EFFECT OF FISHING AND MATURATION ON THE *BARBUS BYNNI* POPULATION OF THE NOZHA-HYDRODROME

by

M.T. Hashem & A. El-Agamy

ABSTRACT

The *Barbus bynni* in the Nozha hydrodrome is now far less abundant than it was in the early years. A historical account on the Hydrodrome and its fishery is given. The length frequency and age composition of the fish in the commercial catch are discussed. The size and age at first maturity, as well as the sex ratio are studied. Fecundity according to fish length and weight are also estimated. A size limit is recommended to protect the stock of *B. bynni* in the N. hydrodrome.

INTRODUCTION

Barbus bynni Forsk. is widely distributed in the River Nile (Boulenger, 1907). In the Nozha hydrodrome, before 1964, the B*arbus bynni* comprised about 50% of the annual fish yield and the majority of the catch was composed of large fish (Elster, 1960). After 1964, the state of *B. bynni* population has been totally changed . The annual catch of the species has been markedly dlecraesed and the majority are composed of small fish of sizes less than 55 cm. T.L. The factors responsible for such changes have to be discussed in order to find the proper management necessary for a better exploitation of the fishery.

MATERIAL & METHODS

All the materials used in this study were collected from the commercial catch of the Nozha-hydrodrome during the period (1966—1973). The main fishing gear used were Gill & Trammel nets. Fish abundance in the commercial catch was estimated. The total fish length was measured to the nearest centimeter for length frequency analysis. The sex and stage of maturity were recorded for the fish during 1968—1969. Moreover, the ovaries of 15 fish, collected during January, February and March 1969 were examined for fecundity estimation.

FISHERY OF THE NOZHA-HYDRODROME

The Nozha-Hydrodrome was constructed during the second World War. It is an isolated part of Lake Mariut (near Alexandria), having an area of 504 hectars and a water depth of about six metres. The hydrodrome is regularly supplied with fresh water from the Nile through Mahmoudia Canal. It is worth mentioning that since 1969 the water level has been raised by about two metres more than normal, to be used as a reservior for drinking water to Alexandria City.

Different fishing gears have been used in the hydrodrome. The most common are gill and trammel nets whose heights are 110—120 and 150—170 cm, respectively and are of 70 mm. mesh size (from knot to knot) for the gill nets and the inner layer of the trammel nets. Also, hooks (baited with shrimps or small fish) and wire traps, as well as seine and trawling nets are frequently used.

The exploitation of the hydrodrome as a fishing area started in 1954. At that time, the majority of the catch was composed of Nile fishes, while few species like the *Mugil*, *Anguilla* and *Hemirhamphus* spp. were immigrants from the sea. In 1954, *B. bynni* contributed about 50% to the total catch, while the Mullet and *Tilapia* spp constituted 18 and 16% of the total catch, respectively (Elster, 1960).

To increase the mullet production, and consequently the total fish catch, annual mullet fry transplantation has begun since 1954. However, the total fish yield of the hydrodrome up to 1964 was still unsatisfactory. It was believed that the presence of large amounts of different carnivorous fish species especially those which attain big sizes such as *Lates*, *Clarias*, *Bagrus* and *Anguilla spp.* greatly affected the hydrodrome fiish production. So, to reduce the effect of these predators, partial drainage of the hydrodrome accompanied by exte-

nsive fishing operations were carried out during the period from July 1964, to the end of January 1965.

Moreover, the common carp *(Cyprinus carpio)* was introduced into the hydrodrome during February-March 1965. In the following years this fish has well established itself in the hyrodrome, especially in 1968, when a successful spawning has happened.

To review the abundance of fish species in the hydrodrome before and after the overfishing period of 1964—1965, and after the introduction of the common carp and the annual transplantation of mlulet fry, a comparison of the fish yield in seven months during two fishing periods (Table 1), shows a serious change in the fish population of the hydrodrome. The domenent *B. bynni* constituting approximately half the catch during September, 1954—March, 1955, has given its place to the common carp during October 1968—April, 1969, and has by far been decreased and only contributed 1.7% of the commercial catch.

Table 1. : Species composition of the commercial catch of the Nozha-Hydrodrome during 7 months (September, 1954—March, 1955 October, 1968 and April, 1969).

Fish species	1954—1955		1968—1969	
	kg.	%	kg.	%
Grey mullet	2739	18.3	30761	27.1
Tilapia sp.	2425	16.2	3224	2.8
Lates niloticus	409	2.7	12418	10.9
Barbus bynni	7704	51.5	1921	1.7
Labeo niloticus	+	+	619	0.5
Anguilla sp.	1271	8.5	3932	3.4
Bagrus sp.	66	0.4	3085	2.7
Clarias sp.	15	0.1	88	0.07
Synodontis	314	2.1	108	0.09
Common carp	—	—	57400	50.5
Other fish	6	+	155	0.1
T otal catch	14949	100	113707	100

\+ Labeo niloticus was insignificant in the catches of 1954—1955.

Inspection of the annual catch of different fish species in the N-hydrodrome, over the years from 1966 to 1973, reveals large variations (Table 2). It has to be mentioned that the number of fishermen per day, the number of fishing days per year, the types of fishing methods used, success or failure of *Carp* spawing, and the rate of stocking with mullet fry, were not constant throughout the whole period, and in consequent, variably affect both the fish yield and the species composition of the commercial catch.

Thus, moderate fishing intensity during 1966 resulted in the production of 28 tons, whereas intense labour attended in 1968 raised the fish yield to 114 tons. At the same time, the successful spawning of the common carp in 1968 contributed to the high fish production of the N-hydrodrome during that year. During 1969 & 1970 the common carp kept on nearly the same percentage of the total catch as in 1968, although its landing has sharply decreased from 47 tons in 1968 to 24 tons in each of the following two years. This decrease can be attributed to the raising of water level of the hydrodrome in 1969, a factor which is thought to have affected the spawning of the common carp, and consequently its production, causing its decrease in the subsequent years.

When the grey mullet production is concerned, the rate of stocking with mullet fry has to be taken into consideration. Thus the large amount of mullet produced in 1968 was the result of high rate of stocking during 1965 and 1966, when about five millions of mullet fry were transplanted in the hydrodrome. Also the high rate of stocking during 1968 and 1969 resulted in high mullet production in 1971.

As regards the annual production of *Lates niloticus*, it was more or less equal in all the years, except for a marked increase during 1968, and a marked decrease during 1971. The relatively high catch of *Eels* during 1969 and 1970 may be the result of intense fishing by effective fishing methods (hooks) during these years.

The annual catch of *Tilapia* has been progressively decreased, while that of *Bagrus bayad* and *Labeo niloticus* has been generally increased throughout the whole period. At the same time, the annual catch of *B. bynni* has been markedly decreased from 5472 kg (19.6%) and 3018 kg (5.6%) in 1966 & 1967 respectively, to 1714 kg (3.0%) in 1970, and even to 242 kg (0.5%) in 1973.

Table 2. Annual fish catch (kg. & %) of the Nozha hydrodrome in accrodance to fish species (percentage between brackets). *From* : Egyptian Yearbook of Fishery-Statistics - Coastguards, 1966—1973.

Fish species	1966	1967	1968	1969	1970	1971	1972	1973
Common carp	770	8299	47410	23661	23730	8238	1726	2354
	(2.8)	(15.4)	(41.8)	(40.5)	(41.3)	(11.7)	(4.1)	(4.4)
Grey mullet	4576	13296	32756	13472	12751	38158	18597	23130
	(16.4)	(24.5)	(28.9)	(23.1)	(22.2)	(54.0)	(43.7)	(42.8)
Lates niloticus	3618	5727	13056	3751	3465	883	3390	4465
	(16.5)	(10.6)	(11.5)	(6.4)	(6.0)	(1.2)	(8.0)	(8.4)
Anguilla sp.	419	1498	1459	780	2745	1810	753	605
	(1.5)	(2.8)	(1.3)	(4.8)	(4.8)	(2.5)	(a.8)	(1.1)
Tilapia sp.	10351	18699	12087	8175	5433	8098	2823	6170
	(37.1)	(34.6)	(10.6)	(14.0)	(9.4)	(11.5)	(6.6)	(11.4)
Bagrus bayad	368	1450	1770	3396	4528	3938	2374	3392
	(1.3)	(2.7)	(1.6)	(5.8)	(7.9)	(5.6)	(5.6)	(6.3)
Barbus bynni	5472	3018	2936	1487	1714	749	126	242
	(19.6)	(5.6)	(2.6)	(2.5)	(3·0)	(1.1)	(0.3)	(0.5)
Labeo niloticus	586	1026	1362	1518	2667	5205	4381	5635
	(2·1)	(1.9)	(1.2)	(2.6)	(4.6)	)7.4)	(10.3)	(10.4)
Other fish	775	1016	666	169	446	3553	8371	8104
	(2.8)	(1.9)	(0.6)	(0.3)	(0.8)	(5·0)	(19.7)	(15.0)
Total catch	27934	54036	113525	58421	57479	70631	42541	54097

* The cath of 1972 is for the period from July to December only.

LENGTH-FREQUENCY AND AGE-COMPOSITION OF B. BYNNII IN THE COMMERCIAL CATCH

During the period from September 1954 to March 1955 ,approximately 70% of *B. bynni* in the commercial catch of the Nozha-hydrodrome were large fish of 55—72 cm long, and 15 % were smalll fish within the size range 30—40 cm. (Elster, 1960). The corresponding percentages during the same months of 1968—1969 are 15.5 and 53%, respectively. The high percentage of large fish recorded during the first period was due to the accumulation of comparatively old fish, as no fishing was practically performed in the preceding years (Elster, 1960), while the extensive fishing in 1964—1965 caused the disappearance of such large fish in the second period. This can be proved from stydying the age composition of *B. bynni* in the last period which reveals that fishing during 1968 and 1969 was mainly operated on fish of age group I. On the whole all fish caught in 1969 are fish of year classes 1965, 1966, 1967 and 1968, i.e. the years following the overfishing period, and only one specimen (0.3 %) belongs to 1964 generation. Most of the old fish that belong to years preceding the overfishing period, were caught in 1968. They constitute 3.1% of the total catch, of which 2.6 % are 1964—year class and the remaining 0.5 % are fish of the year classes 1959—1962.

Comparing the annual size composition during the years following the overfishing period, we find a decreasing percentage of the small fish of 11—30 cm long, an increasing percentage for the moderately sized fish of 31—45 cm, and then the percentage of large fish decreases from 62.3 to 41.7 and 25.6 % during 1967, 1968 and 1969 respectively (Table 3 & Fig. 1). The data also show that the fish are highly represented over two size ranges which are between 16—30 and 46—55 cm in 1967, between 26—40 and 51—60 cm in 1968 and between 31—40 and 51—60 cm in 1969. The relatively less abundant fish of the size range 41—50 cm. is most probably due to selectivity of the different fishing methods used in the hydrodrome (Hashem, 1973). The same observation was also recorded during the commercial fishing of *B. bynni* in 1954—1955 (Elster, 1960).

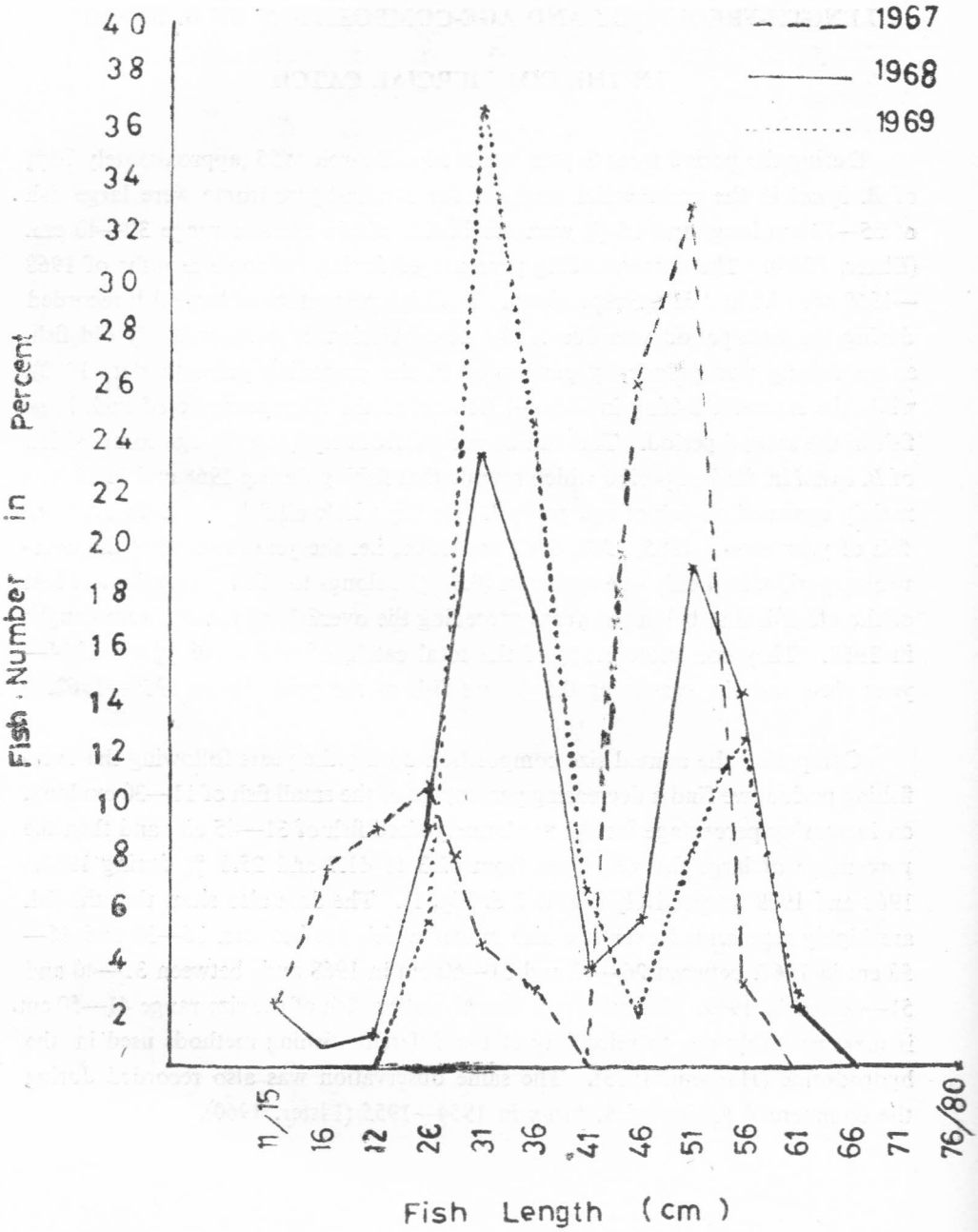

Fig. 1 : Annual size Composition of *B. bynni* in the catch of the Nozha hydrodrome, after the overfishing period.

Table 3. Annual size composition of *B. bynni* in the catches of the Nozha-hydrodrome during 1967—1970

Length group (cm.)	1967		1968		1969		1970	
	N	%	N	%	N	%	N	%
11/15	3	2.3	28	2.3	1	0.3	—	—
16	10	7.7	11	0.9	1	0.3	—	—
21	12	9.2	15	1.2	—	—	—	—
26	14	10.8	111	9.1	17	5.5	1	1.6
31	6	4.6	285	23.4	113	36.7	8	12.9
36	4	3.1	211	17.3	76	24.7	18	29.0
41	—	—	48	3.9	21	6.8	9	14.5
46	34	26.1	68	5.6	6	1.9	11	17.7
51	43	33.1	234	19.2	25	8.1	5	8.1
56	4	3.1	173	14.2	39	12.7	8	12.9
61	—	—	27	2.2	9	2.9	2	3.7
66	—	—	2	0.1	—	—	—	—
71	—	—	3	0.2	—	—	—	—
76/80	—	—	3	0.2	—	—	—	—
T.N.	130		1219		308		62	

REPRODUCTION

For the study of sexual maturation of a fish, it is more subjective to collect the data during the spawning season. However, in the present work, the collection was made all the year round. Therefore, it was possible to follow the various maturity stages according to different months and to study the monthly variations of the sex ratio (Table 4).

The *B. bynni* of the Nozha-hydrodrome is shown to have a long spawning season, which starts in April and ends in September. This is evident from the fact that ripe fish are obtained in April, May and June with maximum percentage in May, and the spent fish are found during the period from April through September with the maximum percentage in July. This confirms the finding of Latif

(1974) who stated that mature ovaries of *B. bynni* in Lake Nasser are distinguished in spring and summer. Also, it is worth mentioning that during plankton hauls in the Nozha-hydrodrome on 28 April 1968, the larvae of *B. bynni* (average total length of 16 mm) were caught. However, Elster (1960) has pointed out that in 1955 males of B. *bynni* with running milt were first observed in the Nozha-hydrodrome on 21st February and females with loose eggs on 3rd March while the first spent females was caught on 5th March.

Table 4. Monthly sex ratio, and percentage of matuirty stages for the combined sexes of *B. bynni* in the Nozha-hydrodrome during 1968—69.

Month	No. of fish	Sex ratio		Percentage of Naturity Stages				
		Male	Female	I+II	III	IV	R.	Sp.
April 1968	20	1.5	1.0	15.0	15.0	25.0	35.0	10.0
May	26	1.0	1.0	15.4			73.1	11.5
June	12	1.0	1.4	16.6			33.3	50.0
July	16	1.0	1,3	6.3				93.7
August	22	1.0	1.8	31.9	13.6			54.5
September	15	1.0	1.5	32.3	26.7	6.7		33.8
October	27	1.0	1.4	6.3	18.5	18.5		
November	29	1.0	1.4	51.6	20.7	27.6		
December	15	1.0	1.5	46.7	33.3	20.0		
January 1969	13	1.0	1.6	46.1	30.8	23.1		
February	25	1.0	1.1	44.0	20.0	36.0		
March	11	1.0	1.2	27.3	27.3	45.4		

As for the sex ratio of *B. bynni* in the Nozha-hydrodrome during 1968/1969, it is evident that the females have the advantage over males allover the year except in April and May, which may be correlated with the start of spawning. During the year, the overall ratio of males to females is (1.00 : 1.26).

When the size and age at first maturity are concerned, the collected data provide some variations among the two sexes (Table 5). The smallest mature male of *B. bynni* appears at the 47—48 cm length group, i.e, during its third year of life; whereas the smallest mature female appears at the 53—54 cm length group, i.e.

during the fourth year of life. This means that the females of *B. bynni* in the Nozha-hydrodrome attain their first maturity at a size and age greater than the males. Also, it was noticed that all males and females were found to be mature at lengths greater than 58 and 62 cm respectively.

Table 5. Number and percentage of the mature and immature fish at different length intervals.

Length	Males				Females			
interval	Immature		Mature		Immature		Mature	
(mm.)	No.	%	No.	%	No.	%	No.	%
400—449	3	100	—	—	8	100	—	—
450—	8	67	4	33	8	100	—	—
500—	10	41	20	59	11	61	7	39
550—	3	12	21	88	9	22	32	78
600—	—	—	1	100	1	5	18	95
650—699	—	—	—	—	—	—	2	100

Therefore, on the basis of attainment of sexual maturity, it would be recommended to protect the *B. bynni* of the Nozha-hydrodrome till their fourth year, after they have reached a total body of about 55 cm. This size limit is deemed desirble, since it is the size at which about 50 % of the fish have mature gonads.

FECUNDITY

For fecundity estimation, 15 ovaries of *B. bynni* in the ripe and nearly ripe stages were collected from the Nozha-hydrodrome during the prespawning period. The microscopic examination of the ripe ovary reveals the presence of more than one size group of ova. This introduces a difficulty in estimating fecundity because of the continuity of size of ova from the very small to the very large ones. How-

ever, the following three size groups of ova are differentiated in the ripe ovary of *B. bynni* ;

1) transparent small oocytes with a diameter less than 0.5 mm.. They are the reserve oocytes of stages I & II which are preserved to the next spawning season.

2) oocytes of a yellow-white colour of a diameter more than 0.5 mm. and less than 1.0 mm.. These are the reserve oocytes of stage III which are believed to be released in the same spawning season.

3) oocytes with a diameter more than 1.0 mm. of stages IV & V. They are more transparent and those of stage V are characterised by the presence of oil drops in the eggs.

The presence of more than one size group ova in the ripe ovary of *B. bynni* means that this species perform fractional spawning. This is in agreement with the observation of Latif (1974) that the large eggs in the mature ovaries of *B. bynni* in Lake Nasser are intermingled with milky small eggs indicating fractional spawning species.

In estimating fecundity the gravimetric method is followed, counting only the more developed oocytes of stages III, IV & V. The absolute fecundity, which is the number of mature eggs released by a female fish in the spawning season and the relative fecundity, which is the number of eggs per gram of fish weight, are considered in the present study.

In literature there is a lot of information on fecundity as a function related to length, weight, and age of different fish species, where it is shown that the fecundity increases with the increase of these parameters. This fact is in accordance with the present results (Table 6). Thus, for *B. bynni* ranging in length from 57 to 73cm. and in weight from 2330 to 5200 grams, the absolute and relative fecundities generally increase from 24 to 99 thousand eggs and from 9.6 to 32.7 eggs per gram of body weight respectively. However, the small number of the examined fish is responsible for the deviations from this increasing trend, as it was found that wide variations in fecundity exist for fishes of the same length, weight or age.

Table 6. Absolute and relative fecundity of *Barbus bynni* in the Nozha-hydrodrome during 1969.

Total length (cm.)	No.of fish examined	Av.body wt. (gm)	Av.wt. of ovary (gm)	No.of eggs per gram of ovary	absolute fecundity	Relative fecundity
57	1	2500	45	533	24000	9.6
58	4	2576	56	732	41000	15.9
59	2	2330	80	638	51000	21.9
60	1	3175	94	574	45000	17.0
61	2	2685	88	716	63000	23.5
62	1	2810	85	882	75000	26.7
63	2	3025	135	733	99000	32.7
65	1	3830	125	707	88000	23.0
73	1	5200	143	650	93000	17.9

DISCUSSION & RECOMMENDATION

The available data on the size composition of *B. bynni* in the catch of the Nozha-hydrodrome, during the last years indicate that more than 85 % of the fish taken in the commercial fishery are of the undersized fish, that have never spawned.

This , of course, resulted in the serious drop observed in the catch of *B. bynni* during the last years. So , beside the biological & ecological relationships, which prevail in the hydrodrome, the continuous stress of fishing on the stock of *B. bynni* since 1964, is the most affecting factor in this respect. Therefore, it would be recommended to protect the *B. bynni* of the Nozha-hydrodrome till their 4th year, after they have reached a total body length of about 55 cm. This size limit is deemed desirable, since it is the size at which about 50 % of the fish have mature gonads. Thus, in order to protect a continuous recruitment for the spawning stock of *B. bynni* in the Nozha-hydrodrome, a size limit of 55 cm T.L. must be established.

SUMMARY

All the materials used in this study were collected from the commercial catches of the Nozha hydrodrome during the periods (1969—1973). Partial draining accompanied by extensive fishing was carried out in the hydrodrome during 1964/1965. Annual transplantation of mullet in the hydrodrome has began since 1954. Moreover, in 1965 the common carp was introduced into the hydrodrome, where a successful spawning was happend in 1968. Also, it has to be mentioned that since 1969, the water level of the hydrodrome has been raized by about two meters more than normal.

The *B. bynni* in the Nozha-hydrodrome is now far less abundant than it was in the early years. Before the overfishing period (1964), the *B. bynni* comprized about 50 % of the total catch, while after the overfishing period its annual catch comprized about 3%of the commercial catch in 1968—1970, and even (0.5%) in 1973.

It was also found that in the early years the majority of *B. bynni* in the commercial catch was composed of large fish of more than 55 cm in total length. This was due to the accumulation of comparatively old fish, as no fishing was practically performed in the preceding years. In the last years and as a result of the extensive fishing operations carried out in 1964 , and the subsequent years, the majority of *B. bynni* has been composed of smaller fish of less than 55 cm T.L.

The study of sexual maturation of *B. bynni* in the Nozha-hydrodrome during 1968—1969, shows that this fish species has a long spawning period, which starts in April and ends in September. Sexual maturity is first attained during the 3rd year of life for the males and during the 4th year for the females. The smallest size of maturation is found to be 47 cm.T.L. for the males and 53 cm. T.L. for the females. The overll sex ratio throughout the year was found to be (1.0 : 1.2), with the advantage of females over males.

So, it has to be recommended that on the basis of sexual maturation, a size limit of 55 cm. is deemed desirable since it is the length at which 50 % of the fish have mature gonads. Thus, in order to protect a recruitment for the spawning stock of *B. bynni* in the Nozha hydrodrome, a size limit of 55 cm.T.L. must be established.

Also, microscopic examinetion of the ripe ovary of *B. bynni* revealed the presence of more than one size group of yolked ova. This means that this fish perform fractional spawning habit. The absolute and relative fecundity of *B. bynni* was found to increases with the increase of fish length and fish weight.

BIBLIOGRAPHY

Boulenger, G.A. (1907) : The fishes of the Nile. Publ. by Hugh Rees, Ltd., London.

Egyptian Year Book of Fishery Statistics (1966—1973) : Coastguards Fishery Department.

Elster, H.J. , Jensen, K.W. & Scientific Staff of Alexandria Institute of Hydrobiology (1960) : Limnology and Fishery Investigations of Nozha Hydrodrome near Alexandria, 1954—1956. Min. Agric. Egypt, Hydrobiol. Dept., Notes & Memoires No.45.

HASHEM, M.T.; Soliman, I.A. & Al-Sayes A.A. (1973) : Selecitivity of Gill and Trammel nets for *Cyprinus carpio* and *Barbus bynni* of the Nozha Hydrodrome. Bull. Inst. Ocean. & Fisheries, A.R.E., Vol.3.

Tatif, A.F.A. (1974) : Fisheries of Lake Nasser. Aswan Regional Planning, Lake Nasser Development Centre; A.R.E.