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POSSIBILITY OF GRADING FISH BY NATURAL METHOD

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ABSTRACT

Grading fish into groups of similar individual sizes is a common management practice in fish farming. Grading has several advantages: reducing fish losses through cannibalism, improving supplementary feeding efficiency through adequate food ration, increasing the accuracy of stock estimates for monitoring, reducing the proportion of small fish at harvest of fattening ponds and increasing production, for example by increasing the proportion of faster growing males in tilapia ponds. The aim can be achieved by the some objectives (easing of harvesting fish, decreasing of harvesting time fish and decreasing of harvesting costs). All experiments were carried out at different combinations of water speed (0.6, 0.8 and 1.0 m/s), grading sieve depth (50, 70 and 90 cm) and grading sieve holes area (12, 20 and 28 cm2). In each experiment, a test was carried out in Manzala Lake to determine the dead fish ratio, grading efficiency and fuel consumption rate. The experimental results revealed the following:

1-Increasing water speed decreased grading efficiency and increased both dead fish ratio and fuel consumption rate.
2-Increasing grading sieve depth decreased dead fish ratio and increased both grading efficiency and fuel consumption rate.
3-Increasing grading sieve holes area decreased dead fish ratio and increased both grading efficiency and fuel consumption rate.

INTRODUCTION

Fish is one of the most important sources of protein food. This is characterized by many health benefits that make it first major food for people eat. Fish is also characterized by the short life cycle to reach commercial size and weight. Because fish production in Egypt resulting from lakes and sources of fresh water, which is estimated at about 387 thousand tons does not meet domestic consumption, which leads to import about 220 thousand tons/year .So tended to encourage state aquaculture, producing about 668 thousand tons/year (Central Agency for Public Mobilization and Statistics, 2011). Fish harvesting is an absolute prerequisite for efficient industrial fish processing. Actual catch often contains fish of different sizes and species. Harvesting by size and separation of species ensures uniform flow for next processes thus increasing capacity and quality. Lewis (1976) showed that the pond screen in common use is the perforated plate aluminum screen. Some of these are mounted on 1¼ inch OD x .125 inch T aluminum tube frame with 3/16 inch blind rivets at 4 inch centers. Others are mounted on redwood frames. Some hatchery men feel it is easier to make the redwood frames fish tight than the metal frames due to irregularities in the concrete. Aluminum plates with many sizes of holes and oblong slots are used varying from 1/16 inch holes to a ½ inch x 1½ inch staggered slots and a rack with vertical bars used with brood fish with 1 inch spacings between the bars. Frank *et al* (1982) fund that standard sieves in graded series from 25 mm through 1 mm mesh; 3) description of the bottom type over which each seine-haul was made for fishes as silt, silt-sand, sand, etc.; and description of the bottom type on which each sample of benthic invertebrates was taken, in a manner similar to that for seine-haul Dowidar and Abdel-Moati (1983) show that the Lake is shallow, with an average depth of about 1.25m. The water level of the lake is often subjected to variations, which may expose or cover extensive areas along its shore. The lake bottom is covered with sandy-silt and silty-clay with an accumulation of cardium shells. Lake Manzala is productive in fish, 90% Tilapia spp. Carbs. Shrimps are also fished from this lake. Fischer and Eckmann (1997) show that the area shallower than 40 cm water depth was separated from the deeper parts of the mesocosm by a 4 mm knot-to-knot mesh curtain, which confined fish to the shallows while allowing a free exchange of water. Earlier studies have shown that many littoral dwelling fish in Lake Constance, among them juvenile cyprinids, significantly prefer the uppermost littoral area (< 40 cm water depth). Bohdan *et al* (2004) resulted that the examined length frequency of pikeperch and bream retained in fyke-nets covered with 6 mm mesh size netting provided the materials for assessing the number of fish that entered the net and managed to escape from it through the sieves. This paper presents the analysis of results obtained with three sieves of various hole sizes (18×30, 22×36, 20×65 mm) and fund that the Ninety-four specimens of Hirudinea belonging to 13 species were found in Lake Wigry. Specimens of all species were found at depths of up to 2 m. This is confirmation of the tendency of leech occurrence described by Rzóska (1935) and Pawłowski (1936). Guy *et al* (2006) studied that using a Brett-type swim-tunnel respirometer the relationship between oxygen consumption and swimming speed was determined in fish acclimatised to 7, 11, 14, 18, 22, 26 and 30°C. The corresponding maximum swimming speed (U_{max}), optimal swimming speed (U_{opt}), active (AMR) and standard (SMR) metabolic rates as well as aerobic metabolic scope (MS) were calculated. Using simple mathematical functions, these parameters were modelled as a function of water temperature and swimming speed. Both SMR and AMR were positively related to water temperature up to 24°C. Above 24°C SMR and AMR levelled off and MS tended to decrease. We found a tight relationship between AMR and U_{max} and observed that raising the temperature increased AMR and increased swimming ability. However, although fish swam faster at high temperature, the net cost of transport (COT_{net}) at a given speed was not influence by the elevation of the water temperature. Although U_{opt} doubled between 7°C and 30°C (from 0.3 to 0.6 m s^{-1}), metabolic rate at U_{opt} represented a relatively constant fraction of the animal active metabolic rate (40-45%). Hofmann (2007) resulted that the maximum current velocity was 0.20 – 0.25 m s-1 in the lower part of the fish compartment at a water depth of 0.4 m and 0.30 – 0.40 m s-1 at a water depth of 0.2 m. These values were comparable to those occurring at the Littoral Garden, where maximum current velocities of around 0.3 m s-1 and 0.4 m s-1 are typical in water depths of 0.4 m and 0.2 m, respectively. Kazutaka Yanase *et al* (2007) found that the water temperature significantly

(*P* < 0.01) affected mean contraction times for all fish tested, but fish length did not affect contraction time (*P* = 0.49). The mean pooled contraction times at each water temperature were 30.2 ms at 10 °C, 22.5 ms at 15 °C and 20.0 ms at 20 °C. For all size groups, the temperature effect on the muscle activity made tail beat frequency greater from 16.6 Hz at 10 °C to 25.0 Hz at 20 °C on average. We then used this data to calculate the maximum tail beat frequency and swimming speed of each group of fish at each water temperature. All estimated maximum swimming speeds were in excess of the typical trawl towing speed of 1.5 m s^{-1}, and the implications of these results for seasonally varied towing strategies are discussed. András *et al* (2011) fund that the optimal velocity of water is 2–3 cm/sec (1.2–1.8 m/min) for smaller fish and 4–10 cm/sec (2.4–6 m/min.) for larger ones. However, the actual speed of water per second should not be faster than from one-half to three-quarters of the length of the reared fish. The main objective of the present study is to grading fish by natural method (water) and achieving the following: Harvesting fish in short time, decreasing cost of grading fish and decreasing dead fish ratio.

MATERIALS AND METHODS

The experiments were carried out at el-Manzala Lake - El-Gamalia region, Dakhlia Governorate.

Specifications of the experimental box:

Experimental box dimensions of (160 x 50 x 100 cm) consists of two parts(A, B) separated by a grading sieve(H), with dimensions of (50 x 100 cm), consisting of a one area holes for each grading sieve and the work of these holes, commensurate with the physical properties of the fish as well as the sizes required for marketing. The first part(A) which dimensions (70 x 50 x 100 cm) are fed the fish to be graded or sorted and then run the pump so as to move the water at a certain speed Vtthrk Fish reverse the movement of water Fishes least volume of constituent holes area to grading sieve carried out the holes and move to the second part(B) of the experimental box which dimensions (90 x 50 x 100 cm) and the remaining fish most larger holes area in the first part of the experimental box as shown in fig(1).

Fig (1): The three projections of the experimental box

Specifications of the grading sieve:

Sieves are considered of the most important means for the success of the grading process. There are three types of sieves in terms of holes consisting of sieves first grading sieve holes area of 12 cm 2 (2x 6 cm2), the second holes area of 20 cm 2 (2.5x 8 cm2) and the third holes area 28 cm 2 (3.125x 9 cm2) as shown in fig (2).

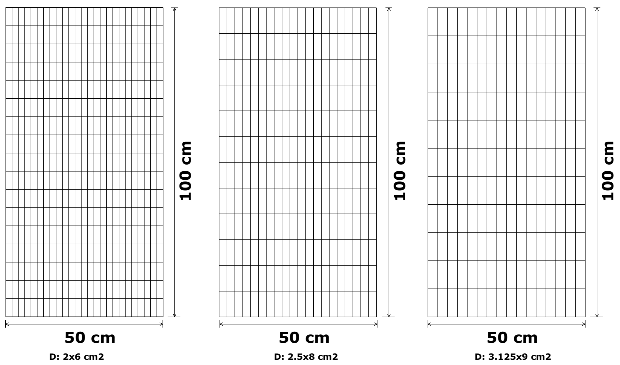

Fig (2): Three kinds of grading sieves

The pump specification: A pump was used in the experiments. Its characteristics are presented in Table (1).

Table (1): The specifications of the used pump:

Source of manufacture	Germany
Engine	Diesel, 3 cylinders
Power	16 hp (6.53 kW)
Fuel tank	20 L

Physical properties of fish:

One hundred samples of fish were taken randomly to determine the mentioned specifications as presented in Table (2).

Table (2): The physical properties of fish

No. of sample	Average of length (cm)	Average of height(cm)	Average of thickness(cm)	Average of weight(g)
1	21.5	9.6	3.25	210
2	16.5	7.36	2.36	110
3	14.8	5.57	1.67	65
4	12.6	4.33	1.49	35
5	10.1	3.14	1.15	19

The used measuring devices:

1-An electric weight: A Digital balance (accuracy of 5g) was used to weigh the samples of fish obtained from plots of replicates.

2-Assisting tools: Different workshop instruments were used to adjust, assemble and maintain the pump.

3-Steel tape: A steel tape was used to measure the length of the replicated tracks.

4-Stopwatch: A stopwatch was used to measure the time of each experiment.

5-Vernier caliper: Vernier caliper was used to measure the dimensions of fish (thickness and height, cm) with accuracy of 1/20 mm.

6- Flow meter: A flow meter (model 2000) was used to measure the water speeds m/s.

Fig (3): A flow meter

Experimental procedure

All experiments were carried out at different combinations of water speed, grading sieve depth and grading sieve holes area. In each experiment, a test was carried out in Manzala Lake to determine the dead fish ratio, grading efficiency and fuel consumption rat. All treatments were carried to Manzala Lake experiment was conducted within the waters suitable temperature, the suitable proportion of oxygen and water depth between 100-140 cm.

Experimental Treatments:-

a)Water speed (0.6, 0.8 and 1.0 m/s),

b)Grading sieve depth (50, 70 and 90 cm),

c)Grading sieve holes area (12, 20 and 28 cm2).

1- Grading efficiency:

The grading efficiency was calculated according to the following (equation 1):

$$HE = \frac{Y - L}{Y} X100 \quad (1)$$

Where:

HE = grading efficiency (%).

Y = total fish graded (ton/fed).

L = (U+D) = total fishes losses (ton/fed).

U = ungraded fishes (ton/fed).

D = total dead fish (ton/fed).

2- Dead fish ratio:

The quality of the lifted fishes was determined by counting the total dead and undead fishes collected from the same area.

The results of the total dead fishes were divided into two classes *according to Amin, (1990).*

$$Dr = \frac{W}{Y} X100 \quad (2)$$

Where:

W = mass of dead fishes (kg).

Y = total fishes yield (kg).

3- Fuel consumption rate:

Fuel consumption rate per unit time was determined by measuring the volume of fuel consumed during grading time. It was determined as follows:-

1-The pump tank was filled to full capacity before and after all treatments.

2-The grading operations were then carried out and the time needed was recorded with a stop watch.

3-Amount of refueling after the test represented the fuel consumption for treatment.

The fuel consumption per unit time is calculated by using the following (equation 3):-

$$F.C = \frac{F}{t} l/h \quad (3)$$

Where:

F.C. = Fuel consumption rate, L/h.
F = volume of fuel consumption.
t = time of grading.

RESULTS AND DISCUSSION

1. Effect of water speed on grading efficiency, %, dead fish ratio and fuel consumption rate:

Increasing water speed resulted in decreasing the grading efficiency as shown in Fig (4a). By increasing water speed from 0.6 to 0.8 m/s, the grading efficiency decreased from 67.23 to 57.45 %. While increasing water speed from 0.8 to 1.0 m/s, grading efficiency decreased from 57.45 to 42.38 %. All these results were obtained under 50 cm grading sieve depth with grading sieve holes area of 12 cm2. Similar trends were shown under different grading sieve depths and grading sieve holes areas. These results may be due to that the increase of the water speed led to increase congestion in front of the fish grading sieve, leading to a partial blockage of the sieve openings grades, leading to low grading efficiency.

Increasing water speed resulted in increasing the dead fish ratio as shown in Fig (4a). Increasing water speed from 0.6 to 0.8 m/s resulted in increasing dead fish ratio from 3.65% to 4.51% under the grading sieve holes areas of 12 cm2 and grading sieve depth of 50 cm. While increasing water speed from 0.8 to 1.0 m/s resulted in increasing dead fish ratio from 4.51% to 4.95% under the same conditions. Similar trends were shown under different grading sieve holes area and grading sieve depth. These results may be due to that the Increase of the water speed leads to increase crowding in front of the fish grading sieve, leading to suffocation of fish and consequently increase the percentage of dead fish.

From data shown in Fig (4a), it could be concluded that increasing water speed resulted in increasing the fuel consumption rate. Increasing water speed from 0.6 to 0.8 m/s resulted in increasing fuel consumption rate from 1.33 to 1.65 L/h under the grading sieve holes area of 12 cm2 and grading sieve depth of 50 cm. While increasing water speed from 0.8 to 1.0 m/s resulted in increasing fuel consumption rate from 1.65 to 2.11 L/h under the same conditions. Similar trends were shown under different grading sieve holes areas and grading sieve depths. These results may be due to that the increase of water speed lead to increase friction between the grading sieve holes and water and thus increase the fuel consumption rate.

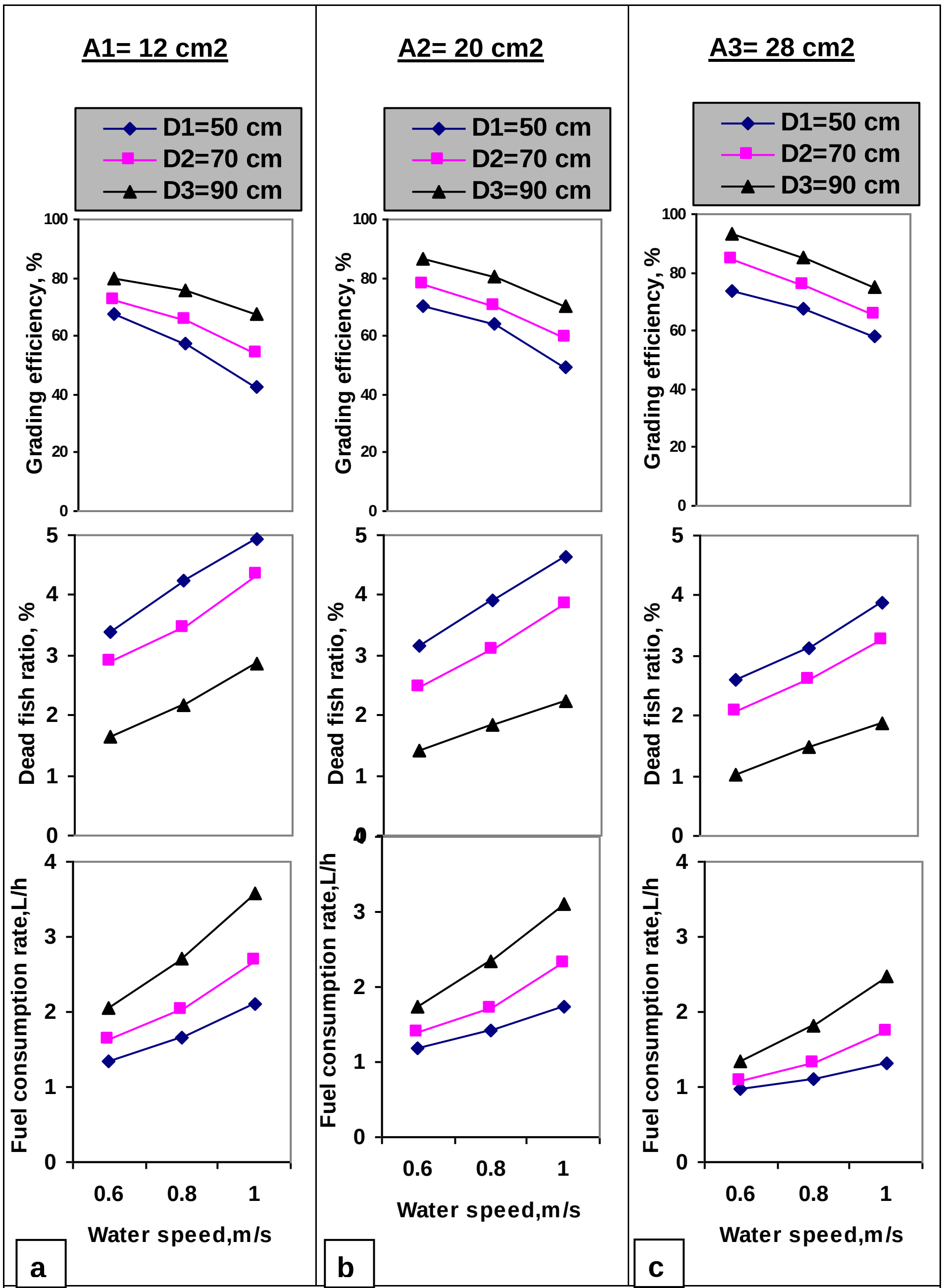

Fig. (4) Effect of water speed (S) and grading sieve depth (D) on grading efficiency, dead fish ratio and fuel consumption rate at different grading sieve holes areas (A1, A2 and A3).

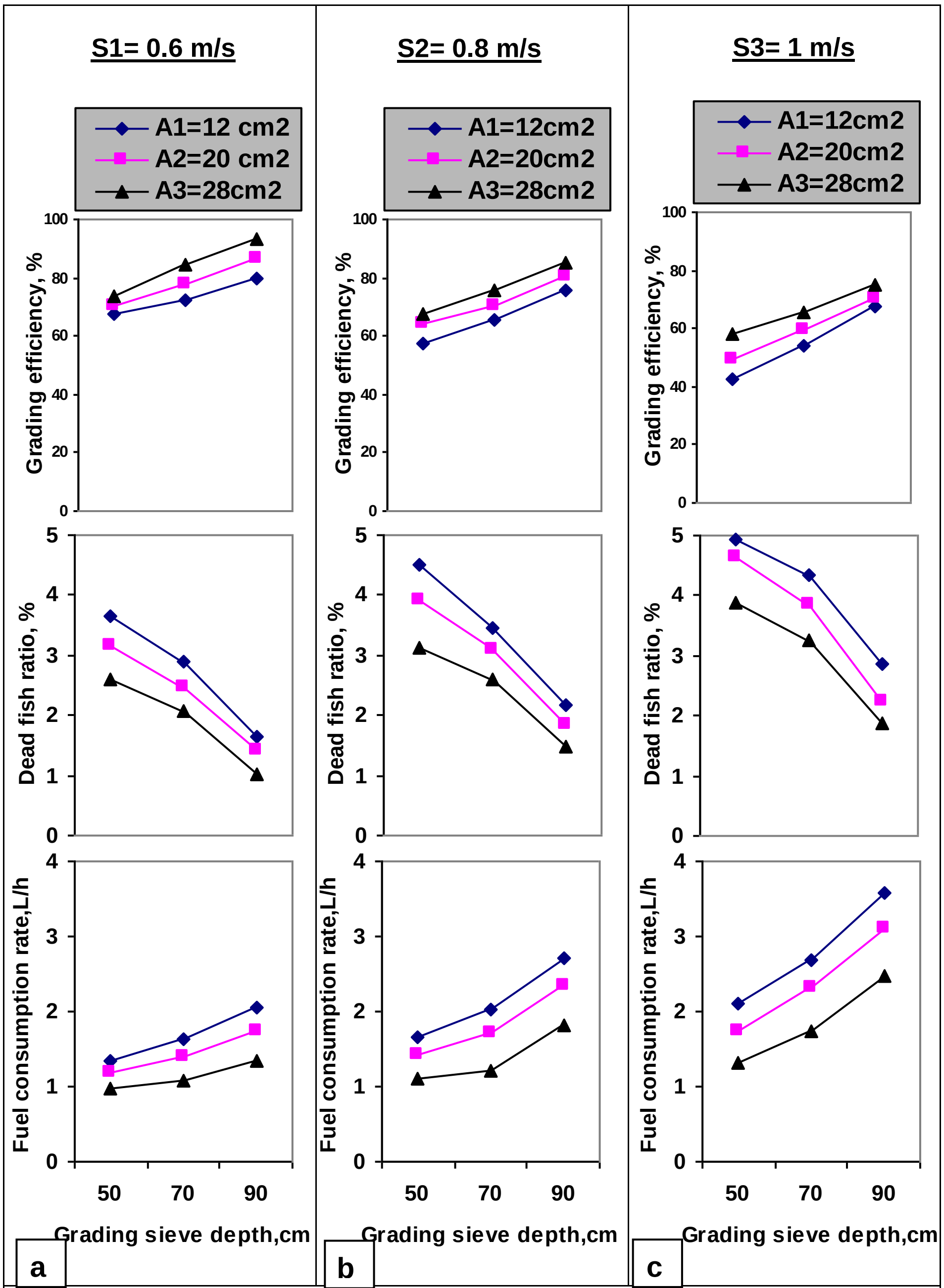

Fig. (5) Effect of grading sieve depth (D) and grading sieve holes area (A) on grading efficiency, dead fish ratio and fuel consumption rate at different water speeds (S1,S2 and S3).

2. Effect of grading sieve depth on grading efficiency, %, dead fish ratio and fuel consumption rate:

Results in Fig (5a) show that increasing grading sieve depth resulted in increasing the grading efficiency. Increasing grading sieve depth from 50 to 70 cm at water speed of 0.6 m/s resulted in increasing the grading efficiency from 67.23 to 72.42%. Also, increasing grading sieve depth from 70 to 90 cm resulted in increasing the grading efficiency from 72.42to 80.03%. All these results were obtained under 12 cm2 grading sieve holes area and water speed of 0.6 m/s .Similar trends were shown under different water speeds and grading sieve holes areas. These results may be due to that the increase of grading sieve depth lead to an increase in the number of grading sieve holes under the water's surface, thereby increasing the exposed area in front of the fish and thus the grading efficiency increased.

It could be concluded From Fig (5a) that, increasing grading sieve depth resulted in decreasing the dead fish ratio under 12 cm2 grading sieve holes area and water speed of 0.6 m/s. As increasing grading sieve depth from 50 to 70 cm resulted in decreasing the dead fish ratio from 3.65% to 2.90% while increasing grading sieve depth from 70 to 90 cm resulted in decreasing the dead fish ratio from 2.90% to 1.65% under the same conditions. Similar trends were shown under different grading sieve holes areas and water speeds. These results may be attributed to that the Increase in the grading sieve depth leads to an increase prone area of the grading sieve, leading to a lack of fish in front of contention grading sieve and thus lower the percentage of dead fish.

Increasing grading sieve depth resulted in increasing the fuel consumption rate Fig (5a). It is easy to notice that increasing grading sieve depth resulted in increasing the fuel consumption rate. As increasing grading sieve depth from 50 to 70 cm at water speed of 0.6 m/s resulted in increasing the fuel consumption rate from 1.33 to 1.62 L/h under grading sieve holes area of 12 cm2. On the other hand, the increase grading sieve depth from 70 to 90 cm resulted in increasing the fuel consumption rate from 1.62 to 2.05 L/h under the same conditions. Similar trends were shown under different grading sieve holes area and water speeds. These results may be due to that the increase in the grading sieve depth leads to increase prone area that hinder the movement or the speed of the water thus increasing friction and thus increase the fuel consumption rate.

3. Effect of grading sieve holes area on grading efficiency, %, dead fish ratio and fuel consumption rate:

Increasing grading sieve holes area resulted in increasing the grading efficiency Fig (6a). It was found that; increasing grading sieve holes area resulted in increasing the grading efficiency as a directly proportional relationship. With grading sieve holes area of 12, 20 and 28 cm2 the grading efficiency values were 67.23, 70.32 and 73.55%, respectively. These results were obtained under grading sieve depth of 50 cm and water speed of 0.6 m/s. Similar trends were shown under different grading sieve depths and water speeds. These results may be due to that the increase in grading sieve holes area leads to increase opportunity to deliver out a large number of fish, thus increasing the grading efficiency.

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Increasing grading sieve holes area resulted in decreasing the dead fish ratio From data shown in Fig (6a), it is easy to notice that increasing grading sieve holes area resulted in decreasing the dead fish ratio. As increasing grading sieve holes area from 12 to 20 cm2 at water speed of 0.6 m/s resulted in decreasing the dead fish ratio from 3.65% to 3.17% under grading sieve depth of 50 cm. On the other hand, the increases in grading sieve holes area from 20 to 28 cm2 resulted in decreasing the dead fish ratio from 3.17% to 2.59% under the same conditions. Similar trends were shown under different grading sieve depths and water speeds. These results may be due to the Increase of the water speed leads to decrease crowding in front of the fish grading sieve leads to a lack of fish suffocation leading to a lower percentage of dead fish ratio.

From shown curves in Fig (6a), it could be concluded that increasing grading sieve holes area resulted in decreasing the fuel consumption rate. As increasing grading sieve holes area from 12 to 20 cm2 resulted in decreasing the fuel consumption rate from 1.33 to 1.18 L/h. While increasing grading sieve holes area from 20 to 28 cm2 resulted in decreasing the fuel consumption rate from 1.18 to 0.98 L/h. All these results were obtained under 50 cm grading sieve depth with water speed of 0.6 m/s. Similar trends were shown under different grading sieve depths and water speeds. These results may be due to the increase of the grading sieve holes area leads to lower friction at the level of the holes and therefore lower fuel consumption rate.

CONCLUSION

After proceeding all treatments it was observed that the optimal characteristics for grading fish process are as follows:

- Water speed of 0.6 - 0.8 m/s (about 0.7 m/s),
- Grading sieve depth of 90 cm and
- Grading sieve holes area of 28 cm2.

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إمكانية تدريج السمك بالطريقة الطبيعية

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تعتبر الأسماك من أهم مصادر الغذاء منذ أن عرفها الإنسان القديم وهى لا تزال حتى الآن تتمتع بمكانه مرموقة في جميع دول العالم كمصدر هام للبروتين الحيواني كما تعتبر عملية تدريج الأسماك من العمليات الهامة التي تجرى بهدف مجموعة من الأسماك ذات الأحجام المتماثلة كما يعرف التدريج باسم الفرز، هو الشيء الذي نفعله أثناء عملية التفريخ وذلك بفصل أبطأ اسماك البلطي من حيث النمو ويرجع ذلك في الغالب إلى علم الوراثة الطبيعية، ولكن التنافس على الغذاء يزيد من تفاقم الوضع بالنسبة للحجم الأصغر من اسماك البلطي كما نجد أن إجراء عملية التدريج بالطريقة التقليدية لها عدة عيوب منها زيادة النسبة المئوية للأسماك النافقة والمفقودة والتى قد تصل فى بعض الأحيان الى نسبة تتراوح من ١٠% الى 13% من خلال عدة تجارب عملية اثناء عمليات التدريج التقليدية وبالتالي انخفاض نسبة الأرباح المتوقعة ، زيادة الوقت والعمالة اللازمة لإجرائها وبالتالي زيادة التكاليف ومن هنا فكرنا فى إجراء عملية التدريج ولكن باستخدام طريقة جديدة وهى استخدام المياه فى عملية التدريج وذلك لعدة أهداف منها تخفيض النسبة المئوية للأسماك الميتة ، وتخفيض التكاليف اللازمة لحصاد الأسماك، وتحسين كفاءة التغذية التكميلية من خلال الحصص الغذائية الكافية، والحد من نسبة الأسماك الصغيرة في حصاد البرك وكذلك زيادة فرصة تسمين الأسماك وزيادة الإنتاج منها وبالتالي زيادة نسبة الأرباح المتوقعة.

عوامل الدراسة: أجريت هذه التجربة ببحيرة المنزلة بمحافظة الدقهلية وتم دراسة ثلاثة عوامل هي كالتالي:-

١- سرعة المياه: (٠.٦ ، ٠.٨ و ١.٠ متر/ ثانية).
٢- عمق غربال التدريج: (٥٠، ٧٠ و ٩٠ سم).
٣- مساحة فتحات غربال التدريج: (١٢، ٢٠ و ٢٨ سم٢).

القياسات:-

١- كفاءة التدريج،
٢- النسبة المئوية للأسماك الميتة أو النافقة،
٣- معدل استهلاك الوقود.

النتائج: تم إجراء التجربة وكانت من أهم نتائجها كالتالي:

١- زيادة سرعة المياه تؤدى إلى انخفاض كفاءة التدريج، زيادة % للأسماك الميتة وزيادة معدل استهلاك الوقود وعليه فنجد ان افضل سرعة للمياه من خلال النتائج المتحصل عليها وهى اعلى كفاءة واقل% للأسماك الميتة ومعدل استهلاك للوقود منخفض تتراوح ما بين ٠.٦ الى ٠.٨ متر/ثانية.
٢- زيادة عمق غربال التدريج يؤدى إلى زيادة كفاءة التدريج، انخفاض % للأسماك الميتة وزيادة معدل استهلاك الوقود وعليه فنجد ان افضل عمق لغربال التدريج هو ٩٠ سم وذلك من خلال النتائج المتحصل عليها وهى اعلى كفاءة واقل% للأسماك الميتة ومعدل استهلاك للوقود منخفض.
٣- زيادة مساحة فتحات غربال التدريج تؤدى إلى زيادة كفاءة التدريج، انخفاض % للأسماك الميتة انخفاض معدل استهلاك الوقود وعليه فنجد ان مساحة فتحات غربال التدريج والتى تساوى ٢٨ سم٢ هى افضل مساحة لفتحات غربال التدريج وذلك من خلال النتائج المتحصل عليها وهى اعلى كفاءة واقل% للأسماك الميتة ومعدل استهلاك للوقود منخفض.