



Potential yield and fishing season of anchovy (*Stolephorus* sp.) in Banten, Indonesia

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Abstract. Banten Province has potential, strategic and abundant fisheries resources. Anchovy (*Stolephorus* sp.) is one of economically important commodity in the area, contributed to 28% (6,474.5 tons) of small pelagic catch in 2015. Demand for anchovy products is increasing and the processing industries are growing at local as well as national level. This research aims to estimate potency and fishing season of anchovy fisheries in Banten Province. It was conducted in six months (February to July 2017), covering four regencies and two cities. Potency of fish resources was analyzed using surplus production model while fishing season of anchovy was analyzed with fishing season index. Study finds the potency of anchovy resources in Banten Province is 4,860.39 tons. Most of it was caught in Northern Java Sea waters by 3,044.82 tons (63%). Fishing season is almost all year but peaks of season vary among areas. Fishing season of anchovy in the Northern Java Sea occurred in January to June, with the peak season occurred in April. In the Sunda Strait occurs in April and June to September, the peak season occurred in April. In Southern Java Sea occurred in January to March and July to September, with the peak season occurred in August.

Key Words: anchovy, April, Banten, Northern Java Sea, peak season, potency.

Introduction. Anchovy (*Stolephorus* sp.) is one of economically important small pelagic fishes that greatly contributed to fisheries production in Banten Province. It is commonly caught by lift net that has economic value between USD 5.77-6.92 per kg (Susanto et al 2017). The production in 2015 reached 6,474.5 ton or 28% from total small pelagic fish production (Dinas Kelautan dan Perikanan 2017). Actual production may be higher than number estimated since the fishermen infrequently land their anchovy at fish landing sites, or directly sell the fish to anchovy collector (commonly called langgan or palele) on the sea, so it was not entirely recorded at the fishing port. It was become indicator of a poor fishery management due to large quantity fluctuation and increased variability in anchovy catches (Paredes & Gutierrez 2008; Tvetaras et al 2011).

The information about maximum sustainable yield (MSY) and peak fishing season of anchovy in Banten Province was still limited. A major issue in anchovy fishery in the area was the fluctuation of catches that heavily relied in fishing seasons. Small pelagic fishing season in Sunda Strait was occurred on August (Jumarang & Ningsih 2013). Fishing season cycle in Banten Province is commonly influenced by monsoon wind, especially at Sunda Strait. Information about fishing season could be support to fisheries management approaches to conserve and improve anchovy stocks and resources in Banten Province (Rola et al 2018).

The limited knowledge and innovation caused anchovy fishery cannot maintain the stability of amount product yearly. However, the fishermen and government officer of Banten Province have no strategy to optimize the utilization of anchovy resources. It is necessary to inform the potential yield and fishing season of anchovy to fisheries actors as an effort to develop and utilize the potential of anchovy. The aim of the research is to estimate potential yield and fishing season as main information to formulate the management strategy of anchovy fisheries in Banten Province.

Material and Method. The research was conducted from February to July 2017 in Banten Province, covering four regencies and two cities: Serang Regency, Serang City,

Cilegon City, Tangerang Regency, Lebak Regency and Pandeglang Regency. Location selection was based on fisheries production and anchovy fishing activities in each area. The primary data in each region come from interview process with fishermen, government officer of fisheries and marine agency, processing industries, fish landing place manager and distributors of dried anchovy. The published time series data (5 years) from government office also collected includes types and number of fish production, fish production value, type and number of fishing gear.

The number of fish resource was analyzed using surplus production model (Sparre & Venema 1998), so that the potential value of biological resources of anchovy can be obtained. The potency of anchovy was defined on MSY and total allowable catch (TAC). The analysis of the fishing season uses the average percentage method based on time series analysis (Kekenusa 2006). The potency and fishing season describe on thematic map for Java Sea, Sunda Strait and Indian Ocean area.

Results and Discussion

Potential yield of anchovy. Banten Province has various water characteristics. In the north, coastal area directly borders with the Java Sea under administration of Serang City, Serang Regency, and Tangerang Regency. Coastal areas in the western part of Cilegon City and Pandeglang Regency directly adjacent to the waters of the Sunda Strait where water masses from the Java Sea and Indian Ocean meet. The condition of mixing the water masses between the two waters causes the region to become a potential fishing area throughout the year (Sachoemar & Yanagi 2000; Kunarso et al 2005; Salim & Sutanto 2014). Meanwhile in the southern coastal area, Lebak regency has coastal areas directly adjacent to the Indian Ocean that is rich in various types of fish, especially large pelagic fish group that has high economic value.

Anchovy in the areas are caught by various types of fishing gear (fixed lift net, floating lift net, stick-held dip net, and boat lift net) that also caught other small pelagic fish such as mackerel, scads, and sardines (Susanto et al 2017). The multi-species and multi-gear nature of fish resources in Indonesia is a limiting factor in determining the potency of fish resources species-based in Banten Province. Due to the different water characteristics, the estimation of the potential of small pelagic fish resources and the anchovy is further divided by the main waters area. Estimation of potential obtained can provide a more accurate picture so as to reflect the condition of small pelagic fishery resources, especially anchovy in the waters of Banten Province.

The value of sustainable potential of anchovy resources in Banten was estimated to 4,860.39 tons, reaches 18% of the total potential of small pelagic fish. Northern Java waters have highest resources compared to other regions. In contrast, the territorial waters of southern Java Sea (Indian Ocean) have a smaller potential of anchovy resources compared to other regions. An estimate of the potential of anchovy is presented in Figure 1. The value of this sustainable potential yield is one of the important parameters for the management and policy determination of anchovy fisheries in the future (Supardan et al 2006; Pangalila 2014; Sutono & Susanto 2016).

The territorial waters of the Indian Ocean are an area of oceanic waters with a base of waters that have a mountainous topography and hilly terrain. Prominent resources in this area of the waters are large pelagic fish such as tuna. Some other resources are shrimp and demersal resources located primarily in areas close to shore (Kementerian Kelautan dan Perikanan 2014).

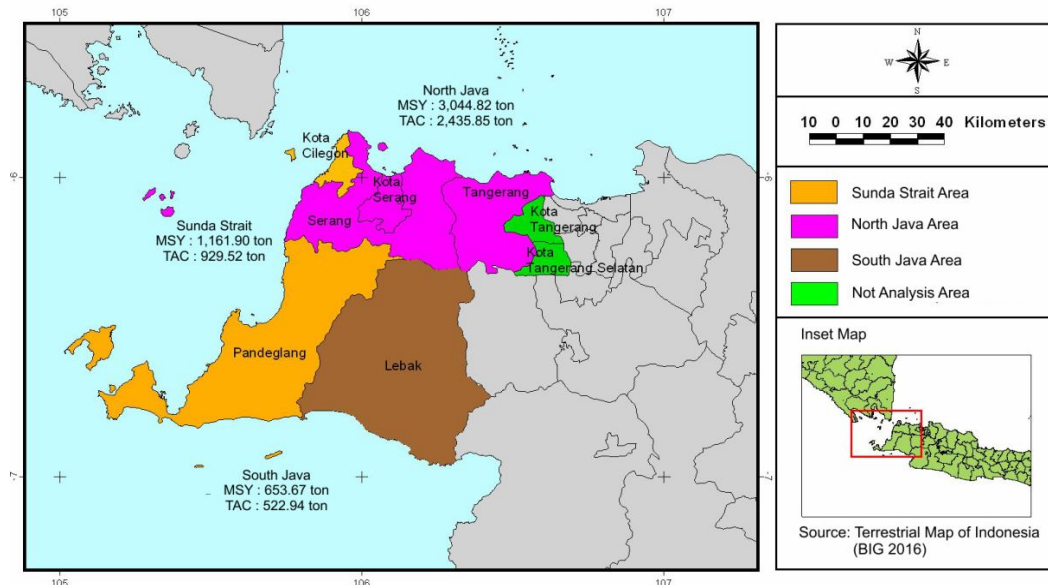


Figure 1. Potential yield of anchovy in Banten Province.

Fishing season of anchovy. Fishing season was obtained from the pattern of highest yields of anchovy catch by fishermen. During fishing season, the fishermen' yield rate is higher than at any time than other season. In simple words, fishing season in each year is the period (month) where the number of catch is greater than the average catch during the season period (Uktolseja 1997). The value of fishing season index can be used in the timing of fishing operations. This fishing season index is derived from frequency of fishing operations using monthly catch per unit effort (CPUE) data over certain period of time. Based on the value of the fishing season index, fishing season pattern could be easily drawn to determine proper fishing time (Syahrir et al 2010). The results of the fishing season index calculation of anchovies are presented in Table 1 and Figure 2.

Fishing season in Banten Province can be said almost all year, but peaks of season vary among areas. Fishing season of anchovy in the Northern Java Sea occurred in January to June, with the peak season occurred in April. In the Sunda Strait occurs in April and June to September, with the peak season occurred in April. In Southern Java Sea occurred in January to March and July to September, with the peak season occurred in August.

Table 1
Fishing season of anchovy in Banten Province

Month	Fishing season index (%)		
	Northern Java Sea	Sunda Strait	Southern Java Sea
January	99.96	34.23	164.90
February	134.59	60.26	125.74
March	145.27	71.84	126.57
April	219.08	403.29	34.97
May	84.40	44.06	28.64
June	128.94	134.53	87.01
July	34.51	147.54	113.52
August	33.17	108.85	174.59
September	27.73	87.94	158.91
October	108.50	51.24	61.63
November	96.88	28.29	57.76
December	86.96	27.93	65.76

Note: Bold numbers are peak season of each area.

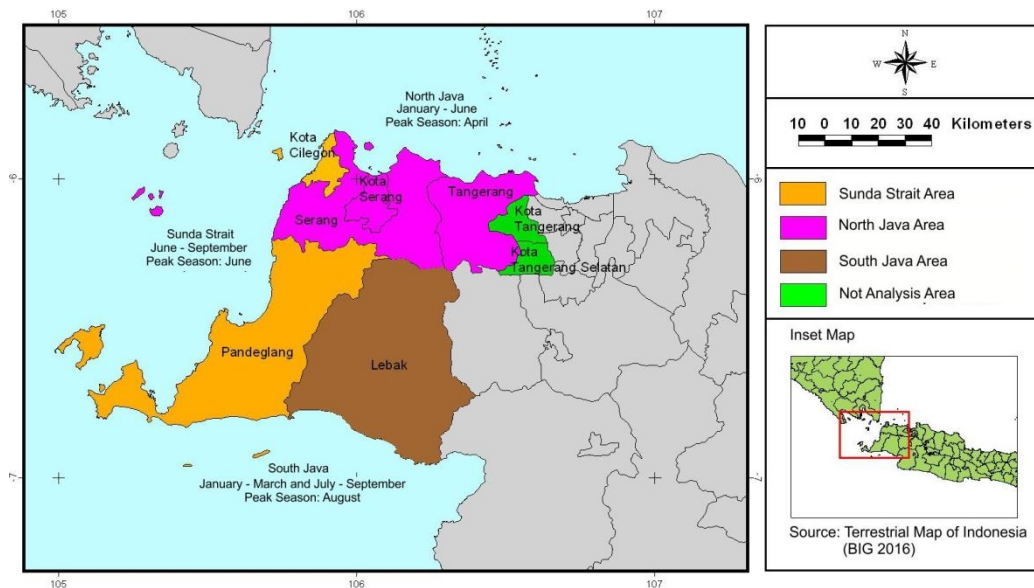


Figure 2. Fishing season of anchovy in Banten Province.

Fishing season of anchovy fishery was also reported by several studies with different season peaks. Fishing season pattern of anchovy fishery in Pemalang Regency - Central Java waters peaks on March and July to September (Rahmawati et al 2013), while in Tegal Regency coast peaks on March to June (Sutono & Susanto 2016).

Anchovies are usually caught by lift net and boat seine. Lift net operated at night which uses light to attract fishes in order to harvest them. While boat seine operated during the day. During west monsoon, lift net fishermen paused their activities due to strong wind and waves.

The abundance of small pelagic fish, including anchovy, tends fluctuating. Anchovy are likely to occupy coastal waters whose environmental conditions are more dynamic. The dynamics of anchovy is also influenced by fishing pressure because of its habitat in coastal areas that is relatively easy to reach by small scale and large scale fishing business (Simbolon 2011). The condition of Sunda Strait waters is dynamic because it is a mass mixing water from the Java Sea and Indian Ocean allegedly also have a positive impact on the productivity of anchovy fishery in Pandeglang area.

Similarly, Riyanti (2017) suggested that industrial activities in Bojonegara – Serang Regency coastline have negative impact to the activities of anchovy fishery based on Kepuh landing place. The boat seine that once operated in Bojonegara waters now shifted away to the Pulau Panjang waters, since anchovy are no longer caught in the waters of Bojonegara due to industrial waste.

Weather changes such as the western and eastern seasons also affect the location of the fishing ground of the lift net, especially the stationary lift net. In general, stationary lift net moved to different fishing locations twice a year, i.e. after the west monsoon (March-July period) and after the east monsoon (August-November period). However, further research is needed related to the location of lift net fishing ground in all waters of Banten Province.

Conclusions. Potential yield of anchovy resources in Banten Province estimated 4,860.39 tons year⁻¹, reaches 18% of the total potential of small pelagic fish. Waters in Northern Java Sea have the greatest potential of anchovy resources compared to other regions. Fishing season in Banten Province can be said almost all year. Fishing season of anchovy in the Northern Java Sea occurred in January to June, with the peak of fishing season occurred in April. Fishing season of anchovy in the Sunda strait occurs in April and June to September, with the peak of fishing season taking place in April. Fishing season of anchovy in Southern Java Sea occurred in January to March and July to September, with the peak of fishing season occurred in August.

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References

- Dinas Kelautan dan Perikanan, 2017 [Fisheries statistical report of Banten Province, year 2015]. Dinas Kelautan dan Perikanan Provinsi Banten, Serang, 70 pp. [in Indonesian]
- Jumarang M. I., Ningsih N. S., 2013 [Mass water volume transport in Sunda Strait because of enso, monsoon and dipole mode]. Prosiding Semirata FMIPA Universitas Lampung, pp. 409-415. [in Indonesian]
- Kekenusa J. S., 2006 [Analysis of fishing season for skipjack tuna *Katsuwonus pelamis* in the water adjacent to Bitung, north Sulawesi]. Jurnal Protein 13:103-109. [in Indonesian]
- Kementerian Kelautan dan Perikanan, 2014 [Potency and level of utilization of fish resources in fishery management area of Republic of Indonesia]. Suman A., Wudianto, Sumiono B., Irianto H. E., Badrudin, Amri K. (eds), KKP dan Ref Publisher, Jakarta, 224 pp. [in Indonesian]
- Kunarso, Ningsih N. S., Supangat A., 2005 [Upwelling characteristics along the southern waters of Nusa Tenggara Timur and West Sumatera]. Ilmu Kelautan 10:17-23. [in Indonesian]
- Pangalila F. P. T., 2014 [Anchovy fishery assessment in Buyat Bay]. Jurnal Ilmu dan Teknologi Perikanan 1:148-154. [in Indonesian]
- Paredes C. E., Gutierrez M. E., 2008 The Peruvian anchovy sector: costs and benefits. An analysis of recent behavior and future challenges. IIFET Conference Proceedings 2008, Portsmouth, UK, 10 pp.
- Rahmawati M., Fitri A. D. P., Wijayanto D., 2013 [Analysis of catch per unit effort and the pattern of anchovies (*Stolephorus* spp.) fishing season in Pemalang waters]. Journal of Fisheries Resources Utilization Management and Technology 2:213-222. [in Indonesian]
- Riyanti T., 2017 [Effect of industrial waste disposal on the change of boat seine fishing ground in Bojonegara waters of Banten Province]. Jurusan Perikanan, Fakultas Pertanian, Universitas Sultan Ageng Tirtayasa, Serang, 43 pp. [in Indonesian]
- Rola A., Narvaez T. A., Naguit M. R. A., Elazegui D., Brillo B. B. C., Paunlagui M., Jalotjot H. C., Cervantes C., 2018 Impact of the closed fishing season policy for sardines in Zamboanga Peninsula, Philippines. Marine Policy 87:40-50.
- Salim A., Sutanto T. E., 2014 [Model of oil spill movement in the waters of the Sunda Strait]. Cauchy 3:99-107. [in Indonesian]
- Sachoemar S. I., Yanagi T., 2000 Seasonal variation in sea surface temperature around Java derived from NOAA AVHRR. La mer 38:65-75.
- Simbolon D., 2011 [Bioecology and dynamics of fishing ground]. Departemen Pemanfaatan Sumberdaya Perikanan, Fakultas Perikanan dan Ilmu Kelautan, Institut Pertanian Bogor, Bogor, 219 pp. [in Indonesian]
- Sparre P., Venema S. C., 1998 Introduction to tropical fish stock assessment. Part I - Manual. FAO Fisheries Technical Paper No. 306.1, Rev. 2, Rome, 407 pp.
- Supardan A., Haluan J., Manuwoto, Soemokaryo S., 2006 [Maximum sustainable yield (MSY) and its application of the utilization policy of fish resources in Lasongko Bay Buton Regency]. Buletin PSP 15: 35-49. [in Indonesian]
- Susanto A., Irnawati R., Mustahal, Syabana M. A., 2017 Fishing efficiency of LED lamps for fixed lift net fisheries in Banten Bay Indonesia. Turkish Journal of Fisheries and Aquatic Sciences 17:283-291.
- Sutono D., Susanto A., 2016 [Anchovy (*Stolephorus* sp.) utilization at coastal waters of Tegal]. Jurnal Perikanan dan Kelautan 6(2): 104-115. [in Indonesian]

- Syahrir R. M., Baskoro M. S., Darmawan, Lubis E., Wiyono E. S., 2010 [The pattern of the pelagic fishing season at Apar Bay]. *Jurnal Ilmu Perikanan Tropis* 13(1):24-31. [in Indonesian]
- Tveteras S., Paredes C. E., Penna-Tores J., 2011 Individual vessel quotas in Peru: stopping the race for anchovies. *Marine Resource Economics* 26(3):225-232.
- Uktolseja J. C. B., 1997 [Abundance index of tuna and skipjack around the FADs]. Balai Penelitian Perikanan Laut, Jakarta, 29 pp. [in Indonesian]

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