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Some Ecological Needs of The Species in The Aquatic Mollusca in Tunceli Region (Turkey)

Serap Koşal Şahin

Istanbul University, Department of Inland Water Resources and Management, Istanbul, Turkey

***Corresponding Author**
E-mail:serap@istanbul.edu.tr

Abstract

Total of 10 Mollusca (Gastropoda and Bivalvia) species obtained from 20 different sampling locations in Tunceli were examined to determine relationships between species and their ecological characteristics from July 2015 to June 2016. Canonical Correspondence Analysis (CCA) was applied to determine the relationships among the Mollusca fauna and physicochemical variables. CCA explained 81.897 % of the species and environmental variation by the second axis. Water temperature (T), dissolved oxygen (DO), pH and Ca^{+2} were the most influential variables on the Mollusca fauna. The influence of electrical conductivity on species distribution was significantly higher (P = 0.02) than that of the other ecological factors. The most frequently occurring species were clustered into 4 main groups based on their ecological characteristics using unweighted pair group mean averages (UPGMA).

INTRODUCTION

Benthic macroinvertebrates are currently used in lake monitoring and diferent indexes were proposed to assess the ecological status of lentic ecosystems [1]. Gastropoda is likely to be a common group of macrobenthic fauna in aquatic ecosystems. The Mollusca is an extraordinarily varied phylum with estimates of 80.000–100.000 described species and total diversity possibly as high as 200.000, they are second only to arthropods in species richness. They occupy a prominent place among aquatic organisms suitable for biological monitoring. [2-3]. They react strongly to environmental changes. This makes them suitable for studies of the relationship between organisms and environment. The distribution of freshwater snails depend on water quality, e.g. pH, DO, calcium etc. and temperature. Most live submerged, and many are specialized for particular habitats aquatic vegetation, stones, rocks, wood and other solid surfaces, or soft sediment. Most freshwater gastropods are micro-herbivorous and/or micro-omnivorous grazers feeding on bacterial films, algae and diatoms [4]. Freshwater gastropods are promising tools as pollution indicators through assessments of mollusca community composition and/or biological monitoring programs that rate water quality and status of aquatic biotopes based on invertebrate assemblages. They also have utility in monitoring and assessing the effects of endocrine-disrupting compounds and as monitors of heavy metal contamination [5-7].

MATERYAL AND METHOD

Study area and stations

Tunceli province is located at the upper Fırat River basin in the Taurus orogenic belt of the mountainous district of the Eastern Anatolia and has a rich position regarding streams. Molluca samples were collected from 20 stations. This study was carried out in three streams of Tunceli (Munzur River, Aunca Creek and Kodi Creek). Munzur River originates from the Munzur Mountain located in the north of Ovacık. Aunca Creek and Kodi Creek are the tributaries of Munzur River. A total of sixteen stations were chosen on the streams for this study; three stations on the Aunca Creek (A1-A3), seven stations on the Kodi Creek (K1-K7), ten stations on the Munzur River (M1- M10) in July 2015 and June 2016 (Figure 1). The Mollusca samples were gathered from these stations with surber net (25*25 cm). Among the sampling sites, we included a variety of different types of aquatic habitats; for example, creeks, springs, ditches, ponds, lakes, troughs, etc. The sediment was sieved by using a sieve mesh of

0.5 mm. Mollusca were preserved in 75 % ethanol. In the laboratory, they were identified and counted using a trinocular microscope. Mollusca were identified at the species level using taxonomic keys [8-10].

Figure 1. The study area and station

Physicochemical Analysis

Water samples for physicochemical analyses were collected from each station, using prewashed polyethylene bottles. Water temperature (°C), dissolved oxygen (DO mgl-1), EC (electrical conductivity µS/cm) and pH were measured by using YSI 556 model multi-parameter

instrument as in situ. The levels of NH^--N (ammonium nitrogenmgl-1), NO^--N (nitrate43 nitrogen mgl-1), NO^--N ((nitrite nitrogen mgl-1) and Ca^{+2} (mgl-1) were analysed in the laboratory according to standard methods [11]. All materials were deposited in the laboratory of Istanbul University, Faculty of Fisheries.

Statistical Analysis

The relationships between species and physicochemical variables were examined by applied Canonical Correspondence Analysis (CCA) (Figure 2). We used CCA with 10 species and the 9 influential environmental variables within 20 sites. Using quantitative data, unweighted pair group mean averages (UPGMA) applied with Jaccard's's coefficient tests were used to evaluate possible clustering relationship among the species (Figure 3). UPGMA was performed with a multivariate statistical package program (MVSP, version 3.1) [12] while CCA was done with the CALIBRATE program, version 1.0 [13] (Figure 2, Table 1). Ecological tolerance (u_k) and optimum estimates (t_k) determined with the C2 program [14] (Table 2). For all statistical analyses, we used only living species.

RESULT AND DISCUSSION

A total of 10 freshwater Mollusca taxa *Theodoxus anatolicus* (Récluz, 1841), *Bithynia pseudemmerica* (Leach, 1818), *Bithynia tentaculata* (Linnaeus, 1758), *Ancylus fluviatilis* (O.F. Müller, 1774), *Galba truncatula* (Linnaeus, 1767), *Radix ovata* (Draparnaud, 1801), *Physella acuta* (Draparnaud, 1805), *Planorbis planorbis* (Höglund, 1947), *Acroloxus lacustris* (Linnaeus, 1758), *Pisidium amnicum* (O.F. Müller, 1774), *Pisidium casernatum* (Linnaeus, 1758) were collected from 20 different bodies of Tunceli.

The mollusc species were grouped into 4 main clusters on the UPGMA dendrogram (Figure 3); 2 species (*Ancylus fluviatilis* and *Acroloxus lacustris*) were located separately. The 3 groups consist of the 2 Gastropod species (*Theodoxus anatolicus, Planorbis planorbis*) 2 Bivalvia species *(Pisidium amnicum, Pisidium casertanum*) and the 4 species (*Bithynia pseudemmerica, Bithynia tentaculata, Radix ovata* and *Physella acuta*) (Figure 3).

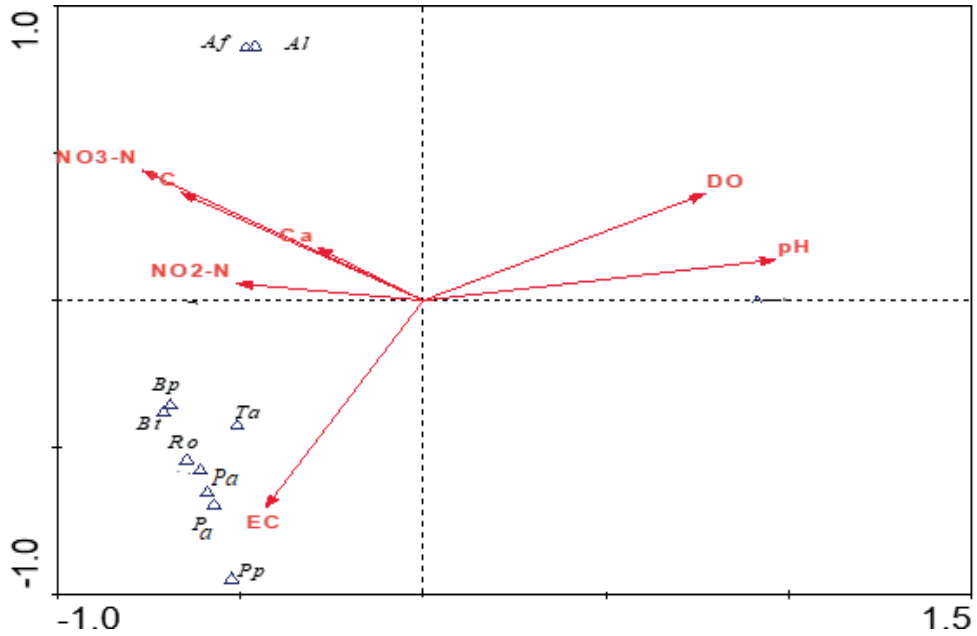

Figure 2. CCA diagram shows correlation among the seven environmental variables: Water temperature (°C), DO (dissolved oxygen mgl-1), pH, EC (electrical conductivity µS/cm), NO2- N(nitrite nitrogen mgl-1), NO3-N(nitrate nitrogen mgl-1) Ca^{+2} (mgl-1) and 10 species (Ta: *Theodoxus anatolicus*, Bp: *Bithynia pseudemmerica*, Bt: *Bithynia tentaculata*, Af: *Ancylus fluviatilis,* Al: *Acroloxus lacustris*, Ro: *Radix ovata*, Pac: *Physella acuta*, Pp:*Planorbis planorbis*, Pa: *Pisidium amnicum*, Pc: *Pisidium casernatum*).

Table 1. Two axix of CCA summary table show about 81.9 % of the corelation among eight enviromental variables and the most frequently occuring species

Axes	1	2	3	4	Total inertia
Eigenvalues	0.71	0.411	0.130	0.059	4.813
Species-environment correlations	0.76	0.675	0.486	0.529	
Cumulative percentage variance					
of species data	20.2	28.9	31.7	32.9	
of species-environment relation	60.3	80.4	81.9	78.3	
Sum of all eigenvalues					4.813
Sum of all canonical eigenvalues					1.577

Table 2. Species tolerance (tk) and optima estimates (uk) of the most common species. Abbreviations: Sp: species code; Count: number of species occurrences found among the sampling sites

	DO (mgl-1)		**pH**		**T** (°C)		**EC** (µS/cm)		**NH_4-N** (mgl-1		**NO_3-N** (mgl-1)		**NO_2-N** (mgl-1)		**PO_4-P** (mgl-1)		**Ca^{+2}** (mgl-1)	
Sp	U_k	t_k	U_k	t_k	U_k	t_k	U_k	t_k	U_k	t_k	U_k	t_k	U_k	t_k	U_k	t_k	Uk	tk
Ta	0.18	0.6	7.64	0.182	9.27	1.40	432.18	25.07	0.01	0.005	0.02	0.013	0.001	0.001	0.1	0.02	42.62	2.47
Ro	6.34	0.9	7.54	0.113	11.79	3.01	420.94	13.38	0.01	0.006	0.02	0.005	0.001	0.001	0.6	0.06	48.88	7.46
Bp	5.78	0.6	7.48	0.182	13.52	1.40	413.25	25.07	0.01	0.005	0.03	0.013	0.001	0.001	0.1	0.02	53.16	2.47
Bt	5.78	0.5	7.48	0.182	13.52	1.40	413.25	25.07	0.01	0.005	0.03	0.013	0.001	0.001	0.1	0.02	53.16	2.47
Pp	6.08	0.10	7.60	0.162	11.63	0.7	452.48	20.68	0.01	0.005	0.00	0.013	0.001	0.001	0.3	0.00	54.82	1.01
Al	6.87	0.60	7.69	0.240	10.64	1.99	396.72	67.56	0.01	0.005	0.00	0.018	0.0001	0.001	0.0	0.01	47.71	6.49
Af	5.87	0.50	7.43	0.182	10.77	1.40	430.19	25.07	0.01	0.005	0.02	0.013	0.001	0.001	0.1	0.02	53.73	2.47
Pc	5,87	0.60	7.43	0.182	10.77	1.40	430.17	25.07	0.01	0.005	0.02	0.013	0.001	0.001	0.1	0.02	53.73	2.47
Pa	5.78	0.50	7.48	0.182	13.52	1.40	413.25	25.07	0.01	0.005	0.03	0.013	0.001	0.001	0.1	0.02	53.16	2.47
Pac	5.23	0.6	7.51	0.180	11.65	1.26	411.18	25.10	0.01	0.005	0.02	0.013	0.001	0.001	0.1	0.02	53.72	2.46

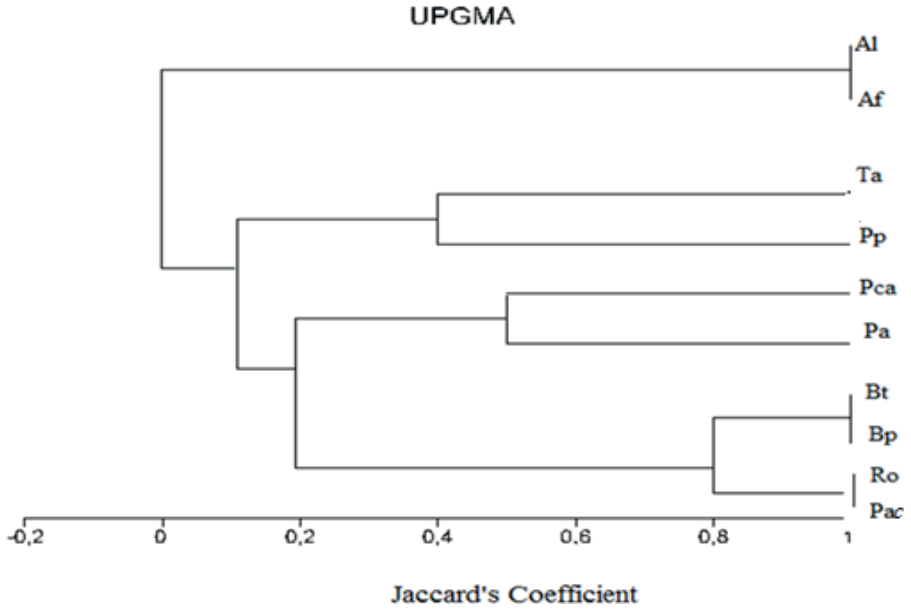

Figure 3. UPGMA diagram shows 4 clustering groups of 10 Mollusca species. Two species (Al, Af) show independent distribution.

Electrical conductivity was the most significantly influential factor on species, while the other variables showed weak or no influence. Electrical conductivity, dissolved oxygen and pH showed an inverse relationship with NO3-N ((mgl-1), NO2-N ((mgl-1) and Ca^{+2}(mgl-1).

During the present study, *Planorbis planorbis, Physella acuta, Bithynia pseudemmerica, Bithynia tentaculata, Radix ovata* showed highest tolerance to pH and DO (Figure 2). These species can tolerate lower oxygen level (5.7-6.2 mgl-1) while *Ancylus fluviatilis, Acroloxus lacustris*, prefer higher oxygen level water (8.82-10.92 mgl-1) (Table 3).

Table 3. 8 physicochemical variables from 20 different water bodies in Tunceli Region (Turkey). DO (dissolved oxygen (mgl-1), pH, EC (electrical conductivity µS/cm), NH4-N (ammonium nitrogen mgl-1), NO2-N (nitrite nitrogen mgl-1), NO3-N(nitrate nitrogen mgl-1), Ca^{+2} (calcium mgl-1), PO4 (phosphate mgl-1); 10 species (Ta: *Theodoxus anatolicus*, Bp: *Bithynia pseudemmerica*, Bt: *Bithynia tentaculata*, Af: *Ancylus fluviatilis*, Al: *Acroloxus lacustris* Ro: *Radix ovata*, Pac: *Physella acuta*, Pp: *Planorbis planorbis,* Pa:*Pisidium amnicum*, Pc: *Pisidium casernatum.*

Stations	Species	pH	DO mgl-1	EC µS/cm	NH4- N mgl-1	N03-N mgl-1	N02-N mgl-1	PO4 mgl-1	Ca^{+2} mgl-1
1	Al, Af	8.19	10.21	321.2	0.01	0.02	0.001	0.01	90.741
2	Ta, Pp, Pac	7.38	8.14	350.4	0.01	0.02	0.001	0.01	45.1815
3	Al, Af	8.93	10.03	298.7	0.01	0.03	0.001	0.01	99.9269
4	Bt,Pa,Bp	7.86	9.06	328.3	0.01	0.06	0.001	0.01	38.9698
5	Bt, Bp	8.01	8.06	296.3	0.01	0.06	0.001	0.01	64.981
6	Bt,Pa,Bp,Ro	8.04	7.07	322.8	0.01	0.08	0.001	0.01	44.0615
7	Al,Af	8.11	10.16	292.2	0.01	0.05	0.001	0.01	36.9269
8	Ta	7.91	6.2	348.7	0.01	0.01	0.001	0.01	38.9698
9	Bt,Bp,Ro	7.53	5.7	291.1	0.01	0.05	0.001	0.01	89.998
10	Pa,Pc	8.11	5.28	312.2	0.01	0.08	0.001	0.01	51.002
11	Pac	8.1	8.68	350.9	0.01	0.07	0.001	0.01	31.254
12	Ro,Bp	8.12	6.98	264.5	0.01	0.03	0.001	0.01	35.987
13	Pac	8.56	7.2	204.4	0.01	0	0	0.01	51.0659
14	Af, Al	8.58	10.15	356.9	0.01	0	0	0.01	42.9599
15	Pac, Pp	8.96	9.9	393.4	0.01	0	0	0.01	45.0001
16	Pp, Pac	8.74	8.24	310.1	0.01	0	0	0.01	42.352
17	Ta, Pa, Pc	9.16	8.19	226.8	0.01	0	0	0.01	50.9879
18	Bp, Bt	8.73	8.4	375.1	0.01	0	0.001	0.01	42.0041
19	Pa,Pp,Pco	8.98	9.8	398.5	0.01	0	0	0.01	44.9985
20	Pp, Pac	8.92	9.55	371.5	0.01	0	0.001	0.01	43.9874

Finally, nothing was known about the life cycle and ecological requirements of these Mollusca species in some countries. We found that most of these species show a wide tolerance for different water conditions, and that their prevalence shows a positive relationship with EC, Ca and some of nutrients. Although our knowledge of species ecology is still somewhat limited and results can not be generalized for many species, we assume that species with high ecological tolerances and optimum levels are not directly limited by some physicochemical parameters. However, the levels and the type(s) of such variables differ from species to species knowledge on species characteristic can help increase our understanding of aquatic gastropod and their importance in ecological and biological studies. Further detailed studies on each of these individual parameters are needed.

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