesopotamia Province, the immigrants, whether from east or west, were able to diversify.

The northern route, from the Black and Caspian Seas into the Mesopotamian Province, does not seem to have functioned as well. The uplift of the Turkish Plateau and elevation of the Taurus Mountains blocked this route by the time water conditions were most favorable. The exchange seems to have been both ways, with Barbus and Varicorhinus becoming established in the Black and Caspian Basins, and Leuciscinae penetrating into the Mesopotamian Province. Alternate routes between the Sarmatian Basin and Mesopotamian Province, particularily through Azerbaijan, probably provided a route for exchange, although the general aridity would have reduced the possibility of exchange.

TABLE 31. FAUNAL ASSOCIATIONS

TIGRIS-EUPHRATES BASIN FISH FAUNA

SYSTEMATIC LEVEL	TIGRIS-EUPHRATES FAUNA	KARUN FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA	MARINE FAUNA	ENDEMIC FAUNA
Order	10	10	10	4	8	0
Family	19	18	17	6	11	0
Genus	43*	31	25	12	14	4
Species	80*	49	20	5	18	15
Subspecies	9	4	1	0	0	1

*Includes the following introduced species:
Cyprinus carpio
Ctenopharyngodon idellus

TABLE 32. FAUNAL ASSOCIATIONS

TIGRIS-EUPHRATES BASIN FISH FAUNA

FRESHWATER ONLY

SYSTEMATIC LEVEL	TIGRIS-EUPHRATES FAUNA	KARUN FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA	ENDEMIC FAUNA
Order	5	5	3	3	0
Family	10	9	7	5	0
Genus	30	18	11	12	4
Species	62	31	2	5	15
Subspecies	9	4	1	0	1

The fauna shared with the Sarmatian fauna, mostly the Barbinae and Leuciscinae, shows a greater variety of genera than the fauna shared between the Mesopotamian and Oriental faunas. It would appear that only a few representatives of the Oriental families were successful in becoming established in the Mesopotamian fauna, but they represented a variety of families. On the other hand, the exchange between the Mesopotamian and Sarmatian, probably occurring along a wider front, included fewer families but more genera from those families. (Tables 31, 32)

Karun Subdistrict (Table 33)

The Karun Subdistrict includes the Karun River and associated rivers. It drains the western part of Iran, with headwaters on the Zagros Mountains and the mouth in the Shatt-el-Arab with the Tigris and Euphrates. The close association with the Tigris and Euphrates Rivers is evident in the close association of their fish fauna. The marine species found in the Tigris-Euphrates Subdistrict are by and large found also in the Karun (Tables 34 and 35).

The Karun River contains a variety of habitats, from the high mountain streams to the lowland swamps and deltas. As was discussed in the Chapter on Individual Basins, tributaries and forks of the Karun River flow in valleys running along the mountain range, then cutting through ridge lines into another valley or to join another fork or tributary. Where the streams cut throught the ridgelines, the current is often strong, a result of the compression of the flow by the narrow canyons. These points of high velocity act to separate the Karun system into sections since movements of fish against the

TABLE 33. KARUN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Lamniformes				
Family Carcharhinidae				
Carcharias lamia	M		4,32,34,35	
C. gangeticus	M		4,32,34	
Order Rajiformes				
Family Pristidae				
Pristis cuspidatus	M		4,32,34,35	
P. zysron	M		4,32,34,35	
Order Clupeiformes				
Suborder Salmonoidei				
Family Salmonidae				
Salmo trutta ssp	3	19	1,3,4,15,16 17,18,20,21 22	
S. gairdneri	I			
Suborder Clupeoidei				
Family Clupeidae				
Hilsa ilisha	M		4,31,32,34,35	
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Phoxinellus tricolor	1	2,3,4	2,4	
Leuciscus cephalus lepidus	1	S	S,2,3,4	4
Aspius vorax	1	S	4	
Chalcalburnus mossulensis	1	S,2,7,10 11	4	
Alburnus capito	1	S,2,4,10 11	4	
A. mossulensis	1	S,2,4,10 11	4	
Alburnoides #1	1	S	E	
Subfamily Chondrostominae				
Chondrostoma #2	1	S,2,3,4	E	
Chondrostoma #3	1	S,2,3,4	E	
Chondrostoma #4	1	S,2,3,4	E	
Chondrostoma #5	1	S,2,3,4	E	

TABLE 33. KARUN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Subfamily Barbinae				
Garra rufa	2	O,6,7,9	2,4,10,11	
Iranocypris typhlops	1	E		
Varicorhinus macrolepis	1	S,0,2,3,7 10	4,11,12	
V. macrolepis #1	1	S,0,2,3, 7,10	4,11,12	E
Varicorhinus #3	1	S,0,2,3, 10,11	4,7	
V. trutta	1	S,0,2,3 7,10,11	4	
V. fratercula	1	S,0,7,10	2,4,11	
V. damascinus	1	S,0,7,10, 11	2,3,4	
Cyprinion macrostomum	1	O,6,7,8 9,10,11	2,4	
Cyprinion #1	1	O,2,4,6,7 8,9,10,11	E	
Barbus luteus	1	S,0,1,3, 6,11	2,4,7	
B. sharpeyi	1	S,0,1,2,3 6,7,11	4	
B. chantrei	1	S,0,1,3,4 6,7,11	2	
B. grypus	1	S,0,1,2,3 6,7,11	4	
B. barbulus	1	S,0,1,3,6 11	2,4,7	
B. longiceps	1	S,0,1,3,6 7,11	2,4	
B. xanthopterus	1	S,0,1,2,3 6,7,11	4	
B. kosswigi	1	S,0,1,2,3 6,7,11	4	
B. esocinus	1	S,0,1,2,3 6,7,11	4	
Barbus #4	1	S,0,1,2,3 4,6,7,11	E	
B. subquincunciatus	1	S,0,1,2,3 6,7,11	4	
Subfamily Cyprininae				
Cyprinus carpio	I			
Carassius carassius	I			
Ctenopharyngodon idellus	I			

TABLE 33. KARUN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Family Cobitidae				
Cobitis taenia?	1	S,11,4?	19,21	
Noemacheilus tigris	1	S,0,3,11,9	2,4	
N. insignis euphraticus	1	S,0,9,11	2	3,4
N. panthera	1	S,0,2,3 9,11	2,4	
N. kermanshahensis	1	S,0,2,3 4,9,11	E	
Noemacheilus #6	1	S,0,2,3 4,9,11	E	
Noemacheilus #7	1	S,0,2,3 4,9,11	E	
Noemacheilus #8	1	S,0,2,3 4,9,11	E	
Suborder Siluroidei				
Family Tachysuridae				
Tachysurus thalassinus	M		1,4,6,31 32,34,35	
Family Bagridae				
Mystus pelusius colvillii	2	O	2	4
Family Sisoridae				
Glyptothorax kurdistanicum	2	0,4	E	
Family Clariidae				
Heteropneustes #1	2	0,4	0,4	E
Heteropneustes #2	2	0,4	0,4	E
Order Anguilliformes				
Family Muraenesox				
Muraenesox cinereus	M		1,4,6,32 33,34,35	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius sophiae	3	O,2,3,6 7,9,10,1	4,11	
A. dispar	3	0,2,3,9 10,11	1,4,6,7,2 30,31,32	1,4,6,7
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			

TABLE 33. KARUN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Mugiliformes				
Family Mugilidae				
Mugil abu	4		4	
M. abu zarudnyi	4		4	
Mugil #1	4		E	
M. dussumieri	M		4,31,32,33 34,35	
M. waigiensis	M		4,6,31,32 33,34,35	
Order Perciformes				
Suborder Gobiodei				
Family Gobiidae				
Trypauchen vagina	M		4,32,34,35	
Scartelaos tenuis	M		1,4,31,32 33,34,35	
Boleophthalmus dussumieri	M		4,31,32,33,34	
Family Periophthalmidae				
Periophthalmus koelreuteri	M		1,4,6,9,31 32,33,34,35	
P. waltoni	M		4,6,9	
Suborder Stromateoidei				
Family Stromateidae				
Chondroplites chinensis	M		4,32,34,35	
Pampus argenteus	M		4,32,34,35	
Order Pleuronectiformes				
Family Soleidae				
Synaptura orientalis	M		4,32,34,35	
Order Mastacembeliformes				
Family Mastacembelidae				
Mastacembelus simack	2	O	2,4,7	

current is difficult. The separation into sections and the variety of habitats present in the basin would seem to favor endemism. Only one of the twenty four genera and fourteen of the fifty three species of freshwater fish in the basin are endemic (Table 35). A systematic collection of the Karun Basin would probably uncover additional endemic species.

The marine element in the Karun Subdistrict fauna is essentially the same as that in the Tigris-Euphrates Subdistrict. The delta area is not as well developed in the smaller Karun River so that the marine element does not penetrate as far upstream.

The largest group of fish are the Barbinae, with five genera and nineteen species. The Barbus, with eleven species, comprises over half the representation of the subfamily. With the exception of one undescribed species, all the Barbus are reported also from the Tigris-Euphrates Subdistrict. The Varicorhinus are not as well represented, with only five species present. The other three genera include Cyprinion and Garra, widespread in the Mesopotamian and Oriental faunas of Iran, and the endemic blind cave fish Iranocypris.

Six genera of Leuciscinae are present, five of which are shared with the Sarmatian fauna. The sixth genus, Phoxinellus, is characteristic of the Palestinian and Asia Minor faunas. The genera of this subfamily parallel those of the Tigris-Euphrates Subdistrict, but are represented by fewer species and subspecies.

The subfamily Cyprininae is not native to the Mesopotamian fauna, but is represented in Iran by three introduced species.

Half of the endemic species are found in the genera Chondrostoma and Noemacheilus. None of the Chondrostoma corresponded to previously described species. Three of the four undescribed species in the Karun were taken only in the Karun, while the fourth was found also in the Tigris River. Seven species of Noemacheilus were found, of which three were undescribed endemic species, while a fourth species has so far been described only from the Karun River.

Five species of fish have been introduced into the basin in Iran. The mosquito fish Gambusia was introduced in the 1960s as part of a malaria mosquito abatement program. Three members of the subfamily Cyprininae were introduced: Cyprinus carpio, introduced as a food source; Ctenopharyngodon idellus as an irrigation canal vegetation control, and Carassius carasssius as a release of pets. C. idellus releases were to be controlled situations that would prevent their entry into the mainstem Karun River, but the extensive flooding that has occurred recently in the Khuzistan Plain could very easily allow escape into the river.

The fifth species is the rainbow trout, Salmo gairdneri, released into the Upper Karun. I do not know if the population has taken. In reviewing my notes of the Karun fishes, I found one collection of trout from the Karun; I had placed it in Salmo trutta caspius, the Caspian trout, but did not make a study of the specimen. This is the first collection I am aware of of native trout in the Karun Basin, although they would certainly be expected. Unfortunately, I did not make sufficient notes to now tell if the fish belongs to

TABLE 34. FAUNAL ASSOCIATIONS

KARUN BASIN FISH FAUNA

SYSTEMATIC LEVEL	KARUN FAUNA	TIGRIS-EUPHRATES FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA	MARINE FAUNA	ENDEMIC FAUNA
Order	10	10	10	3	7	0
Family	19	18	17	5	11	0
Genus	36*	33	23	10	13	1
Species	70*	49	17	4	17	14
Subspecies	8*	4	0	0	0	3

*Includes the following introduced species:
Salmo gairdneri
Cyprinus carpio
Carassius carassius
Ctenopharyngodon idellus
Gambusia affinis affinis
Gambusia affinis holbrooki

TABLE 35. FAUNAL ASSOCIATIONS

KARUN BASIN FISH FAUNA

FRESHWATER ONLY

SYSTEMATIC LEVEL	KARUN FAUNA	TIGRIS-EUPHRATES FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA	ENDEMIC FAUNA
Order	5	5	3	3	0
Family	10	9	6	3	0
Genus	24	21	10	10	1
Species	53	32	1	4	14
Subspecies	8	4	0	0	3

S. trutta caspius, S. trutta macrostigma or would be a new form.

Lake Marivan, or Lake Zaribar, is located in the Karun Subdistrict. Its fish population is representative of the Subdistrict, but the fish in the lake show some divergence as a result of their isolation from the river populations.

The Karun Subdistrict fauna history and composition parallels that of the Tigris-Euphrates. The relationships with other faunas (Tables 34 and 35) is essentially the same, with a closer tie to the Oriental and African faunas at upper systematic levels. Endemism is not as high as found in the Tigris and Euphrates, but this may be a result of insufficient collections, particularily in the less accessible headwaters areas.

Neyriz Subdistrict (Table 36)

The Neyriz Subdistrict is comprised of the Neyriz and Bakhtegan Lakes and the Kur River Basin. It is an enclosed basin bordered on the west by the Maharlu and Karun Subdistricts, on the north by the Isfahan Subdistrict and on the south and east by the Mond and Kol Subdistricts and the Baluchistan Subregion. In addition to the Kur River, the basin contains many springs, some rather large, including thermal and saline springs. As the site of the ancient city of Persepolis, the Neyriz Valley has been occupied continuously for over 2,500 years, with irrigated farming being practiced throughout the time of settled occupation.

TABLE 36. NEYRIZ BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP.
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Chalcalburnus megacephalus	1	S,2,4,5,7	10	
Alburnus iblis?/heckeli?	1	S,2,5,7, 10	4?	
Subfamily Barbinae				
Garra rufa	2	O,6,7,9	2,4,5,10	
Varicorhinus macrolepis	1	S,O,1,2,3 7,10	4,5,12	
V. fratercula	1	S,O,1,3, 7,10	2,4,5	
Cyprinion macrostomum tenuiradius	1	O,6,8,9	2,4,5	7,10
Barbus #3	1	S,0,1,2, 3,4,5,6,7	7?	
Family Cobitidae				
Cobitis linea	1	S,4?5?	E	
Noemacheilus persa	1	S,0,2,3,4 5,9	E	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius sophiae	1	S,0,1,2,3 6,7,9,10	4,5	
Aphanius #3	1	S,0,1,2,3 4,5,6,7 9,10	E	
Family Poeciliidae				
Gambusia affinis affinis G. affinis holbrooki	I			
Order Perciformes				
Family Cichlidae				
Species #2?	3	O,1,2	E?	

TABLE 37. FAUNAL ASSOCIATIONS

NEYRIZ BASIN FISH FAUNA

SYSTEMATIC LEVEL	NEYRIZ FAUNA	ENDEMIC FAUNA	MAHARLU FAUNA	KARUN FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA
Order	2(3)*	0	2	2	3	2
Family	4(5)#	0	2	3	4	3
Genus	10(11)	0	4	9	6	7
Species	12(13)	3(4)*	3	6	0	1
Subspecies	3	0	1	0	0	0

* Includes a species of Cichlidae which may be in this or an adjoining basin.

\# Includes the following introduced species of the Family Poeciliidae:

Gambusia affinis affinis
G. affinis holbrooki

Heckel (1846) made the first collection of fish from the basin. I have been able to find most of the species described by Heckel. Most notable from recent collections has been the absence of *Cobitis linea*, until recently the only report of this genus from the Mesopotamian fauna.

Ten genera and twelve species have been reported or collected within the basin. They are similar to the Karun Subdistrict fishes, although four of the species are endemic to the basin and one other is shared only with the Maharlu Basin. This includes the family Cichlidae, which may be present in the Subdistrict. (Table 37)

The Neyriz Subdistrict at one time drained into the Karun River. The separation from the Karun, through the Maharlu Basin, is not great. The current fish populations probably derived from the original immigrants into the basin from the Karun, having undergone divergence following separation. Nine of the 10 genera and six of the twelve species in the basin are found also in the Karun. One species of *Varicorhinus* is shared with the Isfahan Basin to the north, suggesting that exchanges may have occurred between the Isfahan and Neyriz Basins in the past.

Maharlu Subdistrict (Table 38)

The Maharlu Subdistrict includes the Maharlu Basin, which contains a saline lake and a number of springs and qanat systems, but no perennial streams.

TABLE 38. MAHARLU BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Chalcalburnus megacephalus	1	S,2,4,5,7	11	
Alburnus doriae	1	S,2,4,5, 11	E	
Subfamily Barbinae				
Garra rufa	2	O,S,6,7,9	2,4,5,11	
Varicorhinus amir	1	O,S,1,2,3 4,5,7,11	E	
Cyprinion macrostomum tenuiradius	1	O,6,8,9	2,4,5	7,11
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius punctatus	3	S,O,1,2, 3,4,5,6,7 9,11	E	
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			

TABLE 39. FAUNAL ASSOCIATIONS

MAHARLU BASIN FISH FAUNA

SYSTEMATIC LEVEL	MAHARLU FAUNA	ENDEMIC FAUNA	NEYRIZ FAUNA	KARUN FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA
Order	2	0	2	2	2	2
Family	3*	0	2	2	2	2
Genus	7*	0	6	6	4	5
Species	7*	3	4	2	0	0
Subspecies	3	0	1	0	0	0

*Includes the following introduced species:

Gambusia affinis affinis
G. affinis holbrooki

The basin contains seven species in seven genera. One species is the introduced _Gambusia_, introduced in the 1960's as part of the mosquito abatement program. Of the six native genera and species three are endemic and one is shared only with the Neyriz Subdistrict. All native genera are found in the Neyriz Subdistrict, with the endemism at the species level (Table 39).

All of the genera native to the basin are found also in the Karun River (Table 39). Interestingly, the Maharlu Basin shows a lower direct relationship with the Karun River at the species level than does the Neyriz Basin, even though the Maharlu provided the access from the Karun into the Neyriz Basin. This may be due to the fact the fish in the Maharlu Basin are isolated in springs whereas in the Neyriz Basin the perennial Kur River allows for movements within the basin.

The Maharlu Basin is separated from the Mond Basin by only a low divide, and by only a short interval from the Neyriz Basin. All six of the native genera are found in the Karun and in the Tigris-Euphrates Rivers, indicating the derivation from that fauna. The basin once connected to the Tigris-Euphrates-Karun System through the Mond River, allowing access to immigrants from those rivers. The invasion probably occurred during the period when the sea level was lower and the Tigris-Euphrates-Karun flowed further down what is now the Persian Gulf.

Persian Gulf District

The Persian Gulf District is closely allied to the Tigris-Euphrates District. It is composed of tributaries entering the Persian Gulf from Iran and the Arabian Peninsula. Because of the aridity of the region, the streams are seldom perennial, although springs and short sections of flowing water will occur in the larger drainages. The greatest volume of outflow is in the three rivers in the Mond Subdistrict, which are fed by the mountain snows and rain of the Zagros Mountains.

While the individual river basins are now isolated by aridity and sea water, they were probably connected through the Tigris-Euphrates during the ice ages. As was discussed in more detail in the chapter on the geologic history of Iran, the lower level of the oceans during the ice ages caused the head of the Persian Gulf to move outward, at its lowest point reaching what is now the Straits of Hormuz. The combined flow of the Tigris, Euphrates, Karun, and Persian Gulf streams ran the full length of what is now the Persian Gulf, permitting freshwater connections between rivers.

The fish fauna in the Persian Gulf District resembles that of the Tigris-Euphrates District. However, there is a high degree of endemism. The general distribution and systematics of the fishes strongly support the studies on the geologic history, since the pattern of relationships and the high degree of endemism suggest past connections and subsequent isolation and differentiation.

Access into many areas in the Persian Gulf District is difficult. The fauna must currently be considered poorly known. More families, orders, genera and species are certain to be found.

Mond Subdistrict (Table 40)

The Mond Subdistrict includes the Mond River, Helleh River and Zohreh River. These rivers occupy the central and upper drainage basin of the Persian Gulf in Iran. The area is steep and rugged, and access quite limited. Very little collecting has been done. Most of the collections that have been made have been of the upper Mond, which is accessible at several points by roads from the city of Shiraz. I have seen the lower end of the river from the air and believe that marine species will be found in the lower river, but to date no collections have been made.

The Subdistrict represents an extension of the Tigris-Euphrates fauna, but with a high degree of endemism. The dominant group is the Barbinae, which provides 10 of the 13 native species. This includes undescribed species of Garra, Varicorhinus, and Barbus, and two undescribed forms of Cyprinion allied with C. macrostomum. One of the species reported by Heckel (1846) from the Mond was Barbus albus alpina (discussed at greater length in Systematics Chapter) which is somewhat of a question; it has not been collected since Heckel's report. (Table 41)

The only Leuciscinae collected to date is the endemic Chalcalburnus caudimacula. Notably absent are Leuciscus and Alburnus, both common in other parts of the Tigris-Euphrates District.

One Genus, Gambusia, was introduced into the basin in the 1960's as part of a malaria mosquito control program, and has become established in the rivers and isolated qanats and springs in the basin.

TABLE 40. MOND BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA		
		GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Leuciscinae				
Chalcalburnus caudimacula	1	S,2,4,5 10,11	E	
Subfamily Barbinae				
Garra rufa	2	O,S,6,9	2,4,5, 10,11	
Garra #1	2	S,O,2,4,5 6,9,10,11	E	
Varicorhinus #3	1	S,0,1,2,3 4,5,10,11	4,5	
Cyprinion macrostomum tenuiradius	1	6,8,9,0	2,4,5	10,11
Cyprinion #2	1	0,2,4,5,6 8,9,10,11	E	
Cyprinion #3	1	0,2,4,5,6 8,9,10,11	E	
Barbus albus alpina?	1	0,S,1,3,5 6,11	2,4	E
B. luteus	1	0,S,1,6,11	2,4,5	
B. barbulus	1	0,S,1,6,11	2,4,5	
Barbus #2	1	0,S,1,2,4 5,6,11	E	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius dispar	3	0,S,2,3, 9,10,11	1,4,5,6	
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			
Order Perciformes				
Family Cichlidae				
Species #2?	3	0,9	E?	
Order Mastacembeliformes				
Family Mastacembelidae				
Mastacembelus simack	2	0	2,4,5	

TABLE 41. FAUNAL ASSOCIATIONS

MOND BASIN FISH FAUNA

SYSTEMATIC LEVEL	MOND FAUNA	ENDEMIC FAUNA	TIGRIS-EUPHRATES FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA
Order	3(4)*	0	4	4	3
Family	4(5)	0	3	4	2
Genus	8(9)	0	7	6	5
Species	14(15)	5(6)*	8	0	0
Subspecies	4	1#	0	0	0

*Includes the genus or species of Cichlidae which may be in an adjoining basin

#Includes *Barbus albus alpina*, of uncertain validity; see discussion in Systematics Chapter

The family Cichlidae may be present, but this is uncertain. As was discussed in the Systematics Chapter, a collection of cichlids was made from the "Salt River, Fars." The Mond River drains much of Fars, and may have been the collection site. A second species of cichlid was collected from the Kol River in the adjoining basin to the east.

The Mond Subdistrict fish fauna is closely allied to the Tigris-Euphrates fauna (Table 41).Three of the four families, seven of the eight genera and eight of the fourteen species are found also in the Tigris-Euphrates fauna. All four families in the Mond are also shared with the Oriental fauna - one more than found in the Tigris-Euphrates fauna - but only six genera and no species are common. The Mond was probably colonized during the period when the sea level was lower and the head of the Persian Gulf was much closer to what is now the Straits of Hormuz. The rivers in the Mond Subdistrict would then have flowed into the river carrying the combined flow of the Tigris, Euphrates and Karun Rivers. Following the end of the ice ages and the rise in sea levels, the Mond was cut off from its connections with the Tigris-Euphrates. Following this cut-off by the sea, the Mond River fishes began a process of differentiation, with the result that five, possibly six, species and one subspecies are endemic.

I would anticipate additional families, genera, species and, possibly orders, being found in the basin, including marine fishes in the lower portion of the river.

Lar Subdistrict (Table 42)

The Lar Basin is a small enclosed basin sitting between the Mond and Kol Basins. Its waters are limited to springs and qanats. It is not clear whether this basin once connected to the Mond or Kol River, but I believe it to have been the former.

The fish fauna of the Lar Basin is limited; only two genera are present and one of the two is introduced. Gambusia, with two subspecies, was introduced in the 1960's as part of the malarial mosquito control program.

The only native genus collected from the basin was Cyprinion, with two interesting species. One of the Cyprinion, described by Saadati (1977), is very similar to the form Heckel (1846) described as Barbus albus alpina (See the discussions under Barbus and Cyprinion in the Systematics Chapter for more information), and may be representative of the intermediate stage between Barbus and Cyprinion

The Lar Basin fish probably arrived through the Mond, or through the Kol River, becoming isolated with increased aridity that severed the river connections. The fish able to adapt to living in springs and qanats were able to survive, with some differentiation occurring.

Arabian Subdistrict

Except for a few coastal specimens, I have relied on Banister and Clarke (1975) for a description of the Arabian Peninsula fishes. They show close relationships to the Persian fishes, and probably reached the Arabian Peninsula during the same time as the colonization of the Iranian rivers took place. The fish are predominantly Barbinae, and show some differentiation.

TABLE 42. LAR BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Cyprinion #4	1	0,2,4,5,6 7,9,10,11	E	
Cyprinion #5	1	0,2,4,5,6 7,9,10,11	E	
Order Cyprinodontiformes				
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			

TABLE 43. KOL BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Garra #2	1	2,4,5,6, 7,10,11,0,S	E	
Garra #3	1	0,S,2,4,5 6,7,10,11	E	
Cyprinion watsoni	1	0,2,4,5,7 8,10,11	6,29,30,31, 32	
Family Cobitidae				
Noemacheilus #2	1	0,S,2,3,4,5 11	E	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius ginaonis	1	0,S,1,2,3,4 5,6,7,10,11	E	
Aphanius #2	1	0,S,1,2,3,4 5,6,7,10,11	E	
Family Poeciliidae				
Gambusia affinis affinis	I			
G. affinis holbrooki	I			
Order Perciformes				
Family Cichlidae				
Species #1	3	0,7?,11?	E	
Species #2	3	0	7?11?	
Family Periophthalmidae				
Periophthalmus koelreuteri	M		1,4,5,6,35 31,32,33,34	
P. waltoni	M		4,5,6	

Kol Subdistrict (Table 43)

The Kol Subdistrict contains two rivers, the Kol River and the Mehran River, both of which empty into the Persian Gulf near the town of Bandar Abbas, and close to the Straits of Hormuz. Neither river has flowing water throughout, but would better be described as a series of short flowing sections separated by long stretches of dry river bed. The flowing sections are below springs, which may be saline or quite warm.

The Kol Subdistrict, like the Isfahan Subdistrict discussed earlier, is hard to place in a zoogeographic outline, and would best be described as a transition basin. It contains species with close relationships to the Tigris-Euphrates fauna to the west, but also is similar to the Oriental Mekran fauna to the east. The Subdistrict has a very high level of endemism, with seven of the eleven species, six of which are undescribed, being endemic to the Subdistrict. It is suprising that so few specimens had ever been collected from the Kol Subdistrict since a major highway parallels the river Kol for much of its length.

No Leuciscinae were collected from the Kol Subdistrict. The only Cyprinidae were the Barbinae genera Garra and Cyprinion. The Garra, with two undescribed species, are similar to the Garra in the Mekran coasts. The Cyprinion, C. watsoni, is common along the Persian Gulf coasts.

One species of the cobitid genus Noemacheilus, an undescribed species, was collected from the upper Kol River. It is similar to the N. sargadensis of adjoining basins to the north and east.

TABLE 44. FAUNAL ASSOCIATIONS

KOL BASIN FISH FAUNA

SYSTEMATIC LEVEL	KOL FAUNA	ENDEMIC FAUNA	MARINE FAUNA	MESOPOTAMIAN FAUNA	ORIENTAL FAUNA	SARMATIAN FAUNA
Order	3	0	1	3	3	3
Family	6#	0	1	5	5	3
Genus	7	1	1	5	5	3
Species	11*	6(7)*	2	3	3	0
Subspecies	2	0	0	0	0	0

* Includes one species of Cichlidae which may be in this or in an adjoining basin.

#Includes the introduced Poeciliidae

Three forms of Aphanius were collected, one being the species A. ginaonis. This species lives in the Ab-Garm, a hot spring near Bandar Abbas in the Kol River channel. The fish mostly stayed on the edges of the spring outflow, which reached over $50^{o}C$, but would dart into the deeper, hotter water to feed. The other two forms of Aphanius, which represent undescribed species or subspecies, were found in highly saline waters, sometimes so saline salt crystals formed on the bottom of the stream. In the highly saline, warm waters, Aphanius and Cichlidae were often found together.

The cichlids we collected represented only the second collection of this family in Iran. A previous collection was made in the "Salt River, Fars", which, as has been discussed previously, presents some problems in defining the distribution of the family in Iran since the cichlids we collected and those from the Salt River appear to be different, undescribed species, although they appear to both belong to the same, undescribed genus. The cichlids show their closest affinities with the African and Palestinian species. Cichlids are present in India, in the Oriental fauna, but, as was discussed in the Systematics Chapter, are quite different from the African species and probably represent a long-isolated population separated early in the development of the family.

The genus Gambusia was introduced into the Subdistrict in the 1960's as part of the malaria mosquito abatement program.

While in Bandar Abbas, I often observed the Periophthalmidae which lived in colonies throughout the area. These are the only marine species living in the freshwater areas of the Subdistrict that I have seen. The lower Kol River forms a long delta and certainly contains additional marine species, but no collections have been made.

The Kol Subdistrict, based on the high degree of endemism, was isolated from adjoining basins for some time. Over half the species in the basin are endemic (Table 44). The Basin was probably colonized during the time the Persian Gulf was lowered in the ice ages and the Tigris-Euphrates-Karun River reached to the Straits of Hormuz. The Kol and Mehran Rivers would then have been on the margin of the outflow of these rivers.

The fish present in the basin show affinities to basins to the east and west (Table 44). The same number of families, genera and species are shared with the Oriental as with the Mesopotamian fauna. The Garra, Cyprinion and Noemacheilus show stronger affinities with fishes to the north and east, while the Aphanius and Cichlidae are closer to fishes to the west. The cichlids present a special problem since they are not found in any adjoining basins (with the possible exception of the Mond Basin, as discussed). They have not been reported from Arabia nor from the Tigris-Euphrates, both on what would be the most likely invasion routes. The most probable origin was from the Palestine and Tigris-Euphrates while sea levels were lower, with subsequent differentiation once isolated in the Kol and Mehran Rivers.

I have elected to place the Kol Basin fauna in the Mesopotamian Region, although it is really a transitional fauna, with high endemism, with strong links to the Oriental fauna to the north and east.

ORIENTAL REGION

BALUCHISTAN SUBREGION

Mekran Province (Table 45)

The Mekran Province occupies the coastal basin of the Arabian Sea in Iran. It may be separated into into Districts with further information but at the present time only limited collecting has been done. The area is one of the newest areas geologically and is very mountainous and rough. Very few roads of any kind have penetrated into the area, limiting travel.

The Mekran Province contains several rivers, only two of which, the Sarbaz and the Minab, have been collected in Iran. Other coastal rivers are found between these two rivers but have not been visited. The Sarbaz River shares a delta with the Dashte River, a large river arising in Pakistan. Other branches of the Dashte River arise in Iran and flow into Pakistan where they join the Dashte River. I have included also one isolated basin, the Mashkel Basin of Pakistan, in this Province. It once connected to the Dashte River system, and is still separated from both the Dashte River and Helmand River systems by a comparatively low range of hills. While the floor of the basin is in Pakistan, tributaries of the basin head in Iran.

Of the material I have seen, 13 of the 30 species in the Province in Iran are marine. The goby population, with seven species counting periophthalmids, are found in the Sarbaz River. One of these is an undescribed species or subspecies of "Gobius." The mullets, with species, are also a major group.

TABLE 45. MEKRAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Clupeiformes				
Family Clupeidae				
Hilsa ilisha	M		4,5,32,34,35	
Order Cypriniformes				
Suborder Cyprinoidei				
Family Cyprinidae				
Subfamily Leuciscinae				
Aspidoparia morar	1	M	32,33,34,35	
Subfamily Barbinae				
Discognathus #2	1	M,25,26, 29,30,32	E	
Discognathus #3	1	M,25,26, 29,30,32	E	
Garra sp. Hora	1	M,0,25,26 30,33,34	E	
Garra #4	1	M,0,25,26 30,33,34	E	
Crossocheilus latius diplochilus	1	26	32,33	
Varicorhinus #6	1	M,S,25,27 28,29,30	E	
Cyprinion watsoni	1	M,26	29,30,32	
C. microphthalmum	1	M 29	26,30,32	
Family Cobitidae				
Noemacheilus baluchiorum	1	M,S,25,28 29,30,34,	32,33	
N. kessleri	1	M,S,25,28, 29,30,33,34	22,26,32	
N. prashari lindbergi	1	M,S,25,26 28,29,30 31,34	32	32,33
Noemacheilus #3	1	M,S,25,26 28,29,30, 32,33,34	E	
Suborder Siluroidei				
Family Tachysuridae				
Tachysurus thalassinus	M		1,4,5,6, 32,34,35	

TABLE 45. MEKRAN BASIN FISH FAUNA (CONT.)

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius dispar stoliczkanus	3	M,0,	1,2,4,5,6 7	30,32
Aphanius #3	3	M,0,30,32	E	
Order Mugiliformes				
Family Mugilidae				
Mugil cephalus	M		S,6,32,33 34,35	
M. dussumieri	M		4,5,32,33 34,35	
M. waigiensis	M		4,5,6,32, 33,34,35	
M. speigleri	M		32,33,34,35	
Order Channiformes				
Family Channidae				
Ophiocephalus gachua	1	33,34,35	30,32,33,34 35	
Order Perciformes				
Family Gobiidae				
"Gobius" giuris	M		1,32,33,34 35	
Gobius #1	M		E	
Scartelaos tenuis	M		1,4,32,33 34,35	
Boleophthalmus dussumieri	M		4,5,32,33,34	
B. boddaerti	M		32,33,34,35	
Family Periophthalmidae				
Periophthalmus koelreuteri	M		1,4,5,6,9, 32,33,34,35	
P. waltoni	M		4,5,6,9	
Order Mastacembeliformes				
Family Mastacembelidae				
Mastacembelus armatus	2	M	32,33,34,35	

The largest group of freshwater fish is the subfamily Barbinae, Family Cyprinidae. Five genera with eight species are present. Three of the eight were previously described, while five of the eight represent unnamed species. One of these was described but not named by S.L. Hora, while the other four were previously undescribed, including the first Varicorhinus reported from the Baluchistan Subregion. Aspidoparia morar, a genus common in the Oriental fauna, is the only Leuciscinae found.

Four cobitids, all belonging to the genus Noemacheilus, were collected or reported from the Province, one an undescribed species.

The remaining freshwater fish belong to orders with limited faunas in Iran. The cyprinodonts are represented by Aphanius dispar stoliczkanus, a subspecies characteristic of the Arabian Sea and Persian Gulf Basins, and by an undescribed species of Aphanius. The Channiformes, Ophiocephalus gachua, and the mastacembelid Mastacembelus armatus, are both characteristic of the Oriental fauna.

The fish fauna of the Mekran Province is closely allied to the Oriental Region in general and the Indus Basin and Coastal Pakistan in particular (Tables 46 and 47). It may be described, in general, as a depuaperate westward extension of the Indus Basin fauna. Only a few of the hardier species succeeded in colonizing the coastal rivers of the Persian Mekran.

The Sarbaz River is quite similar to the Dashte River, as would be expected since their mouths are very close, sharing the Bay of Gwadar. While I visited the area, I was able to confirm the presence of the Indian crocodile in the Sarbaz and a tributary of the Dashte River in Iran; this extended the range of the crocodile westward, and helps to show the similarity between the faunas.

The level of endemism in the Province is not high for the Province as a whole; however, it is quite high in the Minab River. The Minab contained the undescribed species of Discognathus, Garra, Varicorhinus and Noemacheilus. The relationships are to the Oriental fauna, but the separation due to aridity and intervening coastal marine waters have isolated the fauna, apparently leading to gradual diversification and the current high level of endemism.

Colonization of the coastal streams probably occurred when the Indo-Brahmaputra, or Siwalik, River flowed into the Arabian Sea. This would not only have provided a highway for movement of fishes, but would also have created a large area of lower salinity water along the shore as a result of the large amount of freshwater outflow (See discussion in chapter on geologic history for a discussion of this river). The Sarbaz, because of its close association with the Dashte River, retained stronger relationships to the Indus Basin fauna to the east, while the more isolated Minab River fauna underwent a process of diversification.

Additional species of fish are present in the Province, but I have not determined their identification so have not included them. Two I believe will belong to the genus Labeo, which is quite common in the Dashte River, and throughout Pakistani coastal drainages. Because of the limited collecting which has been done, particularily in the rivers west of the Sarbaz, other species and probably genera may be expected.

TABLE 46. FAUNAL ASSOCIATIONS

MEKRAN BASIN FISH FAUNA

SYSTEMATIC FAUNA	MEKRAN FAUNA	INDO-ASIAN FAUNA	MESOPOTAMIA FAUNA	SARMATIAN FAUNA	MARINE FAUNA	ENDEMIC FAUNA
Order	7	7	6	4	2	0
Family	8	8	6	4	4	0
Genus	17	16	13	4	7	0
Species	30	21	18	0	13	8
Subspecies	3	3	0	0	0	0

TABLE 47. FAUNAL ASSOCIATIONS

MEKRAN BASIN FISH FAUNA

FRESHWATER ONLY

SYSTEMATIC LEVEL	MEKRAN FAUNA	INDO-ASIAN FAUNA	MESOPOTAMIAN FAUNA	SARMATIAN FAUNA	ENDEMIC FAUNA
Order	4	4	3	2	0
Family	4	4	3	2	0
Genus	10	9	7	4	0
Species	17	10	1	0	7
Subspecies	3	3	0	0	0

The marine element is quite strong in the material collected to date; nearly half of the species, 13 of 30, are marine. The delta area is quite small, but the extensive estuarine waters in the Gwadar Bay seems to encourage movements into freshwater.

For freshwater fish only (Table 47), all families, 9 of 10 genera and 10 of 17 species are shared with Pakistan to the east. While 7 of 10 genera are found also in the Mesopotamian fauna, only one species - Aphanius dispar - is shared.

Baluchistan Province

Bampur District (Table 48)

The Bampur District includes the Bampur and Sirjan Basins. The Bampur Basin contains a depression, the Jaz-e-Murian, and two rivers, the Bampur River flowing from the east and the Halilrud (or Jiroft Rud) from the west. Both rivers have flowing sections separated by long stretches of dry river bed. The Jaz-e-Murian itself contains saline water much of the time, with the water level and surface area fluctuating rapidly with changes in inflow. The Sirjan Basin is an isolated basin to the northwest of the Bampur Basin. It is close to both the Bampur and Isfahan Basins, but the one species of Noemacheilus found in the Sirjan Basin is shared with the Bampur Basin and suggests poast connections from the Sirjan to the Bampur Basin by way of the Halilirud River drainage.

For its size and general lack of perennial water, the Bampur District contains a surprisingly diverse fish fauna. It has seven genera and eleven species of fish in three orders. Three of the

TABLE 48. BAMPUR BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Discognathus rossicus	1	M,31,33,34	25,26,29 32	
Discognathus #1	2	M,25,26,29 31,32,33,34	E	
Garra persica	2	M,S,26,31, 32,33,34	23,25,26	
Varicorhinus #5	1	M,S,25,27, 28,29,31	E	
Cyprinion watsoni	1	M,26	29,31,32	
C. microphthalmum	1	M,29	26,31,32	
Family Cobitidae				
Noemacheilus sargadensis	1	M,S,31,32, 33,34,35	23,25,29	28
N. sargadensis bampurensis	1	M,S,31,32 33,34,35	23,25,28	29
Noemacheilus #1	1	M,25,28,29 31,32,33, 34,35	E	
Order Cyprinodontiformes				
Family Cyprinodontidae				
Aphanius dispar stoliczkanus	3	M,S	1,2,4,5,6 7	32,33
Order Channiformes				
Family Channidae				
Ophiocephalus gachua	1		31,32,33, 34,35	

species, undescribed species of Discognathus, Varicorhinus and Noemacheilus, are endemic. The fauna as a whole shows relationships to Seistan Subregion, Mekran Province and Dashte-Lut District fauna, all neighbouring faunas.

The Barbinae of the family Cyprinidae are best represented, with four genera and six species present. As mentioned, two of the species are undescribed endemics. Three of the remaining species are found also in coastal drainages of the Mekran of Iran and Pakistan. Two of the Barbinae, plus the Noemacheilus sargadensis, extend northward into the isolated Northeast Basins of Iran. The two Cyprinion present are characteristic of the Arabian Sea coastal drainages.

Two species of Noemacheilus were collected, one undescribed. The other species, N. sargadensis, is widespread throughout eastern and central Iran. Three subspecies have been described, two of which are in the Bampur Basin. As was discussed in the Systematics Chapter, I suspect only a single species, with considerable variability, is present throughout its range.

The one cyprinodont, Aphanius dispar stoliczkanus, is characteristic of the Arabian Sea coastal drainages. The other freshwater species is the channiform, Ophiocephalus gachua, which has been found in both the Bampur and Halilrud.

Nikolsky (1897) reported a species he described as Barbus bampurensis, not collected since Zarudny made his collections at the end of the last century. It has been listed as a synonym of several species in other genera. From the description, I suspect it is Labeo but need to see the original specimen or collect other specimens.

TABLE 49. FAUNAL ASSOCIATIONS

BAMPUR BASIN FISH FAUNA

SYSTEMATIC LEVEL	BAMPUR FAUNA	MEKRAN FAUNA	MESOPOTAMIAN FAUNA	SARMATIAN FAUNA	ENDEMIC FAUNA
Order	3	3	2	2	0
Family	4	4	3	3	0
Genus	7	7	6	4	0
Species	11	4	1	2	3
Subspecies	2	1	0	0	0

The associations of the Bampur District fauna are closest to the coastal drainages of the Gulf of Oman (Table 49). The divide between the Bampur Basin and the wekran drainages is not great. In the southwestern part of the basin, near the Minab River drainage, the gap is quite low, and it is not easy to tell in which basin you are located. The low gap between the basins makes it easy to speculate that connections existed fairly recently between the Mekran coastal drainages and the Bampur Basins. Similarily, connections may have occurred with part of the Sarbaz or Dashte drainages, both adjoining the Bampur Basin on the east. The majority of species are shared with the coastal drainages rather than other basins, indicating a common origin and fairly recent connections. While the divide with the Minab River is lower than with rivers to the east, the species show a stronger relationship to the Sarbaz and Dashte River fishes rather than to the highly endemic fauna of the Minab River.

Close associations are also evident with basins to the north and east. The Garra, Discognathus and Noemacheilus present all extend northward to the Sarmatian fauna. The Bampur Basin, based on these fishes, once connected to the Dashte-Lut, which in turn has close associations with other basins to the north, east and west with common species.

The Bampur Basin is in a strategic position with regard to the movement of fishes, since it has adjoining it several basins in both the Oriental and Mesopotamian faunas. Endemism is comparatively low; even the three species mentioned are similar to other species in the Region, suggesting prolonged and recent connections with other basins.

Dashte-Lut District

The Dashte-Lut District encompasses the Dashte-Lut Desert Basin plus the two adjoining basins, the Kerman and Yazd Basins. It covers a large area, but has very little water, severely limiting the potential fish populations. It borders both the Mesopotamian and the Sarmatian fauna, plus several other basins in the Oriental Region.

Dashte-Lut Subdistrict (Table 50)

The Dashte-Lut Subdistrict covers the Dashte-Lut Basin. It contains very little live water, being one of the driest places on the planet. The Tahrud, an intermittent stream along the southwestern edge of the desert, is the only live stream I have seen in the basin. Qanats and a few springs are present.

Four genera and five species, all in the Order Cypriniformes, have been collected from the Subdistrict. Three of the species are shared with the adjoining Bampur Basin to the south. A fourth, the endemic *Varicorhinus rostratus*, is found only in the Dashte-Lut District. The fifth species is a *Noemacheilus*, *N. sargadensis turcmenicus*, which is very close to the Bampur Basin subspecies, and which extends northward into the basins bordering the Aral Sea Basin.

The gap between the Dashte-Lut and the Bampur Basins is quite low. The shared fish fauna suggests recent connections between the two basins, allowing exchanges of fish between the two basins. The Dahste-Lut, because of its location, has the potential for introductions of fish from many basins, but the introduction and movement of fish within the basin is severely limited by aridity.

TABLE 50. DASHTE-LUT BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Discognathus rossicus	1	M,31	25,26,30,32	
Varicorhinus fuscus	1	M,S,27,28 30,31	24,25,29	
V. rostratus	1	M,S,25,30 31	27,28	
Cyprinion watsoni	1	M,26	30,31,32	
Family Cobitidae				
Noemacheilus sargadensis turmenicus	1	M,S,26,31 32,33,34,35	28,30	23

TABLE 51. FAUNAL ASSOCIATIONS

DASHTE-LUT BASIN FISH FAUNA

SYSTEMATIC LEVEL	DASHTE-LUT FAUNA	BAMPUR FAUNA	INDO-ASIAN FAUNA	MESOPOTAMIAN FAUNA	SARMATIAN FAUNA
Order	1	1	1	1	1
Family	2	2	2	2	2
Genus	4	4	3	4	2
Species	5	3	0	0	1
Subspecies	1	0	0	0	1

Kerman and Yazd Subdistricts (Tables 52, 53)

Both of these Subdistricts contain a single, isolated basin on the western edge of the Dashte-Lut Basin. Each contains two genera and two species in the families Cyprinidae and Cobitidae, *Varicorhinus rostratus* and *Noemacheilus sargadensis*. The *Noemacheilus* species is shared with a number of neighbouring basins to the east, north and south. The *Varicorhinus* is shared with the Dashte-Lut Basins.

Both of the Subdistricts share their fauna with the Dashte-Lut and were probably colonized from that Basin.

SEISTAN SUBREGION

Helmand Province

Seistan District (Table 54)

The Seistan District includes the Hamun-i-Helmand Lake and its tributaries. While there are a number of tributaries, primarily from the north and east, the only major river is the Helmand River. The Helmand Basin is of particular interest. It is the largest major internal basin between the Tigris-Euphrates and the Indus River, and between the mountain tier that includes the Himalayas, Hindu Kush and Elburz Mountains. On the north, it is separated by only a low divide from the series of small enclosed basins I have termed the Northeast Basins. In the south, it is separated by a relatively low divide from the Meshkal Basin and tributaries of the Indian Ocean. In the east, its headwaters are very close to the headwaters of the Indus River Basin. The Helmand River, except during drought periods, has a large flow, which empties into the Hamun-i-Helmand. The Hamun-i-Helmand is a complex

TABLE 52. KERMAN BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SHARED FAUNA SPECIES	SHARED FAUNA SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Varicorhinus rostratus	1	M,S,25,30,31	27,29	
Family Cobitidae				
Noemacheilus sargadensis	1	M,S,26,30, 31,32,33,34,35	23,25, 29	27,30

TABLE 53. YAZD BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Varicorhinus rostratus	1	M,S,25,30,31	28,29	
Family Cobitidae				
Noemacheilus sargadensis	1	M,S,26,30,31 32,33,34,35	23,25 29	27,30

of lakes, canals and marshes whose size fluctuates with the amount of inflowing water. The basin contains a variety of habitats from the alpine streams to the warm, quiet waters of the Hamun-i-Helmand.

Most of the basin is in Afghanistan, not Iran. Part of the Hamun-i-Helmand plus some smaller, intermittent tributaries comprise the Iranian portion of the basin.

Only one order, Cypriniformes, with two families, is reported from the Seistan District. The most abundant group is the subfamily Schizothoracinae, with seven species in three genera. Five of the seven species are shared with the Indus River, while two are endemic. Two of the genera, Schizocypris and Schizopygopsis, are considered montane genera which are not normally found in the warmer, quieter waters such as is found in Seistan, and were probably carried into the Seistan area where they were able to survive.

The cobitid Noemacheilus has developed a comparatively diverse fauna, with six species, three of which are endemic. The three non-endemic species are all shared with the Indus River.

Four genera of the subfamily Barbinae are present, with six species. Two of the species, an undescribed species of Garra and Crossocheilus adiscus, are endemic. Unlike the cobitids and schizothoracins, none of the barbinae are found in the Indus River, but, rather, are aligned with the Arabian Sea coastal fauna. The four non-endemic species are all found along the coastal areas of Pakistan.

Three other genera have been reported from the Seistan District but not confirmed. Two of the genera, Labeo and Varicorhinus, are found in several adjoining stream systems and their presence in the

TABLE 54. HELMAND BASIN FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Discognathus rossicus	1	M,31,34	25,29,30,32	
Garra persica	1	M,S,31, 33,34	23,25,30	
Garra #5	1	M,S,25,29, 30,31,33,34	E	
Crossocheilus adiscus	1	31,32,33	E	
Cyprinion microphthalmum	1	M,29,30,31 32	30,31,32	
C. milesi	1	M,29,30, 31,32	32	
Subfamily Schizothoracinae				
Schizothorax labiatus	1	S,32,34,35	33	
S. plagiostomus	1	S,32,34,35	33	
S. zarudnyi	1	S,32,33 34,35	E	
S. esocinus	1	S,32,34,35	33	
S. schumacheri	1	S,32,33,34 35	E	
Schizocypris brucei	1		33	
Schizopygopsis stoliczkai	1	S	22,33,34	
Family Cobitidae				
Noemacheilus rhadinaeus	1	S,M,25,27, 28,29,30, 31,33,34,35	32	
N. ghazniensis	1	S,M,25,27,28 29,30,31 32,33,34,35	E	
N. lindbergi haarlovi	1	S,M,25,27,28 29,30,31,34 35	32,33	E
N. farwelli	1	S,M,25,27,28 29,30,31,32 33,34,35	E	
N. kessleri	1	S,M,25,27,28 29,30,33,34, 35	22,31,32	
N. brahui	1	S,M,25,27,28 29,30,31,33, 34,35	32	

TABLE 55. FAUNAL ASSOCIATIONS

HELMAND BASIN FISH FAUNA

SYSTEMATIC LEVEL	HELMAND FAUNA	ENDEMIC FAUNA	INDUS FAUNA	PAKISTAN FAUNA	MESOPOTAMIAN FAUNA	SARMATIAN FAUNA
Order	1	0	1	1	1	1
Family	2	0	2	2	2	2
Subfamily	2	0	2	2	1	2
Genus	8	0	6	6	4	4
Species	19	6	6	7	0	3
Subspecies	1	1	0	0	0	0

Seistan District would not be surprising. The third genus, Alburnoides, would be more questionable. This genus is native to the Sarmatian fauna, but is not known from any of the adjoining basins. Alburnoides is a highly adaptable genus, as witnessed by its widespread occurrance in the internal basins of Iran, but it would require a major jump in its distribution for it to have become established in the Seistan District but not in any intervening faunas, particularily so since no other genus characteristic of the Sarmatian Leuciscinae has managed to reach the Seistan District.

The relationships of the Seistan District fauna suggest it has received contributions from more than one source (Table 55). The Schizothoracinae and Noemacheilus, which are shared with the Indus Basin and are representative of a montane fauna, probably entered through the headwaters from adjoining tributaries of the Indus River. The Barbinae, on the other hand, are most closely associated with the coastal drainages of Pakistan, and probably entered through the Mashkel Basin or tributaries further to the east.

Of the eight genera and nineteen families in the Helmand fauna, six genera and six species are found in the Indus fauna, and six genera and seven species in the coastal Pakistani fauna. Six species and one subspecies of fish are endemic. Three species are found also to the north and west; the Helmand evidently received contributions from adjoining basins to the north and west, or acted as a conduit for fish moving northward into the Northeast Basins and the Aral Sea. The Helmand Basin, as a whole, is poorly known, and would provide an interesting study area.

Enclosed Northeastern Basins District (Table 56)

Along the Iranian-Afghanistan border are a series of isolated enclosed basins. None is very large. All have a dry playa in the center. None has a perennial stream, although short sections of flowing water may be present below springs. All of the collections of fish I made were from qanats. These basins are bordered on the north by the Tedzhan and Murgab Rivers of the Aral Sea Basin, in the west by the Dashte-Kavir Basin, and in the south by the Helmand and Dashte-Lut Basins.

Four species of fish were collected, all in the order Cypriniformes. None of the species is endemic. Discognathus rossicus is shared with the Helmand, Dashte-Lut and Bampur Basins. Garra persica is a widespread species found also in the Khorasan fauna, Aral Sea Basin, Helmand Basin and the Dashte-Lut. Varicorhinus fuscus is shared only with the Dashte-Kavir Basin. The fourth species, Noemacheilus sargadensis turcmenicus, is a subspecies of a species found in the Aral Sea, Khorasan, Yazd and Kerman, Dashte-Lut and Bampur Basins. (Table 57)

As a rule, only one or two species was found in a single basin. While treated as a unit, it is possible the individual basins in the District had different associations. Those with V. fuscus were apparently more closely aligned to the Dashte-Kavir, while those with the other three species were more closely associated with the Dashte-Lut, Helmand and Aral basins. While the Varicorhinus is more similar to Sarmatian species, the other three show a stronger association with the Oriental fauna to the south.

TABLE 56. ENCLOSED NORTHEAST BASINS FISH FAUNA

SYSTEMATICS	STATUS	SHARED FAUNA GENUS	SPECIES	SSP
Order Cypriniformes				
Family Cyprinidae				
Subfamily Barbinae				
Discognathus rossicus	1	M,31,34	26,29,30,32	
Garra persica	1	M,S,31	23,26,30	
Varicorhinus fuscus	1	M,S,27,28 29,30,31	24,29	
Family Cobitidae				
Noemacheilus sargadensis turcmenicus	1	M,S,26,31 32,33,34,35	27,28,29,30	23

TABLE 57. FAUNAL ASSOCIATIONS

ENCLOSED NORTHEAST BASINS FISH FAUNA

SYSTEMATIC LEVEL	NORTHEAST FAUNA	HELMAND FAUNA	ARAL FAUNA	CASPIAN FAUNA	MESOPOTAMIAN FAUNA
Order	1	1	1	1	1
Family	2	2	2	2	2
Genus	4	3	4	2	4
Species	4	2	2	0	0
Subspecies	1	0	1	0	0

The species present and the relationships suggest more than one invasion occurred, with particular species colonizing a basin depending upon accessibility and the ability to adapt to the limited habitat available.

X. DISCUSSION

Most of the fish species in Iran are found in the basins of the Caspian, Tigris and Karun Rivers, the two basins containing the majority of available habitat in Iran. Because of precipitation patterns, the two basins receive the greatest precipitation and have the greatest run-off. In addition, the Karun and Tigris Rivers, and the Sefid Rud river in the Caspian Basin, are the longest and largest rivers in Iran. Both the Caspian and the Karun and Tigris Basins are associated with or have been associated with the seas and with other faunal areas and not isolated for extended periods by mountains or deserts, facilitating the exchange of species.

The over-riding factor in the distribution of freshwater fish in Iran has been climate. Most of Iran is arid, lacking in any perennial flowing water. Most of the lakes are highly saline. Little habitat is available for fish except in the Caspian and Karun and Tigris Basins. The habitat that is available is often warm, heavy with dissolved minerals and limited in size. In my collecting and traveling, I found that most of the fish in the internal basins south of the Elburz Mountains and east of the Zagros Mountains were in isolated springs and qanats. Due to the lack of water, springs were always developed for livestock, domestic or agricultural use. These springs and qanats are often isolated from one another or from any streams. Their flow is intercepted a short distance from where they appear and utilized in gardens, villages and fields. A few genera of fishes, most notably Varicorhinus but also including Noemacheilus, Cyprinion, Discognathus , Garra, and Schizothorax, showed an ability to adapt to living in the isolated qanats and springs. I discussed this interesting fauna in more detail at the 1975 National Meeting of the American Fisheries Society and a copy of the paper is included in Appendix I.

Access to the internal basins of Iran has been limited. As was discussed in the Geologic History Chapter, the basic internal basins have been present since at least the early Tertiary, well before any of the current fishes moved into Iran. As was discussed in the Climate Chapter, the internal basins were essentially arid in the Pliocene and Pleistocene when the basic Middle Eastern fish fauna was developing. Opportunities may have occurred for a much greater variety of fish to colonize the internal basins at the same time current species entered, but the aridity and lack of habitat would have prevented their establishment.

A number of authors (for an excellent review, see Por, 1975) have discussed the impact of aridity upon the flora and fauna in the Middle East. There is an extensive desert belt running in an arc from western Africa through Arabia, Syria, Iran and into the Rajasthan of India. There is a great similarity of plant and animal forms along this belt. Many plants and animals are represented along the entire arc. The determining distribution factor has been climate, not barriers.

The fish fauna shows a greater degree of differentiation along this arc than the plants or higher animals, but there is still a basic fish fauna occupying the arc. The fauna is characterized by the highly developed Barbinae subfamily of the family Cyprinidae, Noemacheilus, several siluroid families and mastacembelids, salt-tolerant cyprinodonts and cichlids, and the comparative abundance of marine species in accessible rivers. No species is found across the arc as is the case with some of the plants and higher animals, but common genera , subfamilies and families are widespread from Africa through the arc and into India. Migration patterns would have favored movement east and west along this arc. However, in India and Southeast Asia and in Central and Western Africa are much more highly diverse faunas than in the Middle East which would have had an opportunity to move into adjoining regions with existing colonizers but which were not adapted to living in the arid conditions.

The northern limit of the arc is the mountain massif running from the Taurus Mountains in Turkey through the Caucasus, Elburz, Hindu Kush, Himalayas and Tien Shen Mountains in China. This series of mountains provided a topographic barrier to precipitation from the north that contributed to creating arid conditions. It also acted to separate the fish fauna of the arid arc from the Palearctic faunas to the north. Good discussions of the differences in faunas were given by Hora (1938, 1954, 1955), Day (1876), Blanford (1901) and Stewart (1909). The northern fauna is characterized by the subfamily Leuciscinae of the family Cyprinidae, clupeids, sturgeons, salmonids and spiny-rayed fishes.

The mountain ranges have acted more as filters than barriers since some exchange of fish faunas has occurred. This exchange has been more common on the western end of the mountains in Turkey and Iraq where the barrier has been less complete. Gaps occurred in the mountains where the Tedzhan and Murgab Rivers pass through in eastern Iran and western Afghanistan; where the Sefid Rud River cuts through the Elburz Mountains in north-central Iran; in Azerbaijan of Iran, Turkey and the Soviet Union; and, in the past, through the Anatolian Highlands. The Himalayan Highlands fish fauna is aligned with the northern fauna. While tributaries of the Indus River and Brahmaputra River cut through the mountains, the steep, narrow, swift-flowing gorges have been fairly effective barriers to faunal exchanges.

Some faunal exchange has occurred. Three genera, Barbus, Varicorhinus, and Noemacheilus, are common in the arid arc, but are found also north of the mountains. Similarily, some Leuciscinae, such as Alburnus and Leuciscus have become established south of the mountains. As a rule the southern species show a greater capacity for colonization and have established a wider distribution than the northern species when faunal exchanges have occurred.

The Iranian fauna is generally a recent fauna. With the exception of the marine remnants in the Sarmatian Basin the fauna probably did not reach Iran until the major faunal movements of the Pliocene and Pleistocene. While Iran is often pictured as part of a major faunal exchange route between Africa and eastern Asia, conditions did not permit such exchanges until the Pliocene and Pleistocene.

It was while such exchanges were occurring in the Pliocene and Pleistocene that much of the Iranian fauna became established. With the exception of Cyprinion and a few isolated genera the Iranian fauna is not endemic, with all major groups, families and genera being added through colonization.

The majority of species in Iran belong to the Ostariophysian fishes, the major freshwater fish group. Darlington (1957) and others have placed the origin of this group in Southeast Asia, usually in the Yunnan Province of China. This theory has recently been questioned by a number of authors (Patterson, 1972, Gosline, 1975; see also the discussions by Novacek and Marshall, 1976, Gosline, 1973, Gery, 1969). who suggest the origins were in South America or Africa rather than in Southeast Asia.

The most primitive of the Ostariophysi are the characins and some of the siluroids. The characins and family Diplomystidae, the most primitive family of siluroids, are found in South America. Gosline (1975), in his discussion on the origins of the Ostariophysi based on feeding and skull developments, indicates that the siluroids and characins probably arose from a common ancestor. The characins, in turn, gave rise to the gymnotids and cyprinoids. The origins of the Ostariophysi, based on fossil records, probably was in the Cretaceous. By the end of the Cretaceous, exchanges between Africa and South America would not have been possible because of the widening split between the continental land masses as the Atlantic Ocean appeared. For the Ostariophysi to have arisen in Southeast Asia would require that they develop from the original ancestors, move across

Asia and Africa and still invade South America while sufficient connections persisted.

During much of the Cretaceous, the central and southwestern portions of Iran were covered by marine waters. The incipient Elburz Mountain Range, was present, but much of the rest of the Middle East was covered by oceans. This would have left a major marine barrier to the movement of early Ostariophyi from Southeast Asia to Africa in the Cretaceous when any migrations would have had to occur.

I suggest that the origins of the Ostariophysi were in the South American-African area in the Cretaceous. The siluroids and characins developed while the two land masses were connected. The development of the cyprinoids occurred subsequent to the separation of the two continental land masses. Subsequent migrations carried the Ostariophysi into Southeast Asia, but the migration route was to the north, and not through the Middle East where marine barriers persisted.

The earliest cyprinid fossils are not found in Southeast Asia but in Europe (See Novacek and Marshall, 1976; Patterson, 1972). These include Blicca (Paleocene), Chela-(Eocene), and Rutilus (Eocene). These all belonged to the subfamily Leuciscinae. In addition, the early cobitid fauna is found also in Europe (Novacek and Marsahll, 1976), Cobitis in the Miocene and Noemacheilus in the Oligocene. The siluroids, which arose in the Cretaceous, are present in the European deposits in the Eocene, the same timing as their appearance in North America (Patterson, 1972).

In contrast, the earliest reported cyprinid fossils in Asia were found in the Eocene, after reduction of the extensive volcanism. These fish, found in fossil deposits in India, could not have arrived from the east since the connection with Southeast Asia was blocked by marine waters, but had to arrive from the north. These fossils included ganoids, osteoglossids, anabantids and nandids in addition to cyprinids. The fauna did not survive; no freshwater fish fossils have been found in India in the Miocene deposits. The fossils that were present at the Oligocene/Lower Miocene juncture in the Trans Gangetic Region represented an admixture of European fossil freshwater fish forms. (See discussions in Hora, 1938, 1937, 1951, 1953, 1954, 1955; Menon, 1955 , and Fossil Fish Chapter.

Throughout most of the Tertiary, until the end of the Miocene, the direct migration route for freshwater fish from Africa through Southwestern Asia into the Orient was blocked by marine waters. The route of exchange, based on the presence of marine waters and the fossil records would appear to be through the north, through Europe and Siberia into the Oriental Region. I postulate that the origin of the cyprinoids occurred either in Africa, or possibly Europe, from a characin ancestor, migrating along the northern route eastward into the Oriental Region.

Once established in the Oriental Region, this fauna proliferated, radiating outward into adjoining areas. The passage directly into what is now India was blocked by marine waters of the much-larger Bay of Bengal. During the Oligocene, the orogeny that formed the Himalayan Mountains was well underway. This continued into the Miocene when the prinicpal uplift of the Asian Plateau occurred. This mountain chain, including the mountains of China, Iran, Afghanistan and Turkey as well as the Himalayas, separated the fish faunas to the north and south.

Once the marine barrier between India and Southeast Asia was removed in the Pliocene, extensive fish migrations occurred from east to west. In the Pleistocene, this was aided by the presence of a major river, the Indo-Brahm, that ran across northern India to empty into the Arabian Sea (See Geologic History Chapter for more detail). Until it later split into two separate river systems, the Indus and the Brahmaputra, this major river provided a major avenue for the movement of fishes from Southeast Asia across the present-day India and into Pakistan. The hill forms, such as Noemacheilus and Garra, had begun moving westward even earlier (Hora, 1951). Most of the fauna became concentrated along the route of the Indo-Brahm River. In the west, where no major river connections existed, migrations were slowed and a reduction in faunal diversity occurred. The abundant hill fauna in the Seistan Basin probably entered at this time.

A second migration of Ostariophysi was also occurring along the northern face of the Himalayan Mountains from the same Southeastern Asia radiation center. This fauna was less diverse, and was characterized by the abundant Schizothoracinae. This migration began later than the southern migration, occurring principally in the Pleistocene rather than the Pliocene. Unlike the migration south of the mountain massif, the northern fauna lacked a major migration route and did not progress as rapidly.

In addition, the northern migration encountered a well-entrenched ostariophysian fauna, the Leuciscinae, which had become widespread throughout the Holarctic but which was nearly absent from the Oriental Region. The Leuciscinae must have had a radiation center in the Eurasian Area, with a second subcenter in North America (See the discussions by Banarescu, 1969, 1971). This leuciscine fauna comprised the majority of cyprinoids north of the mountains, in contrast to the barbine fauna to the south. In addition, salmonids, clupeids and percoids were well-established in the northern fauna.

During the late Miocene, the Zagros and Mesopotamia were exposed from the sea. The Zagros Mountains underwent orogeny leading to the development of the current mountain massif. During the Pliocene, the connections between the Atlantic and the Indian Oceans were periodically connected and broken (see Geologic History Chapter). During this period, there were times when a migratory route for freshwater fishes was available between Africa and the Orient.

The Mesopotamian Plain was, initially, a large lake and marsh, receiving waters from the north, east and west. For part of the Pliocene and Pleistocene, the delta of the Tigris-Euphrates-Karun was much nearer the mouth of the Persian Gulf at the Straits of Hormuz. This extended freshwater river system existed concurrent with the Indo-Brahm River in northern India. Both were large rivers, and both emptied into the Arabian Sea. I postulate that the close proximity of these two large rivers permitted migrations of fishes both east and west, with the stronger movement to the west. During the same period, the drainages in the Syrian Damascan Depression and Galilean drainages would have favored movement of fish from the Mesopotamian and African faunas into the now-connecting faunas. The basic fauna of much of Iran was established at this time. Subsequent changes in drainages caused the separation of the Indus and Brahmaputra Rivers, while the subsidence along the Mekran Coast and the Persian Gulf moved the seaward extension of the Tigris-Euphrates-Karun back up the Gulf. It retreated to near its current location until the last major glacial advance in the Pleistocene, when the sea level dropped sufficiently that the Tigris-Euphrates-Karun delta moved about half way down the Persian Gulf. (See chapters on Geologic History and Climatic History; also papers by Hora and Menon, op.cit., and Kosswig, 1954, 1955; Steinitz, 1951, 1954).

The Oriental influences reached into the upper tributaries of the Tigris and Euphrates Rivers. During the late Pliocene and Pleistocene, uplift occurred in the Anatolian Plateau where these headwaters were located. The uplift, combined with desiccation and glacial formation, greatly reduced the fauna present. As a result of the glacial action to the north, many Palearctic forms were able to penetrate through the Caucasus and the Aegean Lakes and thence into the Anatolian Plateau. The series of glacial advances and retreats to the north acted like a pumping action to bring a series of invasions. This new fauna replaced part of the older Oriental fauna from the Tigris-Euphrates system. Subsequently, continued uplift of the Anatolian Plateau cut off this access route. (See Kosswig, 1954, 1955, 1969; Steinitz, 1951, 1954).

During the Pliocene and Pleistocene, colonization of the internal basins of Iran occurred. The Sefid Rud River provided an access into the basins of Azerbaijan and the Namak Basins. Immigrants into the Caspian Sea from the northern fauna were able to become established in the Caspian and its tributaries, while a few of the more aggressive genera moved up the Sefid Rud and into the internal basins. A similar, but less aggressive colonication occurred in the northeast, where the advancing Schizothoracinae reached their most westerly extension before connections between the northeastern and Aral Sea basins and the Caspian Sea were severed. The southern internal basins were colonized during the period of major faunal migrations of the Pliocene and Pleistocene, with access into the internal basins occurring through connections with the coastal rivers. The Seistan fauna was colonized from the upper Indus River rather than from coastal drainages, although some invasion, such as Cyprinion, probably occurred from the south. Retreat of the major rivers and continued orogeny severed the basin connections, isolating the internal basins.

As was discussed in the chapter on Climatic History, the internal basins of Iran were not ever much wetter than they are now. The principal basins were established in central Iran as early as the Cretaceous. The existing barriers would have restricted the access during the period of major faunal movements. Of the forms reaching the basins, only those adapted to the arid conditions were able to establish themselves in the internal basins.

Distribution of fish in Iran generally parallels what is known about the geological history. The Zagros area was separated from the rest of Iran by a major fault running from Turkey, then southeast between what is now the Isfahan and the Yazd-Kerman Basins and into the Mekran Coasts. The Namak and Dashte-Kavir Basins were north and east of the fault line, and were connected by rivers cutting through the Elburz Mountains with the Sarmatian Sea Basin. The basins of Azerbaijan and northwestern Iran drained into the Caspian Sea. The basins south of the Zagros fault line drained into the Karun or Tigris Rivers, or into the Persian Gulf and Gulf of Oman.The Seistan Basin, with past connections with the Indus River and coastal river, was intermediate in position. The two transitional basins, the Isfahan Basin and Kol Basin, were at the juncture between influences; the Isfahan, because of the location of the Zagros fault line, had access to the Mesopotamian and to the Sarmatian faunas. The Kol Basin, in the Pliocene and early Pleistocene, was influenced by the mouth of the Tigris-Euphrates-Karun and by the Indo-Brahm Rivers, but became isolated as both river deltas were withdrawn, developing a highly endemic fish fauna showing influences from both major rivers. The remainder of the basins retained a basic fish fauna reflecting the past associations with the major influences of the Sarmatian Sea Basin, Oriental fishes or Mesopotamian fishes.

Iran and adjacent areas have been occupied by man for at least 10,000 years. Because of the aridity, irrigation was initiated at least 5,000 years ago. As a result of the development of water supplies, and the prolonged occupation by man, the fish habitat has been greatly altered. Where once extensive forests and grasslands covered the Middle East, now denuded slopes are found in most areas. The amount and quality of fish habitat has decreased, with the pace quickening in recent years as populations have expanded. Lacking early fish information, it is impossible to know what changes have occurred in fish populations as a result of the alteration of the habitat, but it is certain to have happened. The current fish distribution, then, reflects not only the past invasions of fish and climatic influences, but the prolonged influence of man on the habitat as well.

XI. CONCLUSIONS

For purposes of this thesis 3 classes, 16 orders, 31 families, 104 genera, 367 species and 77 subspecies of fish from throughout the Middle East were considered. In addition to the freshwater fishes, 8 orders, 10 families, 14 genera and 33 species of marine fishes frequently reported from freshwater were included. Of these fish, 3 classes, 16 orders, 31 families, 90 genera, 269 species and 58 subspecies were collected by me or have been reported from Iran. In addition, 1 family, 7 genera, 9 species and 4 subspecies have been introduced. Over half the species and nearly half the genera are in the family Cyprinidae; over 75% of the genera and species are in the order Cypriniformes.

Analysis of the specimens I collected and information in the literature showed that three major faunal groups exist in Iran. The largest and most diverse fauna, the Sarmatian Fauna, is found in the Caspian Sea and the associated Azerbaijan, Lake Rezaiyeh, Khorasan, Isfahan and Dashte-Kavir Basins and in the four subbasins of the Namak Lake Basin. Of the fish found in Iran, 14 of 31 families, 48 of 90 genera, 127 of 269 species and 46 of 58 subspecies are found in the Sarmatian Fauna. This fauna contains marine relicts from the Sarmatian Sea and recent immigrants with strong relationships to the fishes of Europe, the Black Sea and northern Asia. The marine relicts are absent outside the Caspian and Aral Sea Basins. The fauna in the associated basins is best described as a depauperate extension of the

Caspian and Aral Sea faunas. Endemism is most pronounced at the subspecific level, a result of periodic connections between the Caspian, Black and Aral Seas, and the opportunity for invasion from the north. Of the 127 species, 47 are endemic to the Sarmatian Fauna of Iran, while 37 of the 46 subspecies are endemic. Much of the endemism is in the two major marine relict groups, the herrings and the gobies.

The second major fauna is the Mesopotamian Fauna, and includes the Tigris and Euphrates River Basins, the Karun River Basin, the Kol, Mond, Maharlu, Neyriz, and Lar Basins, The Mesopotamian Fauna is a transitional fauna, and does not readily belong in either the Palearctic or Oriental Region. Of the fauna in Iran, 11 or 31 families, 33 of 90 genera, 89 of 269 species and 11 of 58 subspecies are found in the Mesopotamian Fauna in Iran. Of these fish, 9 of the 11 families, but only 12 of 33 genera are shared with the Oriental Fauna. On the other hand, 16 genera out of 33, but only 5 of 11 families are shared with the Sarmatian Fauna. Only 9 genera, but 7 families, are found also in the Ethiopian Fauna. Endemism is high at the specific level; 37 of 89, or over 40%, of the species are endmic, while only 5 of 33 genera are endemic.

The third major fauna is the Oriental Fauna, which represents the western-most extension of the abundant and diverse fauna of Southeast Asia. It is found in the coastal Mekran drainages,and in the Bampur, Dashte-Lut, Kerman, Yazd, Seistan and Enclosed Northeastern Basins. The absence of any major rivers or lakes is reflected in the sparse fauna; only 9 of 31 families, 16 of 90 genera, 39 of 269 species and 3 of 58 subspecies found in Iran have been taken in the Oriental Fauna of Iran. Endemism is quite high; 22 of the 39 species are endemic to the area. All nine families are found further to the east in the Indo-S.E. Asia area, while eight of the nine are shared with the Mesopotamian Fauna. Of the 16 genera, 13 are found in the Indo-S.E. Asia area, 12 in the Mesopotamian Fauna, but only 4 in the Sarmatian. Twelve of the 39 species are found in the Indo-S.E. Asia Area, but only 3 in the Mesopotamian Fauna of Iran.

With the exception of the marine relicts in the Sarmatian Sea and marine fishes entering freshwater along the Persian Gulf and Gulf of Oman, the Iranian fish fauna developed during the major faunal migrations of the Pliocene and Pleistocene. Receding marine waters and the formation of major river systems in Mesopotamia and northern India facilitated an east-west fauna exchange along what is now the Persian Gulf and Mekran Coasts of Iran. At the same time, the pumping action of glacial advances and retreats in the north plus increased precipitation in the north facilitated southward movements of Palearctic fishes. While the mountain massif stretching from the Taurus Mountains in Turkey through Iran, Afghanistan, the Tibetan Plateau to the Tien Shan Mountains in China prevented wholesale exchanges of fauna from the Sarmatian area and regions to the south, some exchange did occur in northeastern Iran, by way of the Sefid Rud River of Iran, and the Anatolian Uplands of Turkey.

The present fish fauna in Iran is the result of colonizers able to establish themselves in the limited habitat in Iran. Species diversity and abundance are best developed in the Sefid Rud and Caspian Sea, and in the Tigris and Karun Rivers where habitat is greatest. In the internal basins, diversity and abundance are limited by lack of suitable habitat. In many areas, only springs or qanats are available for fish, requiring any species that would survive to be able to adapt to that restricted habitat.

Many parts of Iran have not been collected. Additional forms are certain to be found with additional collecting. The northeastern part of Iran, the headwaters of the Namak Basin streams, the western mountains of Azerbaijan, and the coastal drainages of the Persian Gulf and Gulf of Oman, in particular, are poorly known

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APPENDIX

APPENDIX I

QANAT FISHES OF IRAN

PAPER PRESENTED AT THE NATIONAL MEETING OF THE AMERICAN FISHERIES SOCIETY, LAS VEGAS, NEVADA, SEPTEMBER, 1975

Most of Iran is arid. While up to 60 inches of rain may fall along the western shore of the Caspian and lesser amounts elsewhere, along the Western and Northern tiers, the rainshadow effect of the Elburz and Zagros Mountains effectively prevent all but a few centimeters of rain a year from reaching the great interior basin. Along the nothern slopes of the Elburz and western drainages of the Zagros, sufficient rain and snow fall to maintain year-long rivers of sufficient volume to provide for industry, agriculture and domestic needs. Most of these rivers flow into the Caspian Sea, Lake Rezaiyeh or the Persian Gulf. Only four significant rivers are found in the internal basins, and all four disappear into the hot, salty playas so characteristic of the internal basins.

As a result of the shortage of surface water for any purpose in much of Iran, the Persians have developed over the last 3-5,000 years an underground water system called qanats. The principle of the qanat is quite simple; ground water, generally in the alluvial material at the base of a mountain range, is tapped by a deep well. Water is transported via an underground channel by means of gravity flow, emerging into a canal system that transports the water to where it is needed.

When a qanat is desired, a local resident with some success in selecting potential water sites is called in to determine where the initial test well should be dug. The well is dropped 150 to 300 feet on the average, although one well, near the town of Gonabad, is well over 1,000 feet deep. The well, dug by hand, is continued until at least one meter of water accumulates overnight. When it is determined, after measuring the flow for several days, that sufficient water is present, the rest of the complex system is outlined and constructed.

The outlet of the qanat is determined by the location and depth of the head well. In order to prevent the qanat from washing out, while at the same time providing enough of a gradient to maintain the flow, the gradient is generally set at a drop of one foot for every 500 to 1500 feet of horizontal flow. By rather crude methods, the actual position of the outlet is determined and the course of the qanat outlined. Wells are dug at 30 meter intervals, with the horizontal channel then dug from one well to another, working back up the slope towards the head well. All work is done by hand. Material dug out of the wells is placed in a ring around the well to provide protection against erosion or other possible damage to the qanats. If the danger is deemed serious, the wells are covered. Access must be maintained for repair and maintenance. Where the material through which the qanat is dug is not firm enough to support itself, nars, ceramic supports, are placed along the channel for support. The channel is generally three to five feet high, permitting access along the channel by foot.

Most qanats are 6-10 miles in length, with the range being 1 to 25 miles. If a single well does not produce enough water, or if a blockage decreases the efficiency of a channel, one or more side channels, each with its own head well, may be dug. The volume of water varies widely between qanats, and may even fluctuate seasonally in a given qanat. In one study, the flow in 200 qanats ranged from 0.25 to 72 gallons per second.

Once set into operation, the qanats cannot be shut off. All the water may be used during peak summer periods. While some water is used all year for livestock and domestic needs, water is often allowed to drain off in colder periods, usually into natural stream beds. Domestic use is reserved for the point where the water first emerges, where it is cleanest. In many areas holding ponds are used to impound water overnight for use during the following daylight period.

As an indication of how extensive this network is, in the mid-60's about 170,000 miles of channels in 22,000 qanats were in operation in Iran, providing a total flow of 19,500 cubic feet per second, equivalent to 75% of the flow the Euphrates River, and providing 75% of the domestic and agricultural needs of Iran. The construction of dams, canal systems, water pipelines and deep wells has reduced the dependence on qanats, but they still remain a vital part of the country's water system.

Many, and perhaps a majority, of qanats contain fish. None of these fish are restricted to the qanats, nor are all species able to live in qanats. Those that do show a number of adapations.

By and large the fish remain in the lower one to two miles of the qanat, concentrating in the lower one-half mile. They venture out several hundred yards but seldom more. They may remain out during the day if not molested by the villagers, but come out mainly at night if regularily disturbed. This movement is apparently due to a shortage of food in the qanats. Some food material falls down the wells while, especially in older qanats, resident invertebrates and small vertebrates can be established. It appears, however, that most of the food is obtained outside the qanat. This may be in the form of plant or animal life in the gardens near the qanat. In addition, humans provide a ready source of food in many areas. Since the domestic uses are restricted to near the mouth of the qanats, washing of dishes and foods leave a variety of food bits in the water near the mouth of the qanat. In a few instances where gardens and villages are located one to two kilometers outside the qanats, the fish have been found near the villages and gardens rather than at the mouth of the qanat, again suggesting that the fish do not rely on food material produced within the qanat.

So far not detailed studies have been made of the qanat fish behaviour. All appear to be broadcast spawners, or at least they place their eggs on or under gravel and rocks. Despite the realtive constancy of the water temperatures in any one qanat, there seems to be a general spawning period; fishes taken in late summer, fall and early winter were all devoid of mature products, suggesting spawning occurs in spring or early summer.

Some morphological variation was noted in the qanat fishes. Most marked was a trend toward smaller heads in the larger fishes. In the past this difference in head-body lengths led to the establishment of at least two species of Varicorhinus where only one is present, simply the result of changing proportions with aging. In some specimens, large black spots and blotches develop on the sides of the body, often becoming quite large; these show no apparent pattern within or between qanats.

In the qanats with fish, there is usually a single species, occasionally two, rarely three or four species, present. Multiple species is most common in large qanats close to major drainages. Most likely candidates for fish are qanats over 50 years old, located along a river or stream bed - nearly always dry, but occasionally with a trickle or with salty water - and with a flow over one cubic foot per second. Newer qanats were never found to have fish; these seems to be a minimum time, around 50 years from comments of residents, required for invasion to occur. Isolated qanats, and those located higher up the slopes, were less likely to have fish; the closer a qanat was to the playa floor the more likely to have fish. In qanats with less than one cubic foot per second flow, fish were generally found only where there was close proximity to a playa floor or a stream channel.

The pattern of fish distribution suggests the probable route of invasion into a qanat is via surface flow. While most of the qanats are in arid areas devoid of continuous surface flow, they are subjected to periodic short periods of intense precipitation and resultant flooding. Many of the basins have seasonal lakes which have at least a surface fringe of freshwater, so that some lateral movement of fish would occur. When floods do occur, they last for a limited time, but it is probably sufficient to permit fish to move from one location into a new qanat.

While invasion by other routes is possible it is not likely. Birds or other animals that might act as transport are not associated with the qanats. Human transport is unlikely, except in a few cases where they were introduced into garden canal systems. The villagers have little interest in the fish and make no use of them. There would be little reason to go through the trouble of transporting the fish across the desert.

Most of the fishes so far found in the qanats belong to the order Cypriniformes. The majority belong to the genera Cyprinion, Varicorhinus, Discognathus, Schizothorax and Garra, all in the family Cyprinidae. Some representatives of Noemacheilus, family Cobitidae, are also found. Cyprinodontiformes are represented by Gambusia, introduced from the United States, and Aphanius, a native species, in qanats closely associated with river channels.

Populations of these fish are found outside the qanats in springs and rivers, especially in mountains where there is permanent water. These waters also contain species not able to adapt to life in the qanats.

The tendency is for a single species to be found in the qanats in any given basin. In moving from one basin to another, the fish found in the qanats change, although some forms are found in adjoining basins. The arrangement of the fishes in the qanats is a good indication of general zoogeographical relationships. Using the qanat fishes as the principal indicator, three zoogeographical regions can be identified. The internal basins, which are less clear, are separated as a fourth region with connections to the other three. Within the three principal regions are found 11 areas and 16 watersheds.

I. Caspian Sea. Qanats are absent from the main basin and the west, but the fish are distinctive.

  A. Turkoman.

    1. Mashad Watershed. *Varicorhinus capoeta heratensis, Schizothorax pelzami.*

  B. East Persia

    1. Bidjestan Highlands. *Varicorhinus fuscus, Noemacheilus sargadensis.*

  C. Azerbaijan

    1. Lake Urmia

    2. Araxes River Basin

  D. Caspian Sea and littoral

II. Indian

  A. Seistan

    1. Helmand Basin. *Discognathus rossicus*

B. Indian

1. Jaz Murian. *Cyprinion microphthalmum*, *C. milesi*, *Garra persica*, *Noemacheilus kessleri*.
2. Gulf of Oman. *Aphanius dispar*, *Cyprinion milesi*, *Garra persica*.

III. Mesopotamia.

A. Shiraz

1. Persian Gulf, Mond to Karun River
2. Zagros Mountains

B. Median

1. Karun Watershed

IV. Central Basins. Relationships are with the other three basins.

A. Kavir

1. Damghan. *Schizothorax pelzami*
2. Great Kavir. *Varicorhinus* sp. nov.

B. Lut

1. Lut. *Varicorhinus* sp. nov.
2. Yazd. *Varicorhinus* sp. nov.

C. Isfahan

1. Isfahan. *Varicorhinus*, *Noemacheilus*
2. Qom. *Varicorhinus* sp.

Invasions into the Indian Region were along the Persian Gulf and through the Helmand Basin. The Caspian Sea fauna was formed by marine relicts and northern invaders. Mesopotamian fauna came from the north and east. Internal basins were colonized principally through the upper Karun, Sefid Rud, Aral drainages and from the east.

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