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Biomass and Production of Fish Species in the Shadegan Wetland, Iran

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Abstract: Biomass assessment and production of fish species was carried out from April 2010 to March 2011 in the Shadegan wetland. Samples were collected From five stations, Mahshar, Rogbe, Khorosy, Salmane and Ateish, in the Shadegan wetland in Khuzestan Provinces (Iran). More than 3900 specimen fish were measured during the study and depletion method was used for fish stock assessment. Maximum and minimum fish biomass (species) and fish production (species) were *Silurs triostegus, Barbus pectoralis* and *Barbus luteus, Barbus pectoralis* respectively. Maximum and minimum biomass (season) measurements were in Spring (380.40 kg/ha/year) and winter (58.41 kg/ha/year) respectively. Fish production and biomass in wetland Shadegan were estimated 137 (kg/ha/year) and 244 (kg/ha/year) respectively.

Key words: Biomass assessment · Shadegan wetland · Depletion method

INTRODUCTION

Wetlands are supported as significant of species and wild life populations. Loss of wetland has disastrous effects in 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 are occupying about 7 to 9 million km^2 (4-6 percent of Earth surface). Iran wetlands is approximately 1853762 ha 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 Ahwaz, 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].

The aim of the present study was twofold: (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 programs for this economically important fish species and preserve other fish species of the region under study.

Maramazi, [4], Ansari *et al*. [5, 6] and Hashemi *et al*. [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

Biomass assessment and production of fish species was carried out from April 2010 to March 2011 in the Shadegan wetland. Samples were collected from at five stations, Mahshar (48°, 45′E, 30°, 33′N) Rogbe (48°, 33′E, 30°, 41′N), Khorosy (48°, 40′E, 30°, 39′N), Salmane (48°, 28′E, 30°, 40′N) and Ateish (48°, 40′E, 30°, 54′N) in the Shadegan wetland in Khuzestan provinces (Fig. 1). Shadegan wetland (Iran) is a wetland in the south-west of Iran in Khuzestan province. In each season, 5 stations were selected for sampling. Sampling was carried out by

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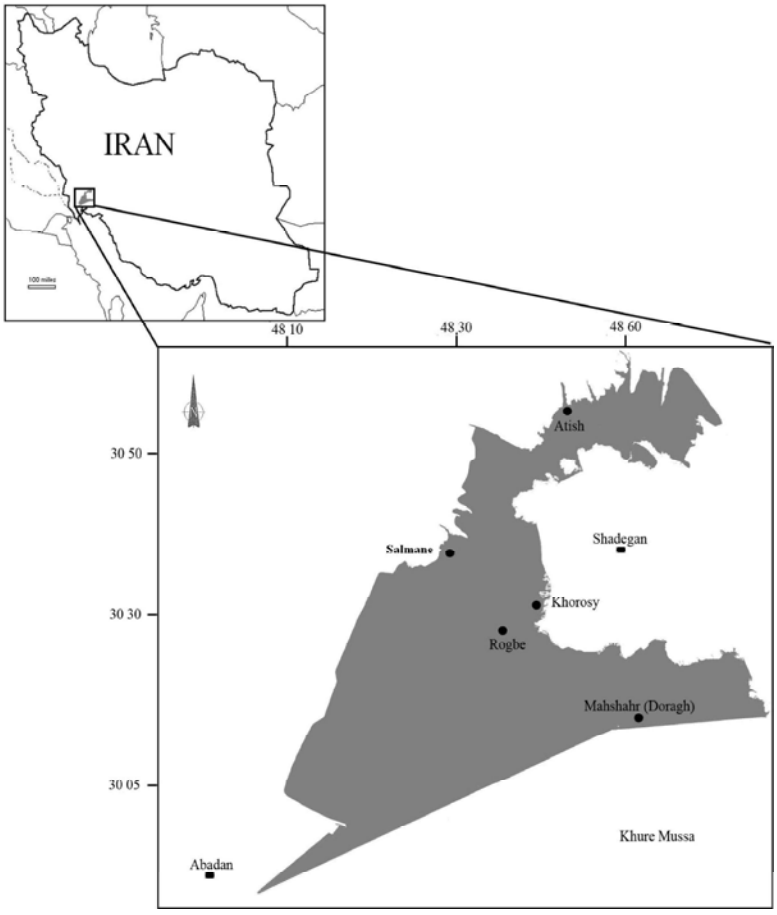

Fig. 1: The map of Iran, Location of Seven Capture sites was sampled in Shadegan wetland (Khuzestan province, South West of Iran)

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 (g) were measured for each fish. Depletion method involves deliberately overfishing an isolated population of fish [8]. After the commencement, N_t (Present fish number in time t) will be equal to the N8 (Original stock size), less the accumulated catch in time t, ΣC_t, ($N_t=N\infty- \Sigma C_t$). Then by definition the catchability coefficient (q), at time t has: $N_t=CPUE_t/q$. By substituting equation is result: $CPUE_t=q\ N\Sigma- q\ \Sigma C_t$. Catch Per Unit Effort at time t, $CPUE_t$ graphed against accumulated catch in time t, ΣCt, 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 $P=0.32+0.94 \log B_t-0.17 \log Wmax$. Wmax and B_t were Maximum fish weight (g) and fish biomass (kg/ha), respectively [9].

RESULTS

This project was carried out from April 2010 to March 2011 and during study more than 3900 specimen fish were measured during the study and depletion method was used for fish stock assessment.. Overall, 27 fish species were identified that maximum and minimum capture was *Cyprinus carpio* and *Tenualosa ilisha* respectively. Mean(±SD) length values and Mean (±SD) weight Values for these species was showed in Table 1.

Table 1: Average values and standard deviation (sd) of size corresponding of fish species from the Shadegan Wetland (2010-11), (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	937	50±95	1085-70	70±167	399- 18
Barbus luteus	763	36±79	245- 23	22±173	257- 95
liza abu	736	28±34	141- 9	70±140	250- 90
Silurs triostegus	518	36±245	3500- 19	89±295	119- 760
Carasius carasius	466	87±102	568- 90	44±172	322- 24
Barbus sharpeyi	290	110±169	651- 15	22±221	374- 115
Aspius vorax	194	117±157	778-37	95±249	257-115
Acantupagrus lutus	68	24±48	151-7	63±133	220-80
Alburnoides bipunctatus	42	9±15	29- 7	41±121	165-98
Hypophthalmichthys molitrix	29	14±94	24- 192	120±204	270- 115
Ctenopharingodon idella	28	145±104	257-37	50±204	270-170
pectoralis Barbus	22	50±123	44-246	33±225	286-166
liza vaigiensis	17	27±62	133-18	28±169	223- 118
Alburnoides sp.	15	9±15	29- 9	12±122	145-101
Hypophthalmichthys nobilis	13	21±114	24- 252	22±240	370- 110
Barbus grypus	11	25±231	303- 153	54±253	344- 151
liza sbviridis	6	22±88	110- 48	36±178	223- 191
Thrssa hemiltoni	5	7±19	22- 15	22±144	153- 132
Heteropenusti fossili	3	28±166	86- 53	70±196	225- 180
Barbus xantropetrous	3	36±146	195- 120	22±214	224- 200
Acanthobrama marmid	3	68±100	160- 25	40±63	150- 11
Sardinella sindensis	3	8±27	31- 23	43±146	155- 138
Mastacembuls mastacembuls	2	28±585	600-570	70±450	465- 435
Cyprinion macrostumus	2	11±16	24- 8	22±105	126- 85
Cyprinion kais	2	25±431	61- 25	19±148	162- 135
burbulus Barbus	2	36±114	156- 72	52±218	257- 180
Tenualosa ilisha	1	-	-	-	-

Table 2. Fish Production (kg/ha) estimates in different season from the Shadegan Wetland (2010-11)

Species	Spring	Summer	Winter	Autumn	Average Biomass	Percentage	Production (kg/ha/yr)
Silurs triostegus	56±93	120±141	12±13	65±90	49±84	%21.38	33.38
Barbus luteus	45±167	20±43	25±27	8±11	38±62	%16.15	40.10
Barbus sharpeyi	10±63	12±53	14±37	7±29	16±47	%12.12	25.93
Cyprinus carpio	24±57	4±74	18±40	10±14	17±46	%5.38	7.78
Carasius carasius	20±22	38±62	19±24	1.3±12	21±30	%7.86	17.67
Aspius vorax	-	13±17	20±55	5±14	7±29	%7.49	16.01
Barbus grypus	11±21	-	-	0.3±0.59	14±21	%5.16	14.13
Hypophthalmichthys molitrix	5±16	-	-	-	5±16	%4.16	11.36
liza abu	10±21	0.2±6	5±8	7±12	7±11	%2.08	8.67
Ctenopharingodon idella	0.6±10	-	-	-	0.6±10	%2.16	7.18
Mastacembuls mastacembuls	1±9	-	-	-	1±9	%2.23	4.12
Acantupagrus lutus	0.1±0.2	3±6	0.5±1	-	3±7.15	%1.93	5.92
Hypophthalmichthys nobilis	-	0.3±6.17	-	-	0.3±6.17	%1.59	4.62
pectoralis Barbus	1±3	-	-	-	1±3	%1.02	3.10
Others	-	0.5±2	0.1±0.07	-	0.3±1.45	%0.37	0.70

The total fish biomass in Shadegan wetland was calculated from multiples weight in number of different stations in every season. The maximum and minimum fish biomass were related *Barbus lutes* (167±25 kg/ha) and *Acantupagrus lutus* (0.2±0.1 kg/ha) in Spring, *Silurs triostegus* (141±12 kg/ha) and *Hypophthalmichthys nobilis* (6.17±1 kg/ha) in Summer, *Aspius vorax* (55.17±19 kg/ha) and *Acantupagrus lutus* (0.72±0.4kg/ha) in Autumn, *Silurs triostegus* (90.28±20) and *Barbus grypus* (0.59±0.4 kg/ha) in winter, respectively (Table 2). Generally, the maximum and minimum fish biomass in shadegan wetland was *Silurs triostegus* (84±49 kg/ha) and *B. burbulus* (3.96±0.02), respectively.

Overall, carp species, *S. triostegus*, *B. lutus*, *C. carasius*, *C. carpio* are included over 60% biomass of Shadegan wetland species. The total fish production

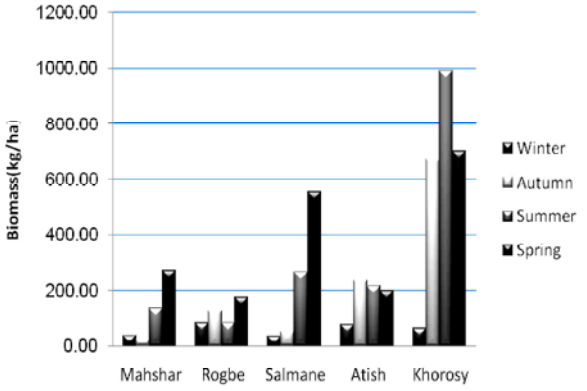

Fig. 2: Value fish biomass in different Station from Shadegan Wetland (2010-11)

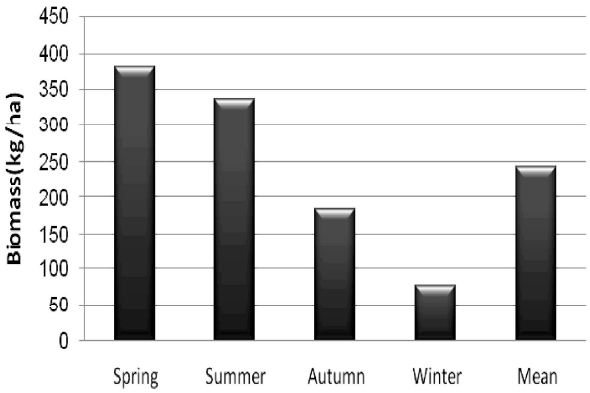

Fig. 3: Value fish biomass in Shadegan Wetland (2010-11)

was calculated from species biomass of different fish. Mean production of fish was estimated 137 (kg/ha). The maximum and minimum fish production amount was to *B. lutes* and *B. burbulus*, respectively. The biomass fish were estimated in different stations and these values was different in Stations (Fig 2). The results of fish catch in Shadegan wetland stations indicated that maximum and minimum fish biomass was found in Khrosoy (701 kg/ha) and Rogbe (175 kg/ha) in Spring, respectively (Fig 2).

The maximum and minimum fish biomass was found in Khrosoy (990 kg/ha) and Rogbe (81 kg/ha) stations in summer, respectively. In Autumun, Mahshar (98 kg/ha) and Khrosoy (671 kg/ha) station and in Winter, Mahshar(36 kg/ha) and Rogbe (81 kg/ha) (60.96kg/ha) stations, maximum and minimum fish biomass was found. Average maximum and minimum fish biomass were in shadegan wetland, spring (381 kg/ha) and winter (71 kg/ha) respectively (Fig 3). The mean all seasons were 244 kg/ha.

DISCUSSION

In this study, the fish biomass in spring and summer was calculated 381 kg/ha, 71 kg/ha, respectively. Average fish biomass in spring and summer of 1997, 70.2 kg/ha &109.2 kg/ha and in 2001, 186.5 kg/ha & 269.4 kg/ha and in 2009, 249 kg/ha & 216 kg/ha was calculated, respectively [4, 5, 6, 7]. In spring, summer and winter were increased of biomass comparing 1997, 2001, 2009 and in autumn was decreased comparing other of years (Table 3). 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 [7, 10] and nutrients entering for river flow may be due to the reason and also maximum phytoplankton production, wetland phytobentos was showed in spring time [10]. 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 14000 t /year. In 1997, the Maramazi, estimated that the total biomass of fish in Shadegan was 22,000 tonnes [4], while this amount calculated 15,000 tons in 2003 [11] and in 2009 was about 11000 tonnes [7]. Total of fish biomass in with comparing 1997, 2001 was decreased, but in 2011 were increased.

The productivity of these areas may have been reduced in approximate proportion to this loss of their floodplain areas. Also, the construction of dams in Khuzestan (Iran) since 1980 has also altered the hydrological regime dramatically [7&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

Table 3: Fish Production (kg/ha) estimates of other researcher in the Shadegan Wetland (2010-11)

Year	Summer	Spring	Autumn	Winter	Mean
Maramazi, 1997	186.5	70.2	-	-	-
Ansari, 2001	269.4	109.7	-	-	-
Hashemi *etal*., 2009	216.9	249.6	166.3	157.4	197.7
Present study, 2011	337	388	184	77	244

Table 4: Summary of the fish production estimates in other systems

Refernce	System	Local	Production (kg/ha/yr)
Dugan, 2003	Flood plain	Niger	31-42
Welcome, 1989	Flood plain	Senegal	54
Welcome, 1989	Flood plain	Nile	8.8
Welcome, 1989	Reservoirs	Nasser	6-25
Welcome, 1989	Reservoirs	dam Kariba	30-40
Welcome, 1989	Reservoirs	damKainji	35-47
Welcome, 1989	Reservoirs	Lagdo	175-300
Welcome, 1989	Lake	Baringo	10-50
Welcome, 1989	Lake	Naivasha	5-60
Welcome, 1989	Lake	Malavi	35-45
Welcome,1989	Lake	Tanganyika	90
Welcome, 1989	Lake	Victoria	29-59
Ita, 1993	Wetland	Hadejia and Ngura	49
Ita, 1993	Wetland	Ogun and Oshun	40
Hashemi *etal*., 2009	Wetland	Shadegan	130
Present study, 2011	Wetland	Shadegan	137

and urban and industrial effluents [10]. 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. It seems induces four species of Cyprinidae (*Cyprinus carpio, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis,* C*tenopharingodon idella*) to Shadegan wetland in 2010 to 2011; biomass and production fishes have increased. 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 fluctuation and floods. The increasing area and flood flow time is improved spawning, growth and survived rate. Positive correlation between being floods 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 [12].

The Khorosy stations in different seasons have high amount of fish biomass. It seems, that entering the jarahi river for east side of the wetland and location of Khorosy 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 Khorosy station in over the year [10].

With survey frequency of fish species in Shadegan wetland was changing comparing 1997 and 2009 [4-6]. 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. 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 [7]. The *C. carpio* has highest rate of biomass to seem 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* [7].

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 [11].

Amount of fish biomass and production in Shadegan wetland was 244 (kg/ha/year), 137 (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 4 [14-18].

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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