DISTRIBUTION AND ECOLOGY OF RECENT MOLLUSKS IN THE EUPHRATES RIVER – IRAQ

Khaldoun S. Al-Bassam[*] and Karim M. Hassan[**]

ABSTRACT

A reconnaissance survey in the Euphrates River from Al–Qaim to Nassiriya showed the following types of mollusks: *Corbicula (Corbicula) fluminalis* MULLER, *Unio tigridis* BOURGUIGNAT, *Mytilus* sp., *bellamya* cf. bengalensis LAMARK, *Melanoides* sp. and *Melanopsis nodosa* FERUSSAC. The distribution of these mollusks is variable in the river basin; generally the pelecypods are common in the northern sector whereas the gastropods are found in the southern sector only. The most common species in the whole river is *C. (Corbicula) fluminalis* MULLER, followed by *Unio tigridis* BOURGUIGNAT. On the other hand, *Bellamya* cf. *bengalensis* LAMARK is the commonest species in the southern sector. The distribution of these mollusks in the Euphrates River seems to be controlled by water salinity, type of dissolved salts, speed of water flow, TSS, BOD and COD contents of the river water. The northern sector of the Euphrates River is characterized by faster flow, lower salinity, better aeration, lower TSS, TDS, BOD and COD concentrations and an HCO_3, SO_4, Ca, Mg water type. In the southern sector the river flow is slower and remarkably higher in TSS, TDS, COD and BOD concentrations relative to the northern sector.

توزيع وبيئة الرخويات الحديثة في نهر الفرات – العراق

خلدون صبحي البصام و كريم محمود حسن

المستخلص

بينت دراسة استطلاعية في نهر الفرات من القائم الى الناصرية وجود الرخويات الآتية:-

Corbicula (Corbicula) fluminalis MULLER, *Unio tigridis* BOURGUIGNAT, *Mytilus* sp., *Bellamya* cf. *bengalensis* LAMARK, *Melanoides* sp., *Melanopsis nodosa* FERUSSAC.

لوحظ ان توزيع الرخويات متباين في حوض نهر الفرات ؛ وبشكل عام كانت فأسية القدم شائعة في محطات القاطع الشمالي من النهر في حين وجدت بطنية القدم في القاطع الجنوبي من النهر فقط . اكثر الرخويات شيوعا كانت *C.(Corbicula) fluminalis* MULLER. تتبعها *Unio tigridis* BOURGUIGNAT من ناحية اخرى كانت *Bellamya* cf. *bengalensis* LAMARK هي الشائعة في القاطع الجنوبي . ان توزيع هذه الرخويات في حوض نهر الفرات يبدو متعلقا بملوحة المياه ، نوع الاملاح الذائبة ، سرعة الجريان ، كمية العوالق الصلبة والمتطلب الإحيائي للأوكسجين والمتطلب الكيميائي للأوكسجين في مياه النهر . يتميز القاطع الشمالي من نهر الفرات بجريان اسرع وملوحة اقل وتهوية افضل من القاطع الجنوبي فضلا عن ان مياه القاطع الشمالي من النهر تحتوي على تراكيز اقل من الأملاح الذائبة الكلية ، العوالق الصلبة والمتطلبات الاحيائية والكيميائية للاوكسجين نسبة الى القاطع الجنوبي ومياه القاطع الشمالي من نوع البيكاربونات- كبريتات ، كالسيوم ، مغنيسيوم . في القاطع الجنوبي من النهر تكون سرعة الجريان ابطأ والمياه تحتوي على تراكيز أعلى من العوالق الصلبة والأملاح الذائبة والمتطلبات الاحيائية والكيميائية للأوكسجين قياسا على القاطع الشمالي.

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INTRODUCTION

The Euphrates River is one of the long rivers of the world. It is 2940 km long, flows out in Turkey and descends southward to Syria and Iraq. Its length in Iraq is 1159 km, entering the country at Al–Qaim and finally joins the Tigris River at Qurna, forming together Shat Al–Arab River. The Euphrates is (500–1000) m wide in the northern sector, (100–300) m in the central sector and (100–150) m in the southern sector. The flow varies from 0.2 m/sec to 3 m/sec, depending on the topographic gradient, discharge and width of the river valley. The gradient is about (30–40) cm/km in the northern sector (Qaim–Hit), decreases to 10 cm/km in the central sector (Hit–Nassiriya) and to 3 cm/km in the southern sector (Shanafiya–Qurna) (Buringh, 1960). The annual discharge at Al–Qaim used to be about 30 billion m^3 in the mid eighties (Asa'ad and Ali, 1986), but it has been highly reduced in the recent years. The flow speed is gradually reduced from north to south.

A reconnaissance survey in the Euphrates River from Al–Qaim to Nassiriya was conducted in 1998. Among the numerous results achieved from this survey was the study of the type and distribution of recent mollusks in the Euphrates River. Samples of dead mollusk shells were collected from 14 stations along the river basin (Fig. 1). This study, though preliminary in character, aims at a better

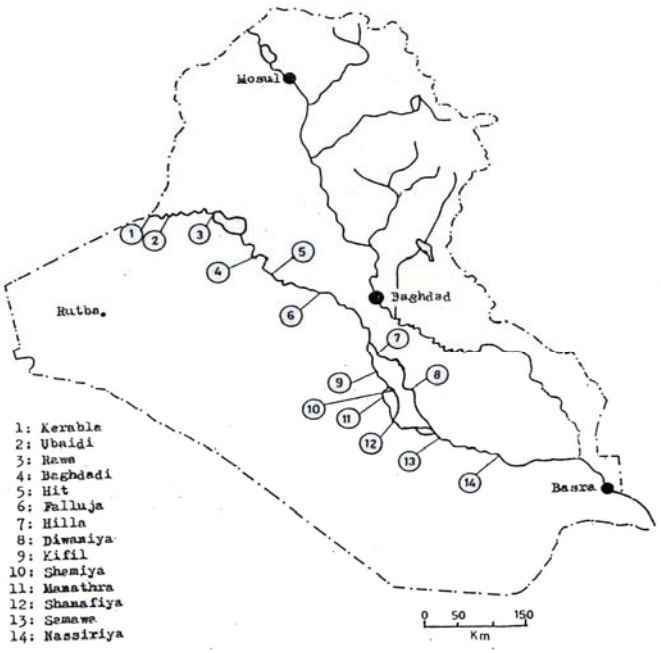


Fig. (1): Location map of the mollusk sample

understanding of the ecological factors controlling the distribution of recent mollusks in the Euphrates River. The variation in type and abundance of these mollusks along the river was compared with the variation in the physical and chemical parameters of the river environment. The Euphrates water was sampled bimonthly in 17 stations in 1998 by the Ministry of Water Resources as part of the National Program to study the environmental aspects of the Euphrates River. Water characteristics and chemical composition were determined in these samples and presented as mean values in Table (1). It should be noted, however, that the mollusk shells were not always collected from the same stations as those of the water samples due to restrictions in accessibility and / or availability of the shells.

MOLLUSKS IDENTIFICATION, HABITAT AND ABUNDANCE

Several types of mollusks were recognized in the sampled stations along the Euphrates River. Their abundance and distribution are variable. These are:-

1. Pelecypods

(a) *C. Corbicula fluminalis* MULLER (Fig. 2a). It ranges in size from 0.5 cm to 3 cm, with thin to thick walls and very abundant in all the stations except Hit and Ubaidi. This species was described in the literature as very abundant in flood plain environment, fluviatile channels and channels of lacustrine delta (Yacoub et al., 198l). They are suspension feeders in freshwater environments (Murray, 1985)

(b) *Unio tigridis* BOURGUIGNAT (Fig. 2b). It is usually found in larger sizes approaching 5 cm and usually with thick walls. This species is the second in abundance, found in many of the stations of the northern, central and southern sectors. It is more frequent in the southern sector and missing at Rawa, Baghdadi, Falluja, Hilla, Diwaniya, Shanafiya and Samawa. They were reported to be abundant in fluviatile channels, marsh channels subenvironment and lacustrine environment (Yacoub et al., 1981). They are suspension feeders and shallow burrowers in freshwater sediments (Murray, 1985).

(c) *Mytilus* sp. (Fig. 3c). It is small in size with thin walls and found in the stations of the northern sector only. They are usually bassally attached, epifaunal suspension feeders (Hassan, 1985).

2. Gastropods

(a) *Bellamya* cf. *bengalensis* LAMARK (Fig. 3a). It is variable in size, generally not exceeding 3cm in length and was found very abundant in the Shanafiya station only. They were described in the literature as abundant in fluviatile channels and muddy environments (Yacoub et al., 1981).

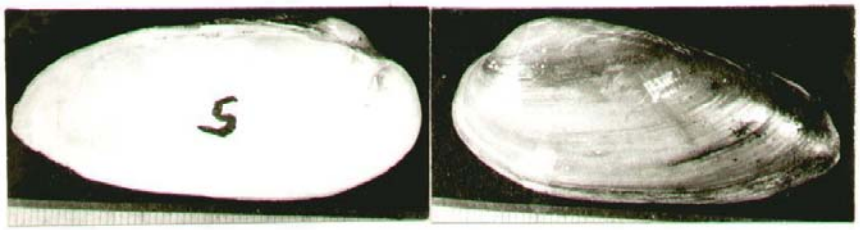
(b) *Melanoides* sp. (Fig. 3b).They have thin walls and small in size. It is a rare species, found in Shamiya station only and was described as abundant in lacustrine environments (Yacoub et al., 1981).

(c) *Melanopsis nodosa* FERUSSAC (Fig. 3c). They have thin walls and small in size. It is a rare species, found in Nassiriya station only and was described to be abundant in lacustrine environment of lakes where subaquatic vegetation is abundant, but it is less developed in marsh subenvironment (Yacoub et al., 1981).

A: *C (Corbicula) fluminalis* MULLER

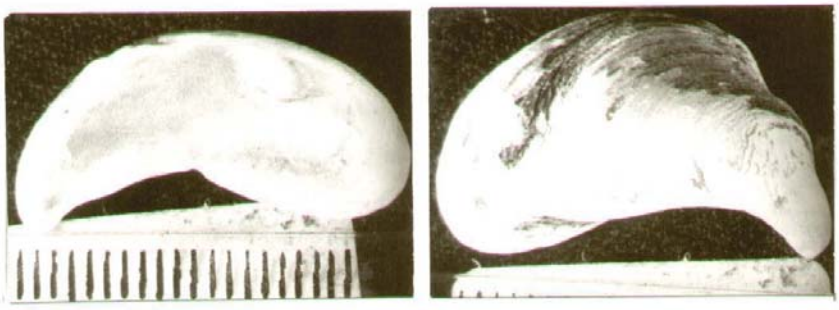
0.5 Cm.

B: *Unio tigridis* BOURGUIGNAT



1 Cm.

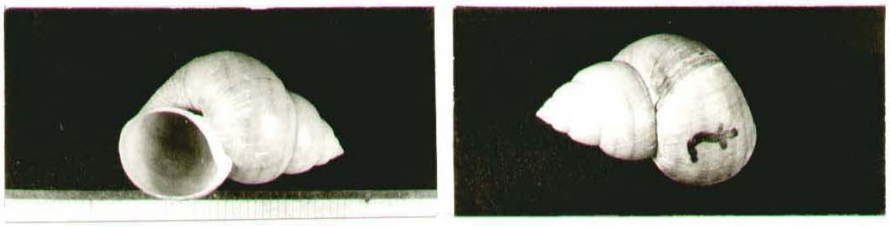
C: *Mytilus* sp.



1 Cm.

Fig. (2): Pelecypods of the Euphrates River

A: *Bellamya* cf. *bengalensis* LAMARK



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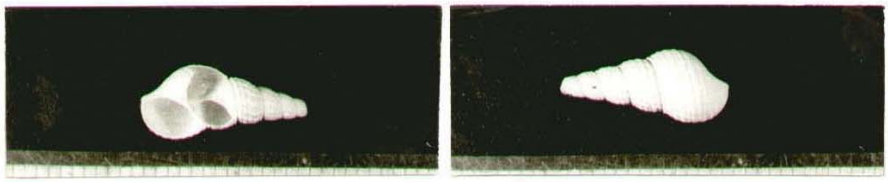
B: *Melanoides* sp.



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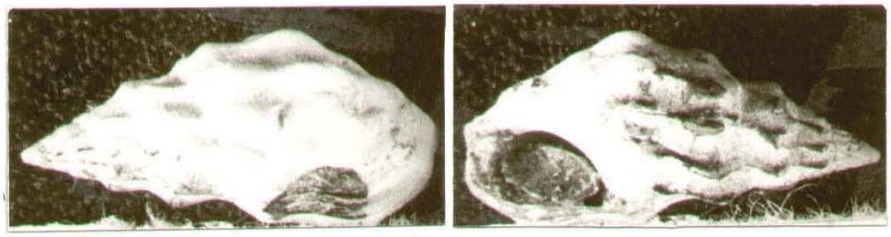
C: *Melanopsis nodosa* FERUSSAC



1 Cm.

Fig. (3): Gastropods of the Euphrates River

ECOLOGICAL PARAMETERS OF THE EUPHRATES RIVER

The Euphrates River shows great variation in physical and chemical characteristics during its course in Iraq from entry point at Al–Qaim till it joins the Tigris at Qurna. Accordingly three sectors can be recognized: northern (Al–Qaim–Hit), central (Ramadi–Kifil) and southern (Shanafiya–Qurna).

The hydrochemistry of the river suffers gradual increase in salinity from north to south, where the TDS (total dissolved salts) content increases from about 400 ppm at Al–Qaim to about 600 ppm at Kifil. However, a sharp increase in salinity occurs abruptly at Shanafiya and continues to Qurna, where the TDS content increases to about 1600 ppm (Table 1). According to the classification of Todd (1980) the Euphrates water from Shanafiya downwards is considered brackish as compared to freshwater in the other parts of the river.

Table 1: Water characteristics and water analysis of the Euphrates River in the year 1998.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
EC	0.68	0.7	0.7	0.74	0.82	0.8	0.88	0.91	0.9	1.0	0.95	2.34	2.4	2.36	2.38	2.41	2.02
pH	8.06	8.14	8.01	8.37	8.15	8.16	8.17	8.1	8.15	8.05	8.05	8.16	8.0	8.07	8.04	8.08	8.10
TDS	424	449	450	475	520	521	579	598	580	634	647	1575	1645	1638	1629	1659	1368
Ca	54	56	58	56	64	62	70	71	71	75	76	116	117	117	118	116	109
Mg	24	25	24	25.8	29	30	29	32	32	33.6	33.2	82	85	82	83	83.5	71
Na	50	51	49	56.3	64	60	69	71	69	75	76.5	262	272	272	273	278	220
K	2.85	2.7	2.64	2.85	3.3	3.1	3.7	3.5	3.2	3.8	3.8	5.5	6.3	6.3	6.2	6.0	4.0
NH_4	0.3	0.33	0.43	0.28	0.39	0.38	1.6	0.25	0.24	0.26	0.3	0.33	0.24	0.32	0.36	0.35	0.38
P	0.22	0.1	0.14	0.05	0.18	0.14	0.19	0.1	0.06	0.07	0.08	0.06	0.06	0.07	0.06	0.06	0.07
Cl	71	72.6	67	86	96.9	94	101	106	102	116	116	370	393	393	395	401	317
SO_4	97	119	142	144	159	155	185	193	194	194	195	483	451	469	465	469	408
HCO_3	143	142	124	120	133	129	122	122	126	147	141	161	170	154	155	161	150
CO_3	11	10.8	8.1	13.2	9.8	10.1	8.6	10	7.2	6.3	8.2	10.8	8.3	13	13.4	11.5	9
NO_3	3.4	3.1	1.76	2.1	2.4	2.5	2.3	2.56	2.0	2.8	3.1	2.02	3.2	2.9	2.96	3.1	3.5
B	0.3	0.35	0.37	0.2	0.32	0.25	0.36	0.39	0.27	0.25	0.35	0.5	0.48	0.5	0.49	0.51	0.34
COD	0.99	0.97	1.1	1.2	1.96	1.4	1.5	1.5	1.48	1.2	1.3	2.4	2.3	2.15	2.2	2.55	2.2
T.H	235	241	245	256	278	281	310	311	310	300	300	631	585	617	572	536	501
SAR	1.39	1.43	1.36	1.48	1.62	1.65	1.72	1.74	1.71	1.8	1.9	4.45	4.6	4.7	4.65	4.7	4.04

1: Al–Qaim, 2:Rawa, 3:Qadissiya Dam, 4:Hit, 5:Ramadi, 6:Khalidiya, 7:Falluja, 8:Hindiya, 9:Kifil
10: Diwaniya entrance, 11: Diwaniya exit, 12: Shanafiya, 13: Samawa entrance, 14: Samawa exit
15: Nassiriya entrance, 16: Nassiriya exit, 17: Qurna.
All values except pH, EC and SAR are in ppm.
Data in this table are results of the Euphrates Project, Ministry of Agriculture (1998-2000), see Al-Bassam (1998).

The hydrochemical variation includes also changes in the hydrochemical formulae of the water (Al-Bassam, 1998). In the northern sector the water is SO_4^- HCO_3 in character with Ca^{2+} and Mg^{2+} as major cations, whereas in the southern sector it becomes Cl–SO_4 type with Na^+ and Mg^{2+} as major cations (Table 2).

The type of hypothetical dissolved salts assumed from hydrochemistry show great variation in the three sectors (Table 3). Calcium bicarbonate is the dominant salt in the northern sector, whereas NaCl is the dominant salt in the central and southern sectors (Al-Bassam, 1998).

Table 2: Hydrochemical formulae of the Euphrates River water (Al-Bassam, 1998) (epm %)

	SO_4	HCO_3	Cl	CO_3	Northern sector
S 0.41 gm/1	36.23	34.95	25.82	3.00	pH 8.15
	Ca	Mg	Na	K	
	43.81	28.09	27.22	0.87	
	SO_4	Cl	HCO_3	CO_3	Central sector
S 0.72 gm/1	42.90	33.48	20.45	3.17	pH 8.23
	Ca	Na	Mg	K	
	38.47	34.11	26.54	0.89	
	Cl	SO_4	HCO_3	CO_3	Southern sector
S 1.44 gm/1	47.13	41.42	9.93	1.80	pH 8.23
	Na	Ca	Mg	K	
	47.52	27.61	24.25	0.62	

Table 3: Hypothetical salt combination in the Euphrates River (Al-Bassam, 1998) (meq %)

Sector	**$Ca(HCO_3)_2$**	**$CaSO_4$**	**$MgCO_3$**	**$MgSO_4$**	**Na_2SO_4**	**NaCl**	**KCl**
Northern	34.95	8.86	3.00	25.09	2.28	24.94	0.88
Central	20.45	18.02	3.17	23.37	1.51	32.60	0.89
Southern	9.93	14.32	1.80	25.81	1.01	46.51	0.62

The TSS (total suspended solids) content of the water is less than 100 mg/l from Al–Qaim to Hilla and more than 100 mg/l from Samawa to Suk Al–Shuikh. COD (chemical oxygen demand) values also increase significantly in the southern sector; they are (3–4) mg/l and (1–2) mg/l, respectively in the northern and central sectors compared to (7–10) mg / l and (4–5) mg/l, respectively in the southern sector. The DO (dissolved oxygen) is decreased to generally less than 7 mg/l from Hit downward relative to values above 7.5 mg/l in the northern sector (Sabri et al., 1998).

The H_2S concentration dissolved in water is higher than 0.5 ppm from Falluja downward compared to less than 0.5 ppm in the other parts of the river (Al-Bassam, 2000). The pH of the water shows narrow range of variation throughout the whole river, indicating slightly alkaline water, ranging from 8.0 to 8.4 (mean values). The flow speed of the river is decreased from north to south according to the gradient of the river valley. Consequently, the river sediments are generally

gravelly–sandy in the northern sector, sandy–silty in the central sector and silty–clayey in the southern sector.

DISCUSSION

The present study shows different abundance rates for the Euphrates mollusks (Fig. 4). Some of these bivalves are abundant in the whole river, such as *C. (Corbicula) fluminalis* MULLER, whereas others are restricted to specific sectors of the river, such as *Mytilus* sp. (northern sector) and *Bellamya* cf. *bengalensis* LAMARK (southern sector). The gastropods are restricted to the southern sector in general.

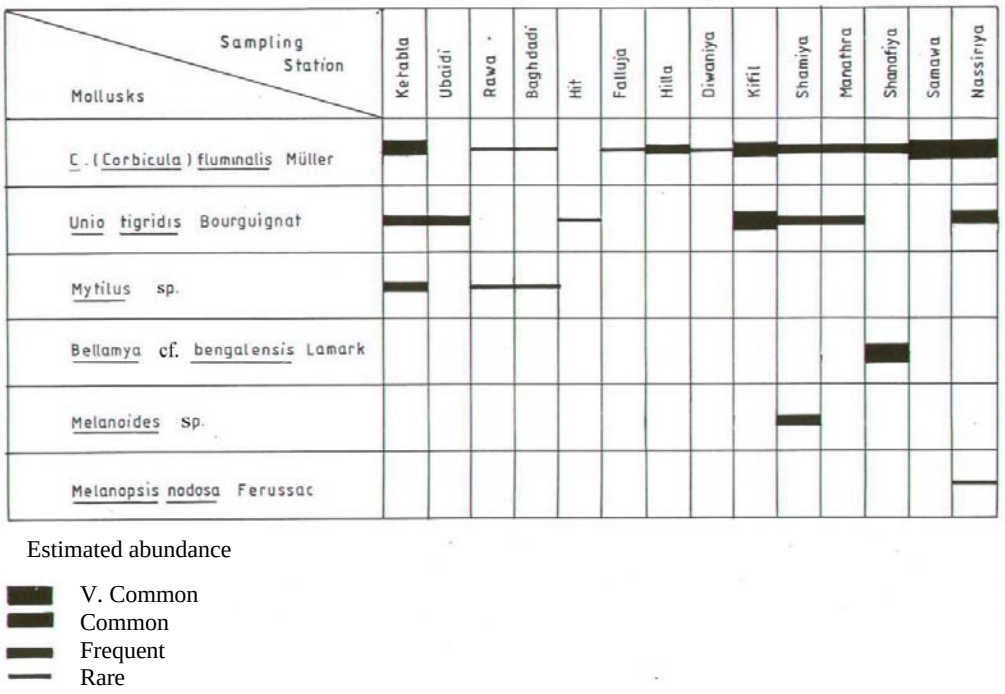


Fig. (4): Distribution and abundance of mollusks in Euphrates River

The factors controlling the distribution of bivalves are substrate, salinity, temperature, dissolved oxygen content, turbidity and food availability (Hallam, 1976). Considering the distribution and abundance of the studied mollusks in comparison with the ecological parameters of the Euphrates River in its various sectors, it can be noticed that the pelecypods C. *(Corbicula) fluminalis* MULLER and *Unio tigridis* BOURGUIGNAT are more versatile and have greater tolerance towards environmental variations. The present results have shown that they thrive in water salinity ranging from 0.4 gm/l (fresh) to 1.6 gm/l (brackish) containing variable types and concentrations of dissolved salts ranging from bicarbonate–

dominant to sulfate–dominant and even chloride–dominant waters. Furthermore, they tolerate relatively wider ranges of TSS, BOD, COD and DO concentrations. They can thrive in sandy, silty and clayey substrates. In contrast, the results obtained show that *Mytilus* sp. is less tolerant towards such environmental changes and seems to require lower salinity (less than 0.5 gm/l) and better oxygenated waters. It is absent in the parts of the Euphrates River with more than 0.5 gm/l salinity.

On the other hand, this study shows that the gastropods in general seem to require higher salinity (brackish) water with more clayey substrate and higher TSS content. They can tolerate less oxygenated waters and an Na–Cl dominated water type. The rare appearance and small size of *Melanoides* sp. and *Melanopsis nodosa* FERUSSAC in the Euphrates River suggests less suitable environment for their existence (stressed environment). They are known to thrive in brackish waters, probably of higher salinity than that of the Euphrates River at the time when this work was conducted.

CONCLUSIONS

- The distribution and abundance of the studied mollusks in the Euphrates River are not uniform; *C.* (*Corbicula) fluminalis* MULLER is the most common and well developed in the whole river basin, followed by *Unio tigridis* BOURGUIGNAT, whereas *Mytilus* sp. is restricted to the northern sector of the river basin. The gastropods are restricted to the southern sector of the river. *Bellamya* cf. *bengalensis* LAMARK is the commonest of the gastropods, followed by *Melanoides* sp. and *Melanopsis nodosa* FERUSSAC.
- The distribution of the studied mollusks in the Euphrates River seems to be controlled by water salinity, type and concentration of dissolved salts, flow speed, nature of substrate, availability of dissolved oxygen and content of suspended solids.
- Among the pelecypods, *C. (Corbicula) fluminalis* MULLER and *Unio tigridis* BOURGUIGNAT have the most tolerance capability towards environmental changes in the Euphrates River and can thrive in fresh and brackish waters. On the other hand, *Mytilus* sp. requires well oxygenated fresh water. The gastropods in general seem to require higher salinity waters (brackish), muddy substrate and can tolerate less aerated waters.

ACKNOWLEDGEMENT

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