Mesopotamia Environmental Journal ISSN 2410-2598
Mesop. environ. j. 2016, Vol.2, No.4: 23-32.

The relationship between aquatic macrophytes and some gastropoda (snails) in the lower reaches of Hammar marsh

Inaam A. A. Qazar

Department of Ecology, College of Science, Basrah University

Corresponding author:enaam_a2000@yahoo.com

To cite this article:
Qazar, I.A.A. The relationship between aquatic macrophytes and some gastropoda (snails) in the lower reaches of Hammar marsh. *Mesop. environ. j.*, 2016, Vol.2. ,No.4 ,pp.23-32.

Received Date : 14 / 5 / 2016 **Accepted Date** : 10 / 6 / 2016 **Publishing Date** : 15/8/2016

Abstract

This study was carried out during 2011-2012 to evaluate the preference of some freshwater snails to specific macrophytes than others. Snails were collected from different aquatic plants; *Ceratophyllum demersum, Potamogeton crispus, Salvinia natans,*and *Hydrilla verticillata* at four stations. The presence of these plants was affected by the water temperature, they almost disappear in winter leading to low snail numbers at that season. Eight snail species were found at the study area; *Bellamya bengalensis* (Lamarck, 1822), *Bithynia hareerensis* Glöer, and Nasser, 2008 ,*Gyrauluse hrenbergi* (Beck, 1837), *Melanoides tuberculata* (Müller, 1774), *Melanopsis nodosa* Férussac, 1823, *Physlla acuta* Draparnaud, 1805, *Radix auricularia* (Linnaeus,1758), *Theodoxus jordani* (Sowerby, 1832). Statistical analysis shows a significant differences ($P<0.05$) between macrophyte's snails number, *C. demersum* and *H. verticilata* was the most preferred macrophyte in this study, while *S. natanus* recorded no occurrence of snails.

Keywords: Snail, Macrophytes, Periphyton, Occurance, Morphology.

Introduction

Gastropods are a common and conspicuous element of the freshwater biota. They inhabit a variety of habitats like rocky bottoms, soft substrate of ponds, and aquatic plants [1]. Numbers of aquatic snails were much higher on aquatic plants than in sediments or other substratum [2, 3, and 4]. Aquatic plant's leaves provide a good substratum for laying eggs, and offer a shelter from predators [5], as well as protecting snails from bright sunlight, high temperature, enhance oxygen levels and reduce the current velocity [6].

[7] found that the severely decreasing of macrophyte richness could lead to the decreasing of *Lymnaeastagnalis* population up to 99% and the population of *Bithynia tentaculata* up to 35% which means that the snail population size depends on macrophyte abundance.

The macrophytes community itself also affected by the presence/absence of snails, according to [8] there is a mutual relationship between aquatic plants and snails, He found a significant increase in growth of *Ceratophyllum* sp. in the presence of snails, or in water chemically conditioned by snails, it was longer, had more healthy nodes of leaves, and more growing tips than *Ceratophyllum* sp. grown in the same environment in the absence of snails. The removal of epiphytes by snail grazing significantly prolonged the life of the *Ceratophyllum* sp. leaves compared to not grazed leaves. That's agree with the results of the laboratory experiment of [9] which showed that the reduction in the snail population density results in the decrease of phytoplankton density and increase of chlorophyll-a values of epiphytic algae on glass as well as the increase of epiphytic algae growing on submerged plants leaves.

Macrophytes provide food for many gastropods [10]. Periphytes are an important source of food for snails, and found that the snails prefer leaves covered by periphyton over those who were prewashed from periphyton [11].The main goal of this research was to determine the most potentially preferred niches for water animals who feed on snails as a food source, as well as enhancing samples gathering for researchers who use snails as biological indicators for pollution.

Materials and methods

Collection of samples

Seasonally samples of four aquatic plants; *Ceratophyllum demersum*, *Potamogeton crispus*, *Salvinia natans*, and *Hydrilla verticillata* with its associated macroinvertebrates were collected from four stations in the lower reaches of Hammar marsh (figure 1), during November 2011 to July 2012, Using a 1/2 m^2 quadrate and pulling the plants using a fork like tool.

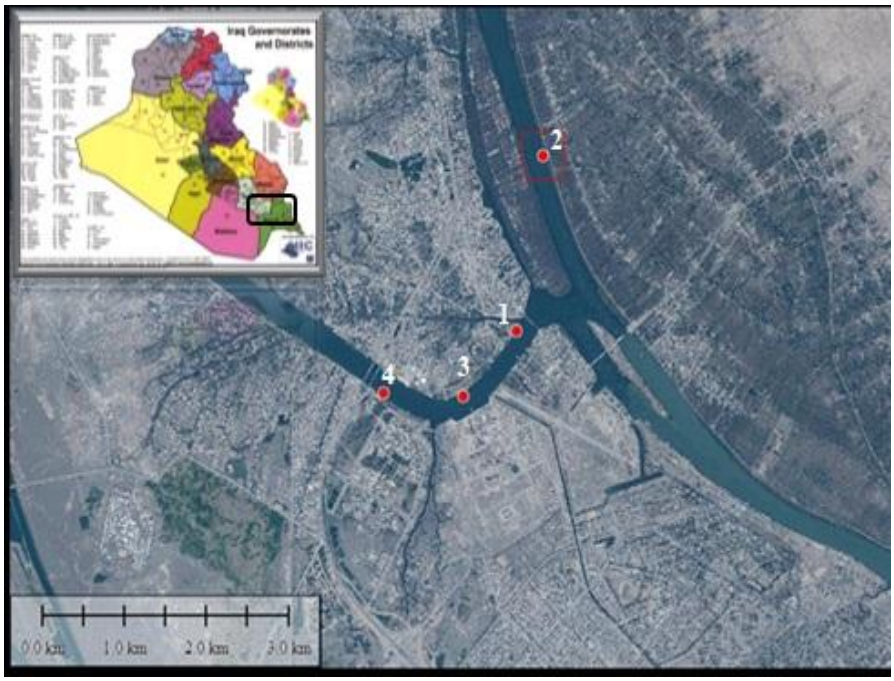

Fig.1: Map of the study area (1,3: Najebia, 2: Jazera, 4: Qarmma)

Identification and sampling count

The number of snail's species and individuals were counted for each type of plant. Snails species were classified according to [12] and [13] using dissecting microscope mod.Wiled MB3. Then updated according to [14]. Plants were classified according to [15]. Water temperature was recorded using thermometer during each sampling.

Statistical analysis

GenStat Discovery edition 4 (2011) statistical program was used in this study to analyze the obtained data.

Results and Discussion

Eight snail species; *Bellamya bengalensis* (Lamarck, 1822), *Bithynia hareerensis* Glöer, and Nasser, 2008,*Gyraulus ehrenbergi* (Beck, 1837), *Melanoides tuberculata* (Müller, 1774), *Melanopsis nodosa* Férussac, 1823, *Physlla acuta* Draparnaud, 1805 , *Radix auricularia* (Linnaeus, 1758), *Theodoxus jordani* (Sowerby, 1832) were found on the aquatic plants in the study area. The studied macrophytes were *Ceratophyllum demersum*, *Potamogeton crispus*, *Hydrilla verticillata*, and *Salvinia natans*, which were found densely during the whole study period except during the cold season. (Figure 2-5)

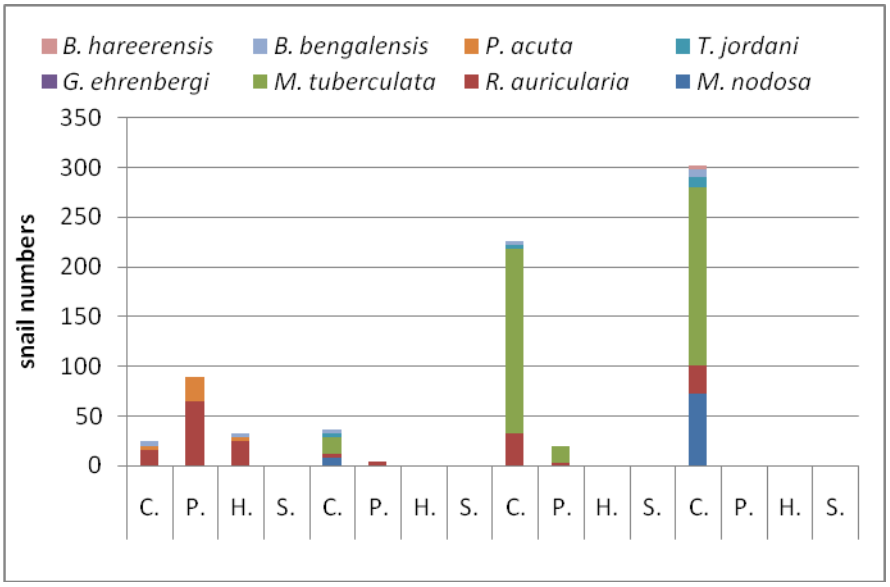

Fig.2: Occurrence of snails on different macrophytes at station 1.

*C. for *C. demersum*, P. for *P. crispus*, H. for *H. verticillata*, and S. for *S. natans*

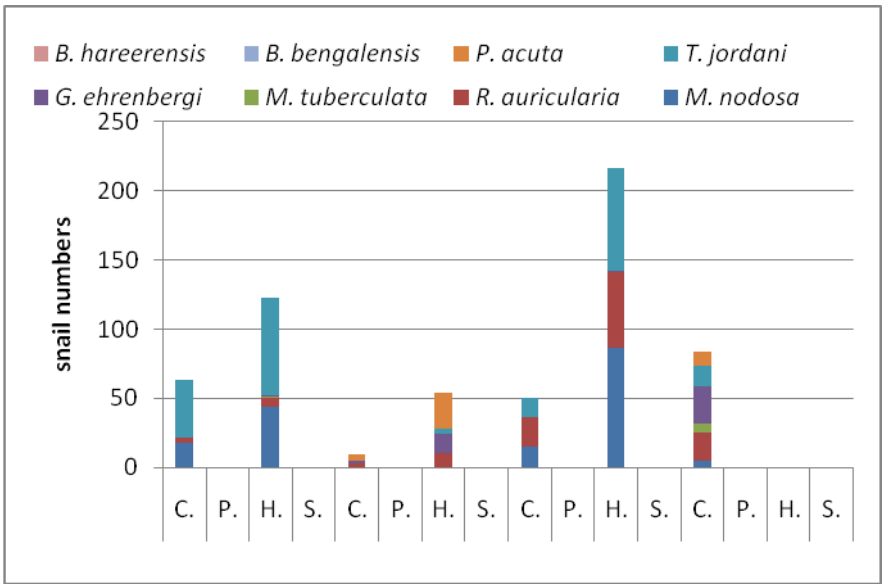

Fig.3: Occurrence of snails on different macrophytes at station 2.

*C. for *C. demersum*, P. for *P. crispus*, H. for *H. verticillata*, and S. for *S. natans*

The relationship between herbivorous snails and macrophytes in freshwater ecosystems depends on the abundance of the snails. The high density of herbivorous snails may have a negative impact on macrophyte biomass [11], but the low occurrence of snails in the present study lead to create a mutualistic relationship. This biotic relationship between snails and aquatic vegetation could be attributed to many factors. The soft parts of aquatic plants and its periphyton are the favorite food resources of the snails [16, 17, and 18]. Freshwater snails graze actively on a

variety of surfaces [19], scraping their food with a modified "tongue" called a radula [1]. Epiphyton-feeding snails have a great impact on the biomass, productivity and species composition of epiphytic communities [20, 4].

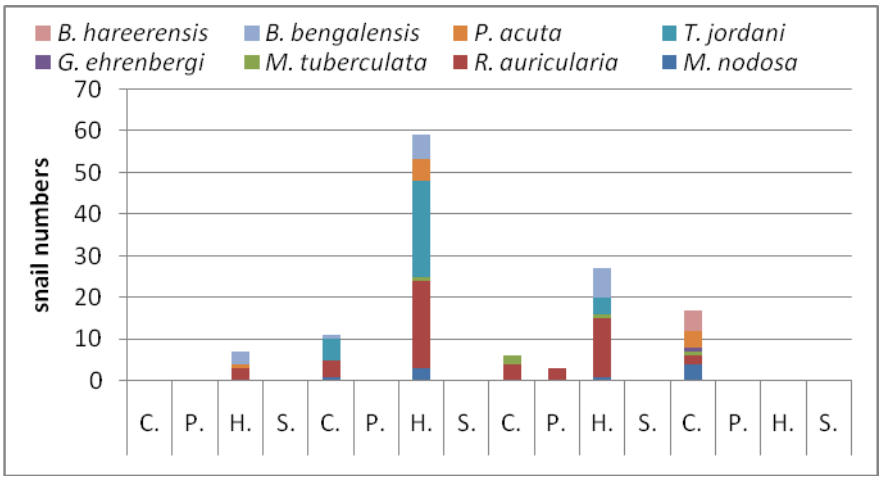

Fig. 4: Occurrence of snails on different macrophytes at station 3.

*C. for *C. demersum*, P. for *P. crispus*, H. for *H. verticillata*, and S. for *S. natans*

Gastropods community was affected by the presence of macrophytes and the relationship among macrophytes, periphyton and the gastropods consuming periphyton [21]. According to [22] and [23] the density of periphytons are highly affected by the density of macrophytes at the same area, But [24] showed that their numbers differs from one macrophyte species to another, *Ceratophyllum sp.* support more species of periphytons than *Potamogeton sp.* and *Salvinia sp.* At the same time *Potamogeton* sp. had more cell numbers $94.09*10^4$ (cell/gm wet weight), *Ceratophyllum* sp. was $70.33*10^4$(cell/gm wet weight), and *Salvinia* sp. 93.95(cell/gm wet weight). The present study indicates that snail's abundance depends on the morphology of the plant rather than the occurrence of periphyton.

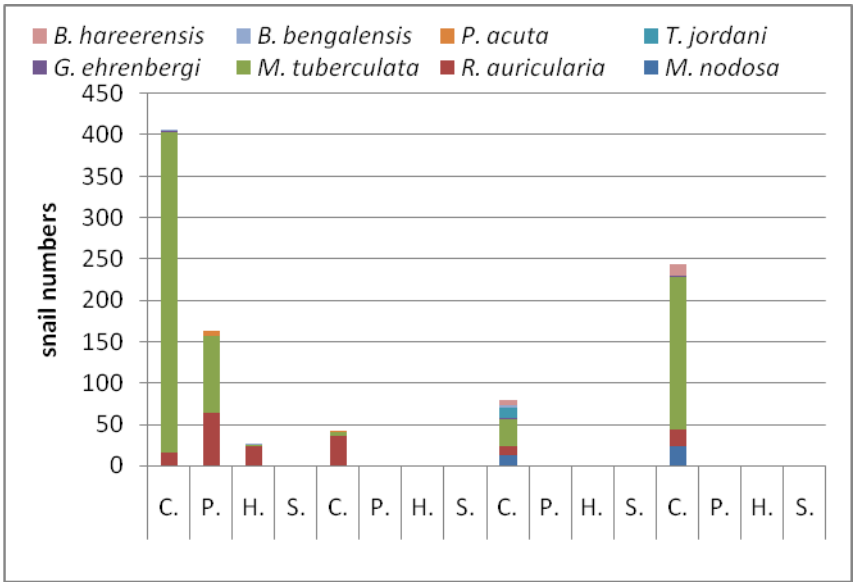

Fig.5: Occurrence of snails on different macrophytes at station 4.

*C. for *C. demersum*, P. for *P. crispus*, H. for *H. verticillata*, and S. for *S. natans*

Number of snail species varied during the study period. *M. tuberculata* ranked the highest occurrence with 1112 individuals/m^2, then *R. auricularia* with 538 individuals/m^2, followed by *M. nodosa* and *T. jordani* with 293, 282 individuals/m^2 respectively. The presence of *M. tuberculata* in all stations and in high numbers in comparison to other species might be due to it's being common and most wide-ranging member of the family Thiaridae [29]. Snail species occurrence varied in this study, this variance was significantly different ($P<0.05$) between stations for only few snails (Table 1).

Table 1: Spatial differences in the mean occurrence of snail individuals during the study period.

Station / Snail	1	2	3	4	L.S.D.
B. bangalensis	1.50^{a}	0.00^{b}	1.06^{ab}	0.31^{b}	1.156
B. hareerensis	0.25^{a}	0.00^{a}	0.31^{a}	1.25^{a}	1.308
G. ehrenbergi	0.00^{b}	2.81^{a}	0.06^{b}	0.25^{b}	2.608
R. auricularia	11.1^{a}	7.4^{a}	3.2^{a}	10.8^{a}	10.15
M. nodosa	5.0^{a}	10.5^{a}	0.6^{a}	2.2^{a}	10.51
M. tuberculate	24.8^{a}	0.5^{a}	0.3^{a}	43.9^{a}	39.71
P. acuta	2.00^{a}	2.56^{a}	0.62^{a}	0.56^{a}	3.354
T. Jordani	1.1^{a}	13.8^{a}	2.0^{a}	0.8^{a}	9.02

Similar letters means no significant differences (P<0.05), different letters means significant differences. L.S.D. = least significant differences.

Water temperature ranged from 8 to 34 c° during the study period. Low water temperature was associated to very low occurrence of aquatic plants and gastropods. Seasonal changes in air and water temperatures had a great effect on snail numbers which were very low in winter, reaches to zero in many stations due to their association with macrophytes which disappear in most of the study area at winter. Snail's reproduction reduces significantly, and predation by omnivorous fish increased with low density of macrophytes [6]. Although snail numbers were decreased in winter, there were no significant (P<0.05) differences among the snail species occurrence except for the snail *B. hareerensis* during this study (Table 2).

Table 2: Temporal differences in the mean occurrence of snails during the study period.

Season / Snail	Winter	Spring	Summer	Autumn	L.S.D.
B. bangalensis	0.69^{a}	0.88^{a}	0.5^{a}	0.81^{a}	1.156
B. hareerensis	0^{b}	0.38^{a}	1.44^{a}	0^{b}	1.308
G. ehrenbergi	1^{a}	0.19^{a}	1.81^{a}	0.12^{a}	2.608
R. auricularia	5.1^{a}	9^{a}	4.4^{a}	13.8^{a}	10.15
M. nodosa	0.8^{a}	7.1^{a}	6.6^{a}	3.9^{a}	10.51
M. tuberculate	1.3^{a}	14.8^{a}	23.2^{a}	30.2^{a}	39.71
P. acuta	2.31^{a}	0^{a}	0.94^{a}	2.5^{a}	3.354
T. Jordani	2.2^{a}	6.8^{a}	1.5^{a}	7.1^{a}	9.02

Similar letters means no significant differences (P<0.05), different letters means significant differences.

L.S.D. = least significant differences.

The differences between macrophyte types were significant for most of the snails (Table 1), the species *C. demersum* recorded the highest indivisual numbers attached to it, followed by *H. verticillata*, meanwhile *S. natanus* never recorded any individual attached on it during the whole study period (Table 3).

Submerged macrophyte differs from other macrophytes by being more dense and complex. They provide a better habitat for snails [25]. The present study indicates that the macroinvertebrates distribution is somehow driven by differences in morphological complexity between plant species. The highest number of snails was recorded on the more structurally complex *Ceratophyllum demersum* and *H. verticillata* than that on *S. natans* and *P. crispus*.

Table 3: Mean occurrence of snails on each macrophyte species during the study period.

Macrophyte / Snail	*C. demersum*	*H. verticillata*	*P. crispus*	*S. natans*	L.S.D.
B. bangalensis	1.56[a]	1.31[a]	0[b]	0[b]	1.156
B. hareerensis	1.81[a]	0[b]	0[b]	0[b]	1.308
G. ehrenbergi	2.12[a]	1[a]	0[b]	0[b]	2.608
R. auricularia	13.9[a]	9.8[ab]	8.7[ab]	0[b]	10.15
M. nodosa	9.9[a]	8.4[a]	0[a]	0[a]	10.51
M. tuberculate	62.4[a]	0.2[b]	6.8[b]	0[b]	39.71
P. acuta	1.62[a]	2.25[a]	1.88[a]	0[a]	3.354
T. Jordani	6.6[a]	11.1[a]	0[a]	0[a]	9.02

Similar letters means no significant differences ($P<0.05$), different letters means significant differences. L.S.D. = least significant differences.

These results agreed with many previous studies such as [26] and [27] who recorded higher total macroinvertebrate abundance on the structurally complex *Myriophyllum spicatum* than on the more simply structured *Potamogeton pectinatus* and *Charabaltica*. [28] Found that the highest abundance of snails was on *C. demersum* and *Elodea canadensis* which were morphologically more complex than other macrophytes in their research.

Conclusions

1- Snails could be found in large numbers on submerged aquatic plants.

2- *C. demersum* and *H. verticillata* was the most preferred by aquatic snails because of its complex morphology.

3- Researchers can collect snail samples easily from *C. demersum* and *H. verticillata* instead of other kinds of plants for monitoring pollutants or other types of studies.

Acknowledgment

The researcher thanks college of Science and department of Ecology for supporting this work.

References

[1] Johnson, P.D. Sustaining America's Aquatic Biodiversity-Freshwater Snail Biodiversity and Conservation. Fisheries and Wildlife, pp.420-530.2009.

[2] Hann, B.J., Mundy, C.J., Goldsborough, L.G. Snail–periphyton interactions in a prairie lacustrine wetland. Hydrobiologia, Vol.457,No.1,pp.167-175.2001.

[3] Qazar, I.A. Concentration of trace metals in environment and some gastropoda (Mollusca) in East Hammar marsh. M. Sc. Thesis submitted to Basrah university, College of Science, 2009.

[4] Zêbek, E. and Szymañska, U. Gastropods and periphytic algae relationships in the vicinity of a small hydroelectric plant on the Pas³êka River in northeast Poland. Arch. Pol. Fish, Vol.22,pp.69-80.2014.

[5] De Ni, H.W. The decrease in aquatic vegetation in europe and its consequences for fish populations. EIFAC occasional paper-19, European inland fisheries advisory commission, Food and agriculture organization of the united nations, pp.8.1987.

[6] Van Schayck, I.R.C.P. Laboratory studies on the relation between aquatic vegetation and the presence of two bilharzias-bearing snail species. J. Aquat. Plant manage, Vol.23,pp.87-91.1985.

[7] Lodge, D.M. and Kelly, P. Habitate disturbance and the stability of freshwater gastropod populations. Oecologia (Berlin), Vol.668,pp.111-117.1985.

[8] Underwood, G.J.C. Growth enhancement of the macrophyte*Ceratophyllumdemersum* in the presence of the snail *Planorbisplanorbis*: the effect of grazing and chemical conditioning. Freshwater Biology, Vol.26,No.2,pp.325–334.1991.

[9] Daldorph, P.W.G. and Thomas, J.D. Factors influencing the stability of nutrient-enriched freshwater macrophyte communities: the role of sticklebacks Pungitiuspungitius and freshwater snails. Freshwater Biology, Vol.33,No.2,pp.271–289.1995.

[10] Lach, L., Britton, D., Rundell, R., and Cowe, R. Food preference and reproductive plasticity in an invasive freshwater snail. - *Biological Invasions*, Vol.2,NO.4,pp.279-288.2000.

[11] Kuan-Yi, L., Zheng-Wen, L., and Bin-He, G. Density-dependent effects of snail grazing on the growth of a submerged macrophyte, *Vallisneriaspiralis*. Ecological Complexity, Vol.6,No.4,pp.438-442.2009.

[12] Ahmed, M.M. Systematic study on mollusca from Arabian gulfand Shatt Al-Arab, Iraq. Center for arab gulf studies- university of Basrah- Iraq, pp.78.1975.

[13] Frandsen, F. A field guide to freshwater snails in countries of the WHO Eastern Mediterranean region. Danish Bilharziasis laboratory, pp.45.1983.

[14] WoRMS. World register of marine species. www.marinespecies.org. (Accessed April 2016).2016.

[15] Al-Mayah, A. A. and Hameem, F. H. Macrophytes and algae . Dar Alhikma press, Basrah University, pp.735.1991.

[16] Underwood, G.J.C. and Thomas, J.D. Grazing interactions between pulmonate snails and epiphytic algae and bacteria. Freshwater Biology, Vol.23,No.3,pp.505–522.1990.

[17] Colon-Gaud, J.C. Macroinvertebrate abundance and distribution of *Hydrilla* and*C eratophyllum* habitats in the Atchafalaya river basin, Louisiana. M. Sc. Thesis submitted to Louisiana state university and agricultural and mechanical College, School of Rrenewable natural resources, 2003.

[18] Giovanelli, A., Silva, C.L.P.A.C., Leal, G.B.E., and Baptista, D.F. Habitat preference of freshwater snails in relation to environmental factors and the presence of the competitor snail *Melanoides tuberculatus* (Müller, 1774). Mem. Inst. Oswaldo Cruz, Vol.100,No.2,pp.76-169.2005.

[19] Dillon, R.T. Freshwater Gastropoda. In:The Mollusks: A Guide to Their Study, Collection, and Preservation. Strum, Pearce, and Valdes (eds.) American Malacological Society, Los Angeles and Pittsburgh, pp.251-259.2006.

[20] Bronmark, C. Interactions between epiphytes, macrophytes, and freshwater snails: a review. Journal of Molluscan Studies, Vol.55,No.2,pp.299-311.1989.

[21] Lodge, D.M. Macrophyte-gastropod associations: observations and experiments on macrophyte choice by gastropods. Freshwater Biology, Vol.15,No.6,pp.695–708.1985.

[22] Al-Zubaidi, A.M. Ecological study on the algae (phytoplankton) in some marshes near Qurna-southern Iraq. M.Sc. thesis submitted to Basrah University, College of Science, 1985.

[23] Al-A'arajy, M.J. An ecological study on phytoplankton and nutrients in Al-Hammar marsh-Iraq. M.Sc. thesis submitted to Basrah University, College of Science, 1988.

[24] Al-Farhan, S.R.N. An ecological study of the benthic algae in some aquatic ecosystems of Basrah. M.Sc. Thesis submitted to Basrah University, College of Science, 2010.

[25] Vasileva, S.Y., Georgiev, D.G., and Gecheva, G.M. On the Communities of freshwater Gastropods on aquatic macrophytes in some water basins of southern Bulgaria. Ecologia Balkanica, Vol.3,No.1,pp.11-17.2011.

[26] Supian Z. and Ikhwanuddin A.M. Population dynamics of freshwater mollusks (Gastropod:*Melanoide stuberculata*) in Crocker range park, Sabah, ASEAN Review of Biodiversity and Environmental Conservation, (ARBEC).www.arbec.com.my/pdf/art13julysep02.pdf, accessed 23 July 2010.2002.

[27] Mieczan, T. Influence of emergent and submerged macrophytes on the structure of planktonic ciliate communities in shallow freshwater lakes (Eastern Poland). International Review of Hydrobiology, Vol.93,No.3,pp.269–283.2008.

[28] Warfe, D.M. and Barmuta, L.A. Habitat structural complexity mediates food web dynamics in a freshwater macrophyte community.Oecologia, Vol.150,No.1,pp.141-154.2006.

[29] Hansen, J.P., Wikstrom, S.A., Axemar, H., Kautsky, L. Distribution differences and active habitat choices of invertebrates between macrophytes of different morphological complexity. Aquatic Ecology, Vol.45,No.1,pp.11-22.2011.