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Identification and Distribution of Fish Fauna in Kaboodval Stream (Golestan Province, Iran)

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Abstract: In order to identify and estimate the population of fish and relationship to environmental factors were studied in the Kaboodval stream, from summer 2009 to spring 2010. Specimens were caught by electrofishing (DC, 200-300V). Results showed that four species of fish have been identified including: Spirlin (*Alburnoides eichwaldii*), sand goby (*Neogobius fluviatilis*), loaches (*Paracobitis malapterura*) and capoeta (*Capoeta capoeta*). The estimated population was calculated as for density in different seasons. Sand goby and spirlin was caught the highest frequency in all four seasons so that sand goby were dominant species. At some seasons, loaches and capoeta has also been observed. In general, many environmental factors such as substrate type, water velocity, vegetation, water depth and temperature play a role in the distribution of fish in this stream.

Key words: Fish · Abundance · Distribution · Kaboodval stream · Golestan province · Iran

INTRODUCTION

The deliberate or accidental introduction of species outside their native range is a key component of the human induced biodiversity crisis, harming native species and disturbing ecosystems processes [1-3]. Although fish are the most diverse and most abundant vertebrate in world and about 40 percent of them live in freshwater but in many parts of the world like Iran, are not enough consistent and appropriate action for further studies to identify and protect them yet. Although few people have been interested to studies of ichthyology, but these studies did not have the necessary continuity [4]. In the water sources, rivers are the greatest feature and the most beautiful landscape of nature [5] and a main factor in urban and rural, agriculture and industry developments and are also important from biodiversity, fishing, tourism, etc. These ecosystems receive agricultural activities, industrial and domestic sewages from the basin and transport to the sea [6]. Several studies have addressed the influence of environmental features on fish assemblages along a river continuum as well as the implications of these changes for environmental and resource assessment. The species life history and temporal variation in fish assemblages are affected by flow regime, channel morphology, physicochemical factors and resources availability. The relative influence of each variable varies with stream size, discharge, geomorphology and pollution [7]. The structure of stream fish assemblages may be a result of stochastic factors, such as disturbance and deterministic interactions, such as competition and predation [8] in addition to the physical and chemical environment [9].

At first, for optimum utilization of water resources must have sufficient, comprehensive and adequate knowledge and according to the fragile ecological recirculating water such as rivers, streams etc., is more delicate and precise action to be identified. Study of fish in aquatic ecosystems are important for evolution, ecology, behavior, conservation, water resources management, resource utilization and aquaculture [10] and in fisheries research, before anything else are done studies on fish [11], in other words, the first step in aquatic ecosystems is to identify the species. Nowadays, understanding the factors that determine the biomass and abundance of fish populations, in fisheries science is the most important issue. One of the goals of population ecology studies is identification the adjustable parameters of distribution and abundance for organisms. The usual approach is that changes in environmental factors makes associated with changes in population size and take up the cause and effect of communication. According to

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various researchers believe that non-biological parameters such as temperature, water flow rate of the river are effective on fish species richness and abundance. Climate variability of Iran requires aquatic study specifically in each region. In addition to importance to the identification of fish species such studies can be very valuable role in promoting the development of aquaculture and finally multiply and finally, the increase in employment can be found. On the other hand, managing the successful application of the ban on fishing and reserves of natural resources depends on the identification of aquatic organisms in region. Also, despite the pressures of processes of population growth entered on present limited resources and needed to better understand the characteristics of aquatic organisms and environment that live in; in order to apply the proper management of knowledge biology and sufficient information about aquatic organisms are very important.

MATERIALS AND METHODS

The habitats located southern Alborz mountains and in terms of geographical, Watershed Kaboodval is located 54° 54' longitude and 36° 53' latitude.Kaboodval stream has been emergence of spring and after short waterway get at the waterfall, water after passing through a steep and tortuous way arrived to a more flat area. According to ecological difference such as slope and substrate, distance from mouth and access to stations during the research, to identify the species, abundance and distribution of species 5 stations were selected (Fig. 1) and seasonally sampling from summer 2010 to spring 2011 were performed.

Fish were caught by electrofishing (1.7 KW, 10A and 200-300 V). At each station doubles the size of the anode wire (40 meters) from the stream were considered to fishing that is located fishing net at the end of this section (6 mm nodes adjacent to the node) for maintenance of fish exposed to shock. In both caught in the same fishing effort to move anodes across the stream [12]. Determined of fish populations frequency in different sites based on Lee Cern [13] which was based on catch per unit effort (two catches) [14]; in this method, the following formula is used:

$$N = \frac{C_1^2}{C_1 - C_2}$$

C_1 = the number of fish in first caught, C_2 = number of fish in second catch and N = number of estimated population.

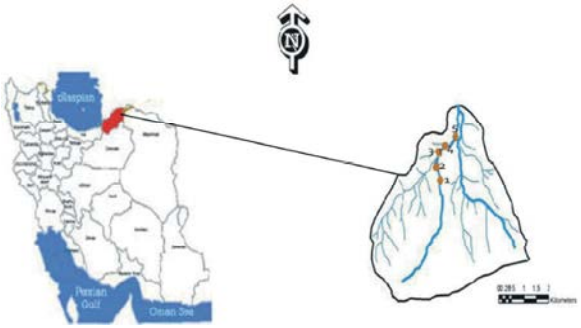

Fig. 1: Location of Kaboodval stream and its research stations

Physicochemical data of water was determined with chemical kits and Water checker device including data such as electrical conductivity, water temperature, phosphate, turbidity, pH and water temperature. Statistical relationships between environmental parameters and factors of cognitive water with fish abundance by using Conoco software were studied. With this method was made the effective role of each of the items listed in the abundance of fish. Also the relationships between environmental parameters were studied by using correlation. Data analysis by using SPSS 17 and Statistical software in levels 0.05 and were drawing diagrams by using Excel.

RESULTS

Physicochemical characteristics in Kaboodval stream due to exposure in the forest and lack of land use had not any significant changes. EC in Station 2 was the lowest value (0.28 µm/cm) and were similar at the other stations. pH between station had not the regular changes and were in change between 8.40- 8.56. Turbidity increased from upstream to downstream, only in station 5 was reduced to station 4. Phosphate in stations 2 and 3 were similar and at station 5 was the highest (Table 1).

In study of physicochemical parameters as seasonal variation, electrical conductivity (EC) and phosphate levels were not significantly different in different seasons. In summer, turbidity levels were higher than in other seasons but in other seasons change was negligible. The water temperature was almost similar in fall and spring and it was lowest in winter (Table 2).

In study the relationship between physicochemical factors in Kaboodval stream, water temperature had a significant positive correlation with turbidity and the pH was a significant negative correlation with water temperature, EC and turbidity (Table 3).

Table 1: Physicochemical characteristic differences between stations in Kaboodval stream

	Factor				
Station	Water temperature (°C)	EC (µm/cm)	Turbidity (mg/l)	pH	PO_4 (mg/l)
1	13.08 ± 1.52	0.29± 0.002	0.85± 0.17	8.5± 0.09	0.34± 0.26
2	13± 1.74	0.28±0.004	1.09± 0.21	8.55± 0.01	0.23± 0.07
3	13.45± 1.53	0.29± 0.005	1.18±0.21	8.51± 0.09	0.23± 0.13
4	14.1± 1.85	0.29± 0.002	1.42± 0.16	8.56± 0.11	0.31±0.07
5	14.05± 1.16	0.29± 0.012	1.22± 0.12	8.40± 0.16	0.5± 0.2

Table 2: Physicochemical characteristics differences in different seasons in Kaboodval stream

	Season			
Factor	Summer	Fall	Winter	Spring
Water temperature (°C)	17.8± 0.97^{a}	12.7± 0.67^{b}	10.5± 1.28^{c}	13.22± 0.29^{b}
EC (µm/cm)	0.29 ± 0.02	0.28 ± 0.007	0.29 ± 0.007	0.28 ± 0.004
Turbidity (mg/l)	1.55 ± 0.3^{a}	0.86 ± 0.17^{b}	1.06 ± 0.42^{b}	1.13 ± 0.21^{b}
pH	8.27 ± 0.12^{c}	8.79± 0.06^{a}	8.5 ± 0.11^{b}	8.46 ± 0.07^{b}
PO_4 (mg/l)	0.31 ± 0.19	0.4± 0.4	0.11± 0.1	0.49± 0.38

Means with the same superscript letters at the same row are not significantly different ($p \geq 0.05$)

Table 3: Correlation of physicochemical factors of water

Variable	Water temperature (°C)	EC (µm/cm)	Turbidity (mg/l)	pH	PO_4 (mg/l)
Water temperature (°C)	1	0.07	0.7**	-0.56**	0.16
EC (µm/cm)		1	-0.13	-0.5**	-0.33
Turbidity (mg/l)			1	-0.48**	0.11
pH				1	0.11
PO_4 (mg/l)					1

Table 4: Hydrological parameters differences between stations in Kaboodval stream

	Station				
Stream specification	1	2	3	4	5
Width stream (m)	3.59± 0.42	3.43± 0.45	2.92± 0.29	3.45± 0.34	3.36± 0.6
Stream Radius (m)	4.14± 0.44	3.66± 0.54	3.12± 0.36	3.59± 0.34	3.92± 0.5
Water Depth (m)	0.18± 0.02^{ab}	0.13± 0.01^{bc}	0.15± 0.001^{bc}	0.1± 0.007^{c}	0.21± 0.07^{a}
Beach Height (m)	0.63± 0.02^{b}	0.56± 0.01^{c}	0.49± 0.03^{d}	0.48± 0.01^{d}	1.22± 0.03^{a}
Channel gap	0.29± 0.02^{a}	0.23± 0.01^{b}	0.3± 0.002^{a}	0.21± 0.01^{ab}	0.17± 0.02^{c}
Stream Width/ Beach Width	0.97± 0.12^{a}	0.67± 0.09^{b}	0.53± 0.05^{bc}	0.49± 0.05^{bc}	0.32 ± 0.06^{c}
Discharge	0.44± 0.04	0.22± 0.04	0.15± 0.02	0.18± 0.02	0.19 ± 0.02
Velocity	0.85± 0.02^{a}	0.59± 0.006^{b}	0.42± 0.004^{b}	0.64± 0.02^{b}	0.36± 0.008^{b}

Means with the same superscript letters at the same row are not significantly different ($p \geq 0.05$)

Table 5: Hydrological parameters differences between seasons in Kaboodval stream

	Season			
Stream specification	Summer	Fall	Winter	Spring
Width stream (m)	2.65± 0.11^{c}	3.01± 0.31^{bc}	3.49± 0.09^{b}	4.35± 0.26^{a}
Stream Radius (m)	2.85± 0.22^{c}	3.35± 0.3^{bc}	3.8± 0.16^{b}	4.74± 0.26^{a}
Water Depth (m)	0.15± 0.03	0.17± 0.03	0.14± 0.01	0.15± 0.02
Beach Height (m)	0.68± 0.14	0.69± 0.16	0.67± 0.13	0.67± 0.13
Channel gap	0.23± 0.03	0.25± 0.01	0.23± 0.03	0.24± 0.04
Stream Width/ Beach Width	0.76± 0.14	0.62± 0.11	0.55±0.12	0.45± 0.08
Discharge	0.3± 0.07	0.22± 0.04	0.22± 0.04	0.19± 0.06
Velocity	0.58± 0.09	0.56± 0.09	0.58± 0.09	0.57± 0.08

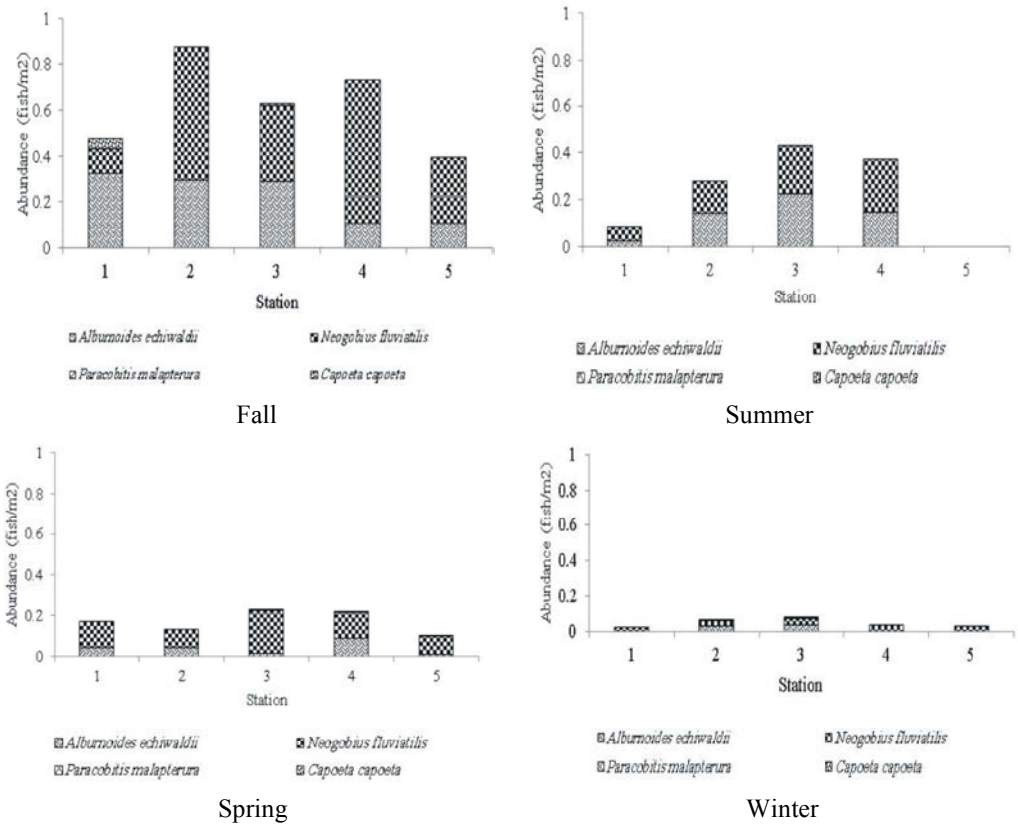

Fig. 2: Composition (m^2) of fish abundance in different seasons

The hydrological parameters at different stations were not showing any significant changes in width stream, stream radius and discharge. In station 4 water depths was lower than the other station and station 5 was highest and in stations 1, 2 and 3 were almost the same. The maximum size of channel gap and stream width to beach width ratio was in station 1 and station 5 was the lowest. Velocity at station 1 was different from the rest of stations (Table 4).

In study of hydrological parameters as seasonal variation, water depth, beach height, channel gap, stream width to beach width ratio discharge and velocity did not show any significant changes in different seasons. Stream width in spring was higher than in other seasons and in summer was the lowest. In winter and fall stream width was similar (Table 5).

Fish Abundance in Differences Season: From 5 stations sampled in different seasons in Kaboodval stream, two species of fish, including sand goby (*Neogobius fluviatilis*) and spirlin (*Alburnoidse eichwaldii*) were collected. Sand goby was estimated the dominant species of stream with highest frequency in all four seasons and five stations. In some seasons, loaches (*Paracobitis malapterura*) and capoeta (*Capoeta capoeta gracilis*) has been observed (Fig. 2).

Fig. 2 shows frequency of different species in different seasons; in summer, most of percent belonging to sand goby (24.62%). Spirlin, capoeta and loaches (respectively 36.08, 1.35 and 0.33 percent) were located in the sequence. In the autumn, winter and spring, the highest frequency belonged to sand goby (respectively 84.09, 53.75 and 24.65 percent) and spirlin were the second frequency of fish in different seasons after sand goby (summer 36.08%, fall 46.16 % winter 23.49% and spring 31.43%). Loaches frequency percent of fish showed up 0.33 % in summer, 0.47% in fall and 3.33% in spring and none of stations in winter loaches was caught. Capoeta were not found in winter and spring in any of the five stations and Prevalence rate in summer was 1.35 percent and in winter 0.94 percent.

The correlation between environmental factors and fish species by using Conoco software, were observed that presence of Spirline had significant positive correlation with vegetation and pH and presence of Loaches had the highest positive correlation with the

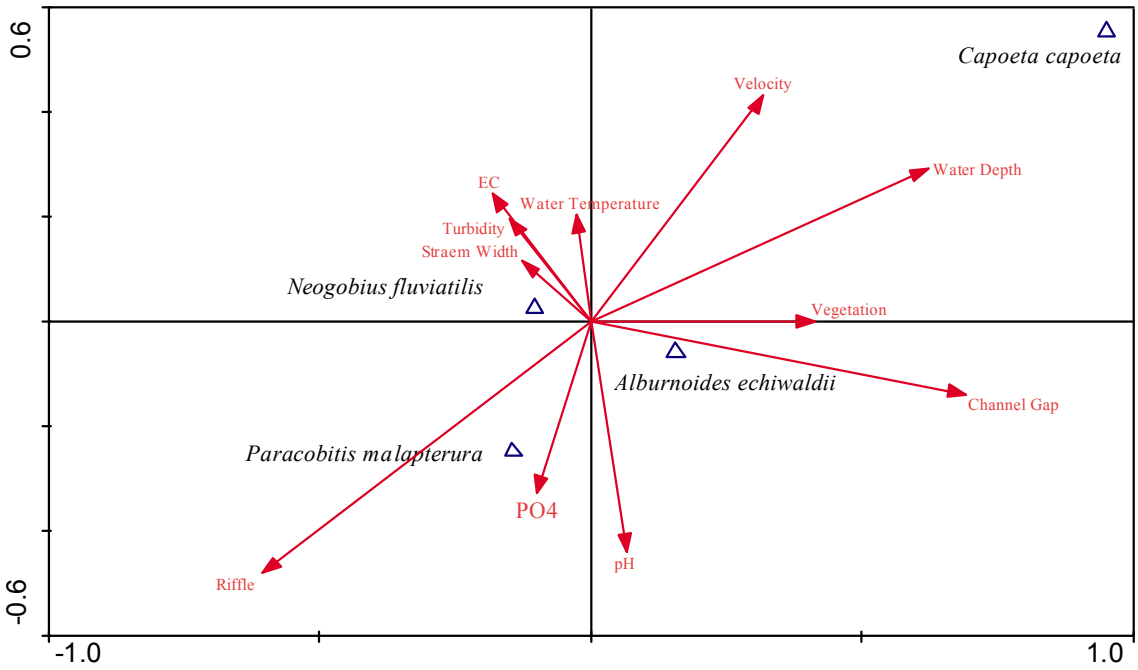

Fig. 3: Correlation between environmental factors and fish species

amount of phosphate and Riffle. Also Sand goby had positively correlated with stream width, EC, turbidity and water temperature. The presence or absences of Capoeta with environmental factors such as water velocity and water depth were positively correlated (Fig. 3).

DISCUSSION

Physicochemical conditions in the river changes with flow regimes [15, 16]. Riverine ecosystems indicate along its path changes in fish distribution and abundance patterns. Fish because of their mobility, able to choose the right place to live and Fish's ability to fight challenges of river conditions affecting the dynamics population [17, 18]. Distribution of each species limited to a certain range of latitude and longitude and it is also limited to a certain temperature range. Of course, this does not mean that determine the final location of one species (in terms of evolutionary) is preferred temperature, other factors may also be equally effective in the temperature range and species is consistent to relative the total situation in which lives it. But no doubt the temperature range where a species can live in the present is determined [14]. Studies on the fish communities in streams and rivers show, environmental factors such as temperature, velocity rate and river bed to be effective on distribution and abundance of fish [15, 19].

According to some experts [19-22] increasing water depth increases the ecological angle and these sites provide suitable shelter for often, fish species provides a habitat, provides good habitat for various species. In addition, increasing the width of the river, down the slope, decreasing altitude and increasing vegetation increased fish diversity.

Kaboodval stream has been an emergence of the spring that the water after crossing the waterfall through a steep path arrive to a more flat area with rocky bed and then is poured to hands down to the sandy beds-stone. Water temperatures along the Kaboodval stream hadn't many changes, so that the temperature of lower section varied 0.97°C to upstream. EC is a measure of the electrical conductivity of water, which represents the approximate amount of ions dissolved in water [14]. Studies in the inland waters of the United States showed that water with electrical conductivity 500-150 µm/cm is different value for fisheries and outside this range, indicating is not appropriate for certain groups of fishes and invertebrates [23]. The average annual change of EC from 0.27 to 0.29 that EC was equal to that measured in this study. It can be considered high and stable water-soluble ions and low salinity somewhat steady in Kaboodval stream. Similar studies for Kamali *et al*. [24] on Kaboodval stream was average range from 4.25 to 8.9 and weren't ordered changes and in this study the lowest average was 0.85

that it was match with Karimian [25]. This phenomenon may be attributing to seasonal precipitation and human involvement in tourism. Turbidity was high along the Kaboodval stream, which was probably due to the influence of the substrate, but downstream turbidity decreased which may be due to deposition of material transported.

Phosphorus is an important environmental factor that regulates biologically fertile lakes, streams and other water reservoirs [26]. In downstream stations in Kaboodval stream the phosphate was higher concentration. Due to the high correlation between soils with phosphorus a small amount is always released in streams, unless soil erosion occurs. Phosphorus concentrations, soluble phosphate form in non-polluted rivers and streams were expressed up to 0.1 mg/l [27]. Accordingly, as for the amount of phosphate in Kaboodval stream was not satisfactory that can result from erosion and leaching, beach and relatively low vegetation and is the result of lower utilization in this stations. In Kamali *et al.* [24] study on Kaboodval stream, phosphate concentration was increased from upstream to downstream that the range was 0.61-1.03. In the present study, phosphate concentration did not follow the regular variation and it can be attributed to agrology and geologic which were not investigated in this study.

In general, many factors such as substrate type, velocity of water, vegetation, water depth and temperature play a role in the distribution of fish and it was not easy to separate of each effect and need more research and experience in the field.

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