Egypt. J. Aquat. Biol. & Fish., Vol.7, No.3: 197 – 211 (2003) ISSN 1110 – 6131

FOOD AND FEEDING HABITS OF BAYAD FISH *BAGRUS BAJAD* (FORSSKAL, 1775) IN El-NOZHA HYDRODROME, ALEXANDRIA, EGYPT

Shnoudy A. Bakhoum and Samir. N. Faltas
National Institute of Oceanography and Fisheries, Alexandria, Egypt

Key words: *Bagrus bajed*, food, feeding habits, El-Nozha Hydrodrome

ABSTRACT

In order to elucidate the food and feeding habits of *Bagrus bajed* fish, stomach contents of 188 specimens with total body length ranging from 22 to 71cm were examined. Samples were collected monthly during the period from July 2000 to December 2001 from the commercial catch of El-Nozha Hydrodrome. The results of relative gut index indicated that *B. bajed* is carnivore. The range of its food material is wide, including cichlid species (*Oreochromis niloticus, Oreochromis aureus, Sarotherodon galilaeus* and *Tilapia zillii*), mullets (*Mugil cephalus* and *Liza ramada*), *Clarias gariepinus*, fish eggs, amphipods (*Corophium volutator*), shrimps (*Leander serratus*) , aquatic insects (chironomid larvae and Coleoptera), vegetable matter and detritus. The maximum feeding intensity was in spring, while the lowest was in winter. Seasonal variation in the diet composition of *B bajed* revealed that fish prey was the main food item eaten throughout the year except in spring, where it represents the second important food item after crustaceans. Variation in food species with fish length revealed an increase in the percentage of fish prey in the diet of this species. The diversity in diet of *B. bajed*, revealed low values in spring increasing in autumn and winter to reach the maximum in summer. Selectivity coefficient for fish prey group of *B. bajed* showed that cichlid species were negatively selected (-0.08), while the positively selected fishes were *Clarias gariepinus* (+0.57) and mullets (+ 0.29).

INTRODUCTION

Bayad fish (*Bagrus bajed*) is widely distributed in freshwater systems of Africa. It inhabits River Nile, Lake Chad, Niger and Senegal rivers, Lakes Mobuta and Tukana (Risch, 1986). *B. bajed* is one of the most preferable freshwater fish food in Egypt. It constitutes

about 1.5% of the total fish production of Egypt (GAFRD, 2000). Also it constituted a nearly similar percentage in the catch of Nozha Hydrodrome (1.34%). The study of diets and food habits of fish and other marine invertebrates through the examination of stomach contents has become a standard practice (Hyslop, 1980). In addition, knowledge of the feeding habits is an important way to understand the mechanism and processes, which structure fish assemblages (Kotrshal and Thomson, 1986). The purpose of this study is to provide detailed information on the feeding habits of this species as well as its variations according to season and fish size. Also to elucidate the effect of the feeding habits of *B. bajed* on the other fish species inhabiting the same area, which play an important role in species composition of the catch in El-Nozha Hydrodrome.

MATERIALS AND METHODS

Samples of *Bagrus bajed* were collected monthly during the period from July 2000 to December 2001 by Seine nets from commercial catch of El-Nozha Hydrodrome. It is an isolated part of Lake Mariut lying in its northeastern side at latitude 31° 10′ E and longitude 30° N. It has a total area of about 504 hectares, while its depth ranges between 3.4 and 3.8 meters below the mean sea level, and the average water depth is about 2.7 meters (Gharib, 1991). A total of 188 fish ranging from 22 to 71cm total body length were examined within the frame of the scientific program for environmental and fishery investigations of El-Nozha Hydrodrome near Alexandria. For each specimen, total and standard lengths (cm), total and gutted weights (g) were recorded. Then, stomachs were preserved in 10 % formalin solution. Weights of food contents (g) were determined and analysed to the lowest possible taxon or category depending on the digestion stage of each item. Number and weight of the different prey in each stomach were taken. The intestine length was measured to the nearest 0.1 cm for computing the relative gut index (RGI). Empty coefficient (percentage of the empty stomachs to the total number of stomachs examined) and fullness index (percentage of the weight of stomach contents to the gutted body weight of the fish) were used to determine seasonal differences in feeding intensity for mentioned species. The contribution of each type of food to the diet was expressed as percentage frequency of occurrence (%O), numerical percentage (%N) and weight percentage (%W). The percentage index

of relative importance (% IRI) after King (1984) and Cortes *et al.* (1996) was used. This index combines prey number, weight and occurrence as described by Hyslop, (1980). Seasonal variations in fullness index were analyzed using the one-way ANOVA test (Snedecor and Cochran, 1980). Contingency table analysis was applied for testing the seasonal variation in diet composition of *B. bajed* and abundance by number of the food categories at different size groups (Crow, 1982). The seasonal variations in diversity of food were determined by using the index of Shannon and Weaver, (1963). Determining selectivity coefficient was carried out after Ivlev (1961), to assess the selectivity of *B. bajed* to each fish prey.

RESULTS

Relative gut index

The relative gut index (RGI) of *Bagrus bajed* was in the range from 0.8 to 1.0 (mean ± standard deviation = 0.92± 0.090) for fish of 18-55 cm standard length. These results indicate that *B. bajed* is carnivore.

Feeding intensity

Seasonal variations of empty coefficient (E. C.) indicated that lowest values of empty stomachs were found in autumn (39.02%) and increased to 48.94% in spring, while the highest percentages of empty stomachs (61.00% and 62.50%) were observed in summer and winter respectively. Fullness index (F.I) revealed that the highest degrees of stomach fullness were in spring (0.98) and autumn (0.59) while the lowest ones was recorded in winter (0.41) and summer (0.43). One-way ANOVA test indicated significant seasonal difference in fullness index of *B. bajed* ($F=3.492$, $df=3$. $p<0.05$). Tukey's honest-significant difference (HSD), showed that this significant difference can be attributed to the difference between its values in spring and winter ($p<0.01$).

Food patterns

Dietary contents in the stomachs of *B. bajed* included cichlid species (*Oreochromis niloticus, O. aureus, Sarotherodon galilaeus* and *Tilapia zillii*), mullets (*Mugil cephalus* and *Liza ramada*), *Clarias gariepinus*, fish eggs, amphipods (*Corophium volutator*), shrimps (*Leander serratus*), aquatic insects (chironomid larvae and Coleoptera), vegetable matter and detritus.

Unidentified fish remains (34.46%) were the most frequent food item found in the diet of bayad. Shrimps, cichlid species and digested

food constituted the second, third and fourth important food items occurring in 28.38%, 25.00% and 20.27% respectively. Amphipods (18.92%) and mullets (8.78%) came next in importance. The rare food items occurred in the stomach of this species included aquatic insects (2.03%), fish eggs, digested food, *Clarias gariepinus* and detritus, which represented 0.68%.

The diet composition of *Bagrus bajed* by number consisted mainly of amphipods (77.09%) and shrimps (13.43%), while other food species were represented by less than 10 %. The most important food items in terms of weight were cichlid species (54.88 %), followed by mullets (14.88%), unidentified fish remains (11.69%), digested food (9.09 %), shrimps (4.41%), *Clarias gariepinus* (2.51%) and amphipods .(2.27%), while aquatic insects, vegetable matter, detritus and fish eggs were represented by less than 0.2 % of the total food weight.

Index of relative Importance showed that amphipods (41.18%) and cichlid species (40.84 %) were the most important food items, whereas shrimps (13.89%) and mullets (3.96%) had lower values in the diet of *B. bajed.* Other food items such as *Clarias gariepinus*, fish eggs and aquatic insects were rarely encountered, representing unimportant part in the diet of this species (Table 1). The food patterns of *B. bajed* based on relative important index are shown in Figure (1).

Seasonal variation of food patterns

Seasonal variation in diet composition of *B. bajed* revealed that fish prey was the main food items eaten through the whole year except in spring, where it represents the second important food item after crustaceans .It occurred in 54 % of examined stomach contents in winter and increased to 61 % in spring to reach the highest values (79% and 86%) in summer and autumn respectively. The lowest numerical abundance was found in spring (3%), while the maximum one was observed in summer (38%). There were no large seasonal differences in the weight abundance of fish prey, as it ranged from 75% to 90 % of the total weight of food bulk through the whole year. Crustaceans such as amphipods and shrimps were rarely represented in summer (%IRI = 19%), increased in autumn (%IRI = 33%) and winter (%IRI = 40%) to become the most important food item in spring (%IRI = 62%), occurring by 70 % of examined stomach and constituting about 97% by number and 11% by weight. Despite the importance of digested food, which occurred in 27% of examined stomach and constituted 13% in winter and 14% in the summer, it was not important

food category in autumn (%O =12 and %W= 3%) and disappeared in the diet of this species in the summer (Table 2). Contingency table analysis was applied for testing the seasonal variation in diet composition of *B. Bajed.* It showed highly significant difference in the prey composition among seasons (G=188.763, $p<0.01$). This can be attributed to the difference in the proportions of the following prey: amphipods (G=69.773, $p<0.01$), cichlid species (G=55.339, $p<0.01$) and shrimps (G=35.907, $p<0.01$).

Feeding variations with fish length

Variation in abundance of food species with fish size for *Bagrus bajed* indicated that the diet of small fishes (less than 30 cm) and fishes from 30 to 39 cm mainly contained crustaceans (94%), while teleosts were represented by minor importance (5-6%). The increase in fish length revealed an increase in the percentage of fish prey in the diet of this species. The Larger fish (>60 cm) fed only on fish prey (68.43%) and shrimps (31.58%)(Table 3).

Feeding diversity

Shannon-Weaver diversity index for the diet of *B. bajed* comprised low values in spring (0.41) increasing in autumn (0.85) and winter (0.97) to reach the maximum value in summer (1.19), (Fig. 2).

Food Selectivity

Selectivity coefficient of the fish prey groups in the stomach contents of *B. bajed* revealed that cichlid species were negatively selected (-0.08), while the positively selected species were *Clarias gariepinus* (+0.57) and mullets (+ 0.29).

DISCUSSION

The relative gut index (RGI) revealed that *Bagrus bajed* of El-Nozha Hydrodrome is carnivore (RGI= 0.8-1.0). Odum (1968) stated that RGI of carnivores have low values (0.6-1.0) , while herbivores have higher values (2.9-8.1).The diet of *B. bajed* had a lot of animal components. Its food items include cichlid species, mullets, *Clarias gariepinus*, fish eggs, amphipods, shrimps, aquatic insects, and detritus beside vegetable matter. This is in agreement with the finding of Hashem (1981) in his study of food and feeding habits of *B. bajed* in Nozha Hydrodrome. He mentioned that this species fed mainly on fish prey, crustaceans and organic detritus that are mostly composed of animal origin. On the other hand, Bishai (1970) in his work on *B. bajed* in Sudan estimated that frequency occurrence of fish prey was

high followed by aquatic insects and crustaceans. According to Hickley and Bailey (1987), *B. bajed* is described as macro-predator in River Nile (southern Sudan), its diet consists mainly of fish prey, aquatic insects, organic detritus and aquatic higher plants.

The seasonality associated with feeding in the present study indicated that the maximum degree of feeding intensity was in spring, while the lowest one was in winter. The seasonal variations in feeding intensity may be attributed to the spawning activities, where the physical space in the body cavity available for the stomach at the spawning period was small, beside the effect of optimum temperature on metabolic rate or food availability (Kuo and Tanaka, 1984; Nwadiaro and Okorie, 1987). Khallaf *et al.* (1991) reported that *B. bajed* is multiple spawner as an environmental adaptation to ensure favourable conditions for the offspring. This finding excludes the role of reproductive activities on feeding intensity. However, The declined feeding intensity in winter during the present study agrees with that reported by Hashem (1981).

Seasonal variations in diet composition of *B. bajed* revealed that fish prey was the main food item eaten through the whole year except in spring, which represents the second important food item after crustaceans. This finding accords with Hashem (1981), who showed that crustaceans appeared most frequently and represented more abundant food items during spring, while the fish prey was observed in a high percentage during winter months in the fish diet. The seasonal variability in the diet composition of this species corresponds to the abundance of these food items in the habitat, which appeared to be influenced by water temperature and other environmental conditions. This agrees with Gharib, (1991) who stated that flourishing of crustaceans in El-Nozha Hydrodrome occurred in spring.

Variation in abundance of food species with fish size for *Bagrus bajed* indicated that the increase in the length range resulted an increase in the percentage of fish prey in the diet of this species. This coincided well with the finding of Bishai (1970) for *B. bajed* in Sudan and Hashem (1981) on the same species in Nozha Hydrodrome.

The diversity in the diet of *B. bajed*, which comprised low values in spring increasing in autumn and winter to reach the maximum value in summer may by attributed to the wide spectrum of food items in summer in the habitat.

Computed selectivity coefficient of the fish prey groups in the stomach contents of *B. bajed* showed that *Clarias gariepinus* and

mullets were positively selected, while cichlid species were not prefered food items for this species. The preference ability of *B. bajed* to these species plays an important role in species composition of the catch in the examined area. Factors that influence food selectivity of predators are the size and morphology of the food organisms (Bentzen and McPhail, 1984).

ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to Prof. Dr A. Alsayes head of fishery branch, N.I.O.F., for his support and valuable advice. Also they extend their gratitude to all the scientific staff of the program for environmental and fishery investigations of the El-Nozha Hydrodrome near Alexandria, for their kind help in collecting the present material.

REFERENCES

Bentzen, D. and McPhail, J. D. (1984). Ecology and evolution of sympatric sticklebacks (Gasterosteus): specialization for alternative trophic niches in the Enos Lake species pair., Can. J. Zool., *62*: 2280-2286.

Bishai, R. M. (1970). Studies on the biology of family Bagrid (pisces) in the Sudan. Ph. D. Thesis, Fac. Sci., Cairo Univ.

Cortes, E. ; Manire, C. A. and Heuter, R. E. (1996). Diet, feeding habits, and diet chronology of the bonnethead shark, *Sphyrna tiburo*: in southwest Florida , Bull., Mar. Sci., *58* (2): 353-367.

Crow, M.E. (1982). Some statistical techniques for analysing the stomach contents of fish .In fish food habits studies. Proceedings of the 3 rd Pacific Northwest technical workshop G. M. Cailliet and C., A. Simensted(eds). Washington Sea Grant publication. Washington univ. Seattle, Wash: pp.8- 15.

GAFRD, (2000). General Authority for fish resources development, data on fish Production in Egypt, Ministry of Agriculture. Cairo., 207pp.

Gharib, S. M. (1991). Study of the biological productivity of the El-Nozha Hydrodrome as a model of artificially fertilized fish farm. Ph.D. Thesis, Fac. Sci., Mansoura Univ., 453pp.

Hashem, M. T. (1981). The feeding and Fatness of *Bagrus bajad.* Bull. Inst. Oceanogr. & Fish., *7*(3) :442-454.

Hickley, P. and Bailey, R. G. (1987). Food and feeding relationships of fish in the Sudd swamps (River Nile, southern Sudan). J. Fish Biol., *30*: 147-159.

Hyslop, E. J. (1980). Stomach contents analysis, a review of methods and their application. J. Fish. Biol., *17*: 411-430.

Ivlev, V. S. (1961). Experimental ecology of the feeding of fish. Yale Univ. press, New Haven, Conn. 302pp.

Khallaf, E. A. ; El-Saadany, M. M. and Authman, M. N. (1991). Oogenesis of *Bagrus bajed*, Forskaal.(Bagridae, Teleostei). J. Egypt. Ger. Soc. Zool., *3*:1-14.

King, K. J. (1984). The food of rig (*Mustelus lenticulatus*) and the relationship of feeding to reproduction and condition in Golden Bay. New Zeal. J. Mar. Freshw. Res., *18*: 27-43.

Kotrshal, K. and Thomson, D. A. (1986). Feeding patterns in eastern tropical Pacific blennioid fishes (Teleostei: Triptrygiidae, Labrisomidae, Chaenopsidae and Blennidae). Oecologia, *70*: 367-378.

Kuo, C. and Tanaka, S. (1984). Feeding habit of Hoki *Macruronus novaezelandidae* (Hector) in water around New Zealand. Bull. Japanese Soci. Scien. Fish., *50*(5) : 783-786.

Nwadiaro, C. and Okorie, P. (1987). Feeding habits of the African Bagrid, *Chrysichthys filamentosus* in a Nigerian Lake. Japanese J. Ichth. *33*(4): 376- 382.

Odum, W. E. (1968). The ecological significance of fine particle selection by the striped mullet *Mugil cephalus*. Limnol. Oceeanogr., *13*: 92-98.

Risch, L. M. (986).Bagridae: in Check-List of the freshwater fishes of Africa. Daget, J. ; Gosse, J. P. and D. F. E. Thys van denAudenaerde (eds.). ISNB, Brussels; MRAC, Tervuren; and ORSTOM, Paris., *2*: 2-35.

Shannon, C. E. and Weaver, W. (1963). The mathematical theory of communication. Urana Univ. Press, Illinois.

Snedecor, G. W. and Cochranw, W. G. (1980) . Statistical methods. Ames, pp. 39-63. Iowa: The Iowa state University Press.

Table (1): Diet composition of *Bagrus bajad* in El-Nozha Hydrodrome. %O =frequency of occurrence, % N= numerical percentage, %W= weight percentage and % IRI = percentage of relative importance index.

Food items	%O	%N	%W	%IRI
Teleosts	**63.51**	**9.1**	**83.98**	**58.83**
Cichlid species	25	4.69	54.88	40.84
Mullets	8.78	1.56	14.88	3.96
Clarias gariepinus	0.68	0.09	2.51	0.05
Fish eggs	0.68	2.76	0.02	0.05
Unidentified fish remains	34.46		11.69	
Crustaceans	**42.57**	**90.52**	**6.68**	**41.18**
Amphipods	18.92	77.09	2.27	41.18
Shrimps	28.38	13.43	4.41	13.89
Aquatic insects	2.03	0.37	0.17	0.03
Vegetable matter	0.68		0.05	
Detritus	0.68		0.04	
Digested food	20.27		9.09	

Table (2): Seasonal variations in the diet of *Bagrus bajad* in El-Nozha Hydrodrome. %O =frequency of occurrence, % N= numerical percentage, %W= weight percentage and % IRI = percentage of relative importance index.

	Spring				Summer				Autumn				Winter			
Food items	%O	%N	%W	%IRI	%O	%N	%W	%IRI	%O	%N	%W	%IRI	%O	%N	%W	%IRI
Teleosts	**60.61**	**2.54**	**74.79**	**38.39**	**78.57**	**37.93**	**84.72**	**81.34**	**85.71**	**8.08**	**90.06**	**66.78**	**54.24**	**18.03**	**82.08**	**59.62**
Cichlid species	12.12	1.27	20.16	8.78	50.00	34.48	62.91	73.94	21.43	3.73	47.51	28.17	28.81	9.58	70.71	55.74
Mullets	6.06	1.27	37.31	7.90	7.14	3.45	2.34	0.63	21.43	4.04	26.39	16.73	0.00	0.00	0.00	0.00
Clarias gariepinus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38	0.31	7.01	0.45	0.00	0.00	0.00	0.00
Fish eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	1.70	8.45	0.03	0.35
Fish remains	42.42		17.32		50.00		19.47		35.71		9.15		25.42		11.34	
Crustaceans	**69.7**	**97.2**	**10.73**	**61.61**	**28.57**	**62.07**	**15.29**	**18.66**	**42.86**	**90.99**	**6.63**	**33.22**	**42.37**	**81.97**	**4.83**	**40.38**
Amphipods	21.21	90.08	3.45	67.05	7.14	24.14	0.84	2.71	19.05	72.98	2.46	36.87	20.34	68.17	1.85	34.32
Shrimps	33.33	7.12	7.28	16.22	28.57	37.93	14.45	22.72	30.95	18.01	4.17	17.61	23.73	13.8	2.98	9.60
Aquatic insects	3.03	0.26	0.20	0.05	0.00	0.00	0.00	0.00	4.76	0.93	0.39	0.16	0.00	0.00	0.00	0.00
Vegetable matter	0.00		0.00		0.00		0.00		0.00		0.00		1.70		0.10	
Detritus	0.00		0.00		0.00		0.00		0.00		0.00		1.70		0.08	
Digested food	27.27		14.28		0.00		0.00		11.91		2.92		27.12		12.91	

Table (3): Variations in diet composition of food species by number with total length groups of *Bagrus bajad* in El- Nozha Hydrodrome.

Food items	Length groups (cm.)				
	<30	30-39	40-49	50-59	>60
Teleosts	**6.37**	**4.95**	**16.39**	**52.94**	**68.43**
Cichlid species	5.73	3.3	4.44	52.94	42.11
Mullet	0.64	1.48	1.71	0.00	26.32
Clarias spp	0.00	0.17	0.00	0.00	0.00
Fish eggs	0.00	0.00	10.24	0.00	0.00
Crustaceans	**93.63**	**94.4**	**83.62**	**47.06**	**31.58**
Amphipods	80.89	79.24	77.13	23.53	0.00
Shrimps	12.74	15.16	6.49	23.53	31.58
Aquatic insects	0.00	0.66	0.00	0.00	0.00

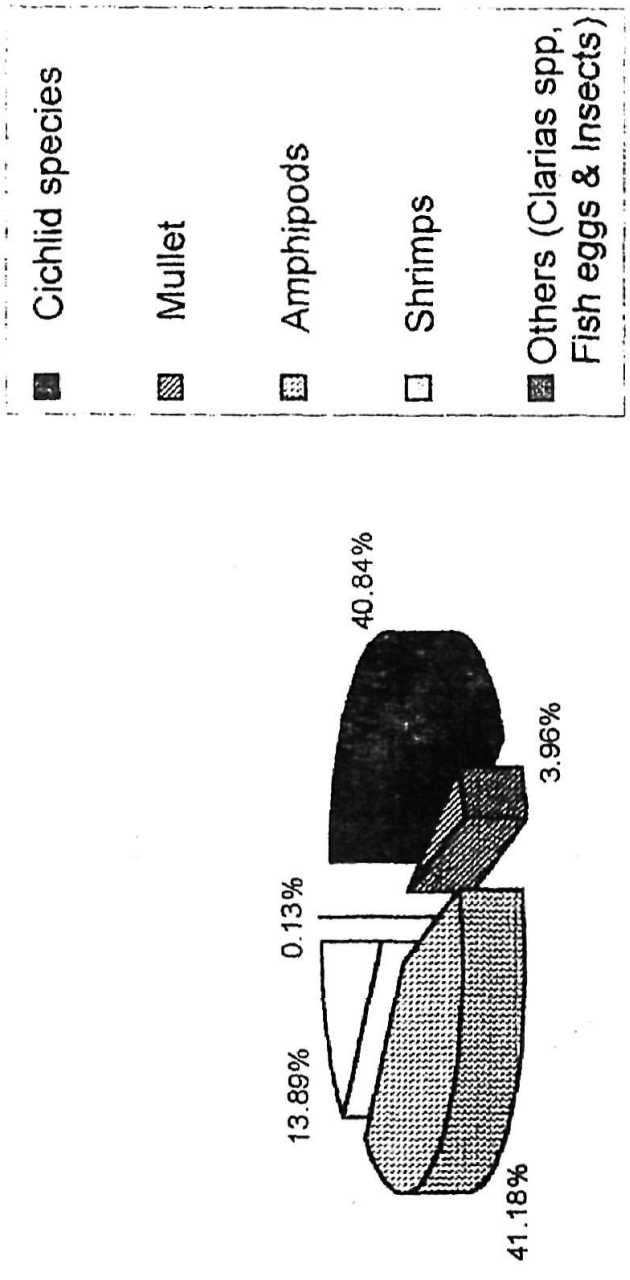

Fig.1. Food patterns of *Bagrus bayad* in El-Nozha hydrodrone.

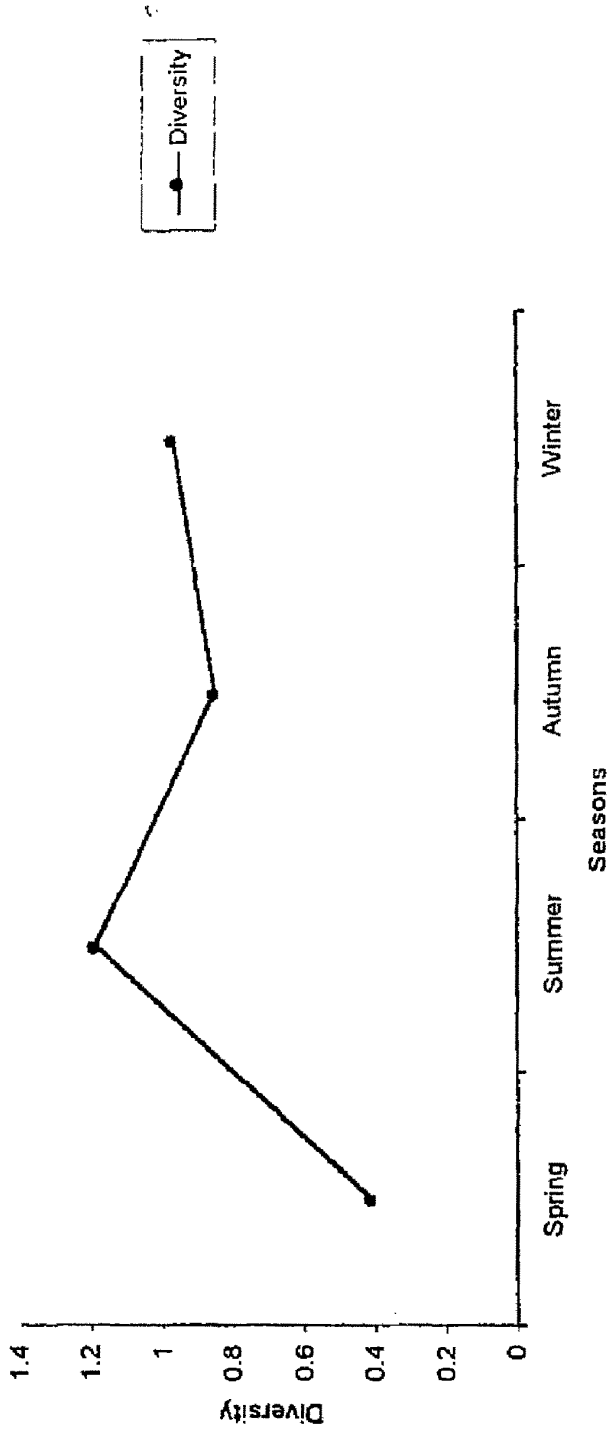

Fig.2. Seasonal variations in diversity index of *Bugrus bayad* from El-Nozha Hydrodrom.