# Extra Buoyancy and Mesh Size as The Measuring Indicators for the Effectiveness and Selectivity of Purse Seine in Sampang Waters of Madura

Fuad, Guntur
Faculty of Fisheries and Marine Science, University of Brawijaya
E-mail : fuad@ub.ac.id

## ABSTRACT

Fishing gear effectiveness is a main parameter to measure effiency rate of fishing operation that becomes a main consideration in preserving fish resources. Nowadays, the sustainability of fish resources is threatened because all fishers are attempting to narrow their net mesh size to increase their haul. The objective of research is to understand the effectiveness and selectivity rates of fishing gear by measure the effectiveness of fishing gear. The calculation of fishing gear selectivity is begun by determining fish size at caught (Lc), fish size at gonad mature (Lm) then comparing both size with mesh size of purse seine. Result indicates that effective speed of fishing operation is achieved when boat speed is 7.1 knots with fish haul rate of 1,000 kg and fishing operation time of 2,853 seconds. Fishing operation speed above 8 knots is not efficient because it increase of fuel consumption although fish haul rate remains similar. Purse seine used in Sampang waters is not selective because the size of mackerel fish at firstly-caught (Lc) < gonad mature (Lm), thus Lc < Lm. Fish size at gonad mature (Lm) is 19.35cm, at firstly-caught is 18.6cm. Regression analysis indicates that there is a close relationship between fish length and fish weight, which is scored at 84%.

**Keywords:** Buoyancy, Net, Effectiveness, Selectivity, Sampang.

## INTRODUCTION

The scarcity of fishery resources is forcing fishers into the difficulty to obtain their expected haul. Fishers resolve this problem by increasing boat speed and also by increasing the number and power of boat machines. Unfortunately, the upgrade of power and number of boat machines can also increase operational cost while fish resources are still scarce. Coping with the scarcity of fishery resources and the increase of fishing operational cost, fishers, therefore, are required to consider the importance of environmental preservation and the effective fishing method (Gambang, Rajali and Awang, 2003). Effective fishing method is related with the control over all styles in using purse seine and also with the improvement of the existing technology to obtain fast and on-target usage. Effective fishing technology will minimize fishing operational cost at similar fish haul rate (Diniah, 2001). [1]

Fishing gear selectivity is a main problem for the preservation of fish resources because all fishers always narrow their net mesh size in dealing with the scarcity of fish resources (Rosyidah *et.al*, 2009). [2] Both the scarcity of fish resources and the increase of operational cost are dilemmas that may impair the implementation of effective and selective fishing operation based on the principle of fish resources conservation. Effective fishing operation can surely reduce fishing operational cost (Simbolon, Jeujanan, and Wiyono, 2013; Hazin, 2006). [3] The effectiveness of fishing operational cost can be measured from net submersion speed because it successfully

2

Fuad *et al.*: *Extra Buoyancy and Mesh Size as The Measuring* ...............................................................

prevents fish from escape. Purse seine can be said as effective if net submersion speed is greater than fish swimming speed. The effectiveness of purse seine can be understood by technical analysis over several attributes such as hanging ratio, shortening, net extension, mesh size, net floating rate, net submersion rate, and extra buoyancy. Technical analysis must be conducted before or during the construction of purse seine net, but in reality, such analysis is not even implemented.

The objective of research is to understand the effectiveness and selectivity rates of purse seine that is operated in Sampang Waters of Madura. Fishing gear effectiveness is measured by comparing boat speed during fishing activity and fish haul rate in every setting. Fishing gear selectivity is measured by comparing fish length during gonad mature and fish length during firstly-caught. Fish size at gonad mature is compared with the mesh size of purse seine.

According to Sadhori (1985), [4] three factors must be controlled to produce effective fishing operation. These factors are fish behavior, fishing boat and fishing gear. Fish movement is controlled in two methods. First is fish gatherer method, usually using lamp, while second method is utilizing fish movement monitoring device. The monitoring device for fish movement is very useful to understand the size of fish school and the species of target fish. This monitoring device may include fish finder and underwater camera. This device is usually equipped into the boat which uses active fishing gear (Urick, 1982). [5].

Fishing gear technology has been developed to capture only fishes at certain size or at gonad mature. For example, purse seine only catches pelagic fishes at certain bigger size (Huse, I., Aanondsen, S., and Ellingsen *et.al.*, 2003). [6] Such fishing gear characteristic is known as fishing gear selectivity. Selectivity is an attribute that must be considered in designing fishing gear because it ensures what fish size is expected to catch. Fish size at firstly-caught is determined by fish size at gonad mature and during reproduction (Lm).

According to Wiadnya et al (2005), [7] the size of fishes captured by the net is the function of mesh size and also the function of how fishes are captured through mesh size. In purse seine, how fishes are captured is determined by mesh size. Fish size that is smaller than mesh size will pass through the net and may not be caught. If mesh size is similar to fish circumference size (body girth), fishes are then caught. This principle helps purse seine to catch fishes which its body size similar to or bigger than mesh size.

## METHODS

This research will calculate the effectiveness and selectivity of purse seine. It begins with calculating net extension, hanging ratio, shortening and extra buoyancy, and also mesh size. The net type that is considered as the object of research is purse seine that is operated in Sampang Waters of Madura. Several data are used to calculate fishing gear effectiveness, such as boat speed during setting, time needed for setting and hauling, fish haul rate in every setting, and operational time effectiveness. The data of effectiveness are taken during fishing operation, and it is recorded in every setting during six times of fishing operations. Some fishing operations are failed due to factors of weather and wave.

Data of purse seine selectivity are collected at sea-level and ground-level. Data at sea-level include fish eye and pupil diameter. Fish eye is preserved into 15%

3

Fuad *et al.*: *Extra Buoyancy and Mesh Size as The Measuring* ...........................................................

formalin and is subjected to histology observation to examine the density of con and rod cells. The data of length, weight, and body circumference of fishes, gonad weight and gonad phase, are collected at ground-level.

**Fishing Gear Effectiveness.**

Fishing gear effectiveness is understood by comparing net extension during fishing operation and net extension with maximum mesh size (Gaertner and Pilar, 2001). [8] Higher effectiveness rate of fishing gear is reflecting maximum net extension during fishing operation such that maximum haul can be obtained. The equation for purse seine effectiveness is:

$$\eta = \frac{A}{A_0} \times 100\%$$

Note:  $\eta$  : fishing gear effectiveness;
A : actual mesh size; and
$A_0$ : maximum mesh size.

Effectiveness is also determined by the efforts spent during fishing operation in comparison with fish haul rate. The efforts are defined as boat speed during setting and time needed for setting. Data of boat speed, time needed for setting, and fish haul rate are analyzed with regression analysis to understand the influence of efforts (speed and time) on different fish haul rate.

**Fishing Gear Selectivity.**

Fishing gear selectivity is measured by comparing fish size at gonad mature ($L_m$) and fish size calculated based on mesh size ($L_{OM}$). Data of fish size at gonad mature ($L_m$) are collected by conducting the analysis over the relationship of fish length and fish weight which is begun by converting fish length into fish weight using squared function (Pauly, 1984). [9] The following is the formula used to convert fish length.

$$W = a. L^b$$

Note:  W : fish body weight (gram);
L : fish body length (cm); and
a & b : constants.

The effectiveness and selectivity of purse seine that is operated in Sampang Waters of Madura are determined by fish gatherer lamp. Fish curiosity is analyzed by measuring fishes' *Maximum Sighting Distance*. Indeed, maximum sighting distance is the ability of fishes to see the object at the longest distance based on their sighting sharpness. Maximum sighting distance can be counted with *phytagoras* equation (Fitri, 2005). [10]

**RESULT AND DISCUSSION**

Purse seine that is operated in Sampang Waters of Madura is counted for 153 units or 2% of total of fishing gears that are still operated. The fish haul rate of purse seine is 5,014.4 tons per-year or 25% of fish production total in Sampang Regency. Purse seine is very productive fishing gear than angler, gillnet and payang, but the operational cost of purse seine is very high. Higher operational cost is caused by expensive fuel price and too many boat workers.

**Purse Seine Effectiveness.**

Effective speed of fishing operation is the comparison between boat speed in every setting and fish haul rate (Monintja, 1993). [11] Cost factor is excluded when maximum speed must be counted because it is hard to calculate fishing operation cost in every setting. Effective speed point is determined based on the highest fish haul rate at the smallest speed and time. Effective speed point can be achieved by increasing boat speed until certain times when fish haul rate reaches constant rate.

Result of research indicates that boat speed average during setting is 7.03 knots with average fish haul rate of 801.6 kg. Time

needed for fishing operation (setting and hauling) is 54 minutes by average. Data show that fishing operation is already optimum. Result of regression analysis indicates that boat speed during setting is influential at 88% against fish haul rate. It means that boat speed during setting is quite significant to fish haul rate.

**Purse Seine Selectivity.**

Based on the calculation of mesh size, the targeted size of mackerel fish (*Selaroides spp*) is fish with body girth over 14.4cm. This measure is verified and compared to the size of fishes captured with purse seine. The observation against the sex of mackerel fish (*Selaroides spp*) captured with purse seine has found that number of female fishes is less than number of male fishes. Female fishes are 33 fishes or 41.25% of fish sample, while male fishes are 47 fishes or 58.75% of fish sample. The sex of mackerel fish is compared because this comparison helps to estimate the balance of population. Regarding to final sampling data, it is shown that the comparative ratio of female and male is 2:3.

Result of data sampling in Camplong Waters indicates that the frequency distribution of the length of mackerel fish (*Selaroides spp*) is 13.3-21.1cm, or in average, the length is 18.6cm. Based on the length of mackerel fish (*Selaroides spp*) captured by purse seine, it is shown that fishes are mostly in Stage 3 or almost gonad mature. Weight frequency of mackerel fish (*Selaroides spp*) captured by purse seine is ranging between 31 and 105 grams with average weight of 70.1 grams. As shown by data above, the increase of fish length is always accompanied by the increase of fish weight.

Result of regression analysis over the relationship between length and weight has indicated that there is close correlation

between fish length and fish weight as shown by R-value (correlation coefficient) of 0.84. T-test against mackerel fish weight is finding the growth type of positive allometric. It means that the growth of fish length is always followed by the growth of fish weight. Weight value is used to measure conditional factors. Testing the different relationship between length and weight among male and female fishes is using *covariance* analysis. Result of test shows that regression curve between male and female is not different to each other.

Macroscopically, gonad maturity rate is shown by gonad visual appearances such as volume, color and blood vessel development. Gonad maturity of mackerel fish (*Selaroides spp*) is observed using the scale of gonad maturity rate suggested by Mansoor in Wudianto (2002). The observation of mackerel fish (*Selaroides spp*) has shown that most fishes remain in gonad maturity rate at level 3 (almost mature) and 4 (mature). Result of observation over mackerel fish (*Selaroides spp*) also shows that the composition of gonad maturity rate is explained as follows: 8 fishes (10%) in TKG I (Immature), 18 fishes (22.5%) in TKG II (Mature), 30 fishes (37.5%) in TKG III (Ripening), and 24 fishes (30 %) in TKG IV (Ripe).

**CONCLUSION AND SUGGESTION**

The use of purse seine has been very effective. Effective speed of fishing operation is 7.1 knots with fish haul rate of 1,000kg and fishing operation time of 2,853 seconds. Haul rate of mackerel fish (*Selaroides spp*) is including fishes with length between 13.3-12.1cm or by average 19cm with almost gonad mature phase (Stage 3). Result of regression analysis indicates that there is close correlation between fish length and fish weight as shown by R-value (correlation

Fuad *et al.*: *Extra Buoyancy and Mesh Size as The Measuring* ..............................................................

coefficient) of 0.84. T-test against mackerel fish weight is finding the growth type of positive allometric. It means that the growth of fish length is always followed by the growth of fish weight. Weight value is used to measure conditional factors. The captured mackerel fish (*Selaroides spp*) has different gonad maturity rate, which is assigned into several categories as following: 8 fishes (10%) in TKG I (Immature), 18 fishes (22.5%) in TKG II (Mature), 30 fishes (37.5%) in TKG III (Ripening), and 24 fishes (30 %) in TKG IV (Ripe).

## ACKNOWLEDGEMENT

## REFFERENCES

Diniah dkk, 2001 "*Pemanfaatan Sumberdaya Perikanan Tina-Cakalang Secara Terpadu*" IPB, Bogor

Rosyidah Ifah , A Farid, A Arisandi, WA Nugraha, 2009 "*Efektifitas alat tangkap mini purse seine menggunakan sumber cahaya berbeda terhadap hasil tangkapan, Journal Kelautan, Vol. 2, Hal. 1*".

Simbolon Danu, B Jeujanan, ES Wiyono, 2013 "*Effectiveness of fish aggregating devices in finsh-catching activities in south east Maluku sea*" Journal Amanisal, Vol. 2, Hal. 19-31.

Sadhori, N. 1985 "*Bahan Alat Penangkapan Ikan*" Penerbit Angkasa, Bandung.

Urick R. J., 1982, *Principles of Underwater Sound, Peninsula Publishing, Los Altos Hills, USA, 3rd*.

Huse, I., Aanondsen, S., Ellingsen, H., Engas, A., Furevik, D., Graham, N., Isaksen, B., Jorgensen, T., Lokkeborg, S., Nottestat, L., Soldal, A. 2003. *A desk- study of diverse methods of fishing when considered in perspective of responsible fishing, and the effect on the ecosystem caused by fishing activity. TemaNord 501, 121.*

Wiadnya, D. G. R., P.J. Mous, R. Djohani, M. V. Erdmann, A. Halim, M. Knight, L. Pet-Soede, & J. S. Pet (2005a) *Marine Capture Fisheries Policy Formulation and the Role of Marine Protected Areas as Tool for Fisheries Management in Indonesia. Mar. Res. Indonesia (2005) 30: 33-45.*

Gaertner dan Pilar, 2001 "*Efficiency of Tuna Purse Seiners and Effective Effort*" Alaska Fishery Research Bulletin, Alaska.

Pauly, 1984. *A Selection of Simple Methods For the Assessment of Tropical Fish Stocks*. FAO Fish pap (234): 52p

Fitri, 2005. *Fisiologi Organ Penglihatan Ikan Baronang dan Kakap Berdasarkan Jumlah dan Sel Reseptor Cone dan Rod. Proseding Seminar Nasional Sains dan Pendidikan Sains IV Universitas Kristen Satya Wacana. Salatiga*.

Monintja D. R 1993. *Study on the development of rumpon as fish aggregating devices (FADs) Mantek, Bulletin ITK, FPIK-IPB. 3 (2): 137 p. Newell. G.E. dan R. C. Newell. 1977. Marine Plankton. Hutchinson Educational, London. 244p.*