EJAR

Basket trap selectivity for tilapia fish at Lake Manzalah, Egypt

El-Azab El-Azab Badr El-Bokhty

National Institute of Oceanography and Fisheries, Alexandria, Egypt

Received 14th May 2009, Accepted 23rd June 2009

Abstract

To obtain a high and sustainable yield in the fisheries**,** the mesh size should be controlled to improve the selective properties of the fishing gear. The present investigation is aimed to evaluate mesh selection and selectivity of the nylon or filament basket traps for catching *Oreochromis niloticus* dominating Lake Manzalah by using a new method for its evaluation. The method of Pope *et al*., (1975) was used for the first time in Egypt in this concern and compared with that of Holt (1957). It was found that the Pope *et al*.,'s model reflects the usual logistic curve while Holt's method reflects a similar reversed normal ogive indicating that the first method could be used to evaluate the selective properties of basket traps. It is recommended also to carry out more experimental studies to ensure the model and to correct the probability of retention in relation with the mesh size.

Keywords: Tilapia, Selectivity, Basket Trap, Lake Manzala, Egypt.

1. Introduction

Inland capture fisheries are complex in nature involving a wide variety of activities undertaken by people from the widest spectrum of socio-economic backgrounds. Freshwater fish represent an essential and often irreplaceable source of high quality, and cheap animal protein crucial to the balance of diets in marginally food secure communities.

Lake Manzalah is the largest natural resource of the Egyptian northern lakes and is recognized as an important fishing area. In the past, fishing gear research was primarily concerned with increasing catches, but now on the emphasis is on better management and ensuring sustainable yields. Problems such as excessive discarding and the by-catch of unwanted fish are being addressed through the development of gears with improved selectivity. (MacLennan, 2003)

Lake Manzalah represents by far the largest single fish production source in Egypt, accounting for about 38 % of the catch of northern Nile Delta Lakes and about 10.96 % of natural fishery resources (GAFRD, 2006). Significant opportunities for further expansion could make the contribution of Lake Manzalah to national animal protein even greater through studying and developing the different fishing gears used in the lake in order to maximize the production of the lake and better use of that resource.

Basket trap (Figure 1) is one of the most common fishing gears not only in Lake Manzalah but also in the other northern Delta Lakes of Egypt. Therefore it is of outmost importance to study the selectivity of these basket traps for *Tilapia* fish species which constitute more than 43 % of total fish caught from Lake Manzalah (GAFRD, 2006).

Selectivity may be defined as differences in the probability of fish of different sizes to be retained by the gear once they have encountered it (Pope *et al.,* 1975). Trap selectivity is complicated as it relies on different factors. Among these factors is the size of the entrance opening, the soak time, the activity of fish as well as the species composition on the ground where the trap is placed which may also influence the selectivity. Trap catches depend on the duration of the soak and there is always a chance that a trapped fish finds the entrance opening and leaves through it. (Munro, 1974). Studies on trap mesh selectivity show that mesh size is a determinant of catch rates and the size at which fish recruit to fish traps. Mesh size also affects the species composition in fish traps, probably through size selectivity. (R. Mahon & W. Hunte, 2001). Thus trap selectivity may not only be a function of the mesh size used in the trap. But when considering the average of a large number of trap catches, some of the above mentioned complications may disappear around the selection curve. (P. Sparre & Venema, 1993). There are two basic models of selectivity. In the first typified by trawl gear, selectivity increases with fish size to a maximum of 1 and remains there for all larger fish. In the second, typified gill nets, selectivity increases with fish size to a maximum of 1 and then decreases with increasing fish size. The former model of selectivity is generally used for fish traps. (R. Mahon & W. Hunte, 2001). Although trap entrance size will impose an upper limit on the size of fish that can be caught in a trap. Also Pope *et al*., (1975) suggested the trawl type of selection for traps arguing that traps behave like cod ends in retaining fish. It was supposed that the probability to retain of the net increases in function of the fish size, the selection ogive, which is generally expressed by the logistic curve would be achieved.

Few local authors had studied the wire basket traps (e.g. El-Zarka *et al*., 1970 and Al-Sayes, 1984) and nylon or filament ones (El-Bokhty, 2004). They relied mainly in their studies on the gill net type methods, Baranov's method (1914) and Holt's one (1957) to study the selectivity of the traps. The present study is an attempt to investigate the basket trap selectivity through using the logistic curve as proposed by Pope *et al*., (1975) and comparing it with Holt's method (1957).

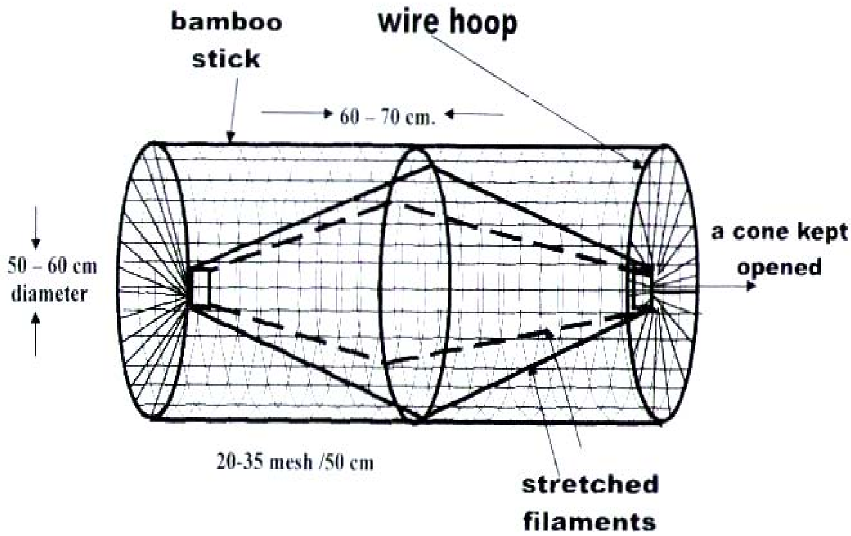

Figure 1: Detailed sketch of a filament basket trap used in Lake Manzalah

2. Materials and methods

The traps used in Lake Manzalah are of monofilament nylon nets tied with three iron hoops which are fastened by bamboo sticks as shown in figure (1). To study the mesh selection, and selectivity of the nylon basket traps in Lake Manzalah, comparative fishing experiments were carried out in the lake during Sept. 2007, using two sets (each of 10 traps) of different meshes of basket traps but with similar mouth openings. These traps A, and B were of mesh bars (mesh bar is the direct distance between two successive knots) 1.65 and 2.25-cm respectively. The traps were set among the aquatic vegetation in the lake. The catch from each group was taken daily at early morning. The fish was measured to the nearest centimeter and weighed to the nearest gram after being sorted into the different species.

2.1. Methods of selectivity calculations

2.1.1. Pope et al.,'s method (1975)

According to Pope *et al.*'s (1975) method, it was suggested that the traps' selectivity could be estimated as that of the trawl nets. Therefore, comparison between the small meshed basket trap (A) and the larger one (B) like those between the cod end and the cover of the trawl nets. The fraction retained by net (B) is plotted against the mid-length of the corresponding length group. A sigmoid curve is obtained which reaches 1.0 (i.e. 100 % retention) at a certain length. This curve is called the gear selection ogive. Points of the curve are calculated from the relation;

$$S_L = 1 / [1 + \exp(S_1 - S_2 * L)]$$

Where, L is the mid-length, S_1 and S_2 are constants. (Paloheimo and Cadima, 1964; Kimura, 1977, and Hoidal *et al*., 1982). The formulas for calculating $L_{25}\%$, $L_{50}\%$ and $L_{75}\%$ are;

$$L_{25}\% = (S_1 - \ln 3)/ S_2,\ L_{50}\% = S_1/S_2 \text{ and } L_{75}\% = (S_1 + \ln 3)/ S_2$$

The selection factor was determined from the relation

$$L_{50}\% = SF * (\text{mesh size})$$

The values of the parameters as shown in Table 1 were used for the estimation of probabilities of capture for *O. niloticus* for the trap "B". The selection curve for the trap "B" was obtained by plotting the probabilities of capture against the interval mid-points. Such trawl gear model was used for traps according to R. Mahon & W. Hunte, 2001.

2.1.2. Holt's method (1957)

This method is based on the assumption that, for two units of net A and B (with mesh sizes slightly different), the shape of their selection curves would be the same and the mean selection lengths would also be proportional to the mesh size. Also, according to this method it is assumed that the selection curve of each mesh size would be normally distributed as the fish isometrically grows. Therefore the logarithms of the ratios of the catch for the successive length groups (for the two units of gears compared) will have a linear relationship.

The selection coefficient (K) is calculated for each two units according to the equation given by Holt as:
$K = - 2a / b (m_a + m_b)$
Where, a and b are coefficients of the equation Ln ratio = a + b*L describing the line of best fit for Ln ratios; m_a & m_b are the mesh sizes of the two gear units compared for the calculation of (K).

The mean selection lengths corresponding to each mesh size were calculated according to the formula:
Mean selection length = Mean selectivity coefficient x mesh size.

3. Results and discussion

3.1. Length structure

The length distribution of fish caught by the two different meshed basket traps is shown at Table 1 and Figure 2. The length structure (as approximated to the normal curves) of *O. niloticus* varied between 7 and 15.9-cm with an average length of 10.92 (± 1.55-cm) for trap A. While the size structure corresponding to trap B varied between 9 and 20.9-cm with an average length of 12.67 ± 2.78-cm). It's evident from the length frequency distribution of *O. niloticus* caught by each mesh has been found to be nearly uni-modal with an increasing average length (as well as the modal length) corresponding to the increase of the mesh size of the trap.

3.2. Selectivity estimation

The catch size distribution is sometimes assumed to directly present the selection curve, ignoring the stock size distribution. Hamely (1975) briefly discussed this case and noted that the result is a rough proxy. Also, Baranov (1948) suggested a simple rule of thumb that fish smaller or larger than 20% of the optimal selection size would only occur rarely in the catches.

3.3. Pope *et al*., (1975) method

The calculated selectivity estimate as proposed by Pope *et al*., (1975) was also endured in Table 1 and Figure 3. The selection range of trap A ($L_{25} – L_{75}$) lies between 8.61 cm and 10.39 cm in respective and L_{50} was 9.41 cm, while the selection range of the trap B ($L_{25} – L_{75}$) lies between 10.85 and 13.87-cm respectively which means that 50% of the catch of that net lies between these two values, while L_{50} was at 12.36-cm which nearly equals to the average length value (12.67 ± 2.78 cm). The selection factor calculated according to this method was 5.49. The main selection length as deduced from this factor will be 12.35 cm which coincides with the L_{50} value. The estimated selection ogive as presented in Figure 3 is a sigmoid curve type from which the selection parameters could be easily obtained.

3.4. Holt's method (1957)

According to this method and as apparent from Table (2) and Figure (4), the plots of Ln ratio (B/A) don't deviate so much from linearity, thus the number of observations is sufficient to calculate the selection coefficient (K) corresponding to the pair of nets used. Such observations were recorded by Al-Sayes (1984). The calculated selection coefficient for Ln ratio (B/A) was 6.326 and the selection lengths for net (A) was 10.44 cm and that for net (B) was 14.23 cm.

Therefore the selection length is increased with the increase of the mesh size. Hence increasing the trap mesh selection sizes for *O. niloticus* may ultimately result in increased yields for this species and lack of (at least) the illegal fish lengths.

Although the Holt's method of calculation seems to be easier in comparing between two nets or more, however there are many unknown factors concerning the way traps work and may be possible that one trap type fished more efficiently than another resulting in infer selection between them when compared together.

Although the selection factor calculated by Pop's method differs from that calculated by Holt's one but it reflects the same logistic curve (Figure 5). Therefore it was suggested to avoid the traditional relationship between the selection factor and mesh size (L_{50} = SF x (mesh size)), which is used in Holt's method, according to Fiorentino & Ragonese (2000). Therefore, it's recommended to carry out more experimental studies using more than two gears in order to ensure the model for the other tilapia species and to correct the probability of pretension.

suggestions. My grateful thanks to Prof. Altaf Ezzat, Ocean., Dept., Fac., Sci., Alex. Univ. for her comments.

Table 1: Estimation of trap selection ogive for Oreochromis niloticus, Lake Manzala according to Pop et al,'s method.

Mid Length	Trap B (2.25cm)	Trap A (1.65cm)	Total No.	SL(fraction)	Ln (1/SL -1)	SL est.
7.5	0	1	1	0		
8.5	0	6	6	0		
9.5	2	25	27	0.07	2.587	0.111
10.5	10	31	41	0.24	1.153	0.205
11.5	18	18	36	0.50	0	0.348
12.5	13	15	28	0.46	0.16	0.526
13.5	17	5	22	0.77	-1.208	0.697
14.5	12	4	16	0.75	-1.099	0.827
15.5	10	1	11	0.91	-2.314	0.908
16.5	7	0	7	1		0.953
17.5	5	0	5	1		0.977
18.5	4	0	4	1		0.989
19.5	3	0	3	1		0.995
20.5	1	0	1	1		0.997
Av. L. (cm)	12.67	10.92				
± S.D.	2.78	1.55				

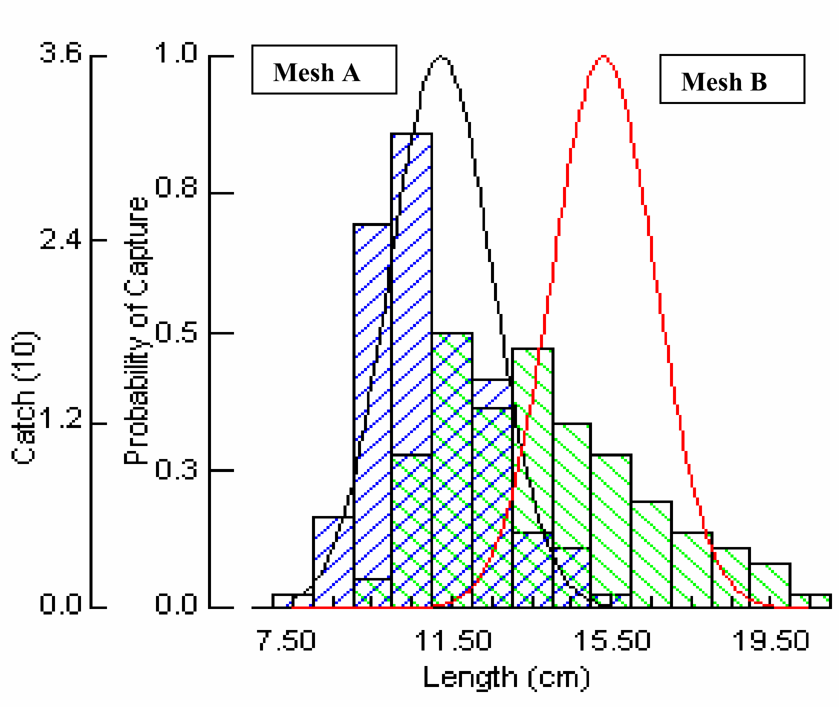

Figure 2: The approximated length distribution of *Oreochromis niloticus* caught by two different meshed basket traps, Lake Manzala.

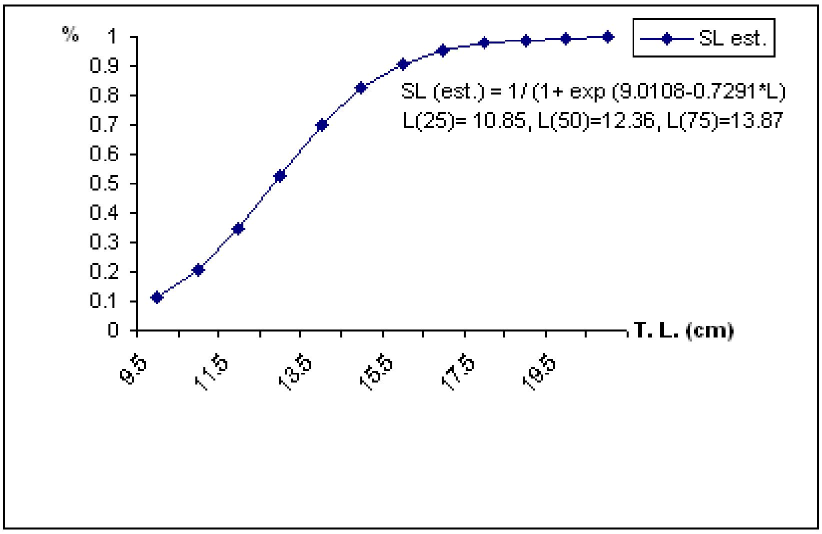

Figure 3: Estimated selection ogive for *O. niloticus* caught by basket trap B, Lake Manzala.

Table 2: The selection factor and selection length of O. niloticus caught by two different basket traps, calculated according to Holt's Method.

Mid Total Length (cm)	Trap B (2.25 cm)	Trap A (1.65cm)	Ln (B/A)	Function equation	Selection Factor	Selection Length (cm)	
7.5	0	1		Y = 0.7203 X - 8.8861	6.326	S. L. (for net A) = 10.44 cm	S. L. (for net B) = 14.23 cm
8.5	0	6					
9.5	2	25	-2.526				
10.5	10	31	-1.131				
11.5	18	18	0				
12.5	13	15	-0.143				
13.5	17	5	1.224				
14.5	12	4	1.0986				
15.5	10	1	2.3026				
16.5	7	0					
17.5	5	0					
18.5	4	0					
19.5	3	0					
20.5	1	0					

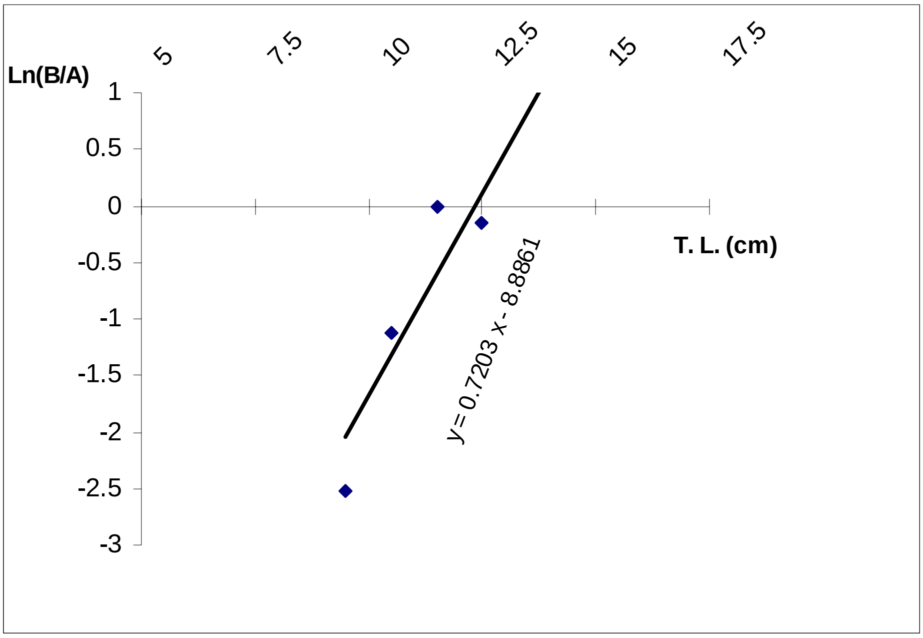

Figure 4: Straight line showing the calculated relationship between Ln ratios and mid total length of *O. niloticus*. (according to Holt's method)

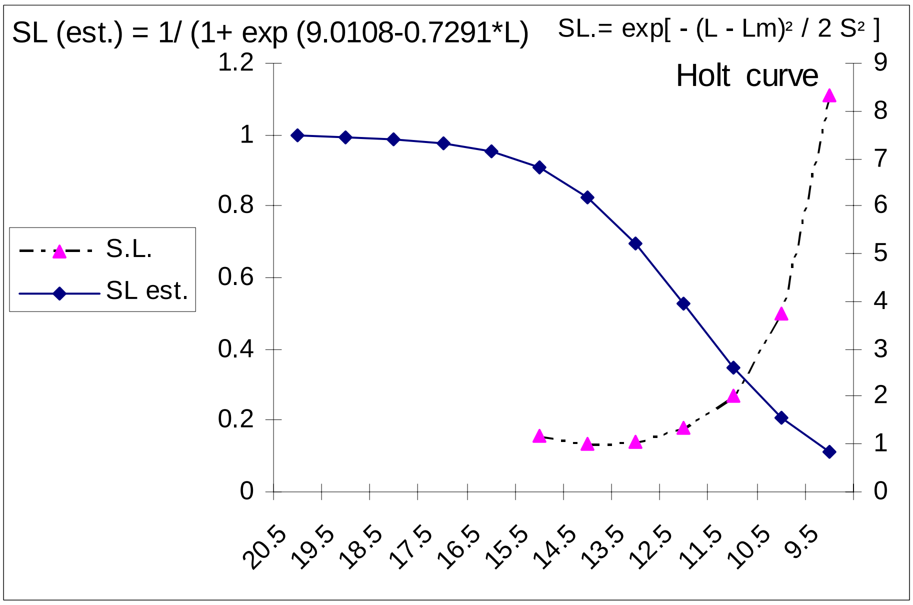

Figure 5: Estimated selectivity curves according to Holt's method (S.L.) and Pope *et al.*'s method (SL est.) for *O. niloticus*.

Acknowledgment

I'm very indebted to Prof. Dr. Abdou A. Al-Sayes, Prof. of Fishing Gears and Methods, N.I.O.F., for his critical review of the manuscript and useful

References

Al-Sayes, A. A.: 1984, Selectivity coefficient of wire basket traps for *Tilapia nilotica*. *Qatar Univeristy, Science Bulletin*, 4: 171-184.

Baranov, F. I.: 1914, The capture of fish by gill nets. Master Poznaniyu Russ. Rybolovstva, 3(16): 56-99. (partially trans. From Russian by W. E. Richer).

Baranov, F. I.: 1948, Theory and assessment of gill net gear. Chapter 7. theory of fishing with gill nets. Pishchepromizdat, Moscow. (Translated from Russian by the Ontario Department of Lands and Forests. Maple, Ont.).

El-Bokhty, E. E. B.: 2004, Biological and Economical Studies on Some Fishing Methods Used in Lake Manzalah. Ph. D. Thesis, Faculty of Science, Tanta Univeristy, 264 p.

El-Zarka S.; Koura, R. and Shaheen, A. H.: 1970, Selectivity of wire basket traps for *Tilapia* (T. *nilotica* , *T. galilaea* , and *T. zilii*). *Journal International pour l'Exploration de la Mer*, 33 (2): 282-291.

Fiorentino F., and Ragonese, S.: 2000, Trawl selectivity in main target species of Mediterranean on the basis of experience reported in literature. Scientific Advisory Committee–GFCM meeting, Sub-Committee on Stock Assessment, Madrid, Spain, 26-28 April, 2000.

GAFRD: 2006, The General Authority of Fish Resource Development, Year–Book of Fishery Statistics, Cairo, Egypt.

Hamely, J. M.: 1975, Review of gill net selectivity. *J. Journal of the Fisheries Research Board of Canada*, 32: 1943-1969.

Holt, S. J.: 1957, A method of determining gear selectivity and its application. Paper No. 515 Sci. meeting ICNAF/ICES/FAO. Lisbon.

Hoydal, K., Rørvik, C.J. and Sparre, P.: 1982, Estimation of effective mesh sizes and their utilization in assessment. *Dana*, 2:69-95

Kimura, D.K.: 1977, Logistic model for estimating selection ogives from catches of codends whose ogives overlap. *Journal du Conseil CIEM*, 38(1): 116-119

MacLennan, D. N.: 2003, Technology in Capture Fisheries. Koyoto Coference Outcome and Papers Presented.
(c.f.internet.www/fao.org/fi/agreem/Koyoto/H6F.asp#)

Munro, J.L.: 1974, The mode of operation of Antillean fish traps and the relationships between ingress, escapement, catch and soak. *Journal du Conseil CIEM*, 35(3):337-350

Paloheimo, J.E. and Cadima, E.: 1964, On statistics of mesh selection. ICNAF Serial No. 1394/Doc. No. 98

Pope, J.A., Margetts A.R., Hamley, J.M. and Akyüz, E.F.: 1975, Manual of methods for fish stock assessment. Pt3. Selectivity of fishing gear. *FAO Fisheries Technical Paper*, 41(Rev.1): 65 p.

Robin Mahon & Wayne Hunte: 2001, Trap mesh selectivity and the management of reef fishes. *Fish and Fisheries*, 2: 356-375

Shawky, K. A.: 1999, Experimental studies on the factors affecting the efficiency and selectivity of trammel nets in Lake Manzalah. Ph. D. Thesis, Zoology Dept., Facutly of Science, Zagazig University, 217 p.

Sparre, P. and Venema, S. C.: 1993, Introduction to tropical fish stock assessment. Part- 1, *FAO Fisheries Technical Paper*, 30611, 376p.

اختيارية الكمائن (الجوابي) لأسماك البلطي في بحيرة المنزلة – مصر

العزب العزب بدر البُختى

المعهد القومي لعلوم البحار والمصايد – الإسكندرية

للحصول على إنتاجية متوازنة للمصايد ينبغي التحكم في سعة الشباك المستخدمة وذلك لتحسين خاصية الاختيارية لشباك الصيد. البحث الحالي يهدف لتقييم اختيارية شباك الجوابي للبلطي النيلي السائد في بحيرة المنزلة باستخدام طريقة Pope *et al*., (1975) ومقارنتها بطريقة Holt (1957). وقد وجد أن النموذج الأول يظهر ويبين المنحنى الطبيعي بينما النموذج الثاني يبين نفس المنحنى الطبيعي لكن منعكسا وهذا يدل على أن النموذج الأول يمكن استخدامه لتقييم الخصائص الاختيارية لشباك الجوابى. كما يوصى أيضا بإجراء مزيد من الدراسات التجريبية لتقييم النموذج للأنواع الأخرى ولتصحيح احتمالية الصيد (المنع) بالنسبة للعين.