دریاچه ارومیه بعنوان یک منبع با ارزش آرتمیا جهت تغذیه بچه ماهیان خاویاری *

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خلاصه :

میگوی آب شور Brine Shrimp *Artemia* بعنوان یک غذای زنده باارزش برای تغذیه بسیاری از بچه ماهیان پرورشی و میگو در سطح وسیعی در جهان بکار برده می‌شود. تخمهای این سخت‌پوست آب شور در سواحل دریاچه ارومیه و سایر دریاچه‌های آب شور ایران یافت می‌شود. اولین بار تخم وآرتمیای زنده بوسیله اینجانب و همکاران از دریاچه ارومیه به کارگاه پرورش ماهیان خاویاری ناحیه " سنگر " جهت پرورش و تغذیه بچه ماهیان منتقل گردیدند. در این مقاله ضمن عرضه نتایج مطالعات فیزیکی و شیمیائی آب و مشخصات ساحل دریاچه ارومیه روش تغذیه بچه ماهیان خاویاری با آرتمیا نیز ذکر شده است. پرورش بچه ماهیان با تغذیه بوسیله مخلوط کرم سفید و دافنیه و همچنین با آرتمیای تنها مقایسه شده است براساس مشاهدات و انجام آزمایشات تجربی موقعیکه بچه ماهیان خاویاری از آرتمیا تغذیه شوند محاسن زیر بدست خواهد آمد:

۱- پرورش آرتمیا در مقایسه با سایر موجودات زنده غذائی مانند دافنیه ،کرم سفید و غیره راحتتر تقریبا در تمام فصول سال صورت گرفته و بسیار ارزانتر تمام می‌شود.

۲- تخمهای آرتمیا را براحتی می‌توان از سواحل شنی ، سنگی ، باتلاقی و یا شناور در آب دریاچه ارومیه بدست آورد و قابلیت نگهداری آن طولانی و آسان خواهد بود.

۳- بچه ماهیان خاویاری که از آرتمیا تغذیه شدند رشد بهتر و مقاومت بیشتری رانشان می‌دهند.

۴- شیوع بیماری در ماهیانی که از آرتمیا تغذیه شدند بسیار کمتر بود.

۵- ماهیان خاویاری جوان در مراحل بعدی پرورشی در استخرهای خاکی حداقل میزان تلفات و حداکثر محصول را در مقایسه با سایر بچه ماهیان خاویاری داشتند.

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about 40% to 60% of the fries might die in earthen ponds. But the fries fed with *Artemia* showed less mortality (about 30 to 40 percent).

Using *Artemia* to feed the fries is economically important either. In veniro's ponds of Sad Sangar fish culture workshop, 6 to 8 million sturgeon larvea might be annually cultured. 0.05 tons of white worm and many times as much *Daphnia* ought to be used in order to feed such a large number of larvea.

White worm is economically expensive to produced, whereas *Artemia* culture is much cheaper. Sometimes $\frac{1}{8}$ to $\frac{1}{10}$ the price of produce white worm.

It is experienced that, if at least 50% of *Artemia* is used instead of white worm, it would be economically profitable. And also fish culture would be much easier and less mortality will be seen among them. Regarding the important future programming for acipensers stocks conservation, more serious attention should be paid to *Artemia* as a live food.

Abundant resources of *Artemia* available in Iran and the valuable stocks in Uroumieh lake and the other saline water should be properly exploited.

The newly hatched sturgeon fries were also fed with 50% of *Artemia* instead of other live feed. In another test, which lasted for 18 days the sturgeon fries fed with 100% nauplii and adults *Artemia* (biomass).

The newly hatched sturgeon fries normal feeding method begins with 100% small *Daphnia* in the early days. Gradually, until the end of their growth period in Veniro's* pool, it can be changed to even 10% *Daphnia* and 90% white worm. Three methods of feeding the newly hatched Acipenser's fries were compared in the test (11):

1- Feeding sturgeon fries with 100% *Daphnia*.

2- Feeding with *Daphnia* and white worm (normal feeding method).

3- Feeding sturgeon fries with 100% nauplii and adults *Artemia* (biomass).

Applying *Artemia* in the above mentioned three tests is noticable in table IV.

Table IV : Comparative growth and survival in *(Acipenser guldenstadti persicus)* and *(A. stellatus pallas)* fed different live food.

Live food source	Species of sturgeon	Duration of cultured test (days)	Average fish weight (g)		Mortality %
			start	end	
Daphnia	*A.guldenstadti*	18	0.35	1.5	25
	A.Stellatus	18	0.22	1.2	30
D.+Enchytraeus	*A.guldenstadti*	18	0.35	1.60	20
	A.stellatus	18	0.22	1.25	24
Artemia	*A.guldenstadti*	16	0.35	3.2	17
	A.stellatus	16	0.22	2.30	19

Conclusion :

As a result, the fries growth rate is increased, their mortality is less and the pathogenic insidence is much lower. Taking the *Artemia* fed fries to earthen ponds reduced the mortality. In normal condittions,

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Table II :Feeding rate and weight incrase in *(Acipenser stellatus pallas)* fed *Daphnia* and *Enchytraeus*.

Age of fry (days)	Daily growth of fry (mg)	% of live feed in diet		Amount of food(g) offered/10000 fry	
		D.	*E.*	*D*	*E*
1	1.5	80	20	72	6
2	3	70	30	126	18
3	4.5	70	30	186	28
4	6.5	60	40	244	52
5	8.5	60	40	300	70
6	10	50	50	300	100
7	12	50	50	300	120

Table III : Feeding rate and weight increase in *(Acipenser stellatus pallas)* fed *Artemia* (nauplii and adults) and *Enchytraeus*.

Age of fry (days)	Daily growth of fry (mg)	% of live feed in diet		Amount of food(g) offered/10000 fry	
		Artemia	***Enchytraeus***	*A.*	*E.*
1	1.5	100	-	75	-
2	3	90	10	135	6
3	4.5	80	20	180	18
4	6.5	70	30	227.5	39
5	8.5	60	40	255	68
6	10	50	50	250	100
7	12	50	50	300	120
8	15	50	50	375	150

Feeding newly hatched sturgeons with *Artemia*

In fact active feeding of sturgeons begin after the yolk sac is completely absorbed. Feeding them with live food should begin as soon as possible to prevent cannibalism. (7)

At this stage *Artemia nauplii* could be fed instead of white worm or small *Daphnia.*

In the following tables traditional feeding of sturgeon fries with *Daphnia* and white worm and *Artemia* substitutes, are given :

Table I : Feeding rate and weight increase in *(Acipenser guldenstadti persicus)* fed *Daphnia (D)* and *Enchytraeus (E).*

Age of fry days	Daily growth of fry (mg)	%of live feed in diet		Amount of food(g) offered/10000 fry	
		D.	*E*	*D.*	*E*
1	2	15	85	16	34
2	4	15	85	15	68
3	6	30	70	30	84
4	8	30	70	30	112
5	11	40	60	40	132
6	14	40	60	40	168
7	16	40	60	40	192
8	19	50	50	50	190
9	22	50	50	50	220
10	27	60	40	60	216

It should be noted that since sturgeon fry is habitually a benthos feeder, the priority should be given to white worm in their rations. This of course, depends on the availability and growth of white worm in corresponding seasons.(7)

In many sturgeon hatcheries, this subject is not taken into consideration.

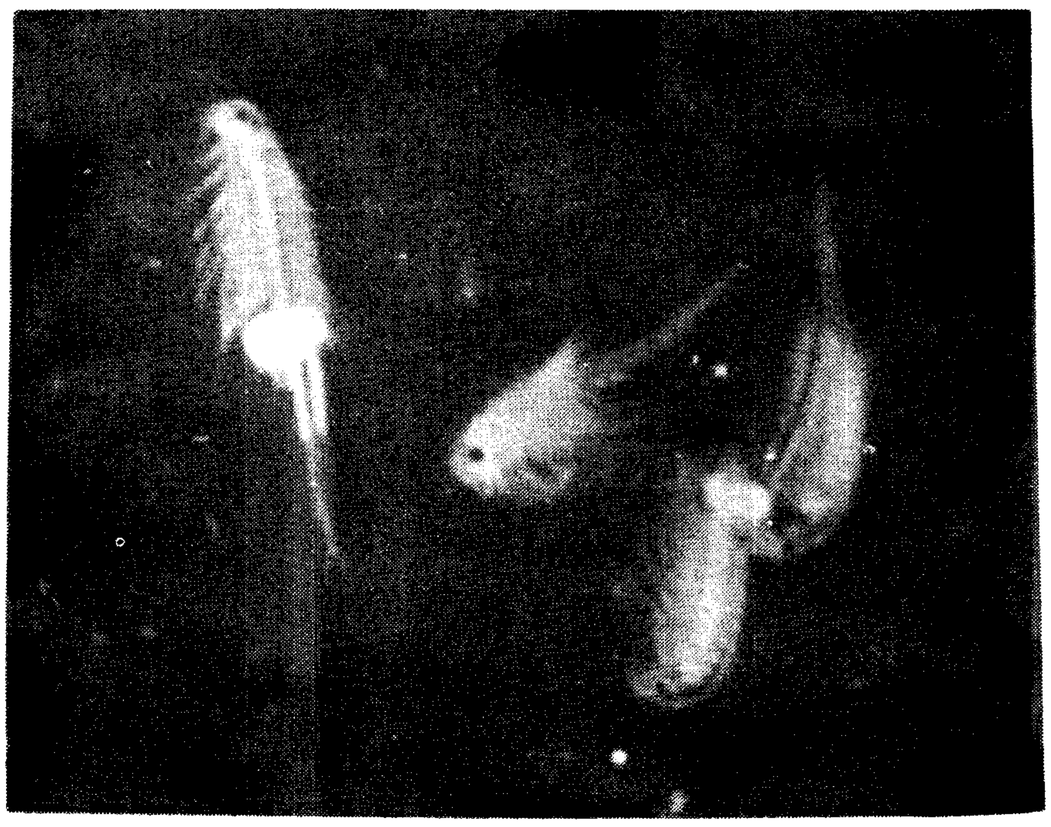
bottom or in water column. In other sampling stations not much eggs were found within the water column, but some were seen within the sediments and salt layers. They, too, were seen along the salt extraction ponds. (4)

Coastal sludge and weeds often contain high number of *Artemia* cysts. In many areas within sampling stations such as Golman Khaneh, *Artemia* cysts were seen so abandanthy within a few meters of coastal bed that could be collected by stirring the bottom.

During the cold seasons, whole *Artemia* and its cysts along with algae form a mass that covers the water surface within a few hundred meters of the area. This condition depends on the velocity of the wind. During high velocity, the mass splits and scatter, and in the absence of wind they aggregate to form long bands of beautiful orange colored masses. In my opinion these masses constitute the most important resources of the Uromieh *Artemia*.

The cysts of Uromieh lake *Artemia* are rather bigger than the cysts of 20 other ones available from different sources in the world markets. Its protein and fatty acids content is higher (1) and its size is larger than mouth size of some newly hatched fish and shrimps. However, it seems that the size is so selected by nature to fit the relatively larg mouth of the newely hatched sturgeons. The mean count of cysts per gram is about 185000.

Artemia uromiana



Sampling areas		I	II	III	IV	V	VI
Ca^{+}	mg/1	600	520	320	640	440	200
Mg^{++}	"	2496	2668	2568	2664	2664	2640
Na^{+}	"	62000	56000	55000	75000	63000	60700
K^{+}	"	1800	1400	1600	2150	1600	1500
Total kations	meq	2981	1718	2664	3569	3023	2907.5
$HCO3^{-}$	mg/1	305	292.8	244	451	378	414
Cl^{-}	"	105080	95140	93820	125315	106500	102240
$SO4^{--}$	"	818	884	588	882	818	774
Total	anions meq	20981	2700.8	2656	3555.4	3022.9	2902.2
NO3	N mg/1	13.7	24.5	16.5	38.5	48	58
NO2		0.7	0.03	0.03	0.9	0.5	0.04
NH3		12.3	14.5	6	11.3	0.4	12
O2	mg/1	2.4	2.3	2.4	-	2.6	2.5
I^{-}	mg/1	0.00065	0.00098	0.0013	0.0005	-	-
Total dissolved Solids dried mg/1, 180°C.		206348	200650	204018	223047	226148	206340

Coast and location of *Artemia* cysts collection :

In general the lake coastal zones comprises of swamps, gravel, sandy/rocky and sandy or a combination of these materials. The cysts could be collected from most of sampling stations. The amount varied depending on the accessibility to the coasts seasonal variation and direction of wind. In flat gravel sandy coast of the lake, the cysts could be abundantly collected in late fall when the wind direction is toward the coast. In sampling stations such as No.5 (khantakhti) and No.6 (Sharaf khaneh) *Artemia* cysts are found suspended near the

Results and Discussion :

The lake characteristics:

It is believed that the lake came into existance during 4th geological period. It is located in the north west of Iran (30° 20 E. long. and 45° 10́ N. lat.), at 1250 m. elevation above sea level. The maximum length is along the north south which is 128-140 km, and the maximum width is 50 km. The surface area ranges from 4750 km^2 to 6100 km^2. Gradients are low (6).

The average depth is 6m. and the deepest part is 16m. The total water reserve is estimated about 12 billion m^3 (4,6).

Chemical composition of the lake water corresponds to those of heavy cold water lakes with high sodium and chloride and sulfate. The degree of its electrical conductivity is very high, with 200 g/lit of solid material (After evaporation).

The water and sluge of this lake is used in treating certain diseases by Iranian and peoples from neighboring countries (8).

The results of chemical analysis of the water samples collected from different stations are shown in the following tables:

Table 1. Physicochemical analysis of lake Uromieh water sampled on November 28,1978 and/or August,18,1987 (range of values for six sampling stations all along the shore of lake)

Sampling areas	I	II	III	IV	V	VI
Weter temp.°C.						
Nov.28,1978	9	5	6	9.5	7	8
Aug.18,1987	24	23	24	24	23	25
Air temp.°C.						
Nov.28,1978	15	12	11	10	10	9.5
Electrical conductivity Mm/Cm	290000	278000	300000	234000	285000	240000
Total alke-linity.mg/1 CaCO3	242	232	206	296	312	308
Total hardness mg/1CaCO3	25400	25000	28400	23600	24400	23000
Salinity p.p.t	151.41	151.52	151.52	167.76	167.76	167.76
Refractive index:	1.3670 - 1.3700					

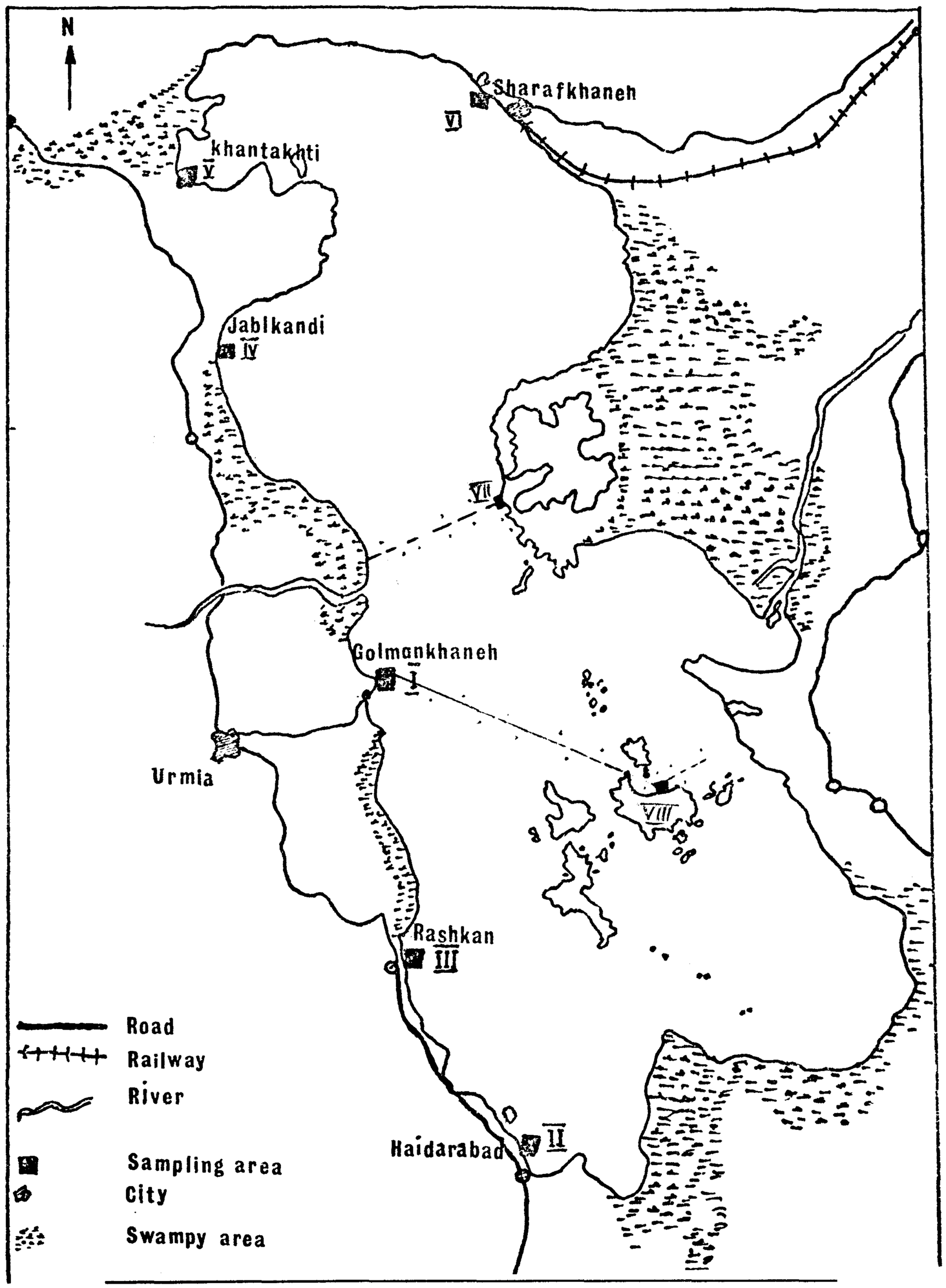


Fig.1: The map of Uromieh lake and sampling areas.
Scale 1: 1200000

Procedures :

In this investigation 2 species of sturgeons; *Acipenser guldenstadti persicus* and *A.stellatus pallas* weighing 40 and 30 mg respectively (after having had their yolk sacs absorbed), were fed with *Artemia* nauplii and biomass.

Artemia cyst were collected from Golmankhaneh coast of the Uromieh lake and after hatching the cysts in conical jar(5), reared in concrete tanks of 13×4×0.9m. dimensions (30g cyst/m3). Description of culture medium is as follow:

Humus	10	Kg
Ammonium sulphate	1	"
Super phosphate	0.5	"
Potassium chloride	0.5	"
Salt water	1	m^3

Salt water of 50-70% salinity was suggested. 0.5 kg/m3 of pigeon drops were used as organic fertilizer in salt water. This mean, conducted for the first time in Iran, was found to be highly effective in stimulating phytoplanktonic growth in the medium. Measures were taken to prevent excess fertilization of the medium. To estimulate the growth of microflora and also direct feeding of *Artemia,* 20g of hydrolysed yeast was added at 3-5 alternative days.

Analytical properties of water were determined by means of spectrophotometry, complexometry and other routine methods.

Eight more stations around the lake and its islands were used to conduct more sampling Fig 1.

The details of these stations are as follow:

1- Golman Khaneh..... west coast of the lake

2- Heidarabad..... south west of the lake

3- Rashkan ..... south west of the lake

4- Jabal kandi ..... west coast of the lake

5- Khan Takhti..... north west of the lake

6- Sharaf Khaneh ..... north coast of the lake

7- Agh Gombad (shahi)..... east coast of the lake

8- Ghouyon Daghi island ..... south east of the lake

Introduction :

Since 1971, breeding and culture of sturgeons synchronous has been implemented with a general trend in development of fish culture in the southern part of Caspian sea. Application of live food have since been rapidly employed in sturgeons culture. Feeding live organisms initially began with cultures of white worm and *Daphnia*. High expenses in the production of these organisms and difficulties in culturing them, particularly white worm, made it necessary to look for substituds with cheaper and easier culture procedures. Application of *chironomous* larva and house fly larva were taken into consideration, but based on their big size and difficulties in supply, were not acceptable. Collection of *Gammarus* from the sea shore was not found to be logical due to its chitinous nature and bacterial contamination and hence its hard digestibility. Finally, brine shrimp (as nauplii and biomass) were found to be feasible live food in all aspects(10). Therefore, since 1972 almost 50% of sturgeon fries diet has gradually been made to be as *Artemia*. Fortunately and after a few years of delay in application of *Artemia* as feed for sturgeons, it has gain close attention and intensively used in recent years.

Generally sturgeon larvae start to feed after half of their yolk sacs are absorbed. In the first 2-3 days larvae start feeding on *Artemia* nauplii and young *Daphnia*. Since the mouth of sturgeons are camparatively larger than other cultured fishes of the same size, they are able to consume larger feed particles and even adult *Artemia* easily, a few days after absorbtion of the yolk sacs(7).

Millions of sturgeon larvae and fries are grown to 100-120 mg within 7-10 days and transferred to ponds for final growth phase before releasing them into the sea.

In 1972, for the first time in Iran, author and his co-workers cultured and propagate *Artemia* in Sangar Dam fish culture plant which was origenally brought from Uromieh Lake(3). *Artemia uromiana* is a bisexual and parthenogentic species which is the sole representative of its kind in Asia(2). Studies which are done afterwards by the author in a research project (sponsored by the University of Tehran) reveals potentials of their resource.

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Uromieh lake as a valuable source of *Artemia* for feeding sturgeon fry

Azari Takami G. *

Summary :

Artemia or brine shrimp as a valuable live food has world wide application in aquaculture(10). The cysts of this crustacean are found in saline water along the Uromieh lake and other saline lakes in Iran. Preliminary experiments were first conducted by transfering *Artemia* cysts and biomass to Sangar Dam fish culture plant to feed sturgeon fries(3). In this article the physical and chemical properties of water and characteristics of the lake coast and the methods of feeding sturgeon with *Artemia* are presented. Growth of fingerlings on white worm *(oligochaet)* and *Daphnia* mixture and *Artemia* alone were compared. Based on these experiments, when the sturgeons fries were fed with *Artemia,* the following advantages were observed:

1- Culture of *Artemia* is easier and cheaper to prepare when compare with the other live food organisms such as white worm, *Daphnia,* etc. and its culture is possible to get almost year around.

2- *Artemia* cysts are easily collected from rocky and marshy sides of the Uromieh lake or even inside its water. It is also possible to keep the cysts with relative ease and long period of time.

3- The fry fed with *Artemia* exhibited a better growth, and higher resistance.

4- Pathogenic incidence in fish fed with *Artemia* was much lower.

5- The young sturgeon reared with *Artemia* showed a comparatively minimum mortaliteis and the highest yeild, when transferred to fish out ponds.

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