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Fish Species Diversity, Distribution and Abundance in Kesseliian Stream, Mazandaran, Iran

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Abstract

Fish species diversity, distribution and abundance were examined from August 2003 to May 2004 during eight sites to the Kesseliian stream of Talar River. Eight species were found in the area: *Salmo trutta fario, Alburnoides bipunctatus, Barbus lacerta, Capoeta capoeta, Leuciscus cephalus, Cobitis taenia, Paracobitis malapterurus and Neogobius fluviatilis.* This is the first reported of sighting *Salmo trutta fario* in this stream. Its fish community was dominated by 4 cyprinid species: *Alburnoides bipunctatus, Barbus lacerta, Capoeta capoeta* and *Leuciscus cephalus*. Fish species diversity increased downstream.The average Shanon-Weaver fish species diversity index ranged from 0 to 1.386. Fish species diversity was significantly related to the distance from the headstream (R^2=0.646 and p<0.05).

Keywords: Diversity, Fish, Kesseliian Stream, Iran.

تنوع زیستی، پراکنش و فراوانی ماهیان در رودخانه کِسلیان، مازندران، ایران

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چکیده

تنوع زیستی، پراکنش و فراوانی ماهیان رودخانه کِسلیان (یکی از شاخه‌های رودخانه تالار از مردادماه سال۱۳۸۲ تا خرداد ماه سال۱۳۸۳، در هشت ایستگاه مطالعاتی بررسی شد. هشت گونه ماهی در این ناحیه تشخیص داده شد که عبارت‌اند از :

Salmo trutta fario, Alburnoides bipunctatus, Barbus lacerta, Capoeta capoeta, Leuciscus cephalus, Cobitis taenia, Paracobitis malapterurus, Neogobius fluviatilis.

S. trutta fario (گونه قزل‌آلای خال‌قرمز) برای اولین بار در این رودخانه گزارش شد. بیشترین جمعیت غالب ماهیان مربوط به ۴ گونه از کپور ماهیان *(A. bipunctatus, B. lacerta, C. capoeta, L. cephalus)* بوده است. تنوع گونه‌ای ماهیان در این مطالعه به سمت پائین رودخانه افزایش داشته‌است و میانگین تنوع گونه‌ای ماهیان بر اساس نمایه شانون (Shanon-Weaver) از صفر تا ۱/۳۸۶ بوده و ارتباط معنی‌داری با فاصله از سرچشمه رودخانه نشان داده است. (R^2 = 0.646, P<0.05)

کلیدواژه‌ها: تنوع‌گونه‌ای، ماهی، رودخانه کسلیان، ایران.

Introduction

Identifying environmental gradients that influence community structure has been a major focus of stream ecology (Minshall, 1988; Power *et al.*,1988) and the distribution of fishes in small streams is characterized by large faunal changes within relatively short distances (Shelford, 1911). Hence, it provides a convenient situation for the study of gradients in species composition and diversity.

Much baseline information on species diversity and abundance is needed before these measurements can routinely by used to assess the status of the fish community. Quantitative relationships between habitat characteristics and community metrics (e.g., diversity, abundance) need to be identified. An understanding of these relationships will assist in the management of soil and water resources, and aid the development of future conceptual models.

This paper presents the results of a quantitative survey of fish distributions in Kesseliian stream in Mazandaran Province carried out from August 2003 to May 2004.

The Study Area

The Kesseliian Stream is one of the major tributaries of the Talar River in Mazandaran Province and an important Caspian Sea sub area (Figure 1).Then Physical characteristics of the study area are given in Table 1. The Kesseliian watershed supports light agriculture. Most parts of the stream run through woodland areas except the last study site which is located within the city of Shirgah.

Materials and Methods

We identified eight study sites along the stream (Figure.1) and in each site; fish were captured using an electro shocker with a direct current of 200-300 v for 200 m length of stream.

Fish specimens were preserved in 10% formalin and were identified based on the basis of Berg (1948 and 1949) and Abdoli (2000).

Due to low water discharge and the more transparent water flowing through the stream, summer season fish specimen collections were used for the required statistics. At this time of the year, the young of the year were large enough to be easily collected and identified.

species diversity index was used according to the following formulae:

$$H = -\sum p_i \log_e p_i$$ (Shanon and Weaver, 1949)

Pi = the proportion of the i^{th} species in the sample.

Stream habitat characteristics such as qualitative description of the substrate, water discharge and air and water temperature were measured. The correlation between fish species diversity and stream characteristics was calculated using linear regression model.

Results

A total of 2869 fish specimens were captured. Eight of fish representing five families were collected from August 2003 until May 2004. The persian and scientific names of the fish species as well as their presence and absence are given in Table 2.

Salmo trutta fario was recorded for the first time in this stream. The ichthyofauna was dominated by 4 ciprinids on the basis of their distributions. *Alburnoides bipunctatus, Barbus lacerta, Capoeta capoeta* and *Leuciscus cephalus* (Table 2). The results show that no fish species was captured at the first site, *S. trutta fario* was observed only at the second site and *B. lacerta* was distributed over 7 out of 8 sites. Moving from upstream to down stream, fish species diversity increased (Figure 2). Average Shanon-Weaver fish species diversity estimates ranged from 0 to 1.386.

Positive relationships between distance from the headstream and fish species diversity were found ($Y= 0.014X + 0.495$, $R^2 = 0.646$ and $p < 0.05$).

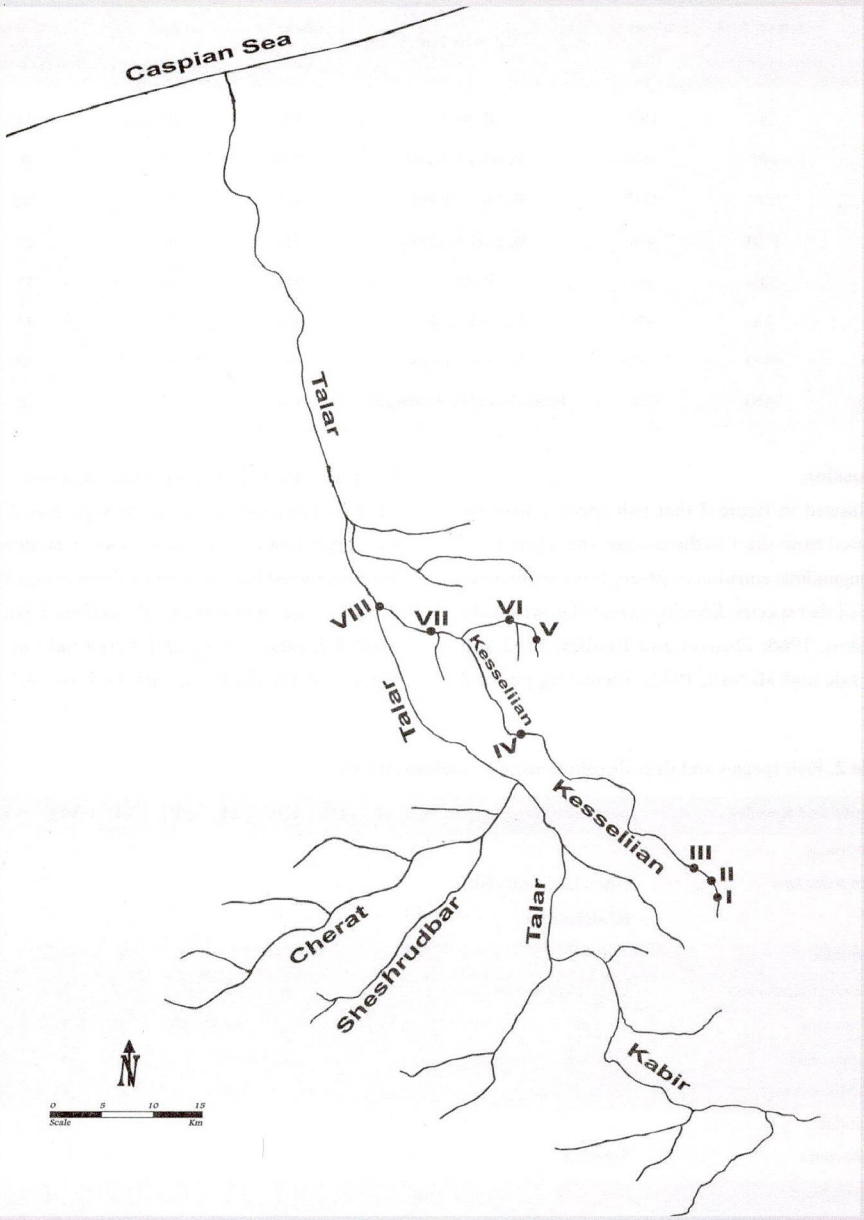

Figure 1. The study area showing the study sites (I-VIII).

Table 1. Physical characteristics of the study area in summer 2003.

Study sites	Distance from headstream (Km)	Elevation (m)	Substrate Type	Discharge (M^3/s)	Air Temperature (o^c)	Water Temperature (o^c)
I	5	1638	Bedrock	0.03	20	12
II	7.91	1330	Bedrock+Gravel	0.15	26	16
III	12.91	1117	Bedrock+Rubble	0.2	22	24.5
IV	47.91	490	Bedrock+Rubble	0.54	32	25
V	4.16	682	Bedrock	0.06	24	18
VI	7.5	450	Bedrock+Rubble	0.08	17	19
VII	60.83	372	Bedrock+Rubble	0.6	26	22
VIII	70.83	216	Bedrock+Rubble+sediments	0.6	27	29

Discussion

We showed in figure 2 that fish species diversity increased from site 1 to the last site. Investigation of the longitudinal zonation in stream fish communities revealed that species diversity increased downstream (Sheldon, 1968; Deacon and Bradley, 1972 and whiteside and McNatt, 1972). Increasing physical heterogeneity and distance were suggested sources of higher downstream diversities, presumably due to a greater variety of physical niches. Some studies have quantified habitat diversity (Tramer and Rogers, 1973; Gorman and Karr, 1978; Sheldon, 1968; Foltz, 1982; Rahel and Hubert, 1991; Reyjol and *et al.*, 2003). Of course the choice of factors to be analyzed is

Table 2. Fish species and their distributions in Kesseliian stream.

Family and Species	persian Name	I	II	III	IV	V	VI	VII	VIII
Salmonidae									
Salmo trutta fario	Ghezelala, Ghezelala-e-Khalghermez	-	+	-	-	-	-	-	-
Cyprinidae									
Alburnoides bipunctatus	Lapack(in Mazandaran)	-	-	+	+	+	+	+	+
Barbus lacerta	Blizem	-	+	+	+	+	+	+	+
Capoeta capoeta	Siahmahi, Tilkhos	-	-	-	+	-	-	+	+
Leuciscus cephalus	Mahi-e-Sefid	-	-	-	+	-	-	+	+
Cobitidae									
Cobitis taenia	Sagmahi	-	-	-	+	-	-	+	+
Balitoridae									
Paracobitis malapterurus	Sagmahi, Marmahi	-	-	-	+	+	+	+	+
Gobiidae									
Neogobius fluviatilis	Gavmahi, Saagmahi	-	-	-	+	-	-	+	+

extremely problematic, since the environmental variables in streams are typically correlated and confounded with one another (Reid, 1961). Almost any variable chosen will have some predictive value, but causation must be determined from independent observations (Sheldon, 1968).

We calculated fish diversity by distance from the source because the distance term is really a residual which can include a whole array of correlated variables (Sheldon, 1967 and Reyjol and *et al.*, 2003).

In this study, although the sampling variances of the estimates are not excessive, the estimates contain other errors which cannot be evaluated. The electric shocker is not an unbiased nor a completely effective method for collecting fish. Small fish are less vulnerable than large ones and different species are collected with quite different level of efficiency (Larimore, 1961). The exclusion of young-of- the-year from the estimates probably improved collecting efficiency over that reported by Larimore (1961).The bias cannot be measured but the relative abundance of small benthic forms is probably underestimated.

With these limitations in mind, the conclusion is that the distribution and diversity of fishes in Kesseliian stream are controlled by structural features of the habitat. Similar results have been reported by Sheldon (1968), Foltz (1982), Angermeier and Schlosser (1989) and Adebisi (1988). Refinement and extension of the structural measurements is possible since the presence of cover, such as roots and logs, produced a slight but observable increase in species diversity.

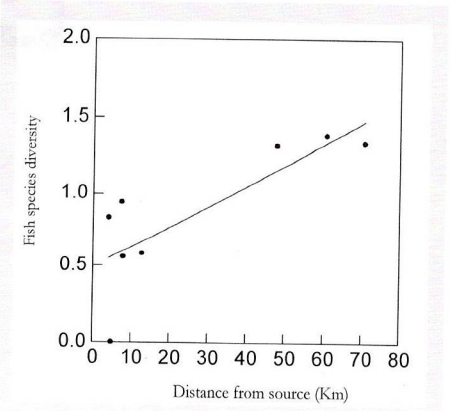

Figure 2. Regression model showing the relationship between distance from source and fish species diversity.

High water velocities seemed to reduce the effective depth, because fish cannot occupy the entire water column (Sheldon, 1968). (space)Distance from the head stream can also reduce the effective depth due to higher water velocities. In this study water velocities decreased from site 1 to site 8 and therefore very a few fish specimens were captured upstream (site 1 had none and site 2 had two species). MacArthur (1965) has discussed two components of species diversity Within - habitat component is a function of structural diversity and, for simplicity, may be viewed as a vertical property such as depth or foliage profile. Between–habitat diversity may be represented as a horizontal property. Different species may live in habitats of similar structure, thus increasing total species diversity without a corresponding increase in the diversity of localized units. The Kesseliian stream fauna also shows changes of the within habitat type.

Abdoli (1993) showed fish species diversity increased as one moves from the head stream toward the estuaries of the Sardabrud River and Chalus River. Gorman and Karr (1978) reported longitudinal changes in fish species diversity.

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References

Abdoli, A. (1993). *Ecological Studies of Fish Populations in the Sardabrud River and Chalus River, Mazandaran, Iran.* M.S Thesis. University of Tehran 94 pp.

Abdoli, A. (2000). *The Inland Water Fishes of Iran.* Tehran: Nature and Wildlife Museum of Iran. 377 pp.

Adebisi, A. A. (1988). Changes in the Structural and Functional Components of the Fish Community of Seasonal Rivers. *Arch. Hydrobiol.*, 113(3): 457-463.

Angermeier, P. L. and I. J. Schlosser (1989). Species – Area Relationships for Stream Fishes. *Ecology,* 70(5): 1450-1465.

Berg, L. S. (1948). *Freshwater Fishes of USSR and Adjacent Countries.* Trudy: ZoologIcheskogo Institute Academic, Nauk U.S.S.R., Vol. 2-3.

Berg, L. S. (1949). *Freshwater Fishes of USSR and Adjacent Countries.* Trudy: ZoologIcheskogo Institute Academic, Nauk U.S.S.R., Vol. 8: 783-858.

Deacon, J. E. and W. G. Bradley (1972). Ecological Distribution of Fishes of the Moapa River in Clark Co., Nevada. *Trans. Am. Fish. Soc.*, IoI: 408-419.

Foltz, J. W. (1982). Fish Species Diversity and Abundance in Relation to Stream Habitat Characteristics. *Fish and Wildl. Agencies,* 36: 305-311.

Gorman, O. T. and J. R. Karr (1978). Habitat Structure and Stream Fish Communities. *Ecology,* 59:507-515.

Larimore, R. W. (1961). Fish Populations and Electro Fishing Success in a Warm – Water Stream. *J. Wildl. Mgm.,* 25: 1-12.

MacArthur, R. H. (1965). Patterns of Species Diversity. *Biol. Rev.*, 40: 510-533.

Minshall, G. W. (1988). Stream Ecosystem Theory: A Global Perspective. *J. Nor. Amer. Bentho. Soc.*, 7:263-288.

Rahel, F. J. and W. A. Hubert (1991). Fish Assemblages and Habitat Gradients in a Rocky Mountain – Great Plains Stream: Biotic Zonation and Additive Patterns of Community Change. *Trans Am Fisheries Soc,* 120: 319-332.

Reid, G. K. (1961). *The Ecology of Inland Waters and Estuaries.* Reinhold, New York. 375pp.

Reyjol, Y., A. Compin. A. Ibarra and P. Lim (2003). Longitudinal Diversity Patterns in Streams: Comparing Invertebrates and Fish Communities. *Arch. Hydrobiol.,* 157(4): 525-533.

Shannon, C. E. and W. Weaver (1949). *The Mathematical Theory of Communication.* Univ. III. Press, Urbana. 117pp.

Sheldon, A. L. (1968). Species Diversity and Longitudinal Succession in Stream fishes. *Ecology,* 49:193-198.

Shelfotrd, V. E. (1911). Ecological Succession. I. Stream Fishes and Method of Physiographic Analysis. *Biol. Bull.*, 21: 9-35.

Thompson, D. H. and F. D. Hunt (1930). The Fishes of Champaign County. I11. *Nature. Hist. Surv. Bull.*, 19: 5-101.

Tramer, E. J. and P. M. Rogers (1973). Diversity and Longitudinal Zonation in Fish Populations of Two (space)Streams Entering a Metropolitan Area. *Amer. Mid. Nat.*, 90:366-374.

Whiteside, B. G. and R. M. McNatt (1972). Fish Species Diversity in Relation to Stream Order and Physiochemical Conditions in the Plum Creek Drainage Basin. *Amer. Mid. Nat.*, 88:90-101.