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MESH SELECTIVITY OF MONOFILAMENT NYLON TRAMMEL NET IN LAKE EDKU, EGYPT.

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ABSTRACT

Experimental fishing operations have been carried out in the Lake Edku during 1990 fishing with the aim of investigating the selection behaviour of the newly introduced monofilament trammel nets in the Northern Delta Lakes.

Nets with three different mesh sizes (i.e. 13.50, 15.20 and 18.00) were being used. Calculation of mean selection lengths of these meshes was carried out according to Baranov's and Holt's methods of calculation. The selection coefficient of monofilament nets for O. aureus does not significantly differ from the selection coefficient of these commonly used multifilament nets.

It is recommended that more attention of the fisheries authorities in Egypt must be paid to the problem of raising the present legal size of the commercial catch of tilapias from 10.0 cm to 15.0 cm. This may help in increasing the total fish production of the Northern Delta Lakes.

INTRODUCTION

Knowledge on the selectivity of fishing gear is one of the most important foundations for fishery resources management. The selectivity of gill nets have already been studied in various parts of the world (Baranov, 1948; Holts 1957; Olsen 1959; and McCombie and Fry, 1966). However, studies on the selectivity of trammel nets are relatively few.

Trammel net is considered as the most important fishing gear used to catch tilapia which constitutes more than 70 % of the fish populations in the Northern Delta Lakes of Egypt (Annon, 1988).

During the last few years monofilament nylon material has been introduced to replace the multifilament material for the manufacture of trammel nets in Egypt. This replacement requires an investigation on the selectivity of the introduced monofilament trammel nets. Since such replacement have occurred in Egypt in the last few years, it is essential in this study to answer the question raised by

many fisheries authorities in Egypt, asking whether the nets will catch tilapias with average lengths similar to those caught by the previously used multifilament trammel nets or less.

The present study shows the results of the experimental fishing carried out at Lake Edku, using experimental monofilament trammel nets with three different mesh sizes. Furthermore, it is aimed to determine the selection behaviour of such monofilament nets for tilapias in Lake Edku.

MATERIAL AND METHODS

The data analysed in the present investigation has been obtained from experimental fishing operations carried out by the authors in Lake Edku during 1990 fishing season. Three sets of experimental trammel nets with different mesh sizes were used throughout the course of investigation. Each set is composed from four net units. The design characteristics of such units are indicated in Table 1.

In order to avoid that the nets do not meet statistically reliable conditions, the positions of the nets were changed symmetrically at every fishing operation giving equal chances for net to catch fish. The fishing time was 12 hours at night time for every operation. The experimental fishing is carried out twice or 3 times weekly. The catch of each mesh for the different fish species as regards the number and weight was recorded separate. The total length of each fish was measured to the nearest millimeter and the weight was measured in grams.

Table (1)

Design characteristics of the experimental monofilament nylon trammel nets.

Specification	Trammel net		
	A	B	C
Mesh size of the innerlayer (cm)	4.69	5.12	6.13
Mesh size of the outer layer(cm)	13.50	15.20	18.00
Depth of net (cm)	90	90	90
Length of unit (m)	25	25	25
Number of units used	4	4	4
Twine diameter of inner layer (mm)	0.12	0.12	0.12
Twine diameter of outer layer (mm)	0.18	0.18	0.18
Hanging ratio of inner layer	0.505	0.455	0.418
Hanging ratio of outer layer	0.478	0.477	0.493

The species composition of the experimental catch of the three meshes used is being analysed in the present investigation. Numbers and weights of fish caught by each mesh were recorded to find out the most effective mesh be used for various fish species in Lake Edku. This analysis will help in suggesting any suitable mesh regulation for fishery management in this lake.

RESULTS AND DISCUSSION

Table (2) illustrated the numbers and weights and their percentages for different fish species caught by various meshes of monofilament nylon trammel nets from Lake Edku. Table (3) showed total numbers, weights and percentages of different fish species caught by various monofilament nylon trammel nets with different meshes from Lake Edku.

The results indicate that net (A) is highly efficient in fishing **Oreochromis aureus** and grey mullet. On the other hand, **Tilapia zillii** has been mainly caught by net (B), which was also very efficient in fishing **Morone labrax.** As for net (c), which has the widest experimental mesh used, it was found out that this net can be used efficiently to catch **Tilapia galilaea** and **Clarias lazera.**

It is a matter of fact that the common length ranges of various fish species comprising the fish populations in Lake Edku, as well as the selective action of the nets used have played an important role in determining the fishing efficiency of the different experimental nets being used throughout the course of investigation. This fact leads us to confirm that monofilament trammel nets are obviously selective by length when used for fishing in the Northern Delta Lakes of Egypt (Lake Edku).

The present results suggest that the highest catch by weight was collected by net (B) with an average 43.88 % of the total fish caught by the three nets (Table 3). If percentage in weight is considered, net (A) become the second with an average of 35.99 %, followed by net (c) with an average 20.13 % by weight of the total fish caught by the three nets. The low fishing efficiency of such net is undoubtly attributed the small average lengths of fish common in Lake Edku.

On the other hand, it is obvious that the experimental catch of net (A) had the highest percentage in number, this is due to the fact that, the average length and consequently the average weight of fish caught by net (A) was less than that caught by either nets (B) or (C).

Selective action of monofilament nets with different meshes:

Table (4) shows the length frequency distribution of various fish species caught by the experimental nylon trammel nets throughout the period of investigation.

Table (2)

Number and weights of different fish species caught by various meshes of monofilament nylon trammel nets from Lake Edku. (for mesh size refer to table 1).

	A		B		C		Total	
Species	No	wt (gm)	No	wt (gm)	No	wt (gm)	No	wt (gm)
O. aureus	360	12510	228	8085	50	3260	638	23855
	(56.43)	(52.44)	(35.74)	(33.89)	(7.84)	(13.67)	-	-
O. niloticus	12	680	10	625	5	590	27	1895
	(44.44)	(35.88)	(37.03)	(32.98)	(18.52)	(31.13)	-	-
T. zillii	20	570	61	2495	8	210	89	3275
	(22.47)	(17.40)	(68.54)	(76.18)	(8.99)	(6.41)	-	-
T. galilaea	3	115	10	585	50	3825	63	4525
	(4.76)	(2.54)	(15.87)	(12.93)	(79.37)	(84.53)	-	-
Morone labrax	49	3145	113	8100	-	-	162	11245
	(30.25)	(27.97)	(69.75)	(72.03)	-	-	-	-
Grey mullet	8	540	-	-	1	200	9	740
	(88.89)	(72.97)	-	-	(11.11)	(27.03)	-	-
Clarias lazera	1	150	5	1700	10	1820	16	3670
	(6.25)	(4.01)	(31.25)	(46.32)	(62.5)	(49.59)	-	-

Table (3)

Total numbers and weights of different fish species caught by various monofilament nylon trammel nets with different meshes from Lake Edku.

	A		B		C	
Species	No	wt (gm)	No	wt (gm)	No	wt (gm)
O. aureus	360 (79.47)	12510 (70.64)	228 (53.40)	8085 (37.45)	50 (40.32)	3260 (32.9)
O. niloticus	12 (2.65)	680 (3.84)	10 (2.34)	625 (2.89)	5 (4.03)	590 (5.96)
T. zillii	20 (4.42)	570 (3.22)	61 (14.29)	2495 (11.55)	8 (6.45)	210 (2.12)
T. galilaea	3 (0.7)	115 (0.65)	10 (2.34)	585 (2.71)	50 (40.32)	3825 (38.62)
Morone labrax	49 (10.82)	3145 (17.76)	113 (26.46)	8100 (37.52)	- -	- -
Grey mullet	8 (1.77)	540 (3.05)	- -	- -	1 (0.8)	200 (2.02)
Clarias lazera	1 (0.2)	150 (0.85)	5 (1.17)	1700 (7.87)	10 (8.06)	1820 (18.37)
Total	453	17710	427	21590	124	9905
Percentage	45.12	35.99	42.53	43.88	12.35	20.13

In can be observed from the data given in Table (4), that there is a positive proportionality between the mesh size oof the net and the average length of the fish caught in cases of **Morone labrax, O. aureus** and **T. galilaea.** In other cases, this proportionality was not clear, such as the cases of **O. niloticus, T. zillii** and **Clarias lazera.**

Hasen et al (1973), assumed that the inner layer of the trammel net acts mainly as a gill net in catching fish, while the outer layers catch fish by entangled them.

Table (4)

Length frequency distribution of various fish species caught by the experimental monofilament nylon trammel nets (for mesh size refer to table 1).

Length (cm)	Morone labrax		O. aureus			O. niloticus			T. zillii			T. galilaea			Clarias lazera			Grey mullet		
	A	B	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
10.5			1	2					1	10	5	1	1	1						
11.5			45	10		3	1		11	9	3									
12.5			180	83	1	2	6		7	17			1							
13.5			100	85	2	2	1		1	15				3				1		
14.5			29	31	4			1		8			3	7						
15.5		6	3	10	20		1	1		1		1	2	19						
16.5	5	7	2	4	14	1	1			1			2	14				1		
17.5	14	17		3	5			1						4				1		
18.5	20	28			2	1							1	1				2		
19.5	7	29			2	1								1				1		
20.5	1	15				1												1		
21.5	2	5						1												
22.5		4				1														
23.5		2																		
24.5																		1		
25.5																				1
Total No.	49	113	360	228	50	12	10	5	20	61	8	3	10	50	1	5	10	8	-	1
Total wt/gm	3.145	8.100	12510	8.85	3620	682	625	590	570	2495	210	115	585	3825	150	1700	1820	540	-	20
Av.L./cm	18.31	19.11	12.86	13.35	16.04	15.33	13.2	17.7	11.9	12.7	10.88	12.5	14.9	15.72	28.3	34.3	30.1	18.6	-	25
Av.wt(gm)	64.18	41.68	39.75	35.59	72.4	56.7	62.5	118	28.5	40.9	26.3	38.3	58.5	76.5	150	340	182	67.5	-	20

Therefore, the major catch is taken through gilling operations by the middle layer. Few fish of either smaller or bigger sizes are entangled while touching the outer layer of the net. Entanglement occurs usually by mouth or spines of fish fins.

The absence of a proportionality between the mesh size and fish length, in some cases, can be attributed to the double mechanism of trammel nets in catching fish, specially when the catch of the net is not large in number. In such cases one or two entangled fish with size away from the common range of fish gilled will affect the calculated average length of fish caught by a net with a certain mesh.

Selection factor or monofilament trammel net for O. aureus:

It is obvious from Table (4) that O. aureus is caught by the three nets with different meshes used in the experiment in sufficient numbers for selectivity calculations and analysis. The other fish species, however, were not caught in sufficient numbers. Therefore, calculation of selection factor will be adopted in the present work for O. aureus only. This fish species is considered as the main and most common between the fish populations in Lake Edku. For analysis of the data, two methods of calculation were followed. The first of which was described by Baranov (1948), whereas the second by Holt (1957). According to Baranov's method, it is assumed that the mesh size of a certain net is proportional to the modal length of fish caught in it. The proportionality factor (K) can be determined by plotting the length frequency graphs of the three meshes used in the experiment (i.e. A,B and C) as shown in Fig. (1). From these graphs the optimum length $_{m}l_{A}$ and $_{m}l_{B}$ of fish caught by the three meshes are calculated according to the formula :

$$\theta = Kl_m$$

where θ is the mesh size; l_m is the modal length; and K is the selection coefficient which is calculated from the formulae :

$$_{A}K_{B} = \frac{2\theta_A \, \theta_B}{L_o \, (\theta_A + \theta_B)}$$

where L_o is the optimum length of fish caught by A and B nets.

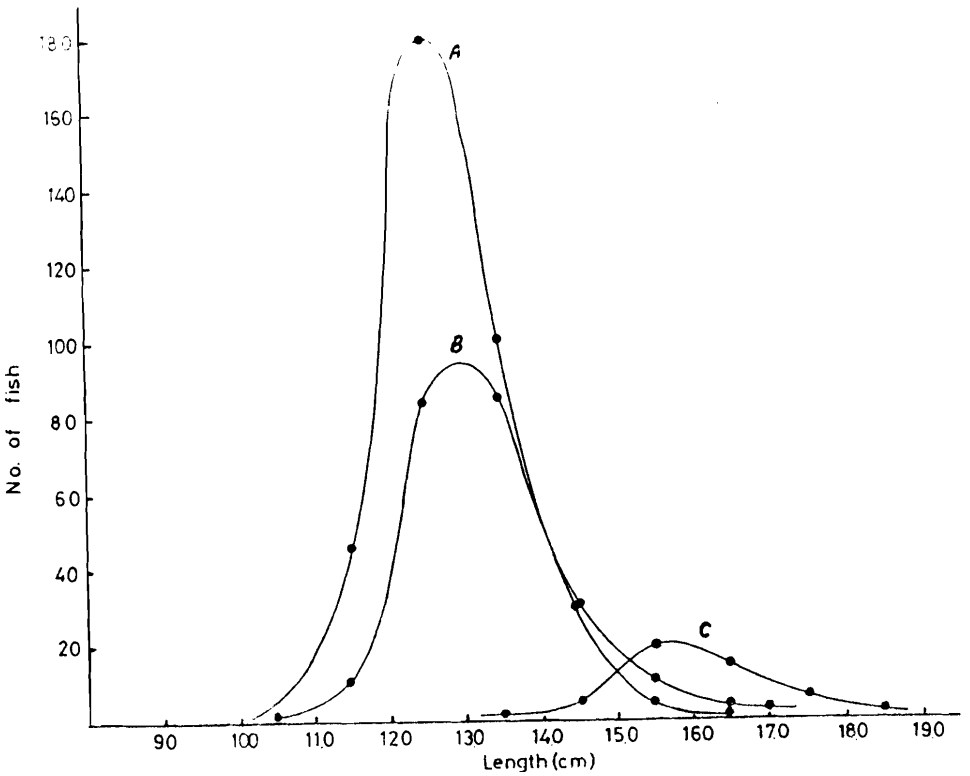
The values of selectivity coefficient (K) were therefore calculated for every two meshes used and are found to be :

$_{B}K_{A} = 0.3376$; $_{C}K_{B} = 0.3671$; $_{C}K_{A} = 0.3543$; and the arithmetic mean of (K) is 0.353.

Therefore, the selection lengths of the three meshes used will be : for mesh A = 13.29 cm; for mesh B = 14.50 cm; and for mesh C = 17.36 cm.

Fig. (1)

Length frequency curves of O. aureus caught by the various experimental meshes from Lake Edku.



According to Holts method of calculation, it is assumed that the fish growth is isometric. The length frequency distribution of a certain mesh is therefore expected to be normally distributed. Therefore, the plots of logarithm ratios of the catch caught by nets with two different mesh sizes, against length will show a straight line as given in Table (5) and represented by Fig. (2). The value of the selectivity coefficient (K) was calculated for each pair of nets according to the formulae:

$$ {}_{A}K_{B} = \frac{-2a}{b\ (M_A + M_B)} $$

where ${}_{A}K_{B}$ = selection coefficient; a = intercept; b= slope; M_A = mesh size of net (A); and M_B = mesh size of net (B).

According to Holt's method, it was found that the selection coefficient are: ${}_{A}K_{B}$ = 2.28286; ${}_{B}K_{C}$ = 2.7631; ${}_{A}K_{C}$ = 2.8168; and the arithmetic mean of K = 2.8028.

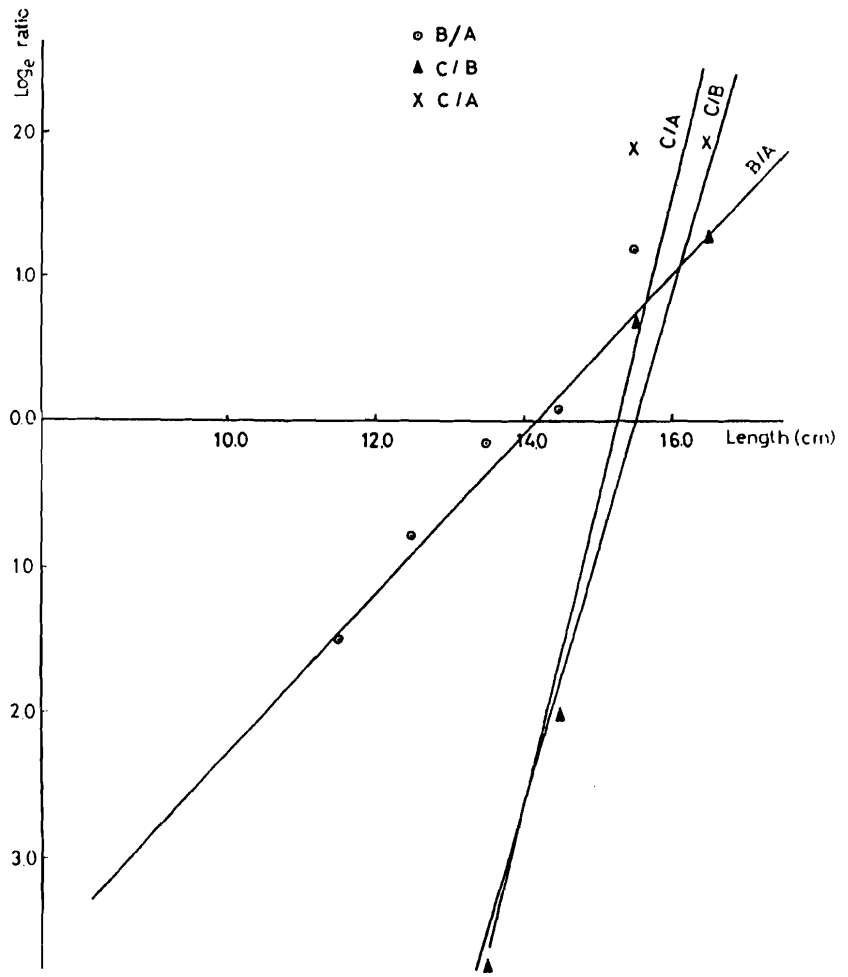
Table (5)

Length frequency distribution of (O. aureus) caught by the three experimental nylon trammel nets from Lake Edku (for mesh size refer to table 1).

Length	Frequency(No.of fish)						Loge ratio		
				B/A	C/B	C/A			
cm	A	B	C				B/A	C/B	e/A
8.5									
9.5									
10.5	1	2							
11.5	45	10		0.2222			-1.5041		
12.5	180	83	1	0.4611			-0.7741		
13.5	100	85	2	0.8500	0.0235	0.0200	-0.1625	-3.7508	-3.9120
14.5	29	31	4	1.0689	0.1290	0.1379	+0.0667	-2.0479	-1.9812
15.5	3	10	20	2.3333	2.0000	6.6667	+1.2039	+0.6931	+1.8971
16.5	2	4	14		3.5000	7.0000		+1.2528	+1.9459
17.5		3	5						
18.5			2						
19.5			2						
20.5									
21.5									

Fig. (2)

Straight lines expressing the relationship between log ratios and length of O. aureus using nets with different mesh sizes A,B and C (Refer to table 1).



According to Holt's method; $l_m = KM$ where l_m = selection length; and M = mesh size. Therefore, the following mean selection lengths of the three meshes used are :

A^{l}_{m} = 13.15 cm; B^{l}_{m} = 14.35 cm; and C^{l}_{m} = 17.18 cm. The normal curves of fish length distribution caught by different meshes are shown in Fig. 3. These curves are more or less sharply peaked and slightly skewed.

The above calculations indicate that the mean selection lengths for the three meshes used, do not vary much when either the method of Baranov or Holt is followed in the analysis of data. This suggest that any of the two methods is valid in the calculation of monofilament trammel net selectivity for **O. aureus** in Lake Edku.

It seems that the selection coefficients attained in the present work, i.e. 2.7631-2.8286 are very near to that mentioned by Ezzat et al (1979) in their work on trammel net selectivity for **O. niloticus** and **T. zillii** in Lake Borollus, used trammel nets manufactured from multifilament nylon twines. The inner layers of such nets were manufactured of twines T_d 210/2 while the outer layers were made from twines Td 210/3. They concluded that the selection coefficient of such nets was 2.534 for **O. niloticus** and 2.999 for **T. zillii**. Thus, it was suggested that there is no need for any further laws for the regulation of trammel net fishery, in case a partial or complete replacement of multifilament nets by monofilament one.

On the other hand, more attention of the fisheries authorities in Egypt must be paid to the problem of raising the legal size of tilapias in the Egyptian Northern Lakes. The fisheries management of such fish must be based on the criterion of gaining extra weight. This is due to the fact that tilapias are commercially caught with an average length ranging between 10.0 and 11.0 cm (El-Zarka et al, 1970). This size does not affect the breeding success of tilapias because these fish reach their first maturity and spawn at this size or even less. The fishery biology studies carried out on **O. niloticus** in the Egyptian Lakes indicate that the average weight of **O. niloticus** increase from about 15.0 gm to about 75.0 gm if the average length increases from 11.0 to 15.0 cm. Therefore, the commerical catch of tilapias may be expected to increase by more than four to five times if the legal size is shifted from 11.0 cm to 15.0 cm. It is a matter of fact that all the biological conditions prevailing in the Northern Delta Lakes such as primary production and food availability have to be taken into consideration if few management laws may be attempted in regard with the above discussed proposal which is based on the length-weight relatioship of Tilapias in the Egyptian Lakes.

SUMMARY AND CONCLUSIONS

Trammel net is considered as the most common fishing gear in the Egyptian Northern Delta Lakes. This net is highly efficient in catching most of the fish species comprising the fish populations in such lakes.

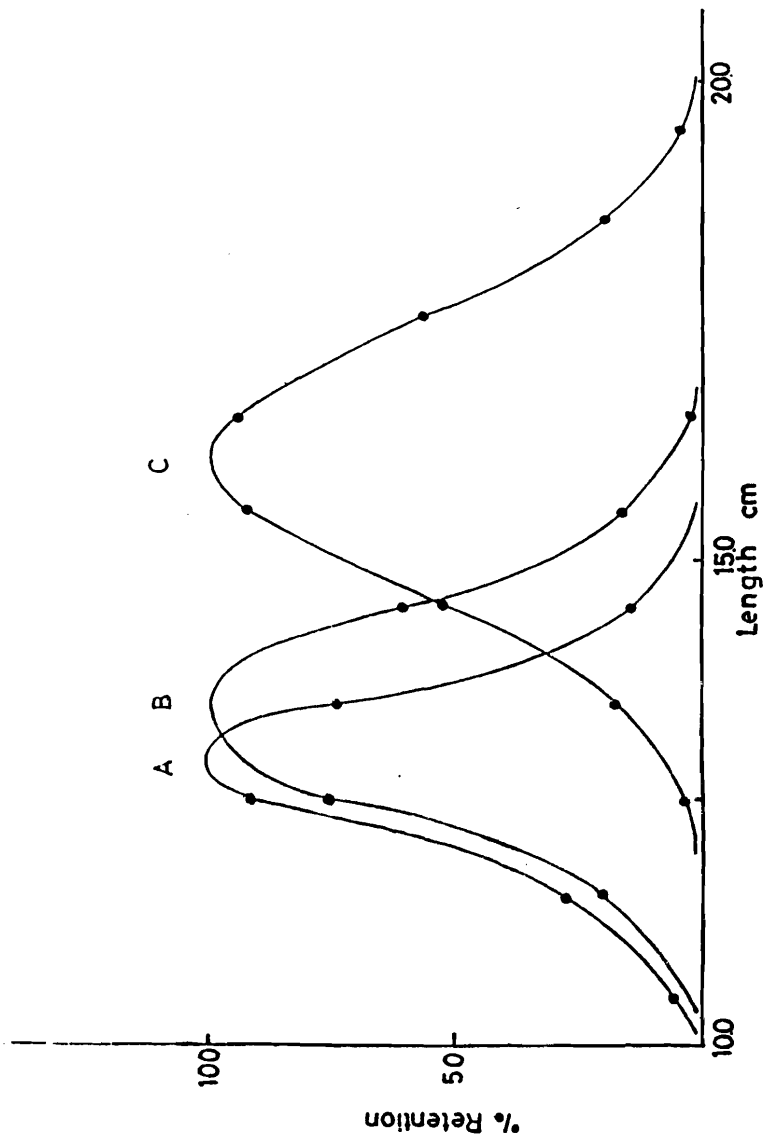


Fig. (3)

Normal selection curves O. aureus caught by nets with meshes A,B and C (Refer to table 1).

Experimental, monofilament nylon trammel net with different mesh sizes were used in fishing operations carried out in Lake Edku during the fishing season of 1990. Calculation of selectivity coefficient of such nets was followed by adopting both Baranov's and Holt's methods of calculation. It is concluded that the two methods are valid to calculated the selectivity coefficient of monofilament trammel net for **O. aureus** in Lake Edku.

Comparing the results obtained in the present work on monofilament net selectivity for **Tilapia** spp. with previous work carried out by various authors on multifilament net selectivity for the same fish. It was found that there is no significant difference between the selectivity coefficient of either mono-or multifilament nets especially for **O. aueus.**

Therefore, the management laws of tilapias fisheries in the Northern Delta Lakes of Egypt does not require further modifications due to any expected partial or complete replacement of multifilament trammel nets by monofilaments ones.

If any modifications may be required, the present average legal length of tilapias have to be taken into consideration, as it is considered to be commercially small. Such average length is suggested to be raised from 10.0 cm or nearly so to about 15.0 cm, to raise the average weight of fish caught from about 15.0 gm to nearly 75.0 gm. This will assess in increasing the total fish production from the Egyptian Northern Lakes. In such a case, more detailed investigations have to be carried out taking into account the food availability and the present primary productivity of our lakes.

REFERENCES

Anonymous, 1988. Egyptian Year-book of Fishery Statistics. Ministry of Scientific Research, Inst., Ocean., Fish. A.R. of Egypt.

Baranov, F.J., 1914. The capture of fish by gill nets. Mater pozmanyn Russ. Rybolovstva, 3 (16): 56-99. (In Russian).

El-Zarka, S.; A.H. Shaheen; and A.A. Aleem, 1970. Tilapia in Lake Mariut. Age and growth of **Tilapia nilotica** in Lake Mariut. Bull. of Inst. of Ocean. and Fish. Vol. I : 151-182.

Ezzt, A.; A.M. El-Maghraby; and A.A. Alsayes, 1979. Trammel net selectivity for **Tilapia nilotica** and **Tilapia zillii** in Lake Borollus. Investigation Pesquera. Vol. 43 (1): 245-260.