Seasonal variations in food selectivity, condition factor and the hepatosomatic and gonadosomatic indices in the endangered killifish *Aphanius dispardispar* (Teleostei: Cyprinodontidae) in Alhasa, Saudi Arabia

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Abstract: Food selectivity investigations of *Aphanius dispar dispar* were carried out during March 2010 to February 2011 from two different sites at Alhasa, Saudi Arabia. The electivity index (Ei) was found positive for all food items collected from the fish gut. The electivity index for the various food items were recorded as: blue green algae 0.4±0.19; and 0.36±0.14; desmids 0.43±0.21 and 0.33±0.21, diatoms 0.43±0.21 and 0.23±0.20, green algae 0.19±0.24 and 0.32±0.17, invertebrates 0.28±0.23 and 0.29±0.12, protozoa 0.24±0.12 and 0.28±0.07 and rectifiers 0.19±0.24 and 0.28±0.09 for Sites1 and 2, respectively. The condition factor (K) varied from 1.39 - 1.87 and 1.44-2.23. The hepatosomatic index (HIS) was ranged from 2.64 - 4.56 and 1.59 - 4.88 and the male gonadosomatic Index in male was recorded at 0.78 -1.98 and 1.52- 6.95 and female as 0.19 - 4.08 and 2.97 - 11.07 for site 1 and 2, respectively. *A. d. dispar* is an omnivorous fish that feed actively on both phytoplankton and zooplankton. The high values of (K), (HIS) and (GSI) throughout the year indicated that this fish is healthy and well adapted to its environment. *Aphanius d. dispar* is an endangered fish species and should be protected from predation and exotic fish competition.

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1.Introduction

The study of food selectivity of fishes in their habitat can lead to an understanding of fish feeding behavior and may also be an important factor for management of fish population (Shamsi, 1984; Shamsi et al., 1985; Al-Akel et al., 1987; Al-Akel et al., 1996, Olsen et al., 2000). The study of diet composition and food selectivity may also be useful to describe seasonal variations of nutritive value of the diet of the fish population (Windell and Bowen, 1978; Getachew and Fernando, 1989). The direct observation of fish feeding behavior or the analysis of fish gut contents can serve as a good tool for fish feeding analysis (Adrian and Barbieri, 1996). Quantitative and qualitative changes in fish food during the life span are useful tools to define the diet of a particular fish species (Shamsi et al., 1985; Al-Akel et al. 1996). Fish feeding is selective, but it can vary according to availability of food in the environment, which means that fish feeding habits are extremely adaptable where fish can use food item readily available in the environment (Azevedo, 1972).

The main factors that determine the type of prey ingested prey, are feeding preference (Shaw et al., 2003; Hagiwara et al., 2007; Nunn et al., 2007), a availability of fish prey, Prey mobility and its distribution in the water column, catching efficiency of the predator, water temperature and turbidity Moore and Moore (1976). It has been stated that changes in feeding habits of a fish species are a function of the interactions among several environmental factors that will influence the selection of food item (Ribeiro and Nuňer, 2008).

This study aimed to establish the interaction between the endangered killifish *Aphanius dispar dispar* and its food selectivity, and in its environment at Alhasa of Saudi Arabia in order to help in managing and conserving its population and to maintain fish biodiversity in the country.

2.Material and methods

2.1.A study area:

The present study was carried out in Alhasa, Saudi Arabia at two different environments of aquatic bodies represented by a natural spring known as Aljawharia spring (25°25′50"N, 49°37′ 26" E) and designated as a site-1 and site-2 as an artificial concrete canal (25°18′N, 49°9′ 10" E).

The average depth of the spring was found to be 1.2 meters and its area was around 100 m^2 with continuous water flow. The concrete canal has a maximum depth of 1 m and 3 meters in width. The canal carries clean water from the spring in the fields of date palms and vegetables. *A. d. dispar* has been found in both the water bodies.

2.2.Water analysis:

Water samples were collected on monthly basis from both sites for a period of one year i.e. from March 2010 to February 2011. The water samples were collected between 7 - 9 am. The procedure described in APHA (1998) was followed for the collection of water samples. Dissolved oxygen, conductivity, temperature and pH were measured on the spot at the time of sampling using digital oxygen meter (*HANNA*: *HI*- 91-43), a conductivity meter (*AD-31*: *EC/TDF)*, a standard mercury thermometer and a pocket pH meter (*HANN – HI8912-5)*, respectively. Samples of nitrate-nitrogen and phosphate -phosphorus were analyzed in the laboratory by using (DR/ 2010) Spectrophotometer.

2.3.Plankton collection:

The water samples (1litre) for phytoplankton were collected monthly, from March 2010 to February 2011, with the help of sampling bottles at different depth and preserved in 1% lugols solution. Zooplankton were collected by filtering 20 liters of water from the sampling site using a plankton net (mesh size 60/-I) and were preserved in formalin solution.

2.4.Fish collection:

10 fish samples were collected monthly from each site for a period of one year by using a hand net at 7 - 9 am in the morning. The total number of sampled fishes was 240 fish from each site. The total length (mm) of each fish was measured with a caliper, and the wet weight (g) was recorded with analytical scale (*Mettler H-80*).

2.5.Analysis of gut content:

The fish were dissected in the laboratory where their liver, gonads and gut were removed and weighed on electric balance. The gut contents were poured in separate Petri dishes and mixed thoroughly and analyzed under stereo-microscope. The food organisms in the gut and in the environmental samples were identified and counted separately using the keys described by (Ward and Whipple, 1963; Needham and Needham, 1964; Tonapi, 1980; Gopal et al., 1981; Al-Akel, 1996, 2003). Abundance of food organisms was expressed as percentage of the total items counted. Three sub-samples were counted and the means were calculated.

2.5.1.Electivity index(Ei)

Th1.e electivity index of fish was determined by the following formula described by Ivlev 1961:

***Ei*=(*ri-pi*)/(*ri+pi*),** Where:

Ei=Ivlev, s index of electivity.

ri= the relative abundance of prey item in the gut or the relative percentage, and

pi = the relative abundance of the same prey item in the environment.

The index has a possible range of -1 to +1, with negative values indicating avoidance or inaccessibility of the prey item, zero indicating random selection from the environment, and positive values indicating the active selection.

2.5.2Condition factor (K):

The condition factor (K) was calculated by dividing weight with body length, and determined (Htun-han, 1978; King, 1995) as:

$K = Wx100/ L^3$, Where:

K= condition factor.

W= body weight

L^3 = body length

2.5.3 Hepatosomatic index (HSI):

The hepatosomatic index (HSI) is defined as the ratio of liver weight to body weight, and determined by Htun-han (1978) as:

HSI = LWx100/BW, Where:

LW= liver weight.

BW= body weight, and

2.5.4 Gonadosomatic index (GSI):

The gonadosomatic index (GSI) was defined as the ratio of gonad weight to body weight, and determined by Htun-han (1978) as:

GSI=GWx100/BW, Where:

GSI = gonadosomatic index.

GW = gonadal weight.

BW= body weight

The three factors were measured to give information on general health condition of the studied fish and its fecundity.

2.6. Statistical analysis:

Statistical analysis was performed according to Sokal1and Rolf (1995) using ANOVA (two-way analysis).

3. Results

3.1.Water quality:

Table 1 shows the water characteristics of the two sites: water temperature varies between 21-34 and 18-36 ℃ at two sites. Dissolved oxygen was recorded as6. 11-12.45 and 5.57 -12.38 mg/l. pH of the water was found to be: 7.4 – 8.3 and 7.3-8.6; nitrate nitrogen varied between 1.79 -184.94 and 1.1 - 1950.0 mg/l, from site 1 and 2, respectively. The phosphate showed a variation from 1.27 - 6.8 and 0.95 - 7.12 mg/l, and water transparency ranged between 82-119 cm and 39-121 cm, for site 1 and 2, respectively.

3.2.Electivity index(Ei):

The predator's preference for prey is defined as electivity index, *Ei*= (*ri-pi*)/(*ri+pi)* .The values of the monthly selectivity index (*EI*) for all food items were recorded out and presented in tables 2 and 3. It is noticed that all food items were found in the stomach of *A.d.dispar* in all months of the year. The monthly average (*Ei*) values of the phytoplankton includes, blue green algae (0.4±0.19; 0.36±0.14), desmids (0.43±0.21; 0.33±0.21), diatoms (0.43±0.21; 0.23±0.20), green algae (0.19±0.24; 0.32±0.17) from site 1 and site2 respectively, while the includes invertebrates (0.28±0.23; 0.29±0.12), protozoa (0.24±0.12, 0.28±0.07) and rotifers (0.19±0.24; 0.28±0.09) for a site I and 2, respectively. Statistical analysis of ANOVA shows none significant differences in the means of the electivity index (*Ei*) either between the two sites or between the months of the year ($p>0.05$).

Table (1) Shows water characteristics at site1 and 2 of Alhasa of Saudi Arabia, 1*= Site 1, 2*= Site 2, $\bar{x}$= mean value, SD = standard deviation.

Months	Temp.	Oxygen	pH	No3	Po4	Transparency
	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD
Mar.2010 –1*	23.2±0.51	9.91±0.06	7.5±0.0	77.13±1.26	1.66±0.12	87±0.49
Mar.2010 -2*	26.2±0.03	9.95±0.0	7.3±00	62.27±2.33	1.80±0.22	121±2.19
Apr. 1*	29.9±0.27	7.7±0.01	7.8±0.0	71.68±0.98	1.37±0.08	116±0.84
Apr 2*	31.7±0.08	8.36±0.0	7.4±0.04	57.11±1.58	1.1±0.12	81.1.69
May -1*	30.1±0.33	9.61±0.01	8.0±0.04	112.62±0.88	2.19±0.06	102±1.16
May -2*	32.4±0.02	6.88±0.0	7.8±0.01	105.76±0.88	0.95±0.36	73.1.2
Jun –1*	31.6±0.46	7.19±0.0	8.1±0.03	171.09±3.61	4.44±0.11	91±0.26
Jun -2*	32.2±0.01	6.06±0.18	7.6±0.07	195.01±3.78	4.33±0.06	69±0.65
Jul- 1*	34.6±0.51	6.26±0.06	7.8±0.01	178.22±1.05	5.92±1.23	92±0.93
Jul -2*	36±0.06	6.31±0.41	8.4±0.09	186.22±4.25	6.63±0.25	48.0± 1.02
Aug – 1*	34.1±0.25	6.15±0.02	7.7±0.01	184.94±3.84	6.81±0.02	83±0.76
Aug -2*	33.8±0.12	5.57±0.0	7.8±0.07	191.34±2.98	7.12±0.40	47 ±1.04
Sep- 1*	33.3±0.29	6.11±0.02	7.4±0.08	160.35±.68	3.58±0.14	82±1.19
Sep -2*	33.2±0.04	7.27±0.0	8.2±0.05	131.07±2.01	3.71±0.36	56.0±1.34
Oct-1*	29.9±0.62	7.23±0.01	7.8±0.0	112.31±0.75	3.01±0.08	97±0.68
Oct -2*	32.1±0.02	7.72±0.0	8.0±0.0	70.23±1.05	3.08±0.16	84 ±1.89
Nov- 1*	23.1±0.36	7.47±0.02	8.0±0.02	80.13±0.92	2.63±0.36	95±0.85
Nov -2*	32.2±0.01	7.91±0.04	7.9±0.01	79.17±0.66	2.68±0.21	39±0.73
Dec- 1*	26.6±0.16	7.65±0.06	7.8±0.02	63.17±1.25	2.49±0.15	119±0.71
Dec 2*	18.1±0.01	8.27±0.06	8.6±0.02	68.46±2.59	2.23±0.09	56±0.88
Jan-1*	21±0.49	8.510.02	8.3±0.01	51.79±1.87	1.57±0.09	91±1.18
Jan -2*	21.2±0.21	8.76±0.11	8.2±0.11	57.51±1.36	1.35±0.33	57±1.87
Feb 2011-1*	26.5±0.28	±0.0112.45	7.6±0.0	68.67±0.38	1.27±0.13	96±0.52
Feb 2011-2*	31.7±0.09	12.38±0.01	7.9±0.15	62.72±1.74	1.14±0.06	79±1.06

Table (2) electivity index (Ei) of *A.d. dispar* at site 1 of Alhasa of Saudi Arabia, n= number of species in each food item, $\bar{x}$= mean, SD= standard deviation.

Food items	Mar. 2010	April	May	June	July	August	September	October	November	December	Jan. 2011	February	Average
	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ± SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD	$\bar{x}$ ±SD
Blue-green algae n(12)	0.39 ±0.66	0.71 ± 0.26	0.75 ±0.24	0.48 ±0.49	0.52 ±0.57	0.40 ±0.53	0.05 ±0.77	0.29 ±0.31	0.29 ±0.68	0.16 ±0.27	0.31 ±0.20	0.38 ±0.45	0.4 ±0.19
Desmids n(12)	0.27 ±0.75	0.31 ±0.67	0.44 ±0.69	0.44 ±0.69	0.43 ±0.19	6.11 ±0.62	6.11 ±0.62	0.62 ±0.51	0.28 ±0.74	0.45 ±0.49	0.20 ±0.75	0.48 ±0.64	0.43 ±0.21
Diatoms n(18)	0.28 ±0.79	0.60 ±0.60	0.40 ±0.67	0.58 ±0.69	0.26 ±0.74	0.47 ±0.55	-0.07 ±0.68	-0.22 ±0.52	0.20 ±0.76	0.43 ±0.76	0.12 ±0.64	0.36 ±0.74	0.43 ±0.21
Green algae n(15)	0.46 ±0.70	0.03 ±0.74	0.65 ±0.62	0.16 ±0.77	0.00 ±0.79	0.17 ±0.65	0.11 ±0.70	-0.09 ±0.51	0.48 ±0.70	-0.22 ±0.85	0.24 ±0.66	0.30 ±0.70	0.19 ±0.24
Invertebrates n(6)	0.00 ±0.32	0.98 ±0.94	0.01 ±0.80	0.30 ±0.70	0.44 ±0.35	0.25 ±0.48	0.16 ±0.48	0.41 ±0.27	0.48 ±0.78	0.17 ±0.71	-0.04 ±0.86	0.34 ±0.75	0.28 ±0.23
Protozoa n(35)	0.27 ±0.81	0.21 ±0.67	0.20 ±0.94	0.36 ±0.77	0.50 ±0.75	0.22 ±0.69	0.36 ±0.74	0.09 ±0.62	0.09 ±0.68	0.24 ±0.75	0.12 ±0.67	0.27 ±0.74	0.24 ±0.12
Rotifers n(13)	0.27 ±0.76	0.22 ±0.65	0.03 ±0.79	0.03 ±0.79	0.18 ±0.52	0.47 ±0.72	0.32 ±0.64	0.21 ±0.45	0.39 ±0.57	0.45 ±0.56	0.40 ±0.72	0.30 ±0.56	0.19 ±0.24

Table (3) electivity index (Ei) of *A. d. dispar* at site 2 of Alhasa of Saudi Arabia, n= number of species in each food item, x̄ = mean, SD= standard deviation

Food items	Mar. 2010	April	May	June	July	August	September	October	November	December	Jan. 2011	February	Annual average
	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD	x̄ ±SD
Blue-green algae n(12)	0.35 ±0.66	0.36 ±0.77	**0.0** ±0.70	0.24 ±0.75	0.42 ±0.66	0.39 ±0.60	0.47 ±0.50	0.33 ±0.66	0.60 ±0.51	0.40 ±0.51	0.30 ±0.56	0.48 ±0.67	0.36 ±0.14
Desmids n(12)	0.46 ±0.58	0.28 ±0.58	0.18 ±0.56	0.48 ±0.56	-0.03 ±0.71	-0.04 ±0.82	0.29 ±0.71	0.42 ±0.66	0.43 ±0.78	0.39 ±0.59	0.52 ±0.45	0.65 ±0.56	0.33 ±0.21
Diatoms n(18)	0.44 ±0.74	0.58 ±0.61	0.34 ±0.75	0.19 ±0.00	0.44 ±0.62	0.13 ±0.63	-0.08 ±0.69	0.17 ±0.73	0.03 ±0.68	-0.01 ±0.61	0.19 ±0.57	0.42 ±0.59	0.23 ±0.20
Green algae n(15)	0.48 ±0.67	0.07 ±0.63	0.64 ±0.60	0.38 ±0.69	0.34 ±0.79	0.31 ±0.69	0.35 ±0.66	-0.02 ±0.50	0.46 ±0.50	0.27 ±0.53	0.32 ±0.42	0.32 ±0.66	0.32 ±0.17
Invertebrates n(6)	0.46 ±0.02	0.32 ±0.36	0.49 ±0.21	0.29 ±0.14	0.39 ±0.07	0.22 ±0.13	0.27 ±0.30	0.08 ±0.14	0.25 ±0.30	0.13 ±0.19	0.25 ±0.10	0.37 ±0.07	0.29 ±0.12
Protozoa n(35)	0.37 ±0.77	0.26 ±0.68	0.13 ±0.67	0.31 ±0.73	0.37 ±0.62	0.31 ±0.70	0.19 ±0.63	0.33 ±0.62	0.24 ±0.73	0.31 ±0.66	0.28 ±0.74	0.31 ±0.64	0.28 ±0.07
Rotifers n(13)	0.44 ±0.05	0.31 ±0.21	0.40 ±0.22	0.29 ±0.08	0.39 ± 0.04	0.24 ± 0.09	0.18 ± 0.19	0.14 ± 0.15	0.25 ± 0.18	0.17 ± 0.14	0.26 ±0.06	0.36 ± 0.05	0.28 ±0.09

3.3.Condition factor (K):

The monthly average condition factor (K) showed values between 1.39 - 1.87 at the first site and 1.44 -2.23 at the second site, (Table 4 and Fig 1) where the values of the condition factor for second sites was higher than site 1 (P<0.05).

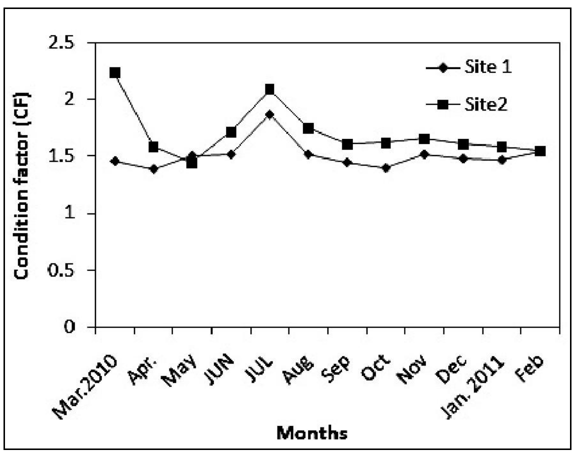

Fig (1) Condition factor (CF) of *A. d. dispar* at site 1 and 2 of Alhasa of Saudi Arabia

3.4.Hepatosomatic index (HIS)

The hepatosomatic index of *A. d.dispar*, (Table 4 and Figure 2), showed high values throughout the year (2.64 - 4.56 for Site 1 and 1.59 - 4.88 for Site 2) for both sexes. The two sites showed non-significant differences (p>0.05).

3.5.Gonadosomatic Index (GSI)

The monthly average of the gonadosomatic index (GSI) for both sexes ranged from 0.78 -1.98 for males and 1.52- 6.95 for females at site 1 and at site 2 it varied from 0.19 - 4.08 for males and 2.97 - 11.07 for females, (Table 5). Statistical analysis showed significant differences (p<0.05) between the two sites while there was the difference between males and females were highly significant (p<0.01).

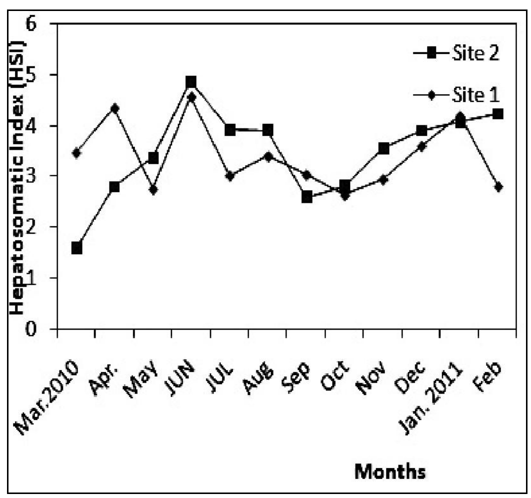

Fig (2) Hepatosomatic index (HIS) of *A. d. dispar* at site 1 and 2 of Alhasa of Saudi Arabia

Table (4) condition factor(K) and Hepatosomatic index(HIS) at site 1 and 2 of Alhasa of Saudi Arabia for *A. dispar*.

Months	condition factor (K)				Hepatosomatic index(HIS)			
	Site 1	±sd	Site2	±sd	**Site 1**	**±sd**	**Site 2**	**±sd**
Mar.2010	1.46	±0.12	2.23	±0.66	3.47	±1.04	1.59	±1.30
Apr.	1.39	±0.11	1.58	±0.19	4.34	±1.55	2.81	±1.22
May	1.51	±0.11	1.44	±0.12	2.76	±0.87	3.38	±0.86
JUN	1.52	±0.10	1.71	±0.18	4.56	±2.36	4.88	±1.50
JUL	1.87	±0.21	2.09	±0.39	3.02	±1.12	3.93	±0.91
Aug	1.52	±0.14	1.75	±0.20	3.40	±1.23	3.92	±1.34
Sep	1.45	±0.13	1.61	±0.15	3.04	±1.20	2.61	±0.86
Oct	1.40	±0.27	1.62	±0.15	2.64	±0.59	2.82	±0.98
Nov	1.52	±0.16	1.65	±0.12	2.95	±0.69	3.56	±1.57
Dec	1.48	±0.14	1.61	±0.13	3.60	±0.86	3.91	±1.21
Jan. 2011	1.47	±0.13	1.58	±0.12	4.19	±1.17	4.08	±0.97
Feb	1.54	±0.10	1.55	±0.14	2.81	±1.03	4.25	±0.84

Table (5) Show Gonadosomatic Index (GSI) of *A. d. dispar* at site 1 and 2 of Alhasa of Saudi Arabia, $\bar{x}$ = mean, SD= standard deviation.

Months	**Gonadosomatic Index (GSI)**							
	Site 1 $\bar{x}$ ±SD				Site 2 $\bar{x}$ ±SD			
	Male		Female		Male		Female	
	$\bar{x}$	±SD	$\bar{x}$	±SD	$\bar{x}$	±SD	$\bar{x}$	±SD
Mar 2010	1.73	±0.36	1.52	±0.42	0.19	±0.10	3.88	±1.49
Apr	0.82	±0.26	6.95	±2.94	0.85	±0.55	7.0	±3.29
May	0.78	±0.14	3.32	±1.12	1.45	±0.52	3.53	±1.81
Jun	1.08	±0.27	5.73	±1.09	3.02	±1.38	11.07	±5.61
Jul	0.93	±0.28	3.85	±1.69	1.20	±0.48	3.83	±2.13
Aug	1.09	±0.15	4.26	±0.83	4.06	±0.40	4.41	±1.07
Sep	1.26	±0.44	4.08	±0.50	0.84	±0.26	2.97	± 1.64
Oct	1.11	±0.33	3.56	±1.69	0.67	±0.28	3.25	±0.88
Nov	1.22	±0.19	3.07	±0.86	0.78	±0.32	3.26	±0.90
Dec	0.84	±0.28	2.30	±0.32	0.69	±0.35	3.67	± 1.62
Jan 2011	1.98	±0.16	4.13	±0.61	0.93	±0.24	4.54	±1.32
Feb	1.57	±1.57	4.87	±2.91	0.89	±0.27	9.95	±4.89

4.Discussion

The results of the present study show that the water temperature at the two sites of the studied area varies between 21 – 34°C which is the optimum temperature for fish growth and breeding. Water temperature is a very important factor for fish distribution and aquatic organisms and their activity in the environment. Different fish species vary greatly in their response to water temperature. Water temperature affects photosynthesis, osmotic regulation in addition to effect on water density, viscosity, oxygen dissolution in the water, fish respiration (Saadi, 2009; Plumb and Blanchfield, 2009). Aquatic environment flourished at the beginning of the rising temperature in the spring until it reaches the critical level in the summer and reduces aquatic productivity (Jhingrn, 1982; Shamsi and Jafri, 1989). The water pH varies between 7.3 - 8.6 which is suitable for aquatic productivity and the life of the fish (Hora and Pillay, 1992). The dissolved oxygen varies between 12 - 15.57 mg/l during the winter and summer, respectively, which indicate a very high level of dissolved oxygen throughout the year. The oxygen values are good indicators of a suitable environment for all types of fish and *A. d.dispar* is not an exception. The results also show an increase in nitrate level during the summer which may due to high temperature and the higher rate of decomposition of organic matter in these water bodies.

Analysis of stomach content to study the feeding habits of fish has become a standard practice (Hynes, 1950; Hyslop, 1980). Fish feeding pattern and quantitative assessment that resulted from the analysis of stomach content is an important aspect of fisheries management. Lager (1949) pointed out that the gut contents only indicate what the fish would feed on. A study of food selectivity determines the most frequently consumed prey and the relative importance of different food types to fish nutrition and to quantify the consumption rate of the individual prey types. Ivlev (1961) proposed a somewhat different quantitative measure of selection which has been widely used as mean of comparing the feeding habits of fishes and other aquatic organisms with the availability of potential food resources in natural habitats.

The result of this study has, therefore, indicated that: *A. d. dispar* shows great values with positive results which means that this fish feeds actively on both phytoplankton and zooplankton as they present in the water samples and it is an omnivorous fish species. Daud, (2011) stated that Some fishes demonstrate some kinds of obligate and facultative feeding electivity, other fishes are restricted to a single or few target species. Aphanius dispar has been reported by Suliman, (2009) and Haq, (2013) as a larvivourus fish which could be used in mosquito control. (Kaufman et al., 2007; Morley et al., 2012) reported that HSI as an indicator which varies among species and condition factor (K) perform better than (HSI). But in species that use the liver as a storage site of lipids (HSI) may be more effective than the value of K. In the present study all the indices (HSI, GSI and K) show high values which means that all indices can be used to study condition of *A. dispar*. A study of *Aphanius isfahanensis* from southern Western Ghats, India showed a high condition factor with indication of healthy fishes (Kannan, et al., (2013)

Gonadosomatic index (GSI) shows a very high significant differences between males and females ($p<0.05$) and a highly significant difference between the two sites ($p<0.05$), where site 2 shows higher values of GSI than the site -1and females shows higher values than males in both sites throughout the year as a result of the continuous breeding behavior of the *A. dispar* (Suliman et al., 2010). The higher value of GSI indicates that food types and availability has better impact on the reproductive function (Van Ginnekenet al., 2009).

Condition factor (K) is calculated by weight/body length to compare growth condition of fish. Good environmental quality gives a high condition factor, while a low condition factor reflects poor environmental quality. The condition factor (K) reflects information on the physiological state of the fish in relation to its welfare, (Kumolu-Johnson and Ndimele,2010). In this study the condition factor (K) shows high values for both studied sites. The above values showed good to excellent conditions of the fish in both sites.The values of (k) were higher at site 2 and significantly different from site 1 ($p<0.05$), which indicate a better environmental conditions at site 2. Probably because of shallow water level and high plankton production.

The results of this study show that the environment of the Alhasa of Saudi Arabia is highly stable and a suitable environment for *A. d. dispar*. This fish and its environment should be protected and conserved by implementing the rules and regulations especially those which are concerned with the introduction of exotic fish species. Exotic fishes such as tilapia and poecilia may compete in space and food with the *A. d.dispar*and they may also have a predatory behavior against this fish and its eggs. *Aphanius d. dispar* is an important native fish of Saudi Arabia and it deserves conservation because it has a good potential for mosquito control, in addition to its role in the aquatic ecosystem as a part of the biological diversity of the aquatic life of the country. So, *A.d.dispar* as an endangered fish species should be prevented from competition and predation by intruder fishes such as tilapia and *Poecilia* in order to conserve the fish population and to maintain the biological diversity of the aquatic life of the country. The fish can also be used in biological control of vectors of some diseases such as malaria, dengue and the fever of the rift-valley.

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