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# بررسی تکثیر مصنوعی وپرورش ماهی سفید Rutilus Frisii Kutum(Kamensky) در ایران

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**خلاصه:**

ماهی سفیدکماز ماهیان با ارزش شیلاتی است با افزایش صید بی‌رویه وتقاضای روزافزون مردم وآلودگی های محیطی در خطر نابودی نسل واقع گردیده بود .

کوشش های زیادی درجهت حفظ و افزایش ذخائر این ماهی در شیلات ایران بخصوص پس‌از ملی شدن شیلات و به ویژه در ده‌سال اخیر به عمل آمده است .

بااجرای‌طرح‌تحقیقاتی بررسی‌بیوتکنیکی‌تکثیر و پرورش ماهی سفید مصوبه شورای پژوهشی دانشگاه تهران‌وهمکاری سازمان تحقیقاتی شیلات ایران مطالعات دامنه داری در زمینه شناخت این‌ماهی وبیوتکنیک تکثیر مصنوعی و پرورش آن به‌عمل‌آمده است . در این مقاله‌که قسمتی از نتایج طرح مزبور درآن آمده است هزاران ماهی از نقطه نظر مهاجرت ، بیومتری ، طرز تخم‌ریزی طبیعی ، شرایط تکثیر مصنوعی وانکوباسیون و پرورش آن در استخرهای خاکی مورد مطالعه قرار گرفته اند تا روش های علمی حفظ‌وافزایش ذخایر آن ابداع گردد .

خوشبختانه درسال‌های‌اخیربارهاکردن دهها میلیون بچه ماهی سفید به دریای خرزذخایر این ماهی بطرز قابل ملاحظه‌ای افزایش یافته و انتظار اینست که در سال های آینده نیز این روند بادیدگاههای علمی تر و بصیرت کافی انجام یابد تا افزایش ذخایر این ماهی‌سبب‌لطمه به ذخایر سایر ماهیان با ارزش شیلاتی (تاس ماهیان ) و تباهی نسل ماهی سفید نگردد .

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The growth rate of fish fry in the Havyg Hatchery is as follows:

The average length of the young fish was:

10mm (minimum 8mm, maximum 14 mm) after one week.

12mm(minimum 10 mm, maximum 15 mm) after two weeks, and 14mm(minimum 11 mm, maximum 20 mm) after four weeks.

ACKNOWLEDGEMENTS

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We are also indebted to the members of fisheries research organization of Iran in Bandar Enzeli.

After the termination of the incubation period, or as soon as the first larvae were observed in the incubator, the contents were emptied into a large plastic container and exposed to the sun. During the gradual increase the water temperature all eggs in the container hatched. The larvae absorbed their yolk-sacs during the first and second days of their lives.

In modern hatchery, larvae reared in Zugg incubators of 200 l. capacity are fed from their second day with a mixture of milk and eggs after five days, the yolk- sac disappeared completely, The young fish are transferred to the ponds for further rearing.

Kutum fingerling rearing

Kutum fry production started in 1975 at the Havyg Hatchery. At present, 15(terrestrial) ponds(dimension 60x30x1.5 meter) with the capacity of rearing six million fish fry, are in use.

The Havyg Hatcher produced 5,111,605 fish fry in 1977 with an average weight from 1 to 1.8 during one months in four rearing times(table III).

In intensive rearing, the quantity of nutural food was not sufficient and artifical foods was supplied to compensate for the shortage. The condensed granulated food used contained 57% inferior quality wheat, 15% fish meal, 23% soya cake and 5% sorghum. The protein content of this artificial food was 28%.

| | Total fish cultured | Average weight |
|---|---|---|
| Intensive rearing | 3,705,500 | 1. g |
| Non-intensive rearing | 1,406,105 | 1.8 g |

Table III. Total Kutum fry production with an average weight in intensive and non-intensive rearing in 1977.

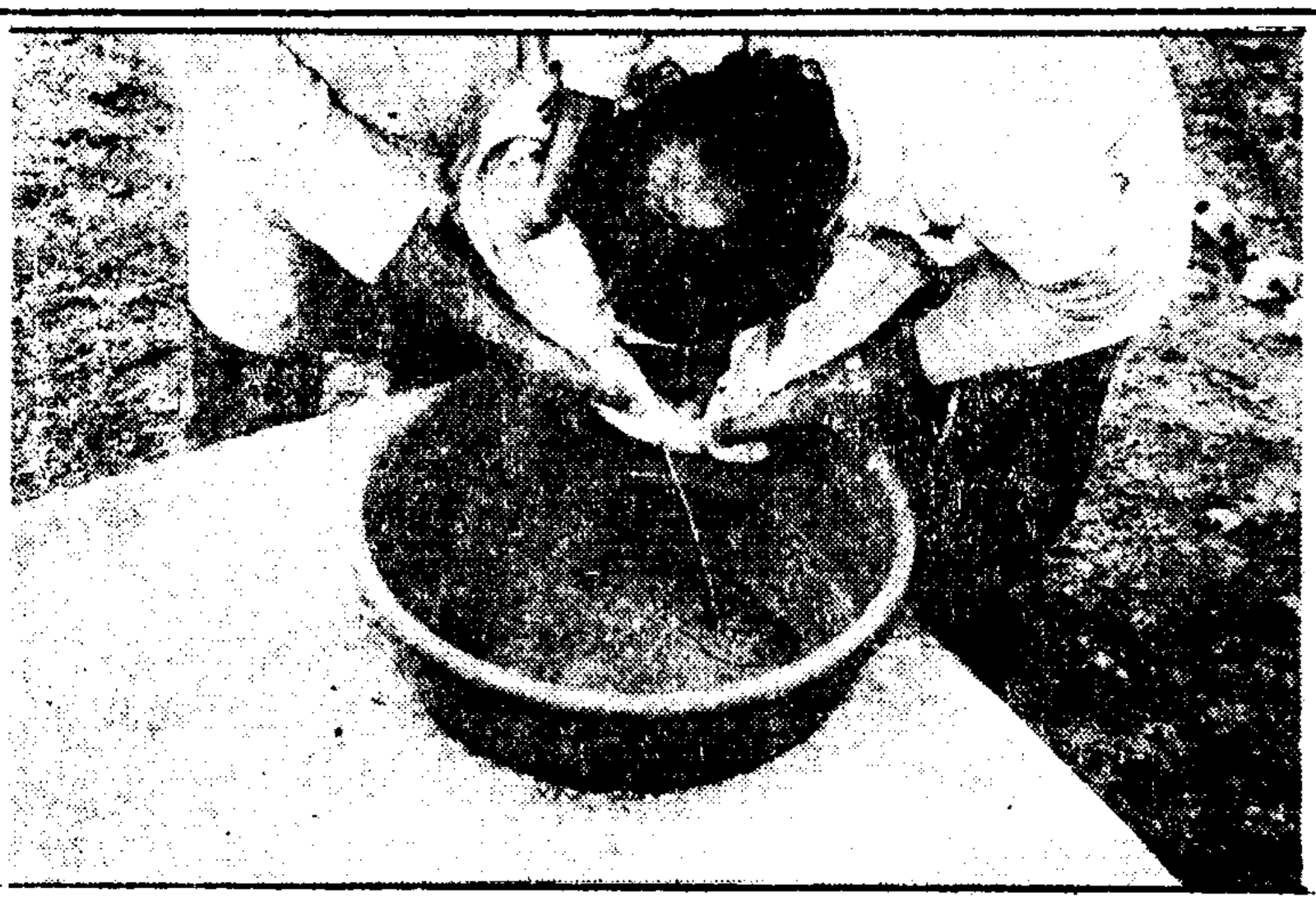
The milt was obtained by the same treatment(Fig 7).

Eggs acquired from one female fish were normally mixed with the milt of two different males and after one minute the fertilized eggs were washed with water. Washing must be done with the most extreme care, by the gradual addition of water into the container and stirring of the mixture with a plastic spoon. The washing should be continued until all eggs are no longer adherent.Fertilization of eggs is satisfactory if care is taken during the processing. According to a survey which was conducted at numerous stages in 1977, the fertilization rate was not less then 90% in the Havyg Hatchery(1).

Kutum eggs incubation period

A Sece-Green incubator has been used in the Havyg Hatchery for the incubation of the eggs(Fig 8). It consists of a wooden box measuring 32X25x52 cm. The bottom is covered with a metal screen of 1.5 mm mesh size for support of the eggs during development. If the incubator is to be used for early larval rearing, the mesh size of the screen must be less than 1 mm. The capacity of the incubator is 2 kg of fertilized eggs (5).

The incubation period was directly related to the water and air temperature. In our experience the shortest time for Kutum eggs to develop to the larval stage in artificial conditions was seven days at 16-20$^{oc}$ and longest period 20 days at 10-14$^{oc}$.



ig.6. Stripping of eggs in Condition

Fig.7. Milt taking

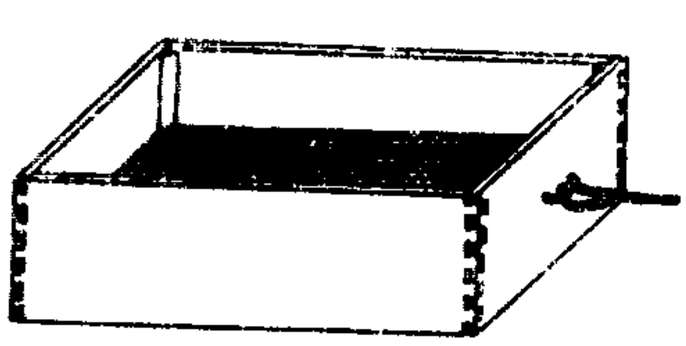


Fig.8. A Sece-Green incubator

Natural spawning of Kutum

A female Kutum at spawning was always accompanied by two males, when the female tried to deposit her eggs in shallow zone of the river. Occasionally parts of the fish protruded from the water. Spawning occured intermittently. The female sharply rubbed its lower abdomen and pectoral area onto the gravelly bottom, made convulsive movements, and released a quantity of eggs. The males become juxtaposed to the females, actually touching them. They displayed the same movements as the female and the milt was discharged intermittently.

It is assumed that the spawning of Kutum is accompanied by preliminary courtship. Female and male spawned simultaneously. The eggs were adhesive and adhered to the bottom and sides of the stones immediately and remained there for 20 days at 10-14$^{oc}$ until the larvae hatched(6).

Fertilization continued until the female laid all her eggs. Some male or female fish were seen to suffer traumatic damage from the gravel. It was observed during spawning that males and females changed their males.

Artificial spawning of Kutum

The stripping of eggs was performed in dry conditions. The fish were held after removing excess surface water with a cloth and eggs expressed by applying pressure to the abdomen with thumb and fingers. Eggs in ovarian fluid were collected into a container(Fig 6).

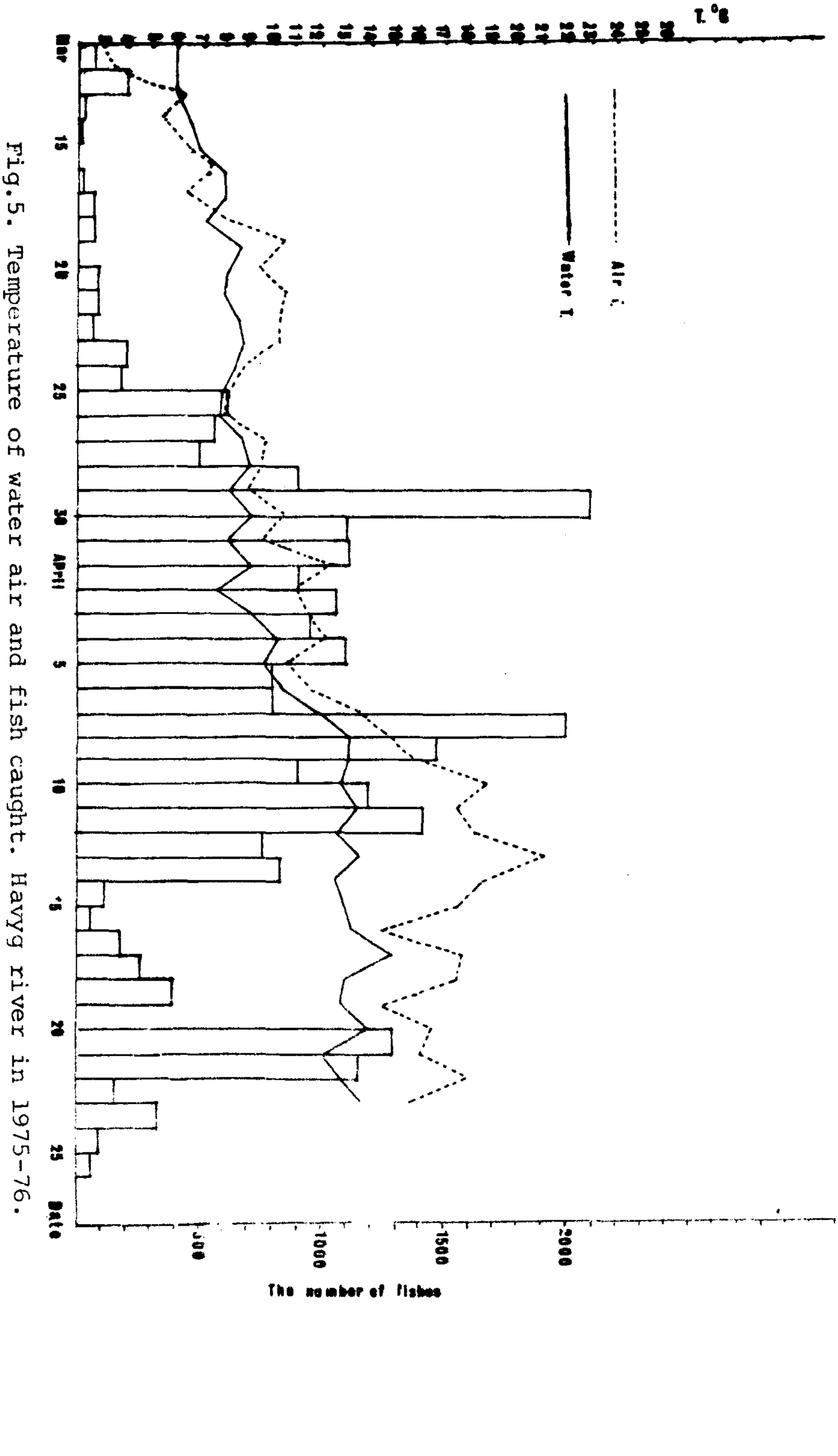



Fig.5. Temperature of water air and fish caught. Havyg river in 1975-76.

In 1975-76, a careful programme was conducted to acquire more accurate information about the migration of Kutum in Havyg river. Data analysis on results collected in Havyg, indicate that Kutum, in regard to the weather conditions and flow, began to enter the Havyg when the water temperature was $6^{oc}$ and air temperature $3^{oc}$(Fig.5). In this year a positive campaign against illegeal fishing in the sea and the rivers was started and these conservation measures probably contributed to the ease with which Kutum migrated into rivers. Discrepancies were observed with regard to the time of migration and quantity of fish run into the river, in comparison with years(see table II) The peak of migration occurred on the 28th March,6th April and 19th April .During that time the conditions were as summerised in table II.

The data show that the spring form of Kutum started migration when the water temperature in the Havyg river was $6^{oc}$ and optimum average water temperature for migration is between $11^{oc}$ and $13^{oc}$. In suitable conditions,the migration lasts until the end of April. Male fish run first, with an equal sex ratio peak migration.

In favourable water turbidity and flow, the fish ran into the rivers during the day and night, but at the end of spawning season, due to the water clarity, the fish migrated only during the night, and in the early morning the spawned fish returned to the estuary.

| Date | Air T.c° | Water T.c° | Number of fish caught | The whole Eggs obtained kg |
|---|---|---|---|---|
| 1976 | | | | |
| 28th March | 10.3 | 9.1 | 1.300 | 40 |
| 6th April | 9.8 | 12.1 | 1.737 | 52 |
| 19th April | 14.6 | 11.6 | 1.290 | 61 |
| 1977 | | | | |
| 28th March | 12.3 | 11.8 | 980 | 60 |
| 6th April | 14. | 13.5 | 860 | 40 |
| 23rd April | 15.6 | 12 | 750 | 36 |

Table II. Temperature conditions in the Havyg rivers and the quantity of Kutum and eggs during migration period.

bers of Kutum participated in winter migration and the bulk of migration occurred the rivers Nahangroga, Pirbazarroga, Sossarroga and Enzeliroga. (Fig.1). However, these migrations decreased with the deterioreation of natural spawning grounds and excessive catches.

The second form of Kutum migration take place at the end of winter, or at the beginning of spring. During this migration the fishes are mainly lithophilous and are gravel spawners.

After development of their products during the last months of winter and primary months of spring, Kutum spawn and then immediately swimdown stream.

The entrance of the fish into rivers for spawning depends upon temperature and also on the flow. The production of fingerling by Iranian Fisheries Research Organization is based on the use of stock from spring runs.

The migration of Kutum into the Dinachal river in the year 1975 occurred on 1st November. On this day, 80 sexually immature specimens of Kutum were observed. On 11th February, five spawners were caught and 600 g of eggs (weighed after fertilization) were obtained. The peak of migration in this river occurred on the 26th March, when 3,845 specimens were caught and 190 kg eggs were obtained (weighed after fertilization). The average water and air temperatures on that day were $10.5^{oc}$ and $12.2^{oc}$ respectively. The migration of fish to the river was continuous until 11th May.

| Sex | - | - | M | F | M | F | M | F | M | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Age in years | 2 | 3 | 4 | | 5 | | 6 | | 7 | |
| Length in cm | 26.4 | 37.2 | 42.1 | 42.5 | 49.2 | 50.7 | 52.7 | 53.8 | - | 58.5 |
| Weight in g | 271 | 662 | 1072 | 1070 | 1649 | 1894 | 2069 | 2281 | - | 2797 |

Table I. Mean length and weight of ungutted Kutum of different age groups.

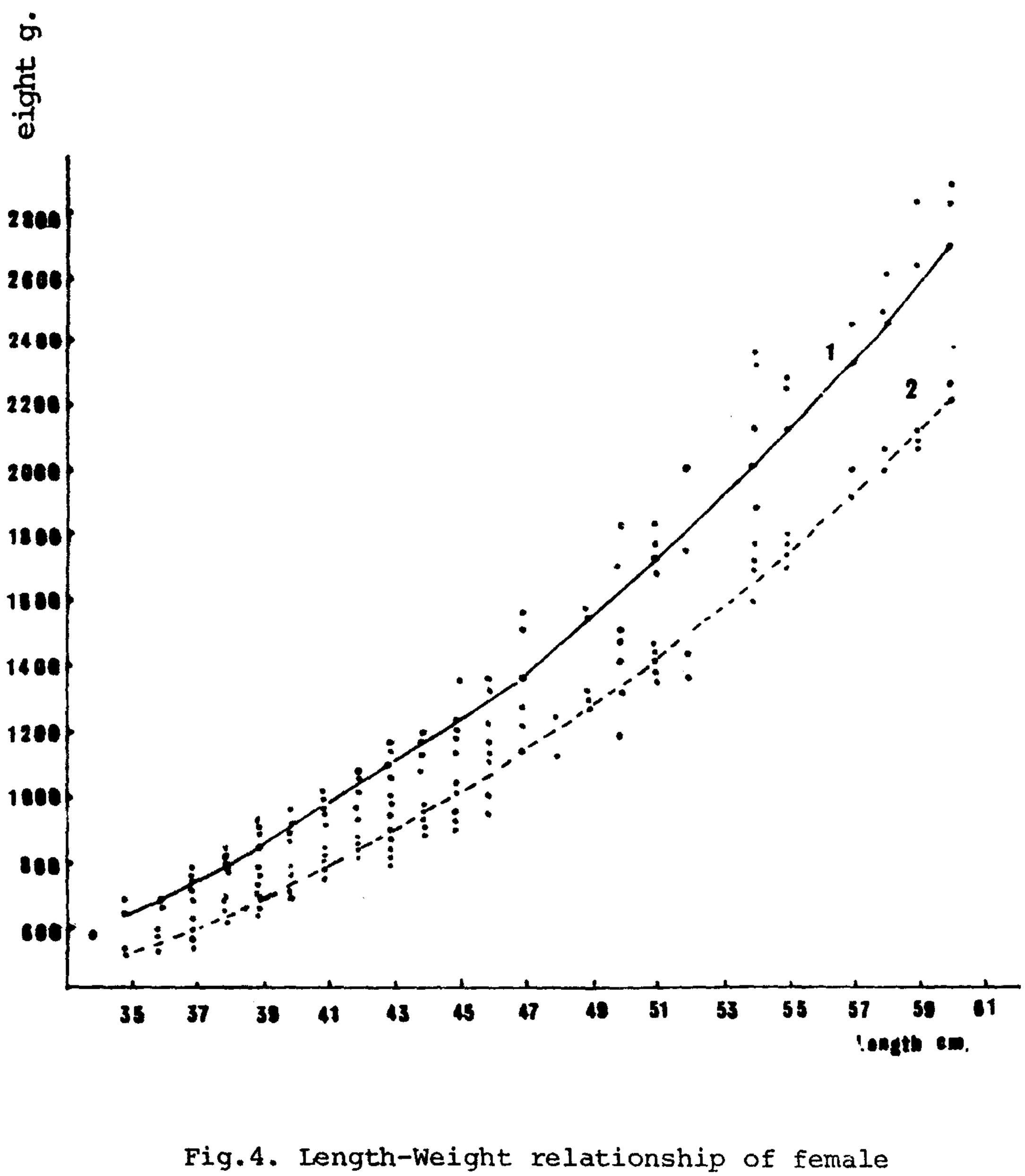



Fig.4. Length-Weight relationship of female Kutum.

1. Ungutted female.
2. Gutted female.

largest specimen examined was 60 cm in length, weighed 3240g. and this seven years old fish produced 124712 eggs(1).

On average, there were 275 eggs per g.before fertilization. After fertilization, the egg number was 64 per g.(1).

An estimation of the length-weight relationship indicated that female fish of 47 cm length and upwards increased more rapidly in weight than fish of shorter lengths (Fig 4).

Curve 1- Length- weight relationship of female Kutum with ovaries: log W=- 1.4041+2.7177 log L.

Curve 2- Length- weight relationship of gutted Kutum: log W=- 1.5551+2.7555 log L.

Where:W=Weight in g and L= fork length in cm.

The analysis of this data is summarised in the table I:

Kutum migration

There are two spawning populations of Kutum(winter and spring). Each spawning take place once per year(5). The winter form white fish are predominatly phytophilous. At the end of autumn or the beginning of winter schools of Kutum enter the rivers which have the quantities of emergent and submerged aquatic plants. The migration is upstream and the fish deposit their eggs on the submerged parts of the water plants(6). In the past, large num-

During the current year, two experiments were conducted to investigate the growth rate of young fish in the earthen ponds. First eight ponds with a surface area of 14,400 $m^2$ were used for intensive rearing and secondly, five ponds with a surface area of 9000 square metres were used for non intensive rearing.

## RESULTS AND DISCUSSION

### A brief description of Kutum biology

Rutilus frisii Kutum (Kamensky) is a member of the family Cyprinidae and sex is externally distinguishable (3).

Females are somewhat larger than males and possess a rounded abdomen (Fig.2). No epithelial tubercles appear on the body of the female, but the elongated body of male fish is covered with epithelial tubercles, particullary at spawning time(Fig 3). Males normaly mature between the third or forth year, but younger mature fish were occasionally encountered.

The female Kutum reaches sexual maturity during its fourth year of life. It was recently observed that the fish spawn annually and probably migrate to the rivers in which they were spawned, an anadromous migration similar to that of the Salmon.

An average femal produces 86000 eggs, but the smallest mature fish examined was 34cm in length, weighed 550g and produced 33768 eggs. The fish was four years old.The

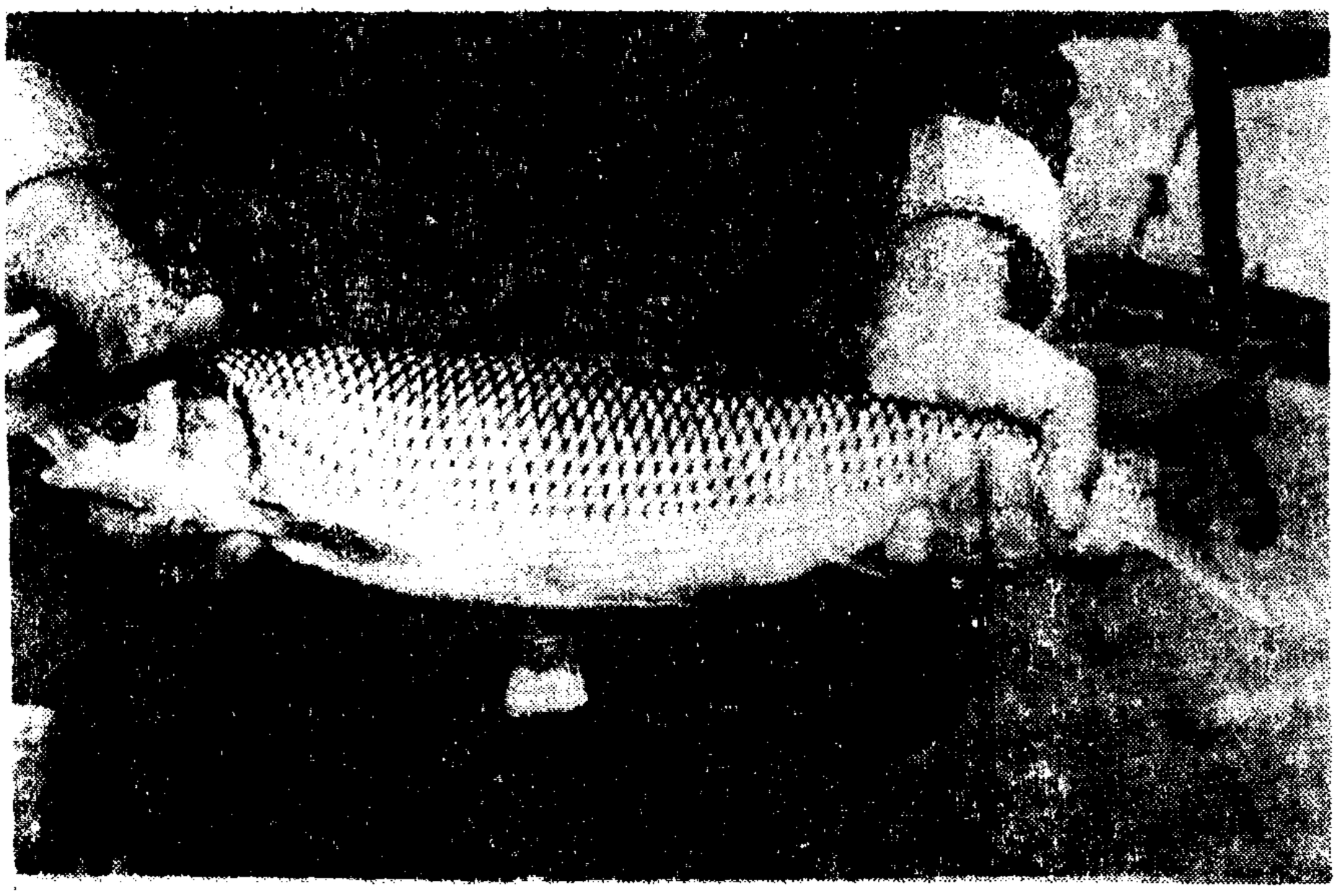


Fig 2. Female white fish

Fig 3. Male white fish with epithelial tubercles

METHODS

During the years (1976-1977) the Iranian Fisheries Research Organization initiated a successful workable plan with limited funds to produce Kutum fingerlings in order to increase the stock in the Caspian sea. It was therefore dicided to construct two modern Kutum production units and for the execution of this project we had to collect the results of related experiences and biologocal data on culturing of this fish. The collection of biological data on Kutum started in 1965 and we have not obtained sufficient information about mentioned aspect up to this date.

More than 6917 Kutum was caught by purse seine nets from the main stream and all the mature female and male was used for artifical breeding and scientific study.

In this survey five samples were examined for each centimetre of length increment. A total of 140 fish were used ranging from 34 cm(The smallest spawner found in the rivers) to 61 cm in length. Along with the sex, the fork-length to the nearest centimeter and round wights to the nearest 5 grams were recorded and scale samples were taken for age determination.

The growth rate of Kutum in relation to its weight and length increments was calculated for different ages.

Furthermore 100 white fish were opened for egg studying from point of view of total number, diameter and fertility.

2- The mechanisation and expansion of agricultural land led to increased water consumption and dicreased river flow during the upstream migration of Kutum, thus interfering with spawning as described later.

3- The application of fertilizers and insecticides in agricultural practices in the Lagoon's water-shed led to pollution of the water.

4- Indiscriminate transfer of fish fry by pumping the river water to farms for irrigation caused massive fry mortalities.

5- The establishment of industries and the resultant discharge of waste water caused further pollution.

6- Excéssive catches of adult Kutum sometimes annihilated all spawners in a river. The total catch was 5854. tons in 1918 and had decreased to 172 tons in 1937(4).

The initial measures for recovery of Kutum stock included the immediate ban of fishing in the Lagoon and rivers and effective control of illegal fishing. These measures stimulated experimentation in artificial spawning in a few rivers surrounding Bandar Enzeli but insufficient to replace stocks.

Since 1925 artifical breeding was actively encouraged by the "Shilat" and was carried out for several years in the ten most important rivers flowing into the Southern Caspian sea, namely Havyg, Lemir, Dinachal etc.... This procedure was limited to larvae production and the release of larvae into the rivers.

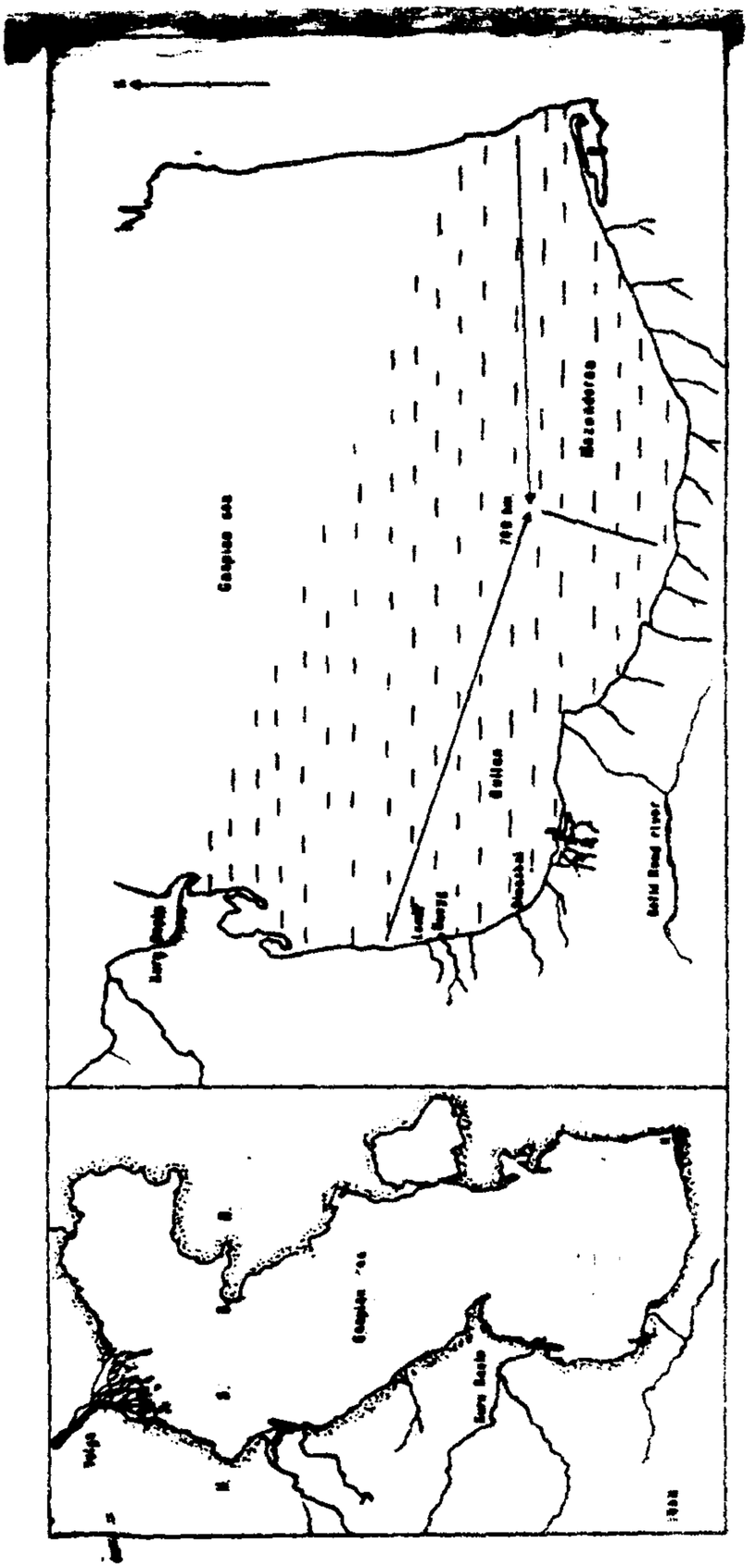


Fig.1. Southern part of Caspian sea. E.Enzell Lagoon
H. Hosseingoli Gulf. B. Bandar Enzeli. 1. pirbazarroga.
2. Sossarroga. 3. Enzeliroga.

INTRODUCTION

Caspian roach, locally known as Kutum is the most popular fish in Iran, which a white fish of high economic value to the fishing industry. This migratory fish inhabits the southern part of Caspian sea from the Kura Basin to the Hosseingoly Gulf in Mazenderan(Fig.1),(3).

During the past, Kutum was caught only in the Enzeli Lagoon and the adjacent rivers, with the aid of a few small fishing units, but from 1946 to 1947 the rate of catches increased and large beach nets, which were hauled mechanically, were employed for fishing in the sea.

The Iranian Fisheries Company, "Shilat" at that time established 18 mechanically operated fishing areas on the coast of Guilan. These extensions of fishing area were followed by large groups of native independent fishermen obtaining licences to set up additional fishing area on the sea shore. The result was that the catch of Kutum increased tremendously.

The lack of management and intensive catch of Kutum during the last forty years and the lack of concern for spawning grounds led to an overexploitation of Kutum.The result was a general shortage of white fish in this area. The main factors which contributed to the shortage of Kutum were:

1- Evaporation and recession of the Caspian sea water level, which decreased the water surface in the Lagoon and increased the growth rate of aquatic vegetation(2).

# A STUDY ON ARTIFICIAL PROPAGATION AND CULTURING OF THE WHITE FISH*

# RUTILUS FRISII KUTUM (KAMENSKY) IN IRAN.

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ABSTRACT

Artificial propagation and culturing of white fish, Rutilus frisii Kutum (Kamensky), were studied during the past ten years. It was attempted to collect some data on biology and spawning habits of white fish in the Southern part of Caspian sea, which is of outmost important to Iran. The growth properties of the mature white fish was studied and some experiments have been done on artificial propagation and incubation period and egg fertility, fry growth and rearing in the Havyg river. This river is one of the prefferred spawning sites of this fish.

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* White fish is the English translation of its persian name,(Mahisefid)but it is a Cyprinid,subspecies of Rutilus frisii and not related to the North American White fish Coregonus Sp.other name for this fish are the Southern Caspian Roach,(in English)and the Kutum, (in Russian).Throughout this paper the name white fish or Kutum will be used.

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