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The effect of becoming waterless and experiments of livingplace reconstruction on Mollusca living in the soid laces of Upper Kiskunság

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It is commended to remembrance of my master dr. Andor Richnowszky

Abstract: The escape factor of the species is the sudden decrease of waterdepth, increase of pH value, quantity of sodium carbonate value of conductivity. The survival: in the sodic lakes nearly every species forms thin skin or chalky iclusion on its mouth sometimes. Individuals of certain species stay on the surface in latent condition but individuals of other species hide in still humid mud or into the polygonal rents of parched bed.

Raising of problem

The extremely dry weather of the last, nearly one and a half decade has put to the test the sodic lakes placed on the territory of National Park called "KISKUNSÁGI" (HUNGARY).

Our big sodic lakes have shrivelled or temporarily have disappeared because of the permament lack of precipitation. The permamental livingplace reconstruction has been started with return of water artificially by the Directory of National Park "Kiskunsági" on territories number I. and II.

The water has been brought according to definite order from canal XXXI to the "Halas-tó" (fish-pond) of Apaj-puszta and from the Main Canal "Kiskunsági" to the "Fehérszék" of "Fülöpszállás" in the last three years. In the summer period the territories are kept dry for two months and the rich occured fitomassa is cleared away by mowing.

The molluscs – in their death as welle! – are good indicator organisms and suitable for analysis of former conditions and for observation of reconstruction's process. The continuous dry period and the livingplace reconstructional initiations have caused decided difference in coenosis of watersnails living in the sodic lakes of Upper Kiskunság (Szabó, S. 1992 b). These differences are og importance according to order in the biomassa of the snailcoenosis.

I have examined the next problems in my researches:
- the dispersion, and change of snailcoenosis,
- the questions of survival, return and spread,
- the methodics of snailbiomassa,
- the biomassa of snailspecies, snailcoenosis in the sodic waters.

Paralell with the work done in the living-place reconstructional territories I. have done some observations in the territory number III. of National Park "Kiskunsági" at "Kelemenszék", at lake "Kisréti", at "Zabszék" and at "Pipásszék"; in the territory number II: at "Pozsáros" of Kunszentmiklós, at lake "Gyékény" and next to territory number II. at lake "Háromszögi".

Methods

Field work

I went to the collecting places of territory number II. once a fortnight, and to territory number III. once a fortnight, and to territory number III. once a month. I worked with waternet and a quadrat 50x50 cm dividing 25. The layer research of the dried beds was done with a two cubedecimeter piston-drilling. In the open deep water I collected from boat. I applied faunaprospecting, selecting collection and coenological collection to help the analysis of quantitative relations on both territories. I wrote down the oecological potentialities of the living-place; and I performed the necessary waterchemical researches with the help of VISOCOLOR test.

Laboratorial work

I selected, decided and systematiced the collected material in my laboratory. I selected the mollusca from the drill-samples by 5 centimetres slices sluicing. In case of characteristic species by experiments made in aquarium.

Lack of suitable laboratorial equipments I applied the approaching method, the Haarlow-index (Balogh, J. 1953) as measuring of snailbiomassa. The Haarlow-index means: the volume of animal multiplied abundancia. In case of *Lymnaea* I used conical shape as volume, while in case of *Planorbidae it was disc and in case of Acroloxus lacustris* it was pyramid. I was able to check this in case of big species by pouring gypsum into the empty shields and after that I measured the watervolume displaced by the shield in a measuring-tube. The difference between the approaching volume measurement and the cheking was negligible.

Results

There is not enough data about Mollusca from the examined territories. Based on literary data Soós had done collection first at Fülöpszállás on his exploratory expedition between 1909 and 1911 (Soós, L. 1915). After establish of National Park "Kiskunsági" – KNP in the next – Richnovszky, A. did studies in the sodic lakes of territory number III. (Richnovszky, A. 1978). We have got data from territory of Apajpuszta based on mapwork of recens mollusca spreading (Pintér, L. et allii, 1979). In the earlier period I myself have performed discovery work (Szabó, S. 1980, 1982, 1986, 1990a,b, 1992 a,b)

Analysis of the specieslist

16 species have written down up to now from territory Fülöpszállás and Szabadszállás. Richnovszky described 9 species from "Kelemenszék" in 1977. Im the beginning of the experiment there were 3 species in the "Fehérszék" but now there are 11. There are 6 species in the "Kelemenszék" in the "Zabszék" and there is only one species in the Pipásszék". In territory of Apaj there are 16 recens species in contradictio to the published literature, which said there were only 4 species. In the drill-samples I have found pieces of death landsnails *(Chondrula tridens, Vallonia pulchella),* and the water – *Valvala pulchella* is know only from drilling in this territory. In the neighbouring lake "Háromszögi" – which belongs to Kunszentmiklós – there are 10 species and in the "Pozsáros" there are 7 species.

Dispersion – diversion

The sodic livinplaces are extremely varied because of the multicolourness of substratum, water, flora and exposition. The dispersion (distribution) and diversion (variety) of malacocoenosis tend towards the extremes because of the oecological potencialities and autoecological extremes here (Szabó, S. 1986).

National Park of Kiskunság, territory number III.

The number of species has grown with 67% compared to the beginning of the experiment, but at the same time the absolute quantity of individuals number hasn't changed. The reason of the fact – mentioned above – is that the individuals number of *Anisus spirorbis* has regressed remarkably and this can be explained as a sort of gradational presentation of two competing species (*Gyraulus albus, Segmentina nitida)*

Reeds is the richest in species and number of individuals. The *Physa acuta* and the *Gyraulus albus* are spreaded equally in marschland parts. At the beginning of the experiment the *Anisus spirorbis* was equallly spreaded but later it showed cummulative (enriching) and insular (island resembling) dispersion. The cummulative presentation in large number of the big sized *Lymnaea stagnalis* and the *Lymnaea peregra* is very interesting in the open watered lake. Dispersion of the these species is insular or accidental uncommon, that the quantity, number and spread of the species are considerably less in the alimentary canal than in the (Fehérszék).

The living species are half as much in lake "Kisréti" and "Kelemenszék" examined as control. The number of individuals is very low and the dispersion is insular or accidental. The *Anisus spirorbis* the only one which presents in large number at either place in cummulative dispersion.

National Park of Kiskunság, territory number II.

I have got to know thorougly this big part of the KNP for 3 years. I took a lot of seasonal interspecific pictures about the livingplaces. They became specific because of watermoving and flora.

The alimentary canal is the richest in species (9), but remarkable that the interspecific characteristics of the species are least favourable, there are 6 species in lake signed "A", most of them in the north–east corner of the reeds near the receiver mouth. There are only 2 species in lake signed "B".

There are 10 artifical fish-ponds between the alimentary canal and the lake signed "A". The extention each of these ponds is about 10 ares (1000 m^2). There is no connection between the canal and the ponds or the canal and the lake signed "A". The ponds are connected with each other only. They are fed by precipitation and water coming through the soil.

There is certain open water in pond number 1 but all the others are covered by vegetation. 8 species live in these fish-ponds. Division, individual number and dispersion of these species depend on the potentialities of the livingplace (see next chaters).

In wiew of all territory of Apaj the *Anisus spirorbis* is cummulative and on certain territories the dispersion is equal. Dispersion of the next species - such as: *Lymnaea* peregra, *Lymnaea stagnalis, Planorbarius corneus, Planorbis planorbis, Armiger crista* and *Segmentina nitida* - is insular but a lot of them have much more favourable characteristic in the fish – ponds. Dispersion of the other species is inequal with negligible abundancia. The dates of Apaj are nearly the same as my experience from KNP control territory number II (Szabó, S. 1990-b).

The survival

The problem of becomming waterless periodically of the sodic lakes and the longlasting waterless of the two examined territories propose the question of mollusc fauna's survival. The literary datas, the skins found on the surface and the fossil materials of drill-samples done in 50–150 cm depth on both territories prove that these parts were richer in species earlier compared to the beginning of the experiment. According to the literature and my experience the reason of individual's decay in large numbers is the increase of becoming concentrated with decrease of the water at same time. (Szabó, S. 1990 b). According to Richnovszky the species and individuals settle in – mostly by the birdmigration – year by year (Richnovszky, A. 1989).

I examined this question – mentioned above – on ground and among laboratorial circumstances and experienced decay in large numbers in species of *Lymnaea peregra* and *Lymnaea stagnalis* for example in case of sudden waterlevel fall in the storage lake number I of Apaj after stopping the pumps.

Contradiction to this in the 1–2 cm deep slowly ebbing water of "Fehérszék" and on its substratum the individuals of *Lymnaea peregra* show complete activity.

The fact, that I experienced during the drought in 1991 is inconsistent with the common, multitudious and complete decay. I digged down three plastic pools with opened bottom in 15 cm depth on the territory of Apaj in the open part of fish-pond number I and I didn't touch the bottom of the pond.

Afterward I filled up the plastic ponds and supplied with water 2-3 times a week because of the evaporation. According to the expansion of territory individuals of *Anisus spirorbis* already appeared after a week. Also in the 10–20 cm deep water developed after the rainstormes in July 1991 snails were appeared on both territories and their abundancia , constancia and dominancia value and dispersionpicture were similar to the value of the pre-drying period.

Based on my experience it seems the activity of species decreases because of the unfavourable oecological elements and the majority of individuals goes through difficulties in their oecological refugiums" during the unfavourable period. Escaping factors of the snails according to the results until now are: the drastic decrease of the waterlevel, the sudden increase of the water's electrical conducticity (total salinity), rise of the pH value over 9, and obtaining 25 mg/l Na_2CO_3 content of water.

After the period of summer rainy weather there was no major bird-moving. I don't preclude the possibility of remote pick – up of species by birds – but not return in large numbers –, because it is my only explanation for appearance of *Perforatella rubiginosa* on territory of Apaj and for appearance of *Armiger crista, Segmentina nitida* in lake "Háromszögi".

I examined the survival in mud by laboratorial experiments in aquariums and by 50–150 cm deep drilling – 10 drillings on one territory. The mortality of species is extreme, it is between 20–80%.

A lot of individuals decay particulary from mature specimen of *Lymnaeas*, and it is quite less in case of *Planorbarius corneus*.The most individual of *Anisus spirorbis* and *Planorbis planorbis* go through the unfavourable period.

Nearly every species forms thin skin or chalky inclusion on its mouth during the time of becoming waterless: *Planorbarius corneus, Planorbis planorbis, Anisus spirorbis, Segmentina nitida.*

Most of the individuals of *Anisus spirorbis* and *Planorbis planorbis* stay on the surface and other species hide in still humid mud but not deeper than 10–15 cm, and the *Planorbarius corneus* and *Lymnaea peregra* slip into the polygonal rent of parched bed.

All individuals of *Lymnaea stagnalis* decayed during the experiments in aquarium even if they dealt with the drought for a little while by touching the mud with their mouths. I also didn't succeed in observing the survival on dry ground. There is a flowing across canal between the water storage number I and the lake signed "A" and in the 2–3 cm deep water of its bowe these individuals assembled in large numbers during the dry period.

Return - settlement

At the beginning of the experimental period the occurence of species was mosaic-like on both territories. In the last three years I was able to observe the return and settlement of mollusca well with the help of colouring experiments and network-coenological maping on the livingplace reconstructional territories.

National Park of Kiskunság, number III.

The reason for 67% increase of species number is double. On the one hand the *Lymnaea stagnalis* – not as animite but fresh subfossile condition – existed earlier in all probability. The colouring experiments show their definite moving between the deeper parts of reeds and the open water. The egg piles settled on many specimen's shell moving in the open water are unusual experience (in case of *Lymnaea peregra* as well!) They drag along these piles of eggs but in normal case they take them on the flora.

Settlement of *Gyraulus albus, Hippeutis complanatus* and *Segmnetina nitida* from the alimentary canal can be definitely observed by the network – coenological mapping. The reason for appearance of *Armiger crista* and *Lymnaea palustris still unexplained.*

National Park of Kiskunság, territory number II.

In the examined period I experienced settlement only once on territory Apaj. The appearance of *Perforatella rubiginosa* in autumn 1991 was not longlasting because I did not find any individual of them since then in spite of the accurate research.

The settlement of mollusca has definitely positive tendency at Apaj. The *Anisus spirorbis* seems to go into latent condition there, where it is touched by negative effects of the oecological elements. The direction of migration is definitely radial in case of this species. Now it is widely spreaded in the whole lake signed „A" and its caracteristics are influenced only by the pH value and Na2C3 amount of water. Now more generation live together. In case of prosperous waterlevel we can expect the pullulation of these individuals in large numbers, wich has significant effect on biomassa.

There are definite oecological refugiums in case of other species, for example the *Segmentina nitida, Planorbarius corneus* in the north-west reeds of lake signed „A" , the *Lymnaea peregra* in more digged hole next to the dams, the *Lymnaea stagnalis* and the *Planorbis planorbis* at the enviroment of the waterstorage outlet.

The fishponds – mentioned before – deserve attention. They are not linked to the reconstructional watersystem but are linked to each other by the smaller linking canals. The ponds – although they are separated pieces – show balanced picture comparing to other territories. On basis of the picture showing by malacocoenosis we can conclude that, there was water here – it is a relatively deeper part in one or two period of the year before the reconstructional period. On basis of researches the pond signed 3/a" plays central role there, where the characteristics of species are the most favourable. Moving off anywhere from this pond the values are getting worse except *Planorbis planorbis* and *Anisus spirorbis.* I have to mention the pond number I, which east part is open watered (pelagic), and its west part has got similar conditions to the other ponds. At the east part of the pond the degradation occurs always earlier then at the other places because of the faster increase of the pH value and the Na_2CO_3 amount of water.

The biomassa of snailspecies in sodic waters

Morphology – and sometimes colour – of mollusca living in sodic waters differs from the molluscs' living in other waters (Richnovszky, A. 1993). It is the same in case of snailbiomassa.

Against the common literary measure facts (Soós, L. 1943) in the sodic waters of Upper Kiskunság the mature specimen of watersnails reach only 40–80% of the average size. The *Lymnaea stagnalis* reach the average size in the reeds. The *Lymnaea palustris* can be found in capital size around Apaj. The size of *Anisus spirorbis* is between 80–100% depending on the chemical conditions of water. The *Hippeutis complanatus* show the smallest size (38%)

Biomassa of snailcoenosis in the sodic lakes

From the examined lakes "Fehérszék" and "Pozsáros" have the largest biomassa and the biomassa of lake "Kisréti" and fishpond of Apaj is not negligible. "Kelemenszék", "Zabszék", "Pipásszék" have insignificant snailbiomassa.

Apaj: Fishpond (livingplace reconstruction)

In the reeds found at north–east part of the lake the value of biomassa is the largest. By the way the oecological refugium of *Lymnaea stagnalis* is here. Moving off the snailbiomassa may decrease in opened waters even one seventieth.

Lake Háromszögi, Pozsáros, lake Gyékény

These small lakes are similar to each other in biomassa, coenological characteristics and species combination. They can get watersupply – in case of high water level – from the canal number XXXI apart from the precipitation.

Fehérszék (livingplace reconstruction)

Due to the reconstructional work lasting more than 3 years there are 67% more species here with increasingly better conditions. There were species – with big bodies – in the opened water only here in large numbers because this lake gets the fresh water from the alimentary canal from the direction of the opened water. Here, in the opened water the value of snailbiomassa was much higher than in the reeds.

Kelemenszék

In this lake there are species – with big body – only near the fresh water coming from the canal. The snailbiomassa of the lake – in view of the whole lake – is very low it doesn't reach one tenth value of the "Fehérszék".

Lake Kisréti

In the reeds and in the hardly any deep water the big bodies species are breeded quite well. Just only the *Anisus spirorbis* live in the opened water. The difference of snailbiomassa is more than 70 times here as welle.

Zabszék, Pipásszék

Practically only the Anisus spirorbis live in these lakes. The snailbiomassa is extremely low and in the opened waters it is insignificant, and it doesn't reach one fiftieth of the Fehérszék's.

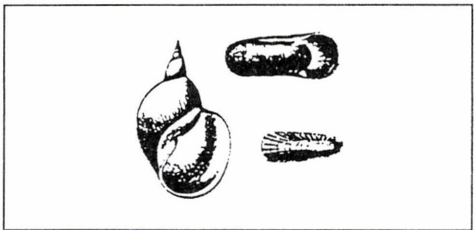
Change of snailbiomassa

Locally: The biomassa of reeds is always higher than the opened waters, except Fehérszék. It comes from the nourishment – the species with big body are mostly detritus eaters – and the chemical connection of water. The snailbiomassa is decreased desperately by increase of water's pH value, electric conductivity (total salinity) and Na_2CO_3 amount.
Aggregate: The livingplace reconstructional territories and parts having foreign" water occasionally have higher snailbiomassa considerably. The reason for this higher snailbiomassa is the reduction of watersalinity. The waters hardly reach the 900 S conductivity value which is typically minimum in case of salines. The snailbiomassa of Fehérszék is shown tendency of successional changes. In the high salinity, and 5000 – 12 000 S conductivity of "Zabszék" and "Pipásszék" the coenosys and biomassa is similar to the value of 1970's.

Summation:

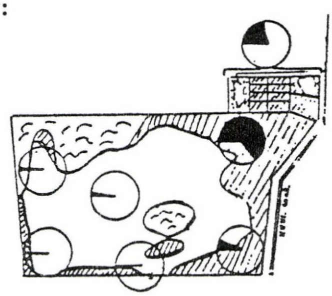
A) The water reduction and desiccation of sodic lakes cause extinction of some species in large numbers but in case of characteristic species the survival is solved by periodic return of water.
B) The proved escaping factors are till now: drastic reduction of water, pH value above 9, Na_2CO_3 amount of water risen at least above 25mg/l.
C) The species stay in the 10–15 cm deep mud under the surface during the total parching, the species with bigger body go into the polygonal rents of the soil or into the still existing deeper marshy parts during the drought.
D) In consequence of returning water mollusc start to return slowly from the oecological refugiums being deeper parts of ex-livingplaces.
E) During the livingplace reconstruction the settlement of mollusc from the alimentary canals can be experienced.
F) As a method of measuring snailbiomassa the Haarlow-index can be applied well. In the sodic lakes of Upper Kiskunság the extremeties of snailbiomassa are determined by the flora and the chemical connection of water.

production

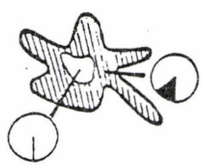


Haarlow index:
abundancia × volumen

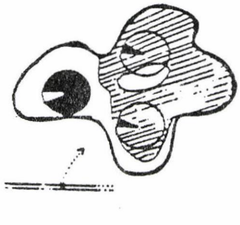
locally:



Apaj: Halas-tó



Kisréti-tó

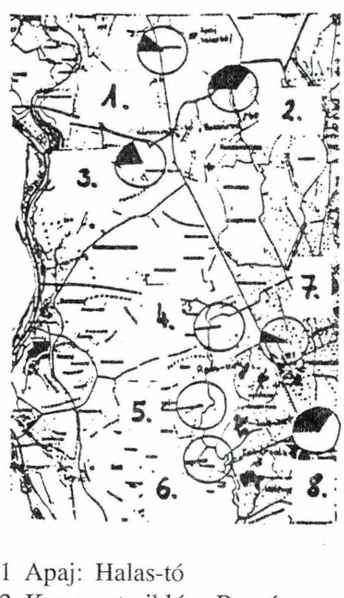


Fehérszék

The production of snailspecies in sodic waters:

A. lacustris	60%
L. stagnalis	100%
L. palustris	80–120%
L. peregra	70%
Ph. acuta	60%
P. corneus	60%
P. planorbis	90%
A. spirorbis	80–100%
G. albus	70%
A. crista	80%
H. complanatus	30%
S. nitida	80%
S. oblonga	70%

aggregate:



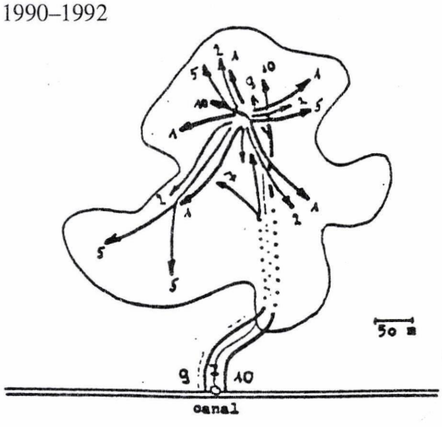
1 Apaj: Halas-tó
2 Kunszentmiklós: Pozsáros
3 Kunszentmiklós. Háromszögi-tó
4 Pipásszék
5 Zabszék
6 Kelemenszék
7 Kisréti-tó
8 Fehérszék

return

Fehérszék:

	SPECIES:	D %	C %
1.	***L. stagnalis***	2,58	20
2.	***L. palustris***	0,7	20
3	*L. peregra*	8,9	100
4.	*Ph. acuta*	6,75	40
5.	***P. corneus***	2,38	60
6.	*A. spirorbis*	52,2	100
7.	***G. albus***	21,6	60
8.	*A. crista*	0,3	20
9.	*H. complanatus*	5,7	40
10.	***S. nitida***	3,9	60
11.	*S. oblonga*	0,19	20

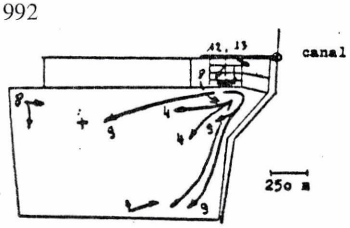
1990–1992



Apaj: Halas-tó

	SPECIES:	D %	C %
1.	*B. tentaculata*	0,03	3,8
2.	*A. lacustris*	0,15	11,2
3.	*L. stagnalis*	0,38	7,6
4.	***L. palustris***	2,62	56,8
5.	*L. auricularia*	0,15	3,8
6.	*L. peregra*	2,16	41,7
7.	*Ph. acuta*	0,27	7,6
8.	***P. corneus***	0,11	10,7
9.	***P. planorbis***	12,52	56,3
10.	*A. spirorbis*	69,33	92,3
11.	*G. albus*	0,07	3,8
12.	*A. crista*	4,46	34,6
13.	***S. nitida***	4,79	26,9
14.	*P. rubiginosa*	0,15	3,5
15.	*S. oblonga*	0,07	3,8
16.	***Pisidium sp.***	2,55	7,6

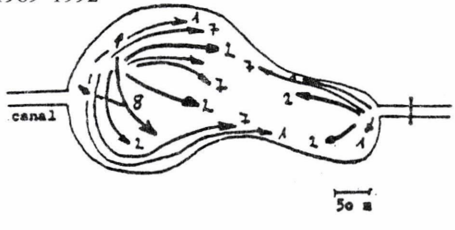
1990–1992



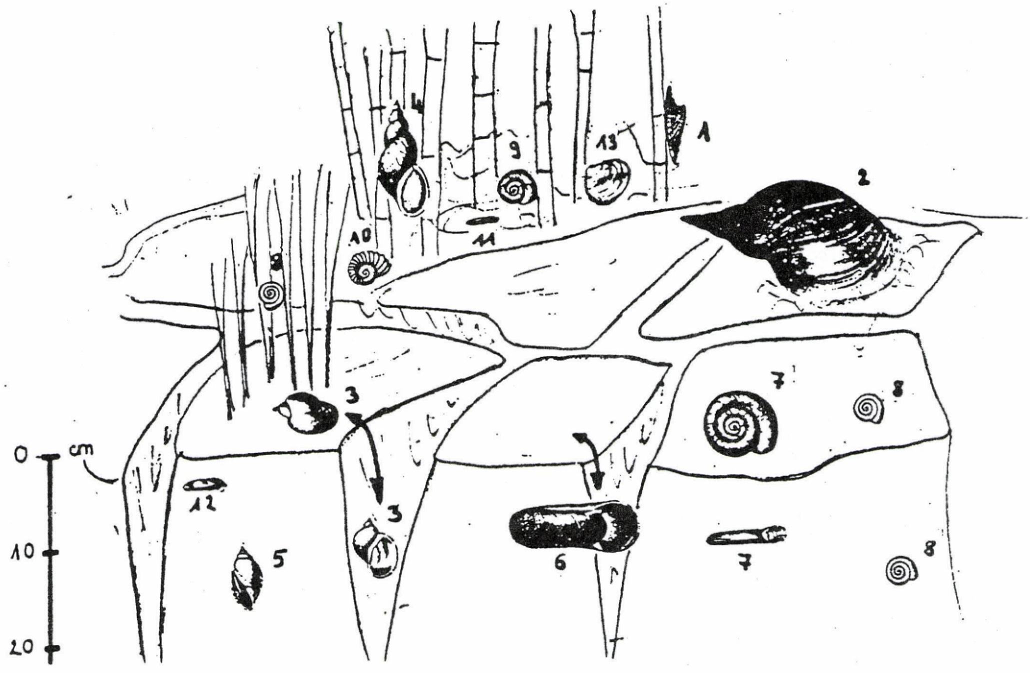
Kunszentmiklós: Háromszögi-tó

	SPECIES:	D %	C %
1.	A. lacustris	7,9	57,1
2.	**L. stagnalis**	3,8	100
3.	L. peregra	19,4	100
4.	Ph. acuta	9,75	85,7
5.	P. corneus	3,96	85,7
6.	A. spirorbis	45,9	100
7.	**A. crista**	8,5	42,8
8.	**S. nitida**	0,4	14,2
9.	S. oblonga	0,1	14,2

1989–1992



escape – survival



species	mortality %
1. *Acroloxus lacustris*	60
2. *Lymnaea stagnalis*	80
3. *Lymnaea peregra*	70
4. *Lymnaea palustris*	40
5. *Physa acuta*	50
6. *Planorbarius corneus*	50
7. *Planorbis planorbis*	20
8. *Anisus spirorbis*	20
9. *Gyraulus albus*	60
10. *Armiger crista*	60
11. *Hippeutis complanatus*	70
12. *Segmentina nitida*	30
13 *Pisidium sp.*	40

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