AQUACULTURE DEVELOPMENT IN SISTAN-BALUCHESTAN 2005 - 2008

Project financed by Italian Cooperation
Italian Ministry of Foreign Affairs

TECHNICAL REPORT

THE HAMUN LAKE

PRELIMINARY ANALYSIS

Executed by CIRSPE, Italy

ROME, OCTOBER 2006

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(General Directorate Development Cooperation)

UNDP
United Nation Development Programme

SHILAT
Iranian Fisheries Organisation

CIRSPE
Italian Research and Study Centre for the Fishery

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ZABOL/ZAHEDAN MARCH-JULY 2006

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THE HAMUN LAKE PRELIMINARY ANALYSIS

(Task 1)

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SHILAT-IRANIAN FISHERY ORGANISATION

AQUACULTURE DEVELOPMENT IN SISTAN BALUCHESTAN (2005 – 2008)

PROJECT EXECUTED BY CIRSPE – ITALY

Project brief description:

The objective of the project is to reduce poverty and social imbalance while raising the income level of the local populations and communities in the ***Province of Sistan-Baluchestan through the reinforcement and dissemination of aquaculture activities.*** The project's main target is to strengthen and expand aquaculture activities in two areas in the Sistan Baluchestan Province, in terms of production, technology, economic results, in order to increase the socio-economic level of target groups and the local communities involved. The project is expected to have significant impact on the living standards of target groups, as well as indirect socio-economic benefits for the local communities, and also generate a model for provincial level replication. The specific objectives, therefore, are: i) Identification of valid production strategies for aquaculture in Sistan-Baluchestan; ii) Identification of appropriate technologies for both the different contexts (fresh water and sea water); iii) The Expansion of the base production and the diversification of the product; iv) Institutional capacity building and professional growth on the part of the Shilat Iranian Fisheries Organisation. The project comprises 3 main components: technical assistance and supply of technology and equipment

FOREWORD

This document is the Technical Report on Preliminary analysis on Hamun Lake. This component is part of the Project Task 1, considering that SHILAT expressed the need to consider the Hamun Lake evolution.

The lake has been one of the most important wet zones in the middle East, protected on the base of the International Conference of Ramsar. Before the drought, the productivity of the Hamun lake system was unrivalled in South Central Asia, with an annual production of 3.500 mt of fish.
Apart from that, 1.7 millions of cattle, goats and sheep lived around the lake producing income for the people in the area and sustaining themselves, as well as supplying the majority of the protein requirements for the region.

A long dispute between Iran and Afghanistan is causing lack of water for the all system of Hamun lake and Helmand river for many years. The rivers are controlled in Afghanistan by a different dams, principally Garishk, Kajaki, Daula and Boghra dams, constructed in the 1940s with US assistance, deep inside Afghanistan. Under agreement between the two Countries (signed on 1973) Afghanistan agreed to let at least 26 cubic metre of water/sec. flow from the dams to Iran. But in 1999 the Taliban closed the dams completely and the lake dried.

On 2005 the two Governments signed a new agreement and a project technical mission carried out on the month of August 2005 controlled the presence of water, estimating a lake surface of about 400.000 ha (considering the two portion in Iran and Afghanistan).

SHILAT request to CIRSPE to consider this new situation and the exigency to connect the development of aquaculture and fishery to the management of the lake, but on July 2006 SHILAT informed CIRSPE that the dams in Afghanistan have been again closed.

Any way there is the need to analysed this situation to know the ecological and socio-economic impact to try to find and propose solution to the two parties.

Rome 1st October 2006

Roberto Ugolini
Project Manager

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ABSTRACT

In June 2003 the Italian Ministry of Foreign Affairs has approved to finance the project "Aquaculture Development in Sistan Baluchestan" (act n.49; 24/6/2003; N. aid 6945.01.3) and the United Nations Development Programme ("UNDP") has agreed to co-operate in its implementation. On 25th of February 2004 the Italian Ministry of Foreign Affairs and UNDP signed the contract that includes the three following components: technical assistance, training, and equipment.

The objective of the project is to increase the income level of the local populations and communities in the Province of Sistan-Baluchestan through the reinforcement and dissemination of aquaculture activities. SHILAT expressed the need to consider the Hamun Lake evolution. The lake has been one of the most important wet zones in the middle East, protected on the base of the International Conference of Ramsar. Before the drought, the productivity of the Hamun lake system was unrivalled in South Central Asia, with an annual production of 3.500 mt of fish. A long dispute between Iran and Afghanistan is causing lack of water for the all system of Hamun lake and Helmand river for many years.

Dams in Afghanistan are controlling the rivers (Garishk, Kajaki, Daula and Boghra dams). Under agreement between the two Countries (signed on 1973) Afghanistan agreed to let at least 26 cubic metre of water/sec. flow from the dams to Iran. But in 1999 the Taliban closed the dams completely and the lake dried. On 2005 the Governments signed a new agreement but from July 2006 SHILAT Hamun lake is dry, because the dams in Afghanistan have been again closed. This document is a preliminary analysis on Hamun Lake situation and evolution. In fact CIRSPE and SHILAT agreed that technical effort must be done to find solutions to the dispute between the parties and, at least, to know the socio-economic and ecological impact of the Lack of the lake in the area between Iran and Afghanistan.

1. INTRODUCTION

The origin of project "Aquaculture Development in Sistan Baluchestan" goes back to the 2000. They are connected to the effort of the Italian Government for reinforcing political and economical relations with the Islamic Republic of Iran, in consideration of the reciprocal interest in the exploitation of Iran's raw materials and for exporting Italian technology, industrial products and consumer goods.

Italy has always considered the importance of Iran in the context of Middle East such as crucial regional Country. The Italian Government has always planned developed projects and emergency initiatives with the purpose to develop the peace process in the Middle East area and, for this reason, is promoting development programmes, investing in local human resources in the area, supporting the civil society and economic productive processes.

In June 2000 the General Department of Development Cooperation of the Italian Ministry of Foreign Affairs and the Iranian Ministry of Foreign Affairs signed a "Meeting Memorandum" expressing the interest to finance cooperation activities in the Province of Sistan Baluchestan, the poorest in the Republic of Iran. The Province borders with Afghanistan and with Pakistan, having a strategic role for the central Government.
The topics relevant to the cooperation program were deeply studied during technical missions carried out by the General Department of Cooperation Development.

Finally the Project Proposal has been approved by the Italian Ministry of Foreign Affairs (act n.49; 24/6/2003; N. aid 6945.01.3), proposing to UNDP to participate to the project. The agreement has been signed on 24 February. The Ministry of Jihad Agriculture – SHILAT Iranian Fisheries Organisation has been designated as the implementing agency and CIRSPE (Italian Fisheries Research Centre-Rome) such as the contractor for providing technical assistance and training (total budget of 1.744.000 Euro), on the base of an agreement with SHILAT on February 2004.

UNDP has taken the duty to manage directly the budget related to the equipment, to be purchased on the base of identification by SHILAT.

The project begun on May 2005; the initial phases have been dedicated to context analysis to up to date the project activities according the SHILAT new exigency and needs.

The project's main target is to strengthen and expand aquaculture activities in the two areas in the Sistan Baluchestan Province, in terms of production, technology, economic results, in order to increase the socio-economic level of target groups and the local communities involved. The project is expected to have significant impact on the living standards of target groups, as well as indirect socio-economic benefits for the local communities, and also generate a model for provincial level replication.

This target can be achieved with the identification of valid appropriate production strategies and of technologies for both the different contexts (fresh water and sea water). Operating strategies must be connected to the market (species, sizes, period of sale, markets) in the 2 sectors of shrimp raising and fresh-waster aquaculture (at least 2 strategies per sector shall be drawn up). Technological packages shall be prepared for fish hatchery activities and shrimp rearing within the two different contexts (Zabol/Zahak and Chabahar/Gowater) (at least 2 packages per sector shall be prepared and tested).

Expansion of the production base and diversification of production will be evaluate and analysed with the aim to reduce the risks of business operations.

Finally, the reinforcement of the extension service must be reached with the undertaking of a clear-cut effort to disseminate the technologies prepared during the project activities, so a professional growth on the part of the Shilat/Fishing Department is also important and crucial for the consolidation of the sector in the Province.

The specific objectives can be remarked as follows.

i) Valid production strategies for aquaculture in Sistan-Baluchestan;
ii) Appropriate technologies for both fresh water and sea water;
iii) Expansion of the base production and the diversification of the product;
iv) SHILAT capacity building and professional growth.

The specific objectives/related activities descriptions are the following.

i) Operating strategies correlated to the market (species, sizes, period of sale, markets) in the 2 sectors of shrimp and fresh-waster aquaculture (at least 2 strategies per sector shall be drawn up).The productive pilot activities in Gowater (Chabahar) will test different strategies based on the stocking density, feeding and fertilisation, comparing the different results both from productive and economical point of view. Attention will be given to diseases that in other region of the world and also in Iran can affect the rearing, reducing the economical sustainability of this sector. In Zabol area the project will evaluate the technical and economical sustainability of different species, such as trout and carps, remarking the importance of the native species Schizosthorax zarudny From this point of view, a new component of the project is related to the lake Hamun evolution.

ii) Innovative technological packages

Technological packages shall be prepared for rearing within the two different contexts (Zabol and Chabahar) (at least 2 packages per sector shall be prepared and tested, for instance oxygenation system, stocking density, Schizothorax reproduction, pre-fattening etc.).

iii) Consolidation/diversification of the production

The aim is to reduce the risks of business operations

iv) Synergies between public (SHILAT)/private sectors

Improving the capacity of the public service, necessary for the new responsibilities and assignments tied to a great dissemination of operations, with the training of personnel, especially in management and technical activities. Reinforcement of the extension service, with the undertaking of a clear-cut effort to disseminate the technologies prepared during the project activities.

Specific initiatives (Internet, Newsletter, Consultation) are organised for donor visibility, both international and national, in part to contribute on bringing together supply and demand (technology and production).

- Internet web page: Project history, Technical and Financial documents and information, project news, technical contributions;
- Newsletter: project news, technical contributions;
- Stakeholder consultations; expert consultations for maximising project results and impacts, minimising the contrasts between the project actors/interests.
- Others: cd-rom, poster, fiery/events participations.

The beneficiaries of the project (who benefit in whatever way from the implementation of the project) are the followings:

a) target groups
the groups who will be directly positively affected by the project at the project purpose level. For instance the SHILAT staff (training and capacity building), the farmers of Gowater complex, the employed people.
b) final beneficiaries
Those who benefit from the project in the long term at the level of the society or sector at large, such as the shrimp private sector in Sistan Baluchestan and also in Iran: hatchery, farmers, processing plant, shrimp feeding firms, bank system.

Shilat/Fishery Directorate is one of the beneficiaries/stakeholder that, participating directly to project management, can achieve a high level of professionalism. Other private (hatcheries, feeding plants and processing plant), the Ministry of Agriculture and the Agricultural/Commercial Banks are also final beneficiaries of the project, considering the objective to develop and consolidate the private sector in the context of Province: sector development plan, import of technology, international market, and access to bank credit.

The project is set in 36 months and it will end on May 2008 on the basis of 3 technical phases:

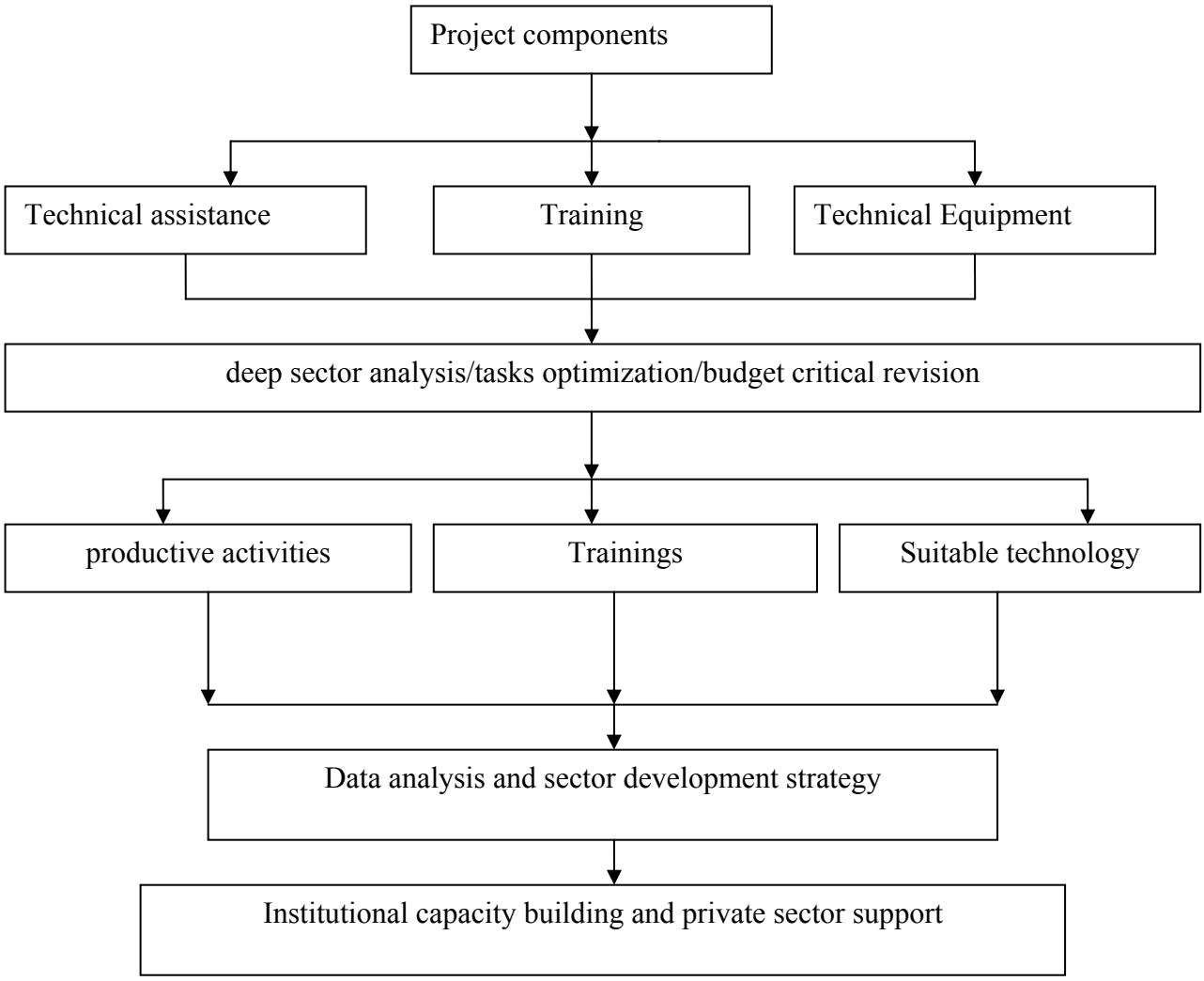
I) Planning (May 2005-November 2005)
Technical/logistic organisation; production activities planning; SHILAT/project new needs and exigency; financial plan revision.

II) Field Activities (December 2005-November 2007)
Pilot production experiences; private sector analysis; training; internet and newletters for project visibility; stakeholder consultations; periodic budget control and revision.

III) Sector Strategies (December 2007-May 2008)
Staheholder consultations; productive data analysis; economic data analysis; project impact; budget control.

The three technical phases are articulated in n. 6 operative phase, according to a project flexible management to update the project needs, considering the context evolution from technical, socio-economic, ecological and Institutional (SHILAT) point of view.

CIRSPE TECHNICAL APPROACH AND MANAGEMENT



CIRSPE and SHILAT have identified n.5 tasks, of which n.3 related to technical assistance, n1 for training and n.1 for project management.

Task 1. Freshwater sector

This task regards the Zahedan/Zabol area and the work is concentrated on Zahak freshwater hatchery. SHILAT has given the indication to concentrate the effort, first of all, on autochthonous/native species of Hamun lake *Schizothorax zarudny*. remarking the importance of methodology approach acquisition that can be very useful for SHILAT technicians. Apart from that on job training for 5 Iranian technicians has been implemented. The project could analyse other suitable species for aquaculture, for instance Indian carp, producing both at experimental and a productive level; CIRSPE proposed to carry out a study on the lake Hamun, considering its importance from a socio-economical point of view, related to the water/dam negotiation with Afghanistan. Task 1 is strictly connected with task 4 for the implementation of shrimp training two groups of Iranian technician participated to trainings in India. Stakeholder consultations are very important to maximize the benefits of the project.

Task 2 – Shrimp sector

The rearing activities have been planned for shrimp rearing (*Penaeus indicus*) in Gowater/Chabahar.
The target is to give technical assistance to the private sector in Gowater area for shrimp rearing to manage two rearing cycle and testing different stocking density. Shrimp PL have been purchase from 3 private hatcheries for this pilot productive activities and given by grant to some private company in Gowater on the basis of cooperation agreement to have the feedback of data and information. These will be used by CIRSPE to elaborate the proposal for the sector development strategy. Apart from that on job training for Iranian technicians has been implemented Task 2 is strictly connected with task 4 for the implementation of shrimp training (one group of Iranian technician on November 2006 will have training in Thailand). Stakeholder consultations are very important to maximise the benefits of the project

Task 3 - Study and development strategy
The technical and economic data connected to pilot productive experiences will be analysed for the elaboration of development sector strategies in Sistan Baluchestan Province. Stakeholder consultations are not only very important to maximise the benefits of the project, but also for strategies identification in order to prevent frictions and contrasts between different sector actors.

Task 4 - Training
Institutional support in terms of training for SHILAT technicians both in freshwater (India) and shrimp sector (Thailand). The project approach has identified SHILAT such as beneficiary/target group of the technical activities, and must be directly positively affected by the project at the project purpose level. The SHILAT staff is beneficiating of training, considering the role of the public sector in aquaculture development in the Islamic Republic of Iran: project development, credit and bank system, extension service.
Obviously, Shilat/Fishery Directorate is also one of the project stakeholder that, participating directly to project management, can achieve a high level of professionalism.

Task 5 - Project management
This task includes the project management and other activities such as visibility (internet and newsletter)and administrative/budget planning and control.

2. AN OVERVIEW OF IRAN

Known as Persia until 1935, Iran became an Islamic republic in 1979 after the ruling monarchy was overthrown and the shah was forced into exile. Iran is located at 32 00 N, 53 00 E, and his surface covers and area of 1.648 million km^2 (1.636 million km^2 of land and 12,000 km^2 of water).

The border countries are: Afghanistan (936 km), Armenia (35 km), Azerbaijan-proper (432 km), Azerbaijan-Naxcivan exclave (179 km), Iraq (1,458 km), Pakistan (909 km), Turkey (499 km) and Turkmenistan (992 km). Altitudes range from 28 m below sea level (shores of Caspian Sea) to 5,671 m (peak of Mount Kuh-e Damavand).

2.1. The Country

Temperature shows great variations over Iran with latitude and altitude, as well as with the seasons: it varies from 50°C in the South to -40°C in the North West. The annual rainfall ranges from 2000 mm in the North, to almost zero in the Lut Desert, with more than 80% of the country characterised by less than 250 mm annual rainfall. Precipitation falls in winter as snow on the mountains of the north and west, and the highest mountains remain snow-covered year round.

The plateau also receives snow but it does not last long and there is no snow along the Persian Gulf coast. Rain falls mainly in November to May with a mean annual of 416 mm. In contrast, rain is uncommon from May to October over most of Iran. The result of this pattern of rainfall is heavy runoff in spring with silt-laden floods and erosion a feature, so that many streams marked on maps are actually dry for much of the year. Insulation is continuous through summer days when clouds are a rarity over much of Iran and the weather remains settled for weeks at a time. Mountain ranges block off the interior of Iran and give extremely continental conditions.

The only exceptions are represented from the narrow littoral zones on the Caspian shore and the Persian Gulf. As consequence, Iran is considered a dry or semi-dry country, with an arid to semi-arid climate. Humidity is generally low because of the altitude, much of Iran being over 1000 m average height.

Seven zones of desert and depressions characterize the Iranian landscape: Dasht-e Kavir in the Central Iran, Dasht-e Lut desert, Sistan and Jazmurian depressions in the southeast, Khuzestan plain in tha southwest, Moghan steppe in the northwest and the Tutkman-Sahra steppe in the northeast.

Six main watershed areas are recognized within the country, but the central and the southern watershed in particular often are divided up into 21 by different authors. More than 20 larger lakes form part of the landscape of Iran.

Wind patterns are deflected by the Zagros and Alborz ranges in the west and north. Summer winds are mainly north and northwest over much of northern and central Iran and are hot, dry, and strong for long periods. The Alborz Mountains in the north block movement of moisture to the south while the Zagros Mountains in the west block moisture from that direction.

The southeast monsoon is almost completely dry before it reaches eastern Iran. In consequence the best watered parts of Iran lie on its northern and western fringes and the interior becomes drier from

west to east and north to south. Interior rivers exist in large part because of mountain ranges which store water as snow, in the case of the Hirmand River and the Sistan lakes, far removed from Iran.

The surface of Iran is sparsely vegetated, both naturally and through the agency of man. Three main climatic types could be detected on Iran: (1) warm, temperate and rainy with a dry summer (Caspian coastal area) ; (2) dry, hot desert (Central plateau) and (3) dry, hot steppe (rest of the country). The nature of the drainages of Iran is directly related to climate.

The 19 drainage basins of Iran, which delimitations are somewhat arbitrary and which nature is directly related to climate, are shown in the following table.

DRAINAGE BASIN	AREA (KM^2)	%
EXORHEIC BASINS		
Persian Gulf	335,864	
Hormozgan		
Makran		
Tigris River	39,702	
ENDORHEIC BASINS		
Bejestan	91,349	
Caspian Sea	193,161	
Dasht-e Kavir	200,747	
Dasht-e Lut	166,160	
Esfahan	97,802	
Hamun-e Mashkid		
Hamun-e Jaz Murian	75,193	
Kor River		
Lake Maharlu		
Lake Orumiyeh	54,747	
Namak Lake	92,332	
Sirjan		
Sistan	90,813	
Tedzhen River	43,496	
Yazd	105,291	

In effect, Iran is a mountainous country and much of it is desert. There are thousands of small springs and streams with no present or recent connection to other water bodies. It could possible to distinguish two types of basin: **exorheic**, that is basins in which the rivers and lakes drain to the sea; and **endorheic**, in which rivers drain to an internal basin such as a lake, or are lost in the desert, and have no connection with the sea. All the exorheic are located in the southern part of Iran. The bulk of the basins, both in number (15) and in area (about 78.1% of Iran), are endorheic. The average altitude of these plateau basins lie at 800 m. They alternates with mountains ridges at an average of 2000 m.

The salt lakes and flats of these basins are fed primarily by groundwater rather than rain and water is lost by evaporation. These are not evidence of marine invasions but of the increasing salinity derived from the mineral content of rainwater. As the water evaporates it leaves behind the minerals and over ten thousand years or less a saline environment develops.

The general data of water resources (since 200-) are provided by AQUASTAT, and showed in the table. Prior to the Islamic Revolution 13 dams had been built in Iran but the five-year development plan (1990-1995) designed 110 dams of which 22 were under construction in 1993. The total domestic, industrial and agricultural water abstraction was estimated at 70 km^3 in 1993, 51% of the renewable water resources. Annual abstraction from aquifers (57 km^3) is more than the estimated safe yield of 46 km^3. An additional 39 km^3 is used annually, 20 km^3 for electricity production, 11 km^3 for flood control and 2 km^3 for control and thence environmental protection of downstream parts of rivers, the remainder being surplus.

The increasing demands will have serious effects on the water supply and hence the fish fauna. Nikravesh (1997) estimates, based on water consumption and population growth, that Iran will be added to the U.N. list of countries facing water shortages in the year 2025.

Internal Renewable Water Resources (IRWR),1977-2001, in km^3	
Surface water produced internally	97
Groundwater recharge	49
Overlap (shared by groundwater and surface water)	18
Total internal renewable water resources (surface water + groundwater – overlap)	129
Per capita IRWR, 2001 (m^3)	1,775
Natural Renewable Water Resources (includes flows from other countries)	
Total, 1977-2001 (km^3)	138
Per capita, 2002 (m^3 per person)	1,900
Annual river flows:	
From other countries (km^3)	×
To other countries (km^3)	56
Water Withdrawals	
Year of withdrawal data	1993
Total withdrawals (km^3)	70.0
Withdrawals per capita (m^3)	1,122
Withdrawals as a percentage of actual renewable water resources	59.1%
Withdrawals by sector (as a percent of total)	
Agriculture	92%
Industry	2%
Domestic	6%
Desalination (various years)	
Desalinated water production (million m^3)	3

2.2. The Sistan region

The Sistan va Baluchestan (= Seistan) basin is located at the Iran-Afghanistan border and is a north-west to south-east oval in shape. The province comprises of two sectors, 'Sistan' in the north and 'Baluchestan' in the south, globally covering an area of 178,431 km^2. The major townships of this province are Iran Shahr, Chabahar, Khash, Zabol, Saravan, Nik Shahr and Zahedan, that is the

center of this province. In the east it has common borders with Pakistan and Afghanistan. In the south is the Oman, to the north and northwest is Khorassan province and to the west stand Kerman and Hormozgan provinces. In the year 1996, the province had a population of approximately 723,000, of which 46.1 % resided in the urban areas, 52.8 % in the rural areas and the rest accounted as non-residents.

Sistan Va Baluchestan province is one of the driest regions of Iran, showing an increase in rainfall from east to west, and an obvious rise in humidity in the coastal regions. The most prominent climatological phenomenon of the region being the heat: this province experiences long, hot summers and short winters, the coldest city being Zahedan and the warmest Iran Shahr.

The province is also subject to seasonal winds from different directions, the most important of which are, the 120-day wind of Sistan known as Levar, the Qousse wind, the seventh (Gavkosh) wind, the Nambi or south wind, the Hooshak wind, the humid and seasonal winds of the Indian Ocean, the North or (Gurich) wind and the western (Gard) wind. Its most obvious feature is the vast *hamun* or swamp comprising open freshwater lakes, reed beds or *neizar*, and the rivers that feed the lakes.

The Sistan basin includes a complex and unique wetlands system consisting of three large shallow lakes (Hamun-i Puzak, Hamun-i Saberi and Hamun-i Helmand) and a series of smaller lakes and marshes with extensive reed-beds. The lowest point in the basin, and hence the ultimate destination for waters, is the saline Godzareh depression in Afghanistan. The basin constitutes an excellent example of large, permanent, freshwater wetlands within an extremely arid desert region.

The wetlands provide a habitat for diverse and globally significant fauna and flora. They are also vital for sustaining the local economy and for regulating the regional micro-climate. They are also an integral part of the region's unique social and cultural structure. The principal river is the Helmand (or Hirmand) which flows from the Paghman Mountains just west of Kabul to end in Sistan after a journey of 1400 km. Along with the Hari or Tedzhen, this is the only major river entering Iran.

The Helmand is the most important river between the Tigris and the Indus and drains an area of 386,000 sq km of which 78,000 sq km or 20.2% lies in Iran (Gleick, 1993). Other minor rivers in the area are Farah Rud, Har Rud and Khash from Afghanistan and Bandan and Shur from Iran emptying into Hirmand. A number of minor streams, flowing from the west and the Birjand highlands, are present, but these are rapidly absorbed or run for only a few days each year.

3. THE HAMUN LAKE

3.1. The Helmand river

There is a vastly extended network of rivers in Iran most of which seasonally are filled with water. Some permanent rivers run from the Alborz or the Zagros to the Caspian Sea, Persian Gulf and Oman Sea. Some temporary rivers either run into a body of water or get dried before reaching any watershed. Here are the watersheds of Iran and the rivers emptying in to each of them.

The Helmand/Hirmand is one of Afghanistan's most important rivers, providing vital irrigation and water for millions within Afghanistan and Iran alike. The river rises in the central Hindu Kush mountains, and flows 1,188 km in a southwesterly direction, finally emptying into a series of landlocked lakes and marshy lagoons straddling the Iranian Afghan border. Along his course, it passes across more than half the length of Afghanistan before flowing northward for a short distance through Iranian territory. This river has several tributaries, including the Arghandab and Tarnak, and draining more than 160,000 km^2.

The Helmand produces 1700-2000 m^3/s in flood and 56 m^3/s in the dry season. The average annual flow is 78 m^3/s per second. The river varies between 200 and 900 m in width and between 2 and 5 m in depth. The annual water income to Iran is about 6 billion m^3/s but this varies markedly and was 14,740 million m^3/s in 1970-1971 and 1976-1977 and 600 m^3/s in 1985-1986 (Mansoori, 1994). UNEP (2003) gives the flows showed in the following table.

Years	1991-2	1992-3	1993-4	1994-5	1995-6	1996-7	1997-8	1998-9	1999-2000	2000-1
million of m^3/s.	2211.7	1783.8	529.5	829.7	1023.8	908.7	2193	258.8	114.1	48

The majority of water flowing in the Helmand originates as precipitation in the upper reaches - falling mostly as winter snow. Hence the level of the river rises with the onset of snowmelt, from spring onwards, and peaks in early summer. Apart from these upper reaches, the river catchment area is semi-arid, arid or very arid. A series of diversion and storage schemes have been constructed on the Helmand river, mostly in the 20th century.

The large schemes include the Kajaki dam constructed in 1952 (1.7 billion m□), Arghandab (or Dahla) Dam (479 million m□) and the Helmand Irrigation (irrigating 99,400 hectares). When constructed, the principal objectives of these schemes were flood control, irrigation, and hydro-power. In addition to these large schemes, many small-scale schemes exist at all points in the river basin (except the upper reaches). These include: irrigation from natural springs; karez (man-made underground canals) for collecting/distributing ground-water; small and deep-wells, both hand and motor driven; up to 60 mobile pumping stations; and small diversions from main rivers or main irrigation canals to household or village irrigation plots. Almost all irrigated agriculture takes place close to the main river course in the river valley.

Other rivers flowing into the Sistan Basin include the Farah, the Harut, the Gulistan, the Khash and the Kajrud3. The drainage areas and flows of these rivers are shown in the following table. These

rivers lie to the north-west of the Helmand. As with the Helmand, all these rivers originate in mountainous central Afghanistan and hence they have a similar seasonal distribution of flows as the Helmand. They also experience similar levels of withdrawals in their middle reaches, although there is no information on large-scale formal diversion or storage schemes.

River	Mean Potential Annual Flow (million m^3)	Drainage Area in km^2
Helmand	7,500	166,000
Farah	1,250	27,800
Harut	210	23,800
Gulistan	40	9,100
Khash	170	10,500
Kajrud	60	20,800
Totals	**9,230**	**258,000**

As it enters the Sistan depression, the Helmand splits into several branches which feed the swamps, the two main ones being the Sistan feeding the Hamun-e Helmand (also Hirmand or Hamun Lake) in Iran and the Parian feeding the Hamun-e Puzak (or Parian) lying mostly in Afghanistan.

The northern part of the Hamun-e Helmand is called Hamun-e Sabari, or Lake Sistan, which lies half in Afghanistan and half in Iran, and the southern part is called Hamun-e Hirmand. Hamun-e Sabari receives water from the Farah River and overflow from Hamun-e Puzak. The Hamun-e Hirmand receives water from the southern or Sistan branch of the Helmand River and overflow from Hamun-e Sabari.

Other rivers flowing from Afghanistan are the Harut, Khospas and Khash but their flow is minor and intermittent compared to the Helmand. The whole lake area of Sistan is often called the Hamun Lake.

3.2. The lake

An ancient seat of civilization, Sistan lies in a large depression divided between Afghanistan and Iran. In the centre of this closed basin lies a historic riverine oasis nourished by the Helmand, one of Afghanistan's major rivers rising in the western Hindu Kush. Remarkably, although the river empties in an extremely arid evaporation pan, it sustains a vast and predominantly freshwater wetland complex, the Hamoun.

Reaching their greatest extent with spring floods, these wetlands cover an area ranging from 2,000-4,000 km^2. Only %40 of this large watershed is in Iran and the rest is in Afghanistan. It consists of several fresh water lakes that are a series of pits with no specific borders. The most well known lakes in this region (following the Ramsar denomination) are “Hamun-e-Helmand”, “Hamun-e-Sabery” and “Hamun-e-Puzak”. The Hamun complex is one of the most important freshwater lake in the Sistan region.

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Name of water body	Total arae (km^2)	water body area (km^2)

North Hamoon Hirmand	194	74
South Hamoon Hirmand	184	104
Hamoon Saberi (IRAN)	366	181
Hamoon Saberi (Afghanistan)	475	-
Hamoon Pouzak (Afghanistan)	394	114
Hamoon Chounag Khargoushi	15	16
Chah nimeh Lake	50	-

The wetlands harbour over 100 species of birds and are an extremely important haven for hundreds of thousands of migratory waterfowl, notably ducks, flamingos, herons, pelicans and shorebirds. More than a third of the Iranian part has been designated as an internationally protected area under the Ramsar Convention on Wetlands, but no land has been set aside for conservation in the Afghani portion.

Rainfall variability in the Hindu Kush means that flooding in the Helmand alternates with droughts, which may cause entire lagoons to dry up. This occurred several times in the past century, when only the uppermost of the lakes remained flooded. Reflecting a dramatic decrease in precipitation, Landsat satellite imagery showed the snow-covered area in the Helmand basin to have decreased by almost two-thirds, from 41,000 km^2 in 1998 to 26,000 km^2 in 2000. By 2001, Iran and Afghanistan were experiencing for the third consecutive year an extreme drought that was so severe that the Hamoun dried out completely.

3.2.1. Hydrology

The Sistan Basin is a very arid region with rainfall below 50mm/year and potential evaporation rates over 4,000mm per year. It consists of three freshwater, inland, permanent lakes; the deltas of several major permanent rivers feeding into the lakes, and; the wetlands and land between and immediately surrounding the lakes. Of the three lakes, Hamun-e-Puzak lies mostly in Afghanistan, Hamun-e-Saberi lies on both sides of the border, and Hamun-e-Helmand lies in Iran.

The lake bottom in Iran is clay and silt and the waters are markedly alkaline. Water at the edges of the reed swamp were 31°C in early May, warmer than the inflowing rivers and the irrigation ditches which were only 22°C at this time. Sistan water are characterized by marked variations in conductivity, temperature, Ph, oxygen, alkalinity and hardness between sites. Conductivity ranges from 1280 to 64,000 mmhos (sic), pH from 7.5 to 9.15, oxygen from 0.64 to 11 mg/l, alkalinity from 3.6 to 165 mval and hardness (CaCO3) 180 to 3500 mg/l in Mansoori's water samples from the Hamun Lake.

Evaporation lowers the water level each year and is caused by extreme heat and the famous Bad-e Sad-o Bist Ruz (Wind of 120 Days) which approaches 200 km per hour. This wind causes serious erosion and marching sand dunes often block streams causing them to change channel. Evaporation has been measured at 4 m per year because of temperatures over 40°C in July. Refilling occurs in February-June and in flood years various hamuns are joined together into one vast lake. 75% of flooding occurs in March-May. There are about 3900 km^2 of seasonal lake and marsh at a maximum, dropping to 1930 km^2 in July-January. The maximum flood zone is about 200 km long and 20 km wide, but the lakes have dried up completely, or almost so, at least 5 times in the past

100 years, e.g. in 1907, 1962 for 5 years, 1970-1971, 1984 for 4 years, 1988-1989, and 1998-2002, with major fish kills resulting There was a big flood in March 1989, spring 1990 and an exceptional flood in February/March 1991 (Khan et al., 1992). The lakes filled in 2005.

Under normal circumstances, the three lakes cover approximately 216,000 hectares (Puzak is 50,000 hectares, Saberi approximately 101,000ha and Helmand 65,000ha). The lakes are very shallow (on average 2-3 m deep) and, as they lie in a flat area, their surface area varies greatly as a function of the incoming water. During great floods the three may join up to become one vast lake4. The main lakes are surrounded by permanent and seasonal wetlands, including vast and rich marshes, reedbeds and salt marshes.

In general water flows through rivers and underground canals from H. Puzak to H. Saberi to H. Helmand. In addition, H. Saberi receives water directly from the Farah river, and H. Helmand receives water directly from the Sistan branch of the Helmand River. Excess water flows from H. Saberi through a seasonal river to the Godzareh depression in Afghanistan. This depression is thought to be highly saline.

3.2.2. Environment

The open lake areas are fringed by reed beds comprised of *Typha*, *Phragmites* and *Scirpus* which are concentrated at the ends of the detrital cones of the river deltas. Usually the reeds recover after drought but in 1991 this did not happen (probably the effects of introduced Ctenopharyngodon idella on the young shoots since fenced areas excluding fish show successful reed growth).

The Hamun-e-Puzak lake is very shallow, with maximum depth of less than 4 m, and is the first of the Sistan lakes to flood and may never dry out completely unlike the other lakes. This lake has extensive reed beds of *Phragmites australis* with associated submerged *Ceratophyllum demersum* and relatively little open water. Reeds are cut as forage for cattle, burnt to improve grazing for livestock, used for boats, for wind-breaks and for cooking and heating.

The Sistan Basin is a unique example of a complex wetland ecosystem within a desert area. The wetlands play a substantial hydrological and ecological role in the natural functioning of a major river. The wetlands are also an extremely important staging and wintering area for migratory waterfowl, as well as an important breeding area for many waterbirds, and are home to a large diversity of mammals, aquatic species and flora.

Due to low precipitation, the wetlands were largely dry during the period 1998-2002. However, in the lower reaches of the river courses, the rivers continued to flow seasonally, and small springs swell and run permanently over short distances. Even in times of intense drought, these areas provide healthy examples of the natural ecosystem, as well as genebanks for the region. Biodiversity in the Sistan Basin Water diversions in Iran implemented during the 20th century have contributed to the degradation of H. Saberi and H. Helmand.

They have lost much of their original characteristics. However, H. Puzak has retained much of its original qualities, and it is representative of how the entire Sistan basin would have been in past times. The richest parts of H. Puzak lie in Afghanistan, for which unfortunately there are very few reliable recent records. Bird Life International (1994) lists 8 globally threatened winter visitors in the Sistan Basin, including *Pelecanus crispus*, *Oxyura leucocephala*, and *Aquila heliaca*. Breeding

species previously recorded in the area include: *Phoenicopterus ruber*, *Anser anser*, *Cygnus olor*, *Netta rufina*, *Picus squamatus flavirostris*, and *Caprimulgus mahrattensis*.

For example, in total, Bird Life International (1994) list 20 wintering and breeding bird species for which over 1% of the global population has been recorded in the Basin. In terms of wintering birds, in 1976 over 500,000 wildfowl were counted on Hamun-i Puzak alone, in what was considered to be a very poor year. Information on aquatic species in the Basin is limited, although it is thought to host a unique and rich diversity. The dominant flora species in the area are *Phragmites australis*, *Typha sp.*, *Carex sp.*, and *Tamarix sp.* The vast *Phragmites* reedbeds are considered particularly unique.

The mammals recorded in the Sistan basin, include the wolf (*Canis lupus*), golden jackal (*Canis aureus*), red fox (*Vulpes vulpes*), striped hyaena (*Hyaena hyaena*), wild boar (*Sus scrofa*), caracal (*Lynx caracal*), goitered gazelle (*Gazella subgutturosa*), and jebeer gazelle (*G. dorcas fuscifrons*).

3.2.3. The Ramsar Convention for Hamun lake

The Ramsar Convention on Wetlands was adopted over twenty years ago as the first of the modern global nature conservation conventions. The period when the treaty was being developed was a time of greatly increased environmental awareness. Looking back, we can see that the Convention was able to break important new ground in global efforts for nature conservation and sustainable development.

Indeed, much of the philosophy behind the Ramsar Convention, including the need for a network of protected areas and the wise use principle for the management of wetlands, has since been adopted in other international arrangements and in national law. Over the years following its adoption, there have been tremendous changes in the Convention. A protocol was adopted in 1982, followed by amendments in 1987.

Presently there are some 75 member States to the Convention throughout the world which have designated almost 600 wetland sites onto the Ramsar List of Wetlands of International Importance. The Convention has a vibrant programme, a well-endowed budget and a sizeable permanent secretariat, the Ramsar Bureau, which serves to assist in the day-to-day operation of the treaty. [Mid-1997 figures are 103 member States and 891 Ramsar sites.]

The Convention defines wise use of wetlands as "*their sustainable utilization for the benefit of human kind in a way compatible with the maintenance of the natural properties of the ecosystem" and sustainable utilization as "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations*". Under the Convention "wetlands" are defined by Articles 1.1 and 2.1 as shown below:

> **Article 1.1:** "*For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.*"

Article 2.1 provides that wetlands: "*may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands*".

In this way, several areas of Iran are considered of interest, and then included in the RAMSAR list. The Convention on Wetlands came into force for the Islamic Republic of Iran on 21 December 1975. The Islamic Republic of Iran presently has 22 sites designated as Wetlands of International Importance, with a surface area of 1,481,147 hectares. The complete list is presented in the following table.

SITE	DATE OF DESIGNATION	REGION	SURFACE AREA	COORDINATES
Alagol, Ulmagol & Ajigol Lakes	23/06/75	Mazandaran	1,400 ha	37º21'N 054º35'E
Amirkelayeh Lake	23/06/75	Gilan	1,230 ha	37º17'N 050º12'E
Anzali Mordab (Talab) complex	23/06/75	Gilan	15,000 ha	37º25'N 049º28'E
Bandar Kiashahr Lagoon & mouth of Sefid Rud	23/06/75	Gilan	500 ha	37º25'N 049º29'E
Deltas of Rud-e-Gaz & Rud-e-Hara	23/06/75	Bandar-e Abbas	15,000 ha	26º40'N 057º20'E
Deltas of Rud-e-Shur, Rud-e-Shirin & Rud-e-Mindab	23/06/75	Bandar-e Abbas	45,000 ha	27º05'N 056º45'E
Fereydoon Kenar, Ezbaran & Sorkh Ruds Ab-Bandans	28/03/03	Mazandaran	5,427 ha	36°40'N, 52°33'E
Gavkhouni Lake & marshes of the lower Zaindeh Rud	23/06/75	Isfahan	43,000 ha	32º20'N 052º47'E
Gomishan Lagoon	05/11/01	Golestan	17,700 ha	37°11'N 053°57'E
Govater Bay and Hur-e-Bahu	01/11/99	Baluchestan	75,000 ha	25º10'N 061º30'E
Hamun-e-Puzak, south end	23/06/75	Sistan & Baluchestan	10,000 ha	31º20'N 061º45'E
Hamun-e-Saberi & Hamun-e-Helmand	23/06/75	Sistan & Baluchestan	50,000 ha	31º20'N 061º20'E
Khuran Straits	23/06/75	Bandar-e Abbas	100,000 ha	26º45'N 055º40'E
Lake Gori	23/06/75	Azarbayjan-e Sharqi	120 ha	37º55'N 046º42'E
Lake Kobi.;;;	23/06/75	Azarbayjan-e Gharbi	1,200 ha	36º57'N 045º30'E
Lake Parishan & Dasht-e-Arjan	23/06/75	Fars	6,200 ha	29º30'N 052º00'E
Lake Urmia [or Orumiyeh]	23/06/75	Azarbayjan-e Gharbi	483,000 ha	37º30'N 045º30'E
Miankaleh Peninsula, Gorgan Bay & Lapoo-Zaghmarz Ab-bandan	23/06/75	Mazandaran	100,000 ha	36º50'N 053º17'E
Neyriz Lakes & Kamjan Marshes	23/06/75	Fars	108,000 ha	29º40'N 053º30'E
Shadegan Marshes & mudflats of Khor-al Amaya & Khor Musa	23/06/75	Khuzestan	400,000 ha	30º30'N 048º45'E
Sheedvar Island	29/12/99	Hormozgan Province	870 ha	26°48'N, 053°24'E
Shurgol, Yadegarlu & Dorgeh Sangi Lakes	23/06/75	Azarbayjan-e Gharbi	2,500 ha	37º00'N 045º30'E

In particular, the Hamun area are described as follow:

Hamun-e-Puzak: The Iranian portion of the vast Hamun-e-Puzak wetland, the majority of which lies in Afghanistan, consists of a complex of shallow freshwater lakes with rich submergent vegetation and extensive reedbeds. An important area for wintering waterbirds. Substantial declines

in bird numbers may have occurred due to widespread drought and vegetation degradation in the Sistan Basin. Human activities include livestock grazing and agricultural irrigation. Placed on the Montreux Record in 1990 because of the possibility that water inflow could be reduced by the construction of a dam on the Helmand River in Afghanistan. Subject of a Ramsar Advisory Mission in 1992. Ramsar site no. 44;

Hamun-e-Saberi & Hamun-e-Helmand: Protected Area. Bordering Afghanistan and forming a single wetland complex with Hamun-e-Puzak, it is located in a closed drainage basin and consists of two shallow, predominantly freshwater lakes and associated wetlands. The area is important for wintering waterbirds. Bird populations may have declined due to drought and river control structures (dams). There is increasing pressure from urbanization and agricultural irrigation. Listed on the Montreux Record in 1990 because wetland water levels were critically affected by drought problems due to dam construction and water diversion schemes on the Helmand River in Afghanistan. Subject of a Ramsar Advisory Mission in 1992. Ramsar site no. 42.

The 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands, held in Spain on 18-26 November 2002, adopted a new Strategic Plan for the application of the Convention during the period 2003-2008. It builds upon the first Ramsar Strategic Plan, which covered the period 1997-2002.

This second Strategic Plan recognizes the adoption by the Convention of a broader approach to wetland conservation and sustainable use in achieving full application of the wise use principle and safeguarding wetland resources. It takes into consideration the results of the 2002 World Summit on Sustainable Development, as well as those of recent major events concerning water resources management.

The Plan provides a renewed challenge for all those with responsibilities for, or commitments to, the delivery of the Convention - Contracting Parties; the Convention's bodies, including the Standing Committee, the Scientific and Technical Review Panel, the Ramsar Bureau (the Convention's secretariat), and the Mediterranean Wetlands Committee (MedWet/Com); the International Organization Partners; and a range of other bodies and organizations with which the Convention works, including in particular the other multilateral environmental agreements (MEAs). Full implementation of the Plan will need effective synergies with other MEAs and increased involvement of non-governmental, civil society, and community-based organizations, foundations and other conservation institutes, national science academies and research councils, research and educational institutions, and national professional scientific and technical societies, as well as significantly increased private sector involvement.

4. THE WATER CONFLICT IRAN-AFGHANISTAN

The Hamun lake region is one of the most critical social and environmental emergencies in post-Taliban Afghanistan. Largely unknown by the international community, this man made disaster with acute political and social implications, has now hit crisis level, impacting on the lives of hundreds of thousands of people in Iran and Afghanistan.

Once covering an area of four thousand square kilometres - or almost double the size of Luxembourg - the Hamun lake region, a series of three interconnected lakes in southeastern Iran and southwestern Afghanistan, is now a wasteland. No water has reached the lower river basin in Sistan for three years now and the destruction of the environment is almost complete. Agricultural lands have been devastated by desertification, while whole villages have been deserted and populations displaced as pressure on local resources intensifies. But a long dispute between Kabul and Tehran has centred on Iran's claim to a portion of the Helmand's waters.

The Helmand river's flow is controlled by a number of regulatory structures, principally the Garishk, Kajaki, Daula and Boghra dams, constructed in the 1940s with US assistance, deep inside Afghanistan. Under an agreement between the two countries signed in 1973, Afghanistan is obliged to let at least 26 cubic metres of water per second flow from the dams into Iran. The trans-boundary waters of the Helmand River are subject to a bilateral agreement signed by Afghanistan and Iran in 1973. Given instability in Afghanistan since the signing of the agreement, it has not been possible to fully implement this agreement. Recent moves towards stability in Afghanistan pave the way for improved implementation and regular cooperation between the two countries.

However, given demographic, economic, political and climatic changes since 1973, it may be necessary to review and revise the 1973 agreement. Since the establishment of the Afghanistan Transitional Administration (ATA) in May 2002, there has been a series of mid and high-level bilateral talks on trans-boundary waters. For example, the Helmand River and Sistan Basin were on the agenda at a Presidential summit in Kabul on the 13th August 2002.

This demonstrates the high priority given to regional cooperation on this issue by the two governments. A direct result of these talks was the one-off release by the Afghan authorities of significant waters from Kajaki reservoir into the Helmand River in October 2002. Throughout the second half of the past century, the amount of water flowing into the Sistan basin has been declining. Over the past five years, a combination of low precipitation, unmanaged water abstractions and political instability have caused the wetlands to go dry. The precise extent of this desiccation is not fully known, but it is thought to possibly cover almost all of three larger lakes and to have lasted for over three years.

Today there is a real danger of social conflict compounded by a number of other causal factors which are interrelated and interdependent. Among these are water rights issues from the Helmand, extensive environmental degradation of productive agricultural land, drought and pressure on the Iranian social safety net. Thus, the Hamun lake region is one of the most critical social and environmental emergencies in post-Taliban Afghanistan.

No water has reached the lower river basin in Sistan for three years now and the destruction of the environment is almost complete. Agricultural lands have been devastated by desertification, while whole villages have been deserted and populations displaced as pressure on local resources intensifies. Largely unknown by the international community, this man made disaster with acute

political and social implications, has now hit crisis level, impacting on the lives of hundreds of thousands of people in Iran and Afghanistan.

At its peak, the lake area was home to huge ecological diversity, including 150 species of birds. As it was one of the only sources of fresh water for thousands of kilometres around, it was a main stopping point for birds migrating from Russia in the north to the Indian Ocean. Additionally, there were 140 species of fish in the area. In short, the productivity of the Hamun lake system was unrivaled in South Central Asia.

With an annual production of 3,500 mt of fish and 1.7 million cattle, goats and sheep living around the lake there was ample income for the people in the area to sustain themselves, as well as supplying the majority of the protein requirements for the region. According to a recent Iranian ministry of health study, however, the birth weight, average child size, growth rates and basic health indicators have all decreased over the past five years.

Equally disturbing is the fact that large artificial lakes created for drinking water purposes in the area - dependent on the river's flow - are quickly going dry. Current indicators show that the Iranian cities of Zabol and Zahedan have only six months of drinking water remaining. But despite the simplicity of the logic, the two countries continue to wrangle over the issue; a fact that continues to prevent real cooperation between the two countries, while exacerbating an increasingly disastrous environmental impact on Sistan Baluchestan and its population.

The Afghani parts of the Sistan Basin lie in Nimroz and Farah provinces. These provinces are very arid – most of the land is desert and all agriculture is irrigated. The population of farmers, nomads and traders of these provinces depend totally for all economic and social activities on the waters brought by the Helmand and other rivers from the central mountains. In interviews, provincial and district senior government officials emphasised that sustainable water management is the leading development objective in these provinces.

The international donor community has pledged over $5 billion in assistance to Afghanistan. Given that Afghanistan is a water scarce country, and that water is the main limiting resource for most socio-economic sectors (notably agriculture and energy), the rehabilitation of the nation’s water management system is a priority for support by the international community. Water sector development activities are expected to address both hard and soft infrastructure, and to cover the rivers flowing into the Sistan Basin.

Collectively, the rivers flowing into the Sistan Basin have a catchment area covering almost one half of Afghanistan; with the Helmand River Basin alone covering approximately one quarter. Moreover, almost one-third of all irrigated land in Afghanistan lies in the Helmand river basin. These facts emphasise the economic and social importance of these river basins to Afghanistan. The Government of Afghanistan is starting an ambitious programme of rehabilitation and reconstruction of society and of its economy following more than 20 years of internal conflict. This programme is described in the National Development Framework (NDF). The NDF bases future development on three strategic pillars, one of which addresses natural resources including the improved utilisation and management of water resources.

The Government of Iran and the provincial government in Sistan/Baluchistan province are highly concerned about water shortages. Over the years, indeed centuries, they have consistently requested the Afghani authorities to release more water – even when this has not been possible for hydro-meteorological reasons. In 1973, Iran started construction of a series of canals to divert water from the Helmand River into the naturally occurring Chahnimeh storage reservoir system, which commenced operations in 1976. The Government of Iran is presently increasing capacity of the

Chahnimeh reservoirs from 0.7 to 1 billion m3. The water in Chahnimeh is presently used as drinking water over a large region.

Focusing specifically on the Sistan Basin, Iran recognizes the international importance of all three larger lakes in the Basin. It has taken management steps to maintain the ecosystem and its functions. These include placing parts of Hamun-i Puzak (10,000 hectares) and Hamun-i Saberi (50,000 hectares) on the Ramsar Convention's List of Wetlands of International Importance. In addition, I. R. Iran recently established the Hamun protected area, covering 193,500 hectares in Sistan/Baluchistan province. This protected area covers all the lakes lying in Iranian territory. This is now managed by the Department of Environment. I. R. Iran is also fully committed to a full and close cooperation with the national and local authorities in Afghanistan.

5. FRESHWATER FISHES

5.1. The natural area an the biodiversity in Iran

Iran is divided into three distinct phytogeographic regions: the Hyrcanian region in the north, the Nubo-Sindian region in the south, and the Irano-Turanian region in the rest of the country, which occupies more than two-thirds of the land-surface. The Iranian vascular plant flora comprises approximately 10,000 species, with 20% of them being endemic.

	No. of species	Extinct	Critically endangered	Endangered	Vulnerable	Total
Mammalia	166	3	7	24	5	**39**
Aves	502	-	1	13	3	**17**
Reptilia	196	-	4	4	1	**9**
Amphibia	20	-	-	2	-	**2**
Osteichthyes (Inland)	188	-	6	1	-	**7**
Osteichthyes (Marine)	>600					
Total	**1072+600**	**3**	**18**	**44**	**9**	**74**

In the zoogeogrephically context, the total mainlad Iranian vertebrate fauna comprises 1072 species, but to these must be added more than 600 marine fish species belonging to the fauna of ten Caspian Sea, the Persian Gulf and the Oman Sea. About 5% of the national territory is under protection for conservative purposes see the following table).

Region	5 of the country's area	Proportion under protection (%)
Hyrcanian	4.06	23.2
Irano-Turanian	69.86	63.4
Nubo-Sindian	26.08	13.4
Total	**100.00**	**100.00**

5.2. The freshwater species in Iran

Iran lies at a region of major zoogeographical interchange and has a diverse and interesting ichthyofauna about which comparatively little is known. The freshwater fishes of Iran comprise 155 species in 24 families.

The fish fauna is dominated by the Cyprinidae which has by far the most genera (31) and species (74) and is distributed throughout Iran. Nineteen families have 5 or fewer species. Endemics

number 24 species although this is expected to increase as new species are described. More than two-thirds of species are restricted to a single drainage basin out of 20 examined although two cyprinid species are reported from 10 or more basins (Coad, 1998). The diversity in families, genera and species is summarized in Table I, based on Coad (1998).

5.3. Basin diversity

The Caspian and Tigris are the largest basins of Iran, and then have the most species. Both these basins shows diverse habitats and a connection to a brackish or marine environment. This latter fact also augments the species diversity of the Gulf basin. On the contrary, the internal basins have few species and less diversity of genus and families, being remote from the Tigris, Gulf and Caspian Sea basins.

Many species are restricted to a single basin while others are widespread. Furthermore, the diversity of the Iranian basin is directly related to its f the neighbouring countries (Iraq, Pakistan and Afghanistan). The complete list of fish species of Iran is showed in the following table.

CLASS	ORDER	FAMILY	SPECIES
CEPHALASPIDMORPHI	**Petrmyzontiformes**	**Petromyzontidae**	***Caspiomyzon wagneri* (Kessler, 1870)**
CHONDRICHTHYES	**Carcharhiniformes**	**Carcharhinidae**	***Carcharhinus leucas* (Valenciennes, 1839)**
ACTINOPTERYGII	**Acipenseriformes**	**Acipenseridae**	***Acipenser gueldenstaedti* (Brandt, 1833)**
			***Acipenser nudiventris* (Lovetzky, 1828)**
			***Acipenser persicus* (Borodin, 1897)**
			***Acipenser stellatus* (Pallas, 1771)**
			***Huso huso* (Linnaeus, 1758)**
	Clupeiformes	**Clupeidae**	***Alosa braschnikowi* (Borodin, 1904)**
			***Alosa caspia* (Eichwald, 1838)**
			***Alosa pontica* (Eichwald, 1838)**
			***Alosa saposchnikowi* (Grimm, 1887)**

			***Alosa sphaerocephala* (Berg, 1913)**
			***Clupeonella cultriventris* (Nordmann, 1840)**
			***Clupeonella engrauliformis* (Borodin, 1904)**
			***Clupeonella grimmi* (Kessler, 1877)**
			***Tenualosa ilisha* (Hamilton-Buchanan, 1822)**
	Cypriniformes	**Cyprinidae**	***Abramis brama* (Linnaeus, 1758)**
			***Abramis sapa* (Pallas, 1814)**
			***Acanthalburnus microlepis* (De Filippi, 1863)**
			***Acanthalburnus urmianus* (Günther, 1899)**
			***Acanthobrama marmid* (Heckel, 1843)**
			***Alburnoides bipunctatus* (Bloch, 1782)**
			***Alburnus alburnus* (Linnaeus, 1758)**
			***Alburnus filippi* (Kessler, 1877)**
			***Aspidoparia morar* (Hamilton-Buchanan, 1822)**
			***Aspius aspius* (Linnaeus, 1758)**
			***Aspius vorax* (Heckel, 1843)**
			***Barbus barbulus* (Heckel, 1849)**
			***Barbus brachycephalus* (Kessler, 1872)**
			***Barbus capito* (Güldenstaedt, 1773)**
			***Barbus pectoralis* (Heckel, 1843)**

			***Barbus sharpeyi* (Günther, 1874)**
			***Barbus sublimes* (Coad & Najafpour, 1997)**
			***Barbus subquincunciatus* (Günther, 1868)**
			***Barbus xanthopterus* (Heckel, 1843)**
			***Barilius mesopotamicus* (Berg, 1932)**
			***Blicca bjoerkna* (Linnaeus, 1758)**
			***Capoeta aculeate* (Valenciennes in Cuvier & Valenciennes, 1844)**
			***Capoeta barroisi* (Lortet in Barrois, 1894)**
			***Capoeta buhsei* (Kassler, 1877)**
			***Capoeta capoeta* (Güldenstaedt, 1773)**
			***Capoeta damascina* (Valenciennes in Cuvier & Valenciennes, 1844)**
			***Capoeta fusca* (Nikol'skii, 1897)**
			***Capoeta trutta* (Heckel, 1843)**
			***Chalcalburnus atropatenae* (Berg, 1925)**
			***Chalcalburnus chalcoides* (Güldenstaedt, 1772)**
			***Chalcalburnus mossulensis* (Heckel, 1843)**
			***Chondrostoma orientalis* (Bianco & Banarescu, 1982)**
			***Chondrostoma oxyrbynchum* (Kessler, 1877)**
			***Chondrostoma regium* (Heckel,**

			1843)
			Crossocheilus latius **(Hamilton-Buchanan, 1822)**
			Cyprinion macrostomum **(Heckel, 1843)**
			Cyprinion milesi **(Day, 1880)**
			Cyprinion tenuiradius **(Heckel, 1849)**
			Cyprinion watsoni **(Day, 1872)**
			Cyprinus carpio **(Linnaeus, 1758)**
			Garra persica **(Berg, 1913)**
			Garra rossica **(Nikol'skii, 1900)**
			Garra rufa **(Heckel, 1843)**
			Garra variabilis **(Heckel, 1843)**
			Gobio gobio **(Linnaeus, 1758)**
			Gobius persus **(Günther, 1899)**
			Heniigrammocapoeta elegans **(Günther, 1868)**
			Iranicypris typhlops **(Bruun & Kaiser, 1944)**
			Leucaspius delineatus **(Heckel, 1843)**
			Leuciscus cephalus **(Linnaeus, 1758)**
			Leuciscus latus **(Keyserling, 1861)**
			Leuciscus lepidus **(Heckel, 1843)**
			Leuciscus persidis **(Coad, 1981)**
			Leuciscus ulanus **(Günther, 1899)**
			Pelecus cultratus **(Linnaeus, 1758)**
			Rhodeus sericeus **(Pallas, 1776)**

			***Rutilus frisii* (Nordmann, 1840)**
			***Rutilus rutilus* (Linnaeus, 1758)**
			***Scardinius erythrophtalmus* (Linnaeus, 1758)**
			***Schizocypris altidorsalis* (Bianco & Banarescu, 1982)**
			***Schizopygopsis stoliczkai* (Steindachner, 1866)**
			***Schizothorax intermedius* (McClelland, 1842)**
			***Schizothorax pelzami* (Kessler, 1870)**
			***Schizothorax zarudnyi* (Nikol'skii, 1897)**
			***Tinca tinca* (Linnaeus, 1758)**
			***Vimba vimba* (Linnaeus, 1758)**
		Cobitidae	***Cobitis aurata* (De Filippi, 1865)**
			***Cobitis caspia* (Eichwald, 1838)**
			***Cobitis linea* (Heckel, 1849)**
			***Cobitis tenia* (Linnaeus, 1758)**
		Balitoridae	***Nemacheilus angorae* (Steindachner,1897)**
			***Nemacheilus bampurensis* (Nikol'skii, 1899)**
			***Nemacheilus bergianus* (Derzhavin, 1934)**
			***Nemacheilus brandti* (Kessler, 1877)**
			***Nemacheilus cristatus* (Berg, 1898)**
			***Nemacheilus frenatus* (Heckel,**

			1843)
			***Nemacheilus kermanshshensis* (Bãnãrescu and Nalbant, 1967)**
			***Nemacheilus kessleri* (Günther, 1889)**
			***Nemacheilus longicaudatus* (Kessler, 1872)**
			***Nemacheilus malapterurus* (Valenciennes in Cuvier and Valenciennes, 1846)**
			***Nemacheilus persus* (Heckel, 1849)**
			***Nemacheilus rhadinaeus* (Regan, 1906)**
			***Nemacheilus sargadensis* (Nikoll'skii, 1899)**
			***Nemacheilus smithi* (Greenwood, 1976)**
			***Nemacheilus stoliczkai* (Steindachner, 1866)**
			***Nemacheilus tigris* (Heckel, 1843)**
	Siluriformes	**Bagridae**	***Mystus pelusius* (Solander in Russell, 1794)**
		Siluridae	***Silurus glanis* (Linnaeus, 1758)**
			***Silurus triostegus* (Heckel, 1843)**
		Sisoridae	***Glyptothorax kurdistanicus* (Berg, 1931)**
			***Glyptothorax silviae* (Coad, 1981)**
	Esociformes	**Esocidae**	***Esox lucius* (Linnaeus, 1758)**
	Salmoniformes	**Salmonidae**	***Salmo trutta* (Linnaeus, 1758)**
			***Stenodus leucichthys* (Güldenstaedt, 1772)**

	Gadiformes	**Gadidae**	***Lota lota* (Linnaeus, 1758)**
	Mugiliformes	**Mugilidae**	***Liza abu* (Heckel, 1843)**
			***Mugil cephalus* (Linnaeus, 1758)**
	Atheriniformes	**Atherinidae**	***Atherina boyeri* (Risso, 1810)**
	Cyprinidontiformes	**Cyprinodontidae**	***Lebias dispar* (Rüppell, 1828)**
			***Lebias ginaonis* (Holly, 1929)**
			***Lebias mento* (Heckel, 1843)**
			***Lebias persicus* (Jenkins, 1910)**
			***Lebias sophiae* (Hecke, 1849)**
			***Lebias vladykovi* (Coad, 1988)**
	Gasterosteiformes	**Gasterosteidae**	***Pungitius platygaster* (Kessler, 1859)**
		Sygnathidae	***Sygnathus abaster* (Risso, 1826)**
	Synbranchiformes	**Mastacembelidae**	***Mastacembelus mastacembelus* (Banks & Solander in Russell, 1794)**
	Perciformes	**Percidae**	***Perca fluviatilis* (Linnaeus, 1758)**
			***Stizostedion lucioperca* (Linnaeus, 1758)**
			***Stizostedion marinum* (Cuvier in Cuvier & Valenciennes, 1828)**
		Sparidae	***Acanthopagrus latus* (Houttunyn, 1782)**
		Cichlidae	***Iranocichla hormuzensis* (Coad, 1982)**

		Gobiidae	***Anatirostrum profundorum* (Berg, 1927)**
			***Benthophilus baeri* (Kessler, 1877)**
			***Benthophilus ctenolepidus* (Kessler, 1877)**
			***Benthophilus macrocephalus* (Pallas, 1788)**
			***Benthophilus magisteri* (Il'in, 1927)**
			***Benthophilus stellatus* (Sauvage, 1874)**
			***Boleophthalmus dussumieri* (Valenciennes in Cuvier and Valenciennes, 1846)**
			***Glossogobius giuris* (Hamilton-Buchanan, 1822)**
			***Knipowitschia caucasica* (Berg, 1916)**
			***Knipowitschia iljini* (Berg, 1931)**
			***Neogobius caspius* (Eichwald, 1831)**
			***Neogobius cyrius* (Kesslerm 1874)**
			***Neogobius fluviatilis* (Pallas, 1814)**
			***Neogobius iljini* (Vasil'eva and Vasil'ev, 1996)**
			***Neogobius melanostomus* (Pallas, 1814)**
			***Neogobius rattan* (Nordman, 1840)**
			***Periophthalmus waltroni* (Koumans, 1955)**
			***Proterorhinus marmoratus* (Pallas, 1814)**

		Channidae	***Channa gachua* (Hamilton-Buchanan, 1822)**

5.4. Sistan basin

Sistan lies on the border with Afghanistan and its freshwater fish species are probably to be fund in Afghanistan too. The native ichthyofauna comprises a mixture of endemic species, species related to or conspecific with high-altitude species from Central Asia and species from Baluchestan in the wider sense. There is little relationship to species from Iran to the west.

The endemics species of Sistan/Baluchenstan basin are: ***Garra persica***, ***Schizocypris altidorsalis***, ***Schizothorax zarudnyi***, ***Nemacheilus bampurensis***, ***Nemacheilus rhadineus***.

The main fish species of Sistan basins could be detected as follow: *Schizothorax zarudnyi*, *Rutilus frisii* (Kutum), *Abramis brama* (Bream) and *Sander lucioperca* (Pike-perch).

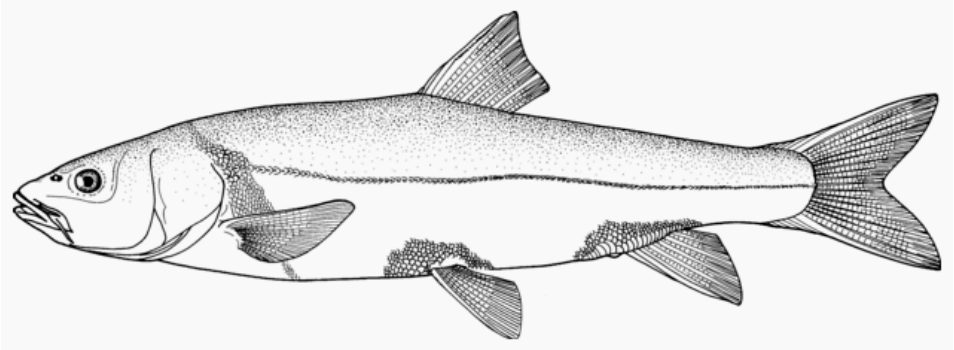
6. THE MAIN FISH SPECIES

6.1. Schizothorax zarudny

Schizothorax zarudnyi (Nikolskii, 1897)

Common name:	Snowtrout
Family:	Cyprinidae
Order:	Cypriniformes
Class:	Actinopterygii
Environment:	benthopelagic; freshwater
Climate:	subtropical
Resilience:	Medium, minimum population doubling time 1.4 - 4.4 years (Preliminary K or Fecundity.)
Distribution:	Asia: Sistan, Iran; Afghanistan
Morphology:	Dorsal spines (total): 4 - 4; Dorsal soft rays (total): 8 - 8; Anal spines: 2; Anal soft rays: 5. Pharyngeal teeth: 5.3.2-2.3.5. Body elongate, depth 5.3-20.2 in % of SL.
Biology:	
Red List Status:	Not in IUCN Red List
Dangerous:	harmless

The schizothoracine fishes is one of the largest and most diverse groups of the Asian area, and its patterns of evolutionary mechanisms and biogeography are very complex. These fishes are specialized for high-elevation rivers and show wonderful adaptations. They dominate the torrential mountain streams and plateau lakes of Central Asia, the Himalayas and the Tibetan Plateau. The Snow Trout (Snow Trout is not a real trout but a member of the carp family) is the one of the most common and commercially most important fish species in Hamun Lake and Helmund river system.



Snow Trout is common in the perennial tributaries, where it attains lengths of 30-35 cm, but according to local fishermen, larger specimen are commonly caught in Hamun River during the dry

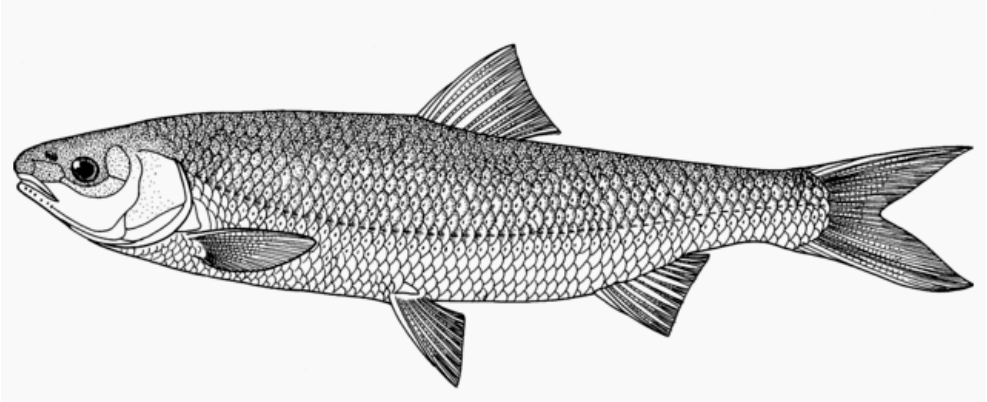
season. The Snow Trout is a river inhabitant and feeds on algae, aquatic plants, some animal food and detritus. The diet consists of 75 % plant matter and 25% animal matter. It prefers rocky substrate where it forages on the algae that grow as crust on rocks and stones.

S. zarudnyi prefers cool, rapid, but not rough, flows with a bottom of stone or pebbles. This fish usually gather in shoals in small pits and gullies and does not migrate far. Males usually mature one year earlier than females. When spawning, the fish move upstream until they reach the mid-part of the river, also swimming into the large tributaries. The spawning takes place only once and lasts from May to June when the water temperature reaches 10°-12° C; the spawning ground is usually sandy-stony with a slow flow.

6.2. Rutilius frisii

Rutilus frisii (Nordmann, 1840)

Common name:	Kutum
Family:	Cyprinidae
Order:	Cypriniformes
Class:	Actinopterygii
Max. size:	70.0 cm TL (male/unsexed); max. published weight: 5,000 g; max. reported age: 12 years
Environment:	benthopelagic; anadromous; freshwater; brackish; depth range - 50 m
Climate:	temperate; 56°N - 36°N, 22°E - 54°E
Importance:	Fisheries: commercial; aquaculture: commercial
Resilience:	Low, minimum population doubling time 4.5 - 14 years (tmax=12; tm=3-5)
Distribution:	Eurasia: in rivers on the northern coast of the Black Sea and in the Caspian Sea basin.
Morphology:	Dorsal soft rays (total): 11 - 12; Anal soft rays: 12 – 14
Biology:	Lives in small schools in deep water, but spawns in shallow water in the tributaries feeding the lakes in April-May. The eggs are laid among weeds and over gravel, and hatch in about 10 days. Becomes sexually mature in 3-5 years. Brackish water populations of the Black Sea are anadromous.
Red List Status:	Data deficient (DD) , 01-Aug-1996
Dangerous:	harmless



This species is distinguished from the related *Rutilus rutilus* by the higher scale count (usually > 50) and the posterior part of the swimbladder being elongate and conical or pointed rather than rounded.

Morphology

Dorsal fin with 3 unbranched and 8-10, usually 9, branched rays; anal fin with 3 unbranched and 9-12, usually 10, branched rays; pectoral fin with 16-19 branched rays and pelvic fin with 8-9 branched rays. Lateral line scales 47-68, mostly 55-58. Scales are regularly arranged over the body. A pelvic axillary scale is present. Scales have numerous circuli, numerous posterior radii, few but distinctively crowded anterior radii and an almost central focus which is broken up into a network of lines.

The posterior scale margin is crenulate and the anterior margin is wavy to crenulate, but scale margins vary greatly between individual scales. Gill rakers are 7-12 and are very short, hardly reaching the one below when appressed. Pharyngeal teeth, usually 6-5, crowns rounded above a slender stalk, posterior teeth with a weakly hooked tip, posterior most tooth margin may be serrated. The gut is an elongate s-shape.

Small specimens up to a year old are silvery on the flanks and belly and the back is steel-grey to pale brown or pale olive. In adults, back scales are circled with black and there is a strong contrast between the back and flank. The anterior part of each flank scale, particularly those of the lateral line, is darkly pigmented. Lateral line scales may have two dots, one above and one below the opening. The sides of the head are silvery with some yellow and darker pigment, the latter particularly in front of the eye. Adults are a bright silvery on the flank. The belly is pearly-white. The iris is silvery, with some spots, and with a marked dark spot above. The dorsal and caudal fins have some grey and a faint orange tint while the pectoral, pelvic and anal fins are colourless to lightly pigmented with black. The pectoral fin may be orange.

Distribution

The species is present in the northern shores and drainages of the Black Sea, and the western shores and drainages of the Caspian Sea. Other populations are found in northwestern Turkey, Bulgaria and other parts of Europe, some subspecifically distinct from *Rutilus frisii kutum*. In Iran it is found along the whole Caspian coast, entering almost all the rivers to spawn and also the Anzali Mordab and Gorgan Bay (Nedoshivin and Il'in, 1929; Kozhin, 1957; Holčík and Oláh, 1992; Riazi, 1996; Oryan *et al*., 1998; Abbasi *et al*., 1999; Kiabi *et al*., 1999; Abdoli, 2000).

It is also found in Valasht Lake (landlocked and introduced about 1850) where it possibly hybridises with native *Chalcalburnus chalcoides* (Armantrout, 1980).

Habitat

This species is migratory, spawning in rivers in March-April and returning to the Caspian Sea. Rezavi (1997) found three populations in Iran, one autumn and two spring populations. However, while the majority of fish migrate into lowland rivers not far from the sea to spawn among bulrushes and cattails, some migrate far upstream into the mountains of Tavalesh and Gilan where spawning conditions are very different. These fish may well overwinter in the river (Derzhavin, 1934). Such fish reached altitudes of about 1000 m before environmental changes inhibited the migration. Young fish migrate downstream, the migration ending in August, and in Azerbaijan enter the sea within 20-50 days. Holčík (1994; 1995) stated that Iranian young from the Anzali Mordab never entered the sea but remained in fresh or brackish water for 1-2 years. Riazi (1996) reports that this species migrates into the Siah-Keshim Protected Region of the Anzali Mordab. Young fish descend the Atrak River and feed in the sea at depths of 4.0-8.5 m. They winter in Iranian waters

(Savenkova, 1985). Some fish are reported at depths of 36.6-53.0 m in the Iranian Caspian Sea (Knipovich, 1921).

Age and growth

Azari Takami et al. (1990) described the biology of this species in Iran. Males normally mature between their third and fourth year, sometimes earlier, females during their fourth year. Life span is at least 9 years in Dagestan (Shikhshabekov, 1979) and 8 years in Iran (Holčík and Oláh, 1992). Spawners are 3-8 years old and the principal age groups are 4-5 years for males and 5-6 years for females in the Anzali Mordab (Holčík and Oláh, 1992; Holčík, 1995). However, recently males are maturing at age 2 and females at age 4 with most spawners at age 3 and 4 years respectively (Holčík and Oláh, 1992). The average size of mature females (700 g) has been decreasing (Bartley and Rana, 1998b). Males grow faster than females until about the third year of life and then more slowly. Males are smaller and have a shorter life span than females (Holčík and Oláh, 1992).

Fish may spend 1 or 2 years in fresh water after hatching (Holčík and Oláh, 1992) and this affects growth, 1 year fish growing more quickly than those spending 2 years in fresh water, maturing earlier and having a shorter lifespan.

Food

Zarbalieva (1987) provides data on feeding of this species in the Caspian Sea. Fish concentrate on a sandy-shellrock bottom and remain there for most of the year to feed. The crab *Rhithropanopeus harrisii* dominates in the diet, 67.9-93.7% by weight. Molluscs, mainly *Ceratoderma lamarcki*, comprise 30% by weight of the food of fish 30-40 cm long. Fish larger than 40 cm seldom take molluscs but occasionally *Clupeonella* spp. Molluscs used to be the main diet item of this fish. Juveniles in the Anzali Mordab of Iran feed mostly on phytoplankton in contrast to the zooplankton reported for Azerbaijan fish (Holčík, 1995). This is a consequence of the poor productivity of this lagoon. Small Iranian specimens from the Caspian Sea had bivalve shell remains, plant remains and in one case a worm. Oryan et al. (1998) state that *Cardium* is the main food of this species on the eastern and western coasts of Bandar Anzali. Crabs and *Balanus* are also important. The hepatosomatic index is highest in February and March, the prespawning period.

Economic importance

Rutilus friisi is the most popular fish in Iran with the highest economic value (Azari Takami *et al*., 1990. Lönnberg (1900) reported an annual catch of some millions in Persian waters. It is caught in rivers and lagoons and by large, mechanically hauled beach nets in the Caspian Sea. Sea nets can be 1500 m long and 18 m deep. The fishing season begins in October and reaches a maximum between 20 February and 10 March, ready for the "Now Ruz" or New Year celebrations when many Iranians eat this fish with rice (Emadi, 1979).

Nevraev (1929) gives catches for various fishing regions in Iran in the early twentieth century. For the period 1901-1902 to 1913-1914 the catch in the Astara region was 0 to 29,053 individuals, for 1901-1902 to 1917-1918 the catch in the Anzali region was 2565 to 124,195 individuals, in the Safid River region from 1904-1905 to 1917-1918 the catch was 100 to 31,799 individuals, and in Astrabad (= Gorgan) region from 1900-1901 to 1912-1913 the catch was 4000 to 323,500 individuals. The total catch for Iran in the 1914-1915 season was 443,000 fish. The catch in Iran from 1956/1957 to 1961/1962 varied from 197,884 kg to 2,066,580 kg (Vladykov, 1964), from 1965/66 to 1968/69 it varied between 159 and 1252 tonnes (Andersskog, 1970), from 1963/64 to 1968/69 it varied between 121.3 and 1252 tonnes (RaLonde and Walczak, 1970b; 1972), from 1987 to 1991 it varied between 3500 tonnes and 8855 tonnes (Holčík and Oláh, 1992), and between 1989 and 1998 it varied between 11,792 kg and 14,336 kg (Caspian Environmental Programme, 2001a) - catch figures are at variance with each other. Holčík and Oláh (1992) report a catch of 3107 kg in the Anzali Mordab for 1990 and for 1932-1964 a range of 95.1-3488.9 tonnes. They are also caught in rogas and inflowing rivers of the mordab in late winter and early spring. Moghim *et al*. (1994) estimate that coastal areas of the southern Caspian Sea have a total biomass of 24,000 tonnes with a

maximum sustainable yield of 7000 tonnes. In 1993-1994 the total catch of this species, including the illegal catch, was 11,175 t with the total stock estimated at 25,400 t and a maximum sustainable yield of 9300 t. More than 25% of the catch was young fish indicative of non-standard methods being used (*Annual Report, 1995-1996, Iranian Fisheries Research and Training Organization, Tehran, p. 19-20, 1997*). In 1994-1995, the biomass of this species in Iran was 241,000 t (*sic*, probably 24,000 t) and the maximum sustainable yield was 9000 t (*Annual Report, 1994-1995, Iranian Fisheries Research and Training Organization, Tehran, p. 37, 1996*). About 62% of the bony fish catch in the Caspian Sea of Iran in 1993-1994 was this species with the mullet *Liza aurata* second at 22% (*Annual Bulletin 1993-94, Iranian Fisheries Research and Training Organization, Tehran*, p. 83, 1995).

Bartley and Rana (1998a; 1998b) comment that the fishery collapsed in 1980 but has risen from 500 tonnes in 1981 to around 10,000 t in 1996 after restocking from around 400,000 fingerlings/year in 1981 to around 142 million/year in 1997. Rana and Bartley (1998a) note that 7 million 1 g fingerlings were released into the Caspian Sea in 1997 which contradicts their earlier report. There is only a state supported stocking programme but ERM-Lahmeyer International GmbH, DHI Water & Environment and GOPA Consultants (2001a) note that this fish is being successfully managed in Iran while it has been fished almost to extinction in waters off Daghestan and Azerbaijan.

Catches in the Bandar-e Anzali area have been as high as 5,480 t in 1939-1940 but fell to 85 t in 1961-1962 (Vladykov, 1964; RaLonde and Walczak, 1972) but have risen again as indicated above. This is attributed to a massive stocking effort with 170 million fingerlings released in Iran in 1991 (cf. Emadi (1993a) below), about a quarter in the Anzali Mordab (Holčík and Oláh, 1992). The Sari hatchery produced 400 million "white fish" over the previous 10 years (Tehran Times, 30 May 1998). Fingerling production in 1996 was 142.1 million (Bartley and Sana, 1998a). Sea ranching increased the yearly catch to 8500 tonnes in 1991, the highest recorded catch in the past being 5850 tonnes in 1940 (Emadi, 1993a). Natural stocks in the past were very high. Migrating fish were so dense at the Mordab mouth that they were caught in buckets and jumping fish literally fell into boats. Savenkova (1990) comments on the marketing of this species in southwestern Turkmenistan.

Experimental culture of triploid *R. friisi* has been carried out at the Gilan Fisheries Research Centre (*Iranian Fisheries Research and Training Organization Newsletter*, 2:2, 1993) to increase fish weight for exploitation but apparently was unsuccessful although the techniques worked with grass carp, *Ctenopharyngodon idella* (*Annual Bulletin 1993-94, Iranian Fisheries Research and Training Organization, Tehran*, p. 70-71, 1995). In addition monoculture and polyculture of this species has been investigated, the latter with grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*) (*Iranian Fisheries Research and Training Organization Annual Report,* 1992-93; Danesh Khoshashi, 1997).

Conservation

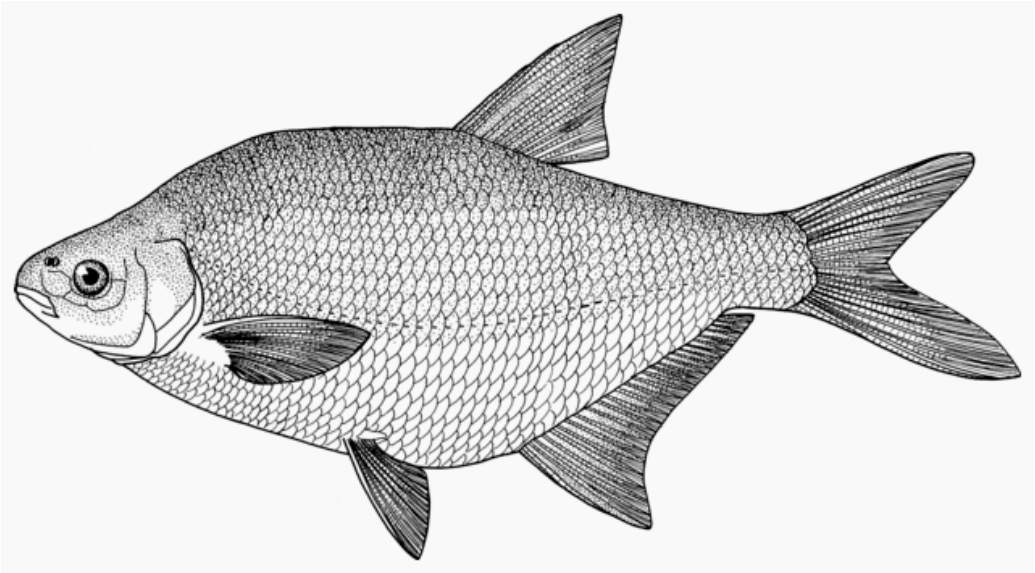
Azari Takami *et al*. (1990) list the following reasons for a decline in the commercial catch of this species: a) regression of the Caspian Sea which decreased the surface area of the Anzali Lagoon and increased the growth rate of aquatic vegetation; b) mechanisation of farming and a consequent increased demand for irrigation water leading to reduced river flows during the spawning migration; c) use of fertilisers and pesticides in rivers draining into the Anzali Mordab ; d) pumping of river water for irrigation causing mass mortalities of fry; e) industrial development increasing the pollution load, and f) excessive catches of adults to the extent that all spawners in a river were taken. Emadi (1979) added such factors as road construction and the removal of sand from banks and river beds, erosion caused by felling trees and shrubs along river banks and in the mountains, construction of bridges and raising of their substructures which formed barriers to migration, and climatic changes. Illegal fishing and non-standard nets threaten the stocks while fingerling release (120-140 million) and improvement of natural spawning areas through rises in water level have contributed to stock increases (*Annual Report, 1995-1996, Iranian Fisheries Research and Training Organization, Tehran, p. 19-20, 1997*).

Measures to combat loss of this valued fish included a ban on fishing in the Anzali Mordab and its tributary rivers (catches here were up to 1000 tons per year (Emadi, 1979)), effective control of illegal fishing and artificial spawning experiments (although the latter was insufficient to replace stocks).
Kiabi *et al*. (1999) consider this species to be of least concern in the south Caspian Sea basin according to IUCN criteria. Criteria include commercial fishing, sport fishing, abundant in numbers, habitat destruction, widespread range (75% of water bodies), absent in other water bodies in Iran, and present outside the Caspian Sea basin. The 2000 IUCN Red List lists this species as DD (Data Deficient). Coad (2000a), using 18 criteria, found this species to be one of the top 4 threatened species of freshwater fishes in Iran.

6.3. Abramis abrama

Abramis brama (Linnaeus, 1758)

Common name:	Carp bream
Family:	Cyprinidae (Minnows or carps)
Order:	Cypriniformes (carps)
Class:	Actinopterygii (ray-finned fishes)
Max. size:	82.0 cm TL (male/unsexed; Ref. 6114); max. published weight: 6,010 g (Ref. 4699); max. reported age: 17 years
Environment:	benthopelagic; potamodromous (Ref. 51243); freshwater; brackish; pH range: 7 – 7.5; dH range: 15; depth range - 1 m
Climate:	temperate; 10 – 24°C; 75°N - 40°N, 11°W - 73°E
Importance:	fisheries: highly commercial; aquaculture: commercial; gamefish: yes; aquarium: public aquariums; bait: usually
Resilience:	Low, minimum population doubling time 4.5 - 14 years (K=0.06-0.17; tm=3-5; tmax=17; Fec=90,000-340,000)
Distribution:	Europe and Asia: east from the Pyrenees and north from the Alps and Middle Asia, in the basins of the North, Baltic, Black, Caspian and Aral seas.
Morphology:	Dorsal spines (total): 3 - 3; Dorsal soft rays (total): 9 - 10; Anal spines: 3; Anal soft rays: 23 – 30; Vertebrae: 43 – 45. Caudal fin with 19 rays (Ref. 2196). Tall, laterally compressed body. Fins darker in adults. Anal fin base twice as long as the dorsal fin (Ref. 35388).
Biology:	Occurs usually in still and slow-running waters where it travels in large shoals (Ref. 9696). Feeds on insects, particularly chironomids, small crustaceans, mollusks and plants. Larger specimens may feed on small fish. The juveniles feeds on zooplankton (Ref. 30578). Can survive out of the water for extended periods (Ref. 9988). The flesh is bony, insipid and soft (Ref. 30578). Marketed fresh or frozen. Eaten steamed, broiled, fried and baked (Ref. 9988).
Red List Status:	Not in IUCN Red List (Ref. 53964)
Dangerous:	harmless



Morphology
The mouth is small but highly protrusible. There is a strong dorsal ridge anterior to the dorsal fin. Dorsal fin with 3 unbranched and 8-10, usually 9, branched rays, anal fin with 3 unbranched and 22-30 branched rays. Lateral line scales are in number of 48-60. The lateral line is moderately decurved. Scales are regularly arranged, sheathing the anal fin base. Scales have numerous fine circuli but only relatively few posterior and even fewer anterior radii. In a fish about 6 cm long there are as few as 8 total radii. The focus is almost central and the anterior scale margin is wavy. There is a pelvic axillary scale. The ventral keel between the pelvic fin bases and the anal fin is well-developed. Gill rakers (18-30) are short, reaching the raker below when appressed. They are strongly tuberculate on the inner surface. Vertebrae 38-47, usually 42-44 in the Caspian populations (lower counts in literature may not include 4 Weberian vertebrae).
Pharyngeal tooth formula modally 5-5, with variants of 6-5 (2.2-4.8%), 5-4 (2.2-4.4%) and 4-5 (8.6%) for collections from the Caspian and Aral seas basins in former Soviet waters (Vasil'yeva and Ustarbekov, 1991). Teeth bear a small hook at the tip in the main row and have long, narrow and flat crowns. In young fish, the hook is more pronounced and the crown has a few tubercles or a series of serrations. The gut is s-shaped with a small anterior loop.

Distribution
Found from the British Isles across Europe north of the Pyrenees and Alps eastwards to the Black, Caspian and Aral sea basins although not in western Transcaucasia. In Iran it is found from the Astara to the Atrak rivers in the whole Caspian Sea basin (Kozhin, 1957) including the Anzali Mordab, its outlets and tributaries and the Siah-Keshim Protected Region Holčík and Oláh, 1992; Riazi, 1996; Kiabi *et al*., 1999), the Safid River (Abbasi *et al*., 1999), Gorgan Bay (Derzhavin, 1934) and freshened areas of the Caspian Sea.
This species is also recorded from the Karakum Canal and Kopetdag Reservoir in Turkmenistan (Shakirova and Sukhanova, 1994; Sal'nikov, 1995) and may eventually reach Iranian waters in the Tedzhen River basin where is has been reported by Aliev *et al*. (1988).

Habitat
The bream prefers still water and is low in numbers even in rivers with weak current. Abundant littoral vegetation and a very muddy bottom are favoured in lakes for reproduction and feeding respectively. It retreats to deeper water in winter, forming schools numbering in the many thousands, packed densely together (Muus and Dahlstrøm, 1999).

This species can tolerate high temperatures of 33-34°C in southern areas like Iran for a time but above 28°C growth rate decreases. Adults can live in a salinity of 12.9 p.p.t., perhaps 14 p.p.t., and eggs may be fertilised at a salinity of 10.2 p.p.t., however preferred levels are 2-4 p.p.t. Salinity and water level changes have significant effects on abundance in this species. Population densities vary markedly in both fresh and brackish water populations.
Bream living in the Caspian Sea basin are semi-migratory. They feed in the brackish sea but spawn and winter in the lower reaches and deltas of large rivers. A spring migration up rivers begins with ice melt or warmer temperatures in the sea and after spawning the fish return to disperse and feed in the sea. In the fall the fish migrate into the deeper parts of river deltas. In Russian parts of the Caspian they are found at depths not exceeding 4-5 m but Knipovich (1921) reports them at 14.6-16.5 m, possibly deeper, in the Iranian Caspian Sea.
There were spring and winter migrants in the southwestern Caspian including the Anzali Mordab (A. M. Shukolyukov in Berg, 1948-1949). The spring bream had a longer snout, deeper head, lower body, lower dorsal and anal fins, and more scales. The spring bream entered the Mordab for spawning only while the winter bream overwintered in bottom pools. Changing conditions in the mordab environment in the late 1980s and the 1990s may have altered this migration. Riazi (1996) reports that this species migrates into the Siah-Keshim Protected Region of the Anzali Mordab.

Food
Young fish feed on zooplankton. Adults use a strong sucking power and a tube-like snout to feed on invertebrates and detritus in mud. This sucking action leaves evident "bream pits" in soft mud, depressions about 10 cm across. In the northern Caspian Sea food items include Cumacea, Corophiidae, the clams *Adacna* (69% by weight) and *Monodacna*, Chironomidae, Polychaeta, Gammaridae, Mysidae, and Oligochaeta. When overcrowded or in turbid conditions, plankton may be eaten in addition to the normal foods (Muus and Dahlstrøm, 1999).

Economic importance
This species is an important food fish being both tasty and of large size. In addition it can live out of water for some time and thus remain fresh while being transported to market.
Nevraev (1929) gives catches for various fishing regions in Iran in the early twentieth century. For the Anzali region from 1901-1902 to 1913-1914 the catch was 2283 to 419,117 individuals, for the Safid River region from 1908-1909 to 1917-1918 the catch was 17,195 to 474,200 individuals (rising steadily but falling in 1917-1918) with no fish reported in the years 1899-1900 to 1907-1908 and in 1918-1919, and in Astrabad (= Gorgan) region from 1900-1901 to 1912-1913 the catch was 20,600 to 1,381,500 individuals with no clear trend, the catches varying markedly from year to year. The commercial catch in Iran from 1956/1957 to 1961/1962 varied from 0 to 158 kg (Vladykov, 1964), from 1965/66 to 1968/69 varied from 0 to 29 tonnes (Andersskog, 1970) and from 1963 to 1967 from 0.5 to 16.0 tonnes (with no reported catch in the first 3 years)(RaLonde and Walczak, 1970b). The catch in the Bandar-e Anzali region from 1933/34 to 1961/62 varied between only 2 kg and over 1394 t with some years reporting no catches. Holčík and Oláh (1992) report a catch of 34 kg in the Anzali Mordab for 1990 and for the period 1932-1964 catches ranged from none to 1133.5 tonnes annually. The total catch of the Northern Shilot (Fisheries Company) from 1965/66 to 1968/69 varied between 13 and 74 t (RaLonde and Walczak, 1972). There are obviously wide variations in annual catches and/or in reporting statistics. The general trend is one of decline in catches with large fish being caught and the average stock size being lowered, resulting in a decreased spawning success. This species has a deep body and immature fish are easily caught. The catch in the Anzali Mordab was important until the end of the 1940s but had virtually disappeared by the 1980s (Petr, 1987).
In former Soviet waters of the Caspian Sea, the age composition in commercial catches was 2-10 years, with the great majority being 3-5 years old. Trawls, seines, pound nets and gill nets are used

in the northern Caspian Sea to catch the bream with 60-70% being taken in spring. Spawning and breeding farms were established in the former Soviet Union to rear young fish. Catches in the Volga-Caspian and Ural regions has been as high as 344,900 centners, prior to 1930, and in the Aral Sea in 1931 the catch was 115,200 centners.
Mono- and poly-culture of this species has been carried out in Iran (*Annual Bulletin 1993-94, Iranian Fisheries Research and Training Organization, Tehran*, p. 77-78, 1995). Polyculture comprised 70% *Abramis brama*, 20% silver carp (*Hypophthalmichthys molitrix*) and 10% grass carp (*Ctenopharyngodon idella*) and gave a greater yield than monoculture.

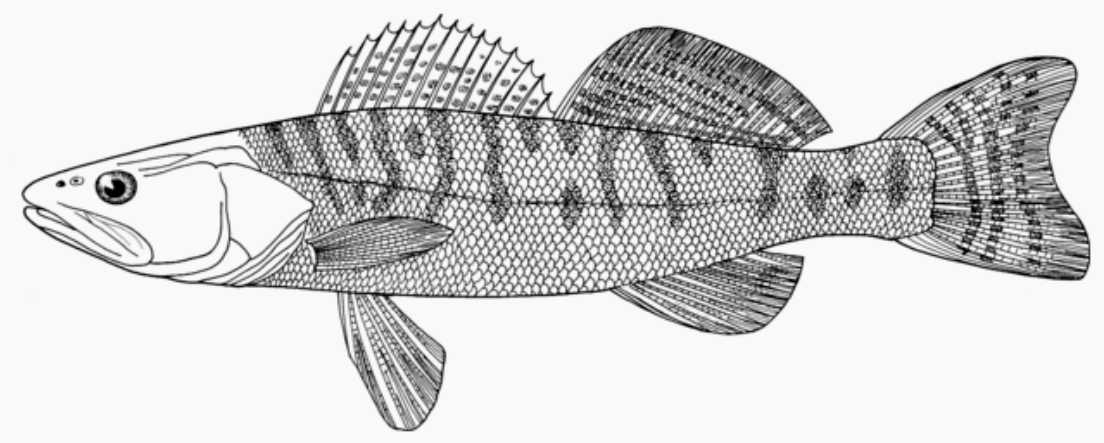
Conservation
The subspecies has been proposed for inclusion in the "Red Book of the U.S.S.R." which forms the basis for measures to protect species (Pavlov *et al*., 1985).
RaLonde and Walczak (1970b) reported that 90% of the bream caught in Iran in 1970 were immature and the stock was in danger of extinction. About 19-20% of commercial catches in the Volga region are from hatchery raised stock (Petr, 1987) and it was thought that stocking could help this species in Iran. During the 1980s and 1990s there were practically no catch figures for this species in Iran. Artificial propagation began in 1986 on an experimental basis and 6 million fish were released (Ghenaat Parast, 1993). In 1992-1993 (an Iranian calendar year), 2.4 million fingerlings were released into the Anzali Mordab and nearby rivers, a 100% increase over the previous year (*Abzeeyan*, Tehran, 4(2):VI, 1993). Total production in government hatcheries for 1990 was 0.66 million fingerlings, in 1991 2.28 million and in 1992 5.3 million fingerlings (Emadi, 1993a). Fingerling production was 11.217 million in 1995 and 8.5 million in 1996 (Bartley and Rana, 1998a; 1998b). In 1999-2000, 20 million juveniles were released (*I.F.R.O. Newsletter*, 23:4, 2000). From October to March 2000, 14 million juveniles raised in the Shahid Ansari aquaculture and breeding centre in Gilan were released into the Caspian Sea and neighbouring water bodies (*I.F.R.O. Newsletter*, 26:2, 2001). Illegal fishing and non-standard nets threaten the stocks (*Annual Report, 1995-1996, Iranian Fisheries Research and Training Organization, Tehran, p. 19-20, 1997*). Billard and Cosson (2002) give an annual production of 15 million alevins.
Ramin (1997) details studies on the artificial breeding of this species in Iran, based on 38 brooders, with the goal of saving it from extinction. Gonadotropic hormone extracted from the pituitary of the common carp was used to induce brooders. One or two doses at 5-6 mg/kg body weight gave optimum stripping of eggs at 18°C. Fertilisation rate was 75-95% and hatching rate was 75-85%. Incubation took nearly 4 days at 18-21°C. The grey, pink or yellow eggs numbered 9142-60,050 per spawner with a swelled diameter of 1.0-1.2 mm. The yolk sac was absorbed after 72 hours and newly hatched larvae were 2.9-3.7 mm long.
Kiabi *et al*. (1999) consider this species to be vulnerable in the south Caspian Sea basin according to IUCN criteria. Criteria include commercial fishing, sport fishing, few in number, habitat destruction, limited range (less than 25% of water bodies), not present in other water bodies in Iran, and present outside the Caspian sea basin. Nezami *et al*. (2000) consider this species to be endangered because of overfishing, habitat destruction and spawning groundn degradation.

6.4. Sander lucioperca

Sander lucioperca (Linnaeus, 1758)

Family:	Percidae
Order:	Perciformes
Class:	Actinopterygii (ray-finned fishes)
Max. size:	130 cm TL (male/unsexed); max. published weight: 20.0 kg; max. reported age: 16 years

Environment:	Pelagic; potamodromous; freshwater; brackish; depth range 2 – 30 m
Climate:	temperate; 6 – 22°C; 67°N - 36°N, 1°W - 75°E
Importance:	fisheries: commercial; aquaculture: commercial; gamefish: yes; aquarium: public aquariums
Resilience:	Low, minimum population doubling time 4.5 - 14 years (K=0.10-0.13; tm=3-5; tmax=16)
Distribution:	Eastern and central Europe, Sweden and Finland, Western Asia; introduced into several European countries. This species has depleted stocks of native fish in some areas where it has been introduced for angling. Several countries report adverse ecological impact after introduction.
Morphology:	Dorsal spines (total): 13 - 20; Dorsal soft rays (total): 18 - 24; Anal spines: 2 – 3; Anal soft rays: 10 – 14; Vertebrae: 45 – 47. Long slender body, without cross-bars. No spines on the gill cover. Caudal fin with 17 soft rays.
Biology:	Inhabit deep, calm waters of lakes, reservoirs, canals and rivers. Feed mainly on fishes (Ref. 30578, 9696). The habitats occupied by S. lucioperca are likely to vary during different seasons, as shown by radio-tracking study done in the United States. In autumn, the adults prefer a substrate of large pebbles in 1.20-1.80 m depth. In winter, when the temperature approaches 5°C, S. lucioperca are found in pits and trenches where they overwinter. When the temperature rises above 2.8°C in spring, they commence upstream migration. Spawning takes place at a temperature of around 11°C on substrate composed of large pebbles in a current of 1.40-1.50 m/sec. After spawning, the parents drift downstream and stay in pools, 1.20-1.80 m deep, for two weeks. Mortalities affect the females after spawning. In summer, Z. lucioperca prefer a substrate of pebbles and are found at variable depths, often on the upstream edge of pits and trenches where there is a rupture of current. When the temperature reaches 30°C, they seek deep pools (Ref. 30578). Spawning is earlier in lower latitudes (Ref. 10999). Pale yellow eggs are found attached to emergent vegetation or stones and gravel (Ref. 41678). Popularly fished by sport fishers. Its flesh is succulent (Ref. 30578). Utilized fresh or frozen and eaten steamed, broiled and microwaved (Ref. 9988). An individual weighing 19 kg was reportedly caught in 1959 in Starnberger, Bavaria, Germany.
Red List Status:	Lower Risk: least concern , 01-Aug-1996
Dangerous:	potential pest



7. FRESHWATER FISHERIES

The long Iranian coastline along the Caspian Sea and the Arabian or Persian Gulf and Gulf of Oman, coupled with a diversified climate in the land area suitable for various type of aquaculture system, makes Iran the biggest fishing nation in the region. There are three categories of fisheries activities in Iran: the southern Fishery (the Persian Gulf and Gulf of Oman); the northern Fishery (the Caspian Sea); and inland fishery and aquaculture. In 2003, these produced 299 000 t, 32 000 t and 110 000 t, respectively.

Catch from wild natural resources is very limited due to overfishing, pollution and illegal fishing. Attempts are in progress to improve matters through a fish stock enhancement programme, conservation, fishing management and a buy-back scheme for reducing the number of existing fishing licences. In contrast, aquaculture is very promising due to the vast areas suitable and diverse climate conditions.

Freshwater fisheries are increasing in Iran and with this exploitation there is a commensurate need for an understanding of the whole ichthyofauna. Inland fisheries finfish production was 30,924 tonnes in 1986. The freshwater fish catch increased from 6954 tonnes/year in 1974-1976 to 24,613 tonnes/year in 1984-1986, a 254% increase and five times the world average. In 1992 Iran had an inland capture fishery of 40,000 t as did Turkmenistan; Kazakhstan had 80,000 t, Uzbekistan 27,439 t, Azerbaijan 36,371 t, Iraq 4400 t, and Armenia 4500 t. The Caspian Sea fisheries grew from 25,987 t to 98,000 t in the decade 1990-2000.

The value of all fish production in Iran rose to 1046 billion rials in 1996 from 171 billion rials in 1989 (Tehran Times, 27 July 1998). Freshwater landings increased from 22,177 t in 1985 to 115,000 t in 1994 (Food and Agriculture Organization, Fisheries Department, 1996). Cold and warm water fish production was 67,000 t in 2001 with per capita annual consumption at 5.2 kg. Production was expected to rise to 220,000 t in 2000-2005 (IRNA, 11 November 2001).

In inland waters the catches of warm water fish were 19,947 t and 21,462 t, of cold water fish 579 t and 775 t (both presumably from fish farming) and from "natural resources" 24,905 t and 20,183 t. These catches (totals 80,855 t and 83,512 t) are less than the totals for the marine catches in the Persian Gulf and Sea of Oman at 277,000 t and 271,000 t but are still significant.

In 1996 the total Caspian Sea catch was 58,000 tonnes while the southern, marine fisheries reached 265,000 tonnes. The gross value of all catches (1995) including marine fish and shrimps was U.S.$45 million while fish imports were at $65 million. Caviar made up nearly 60% of exports in 1994 and nearly half of imports are fish meal. The industry had 111,800 primary employees in 1995, including about 8000 fish farmers. Most fish (70%) is eaten fresh, 15% is frozen and canned, with some smoked or salted and the remainder is made into fish meal. In 1998, the annual fish catch was listed as 65,000 tonnes with the aim of raising the catch to 110,000 t by the end of the 1995-1999 economic development plan. It was estimated that 150,000 t could be obtained from 500,000 ha of ponds and dam reservoirs (IRNA, 23 October 1998).
Consumption of fish in Iran is estimated at 5 kg per capita, having risen from 1 kg in the decade prior to 1999 and is expected to rise to 6.5 kg in the next five-year economic plan (by the year 2000) and to 10 kg by 2004 (later revised to 8.5 kg by 2005. Per capita consumption of fish increased due to increased production but also a government policy of lower prices than for meat and poultry. In 1993, 350,000 tonnes of seafood products were produced comprising 30% of the country's protein requirements and a sevenfold increase over catches before the Islamic Revolution in 1979. The annual fisheries output is expected to reach 1 million tons by the year 2004 from a 1999 level of 400,000 tons.

In 1998, Rana and Bartley (1998) report the average per capita fish consumption in Iran to be 4.5 kg, low compared to the world average of 13.5 kg. The Government's plan is to increase consumption to 6.5 kg by the year 2020 which would require an increase in fishery production from 382,000 tonnes in 1995 to 670,000 t; these amounts conflicting with news reports.

Although the country suffers from the lack of fresh water, the great water bodies in north and south, 1.5 million hectares of inland water bodies and rivers provide huge potential for fisheries activities in Iran. In fact, fisheries sector has significant social and economical rolls in Iran. The FAO reports the following data:

Data for 2003	Production	Imports	Exports	Total supply	Per capita supply
	Tonnes liveweight				**kg/year**
Fish for direct human consumption	401 087	34 156	18 580	416 664	**6.1**
Fish for animal feed and other purposes	39 748				

The long Iranian coastline along the Caspian Sea and the Arabian or Persian Gulf and Gulf of Oman, coupled with a diversified climate in the land area suitable for various type of aquaculture system, makes Iran the biggest fishing nation in the region. There are three categories of fisheries activities in Iran: the southern Fishery (the Persian Gulf and Gulf of Oman); the northern Fishery (the Caspian Sea); and inland fishery and aquaculture. In 2003, these produced 299 000 t, 32 000 t and 110 000 t, respectively.

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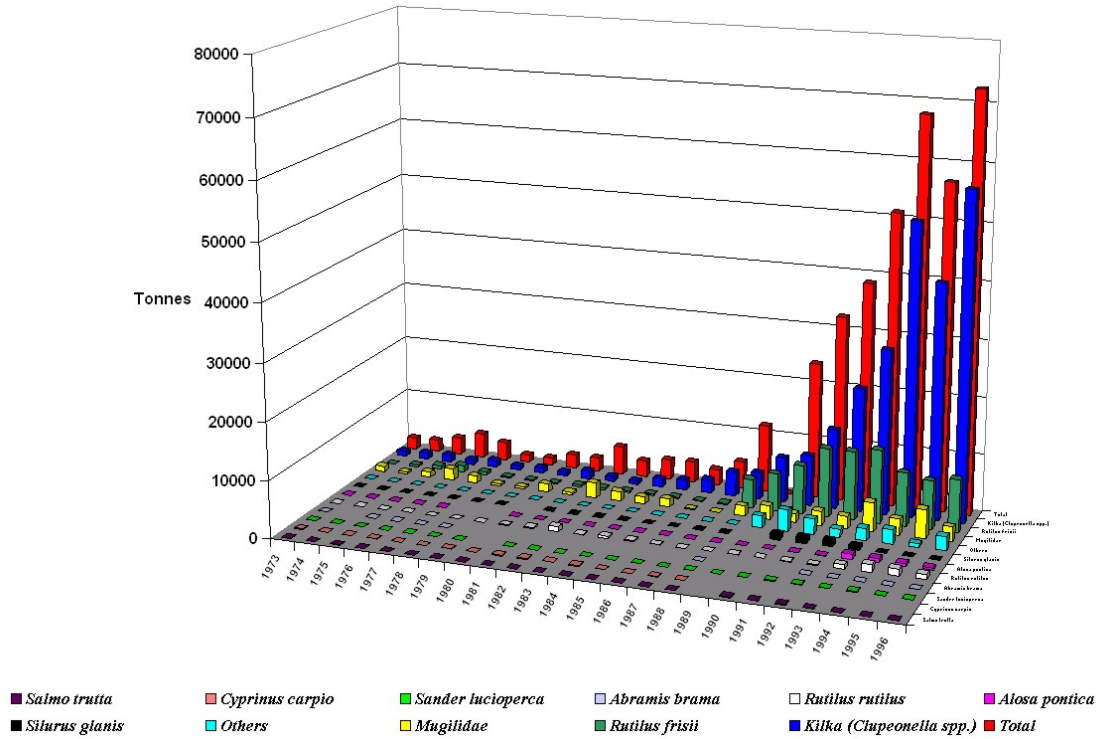
The main item of freshwater fisheries of the Islamic Republic of Iran is the Caspian Sea. The biomass of fishes in the Iranian Caspian is estimated at 556,530 tonnes, 12.7% of the total for the sea, with a fish density of 50.6 tonnes/nautical mile (the lowest values of any Caspian state).

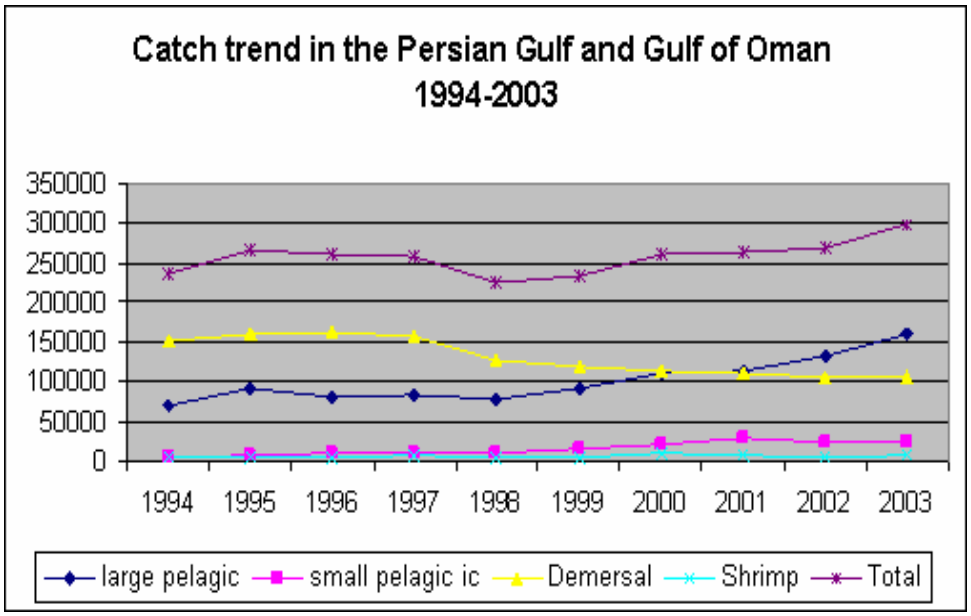


Industrial and semi-industrial fishing fleets owned by private enterprises carry out almost all fisheries in the Persian Gulf and the Gulf of Oman. The main fishing gears used include drift gillnets, wire traps (local name: gargoor), longline, shrimp trawl, angling and beach seine, purse seine and some other traditional forms, such as set nets and set barrier nets. Many boats use a combination of fishing gear. In 2003, there were 62 steel-hulled trawlers, 3 011 wooden vessels and 6 764 outboard-powered small boats active in commercial fishing.

Fishing operations in the Caspian Sea are carried out with a fleet of about 750 wooden vessels (dhow type). Beach seine fishermen catching bony fish species are organized into about 150 working groups or cooperatives (2003 data). Three types of fishing gears are used in the Caspian Sea, including beach seine (pareh) for bony fishes along the coastline; lift net (conical net with light attraction) for kilka (a small pelagic fish similar to anchovy); and set gillnet for sturgeon. Fishing for sturgeon is restricted to the state-owned company due to conservation concerns.

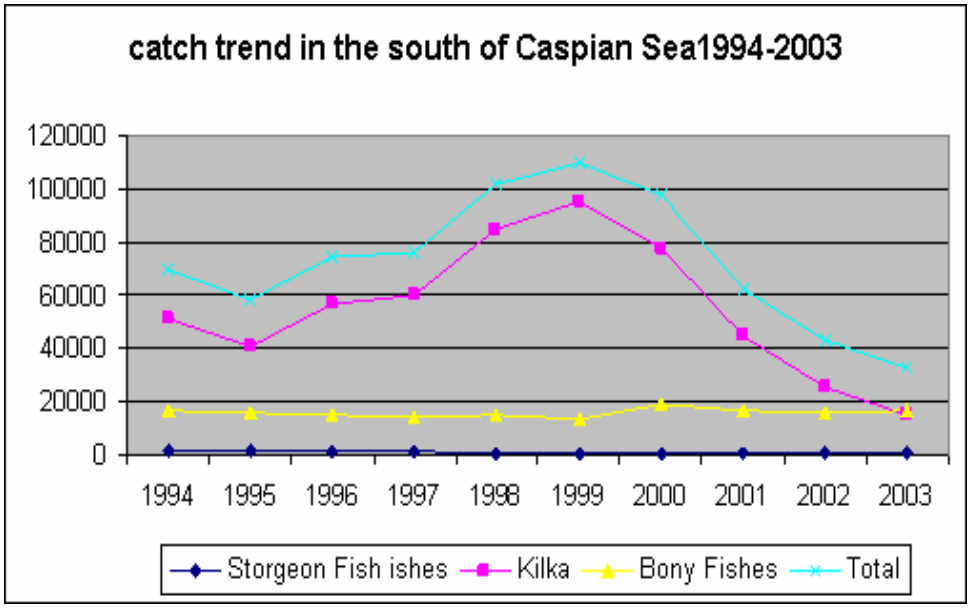
7.1. Southern fisheries

Total fish landings in southern Iran (the Persian Gulf and Gulf of Oman) have been almost stable since 1989, with a recorded 282 319 t in 2003, comprising demersal species (61 271 t), big pelagics (142 065 t), small pelagics (15 197 t) and other (11 573 t, including discards and by-catch). Purse seine fisheries for tuna fishes in the Indian Ocean have been expanded, and in 2003 landed 11 830 t. Trawl fishing outside Iran coastal areas has also increased, with more than 2 000 t landed in 2003.



7.2. Northern fisheries

Total landings along the Iranian portion of southern Caspian coast reached 32 500 t, including sturgeon (463 t), kilka (15 500 t) and bony fishes (16 573 t) in 2003. The bony fishes include kutum (Rutilus frisii; locally called "white fish"), mullets, carp, pikeperch, breams, herrings, mullet and a few others. Harvesting of sturgeon resources are controlled exclusively by the Fisheries Research Organization in collaboration with the Deputy for Fishing and Ports Affairs. Kilka resources have been exploited totally by the private sector, operating motorized vessels equipped with conical nets and light attractors.



7.3. Landing sites

Iran has numerous Provinces, each with considerable autonomy, and landings are reported on a provincial basis. Landings are summarized in Table 1.

Province	Landing place	Relative share in landings	Recorded catch in 2003
NW Persian Gulf			
Khozestan	Fajr jetty	60%	
	Bahrekan	12%	
	Hendijan	9%	
	+ 5 other minor sites		
			33 606 t
Boushehr	Dayer	22%	
	Bandargah	11%	
	Shif	10%	
	+ 20 other minor sites		
			30 131 t
Eastern Persian Gulf, Straits of Hormuz and western Gulf of Oman			
Hormozgan	Jask	17%	
	Cong	13%	
	Qeshm	11%	
	Bandarabbas	8%	
	+ 15 other minor sites		
			64 666 t
Eastern Gulf of Oman			
Sistan & Baluchistan	Beris	27%	
	Konarak	26%	
	Ramin	15%	
	+ 7 other minor sites		
			109 055 t
South Caspian Sea[1]			
Mazanderan		50%	
Gilan		43%	
Golestan		7%	

7.4. Institutional management

Prior to the Islamic Revolution in 1979, the Iranian fisheries were divided into two companies, known as Shilat in Farsi, a northern one centred on the Caspian Sea and a southern one centred on the Persian Gulf. The combined companies, known as the Iranian Fisheries Organization or Shilat, are now under the Jihad-e Sazandegi Ministry, starting in 1987. Jihad-e Sazandegi translates as "Construction Crusade" and is indicative of the attempt to develop the fisheries to serve the growing population of Iran.

The Iranian Fisheries Research and Training Organization officially commenced its activities in 1990. It has departments of Research, Training, Scientific Information and Administration and Research Centres at Bandar Anzali and Sari in the north of Iran and at Bushehr, Bandar Abbas, Ahvaz, Bandar Lengeh and Chahbahar in the south.

The Iranian Fisheries Organization is responsible for fisheries development in Iran. The Organization was a state-owned company with power to act in various fields of fisheries (catching, processing, marketing, etc.). In early 2005, with the aim of monitoring fisheries development and leading the subsector, the Iranian parliament approved a change and it became a governmental organization with a developmental function.

The Organization has four General Directorates for fisheries in the south and three for the Caspian coast. The head of the Organization is the vice minister for Jihad Agriculture, with a mandate to lead fisheries development in all Iran. Fisheries departments in non-coastal provinces have an indirect relation to the Organization through the Jihad Agriculture Organization in each province.

he International Institute for Sturgeon, located on the Caspian Coast, is responsible for research projects related to sturgeon biomass in the Caspian Sea, and tries to strengthen stocks and guide the Fisheries Organization in managing the resources.

The Artimia Research Centre, located in northwest Iran, is responsible for Artimia spp. shrimp research projects, and monitors and gives advice to the Fisheries Organization on management of the Artimia harvest in Orimia Lake.

The legal framework for the Iranian Fisheries Organization (Shilat Iran) derives from the Protection and Exploitation of Natural Aquatic Resources Law approved in 1995. On the base of that law, the Fisheries Organization prepared a Code of Practice, which was approved by the government council in 1999. The guideline indicates the authority of and clarifies responsibilities for four major related organizations: the Environment Organization; the Veterinary Organization; the Natural Resources and Forest Organization; and the Ministry of Energy (Department of Water Resources).

According to the Code, a formal licence is required for construction and operation of aquaculture farms and fishing operations. Some traditional aquaculture activities, including some fish farming in irrigation canals and reservoirs (where aquaculture is not the major activity) are subject a much simpler requirement, namely a letter of approval from the nearest Fisheries office.

Although total landings have increased, catches of certain preferred species, such as sturgeon and kilka in the Caspian Sea, and shrimp, silver pomfret and demersal species in the Persian Gulf, have declined dramatically in the last decade.

Fisheries legislation is in place, but compliance has been limited. Despite huge investments by government in conservation and surveillance activities, illegal fishing methods are still common. Like many other nations, Iran has overcapacity in its fleet and fishing capacity, resulting in too many fishers chasing limited wild fish resources, while simultaneous political, social and economic pressures exist for further expansion of fishing effort. It is extremely difficult to make management decisions and proper action on resource allocation between competing user groups. In addition, environmental challenges continue, with extremely high water temperatures in summer, and environmental degradation from dredging, land reclamation and dam construction on the southern coast of the Caspian Sea.

Each coastal state in the Persian Gulf has their own legislation for fisheries management in place, but the Regional Commission for Fisheries (RECOFI) – the only regional body for fisheries management in the Persian Gulf and the Gulf of Oman – has not been successful yet in harmonizing fishery measures in the area. Overfishing and overcapacity exists in the area, yet there is no arena to negotiate a balance between fishers and living marine resources.
In order to protect fish resources in the Persian Gulf, the Iranian government recently launched a buy-back scheme for vessels engaged in bottom trawl fishing, which led to a substantial reduction in the number of steel-hulled vessels. Shrimp fisheries are open in each province (Bushar, Hormozgan, Khozistan) only on 45 days/year. If the CPUE below a certain level, the fishery will be closed.

In 2001, a jellyfish, Mnemiopsis leidyi, originating from South America, affected marine resources of the Black Sea, and from there it spread to the Caspian Sea and was identified by Iranian scientist in early 1999. This species feeds on the larvae and eggs of kilka and other fishes, which has had a negative effect on kilka resources. Catches fell from 95 000 t in 1999 to 15 500 t in 2003, although there are some signs of recovery.

In order to promote sustainable exploitation of the fish resources of the Caspian Sea, a number of preventive measures were taken, but lack of communication and collaboration among the coastal states has led to difficulties. Although official landings of sturgeon and bony fishes have reduced, illegal fishing has increased. Despite lack of proper management in the Caspian Sea, big investments have been made unilaterally through a buy-back scheme (purchasing issued fishing licences) in Iran to eliminate further erosion of the resources. Gillnet fisheries for bony fishes by the private sector are banned, because of its negative effect on the resources, especially sturgeon. In another programme in 2002, parliament gave permission to the government to reduce the kilka fishing fleet in the Caspian Sea, and about 40 vessels were bought back as their licences expired in 2003.

To counteract the reduction in sturgeon resources in the Caspian Sea, a stock enhancement programme was started in 1973, and since then millions of fingerlings have been released to the sea. In 2003, more than 13 million post-larval (>45 days) indigenous shrimp species were released in the northern side of the Persian Gulf and more than 220 million fingerlings of various fish species released to the southern Caspian Sea under rehabilitation programmes. From monitoring of landings, it is apparent that some species, including Persian Sturgeon, Caspian salmon and Kutum, derive inter alia from the rehabilitation programmes. Table 2 shows numbers of fingerlings released to the Caspian Sea between 1992 and 2002.

7.5. Aquaculture

Lakes, reservoir and pools provide a huge capacity for freshwater aquaculture round the country. Among them some 489 water bodies with an area of 0.5 million ha have a good potential for aquaculture purpose and sport fishing .At the present some 514000 ha of natural and semi-natural water bodies is in operation.
According to water temperature, inland water resources are divided into two groups:

1. Warm water and
2. Cold water bodies.

Major Chinese Carp (warm water) and Rainbow Trout (cold water) are the most important economical species in these resources provide a significant part of the country's aquaculture

products. The government invests a lot of money to supply fish fingerlings to the reservoirs. Lakes, reservoir and pools with a total area of 1.5 million hectares provide a huge capacity for freshwater aquaculture in Iran. Among them, some 489 water bodies with an area of 0.5 million hectares have good potential for aquaculture and sports fishing. At present, some 514 000 ha of natural and semi-natural water bodies are used for production.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cold water	835	1200	1500	1900	2510	4994	7000	9000	12,170	16,026	23,137
Warm water	43,288	44,728	51,554	63,229	61,964	66,137	55,862	52,987	53,843	79,084	67,811

Iran is a major producer of Chinese carps: for the year 1986-1987 aquaculture production was the largest in Southwest Asia and in 1992 at 42,420 t, it represented 50% of the production for West Asia and by value it was 62%. Yearly cultured fish production climbed from 4753 tonnes in 1985, to 15,000 t in 1986, 18,000 t in 1987, 33,684 t in 1988, 39,913 t in 1989, and to 45,134 t in 1990. In 1995, Iran had 32% of the main aquaculture production in West Asia (among Turkey, Israel, Iraq and Syria) although it had been 47% in 1984.

The decline was due to a slower growth rate. The 1995 production was 29,000 tonnes. However other sources differ with a freshwater aquaculture production of 13,615 tonnes for 1995 according to the Food and Agriculture Organization, Rome, Fisheries Department and Network of Aquaculture Centres in Asia-Pacific Bangkok (1997).

Species/Year	1991	1993	1995	1997	1999	2000	% growth 1990-2000
Cyprinus carpio	5502	4206	6561	5435	4600	7000	27
Hypophthalmichthys nobilis	983	1052	1269	1360	1150	1500	53
Hypophthalmichthys molitrix	10,019	12,619	15,228	16,310	13,800	17,000	70
Ctenopharyngodon idella	3143	3155	3942	4078	3450	2000	-36
Total	**19,647**	**21,032**	**27,000**	**27,138**	**23,000**	**27,500**	**40**

Extensive culture systems are practised in inland lakes, dams and agricultural reservoirs, especially along the Caspian coast of Iran, mainly with artificial fish stocking, utilizing government funds with fishermen's participation. In 2003, more than 23% of the total warm-water aquaculture production came from reservoirs and natural and semi-natural waters. Most of the reservoirs are stocked mainly with Chinese carp (common carp, silver carp, bighead carp and grass carp). In 2002, to conform to the FAO statistical guidelines for data collection, there was a change in categories, as a portion of the production from inland waterbodies was now classed as aquaculture.

Aras Dam in west Azerbaijan Province, Hamon Lake in Sistan and Baluchistan, Hoor-al-Shadegan and Hoor-al-Hovize in southern Khuzestan are the main large waterbodies for fish stocking and inland fisheries.

Hosseinzadeh (2003) gives the following figures in tonnes for total fisheries production in Iran (note that southern waters are marine captures):

Province/Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fars	219	118	104	148	203	410	350	491	717	1066	1174
Tehran	297	302	250	308	283	365	368	495	339	638	691.8
Bakhtiari	25	39.5	70	70	105	220	271	381	468	707	1104.6
Mazandaran	20	57	97	150	140	141	170	196	346	740	844.5
Azarbayjan (west)	4	4	30	22	25	104	64	84	108	234	257.7
Lorestan	-	-	-	3	2	11.6	11	68	131	319	670
Bovir Ahmadi va Kohkiluyeh	6	9	9	53	45	39	24	52	43	124	239.2
Khorasan	18	17	18	21	32	38	35	38	55	88	174.5
Others	0	0	0	0	0	0	39	93	303	1078	1876
Total	589	546.5	578	775	835	1328.6	1332	1898	2510	4994	7032
Average (kg/cu m)	-	**9.5**	**9.5**	**9.5**	**9.3**	**10.3**	**10.7**	**11.2**	**12**	**12**	-

7.6. Opportunities in Sistan Baluchestan

Rapid increase of the population besides meeting the required needs of human beings is one of important topics to consider. In line with this, identification and utilization of available resources are useful mechanisms to fulfill this request. Existence of plenty of agriculture water resources in the province which are used as water reservoirs, show that there is an increasing need for optimization of these resources plus using them as multipurpose for aquaculture. By doing so, these resources can be used for improving economic conditions of rural communities and publicizing seafood consumption among households in rural areas.

Considering that extension projects are carried out as pilot plans in different areas of the province, it is one of the most suitable mechanisms to develop appropriate aquaculture and in this regard any kind of fault would have negative impacts on this process, so the selected pond and water resources must have the following qualifications:

- Short distance with center of town to help continuous visits of Experts,
- Having a suitable access road,
- Having good water and electricity facilities,
- Eagerness of farmers to aquaculture,
- Short distance between residences of farmers to aquaculture ponds.

Majority of reservoir ponds for irrigation are filled with dust and sediments after a while and in order to prepare them, we must collect and cleanse the pond of these sediments. Also, if there is a leakage of water in the pond, first of all we must repair the pond. Then if the water is pumped into the pond, we must implement precautionary steps to avoid oil leakage into the pond and prepare it for fish release into it.

After assessing easy access of fish farmer to cheap and suitable feed and also production of feed from agriculture products of the same village (majority of farmers grow clovers for animal husbandry), the composition of fry fish release will be determined and fish release will be carried out.
In this regard, the monitoring of ponds was planned in such a way that expert could visit the ponds every fortnight and each visit included the data collection regarding physicochemical factors of water. Also, regarding feeding of fish, aeration of the ponds and increase in the biomass of ponds, some technical solutions were presented to fish farmers.

Fish consumption in Iran is very low. Per capita consumption was only 1 kg in 1980, and had reached only 6.12 kg in 2003. Inland communities have no tradition of fish eating and prefer other sources of animal protein. Coastal communities prefer fish. Very little data are available on processed fish, which is a minor activity, with the exception of canning, which has been increasing. Processing plants have developed alongside increased shrimp catches for export, and most of the shrimp plants have EU certification and the potential to export their product to any market.

Fish marketing and distribution is poorly developed. In 1998, the Iranian Fisheries Organization created a new position in its organization for directing and improving fish marketing in Iran. Since then marketing has become a major priority in fisheries development. Most people in Iran live in central cities and have beef and chicken in their diet rather than fish or fisheries products. The type of food they usually cook and their culture has harmonized with red meat. Fish is of little interest, even having a negative image in some parts. Therefore, changing the diet and eating habits of people in these areas requires long-term planning and significant investment.

The main international market for Iranian fish and fish products is Europe, especially through Spain. There have been some recent attempts to enter the Japanese and the USA markets, but quantities are small.

Fisheries is a minor component in the national economy, being 0.23% in 2002. Fisheries income in the agricultural sector is about 2.2% of total agriculture value. Although there is potential for fishing and aquaculture, the market is not ready for fish consumption and, culturally, fish is not acceptable in many populated area, especially in the central cities.

A major objective of national policy since 2000 has been to increase annual per capita fish consumption in non-coastal cities in Iran, with a target of 10 kg in 2009. Exports of seafood are allowed only when there are adequate supplies to meet local demand, with the exception of some species, namely: shrimp, cuttlefish, squid, hair tail, catfish, lobster and of course caviar and sturgeon flesh that are export commodities. Because of the proximity of other states in the southern part of the Persian Gulf, some other species, such as silver pomfret, Indian threadfin, seabream, snapper and grouper go to these markets without official permission and custom procedures. In 2003, the total value of recorded fishery trade was US$ 139 million.

The fisheries industry has shown substantial development in recent years, reflecting the privatization process implemented as part of the First Five-Year Development Plan (1986–1990). In the period 1986–1999, fisheries production including aquaculture increased from 1154 195 t/yr to 409 400 t/yr, but since then it has remained stable, with a small increase to 440 835 t in 2003. There

was a sharp increase in fish landings from industrial fleets, attributable to the launching of the deep-sea fishing programme, whereby entrepreneurs were encouraged to venture into the deeper waters of Iran's coastal waters in the Arabian Sea and Indian Ocean to fish the big pelagic species, e.g. tuna. The tuna catch went from 54 415 t in 1997 to 119 248 t in 2003.

Exports of sturgeon fish and fish products have fluctuated since 1989 due to decline and recovery of sturgeon stocks. After an increase from US$ 49 million in 1989 to US$ 63.5 million in 1990, it decreased to US$ 52 million in 1994 and to US$ 45 million in 1995 (mainly due to reduced caviar production). Since then, there has been a steady increase, to US$ 55.5 million in 1999 and then back to US$ 32.7 million in 2003. Caviar accounted for nearly 41% of fish exports in 2003, and shrimp culture has extended its position in non-oil exports of the country to more than 40%, worth US$ 32.7 million, with a promising future for foreign exchange earning in the agricultural sector. In 2003, about US$ 69 million of fish products, mainly fish meal, were imported to Iran, and about US$ 80.8 million was exported, representing a sectoral positive trade balance of US$ 11.6 million. The imported fishmeal is mainly used for poultry, and some for aquaculture.

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THE RAMSAR CONVENTION

Convention on Wetlands of International Importance especially as Waterfowl Habitat

The Contracting Parties,

- RECOGNIZING the interdependence of Man and his environment;
- CONSIDERING the fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna, especially waterfowl;
- BEING CONVINCED that wetlands constitute a resource of great economic, cultural, scientific, and recreational value, the loss of which would be irreparable;
- DESIRING to stem the progressive encroachment on and loss of wetlands now and in the future;
- RECOGNIZING that waterfowl in their seasonal migrations may transcend frontiers and so should be regarded as an international resource;
- BEING CONFIDENT that the conservation of wetlands and their flora and fauna can be ensured by combining far-sighted national policies with co-ordinated international action;

Have agreed as follows:

Article 1

1. For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.
2. For the purpose of this Convention waterfowl are birds ecologically dependent on wetlands.

Article 2

1. Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance, hereinafter referred to as "the List" which is maintained by the bureau established under Article 8. The boundaries of each wetland shall be precisely described and also delimited on a map and they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands, especially where these have importance as waterfowl habitat.
2. Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included.
3. The inclusion of a wetland in the List does not prejudice the exclusive sovereign rights of the Contracting Party in whose territory the wetland is situated.
4. Each Contracting Party shall designate at least one wetland to be included in the List when signing this Convention or when depositing its instrument of ratification or accession, as provided in Article 9.
5. Any Contracting Party shall have the right to add to the List further wetlands situated within its territory, to extend the boundaries of those wetlands already included by it in the List, or, because of its urgent national interests, to delete or restrict the boundaries of wetlands already included by it in the List and shall, at the earliest possible time, inform the organization or government responsible for the continuing bureau duties specified in Article 8 of any such changes.

6. Each Contracting Party shall consider its international responsibilities for the conservation, management and wise use of migratory stocks of waterfowl, both when designating entries for the List and when exercising its right to change entries in the List relating to wetlands within its territory.

Article 3

1. The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.
2. Each Contracting Party shall arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference. Information on such changes shall be passed without delay to the organization or government responsible for the continuing bureau duties specified in Article 8.

Article 4

1. Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening.
2. Where a Contracting Party in its urgent national interest, deletes or restricts the boundaries of a wetland included in the List, it should as far as possible compensate for any loss of wetland resources, and in particular it should create additional nature reserves for waterfowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat.
3. The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna.
4. The Contracting Parties shall endeavour through management to increase waterfowl populations on appropriate wetlands.
5. The Contracting Parties shall promote the training of personnel competent in the fields of wetland research, management and wardening.

Article 5

1. The Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna.

Article 6

1. There shall be established a Conference of the Contracting Parties to review and promote the implementation of this Convention. The Bureau referred to in Article 8, paragraph 1, shall convene ordinary meetings of the Conference of the Contracting Parties at intervals of not more than three years, unless the Conference decides otherwise, and extraordinary meetings at the written requests of at least one third of the Contracting Parties. Each ordinary meeting of the Conference of the Contracting Parties shall determine the time and venue of the next ordinary meeting.
2. The Conference of the Contracting Parties shall be competent:

3. to discuss the implementation of this Convention;
4. to discuss additions to and changes in the List;
5. to consider information regarding changes in the ecological character of wetlands included in the List provided in accordance with paragraph 2 of Article 3;
6. to make general or specific recommendations to the Contracting Parties regarding the conservation, management and wise use of wetlands and their flora and fauna;
7. to request relevant international bodies to prepare reports and statistics on matters which are essentially international in character affecting wetlands;
8. to adopt other recommendations, or resolutions, to promote the functioning of this Convention.
9. The Contracting Parties shall ensure that those responsible at all levels for wetlands management shall be informed of, and take into consideration, recommendations of such Conferences concerning the conservation, management and wise use of wetlands and their flora and fauna.
10. The Conference of the Contracting Parties shall adopt rules of procedure for each of its meetings.
11. The Conference of the Contracting Parties shall establish and keep under review the financial regulations of this Convention. At each of its ordinary meetings, it shall adopt the budget for the next financial period by a two-third majority of Contracting Parties present and voting.
12. Each Contracting Party shall contribute to the budget according to a scale of contributions adopted by unanimity of the Contracting Parties present and voting at a meeting of the ordinary Conference of the Contracting Parties.

Article 7

1. The representatives of the Contracting Parties at such Conferences should include persons who are experts on wetlands or waterfowl by reason of knowledge and experience gained in scientific, administrative or other appropriate capacities.
2. Each of the Contracting Parties represented at a Conference shall have one vote, recommendations, resolutions and decisions being adopted by a simple majority of the Contracting Parties present and voting, unless otherwise provided for in this Convention.

Article 8

1. The International Union for Conservation of Nature and Natural Resources shall perform the continuing bureau duties under this Convention until such time as another organization or government is appointed by a majority of two-thirds of all Contracting Parties.
2. The continuing bureau duties shall be, *inter alia*:
   to assist in the convening and organizing of Conferences specified in Article 6;
   to maintain the List of Wetlands of International Importance and to be informed by the Contracting Parties of any additions, extensions, deletions or restrictions concerning wetlands included in the List provided in accordance with paragraph 5 of Article 2;
   be informed by the Contracting Parties of any changes in the ecological character of wetlands included in the List provided in accordance with paragraph 2 of Article 3;
   to forward notification of any alterations to the List, or changes in character of wetlands included therein, to all Contracting Parties and to arrange for these matters to be discussed at the next Conference;
   to make known to the Contracting Party concerned, the recommendations of the Conferences in respect of such alterations to the List or of changes in the character of wetlands included therein.

Article 9

1. This Convention shall remain open for signature indefinitely.
2. Any member of the United Nations or of one of the Specialized Agencies or of the International Atomic Energy Agency or Party to the Statute of the International Court of Justice may become a Party to this Convention by:
3. signature without reservation as to ratification;
4. signature subject to ratification followed by ratification;
5. accession.
6. Ratification or accession shall be effected by the deposit of an instrument of ratification or accession with the Director-General of the United Nations Educational, Scientific and Cultural Organization (hereinafter referred to as "the Depositary").

Article 10

1. This Convention shall enter into force four months after seven States have become Parties to this Convention in accordance with paragraph 2 of Article 9.
2. Thereafter this Convention shall enter into force for each Contracting Party four months after the day of its signature without reservation as to ratification, or its deposit of an instrument of ratification or accession.

Article 10 bis

3. This Convention may be amended at a meeting of the Contracting Parties convened for that purpose in accordance with this article.
4. Proposals for amendment may be made by any Contracting Party.
5. The text of any proposed amendment and the reasons for it shall be communicated to the organization or government performing the continuing bureau duties under the Convention (hereinafter referred to as "the Bureau") and shall promptly be communicated by the Bureau to all Contracting Parties. Any comments on the text by the Contracting Parties shall be communicated to the Bureau within three months of the date on which the amendments were communicated to the Contracting Parties by the Bureau. The Bureau shall, immediately after the last day for submission of comments, communicate to the Contracting Parties all comments submitted by that day.
6. A meeting of Contracting Parties to consider an amendment communicated in accordance with paragraph 3 shall be convened by the Bureau upon the written request of one third of the Contracting Parties. The Bureau shall consult the Parties concerning the time and venue of the meeting.
7. Amendments shall be adopted by a two-thirds majority of the Contracting Parties present and voting.
8. An amendment adopted shall enter into force for the Contracting Parties which have accepted it on the first day of the fourth month following the date on which two thirds of the Contracting Parties have deposited an instrument of acceptance with the Depositary. For each Contracting Party which deposits an instrument of acceptance after the date on which two thirds of the Contracting Parties have deposited an instrument of acceptance, the amendment shall enter into force on the first day of the fourth month following the date of the deposit of its instrument of acceptance.

Article 11

1. This Convention shall continue in force for an indefinite period.

2. Any Contracting Party may denounce this Convention after a period of five years from the date on which it entered into force for that party by giving written notice thereof to the Depositary. Denunciation shall take effect four months after the day on which notice thereof is received by the Depositary.

Article 12

1. The Depositary shall inform all States that have signed and acceded to this Convention as soon as possible of:
   b) signatures to the Convention;
   c) deposits of instruments of ratification of this Convention;
   d) deposits of instruments of accession to this Convention;
   e) the date of entry into force of this Convention;
   f) notifications of denunciation of this Convention.

2. When this Convention has entered into force, the Depositary shall have it registered with the Secretariat of the United Nations in accordance with Article 102 of the Charter.