E-ISSN : 2355-9926
http://rjls.ub.ac.id

Characteristics of Beach Seine Fishery of East Java: Facing Ministerial Decree of Marine Affairs and Fisheries No. 2/2015

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ABSTRACT

Catch biomass and time-trend perception of Beach seine fishery were studied during 2015, from four different sites in East Java: Padikde Madura, Santan Island Banyuwangi, Prigi Beach Trenggalek, and Dangkal Beach Pacitan. The study aimed to assess the impact of recently Ministerial Decree (No. 2/2015) on this particular fishery. Catch biomass was analyzed based on swept area method. Time trend perception was traced back from fishermen in relation to reduced catch biomass, catch size, habitat degradation, and income contribution from the fishery. The results showed that Beach Seines in East Java are considerably subsistence. It swept fixed-bottom habitats of 1–9 ha. Average catch biomass for all sites was 15±19.4 kg trip^{-1}. With low price of fish catch, fishermen cannot place down their family income solely from this livelihood. Beach seine is more as to maintain tradition of subsistence. Fishermen clearly observed the reduced in catch biomass and catch size compared to what it used to be (±30 years ago). With very low contribution to total catch in the region, negligible impact to habitat degradation, and consumed no fuel subsidy, it is no real reason to include this gear in general ban through Ministerial Decree of Marine Affairs and Fisheries.

Keywords: capture-fishery; fish-catch; beach seine.

INTRODUCTION

As technology develops, the progress in the development of fishing gears and methods may not always based on new concepts and science (Kawamura et al., 1983; Bavinck and Karunaharan, 2006). It is rather due to the ingenuity of fishermen to cope with different fishing conditions and to meet their socio-economic requirements. A beach seine, Pukat Beach (SNI 7277.6.2:2008), is by definition a seine-net which is fished almost half-circled and the catch is pulled onto the shore (Dudley and Tampubolon, 1986; Gray and Kennelly, 2003). Beach seine in East Java was first introduced in the 1920s by immigrants of non-Javanese background (Kendrick, 1993). Exploiting the still untapped resources, Beach seine productions increased dramatically, creating a surplus that sometimes destroyed due to lack of a market, particularly in the southern part of East Java. Fifty years later, in mid 1970s, Government of Indonesia promoted a new fishing technology of purse seine with motorized power boats (Bailey et al., 1987; Buchary, 1999). However, this modern fishing gear did not actually replace the beach seines. Annual fishery statistics showed there at least 19,566 beach seines operating in almost all possible coast-lines of Indonesia, contributing ±2.8% to the national total fishery catch in the last decade (DJPT, 2015). Total numbers of beach seines in East Java vary from time to time. The last

report on fishery statistics in 2015 indicated there at least total 178 active beach seiners in the region. The numbers could have been more if there still appropriate fishing sites left for Beach Seines. However, its contribution to the total catch did not ever reach 2%, and rated the least compared to all other gear types.

A reconnaissance survey held in early 2015 showed there at least 16 coastal areas in East Java have had been used for Beach seine operation. Currently, it only 4 sites are considered to be active, being: Padikde (Madura), Santan Island (Banyuwangi), Prigi Beach (Trenggalek), and Dangkal Beach (Pacitan). At the same time, Ministry of Marine Affairs and Fisheries just enacted a new Decree No. 2/2015, banning the operation of various fishing gears, included beach seine. This study was aimed to assess characteristic nature of beach seine fishery of East Java that is soon be impacted by the newly declared Ministerial Decree.

MATERIALS AND METHODS

Study Sites.

The survey was focused on four sites where Beach Seines are considered active, Padikde Talango (Sumenep), Santan Island (Banyuwangi), Ketawang Prigi Beach (Trenggalek), and Dangkal Beach (Pacitan). Fishermen of Padikde are purely Madurese. Santan Island is considered as a mixed culture between Madurese, local Osing, and Javanese. Fishermen in Prigi Beach and Dangkal Beach are both considered to be culturally Javanese.

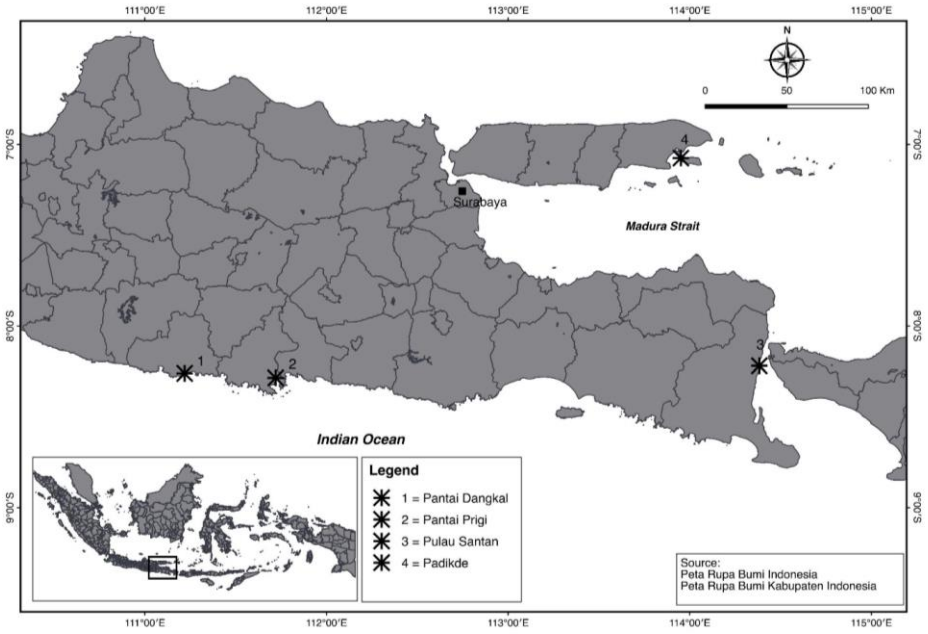

Figure 1. Map of East Java's coastal area indicating fixed-sites of Beach Seine operations used in the study (coded with *).

Variables.

Beach seines at four sites were observed in forth-night for each site, included interview of local fishermen of over 55 years old. Gear dimension was measured based on length of hauling rope combined with wing body-net in terms of piece (1 piece = 60 m). Area of fishing ground swept, in terms of bottom substrate was assessed based on gear dimension (hauling rope and wing body-net). Catching species was identified using fin fish

identification guide (Carpenter and Niem, 1999a; 1999b; 2001a; 2001b). An update of nomenclature (correct naming of species) was based on Eschmeyer et al. (2010), and Kottelat (2013). Catching biomass was estimated through standard weight of a basket filled with catches (weight of a basket fully-filled with fish was assumed to be about 40 kg). Records on catch was maintained by fishermen from each site using specific form. Small allowance was given to each fisherman to keep the catch records.

Area of Fishing Ground.

Beach seine in all sites are operating at the same or fixed area. It was operated forming almost an equilateral triangle to make an efficient use of manpower, pulling the net onto the beach. Total area of bottom substrate swept will be dependent on the length of hauling rope together with equilateral triangle formed by wing body net (Lombardi et al., 2014; see Figure 2). Total bottom swept area was estimated through calculation of the area of triangle and rectangular imagery forms. The area of triangle was estimated using the equations (1) and (2) (Sparre and Venema, 1989; see Figure 2):

$$IC = \sqrt{BC^2 - BI^2} \quad \text{..... (1)}$$

$$SWA_{ET} = \frac{1}{2} * (BC * IC) \quad \text{..... (2)}$$

Where:

C = EC = length of wing body-net (m)

IC = elbow (imagery line) of equilateral triangle

hence BC = BE, and BI = ½ BC (see Figure 2)

SWA_{ET} = swept area (m^2) of equilateral triangle area.

The rectangular area is estimated using the equation (3) and (4):

$$FB = \sqrt{AB^2 - AF^2} \quad \text{..... (3)}$$

$$SWA_{RT} = FB * BE \quad \text{..... (4)}$$

Where:

AB = length of hauling rope (m)

AF = ½*AB (the elbow of equilateral triangle)

SWA_{RT} = swept area of rectangular area (m^2).

Time-trend perception.

Time-trend perception was measured through interview of local fishermen of an age over 55 years old. This time-trend perception was based on six basic questions on: trend in reduced catch biomass, reduced catch size, the use of fishing power (fishing crew or fuel consumption), habitat degradation, and contribution of catch in their family income. Only six local fishermen were selected for interview in each site due to limited numbers of fishermen who age >55 years old.

Catch Species.

The catch species were identified to the most possible taxa. Identification procedure was merely based on morphological characters using finfish identification guide (Carpenter and Niem, 1999a; 1999b; 2001a; 2001b). An update of nomenclature (correct naming of species) was based on Eschmeyer et al., (2010) and Kottelat (2013). Following quick identification, each species was photographed and preserved with 10% formalin for 48 hours. Then, it rinsed in tape water for another 48 hours and fixed to be preserved with saturated alcohol. Careful identification procedure was finalized and all specimens were permanently stored for collection.

Data Analyses.

Average and standard deviation of catch biomass was calculated based on forth-night data collection in each site. Total bottom area swept by the net was estimated based on the area of equilateral triangle plus rectangular forms. Similarity in catch species among sites was clustered based on Euclidean Coefficient and presented in the form of phenogram. All statistical analyses and cluster were elaborated with statistical software of SPSS v.16.

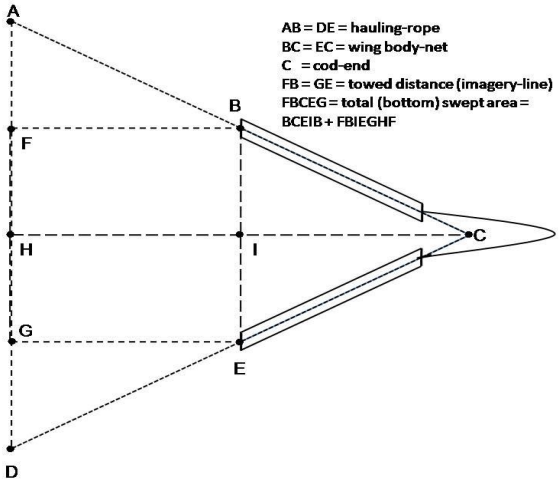

Figure 2. Procedure applied to estimate total bottom area swept by Beach Seine (FBC-CEG) based on equilateral triangle formed by net opening and rectangular towing distance when pulling net onto the beach.

RESULTS AND DISCUSSIONS

Characteristics of Beach Seine Fisheries.

There are two types of Beach seine size in East Java based on the length of hauling-rope and wing body-net (Table 1). These two variables determined total bottom area swept by the gear and consequently, bottom habitats impacted due to gear operations. Beach seines in Banyuwangi were considered the smallest compared to those at other areas. In the contrary, Prigi Beach operated the biggest beach seine, followed by Dangkal Beach, Pacitan. The estimated total bottom areas swept by gear in Prigi is fixed and reached ±8.9 ha. Commercial beach seines in Australia (Broadhurst et al., 2007) commonly composed of anterior wing (375 m), posterior wing (60 m), and a bunt of around 12 m. It produces around 4,000 tons fish annually, contributing AU$ 9 million. Total beach seine in East Java resulted in total catches of about 247 tons (DJPT, 2015). So, in terms of wing body-net, commercial beach seines in Australia are seven times bigger than the size of the largest Beach seine in East Java (Prigi), and even more than 16 times in terms of total catches. This proved that fishermen do not always adapted to new fishing innovation (Kawamura et al., 1983; Bavinck and Karunaharan, 2006).

As size matter, average catch biomass in Prigi was the highest compared to other areas (35.8±33 kg haul^{-1}). Average catch biomass in Madura and Banyuwangi are significantly less and dominated with invaluable species, being lizardfishes and ponyfishes (Table 1). In terms of time being sacrificed for fishing, crews receive payment that significantly below the minimum standard for regional wage. Filling leisure time, community gathering, and passion are the most reasons for them to keep operating the gear. This can be seen from low active fishing days of the gear in all sites (DJPT, 2015).

Total numbers of finfish species found in the catches are comparable among sites. These species diversity were significantly lower than that in Mediterania (Cabral et al., 2003) with 60 species, Australia (Broadhurst et al., 2007) with total 70 species or even South Africa (Beckley and Fennessy, 1996; Nunoo and Azumah, 2015). Australia and Indonesia are considered as two countries

with the most diverse fishery species (Froese and Pauly, 2015). The most reason for less variety species being caught in Indonesia was the fact that it being operated from the shore line, with fixed fishing ground from time to time, and much smaller size of Beach Seine. Species diversity in the catch would have theoretically been much higher if it operated in more variety and wider area of fishing grounds.

Table 1. Characteristic Nature of Beach Seine Fishery Operating Per Site in East Java.

No.	Characteristic items	Sampling Sites			
		Padikde Talango	Santan Island	Prigi Beach	Dangkal Beach
1	Length of wing body-net (m)	60 m	30 m	60 m	60 m
2	Length of hauling rope (m)	240 m	120 m	420 m	360 m
3	Swept-Area (SWA_{ET} + SWA_{RT})	2.9 ha	0.7 ha	8.9 ha	6.5 ha
4	Boat power (machine)	15 HP	manpower	manpower	manpower
5	Fishing crews (fisher)	6	4	30	20
6	Active fishing days $month^{-1}$	$6.8\pm3,5^{bc}$	10.2 ± 4.3^{a}	5.6 ± 2.6^{c}	8.6 ± 3.8^{ab}
7	Average catch biomass (kg)	7.1 ± 3.4^{b}	4.2 ± 3.2^{b}	34.4 ± 33.0^{a}	22.5 ± 12.2^{ab}
8	Dominant species within catches	Lizardfish	Ponyfish	Hairtails	Ponyfish
9	Record species within catches	42	43	37	37

Note: character(s) after values indicate significant difference at $\alpha = 0.05$.

Beach seines, as usually common, operate at places where nursery grounds of most fish occur (Akel and Philips, 2014). However, this is the characteristic nature of small scale and mostly subsistence fisheries, as particularly common. On the contrary, enhanced fishing technology has proven to cause severe over-fishing that lead to economic inefficiency. These over-grown fisheries lately need government subsidies to maintain the business (Sumaila et al., 2012; Sumaila, 2015). Under this circumstance, the unsubsidized beach seines continue to survive with main goal on family food security.

Beach seine operated in Banyuwangi has the most diverse species in the catch (Table 1). Some of the species were not confirmed due to obscurity in morphological sign from one to another. Clustering species similarity among sites resulted in two groups. Species caught in Banyuwangi falls into one group with that caught in Prigi Beach Trenggalek and Dangkal Beach Pacitan (Figure 3). Apart from pony fishes of demersal, species in Banyuwangi (Santan Island) and Pacitan (Dangkal Beach) were dominated with clupeids (mainly oil-sardine), carangids, and scombrids. With no clear reason, catching species in Prigi was more dominated with hairtails species that made it different with the former. Catching species in Sumenep were mostly demersal and reef species, such as serranids.

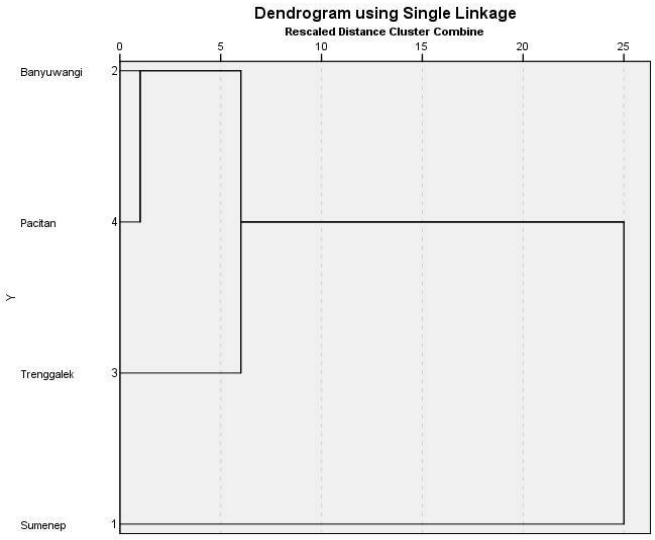

Figure 3. Phenogram indicating species similarity found within catch of beach seine among sites (Padikde Talango Sumenep, Santan Island Banyuwangi, Prigi Beach Trenggalek, and Dangkal Beach Pacitan.

Ministerial Decree Banning Beach Seine Operation.

Ministerial Decree No. 2/2015 is just currently enacted, prohibiting the operation of all gears of towed-net categories, such as Trawls, and pulled-net for Danish Seine. Two main reasons for this ban are most of the fisheries being over-fished, and degradation of important fish habitats, such as coral reefs. Beach seines of all categories are included in this regulation.

Results of fishermen time trend perception showed a clear indication on the onset of over-fishing. This was observed from reduced catch biomass and fish size in the catch compared to around 30 years ago (Table 2). However, over-fishing is closely related to more effective gears with high catchability coefficient, and destructive fishing activities (Burke et al., 2002; Broadhurst and Millar, 2011). Total catch from beach seine in East Java contributes less than 2% of total catch biomass annually, and only up to 2.4% of national total fisheries catch (DJPT, 2015). From this point of view, banning all Beach Seine fisheries may not result in significant replenishment of fishery resources.

The operation of beach seine may result in habitat degradation as it is dredged closely to bottom substrates (Gray and Kennelly, 2003). However, as was clearly mentioned before, all Beach Seines in East Java are operated at fixed fishing grounds. Total bottom substrate, if affected, was less than 9 ha per site. Considering that only four sites are currently active, Beach seine fisheries will not significantly affect toward habitat degradation. On the contrary, mini-trawls and Danish Seines are much bigger size, and always moving from one fishing ground to the other (Garces et al., 2006). Beach seines in many developed countries are still considered as legal fishing gear (Gray and Kennelly, 2003; Cabral et al., 2003; Akel and Philips, 2014; Lombardi et al., 2014), and in developing countries as well (Monteclaro and Abunal, 2013; Nunoo and Azumah, 2015). So, with very low catch contribution, and very limited and localized effect on bottom habitats, beach seine should not be treated as equal as their relatives, such as trawls and other seine nets.

Table 2. Fishermen Time-Trend Perception on Reduced Catch Biomass, Catch Size, Habitat Degradation, and Family Income Contribution from Beach Seine.

No	Questions and Answers of Respondents	Sampling Sites:			
		Padikde Talango	Santan Island	Prigi Beach	Dangkal Beach
1.	Indication in reduced catch-biomass compared to that of 30 years ago:				
	• Clearly reducing	100	100	100	83
	• Some-what reducing	0	0	0	17
2.	Indications in reduced fish size in the catch compared to 30 years ago				
	• Clearly reducing	100	100	100	50
	• Some-what reducing	0	0	0	50
3.	Indication of habitat degradation due to beach seine operations:				
	• Limited degradation	0	0	17	0
	• Almost no impact	100	100	83	100
4.	Impact on family income from beach seine operation compared to 30 years ago:				
	• Quiet impacted	0	0	17	50
	• Less impacted	50	50	17	13
	• Almost no-impact	50	50	66	37
5.	Fishermen interest working/investing in beach seine compared to 30 years ago:				
	• Remain similar	17	0	0	17
	• Decreasing	17	17	17	50
	• Almost no interest	66	83	83	33

CONCLUSIONS

Beach seines in East Java are currently operated at four fixed sites: Padikde Talango Sumenep, Santan Island Banyuwangi, Prigi Beach Trenggalek, and Dangkal Beach Pacitan. The largest bottom area impacted by gear operation was assessed to be ±9 ha, with average catch biomass of 15±19.4 kg trip^{-1}. Total species in the catch varied between 37-42 species and considered low as it was operated near shore line. Considering low catch contribution, negligible habitat degradation, and in order to keep subsistence fisheries, the reason to include this gear in the banning policy may weak.

ACKNOWLEDGEMENT

The authors are very grateful to Ministry of Research, Technology, and Higher Education in Jakarta for encouragement and financial support of this study. Also, we wish to express our sincere thanks to Institute of Research and Community Services (LPPM) of University of Brawijaya for guidance and support.

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