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A Review of Freshwater Fish Fauna in Jordan

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Abstract: A total of 27 fish species belonging to ten families were recorded. The fish fauna distribution in two rivers (Jordan and Yarmouk) and some dams and tributaries in Jordan was examined. The rivers surveyed were generally shallow, fast flowing with clear water and rocky and sandy substrate. At the time of survey, the rivers gave excellent water quality data. Cyprinidae has the highest diversity 0.296% with 8 species; while the lowest one are Anguillidae, Blennidae, Clariidae, Mugilidae and Pseudocrenilabrinae; each represented only by one species (0.037%). Cichlidae represented by 6 species (0.222%), Balitoridae and Cyprinodontidae are represented by three species (0.111%) and finally Acanthuridae is represented by two species (0.074%).

Key words: Review % Freshwater % Fish % Fauna % Jordan

INTRODUCTION

Location, Topography and Climate: Jordan is a relatively small country situated at the junction of the Levantine and Arabian areas of the Middle East. The country is bordered on the north by Syria, to the east by Iraq and by Saudi Arabia on the east and south. To the west is Israel and the occupied West Bank, while Jordan's only outlet to the sea, the Gulf of Aqaba, is to the south. Jordan occupies an area of approximately 96,188 square kilometers including the Dead Sea, making it similar in size to Austria or Portugal. However, Jordan's diverse terrain and landscape belie its actual size, demonstrating a variety usually found only in large countries [1,2].

The Jordan Valley, which extends down the entire western flank of Jordan, is the country's most distinctive natural feature. The Jordan Valley forms part of the Great Rift Valley of Africa, which extends down from southern Turkey through Lebanon and Syria to the salty depression of the Dead Sea, where it continues south through Aqaba and the Red Sea to eastern Africa. This fissure was created 20 million years ago by shifting tectonic plates [3,4].

The northern segment of the Jordan Valley, known in Arabic as the Ghor, is the nation's most fertile region. It contains the Jordan River and extends from the northern border down to the Dead Sea. The Jordan River rises from several sources, mainly the Anti-Lebanon Mountains in Syria and flows down into Lake Tiberias (the Sea of Galilee), 212 meters below sea level. It then drains into the Dead Sea which, at 407 meters below sea level, is the lowest point on earth. The river is between 20 and 30 meters wide near its endpoint. Its flow has been much reduced and its salinity increased because significant amounts have been diverted for irrigational uses. Several degrees warmer than the rest of the country, its year-round agricultural climate, fertile soils, higher winter rainfall and extensive summer irrigation have made the Ghor the food bowl of Jordan [5].

Western Jordan has essentially a Mediterranean climate with a hot, dry summer, a cool, wet winter and two short transitional seasons. However, about 75% of the country can be described as having a desert climate with less than 200 mm. of rain annually. Jordan can be divided into three main geographic and climatic areas: the Jordan Valley, the Mountain Heights Plateau and the eastern desert, or Badia region [3,5].

The Jordan River ends at the Dead Sea, which, at a level of over 407 meters below sea level, is the lowest place on the earth's surface. It is landlocked and fed by the Jordan River and run-off from side wadis. With no outlet to the sea, intense evaporation concentrates its mineral salts and produces a hypersaline solution. The sea is saturated with salt and minerals–its salt content is about eight times higher than that of the world's ocean–and earns its name by virtue of the fact that it supports no indigenous plant or animal life. The Dead Sea and the neighboring Zarqa Ma'een hot springs are famous for their therapeutic mineral waters, drawing visitors from all over the world [1,2].

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Problems and Threatening Factors Facing Fish Fauna in Jordan: The gravest environmental challenge that Jordan faces today is the scarcity of water. Indeed, water is the decisive factor in the population/resources equation. Whereas water resources in Jordan have fluctuated around a stationary average, the country's population has continued to rise. A high rate of natural population growth, combined with periodic massive influxes of refugees, has transformed a comfortable balance between population and water in the first half of this century into a chronic and worsening imbalance in the second half. The situation has been exacerbated by the fact that Jordan shares most of its surface water resources with neighboring countries, whose control has partially deprived Jordan of its fair share of water. Current use already exceeds renewable supply. The deficit is covered by the unsustainable practice of overdrawing highland aquifers, resulting in lowered water tables and declining water quality [5,6].

On a per capita basis, Jordan has one of the lowest levels of water resources in the world. Most experts consider countries with a per capita water production below 1,000 cubic meters per year to be water-poor countries. In 1997, Jordanians consumed a total of 882 million cubic meters (MCM). In 1996, per capita share of water was less than 175 for all uses. This placed Jordan at only 20 percent of the water poverty level. The extent of the crisis is further demonstrated by the fact that, from the 1997 total of 882 MCM, around 225 MCM was pumped from ground water over and above the level of sustainable yield. Likewise, about 70 MCM was pumped from non-renewable fossil water in the southeast of the country. Jordan is also entitled to build a series of dams on the Jordan and Yarmouk rivers to impound its share of flood waters. To this end, the Karama Dam in the Jordan Valley has been built to stor 55 MCM of water, mainly from the Yarmouk and its yield will be used to help irrigate some 6000 hectares in the southern Jordan Valley, these new sources of water will be a sources of fresh water fishes [5,6].

Perhaps an even greater threat to Jordanian fauna and flora is the loss of habitat. Historically, Jordan used to be renowned for its forests and verdant vegetation. Yet today Jordan's forests are much reduced in area. The main causes of deforestation have been cutting trees for wood, clearance for crop cultivation and the prevention of regeneration by overgrazing. The years 1908-17 were one of the most destructive periods for Jordanian forests, as the Ottoman Turks carried out massive felling operations to fuel their Hijaz Railway from Damascus to Madina.

The Major Threats to Fresh Life and Fisheries Include: Over-fishing of high value from fresh water and coastal resources; Destruction of water habitat though inadequate anchoring practices; Coastal erosion and depletion of mangroves; By-catch of non targeted or protected species; Use of illegal fishing gears and fishing out of season and introduction of alien fish species.

Legislative Conservation: The National Strategy presents specific recommendations for Jordan on a sectoral basis, addressing the areas of agriculture, air pollution, coastal and marine life, antiquities and cultural resources, mineral resources, wildlife and habitat preservation, population and settlement patterns and water resources. The plan places considerable emphasis throughout on the conservation of water and agriculturally productive land, of which the contamination or loss of either would bring swift and significant consequences to Jordan [1,2,5,6].

The document is a long-term environmental blueprint for government, NGOs, private sector businesses, communities and individuals. It also contains a wealth of information about Jordan's natural and socio-economic environment. The strategy is predicated on the fundamental principle of sustainable development, which the report defines as "development which increasingly meets human needs, without depleting the matter and energy of the ecosystem upon which development is founded. An economy which develops sustainably would be designed to perform at a level which would allow the underlying ecosystem to function and renew itself ceaselessly.

For Jordan, environmentalism is neither a luxury nor a trend destined to go out of style in time. The country's scarce resources and fragile ecosystems necessitate a viable and ongoing program of action covering all aspects of environmental protection. In order to maintain a viable resource base for economic growth, as well as to preserve the region's natural heritage, Jordan became the first country in the Middle East to adopt a national environmental strategy. With help from the International Union for the Conservation of Nature (IUCN), in May 1992 a team of over 180 Jordanian specialists completed a practical and comprehensive working document entitled National Environment Strategy for Jordan.

The Jordanian habitat and its wildlife communities have undergone significant changes over the centuries and continue to be threatened by a number of factors. A rapidly expanding population, industrial pollution, wildlife hunting and habitat loss due to development have taken a toll on Jordan's wildlife population. Jordan's absorption of hundreds of thousands of people since 1948 has

resulted in the over-exploitation of many of its natural resources and the country's severe shortage of water has led to the draining of underwater aquifers and damage to the Azraq Oasis [5,6].

In recent decades, Jordan has addressed these and other threats to the environment, beginning the process of reversing environmental decline. A true foundation of environmental protection requires awareness upon the part of the population and a number of governmental and non-governmental organizations are actively involved in educating the populace about environmental issues. Jordan's Ministry of Education is also introducing new literature into the government schools' curriculum to promote awareness of environmental issues among the young students.

The Royal Society for the Conservation of Nature has been at the forefront of Jordanian efforts for wildlife conservation. Founded in 1966, the RSCN was the first non-governmental organization of its kind in the Arab world. The Society addresses a wide range of environmental concerns, but its primary concern is for the preservation of wildlife both on the Jordanian mainland and in Aqaba's coral reefs and coastline.

The RCSN has planned a complete system of wildlife reserves to cover the different habitats of the country. To date, six have been established, covering 1.4% of Jordan's total area. Six more reserves are planned and the total land area of the 12 reserves will cover four percent of the country. The Society's preservation programs have included notable successes such as the Arabian oryx, a locally extinct species successfully reintroduced to Jordan in 1978, preservation of the remaining wetlands area at Azraq and combining environmental preservation, archaeology and community development at the Dana Reserve.

While the RSCN's immediate and tangible goals are the consolidation and expansion of Jordan's wildlife refuge system, it also aims to increase public awareness of the importance of preserving nature. With the cooperation of the Ministry of Education, the RSCN has established over 500 nature preservation clubs in schools all over the country, with a combined membership of over 20,000 students.

Methodology

Sample Collection: Examination of commercial species selled in markets and specimens collected by fishers and local people in the area were used as suplementary contributors as well as dead specimens to the surveyor. Preserved fish specimens in Jordan Natural Hisory Museums at both Yarmouk and Mutah Universities in addition to the zoologic museum at Jordan University were used as additional records. A long range of international, regional and even local guidelines were used to identify fresh fishs pecimens [7,8,9].

Status Considerations:

Usually the Possible Status of Recorded Species Is Given as Follows:

1. VE: Vulnerable Endemic
2. O.C: Occasional
3. R: Rare
4. C: Common
5. ND: Not defined
6. NC: Not common
7. E: Endangerd

RESULTS AND DISCUSSIONS

Fish Fauna: A total of 27 fish species belonging to ten families were recorded. The fish fauna distribution in two rivers (Jordan and Yarmouk) and some other dams and related tributaries in Jordan was examined. The rivers surveyed were generally shallow, fast flowing with clear water and rocky and sandy substrate. At the time of survey, the rivers gave excellent water quality data. Cyprinidae has the highest diversity 0.296% with 8 species, while the lowest one are Anguillidae, Blennidae, Clariidae, Mugilidae and Pseudocrenilabrinae; each represented only by one species (0.037%). Cichlidae represented by 6 species (0.222%), Balitoridae and Cyprinodontidae are represented by three species (0.111%) and finally Acanthuridae is represented by two species (0.074%), all results concerning data collection were listed in Table 1.

The characteristics and morphology of the surveyed fresh water fish species observed are described in Table 1. Generally, the rivers in the study areas were swift flowing. The water at all stations was clear with sandy, gravel and rocky bottom and the banks were lined by boulders and rocks. The shore vegetation consisted of primary forest. This appearance was typical of undisturbed forest stream at higher altitudes. However, local inhabitants reported that many of the fish habitats such as pools and deep areas were covered with sediments and rocks [10,11].

Table 1: Status of freshwater fishes in Jordan and Yarmouk Rivers

Fish Family	Fish Species	Distribution	Status
Acanthuridae	*Garra ghorensis*	Restricted to springs in Dead Sea area (southern part of Jordan)	V.E
	Garra rufa	Jordan River and tributaries towards north of Jordan	V.E
Anguillidae	*Anguilla sp.*	Jordan River	O.C
Balitoridae	*Nemacheilus galilaeus*	Yarmouk river	O.C
	Nemacheilus leontinea	Jordan River	R
	Nemacheilus insignus	Jordan River tributaries	V.E
Blenniidae	*Blennius fluvitalis*	Yarmouk river	O.C
Cichlidae	*Astatotilapia flauijosephi,*	Jordan River tributaries	
	Oreochromis aureaus	Jordan river and dams	C
	Sartherodon galilaeus	Jordan River, dams	C
	Tilpa simonis	Yarmouk river	C
	Tilapia-zilli	Jordan River, dams	C
	Tristramella sacra	Yarmouk river	O.C
Clariidae	*Clarias gariepin us*	Jordan river	C
Cyprinidae	*Acanthobrma hulensis*	Jordan River tributaries	N.D
	Acanthobrma lissneri	Widely distributed in Jordan River drainage and in some dams	C
	Acanthobrma terraesanctae	Yarmouk river	C
	Barbus canis	Dams and Jordan River	C
	Barbus longiceps	Dams and Jordan River	C
	Capoeta damascina	Jordan River tributaties and Yarmouk River and Mujib	C
	Hemigrammocapoeta nana	River Jordan and River Yarmouk	NC
	Pseudophoxinus drusensis	Northern part of Jordan River basin	V.E
Cyprinodontidae	*Aphanius dispar*	Restricted to the steams	V.E
	Aphanius richardsoni	The Dead sea area	
	Aphanius sirhani	Restricted to the streams	E
Mugilidae	*Mugil cephalus*	Jordan River	O.C
Pseodocrenilabrinae	*Astatotilapia flavijosephi*	Jordan river	N.D

The physicochemical water parameters [12] for the rivers surveyed were recorded. The water temperature was generally cool, ranging from 18.3-32°C with a mean of 29.6°C for all the seasons. It was probably because the study location was at a relatively low altitude and enclosed by forest canopy in most part. Dissolved oxygen level of the water was with a mean of 6.4 mg/I, indicating not so good aeration, which attributed to relatively high temperature and slow flow rate. The mean pH of the rivers, ranged from 7.5 to 8.9 and the conductivity values were rather uniform.

The fish richness from the two rivers and the canal ranged from 1 to 8 species. However, the species collected at the study area was lower compared to other studies by Ismail, [12] Lowe-McConnell, [7] Mohsin and Ambak, [8] Nelson, [9]. The relatively low number of fish species recorded was probably due to altitude factors since the study sites were located Less than 300m above sea level. Similar observations were reported by Nyanti [10] in *Sayap Kinabalu Park* and Nyanti *et al.* [11] in *Tawau Hills Park.* They found that the species richness of fish assemblages tended to decline with depth or altitude. Although the largest number of fish species recorded was probably due to their sampling stations located at lower altitude, below 600 m, but this study areas of lower elevation generally gave relatively small number of species; this due to other factors related with the over-fishing and sometimes with slow water flow, so the use of illegal methods to catch fish was becoming a major factor contributing to the depletion of the freshwater fish resource here.

Distribution and composition of species in each habitat was closely related to various factors such as food availability, breeding sites, water current, depth, topography and water chemistry [7,8,9]. General distribution of fish species collected from the rivers was shown in Table 1. Most of the rivers studied contained fishes that were anatomically well adapted to living in a slow flowing water environment. For instance, *Garra*, *Nemachilus*, *Tilpa*, *Acanthobrma* and *Aphanius* species were aerodynamically shaped fish. Some of the fishes collected possessed a sucker structure under their body to keep them attached to the substrate in the boundary layer created by the water movement. Generally, *Nemachilus* species fed on algae growing on the rock as well as detritus and insects, it was suggested that this species could be used as a bioindicator of water quality.

All the fresh water fish species identified were listed in Table 1 with their families, distribution and status.

It is obvious that the freshwater habitat of Jordan and Yarmouk rivers was dominated by cyprinid fish (8 species) and mainly common and their abundance is relatively high. The cyprinid fish species in the studied areas are really vulnerable endemic. This family was found in all the stations surveyed. It was found that about one-third of freshwater fishes in both rivers at lower altitudes belonged to the family Cyprinidae. Although only a small number of fishes were caught, the presence of a large number of the balitoridae and cichlidae species in all rivers might indicate that the area could probably serve as a suitable habitat for this species. *Nemacheilus* species (balitoridae) were generally observed to live in swift, clear and rocky bottom streams flowing in highland tropical forest. This kind of fish appeared to be some interest in the communities living around the CRNP to culture this economically valuable fish along the river banks for food.

Some species notably the cyprinids might have the potential of being commercialised as ornamental fish. Generally, the fish fauna in the Jordan and Yarmouk rivers area was dominated by species that were anatomically adapted to live in fast flowing current with clear water and relatively not so higher dissolved oxygen concentration. Fishes living in fast flowing rivers tended to exhibit less variety because of the low variability of food supplies in such an environment. The variability of food in fast flowing streams were usually low because the fast turnover time of available food from the terrestrial inputs [10]. Constriction of the food web altered the quantity of some food and eliminated some specialised fishes [11]. Thus, the surrounding undisturbed area of Jordan and Yarmouk rivers and their surroundind areas was vitally important for fish stock to maintain.

CONCLUSION

With the Jordan and Yarmouk Rivers and related dams and tributaries, a set of policies must be formulated and approved by the governmental and nongovernmental organiosations related to four main subjects: Water Utility Policy, Irrigation Water Policy, Ground Water Management Policy and Wastewater Management Policy. With the National Water Strategy, these four policies are considered as "road map" for the future of its water sector. Other threats to fresh life and fisheries include: Over-fishing of high value marine and coastal resources; Destruction of water habitat though inadequate anchoring practices; Coastal erosion and depletion of mangroves; By-catch of non targeted or protected species; Use of illegal fishing gears and fishing out of season and introduction of alien fish species.

The surrounding undisturbed area of Jordan and Yarmouk rivers are vitally important in maintaining fish stock. The fishes in the upper rivers were dominated by the family cyprinidae and Cyprinodontidae. These species have evolved a variety of mechanisms to adapt to living in swift flowing mountain rivers. The cyprinid fish such as *Acanthobrma hulensis* and *Barbus canis*, Cyprinodontidae such as *Aphanius dispar* known as one of the most commercially important fishes, were found in all the rivers studied. It was recommended that further studies should be done to develop techniques for culturing this exotic fish. The use of illegal methods to catch fish should be banned in the area to prevent further depletion of freshwater fish resources in the rivers and streams of these rivers and surrounding areas.

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