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# Stock Assessment and Production of Fish Species in the Shadegan Wetland (Iran)

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**Abstract:** Stock assessment and production of fish species take place in the Shadegan wetland from November 2008 to October 2009. Samples were collected from fishing site at seven stations: Mahshar, Rogbe, Khorosy, Canal, Ateish, sarakhieh and Abadan road. During to be study were measured more than 2000 specimen and depletion method was used for fish stock assessment. Maximum and minimum fish biomass was in the Shadegan wetland in the spring (249.61 kg/ha/year) and winter (157.90 kg/ha/year). Maximum and minimum fish biomass and fish production in the Shadegan wetland were *Cyprinus carpio, Thrssa ilisha* and *Barbus luteus, Thrssa ilisha* respectively. Mean fish production and fish biomass were estimated 130.41 (kg/ha/year) and 197.7 (kg/ha/year).

**Key words:** Stock assessment · Shadegan wetland · Fish production

## INTRODUCTION

Wetlands are supported as significant of species and wild life populations. Loss of wetland has disastrous effect wild life and biodiversity that has important international and regional effects wild life, scientists believed that wetlands destruction are caused native species global extinction to completely depend on specific habitat [1].

Wetlands in the world was included about 7 to 9 million km$^2$ (4-6 percent of Earth surface).Iran wetlands is approximately 1853762ha and between Middle East wetland was contained 25 % [2].

Shadegan Wetland in Khuzestan province is one of the 18 international wetlands registered on UNESCO's Natural Heritage List. Located 52 km from Abadan and 105 km from Ahvaz, it is Iran's largest wetland and by Linking Jarahi River connect with Persian Gulf waters, the wetland is considered one of the most wonderful natural landscape of the world because of it is unique biodiversity [3].

The Shadegan Wetland is a Ramsar-listed wetland in the south-west of Iran at the head of the Persian Gulf. It is the largest wetland of Iran covering about 400,000hectares. The wetland plays a significant hydrological and ecological role in the natural functioning of the northern Persian Gulf [4].

In this context, the aim of the present study has two objectives: (i) to estimate its stock assessment status and fish production (ii) to determine, how population change of shadegan wetland fish and the exploration pattern of the these population in this water resource. Results will greatly contribute to elaborating management programmes for this economically important fish species and preserve other fish species of the region under study.

Maramazi, [4] and Ansari *et al*., [5-7] were searched fish survey, stock assessment and capture conditions of shadegan wetland. Lotfi *et al*., [3] were considered human activity and effect on shadegan wetland and also diversity and capture situation of shadegan wetland.

## MATERIALS AND METHODS

Stock assessment and production of fish species take place in the Shadegan wetland (Iran) from November 2008 to October 2009. Shadegan wetland (Iran) is a wetland in the south-west of Iran in Khuzestan province. Where the seventh station of season sampling in shadegan

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Table 1: Seven stations in Shadegan Wetland (2008-09)

| Station | Longitudes E | Latitudes N |
|---|---|---|
| Sarakhieh | 48°,45′ | 30°,32′ |
| Mahshar(Doragh) | 48°,30′ | 30°,52′ |
| Rogbe | 48°,33′ | 30°,41′ |
| Khorosy | 48°,40′ | 30°,39′ |
| Kanal | 48°,30′ | 30°,53′ |
| Atish | 48°,40′ | 30°,54′ |
| Abadan road | 48°,29′ | 301°,37′ |

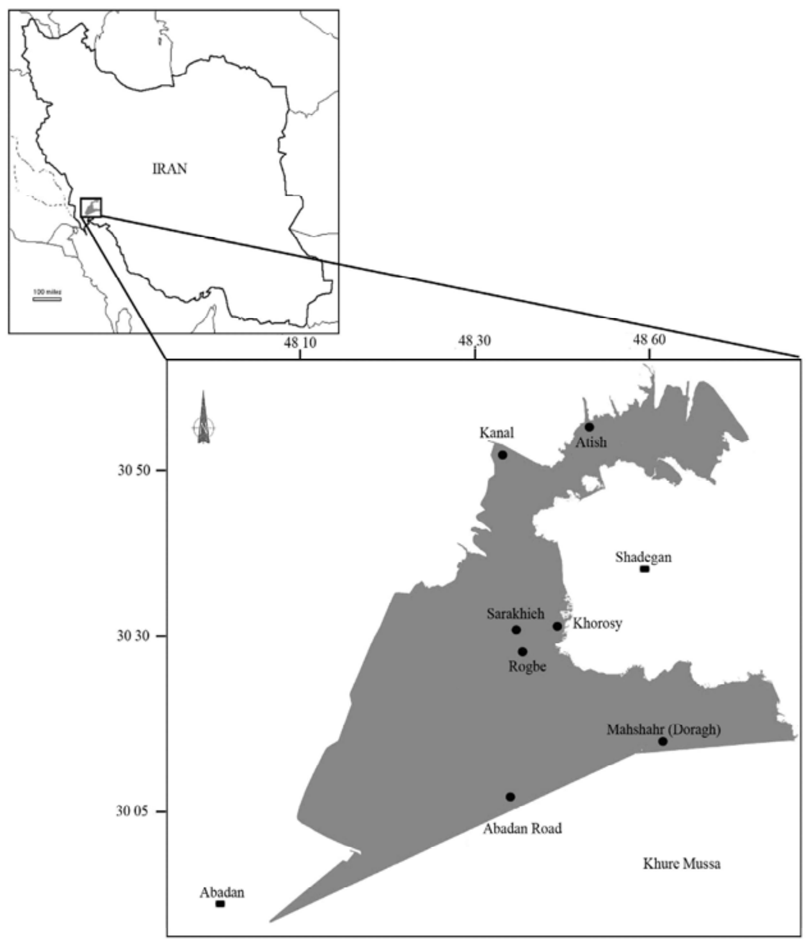


Fig. 1: The map of Iran, Location of Seven Capture sites was sampled in Shadegan wetland (Khuzestan province, South West of Iran).

wetland (Iran) were selected that included Sarakhieh, Mahshahr, Khorosy, Kanal, Rogbe, Ateish and Abadan (Fig. 1, Table 1). In each season, 5 stations were selected for sampling. Samples were taken out by using fixed gill net with 45 mm mesh and then transported to lab with dry ice. Total length with ±l mm and total weight with ±0.01 gr were measured for each fish. Depletion method involves deliberately overfishing an isolated population of fish [8]. After the commencement, N∞(Present fish number in time t) will be equal to the N8 (Original stock size), less the accumulated catch in time t, ∑C∞, ($N_t$=N8- ∑C∞). Then by definition the catchability coefficient (q), at time t has: N∞=$CPUE_t$ /q. By substituting equation is result: CPUE∞=q N∞- q qC∞. Catch Per Unit Effort at time t, CPUE∞ graphed against accumulated catch in time t, qCt, referred to as a Leslie plot(a= intercept and b= Slope) [8].

By using data, biomass amount in enclosed area was calculated and then according to this area, biomass amount in per hectare and finally was investigated for total shadegn wetland. Amount of 800-2000 $m^2$ (enclosed area) was changed in different seasons and at each station according to environmental conditions. CPUE in each station was carried out for five days. Amount of habitable area for fish were considered in total al shadegan wetland using satellite data on 56000 ha. Fish production value was calculated by the formula log P=0.32+0.94 log B∞-0.17 log Wmax. Wmax and B∞ were Maximum fish weight per gr and fish biomass amount per kg/ha, respectively [9].

## RESULT

This project was carried out from November 2008 to October 2009 and during this study was measured over 2000 fish specimen. Overall, 15 fish species were identified that maximum and minimum capture was *Cyprinus carpio* and *Thrssa ilisha* respectively. Mean±s.d length values and Mean ± s.d weight Values for these species was showed in Table 2.

The total fish biomass in shadegan wetland was calculated from multiples weight in number of different stations in every seasons. The maximum and minimum fish biomass were related *Barbus lutes*(58.92±25.5kg/ha) and *Thrssa ilisha*(0/1± 0/1 kg/ha) in summer, *Cyprinus carpio*(46.83± 12 kg/ha) and *heteropenusti fossili* (1.33±1.3 kg/ha) in autumn, *Cyprinus carpio* (67.79± 19.59 kg/ha) and *Barbus grypus* (0.72±0.4kg/ha) in spring, *Cyprinus carpio* (58.64±20) and *Barbus grypus* (0.42 ±0.4 kg/ha) in winter, respectively (Table 3). Generally, The maximum and minimum fish biomass in shadegan wetland was *Cyprinus carpio* (51.05±20 kg/ha) and *Thrssa ilisha* (0.02± 0.01 kg/ha), respectively. Overall, carp species, *B. sharpeyi*, *B. lutus*, *C. carasius*,, *B. grypus*,are included over 70% biomass of Shadegan wetland species. The total fish production was calculated from species biomass of different fish. Mean production of fish was estimated 130 (kg/ha). The maximum and minimum fish production amount was to *Barbus lutes* and *Thrssa ilisha*, respectively (Table 3).

Table 2: Average values and standard deviation (sd) of size corresponding of fish species from the Shadegan Wetland (2008-09),(N= number, M=mean, M(w)= mean weight, M(L)= mean length, Max= maximum, Min=minimum)

| Species | N | M(w)±Sd (gr) | Min- Max | M(L)±Sd (mm) | Min- Max |
|---|---|---|---|---|---|
| *Cyprinus carpio* | 298 | 287±323 | 2017- 19 | 70±256 | 495- 110 |
| *Barbus luteus* | 672 | 36±70 | 370- 15 | 22±169 | 280- 105 |
| *Barbus sharpeyi* | 237 | 187±198 | 1574-23 | 95±236 | 447-140 |
| *Barbus grypus* | 18 | 124±181 | 438-51 | 63±262 | 338-172 |
| *Carasius carasius* | 312 | 94±133 | 411- 16 | 41±191 | 280-11 |
| *Silurs triostegus* | 124 | 444±514 | 2160- 48 | 120±386 | 700- 200 |
| *Aspius vorax* | 168 | 145±163 | 684-50 | 50±251 | 432-180 |
| *Chonoderstoma regime* | 19 | 5±21 | 12-31 | 9±130 | 146-110 |
| *Liza abu* | 382 | 27±45 | 209-10 | 28±150 | 262- 95 |
| *Mastacembuls.mastacembuls* | 24 | 95±297 | 503- 142 | 101±498 | 650-370 |
| *Heteropenusti fossili* | 9 | 21±84 | 110- 34 | 22±203 | 265- 187 |
| *pectoralis Barbus* | 4 | 25±96 | 133- 76 | 15±207 | 230- 194 |
| *Acantupagrus lutus* | 7 | 63±94 | 209- 25 | 36± 161 | 219- 118 |
| *Tenualosa ilisha* | 8 | 7±35 | 46- 26 | 22±148 | 175- 135 |
| *Thrssa ilisha* | 3 | 5±15 | 17- 15 | 4±102 | 105- 100 |

Table 3: Fish Production (kg/ha) estimates in different season from the Shadegan Wetland (2008-09)

| Species | Autumn | Winter | Summer | Spring | Average Biomass | Percentage | Production |
|---|---|---|---|---|---|---|---|
| (kg/ha/yr) *Cyprinus carpio* | 12±46 | 20±58 | 12±28 | 19±69 | 20±51 | %22.28 | 23.10 |
| *Barbus luteus* | 12±27 | 10±35 | 25±58 | 22±45 | 10±41 | %18.31 | 25.63 |
| *Barbus sharpeyi* | 10±29 | 12±33 | 14±34 | 7±34 | 12±33 | %14.44 | 16.02 |
| *Barbus grypus* | 0.75±25 | 0.4±0.42 | 18±22 | 0.4±0.72 | 0.4±12 | %5.38 | 7.78 |
| *carasus carasus* | 24±40 | 1±2 | 19±41 | 1.3±10 | 11±23 | %10.41 | 14.80 |
| *Siluru triostegus* | 12±25 | 31±52 | 2±38 | 38±16 | 31±33 | %14.53 | 20.26 |
| *Aspius vorax* | 11±23 | 1.5±5 | 7±20 | 12±26 | 15±18 | %8.23 | 10.74 |
| *chonoderstoma regime* | 0.5±8 | - | - | - | 0.1±2 | %0.87 | 2.23 |
| *Liza abu* | 10±12 | 0.2±0.46 | 5±8 | 3±8 | 0.2±7 | %3.29 | 5.63 |
| *mastacembuls.mastacembuls* | - | 0.6±1.04 | 0.4±2 | 17±8 | 0.6±2 | %1.25 | 1.95 |
| *heteropenusti fossili* | 1±1.3 | - | 1.3±1.53 | - | 0.5±0.6 | %0.29 | 0.64 |
| *Pectoralis Barbus* | 1±2.8 | - | - | - | 0.3±0.7 | %0.3 | 0.65 |
| *Acantupagrus.lutus* | - | 0.3±0.5 | - | - | 0.3±0.1 | %0.6 | 0.13 |
| *Tenualosa ilisha* | 0.5±2 | - | 0.1±0.13 | - | 0.2±0.6 | %0.29 | 0.73 |
| *thrssa ilisha* | - | - | 0.1 ± 0.1 | - | 0.01± 0.02 | %0.01 | 0.03 |

Table 4: Fish Production (kg/ha) estimates in different Station from the Shadegan Wetland (2008-09)

| Season | Autumn | Fish biomass(kg/hr) | Summer | Fish biomass(kg/hr) | Spring | Fish biomass(kg/hr) | Winter | Fish biomass(kg/hr) |
|---|---|---|---|---|---|---|---|---|
| Station | Canal | 161.05 | Canal | 280.90 | Abadan | 246.17 | Abadan | 140.81 |
| | Ateish | 243.03 | Rogbe | 374.14 | Mahshar | 266.78 | Mahshar | 232.58 |
| | Rogbe | 60.96 | Mahshar | 59.25 | Rogbe | 282.26 | Rogbe | 115.69 |
| | Khorosy | 267.17 | Ateish | 274.37 | Khorosy | 292.07 | Khorosy | 240.78 |
| | Abadan | 100.51 | Khorosy | 96.10 | Ateish | 160.76 | Sarakhie | 95.64 |
| Average | - | 166.31±48 | - | 216.95±23 | - | 249.16±37 | - | 157.90±55 |

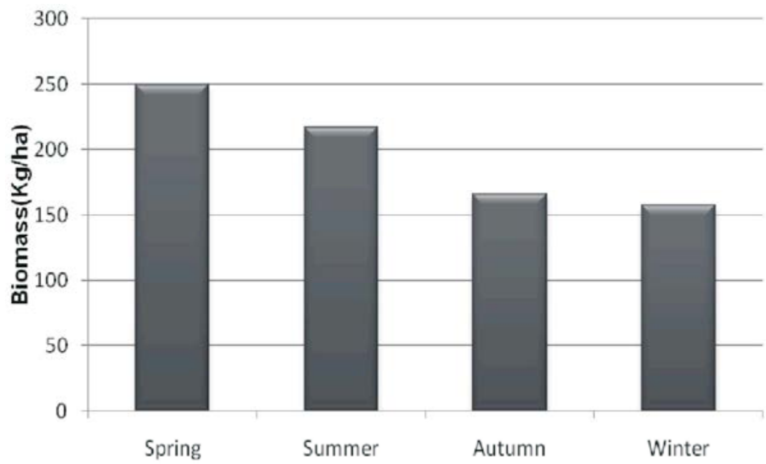


Fig. 2: Value fish biomass in Shadegan wetland Wetland (2008-09)

The biomass fish were estimated in different stations and this values was different in Stations (Table 4 ). The results of fish catch in shadegan wetland stations indicated that maximum and minimum fish biomass was found in Khrosi (240.78 kg/ha) and sarakhieh (95.64 kg/ha) in winter, respectively. The maximum and minimum fish biomass was found in khorosi(292.07 kg/ha) and Ateish (160.76 kg/ha)stations in spring, respectively. In summer, Raghabeh(374.13 kg/ha) and mahshahr (59.25 kg/ha) station and in Autumn, khorosi (267.18 kg/ha).and Raghabeh (60.96 kg/ha) stations, maximum and minimum fish biomass was found. Average maximum and minimum fish biomass were in shadegan wetland, spring (216.95 kg/ha) and winter (157.90 kg/ha) respectively (Fig. 2). The mean all seasons were 197.77 kg/ha.

## DISCUSSION

In this study, the fish biomass in spring and summer was calculated 610249 kg/ha, 95.215 kg/ha, respectively. Average calculated fish biomass in spring and summer of in 1997 was 70.2 kg/ha, 109.2 kg/ha and in 2001, 186.5 kg/ha and 269.4 kg/ha was calculate, respectively [4, 5]. In spring increasing biomass between 2001 and 1997 and decreasing summer between 2001 and 1997 were presented in (Table 5). It seems, climate change and wetland nutrient elements are very effective factor that influenced on biomass. Based on this study, the maximum fish biomass was obtained is spring, it seems appropriate to wetland climate status [10] and nutrients entering for river flow may be due to the reason and also maximum phytoplankton production, wetland phytobentoz was showed in spring time [11]. Total fish biomass of the total shadegan wetland that multiple average fish biomass(kg/ha) in amount of habitable area for fish 56000 ha was estimated about 11071200 per year. In 1997, the Maramazi, estimated that the total biomass of fish in shadegan was 22,000 tons, while this amount calculated 15,000 ton in 2003 [6].

The productivity of these areas may have been reduced in approximate proportion to this loss of their floodplain areas. In addition to, the construction of dams in Khuzestan (Iran) since 1980 has also altered the hydrological regime dramatically [10]. Water quality has also declined in both the Karoon and Jarahi rivers, with waters now carrying increased salinity from upstream irrigation works and higher levels of agricultural chemicals and urban and industrial effluents [11]. Maroon dam construction and irrigation development in upper plains was changed in water flow [3]. The aggregate impact of these changes is most of the remaining area was in Shadegan wetland.

Abundance of fish populations in river, lake with river source and reservoirs widely changed from year to year and the relative frequency of different species is different in population. This change is affected by rainfall

Table 5: Fish Production (kg/ha) estimates of other researcher in the Shadegan Wetland (2008-09)

| Year | Summer | Spring | Autumn | Winter | Mean |
|---|---|---|---|---|---|
| Maramazi, 1997 | 186.5 | 70.2 | - | - | - |
| Ansari, 2001 | 269.4 | 109.7 | - | - | - |
| Present study, 2009 | 216.9 | 249.6 | 166.3 | 157.4 | 197.7 |

Table 6: Summary of the fish production estimates in other systems

| Refernce | System | Local | Production (kg/ha/yr) |
|---|---|---|---|
| Dugan, [17] | Flood plain | Niger | 31-42 |
| Welcome, [13] | Flood plain | Senegal | 54 |
| Welcome, [13] | Flood plain | Nile | 8.8 |
| Welcome, [13] | Reservoirs | Nasser | 6-25 |
| Welcome, [13] | Reservoirs | dam Kariba | 30-40 |
| Welcome, [13] | Reservoirs | damKainji | 35-47 |
| Welcome, [13] | Reservoirs | Lagdo | 175-300 |
| Welcome, [13] | Lake | Baringo | 10-50 |
| Welcome, [13] | Lake | Naivasha | 5-60 |
| Welcome, [13] | Lake | Malavi | 35-45 |
| Welcome, [13] | Lake | Tanganyika | 90 |
| Welcome, [12] | Lake | Victoria | 29-59 |
| Ita, [18] | Wetland | Hadejia and Ngura | 49 |
| Ita, [18] | Wetland | Ogun and Oshun | 40 |
| Present study, 2009 | Wetland | Shadegan | 130 |

fluctuation and floods. The increasing area and flood flow time is improved spawning, growth and survived rate. Positive correlation between being floody and amount capture has in the next year [12, 13]. From a fisheries production perspective, it is important to recognize the enormous hydrological modifications suffered by the marshes in recent times. The fisheries productivity of healthy floodplain rivers is roughly proportional to the total area of the waters in the high-water flood season [14].

From fish biomass shadegan wetland (near 11000 tons), 2000 ton can be harvested. The value of exploitation was estimated to be approximately 3738 tonnes in 2009 [7]. The higher value of exploitation is indicated over fishing during this period. To reach optimum exportation should decrease catch rate and the best way reduce catch rate is reducing fishing activities [15]. These results are important for fisheries management authorities as they suggest that the resource is overexploited and in addition to a substantial reduction in fishing effort would also be required if management objectives are to be achieved.

The Khorosi and raghabeh stations in different seasons have high amount of fish biomass. Parts of wetland was decreased fish biomass amount, it seems, that entering the jarahi river for east side of the wetland and location of Khorosi and raghaben station in near the river month and entering of nutrition element was caused to increase phytoplankton and phytobentozic production that caused to in crease fish biomass in these areas.

The high diversity of phytoplankton has due to stable ecological condition constant in Raghabeh station, over the year. [11]. Also, high rate of macrobentoz (especially chironomus larvae) in Raghabeh and Atish station can increase fish biomass because the most of the major fish species of shadegan wetland were formed bentic species [11].

With survey frequency of fish species in shadegan wetland was changing comparing 1997 [4]. According to data this study, species biomass *B. sharpeyi*, *B. lutus*, *C. carasius*, *L. abu*, *B. grypus*, *S. triostegus* was increased and species of *A. vorax*, *B. pectoralis*, *C. carpio* was decreased (Table 6). It seems, with change in chemical, physical and ecological in wetland is changing diversity. Big species with high valuable were decreased and small species with less valuable species were increased. The increase catch in prolonged years can decrease species with high length and long Life and replace low length and low life [10]. The *C. carpio* has highest rate of biomass to seems than can adapt with Shadegan wetland condition in different season. In autumn, with Increasing freshwater input to wetland has increased diversity of river species such as *B. grypus, B. pectoralis* while in summer and early autumn (before rain fall) with increasing salinity were increased Marine species to wetland such as *Th.ilisha, T.ilisha, A.lutus* [10].

The native marshland fish populations were originally dominated by Cyprinid fish of the genus Barbus. River species were usually reached for feeding and marine species for spawning and passing larval stages to the

Shadegan wetland [4]. Coastal fisheries in the Persian Gulf used the marshlands for spawning migrations and they was be used as nursery grounds for shrimp and fish. Several marine fish species of great economic importance are dependent on the estuarine systems and marshes for spawning, namely the *Pampus argenteus* and *Tenualosa ilisha*. The penaeid shrimp, *Metapenaeus affinis*, undertakes seasonal migrations between spawning in the gulf and nursery and feeding grounds in the Shadegan wetland [7].

Amount of fish biomass and production in Shadegan wetaland was 197.7 (kg/ha/year), 130.04 (kg/ha/year), respectively. Fish production in various water body was (flood plains, water reservoirs, lakes and wetland) 8.8-54.7 (kg/ha/year). These changes are shown in table 6 [9, 13 16-18].

## CONCLUSIONS

Considering fish production and biomass values it can be concluded that: fish production of Shadegan wetland was most of inland water and is one of area with high potential.

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