

Study of Non-native Fish in the Rivers of Tehran Province

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Research

Abstract

Background: Invasive non-native species are non-native animals or plants that have the ability to spread, causing damage to the environment, the economy, our health, and the way we live. The freshwater ecosystems of IRAN are an enriched habitat for different endemic fishes which are valuable in many aspects. More than 202 valid species are reported from inland waters of Iran of which 39 are endemics and 23 are exotics. There are many reasons for introductions: reservoir stocking programs, aquaculture, sport fishing, control of disease vectors, and the pet trade. Known impacts of exotic fishes include native species extinction, changes in competition and predation rates, immunological perturbations, the introduction of diseases and parasites, hybridization with native species, and changes in fisheries composition.

Methods: Research in the field of inland marine waters, environmental status, and attention to the management of rivers and aquatic are fundamental. For this purpose, ecological and biological studies, as the most basic viable studies, on every living thing prepares the ground for environmental and fisheries goals. Concerning this issue in this research, it has been tried to study the four rivers, Jajrud, Lar, Hableh Rud, and Nimrud.

Result: After conducting research, the results of this study showed that seven species of non-native fish belonging to the families of salmonoid, Cyprinidae and Loach fish were caught and identified in the rivers of Tehran province and also, the results of this study led to the identification of 7 non-endemic fish species of 6 gender and three families in these zones.

Conclusions: They threaten our native plants, animals, and habitats, often by displacing native species and dominating habitats. The solution to these problems must involve the following: (1) better enforcement of legislation

governing the sale and transport of live organisms, (2) development of native-species aquaculture.

Keywords: Salmonidea, Cyprinidae; Nemacheilidae; Oxynoemachilus; Non-endemic.

Introduction

IRAN in a zone of major zoogeographical interchange and its significant biodiversity has long been of interest to naturalists and scientists [1]. The freshwater ecosystems of Iran are an enriched habitat for different endemic fishes which are valuable in many aspects. The confirmed freshwater fishes of Iran comprise 202 species in 104 genera, 28 families, 17 orders, and 3 classes found in 19 different basins. There are also 23 species whose presence in Iranian waters needs confirmation by specimens [2]. New fish species are being described from this country almost every year, but population growth, demands for aquaculture, fish introductions and translocations, drought, pollution, and habitat destruction have marked effects on Iran's freshwater and have changed fish compositions. Moreover, the taxonomic problems of some taxa still need to be resolved. This paper presents an updated checklist of Iranian freshwater fishes including non-endemic species, with notes on taxonomy [3]. Fish are of the earliest known vertebrates that have been born, and today, with about thirty thousand species, the most abundant vertebrate group, i.e., slightly more than half the number of living vertebrates, and are distributed in various habitats [4].

Taxonomic studies in diverse groups of vertebrates, i.e., fish, gain valuable information. Fish are a diverse group in number, size, shape, and habitat [5]. Eleven thousand five hundred species of these fish live in sweet waters; the study of fish in aquatic ecosystems

is essential in evolutionary terms [6]. Sweet water's fishes live in rivers and lakes with a salinity of less than 0.05%, and their longer lifespan is in inland waters. According to FAO studies in 2012, most fish species belong to freshwater. In terms of the physiological structure, they are different from saltwater fish, and in recent years, freshwater fish stocks have contributed a large share of animal protein [7].

Iran is located in a region that is very important in terms of animal geography. However, there is little information about the fauna of its fish that is highly interesting and diverse. Studies on river fish communities have been shown that non-biological factors such as temperature, water flow rate, and river bed type have been effective in the distribution and abundance of different fish species, which also affects species richness, species diversity, and fish production in different parts [7]. Considering the extent of the aquatic ecosystem in Iran, fishes have great diversity. Domestic water, including rivers, springs, streams, lakes, and ponds, are the most important freshwater resources that have a considerable portion of the fish population and are very important in terms of ease of access and study. Rivers are more interested than any other aquatic environment in the country because they have more easy access. The number of species and their structure is two important principles in any animal society, and the diversity of species indicates the stability of an ecosystem and its communities and processes. The presence of various fish species in each part of a river explains the changes in the environmental conditions of that section. As a result of the construction of the dam and the many changes in water intensity, there is a possibility that some species will disappear, and their biological and demographic characteristics will change. Therefore, investigating the changes of species and frequency in a region is important [8]. In recent decades, many non-native fishes have been intentionally or unintentionally introduced to domestic water in Iran [7].

Given the importance of this freshwater ecoregion, the frequent threats caused by the introduction of non-native species [9] may lead to negative impacts on the endemic fish fauna, thereby increasing the risk of extinctions [10-13]. Indeed, there is an increasing need for empirical research on the invasion process in the river's ecoregion. The introduction of non-native species causes environmental, economic, and social problems; for this purpose, the biodiversity of non-native fish species in the rivers of Tehran province is examined. For this purpose, the biodiversity of non-native fish species in the rivers of Tehran province is examined.

Materials and Methods

Collect samples

At first, based on the possibility of access, the natural condition of the area, vegetation cover, slope of the land, joining of sub branches to the main branch, the velocity of water flow, vegetation, and riverbed, stations were identified in the Understudy Rivers. For this purpose, four stations were considered in the Jajrud River, two stations in Lar River, four stations in the Hablehrood River, and two stations in the Nimrud River. Table 1 shows the names of different stations in each river. The samples were randomly collected and consisted of the male and female populations and different sizes to study different parameters. The fish may be identified with the initial observation at the sampling site. The living specimens must be moved fast to the laboratory [14] (Table1).

The sampling operation was carried out monthly and did not perform in mountainous regions due to the frost in the months that were not possible for sampling. An electric shocker was used to catch fish. Figure 1-6 shows a picture of the electro shocker. During sampling, the temperature of the water and the environment was measured by the thermometer.

Samples were collected after gathering in glass sampling containers, or plastic bin and sampling site properties such as a river, lake, local name, geographical latitude and longitude, sampling Province, sample collection date, or even some tips on habitat and color of samples were labeled with the tag. The sampling operation was carried out monthly and did not perform in mountainous regions due to the frost in the months that were not possible for sampling. An electric shocker was used to catch fish. Figures shows a picture of the electro shocker. During sampling, the temperature of the water and the environment was measured by the thermometer.

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The method of fish identification

To identify some fish and understand the biological factors governing their environment, measuring the distance between different parts of the fish body and the lifespan of each of them has particular importance.

In this study, meters were used to evaluate biometric traits.

Table1. Geographical location of rivers

Geographical location	Station	River
35°69'56"	Fasham	Jajrud
35°73'26"	Saeedabad	
35°66'71"	Khojir	
35°47'28"	Pakdasht	
35°57'44"	Zarindasht	Hablehrud
35°51'95"	SiminDasht	
35°63'65"	Khomedeh	
35°69'51"	Anzaha	
35°45'00"	Pleur	Lar
35°53'45"	Lar	
35°72' 51'	Nimrud	Nimrud
35° 74' 55'	Arjmand	



Figure 1: Image of a caught pond fish.



Figure 2: A picture of a caught spiralin fish.



Figure 3: Image of a caught Capoeta (Capoeta aculeata).



Figure 4: Picture of a caught Goldcorp.



Figure 5: An image of the caught Carassius fish species.

In addition to examining the morphological attributes including body shape, body-color, mouth shape, type and number of fins and form of placement of meristematic or counting traits such as the number of soft and hard rays of fins and biometric traits such as total length, standard length, fork length, head length, etc. were examined.

In general, in the fish body, the head, body, tail, and fins can be distinguished. The head is from the tip of the snout to the end of the gill cover, the body is from the end of the cover to the extension of the anus, and the tail is from the anus to the end of the caudal fin [15] (Figure 7).

In addition to measurable characteristics, the count of some parts in fish helps to identify and classify fish so that the counting of (hard and soft) radius of fish fins, type, and the number of squamous, or the indentations and color of the body is of a diagnostic of importance. To species identify, according to the critical meristic data such as indentations on the lateral line, the formula for the radiuses of the dorsal and anal fins, pharyngeal teeth, gill spines, the number of mustaches, and descriptive traits such as the number and position of fins, the type of fillets, and so on, reference identification keys such as the book of Iranian inland water fish and the book of freshwater fish were used [16-17].

To determining the status of species identified in different classes of the IUCN from article [17] the Atlas of fish in the southern basin of the Caspian Sea

and the Atlas book of Iranian Fish [18-19].

Results and Findings

Sampling results from different stations show that non-native species have been lived in the understudy river, which is presented below:

Classification of non-native fishes in the rivers of the Tehran province

Non-native fish caught in the rivers of Tehran province were first classified after identification; as a result, it is shown in (Table 2).

Jajrud River: At different stations studied in the Jajrud River, following the fishing and detection of fish, the following results were obtained (Table 3).

As shown in Table 3, rainbow trout were caught at Saeedabad and Khajir stations, and at Pakdasht station, species of goldfish and pond Carassius fish were caught. No non-native fish were caught at Fasham station.

Hableh Roud River: The following results were obtained at various stations studied in the Hableh Roud River after fishing and fish identification operations:

The following results were obtained at various stations studied in the Hableh Roud River after fishing and fish identification operations (Table 4).

Table 4 shows that rainbow trout have been caught in Zarrin Dasht and Simin Dasht stations, and no non-native fish have been caught in Khamadeh station.



Figure 6: Barbeled loach species with the scientific name *Oxynemacheilus angorae*.

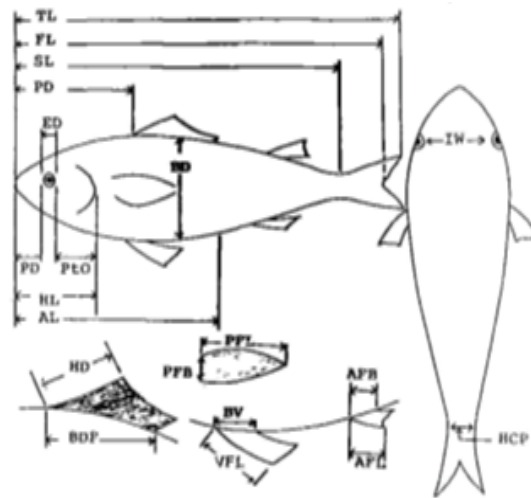


Figure 7: Biometrics of pats and methods of counting and measuring in a bony fish [16].

Table 2. Classification of non-native fishes in the rivers.

type	branch	subbranch	Above class	class	order	family	genus	specis
anim al	chorda ta	vertebrat es	Gnathostom ata	Bon y fish	Salmonidae-like	Salmonidae	Oncorhynchus	mykiss
							Salvelinus	fontinali s
					Cyprinidae-like	Cyprinidae	Carassius	auratus
							Carassius	Carassiu s
							Capoeta	aculeata
							Alburnoides	eichwald ii
Cypriniform es	Nemacheilid ae	Oxynoemachi lus	angorae					

Table 3. Results of non-native species in the studied stations of the Jajrud river.

Persian name	scientific name	Family name	Number of non-native species	Station name
-	-	-	-	Fasham
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Saeedabad
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Khojir
Goldfish (Karas)	Carassius auratus	Cyprinidae	2	Pakdasht
bouere Carassius fish	Carassius carassius			
			4	Sum

Lar River: At the two stations surveyed on the Lar River, after the fishing operation and the identification of fish, the following results were obtained (Table 5).

As shown in Table 4, at the Lar station, five species of fish were caught, of which three species belong to the

Cyprinidae family, one species belongs to the loach fish family, and one species belongs to the Salmonidae family. Nevertheless, no non-native fish were caught at the Polour station.

Nimrod River: After fishing and description fish, the

Table 4. HablehRoud non- native species.

Persian name	scientific name	Family name	Number of non- native species	Station name
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Zarindasht
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Simindasht
-	-	-	-	Khamadeh
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Enzeha
			1	Sum

Table 5. Lar River non- native species.

Persian name	scientific name	Family name	Number of non- native species	Station name
-	-	-	-	Polour
Juibar dogfish	Oxyneomachilus angorae	Nemacheilidae		
Capoeta capoeta	Capoeta aculeata			
spirlin	Alburnoides eichwaldii	Cyprinidae	5	Lar
bouere Carassius fish	Carassius auratus			
Brook fish (pond salmon)	Salvelinus fontinalis	Salmonidea		
			5	Sum

following results were obtained at the two stations studied in the Nimrud River (Table 6).

As shown in Table 6, the only non-native species in Nimrud and Arjmand stations is the rainbow trout.

Due to the above results, the number of non-native species caught in rivers studied in recent research is shown in Table 7. As can be seen, there are six species of non-native fish at rivers of the Tehran Province (Table 7).

Morphological and ecological characteristics of the studied fish

Specifications of salmoniformes: The order includes five families: The Salmonidae family, the Thymalidae, the Osmeridae, the Esocidae, and the Umbridae family. Among the families mentioned above, only the families of *Esox lucius* and dogfishes do not have fat fins, and other families have fat fins. The fat fins are located in the Intermediate between the dorsal fin and tail of these fish and do not have hard and soft rays [20].

General specifications of the salmonidae: The salmon family has seven genera named *Salmo*, *Hucho*, *Oncorhynchus*, *Salmothymus*, *Salvelinus*, *Stenodus*, and *Coregonus*.

The salmons comprise about 66 species and live in the cold and oxygen-filled waters of the Northern Hemisphere. Only two species of the salmons include the Caspian Sea trout and the *Salmo trutta fario* are

native to Iran. However, other salmon species have been identified with a percentage of different success in Iran's inland waters. These fishes have features that distinguish them from other fishes. Except for their heads, their body surface is covered with scales; they have a fatty fin, they have a complete and distinct lateral line, have free gill membranes, they have pyloric appendages (210-11), three of the vertebrae of the spinal cord are located in the caudal stem. The female fish of this family do not have an egg-laying duct, and the eggs fall after they ripen in the abdominal cavity and then are directed out of the genital tract. Therefore, it is possible to easily remove the eggs from the body of the female fish by dragging the hand on the hypogastrium of the mature female fish. They have large swim bags, small dorsal fin with a low radius (less than 17). In the salmon family, there are anadromous lift migratory fish that enter fresh water to spawn from the sea. Besides, Potamodromous migratory fish are found in the waters of rivers and lakes, and only in their habitat, which is freshwater, do they migrate to the upstream. The spawning season is often the season of autumn and winter [21].

The colorful rainbow trout with the scientific name *Oncorhynchus mykiss* and the English name rainbow trout: In appearance, it has an elongate body and developed fins, with eight numbers, and includes two thoracic fins, two ventral fins, an anterior fin, and two dorsal fins. The other dorsal fin is small and without radius and on the caudal peduncle, known as a fat flap, which is the

Table 6. Results related to non-native species in the studied stations in Nimrud river.

Persian name	scientific name	Family name	Number of non-native species	Station name
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Nimroud
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Arjmand
			1	Sum

Table 7. Results related to non-native species in the studies rivers in the present study.

Persian name	scientific name	Family name	Number of non-native species	Station name
rainbow trout Goldfish (Crucian)	Oncorhynchusmykiss Carassius auratus	Salmonidee	3	Jajroud
bouere Carassius fish	Crassius carassius	Cyprinidae		
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	HablehRoud
Jubar dogfish	Oxymelanus angorae	Nemacheilidae		
Capoeta capoeta	Capoeta aculeate			
Spiralin	Alburnoides eichwaldii	CYprinidae	5	Lar
bouere Carassius fish	Carassius auratus			
Brook fish	Salvelinus fontinalis	Salmonidea		
rainbow trout	Oncorhynchusmykiss	Salmonidea	1	Nimrus

main characteristic of all salmonids. Rainbow trout has a large mouth open to a large extent when hunting prey due to the jawbone's looseness and hunts' big prey. The primary color of the head and the edges of the fish body is a bright yellow color, which above its sideline, many dark spots are visible. The color of its body varies in different rivers and is very dark in rivers that are in shadow. The length of this fish is 40 cm in length, and its weight reaches 1.3 kilograms. This fish has 63-61 vertebrae, 19-gill spines, and 48 pylorus appendages. Like most salmonids, it has sharp teeth which are placed on the Vomer of the mouth-above [22] (Figure 8).

Pond salmon with the scientific name *Salvelinus fontinalis* and the English name brook trout:

Brook trout are native species to North America's freshwater. The best water to breed such water is spring or well. The optimum temperature range for this fish is between 5 and 12 ° C with a maximum of 16 ° C. This type of fish cannot grow condensed. Its growth rate is slow but slower than the growth of rainbow trout. In terms of quality of meat, this kind of fish is very welcomed. Brook trout has a dark brown olivaceous upper body and an orange olivaceous lower body. Pale spots on the head and tail. What distinguishes this fish from brown trout is the cream marks on the back and dorsal fin. Besides, the shape of this fish is a branch, and its jaw is vast and continues to the back of the eyes. This fish is considered to be old at the age of four or five. The typical size is 25 - 30 cm and is recorded and recorded at a maximum of 6 / 6 kg [23] (Figure 1).

Specifications of cypriniformes order: The members of this order are freshwater fishes and from other orders, and by having beaver are different (a

small set of bones that connect the middle ear to the swim bladder). In this order, the ventral fins are often located in the ventral part, behind the pectoral fins. There are often no thorns, and if there are, there is only one (there are sometimes two thorns on the dorsal fin). Abdominal fins have no thorns, and the shoulder girdle often includes a middle clavicle. The fish in this group do not have a butterfly base bone, but they do have a butterfly orbital bone. The body is covered with circular scales or bare or covered with bony plates. Cyprinidae inhabits the waters of North and South America, Europe, Africa, Asia, and Australia are mainly indicators of freshwater. This order has a different external appearance, but most have eruptionable mouths and lack of teeth and have characteristic pharyngeal teeth. Their head is non-scale, except for a few species of Loach fishes, all without fat fin [24].

General characteristics of the cyprinidae family:

Cyprinidae family is one of the most influential families of the fish, and its members are scattered around the world. Members of this family are the most original freshwater species, but they live in brackish water. Members of this family can be identified based on pharyngeal teeth and thin lips (usually found on the border of the upper jaw only in the prefrontal bone). The spindle-shaped body to relative tall, large eyes, clear scales, pelvic fins in the abdomen and smallmouth, lower or semi-lower are of the features of this family. The upper jaw is edged, and the mustache, if present, is no more than two pairs (except for Gobiobotia). There are limited to one to three rows of pharyngeal



Figure 8: Picture of a caught rainbow trout.

teeth (less than 7 in the most extensive series [25])

The swim bladder is often released without a bone capsule. Usually, they have semi gills and bodies covered with scales and rarely naked. The first, second, third and fourth radius in dorsal and anal fins is hard, and the first radius of the ventral fin and the first (or first and second) radius of the thoracic fin may be hard. The last two radii of the dorsal fin (often the anus fin) are often thin, unconnected, bony, and rarely become a thorn. Sometimes in the dorsal region, it is serrated, and its tip is sharp or flexible. There are 1 to 2 hard radius and 6 (rarely 4 to 10) soft radius in the ventral fin. Most of them are hunters, who feed on the day from invertebrates, but some are meat-eaters, others feed on algae, higher plants, and organic sap [25].

Spirlin fish with the scientific name of *Alburnoides eichwaldii*: The swollen body and middle mouth and Horizontal mouth gap can be seen. The color of ventral and anal fins tends to be reddish. The body height is high, and there is a dark stripe on either side of the sideline. The main characteristic of this fish is the black sideline. During mating and spawning on the lateral line, dark stripes appear Dark-colored stripes extending from the gill cover to the base of the tail fin. The maximum body size is 15 cm [26].

They have pharyngeal teeth. This fish lives in middle and upper parts of oxygen-rich rivers with rocky and stony bed collectively. This species is observed in clear water and rivers or aqueducts with rapid water flow. Feed on a large value of aquatic insects. Breeding is in the spring, and the peak of the spawning period is in Ordibehesht. (Figure 4) [26].

Capoeta with the scientific name of *Capoeta aculeate*: The body is extensive, and the mouth is

large and horseshoe. The lower lip is horny and sharp and has a pair of barbels. It has a dorsal fin and a conical tail fin. Body-color is gray on the back and silver on the sides, and the abdomen is white. The body is covered with large scales. The anus is located in front of the base of the aneurysm, and the body length reaches 20 cm. According to this study, the lateral line is 52-36: L.L. The last hard radius of the dorsal fin is thick and serrated, with long teeth and a small distance, but not complete. In smaller fish, the teeth are relatively larger and more comprehensive than the larger fish. The main row of teeth in large fish is spoon-shaped with a broad crown. The number of the spine vertebrae is 39 to 44, and the number of gill spines is 16 to 25, which are shorter. The food of this fish includes filamentous algae, plant pieces, and diatoms. Their reproduce period is in the spring, but their spawning period is from Esfand to Tir. The peak of the spawning of the females is in Ordibehesht and males in Farvardin [27] (Figure 3).

Goldfish or golden carp with the scientific name *Carassius auratus* and the English name Goldfish

This species has diploid and triploid types. Diploid specimens have created Subclass C. a. *auratus*, which has been introduced to Iran from Western Europe or learned from water resources as vast as Iran's water bodies. Tripleploid specimens created the subclass C. a. *gibelio* and introduced it to Iran from Eastern Europe. So, this is not a native of Iran. The dorsal fin has 3 to 4 hard radius and 12 to 20 soft radii, and the anus fin has 2 to 4 hard radii (usually 3) and 5 to 6 soft radii (usually 5). The scale's number of sidelines is between 21 and 36. The anterior edges of the scales are wavy and have a limited number of succeeding and anterior radii. The radii of the gill are extensive and have a jagged inner edge. These radii

appear in the young fish to the 5th to the eighth thorn. The number of gills radius depends on fish size and ranges between 35 and 54. The vertebrae spine has 25 to 34 vertebrae. The formula for pharyngeal teeth is 4-4, and these teeth are long, thin, flat, and have a vertical tip. The maximum length of the fish was 52 cm in length, and its maximum weight was 5 kg (Figure 4) [28].

Carassius fish or pond Carassius with the scientific name *Carassius carassius* and the English name Crucian carp: This fish is often mistaken with common carp. Nevertheless, common carp has two barbells in the side of the mouth, which is not seen in this fish. Crucian carp had thicker and fleshy body than common carp. The dorsal fin has 3 to 5 hard radii, and 15 to 19 soft radii (average 14) and the anus fin has 2 to 3 hard radii and 5 to 6 soft radii (usually 5). The number of scales in the lateral line is 28 that is variable to the top and bottom of the number 5 to 7. The number of radii of the first-gill bow in adults is 39 to 50. The small swim bladder is located in the posterior part of the body and is a conic section [29].

In this subspecies, the last non-branched radius of the dorsal and conical fins is harder than the *C. Carassius* species, and its rough edge has more serrulation. These teeth start with a wide range of radius base. The dorsal fin is thin and has a considerable distance from the head. The dorsal fin cleft in this subspecies is more profound than the *C. Carassius* species. The spinal vertebrae range between 29 and 31 vertebrae. The body thickness is 1.2 to 2.7 of the body lengths, which in the widespread species; this value reaches 2.9 of the body lengths. In species with high body height, the body's length is doubled or more than twice the body thickness. The sides of the body are silver, sometimes black or gold. This fish prefers stagnant waters, cold and natural pools for life, but its habitat is not effective in the taste and flavor of fish meat. Feeding of this species is often from plant and animal plankton. While the main food is made by aquatic plants, *Carassius* Fish can live out of the water for a long time, and in this mode, are more active than common carp. Maturity is achieved in the fourth year of life; of course, some species may mature at the age of three or two (Figure 5) [29].

Specifications of Cyprinodontiformes orders: The swim bladder lacks the lumen, and the ventral, dorsal fins are located in the abdomen with more than 70 radii. The fins do not have thorns, and the pectoral fins are above their vertical base. The jaws do not cover the edges of the mouth. They often have no sidelines, and the chest fin has four radii. Pelvic fins in these fishes are degenerated and do not present

in some species. The scales are usually circular, but in male fish, there are several ctenoid species. The caudal fin is symmetrical and often rounded. They lack the middle clavicle bone of the pelvic girdle on the abdomen and the Hedgehog – Butterfly and the intercostal bones, and the bones lack cells. They are generally known omnivore, but many of their species are highly efficient predators that feed on insects. Omnivore is one of the characteristics that allow them to live in harsh and changeable environments. Of these orders, eight families live in tropical and warm regions, in the Brackish and freshwater waters and the seas [30].

Barbeled loach fish with scientific name *Oxynemacheilus angorae*: It has three pairs of barbels, and its standard length is 8/5 times of the length of the caudal tail. The dorsal and dorsal fins are almost round, and the body is covered with small dark brown spots. On the caudal tail, there is a sharp hump like a crown. This species is seen in the upper and middle parts of rivers with the stony and rocky bed (Figure 6) [31].

Discussion

Research in the field of aquatic animals, their environmental condition, and attention to the management of rivers and aquatic is fundamental. For this purpose, ecological and biological studies, as the most available necessary studies, on every living thing prepares the ground for environmental and fisheries goals.

The studies on four rivers of Jajrud, Lar, Hablehe Rud, and Nimrud showed that seven non-native species of fish belonging to the families of Salmonidae, Cyprinidae, and loach fishes were caught and identified in the rivers of Tehran province.

In the Jajrud River, after passing of Latian dam and crossing the two farms of rainbow trout in two stations of Saeedabad and Khojir, these fish species are caught, which indicates the escape of fish from fish farms. The reason for this claim is the lack of this species in the upstream, which is pristine, and there is no farm in those areas. In the case of Fasham station, no non-native species were caught. In the downstream of the Jajrud River, at Pakdasht station, two species of goldfish and pool carp or *Carassius* were caught due to the presence of residential houses in the Parchin area and the release of feast night fish. In these areas where rapid local access to the river is possible, the release of fish by people is particularly evident in Farvardin (Novruz).

In the Lar River, five species of non-native fish *Oxynemacheilus angorae*, *Alburnoides eichwaldii*,

Carassius auratus, *Capoeta aculeate*, and *Salvelinus fontinalis* were caught and identified. The absence of non-native fish led to the growth of salmon *trutta fario* as a single species, but non-native species also found in this study. The mode of arrival of non-native species in the region is unknown and may have entered into the environment as prey by the hunters whom a fishing license had been issued. In the case of *Salvelinus fontinalis*, this fish has evolved to develop into Iran, which, owing to its appearance, is likely to leave one of its growers in the Lar River to continue to grow organically. Thus the tracks of this fish are opened to the important river Lar. In the Hableh Rud River, similar with the Jajrud River, due to the perch of several rainbow trout farms on the river path (Simin Dasht, Zarrin Dasht, and Enzeha stations), the mentioned species was caught in the studied stations, but in Khumadeh, No traces of non-native species were found.

In the Nimrud River, in both Nimrud and Arjmand stations, rainbow trout, fugitive fish from farms in the area were caught and identified.

Yousefi Siahkalroodi et al. reviewed the faunistic of fish species of the Seymareh dam in Ilam province. They showed that the *Carassius* fish, along with other farmed fish, came to the Seymareh Dam. This result is consistent with the results of the recent study at the Pakdasht station from the Jajrud river and the Lar river, which can be justified with the release of feast night fish in every new year [32].

In a study named "Frequency and Biodiversity of Rivers of Fish species in Hazar River in Mazandaran Province," showed that *Oncorhynchus mykiss*, *Carassius auratus* and *Liza Saliens*, *Gasterosteus aculeatus* and *holbrookii* *Gambusia* are non-native [33].

The first species in Jajrud, Hableh Rud, and Nimrud rivers corresponded to the present study. The second species, *Carassius*, was caught in Pakdasht station from Jajrud and Lar River.

Abbasi, K. by identifying and examining the fish population of Aq Gol, Pir Salman lagoons, wetland areas, and Gamasiab and Khorramabad rivers of Hamadan province, indicate that among the species identified in the river, four species were non-native: *Carassius auratus*, *cyprinus Carpio*, *Pseudorasbora parva* and *Gambusia holbrookii*. These results were in line with the recent study at the Pakdasht station on the Jajrud River and the Lar River, where *Carassius* were caught [34].

Rainbow trout have been reported in the waters of the Caspian Sea basins, Lake Urmia, Salt Lake,

Kerr River, Zayandeh Rud River (Isfahan), and North Karun Basin. These sites consist of a number of rivers in Alborz and Zagros Mountains and a number of sluices. In more than four years, nearly 2 million finger-fed juveniles were released in 20 different locations (except for breeding farms of this species), especially in the highlands of fish-free mountains; subsequently, productive populations have been reported to have originated in places such as Gohar Lake, Nimrud, Jajrud, Madarsu River of the Golestan National Park, Dez River, and Bazoft Water [14].

In the study of fish in the rivers in question, 7 species were identified and 6 genera and 3 families. In addition to the species diversity that these families have, it shows their optimal biological conditions and their high adaptability to environmental conditions. Most members of the fish family eat everything, which is an important reason for the survival of members of this family. The presence of non-native fish in addition to changes in the habitat of native fish endangers the competition for life and survival for native fish. The presence of invading and non-native fish in aquatic ecosystems causes destruction of habitat and spawning sites, disruption of water quality, food competition with native fish, creating of the hybrid generation, and introduction of parasite and new pathogenic agent. In a study entitled "Study of species diversity and abundance of fish in the Persian Gulf Martyrs Lake, in Chitgar, Tehran, studied the species composition and abundance of the Chitgar Lake fish population? They selected 34 stations in the lake's water body, and the sampling was carried out with surrounding and throwing gillnets. In this study, 18 species of fish, including 11 species of Cyprinidae family, one species of Cichlidae, one species of Loricariidae, one species of Pangasiidae, one species of Serrasalminidae, one species of Poeciliidae, one species of Salmonidae, and one species of Scaridae were identified. Among these fish, only one species of native fish named *Capoeta bonsai* was seen. Most of the lake's fish are included invasive and non-native species: *Hemiculter Leuciscus*, *Hohenackeri Alburnus*, *Carassius auratus*, *Carassius Gibelio*, and *Pseudorasbora Parva*. In the siege with a surrounding net, the most abundant fish were *Hemiculter Leuciscus* fish with 62% and *Hohenackeri Alburnus* with 35%. In fishing with the gillnet, these two fish were present with 69 and 12% frequency, respectively. Eventually, with the throwing net, *Hohenackeri Alburnus* with 38%, *Pseudorasbora Parva* with 21%, and *Hemiculter Leuciscus* with 17% had the largest population in the coastal area. The least common were ornamental fish such as Parrotfish and *Pangasius hypophthalmus*. More than 90% of the fish population is invasive and non-native. Therefore,

the presence of invasive fish and the lack of predatory fish may increase the trophic level in the Chitgar Lake [35].

According to what is mentioned, the study of fish in the canvases of aquatic systems is vital for investigating the evolution, ecological, ethology, conservation, water resources management, resource utilization, and fish farms. Also, despite the growing pressures on current limited resources due to population growth, fishes have received more attention than other aquatic animals because of their importance in human nutrition and protein supply, and there is an urgent need for a better understanding of aquatic biota and their environment. To apply correct management, understanding biology, and having sufficient and appropriate information about the aquatic life is very important. Today human intervention to natural capacities of resources are caused many problems such as excessive exploitation, increasing development activities in sensitive ecological regions, land-use change, development of industrial and agricultural activities, illegal hunt and its likes, and finally, the destruction of natural ecosystems along with decreasing in population and some cases the extinction of many plant and animal species. Lack of sufficient knowledge of the biological diversity of the fishes of the rivers and their status will also cause no proper management and Operation of Rivers are carried out [15].

Water resources of Tehran province can be classified into two categories: groundwater and surface water resources. The Alborz heights in the north of the province have provided favorable conditions for precipitation and formation of permanent and lush rivers. Several permanent and seasonal rivers in the province are used to make the plain drinkable and to extract it for agriculture, drinking, and industry. Hableh River, Shoor River, or Abhar River, Lar River, Jajrud, Nimrud (Firoozkooh), and Kan River are among the most crucial land flows in the province. These rivers, in terms of bed structure, hydrologic characteristics, and having potential biological potentials such as high self-purification power and rich oxygen, ecologically, the ecosystem has been adapted to a variety of aquatic species. Unfortunately for various reasons such as the establishment of service units, agricultural lands, rural residential centers, the entrance of different types of urban and agricultural sewages, illegal catch and arrival of non-native fish, aquatics habitats of the above rivers have been threatened so that there is a significant decrease in the populations of some species of aquatic species [15].

Conclusion

In general, the results of this study resulted in the identification of 7 non-native fish species from 6 genera and three families in these regions. The identified families were Cyprinidae, Salmonidae, and Cobitidae, of which 4, 2, and 1 species of each one were found, respectively.

Among the non-native fishes, the highest rate has belonged to rainbow trout that was caught from the Jajrud rivers (Saeedabad and Khajir stations), Hableh Rud (Zarrin Dasht, Simin Dasht, and Enzeha stations) and Nimrud (Nimrud and Arjmand stations).

Non-native fish entering rivers may compete for food and spawning places with indigenous fish. Some of them are capable of hybridized with native fish, so their identification and monitoring of their effect on water resources are essential.

The ecological study of non - native fish and the study of their food and reproductive competition with indigenous fish.

Investigation of molecular studies of non-native species, with the aim of studying their population. This species, the most widely distributed exotics within the state, have had negative impacts on fisheries and on fish species compositions in reservoirs. The solution to these problems must involve the following: (1) better enforcement of legislation governing the sale and transport of live organisms, (2) development of native-species aquaculture.

According to the studies carried out in this study, the following suggestions are recommended by those interested:

Investigating the final status of non-native fishes in the rivers of Tehran province and other rivers of the country, to find ways of entering rivers and managing indigenous fish stocks.

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