

Study of Spawning Season and Spawning Ground of Soboor (*Tenualosa ilisha*, Ham. Bunch., 1822) during its Migration in Khuzestan Rivers

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Abstract: During 12 months of sampling, from 17 stations, 327 specimens of Soboor fish *Tenualosa ilisha*, including 120 females, 113 males and 86 immature were caught. Total length (TL) of the fishes was 120-500mm. Maximum diameter of soboor ova 0.795mm and the ova with diameter more than 0.7 mm released at one spawning round. Temporal and spatial distribution of ova diameter corresponding to GSI changes showed that ova with diameters between 0.64 to 0.795 mm released spontaneously in many rounds along fish migration route during its spawning season. The results indicate that the spawning of soboor begins upon its entering to Bahmanshir and Arvand Rivers on April and continued up to Shushtar and Dezful cities on September where their migration route and season are ended.

Key words: *Tenualosa ilisha*, spawning season, ova diameter, GSI

Introduction

Some scientists attribute Soboor to *Hilsa* genus, but based on Marammazi (1994) findings it belongs to *Tenualosa* genus so its scientific name is *Tenualosa ilisha* (Ham. Bach. 1822). This anadromous species belongs to Clupeidae family and is considered as an important pelagic fish in the Indian Ocean coast.

Soboor distribution zone is very wide, covering northern part of the Persian Gulf to Pakistan, India, Burma, China and southern part of Vietnam (Islam & Talbot, 1968). This fish has different names in different countries. The English and French names are Hilsa shad and Alose paluva respectively, but in the Persian Gulf region this fish is known as "Soboor" (Bianchi, 1985). Furthermore, it is known as ilish in Bangladesh (Abdul Quddus *et al.*, 1984a,b,c), and pala or shad in Pakistan (Islam & Talbot, 1968).

Soboor is considered as a very important fish in south of Iran and mainly caught in estuarine and downstream of the Zohreh, Bahmanshir, Arvand and Karoon Rivers in Khuzestan province, southwest Iran. Every year about the late winter to the early fall, many fishermen catch this fish in the area, using different gill nets and transport their catch to the local markets. The total annually catch of this fish, in Khuzestan province, was 2688 mt, for the year 2000 (Parsamanesh *et al.*, 2001). In Iraq this amount was 6576 mt in the period of 1990-91 (Al-Hassan & Laith, 1999).

In spite of its importance, very few studies have been carried out on Soboor. Morphometric and meristic differences between two types of this fish, and their spawning and fecundity aspects were studied by Abdul Quddus *et al.*, (1984c) in Bangladesh waters. Furthermore, Abdul Quddus *et al.*, 1984c compared age and growth of two types soboor in Bangladesh waters. Biological aspects of this fish have been studied in Hooghly River in India by Pillay (1975). Also Ramakirshnaiah (1972) studied biology of soboor in Chilka Lake in India. Seasonal variation of soboor ovary in Allahabad have been studied by Swaroep (1959). In Iran, Marammazi *et al.*, (1993), along with their study on limnological aspects of Zohrh River, studied some morphometric and meristic characters of this fish as well as its feeding habits. Nilsaz *et al.*, (1993) and Safikhani *et al.*, (1998) carried out similar studies on this fish in the middle and downstream of Karoon River in Khuzestan province.

Biological study on Soboor in Iran has been carried out in Bahmanshir River by Marammazi (1994). Also, Marammazi *et al.* (1995) carried out a comprehensive survey on soboor, including biological characters of this fish during its

migration in Karoon river and it's branches. Furthermore, Maramazi *et al.*, (1998) compared morphometric and meristic traits and length frequency of this fish in it's migration routs in Khuzestan province. In this study, ova diameter together with GSI value trend were use as a new manner to determine the spawning season and spawning ground of this fish in the region.

Material and Methods

Due to ecological characters of migration route and because of the location of fishing sites, 17 sampling stations were assigned (Fig. 1).

Sampling in the assigned stations, were carried out using drift gill nets with varying mesh sizes on monthly bases for 12 months (from Feb. to Nov. 2002). Fishes were transferred to the lab using special boxes with ice. After morphometric measurements, the abdomen cavity of the fish was dissected to bring the gonads out. The maturity stage of the gonads were distinguished externally based on the Kesteven method (1960).

To measures ova diameter, some ova were transferred to the counting chamber (with mark of Sedgwick Rafter) and observed by stereo microscope with x4 magnification. The chamber were moved in zigzag manner and after each movement the micrometer turned clockwise and the diameter of any randomly detected ova crossed by the micrometer line, was determined (Pillay, 1957, Clarck, 1925).

For each fish, diameter of 100 ova were measured.

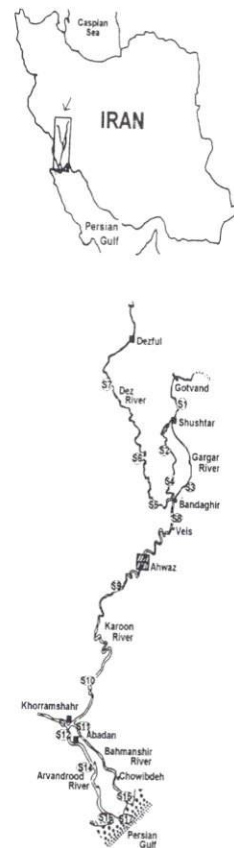


Figure 1: Location of the studied area and sampling stations

Gonadosomatic Index (GSI) was calculated using the following formula:

$$\text{GSI} = [\text{gonad weight (g)} / \text{total body weight (g)}] \times 100$$

Results

During one year study, 327 fishes with total length (TL) ranging from 120 to 500mm were collected from sampling stations, 78 of those fishes were from sea, 114 from Arvandrood River and 101 from Bahmanshir River. Most fishes were caught during April to June, and then the catch reduced so that only 5 fishes with underdetermined (virgin) gonads were caught in October. Among the samples 99 were males, 114 females and the rest were virgin. The main sea fishes were caught in February and July and no fish was caught in other months (Table 1).

Table 1: Soboor's catch distribution and their gonad maturity status at different months

| Month | Soboor catch (individual) | | | Maturity status | | |
|-----------|---------------------------|------|--------|------------------|----------|--------|
| | Total | Male | Female | Unknown (virgin) | Unmature | Mature |
| February | 15 | - | - | 15 | - | - |
| March | 6 | 6 | - | - | - | 6 |
| April | 67 | 47 | 20 | - | 1 | 66 |
| May | 70 | 22 | 48 | - | - | 70 |
| June | 56 | 16 | 38 | 2 | - | 54 |
| July | 36 | 16 | 12 | 8 | 11 | 17 |
| August | 24 | 6 | 2 | 16 | - | - |
| September | 47 | - | - | 47 | - | - |
| October | 6 | - | - | 6 | - | - |
| November | - | - | - | - | - | - |
| December | - | - | - | - | - | - |
| January | - | - | - | - | - | - |
| Total | 327 | 113 | 120 | 94 | 12 | 221 |

Figures 2 & 3 and table 2 show the GSI changes during sampling months at different stations. GSI of female increased in April and reached the maximum amount in June (Fig. 2). Unexpectedly, low GSI observed in July and August (Fig. 2). Similar trend was observed for the male's GSI but started early to develop from March and reached its maximum value in May. Also, maximum value of female GSI observed in stations 4,8,9 and 11 but the minimum value observed in stations 7 and 17 (Fig. 3). Male's GSI shows low fluctuation in all sampling stations.

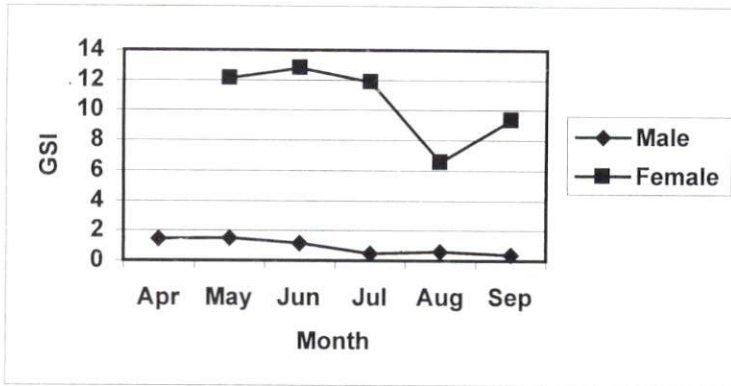


Figure 2: GSI changes of soboor during sampling months

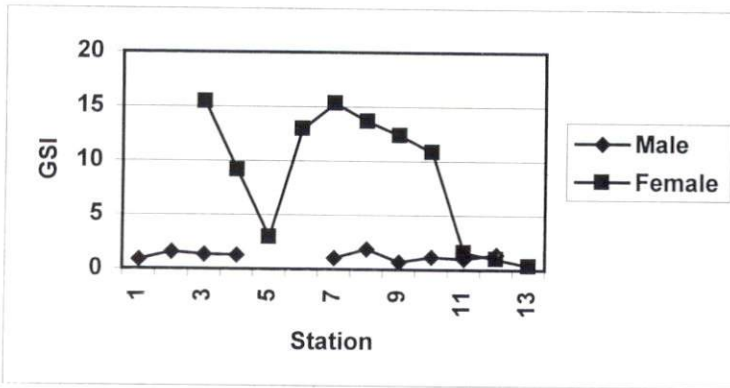


Figure 3: GSI changes of soboor at different sampling stations

Table 2: GSI value of soboor at different sampling stations

| Station | Female | | | | Male | | | |
|---------|-------------|-------|-------|------|-----------|-------|-------|------|
| | Range | X | SD | No. | Range | X | SD | No. |
| 2 | ----- | ----- | ----- | ---- | 0.84-0.97 | 0.89 | 0.07 | 3 |
| 3 | ----- | ----- | ----- | ---- | 1.43-1.76 | 1.59 | 0.23 | 2 |
| 4 | 2.54-24.52 | 15.4 | 8.73 | 5 | 0.76-1.92 | 1.34 | 0.44 | 5 |
| 5 | 2.23-15.97 | 9.1 | 9.74 | 2 | 0.70-1.93 | 1.29 | 0.54 | 6 |
| 7 | 1.61-5.56 | 2.93 | 1.86 | 3 | ----- | ----- | ----- | ---- |
| 8 | ----- | 12.92 | ----- | 1 | ----- | ----- | ----- | ---- |
| 9 | 13-17.13 | 15.26 | 2.09 | 3 | 1.06 | 1.06 | ----- | 1 |
| 11 | 10.74-17.33 | 13.64 | 1.64 | 22 | 1.90 | 1.90 | ----- | 1 |
| 12 | 8.79-16.01 | 12.34 | 1.79 | 32 | 0.24-1.69 | 0.73 | 0.59 | 14 |
| 13 | 6.75-14.76 | 10.79 | 2.21 | 12 | 0.14-2.27 | 1.17 | 0.72 | 14 |
| 15 | 9.88-13.65 | 11.6 | 1.20 | 14 | 0.15-1.70 | 0.99 | 0.52 | 19 |
| 16 | 5.94-14.59 | 11.01 | 2.57 | 18 | 0.73-2.18 | 1.39 | 0.37 | 34 |
| 17 | 0.27-0.39 | 0.33 | 0.09 | 2 | ----- | ----- | ----- | ---- |

Station No. 1 it was not mentioned because soboor was not caught

Ova diameter frequency based on the sampling months and stations are shown in Figures 4 and 5. Ova diameter frequency in April showed two modes with the range of 0.026-0.128 mm and 0.436-0.769 mm (Fig. 4). The ova diameter frequency of matured females caught in May showed one major mode with the range of 0.385-0.769 mm and another minor one with the range of 0.154-0.205 mm (Fig. 4).

In June, only one mode with range between 0.487 to 0.795 mm was observed (Fig. 4). In July almost all of the ova diameter frequencies were similar to those observed in April. Two other size classes, 0.154-0.229 and 0.538-0.692 mm were in the majority and the others were in the minority. Also, an intermediate mode exists with diameter range of 0.436-0.487 mm (Fig. 4). In August, the ova diameter were limited to the range of 0.410-0.641 mm (Fig. 4). The forementioned data obviously indicate that the maximum and the minimum size of the soboor ova were 0.795 and 0.026 mm respectively.

Ova diameter frequency of soboor showed big similarities between different stations except in stations 12, 16 (with similar feature) and 7 (Fig. 5). Ova diameter variation in station 7 was mainly in the range of 0.179-0.538 mm. For the other stations, the ova diameter range was mainly between 0.410-0.769 mm (Fig. 5). The ova diameter distribution in station 12 contained two dominant and some small populations. Ova diameter of the dominant populations occurred in the range of 0.026-0.179mm, while the other were between 0.487-0.744 mm. Almost similar ova diameter distribution was observed in station 16 with the exception of an additional population in the first range (0.077mm) and an additional one of existing in the second range (0.538mm) in the station (Fig. 5).

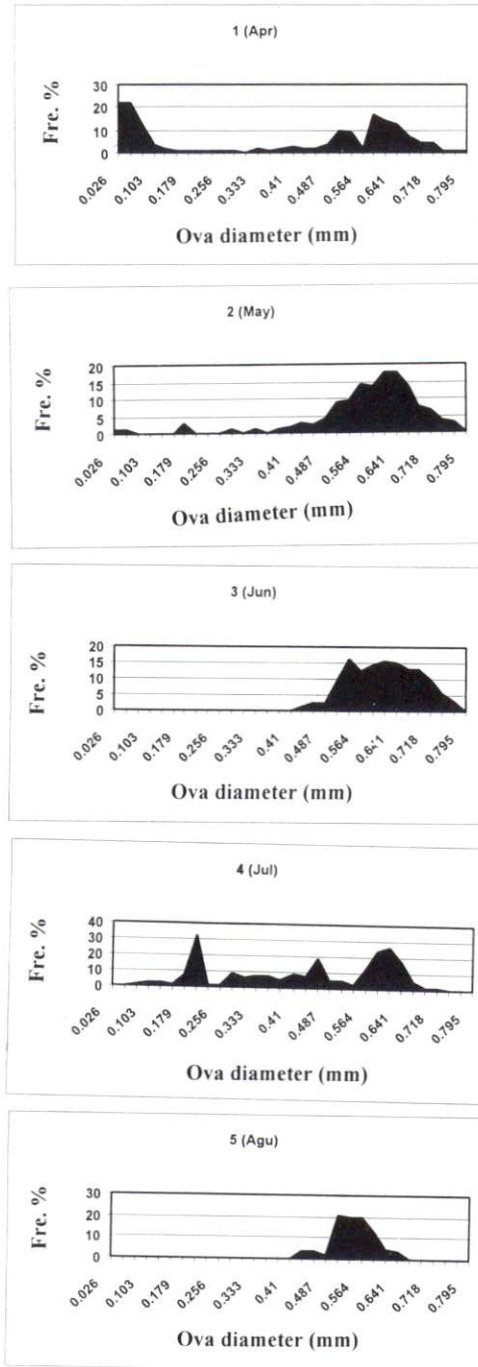


Figure 4: Ova diameter frequency of soobor in different sampling months

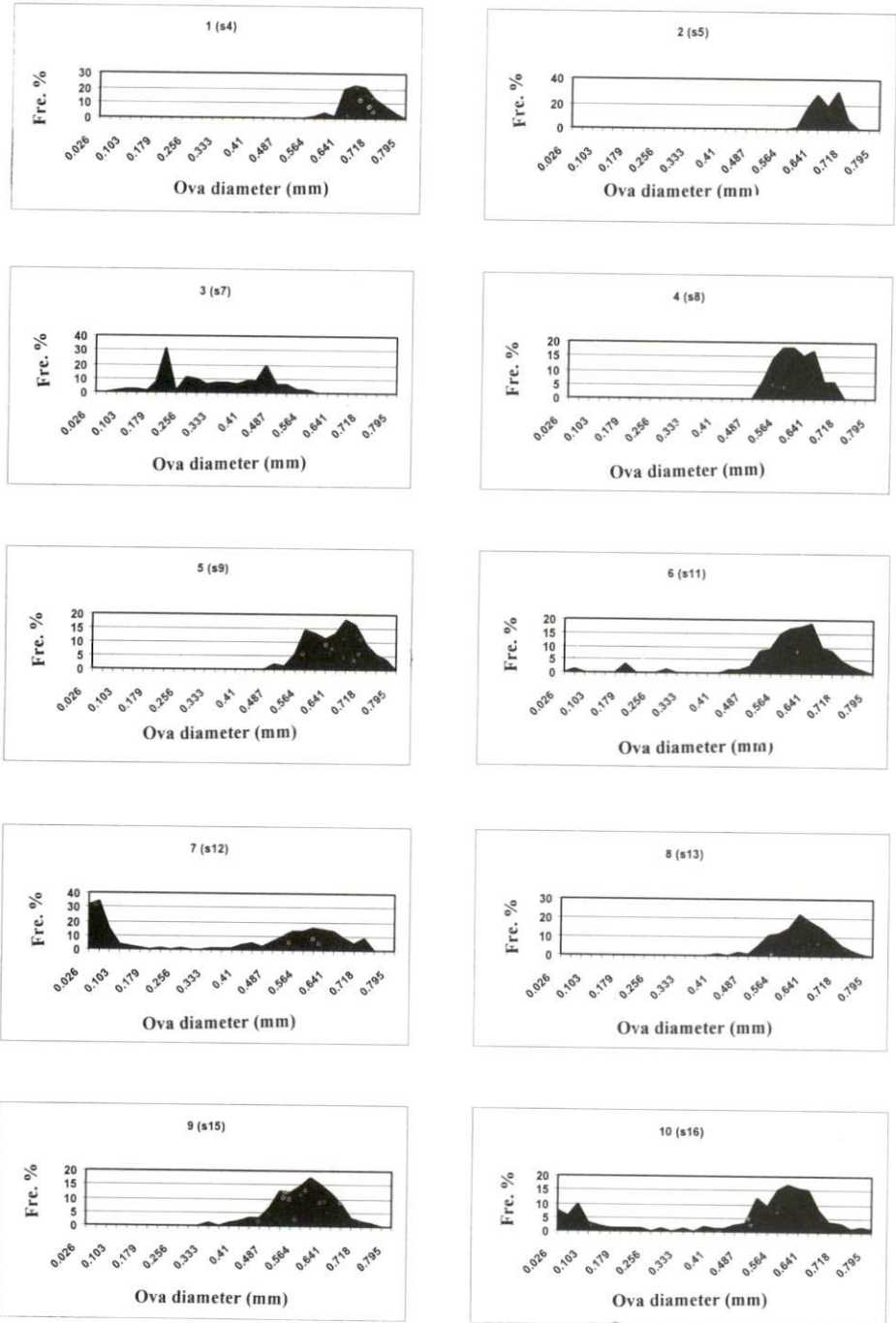


Figure 5: Ova diameter frequency of soboor in different Stations

Discussion

Comparison of GSI in soboor in the present study with those studied in Bangladesh waters (Abdul Quddus *et al.*, 1984a,b,c and that studied in Chilka Lake by Ramakrishnaiah, 1972), revealed that the maximum value of GSI of both sexes were more than those observed in the previous studies.

According to the findings of Abdul Quddus *et al.* (1984b) the average GSI value of male and female fish of type B soboor in winter were 0.43 ± 0.090 and 7.25 ± 1.26 respectively, while those for type A in the same season were 0.15 ± 0.04 and 2.2 ± 0.83 respectively. During monsoon season the average GSI value of type B was 0.17 ± 0.4 for male and 2.4 ± 0.45 for female while those value were 0.53 ± 0.09 and 10.32 ± 1.37 for male and female of type A respectively. Also based on their finding, the GSI value of type B soboor increased between December to March and reached the maximum size in February. Reduction trend in this type occurred between April and November, after spawning season. Also GSI of type A followed an increment trend during June to October and reached its maximum size in September.

Considering the time at which GSI reached maximum value, the findings of the present study are obviously different from those observed in Bangladesh.

According to present study GSI apparently developed from April to August with maximum value in April to June and minimum value in July. Maximum GSI value for type B observed in February, and in September for type A, and in June to August for Chilka lake's soboor in Bangladesh. These differences suggest the differences in reproductive biology, which together with morphometric, and meristic differences (Abdul Quddus *et al.*, 1984a,b,c; Ramakrishnaiah, 1972; Maramazi, 1994) may show presence of separate types or subspecies of soboor in each area, the case which ova diameter requires further studies.

Data of the present study showed that the maximum ova diameter of soboor in Khuzestan waters is 0.795 mm, which is smaller than those of the Indus and Hooghly Rivers (Pillay, 1957). According to the findings of Islam and Talbot (1968), the maximum ova diameter for soboor of Indus River reaches 1 mm during the spawning season and the eggs with ovadiameter of 0.6-1.0 mm are released,

(Ramakrishnaiah, 1972), based on the findings of Pillay (1957), Swaroep (1959) and Mathur (1964), suggested that the soboor in the Hooghly and Ganga Rivers released their eggs in several rounds during their spawning season. He furthermore, explained that matured ovary contained two ova groups, riped and unripened. Based on those findings soboor of the Chilka lake spawned once during their spawning season. Pillay (1957) findings, also, showed two ova groups in matured ovary of soboor in the Hooghly River. First group, with maximum ova diameter of 0.252 mm, which are not released during the spawning season and the other group containing of wide range of 0.252-0.882 mm, which are released during spawning season. Based on Jones and Menon (1951) findings, ova with diameter of at least 0.7 mm are released during the spawning season in several rounds.

Referring to the data of the present study, at the beginning of the spawning season, on April, two groups of ova are observed. On May, further parts of the small eggs are ripened and at the same time, a group of matured eggs are released. On June, all immature eggs were ripened and a part of the eggs were released, too.

In July almost all the eggs larger than 0.718 mm in diameter have been released. But, at the same time, almost all the ova diameter sizes which was observed in April, appeared again in this month. Presence of female with early developed gonads together with decline in GSI value in this month, may suggest the beginning of the second spawning period, the subject which is supported by Al-Hassan (1999) findings. In August, all the eggs with diameter large than 0.692 mm have been released and those between 0.410-0.692 mm were remained to be reabsorbed or, to be released later. These findings closely correspond to those found by Pillay (1957), Swaroep (1959) and Mathur (1964). Nevertheless, there are some differences between fishes of Khuzestan with those of Indus and Hooghly Rivers considering the maximum ova diameter and the ranges of mature and immature eggs. These findings suggest that soboor gradually releases its riped eggs in several rounds while ascending its migration route, during the spawning season. It first releases mature eggs with largest sizes and the others are successively released when they approach the appropriate diameter.

To specify the spawning season and spawning ground two indices were used: GSI and ova diameter.

According to Abdul Quddus *et al* (1984b) between two types of soboor found in Bangladesh waters, GSI of type A reached maximum value (10.32 ± 1.37 for female, 0.53 ± 0.09 for male) in monsoon season. In this season GSI increased from June to October reached maximum value in September which is considered to be the maturing and spawning month for type A. About type B, GSI reaches its maximum value (7.25 ± 1.26 for female, 0.43 ± 0.09 for male) in winter, definitely in February, thus suggested February as the spawning time for this type. Ramakrishniah (1972) found that the GSI of Chilka lake's soboor increased in June and reached the maximum value in September but drastically decreased in November. Based on those findings, he suggested that, the spawning season of this fish occurs between June to September in that area.

Marammazi (1994) showed that GSI of Bahmanshir River's soboor reaches the maximum value from April to July for both sexes. Meanwhile, the average value of GSI of Bahmanshir's soboor is larger than that of those two types of Bangladesh (12.835 ± 2.242 for female, 1.616 ± 0.319 for males).

Our findings showed early migration (in March) of mature males. Matured females enter Arvand and Bahmanshir Rivers in April, when their GSI approached high value. Furthermore, it showed GSI rising, from March for male, and April for female, to August, with the maximum value from April to June and minimum value in July. This time span may whole be considered as the spawning season. This findings, on the other hand, may suggest two spawning periods for soboor, in this region. The first one observed between April to June, and the other one from July to August. The presence of almost all range of ova diameter in July together with decline of GSI value in this month, may also strongly support this suggestion. Al-Hassan (1999) findings also support this theory. His findings suggest two spawning periods for this fish in Arvandrod River, the first form March to May and the second from July to August. To clarify if the presence of wide ova diameter range in the ovaries simultaneously with decline of GSI value in July, indicate the beginning of the second spawning period of the fish, or both

originated from the errors that may have occurred in the sampling process, requires further studies.

Comparison of GSI trend in sampling stations revealed that spawning of soboor takes place along its migration route in Bahmanshir, Arvand and Karoon Rivers. So, all the ascending route in these rivers could be considered as the spawning ground. Catching fishes at spent stage in upper part of Karoon River branches, near Dezful and Shushtar cities suggests the end of the spawning process in this area, when fish ends its migration in October unexpected high GSI value in upstream stations is observed. GSI value was expected to be low in those stations because the fish had released ripe eggs while ascending its migration route. This problem mainly appeared because only few female fishes were caught in those stations, some of them with high GSI value which finally made the GSI value relatively high in those stations.

During migration indicates that the spawning of soboor occurs during stage of the migration period (April to August). In April, all the egg sizes were observed but in August almost all the eggs with large sizes were released and only eggs found were those with medium sizes, which may be reabsorbed or released later, after being fully ripened. Existing of similar distribution pattern of ova diameter in stations 12 and 16 (entering points of Arvand and Bahmanshir to the Persian Gulf), accompanied with the presence of all sizes of ova diameter, suggests the beginning of the spawning of this fish from these points in both rivers. Variation in the pattern of ova diameter frequency in upper stations except in station 7, also suggest the continuing trend of the spawning along with ascending process in the migration route. This difference observed in station 7, which almost include all small sizes of eggs is probably due to the fact that those few females caught in that station mainly are in the early maturity stages the subject which needs further surveys. Nevertheless, this process continued until the spawners reached the upstream of the rivers, near by Shushtar and Dezful cities. Findings trend in ova diameter are well corresponded with those results obtained from GSI value, both showing the beginning of spawning when the fish enter the rivers in April and

the fish enter the rivers in April and ending in September when the fish reached upstreams nearby Dezful and Shushtar cities.

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