AACL BIOFLUX
Aquaculture, Aquarium, Conservation & Legislation
International Journal of the Bioflux Society

Analysis of fish catches by traditional purse seine boat in Aceh waters based on setting and hauling duration

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Abstract. Purse seine is the most used fishing gear by traditional fishermen in Aceh. The maximum yield of the fishing gear is highly influenced by deployment time as soon as they spot a school of fish. Thus timing (setting and hauling) plays major roles to estimate the maximum yield. Because of its large size (e.g., 1,200 m in length and 80 m in depth) and traditional fishermen in Aceh use their bare hands to pull the net, it will give an impact to the efficiency of each fishing trip. The objective of the study is to examine fish catches based on setting and hauling duration. This research and data collection was done in December 2011 with two types of boats that use purse seine as their fishing gear, i.e. day boat and night boat. Purposive sampling method and statistical analysis is used to analyze the data. The results showed that duration of setting and hauling was statistically significant in catching production ($p < 0.05$). The average duration of setting is about 4'33'' to 6'.48'' and average duration of hauling is about 132'23"–134'04", meanwhile the average of fish catches is about 1.100–1.900 kg.
Key Words: fishing gear, timing, fish catches, hauling.

Introduction. The devastating Indian Ocean earthquake and tsunami that occurred in December 2004 ranks among the worst natural disasters ever recorded. In Indonesia's Aceh Province alone more than 186000 peoples died, including an estimated 15-20% of fishers (~ 10000 individuals). In addition, the tsunami damaged or destroyed over 10000 small-scale fishing boats, countless items of fishing gear, and associated fisheries-related infrastructure (Garces et al 2010; Stobutzki & Hall 2005; Rizal et al 2013).

There were no new techniques applied by fishermen after the tsunami as well as there were no records of local knowledge (pre and post-tsunami) to support the fishermen with a higher efficiency in their fishing activities. Such problems made this study necessary. In addition, the importance of scientific observations in order to know the linkage between timing (setting and hauling) and maximum yield of purse seine that they used, may assist the fishermen with their fishing activities.

The income of the fishermen is based on the amount of fish that they catch in each trip. Inefficiencies in fishing, made the traditional fishermen have a lower income despite the fish that they catch are large. Thus, timing (setting and hauling) take the main role to estimate the maximum yield.

Based on statistic data on 2010, an amount of 64.664 resident in Aceh province become a fishermen with 4.901 of them become half time fishermen. With this amount of fishermen, there were a total of 17.927 units of fishing boat and 9.216 units of it are motorized. The total production of fisheries by using purse seine alone as their fishing gear is 53.954,8 tons (Marine and Fisheries Department of Aceh 2011).

If the amount of full fishermen is 59.763 residents, with 53.954,8 tons of production within a year, it means 0.9028 tons or 902.8 kg of fish each fisherman had (a

year catch). If the fish price is between Rp 8.000–10.000 each kg, which delivers the fishermen income within a month, is between Rp 600.000–750.000 (less than USD 100). This income excludes the operational that fisherman spent in each fishing activities.

With the increases of fisheries demand, thus, the effectiveness of the utilization of the fishing gear is necessary. Hence, the objective of the study is to examine fish catches based on setting and hauling duration. This study will bring benefit for fishermen to develop a new technique for setting and hauling processes.

Material and Method

Data collection. The research and data collection was conducted on December 2011. There are two types of boat using purse seine as their fishing gear: (1) day boat and (2) night boat. The data collection is set for 10 times of fishing trip for both types of boats (totally 20 fishing trips). We directly measure the setting and hauling time in each deployment of the gear. The data collections require no special or extra effort by the fishermen. They deploy their net when they spot a school of fish, and later haul the net back into the boat (as they normally do). It is during this regular fishing activity that we record the setting, hauling and amount of fish that they catch.

Boat and fishing gear. The size of the purse seine boat involved in this data collection is about 27–30 gross ton. The boats are wooden, with a round bottom, and powered by a 150–230 horsepower diesel engine. Twenty two fishermen (including a skipper) were onboard for each fishing trip. Most purse seines used by these local fishermen are about 1200 m long and 80 m deep.

There are no differences of boat size, engine as well as fishing gear between day and night boats, except the night boat have water lamp that allow them to attract a school of fish at night. The other difference is on the technique that they use to find the fish. The day boat, needs to find a school of fish by search it along the coast, meanwhile night boat does not need to find instead the fishermen set a spot and turn it on the water lamp that will attract a school of fish.

Method. The method that we use in this study is purposive sampling method. We use independent variable to describe setting and hauling duration called as X1 and X2 respectively and hauling yield is as dependent variable called as Y. The analysis is carried out by using Minitab program. This program enables us to analyze with bifilar linier regression, determination coefficient, F and T test.

Results and Discussion

Setting, hauling, and hauling yield. Data was taken from two types of boat. Since these two types of boat have differences in their fishing technique, it may be possible to find the different setting, hauling and hauling yield. Table 1 and 2 show the setting and hauling duration, hauling yield and wind speed for day and night boat.

Based on Tables 1 & 2 we found different duration in setting and hauling for the two types of boats. It is found that the day boat performs a faster setting and hauling duration rather than the night boat (with different about 2 knots). The possible cause of this different is because, the day boat catch a free swimmer fishes or migrated fish (high mobility) meanwhile night boat catch fish witch attract by the water lamp (less mobile). This attitude in catching the fish also resulted with different amount of fish yield, whereas day boat catches less fish compare to night boat.

The wind speed record during the data collecting also found that wind have a less influence in making huge different for the setting and hauling duration, however, during the data collection, the wind speed is not to high (not in a storm condition, where fishing activities is banded by the authorities).

Table 1

Setting, hauling, and hauling yield on day boat

No.	Setting duration (X_1) (minute)	Hauling duration (X_2) (minute)	Hauling yield (Y) (Kg)	Wind speed m s^{-1}
1	3.66	111.20	1250	5.5
2	4.20	147.95	1000	2.3
3	2.08	69.75	2000	3.6
4	2.22	78.62	2000	2.6
5	5.88	163.69	500	5.6
6	2.31	74.05	2000	7.3
7	6.74	191.34	250	3.9
8	6.62	183.85	250	4.5
9	4.32	154.52	1000	4.9
10	5.29	161.43	750	6
Average	4.33	133.64	1100	4.62

Table 2

Setting, hauling, and hauling yield on night boat

No.	Setting duration (X_1) (minute)	Hauling duration (X_2) (minute)	Hauling yield (Y) (Kg)	Wind speed m s^{-1}
1	4.27	106.69	3250	3.9
2	4.39	112.71	2000	2.9
3	4.21	116.57	3000	3.5
4	4.67	163.20	1250	4.5
5	4.53	91.72	3000	3.4
6	6.02	136.08	1750	5.4
7	5.44	138.06	2000	5.6
8	7.35	165.23	1500	2.3
9	7.42	160.15	1000	4
10	20.07	127.88	250	4.6
Average	6.84	131.83	1900	4.01

Fish catch based on setting and hauling duration

Day boat. The result is shown in Table 3. The model from statistical analysis suggests that the length of setting and hauling time has a negative regression coefficient with Y = 2924 - 247 X1 – 5.64 X2.

Table 3

Simultaneously test for regression function of fishing result by day boat

Source	Df	Sum of the quadrate	Average of quadrate	F_{hit}	F_{table}	P	R-sq (%)
Regression	2	4358821	2179410	370.47	4.74	0.000	99.1
Residue	7	41179	5883				
Total	9	4400000					

Those result in Table 3 also suggest that time setting (X1) and length of time hauling (X2) has a statistically significant effect on purse seine catch result ($p < 0.05$). With coefficient determination (R^2) (0.991) is shown a strong correlation level between setting and hauling time length, 99.1%.

Table 4 shows the effect of each variable which is individually tested for setting (X1) and hauling (X2) time length.

Table 4

The result of partial setting time duration (X1) and hauling time duration (X2) for day boat catch result

Source	*Regression coefficient*	*Standar error coefficient*	T_{hit}	*P*
Variable	2924.50	87.01	33.61	0.000
X_1	-247.25	60.84	-4.06	0.005
X_2	-5.637	2.333	-2.42	0.046

From Table 4, it is shown that each variable (X1) and (X2) has a statistically significant effect on the purse seine catches ($p < 0.05$). A value of –247.25 for coefficient regression of time (X1) which imply it has an opposite direction from increasing of catches. From those it is shown that any reduction in one minute of setting time length, it will increase purse seine catches result of 247.25 kg. It is also due to the change of boat speed during deploying the net, it made a possible to increase the chance to catch the fish.

For the coefficient of hauling duration (X2) with a value of -5.64 also shows the opposite behavior with fish catch. It is found that decreasing of hauling time length in each minute will increase fishing result as much as 5.64 kg.

Night boat. The model from Minitab program suggests that the length of setting and hauling time has a negative regression coefficient with $Y = 5752 - 130 X1 – 22.5 X2$.

From the model above, it is known that variable of setting time duration has negative regression coefficient to the catch result. Regression testing on night boat is presented in Table 5.

Table 5

Simultaneously test for regression function of fishing catch result by night boat

Source	*Df*	*Amount of quadrate*	*Average of quadrate*	F_{hit}	F_{table}	*P*	*R-sq (%)*
Regression	2	7303729	3651865	23.32	4.74	0.000	86.9
Residue	7	1096271	156610				
Total	9	8400000					

From Table 5 it is shown that X1 and X2 have a statistically significant effect on purse seine catches ($p < 0.05$), with R^2 value of 0.869 that gives a strong correlation between two variable of X1 and X2 as height as 86.9%.

Table 6 shows the effect of each variable which is individually tested for X1 and X2.

Table 6

The result of partial analysis of setting time duration (X1) and hauling time duration (X2) for night boat catch result

Source	*Regression coefficient*	*Standar error coefficient*	T_{hit}	*P*
Variable	5752.1	702.5	8.19	0.000
X_1	-130.12	27.69	-4.70	0.002
X_2	-22.471	5.236	-4.29	0.004

From Table 6 it is shown that X1 and X2 statistically significant affect purse seine catches ($p < 0.05$). Regression coefficient of X1 is 2.471 which suggests a contra to increase the catch result. From those it is shown that each one minute reduction of setting time duration will increase purse seine catches as much as 130.12 kg. Meanwhile one minute decrease of hauling duration will increase purse seine catches as much as 22.47 kg.

Conclusions. From the results described above it can be concluded that the most effective for the fishing activities by traditional purse seine boat in Aceh water is shown by night boat. However, seasonal and environmental variation during the data collection is not expressed in the above finding. There for, these preliminary result need more investigation to get a detailed discussion.

Acknowledgements. We thank the Panglima Laot Lhok Krueng Aceh for their kind cooperative and assist in the research. Thanks are also due to our colleagues in Marine Science department, Syiah Kuala University for their kind suggestion in preparing the research.

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Received: 05 April 2014. Accepted: 14 April 2014. Published online: 15 April 2014.
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How to cite this article:
Rizwan T., Dewiyanti I., Haridhi H. A., Setiawan I., Ilhamsyah Y., Alirudin J., 2014 Analysis number of fish catches by traditional purse seine boat in Aceh waters based on setting and hauling duration. AACL Bioflux 7(2):63-67.