

# The Biology Profile of *Sardinella lemuru* in Southern Coast of East Java and Bali Strait, Indonesia

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## ABSTRACT

*Sardinella lemuru* is a species of fish on East Java which has pressure from overfishing and also climate change. This condition can impact their biology profile. The aim of this study was to determine the profile biology (BP) of *S. lemuru* on Southern Coast of East Java. The BP parameters like morphometric and meristic analysis, observation sex ratio, level maturity of gonad and gonad maturity index, were examined. The results showed that the body of *S. lemuru* was compressed or streamline and has blue-green colors on its dorsal. The scale type of *S. lemuru* was cycloid. Females *S. lemuru* were dominant on Southern Coast of East Java. Gonad Maturity Level and Gonad Maturity Index showed that *S. lemuru* from Bali Strait has a higher number than *S. lemuru* from Southern Coast of Malang. Since *S. lemuru* from both origins had similarities in its morphology and gonad, it was suspected that *S. lemuru* was migrating from Bali Strait to Southern Coast of Malang. Further study should be conducted so that the data could more represent biology profile of *S. lemuru* in southern coast of East Java by adding genetical analysis.

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## INTRODUCTION

The condition of Southern coast of East Java is fertile. This condition is influenced by oceanographic process, especially upwelling [1]. Upwelling occurs when water mass and nutrients from the sea bed rises to the surface and make conditions in the surface becomes fertile [2]. In this condition, many small pelagic fish were found in the water column. One of the small pelagic fish most frequently found was *Sardinella lemuru* [3]. It is one of the main commodities small pelagic fish that exist in the South Coast of East Java and Bali Strait [4].

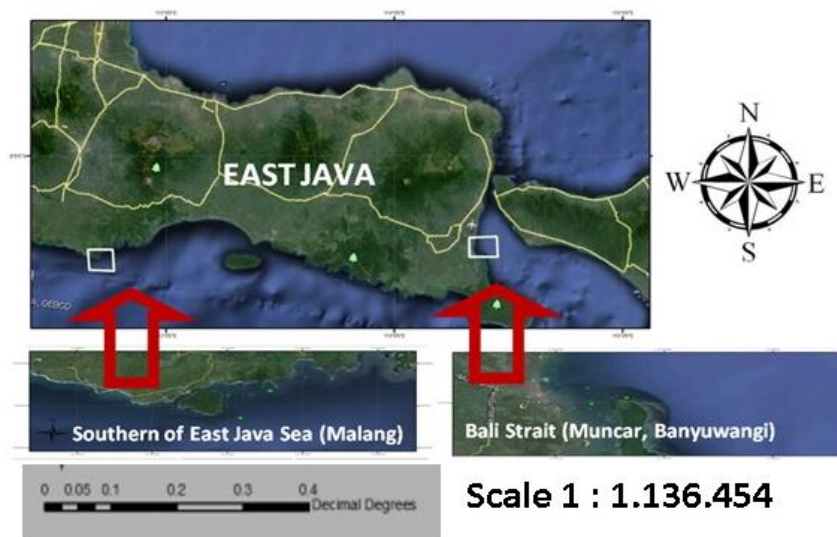
*Sardinella lemuru* has an important economic value because the nutrients containing: 78% water, 20% protein, and 0.7% fat [5]. There was approximately 90% of fish caught by fishermen of Bali Strait [6]. Fishery industries increased because there are many consumers demand for *S. lemuru*. Indirectly, this condition can lead the overfishing condition of *S. lemuru* and affect the biological profile of *S. lemuru* [7]. One of effort to conserve fishery resources especially for *S. lemuru* is necessary to determine the biology profile of *S. lemuru* at Southern Coast of East Java and Bali Strait.

The aim of this study was to determine and classify the biology profile of *S. lemuru*. The biology profile examined in this study was: morphometric and meristic analyses, sex ratio observation, maturity level of gonad and gonad maturity index.

## MATERIAL AND METHODS

### Data Collecting

This study was conducted in August and September 2015. *Sardinella lemuru* was collected from Bali Strait (114,369588 ; 8, 451985) and Southern Coast of Malang, East Java (112,726610 ; 8,467681) (Figure 1). Total specimens used in this study are 30 specimens from two research area. Specimens' size was ranged from 15–17 cm long and 35–45 g weight.



**Figure 1.** Map of research area was showing the two sampling sites: Southern of East Java Sea (Malang) and Bali Strait

### Morphology, morphometric and meristic analysis

The observation of *S. lemuru* morphology included the types of scales, color pattern, body shape, tail shape, tail type and fish weight. Besides morphology, thus morphometrics and meristics parameters were also conducted in this study. Morphometrics analyses were measuring the total length (TL), standard length (SL), forked length (FL) and orbital length (OrbL). While the meristics parameters were including the total dorsal and anal scutes, total dorsal and anal fin rays [8].

### Analysis of sex ratio

Sex ratio analysis was used in order to determine the sex of *S. lemuru* as to be seen on genitalia hole. The genitalia hole was indicated the differences between male and female of *S. lemuru*. The sex ratio can be calculated based on the total male and female. Pattern to calculate sex ratio refers to the reference [9].

$$S = \frac{\Sigma m}{\Sigma f}$$

Note: S = sex ratio  
 $\Sigma m$  = Total male specimens  
 $\Sigma f$  = Total female specimens

### Gonad maturity

Fish maturity can be analyzed by determining the maturity level and maturity index of *S. lemuru* gonad. Maturity level of *S. lemuru* can be observed by looking at the shape, color and weight of the gonads [10]. The Standard to estimate maturity level of *S. lemuru* gonad referred to Holden and Rait (1974) [11]. The description of maturation level of *S. lemuru* was presented at Table 1. Gonad maturity index can be observed by measuring total fish weight and gonad weight. Pattern to calculate refers to the reference [10].

$$GMI = \frac{\text{Gonad Weight}}{\text{Fish Weight}} \times 100$$

**Table 1.** Maturation level of *S. lemuru* gonad [11].

Stage	Status
1	Immature
2	Developing
3	Ripening
4	Mature
5	Spawning

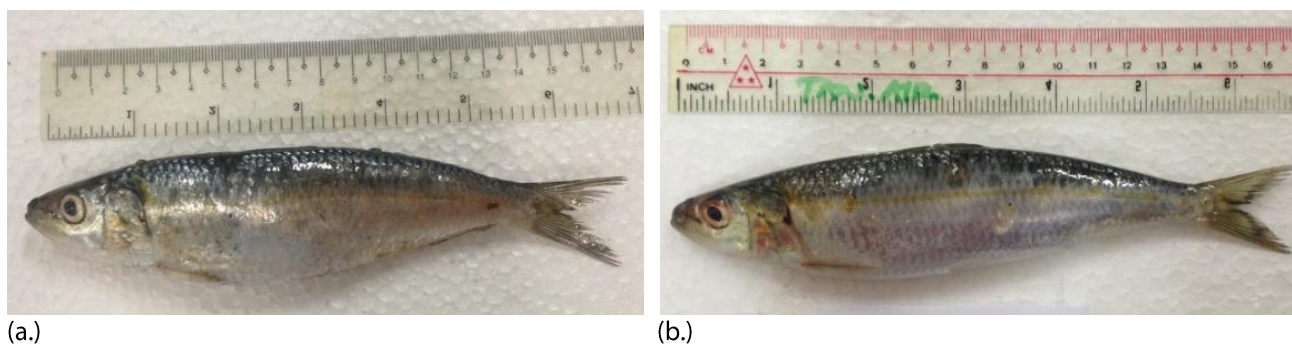
### Statistical analysis

All data were analyzed by with description method. Morphometric and meristic data were analyzed by PAST software with clustering analysis to classify based on the similarity index. The gonad profile was analyzed with description method.

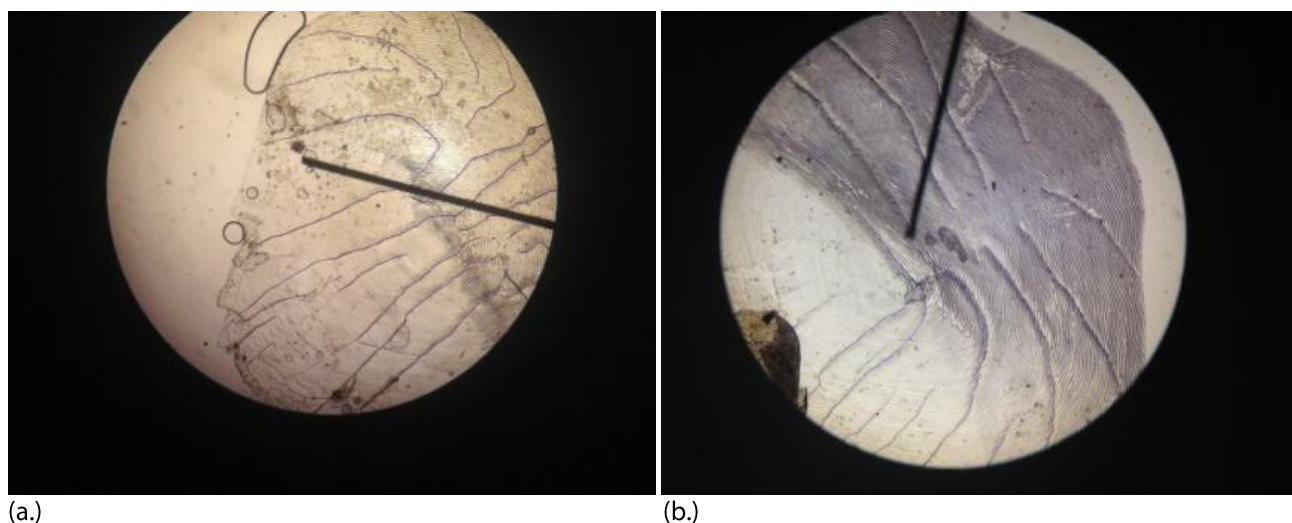
## RESULTS

### Morphology of *S. lemuru*

*S. lemuru* caught from Bali Strait and Southern Coast Malang has been to observed. Then, the morphology form has directly observe such body shape, type of tail and type of scale. The description of *S. lemuru* from Bali Strait and Southern Coast Malang is shown on Figure 2. Scale type of *S. lemuru* also observes in this study that aim to classify *S. lemuru* from two area in Southern Coast of East Java. Fish scale also can to predicts these classify be carnivores or herbivores and also to predict fish ages. Scale type of *S. lemuru* is shown on Figure 3.



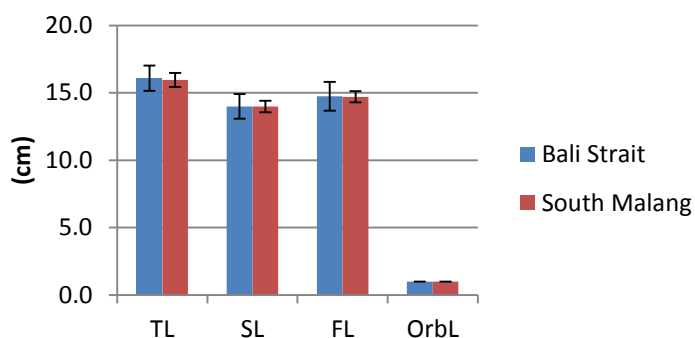
**Figure 2.** Morphology *S. lemuru* : (a.) Bali Strait and (b.) Southern Coast Malang



**Figure 3.** Type scale of *S. lemuru* : (a.) Bali Strait and (b.) Southern Coast of Malang

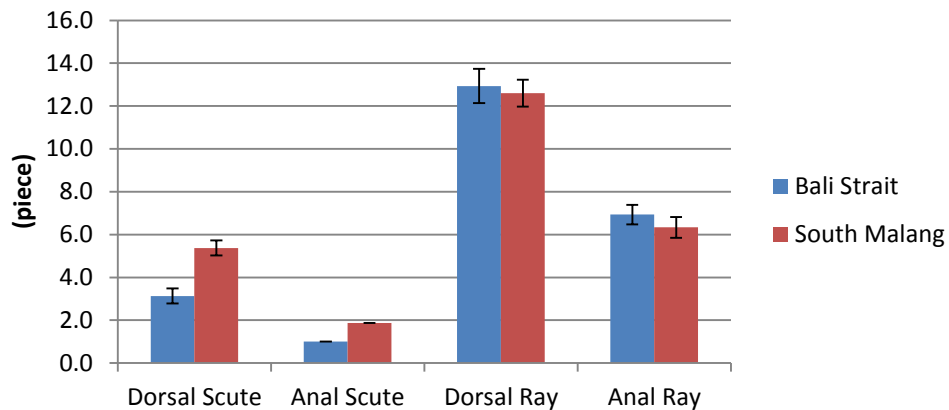
### Morphometric and meristic analyses

Morphometric and meristic data showed that the size of *S. lemuru* from Bali Strait was bigger than *S. lemuru* from Southern Coast of Malang. Enviromental factors in the ocean can affect the growth of fish in the ocean. Upwelling is one of enviromental factor which regulates the nutritions in the ocean. The diagram of *S. lemuru* morphometric is shown on Figure 4.



**Figure 4.** Diagram morphometric of *S. lemuru*

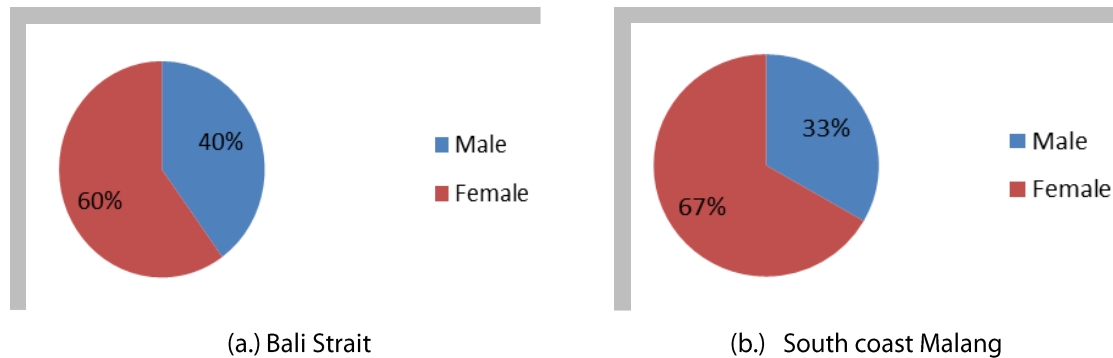
The data of meristic showed the same result with the morphometric data. However, the number of dorsal scute and anal scute of *S. lemuru* from Southern Coast of Malang was more than *S. lemuru* from Bali Strait. This condition can be caused by the environmental factors and the availability of food stock in the ocean. The diagram of *S. lemuru* meristic is shown on Figure 5.



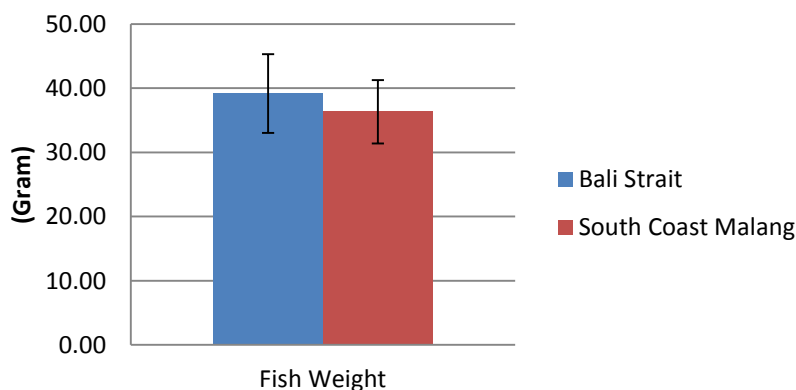
**Figure 5.** The meristic diagram of *S. lemuru*

### Sex ratio analysis

The analysis of sex ratio was aimed to know the sex composition on the fish population. Sex determination on fish can be conducted directly by observing the fish genitalia holes. The sex composition of *S. lemuru* is shown on Figure 6. Measurements of *S. lemuru* gonad weight was also carried out in this study that aimed to determine the profile of *S. lemuru* gonad in Southern Coast of East Java. The diagram of *S. lemuru* gonad weight is shown on Figure 7. Sex ratio of *S. lemuru* can be determined when the data about fish sex was obtained. Sex ratio of *S. lemuru* can be calculated with the ratio of the total number of female with male fish. The result showed that the sex ratio *S. lemuru* in Bali Strait (0,7) was higher than the sex ratio *S. lemuru* in Southern Coast of Malang (0,5).



**Figure 6.** The sex composition of *S. lemuru* in the (a.) Bali Strait and (b) Southern Coast Malang



**Figure 7.** The diagram of *S. lemuru* gonad weight

### Maturity of gonad

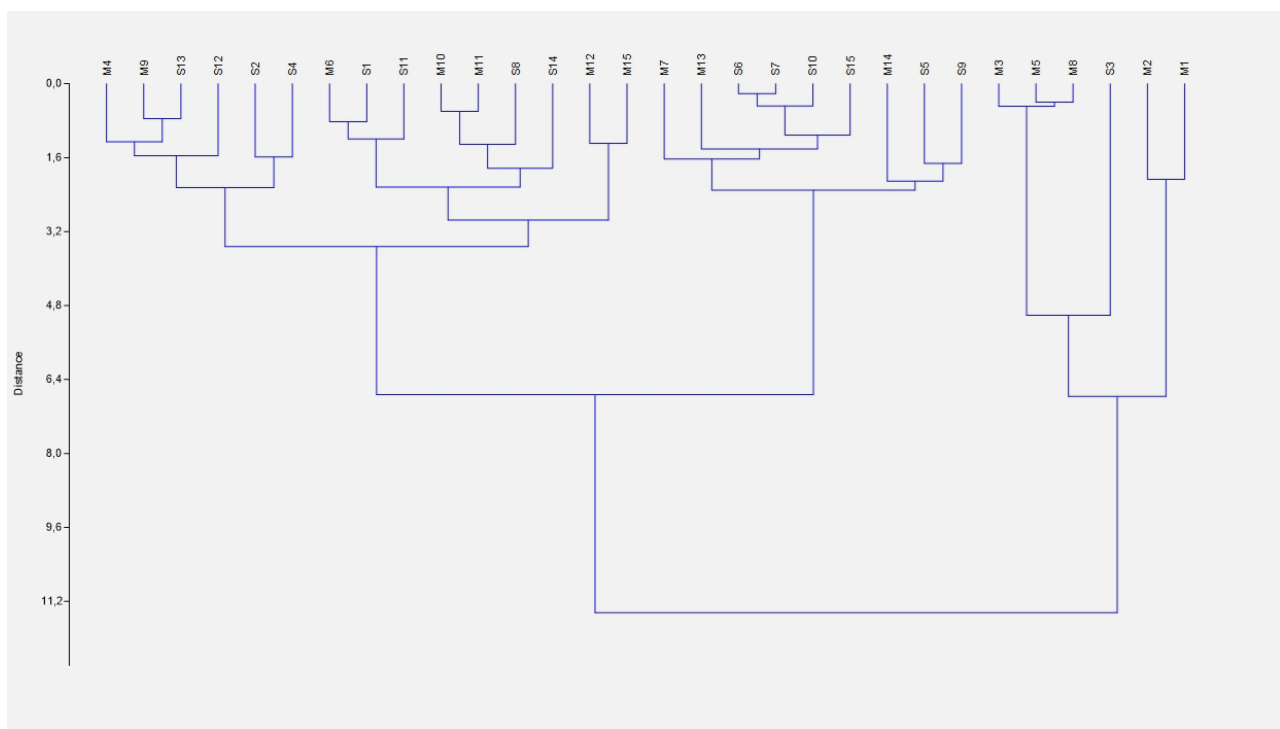
Specimens were dissected on the fish abdomen then fish gonads were observed directly. Analysis to determine Gonad Maturity Level (GML) and Gonad Maturity Index (GMI) was used to observe the condition of the gonads. Table of GML and GMI of *S. lemuru* in Southern Coast of East Java is shown on Table 2.

### Clustering analysis

Morphometric and meristic data were analyzed using clustering analysis. The results of the analysis were obtained based on the index similarity. The result of clustering analysis of *S. lemuru* morphometric and meristic is shown on Figure 8. Based on the result of clustering analysis, the specimen which has the closest index similarity area were S6 and S7 approximately 0,1 while the furthest index similarity are M2 and M1 approximately 1,8.

**Table 2.** Gonad Maturity Level (GML) and Gonad Maturity Index (GMI) of *S. lemuru* in Southern Coast of East Java

Specimen	Bali Strait		Southern Coast of Malang	
	GML	GMI	GML	GMI
1	II	0.005	I	0.003
2	II	0.004	I	0.003
3	II	0.005	I	0.003
4	II	0.006	I	0.003
5	II	0.006	I	0.005
6	II	0.007	I	0.004
7	II	0.007	I	0.003
8	II	0.005	I	0.003
9	II	0.005	I	0.005
10	II	0.005	I	0.004
11	II	0.006	I	0.004
12	II	0.006	I	0.004
13	II	0.006	I	0.003
14	II	0.008	I	0.003
15	II	0.007	I	0.005



**Figure 8.** The result of clustering analysis of *S. lemuru* morphometric and meristic



## DISCUSSION

No significant differences were found on the Morphology of *S. lemuru* from Bali Strait and Southern Coast of Malang. *S. Lemuru* has a compressed body, blue-green colour on dorsal and their scale is cycloid [5]. Morphological form of *S. lemuru* had been studied such as: the similarities morphology of *S. lemuru* on Madura Strait, Bali Strait and Southern Coast Java. There is no significantly differentiation between specimens from three study areas. It means in these areas, *S. lemuru* has the lowest variation of morphology forms [12]. However, *S. lemuru* in Bali Strait has dynamics population because in this area these fish have the highest variation of morphology. *S. lemuru* caught from different area in Bali Strait showed the significant differences [13]. The main habitat of *S. lemuru* from East Java commonly in Bali Strait [5]. Water temperature can also affect the sex formation of fish embryos and their hormonal cycle. The increasing sea surface temperature can stimulate testosterone hormone on the fish body.

Meanwhile, when the temperature lower, hormone testosterone can not stimulates well but the other hormone such estrogen stimulates very well on the fish body. The low temperature in the ocean will mostly produce female sex formation [14]. Monsoons can regulates formation the population of *S. lemuru* in the ocean. *S. lemuru* on Eastern Monsoon mostly found females and so different when on Western Monsoon mostly found males [12]. The weight of *S. lemuru* gonad related with maturity level of gonads. The *S. lemuru* gonad which has heaviest weight can affect maturity level and index [4]. Gonad Maturity Level (GML) *S. lemuru* on January mostly found first stage of GML and turned into second stage at February. Then, *S. lemuru* GML reach on third stage on the end of March. This assumption can justify that spawning season occurs on June until July. On September, mostly in Bali Strait found juvenile of *S. lemuru* with range size approximately 5 cm [15].

## CONCLUSION

Generally, *S. lemuru* on Southern Coast of East Java has no significant differences. Morphology of *S. lemuru* from that area showed similar forms. The body of *S. lemuru* was compressed or streamline and has blue-green colors on its dorsal. The scale type of *S. lemuru* was cycloid. Females *S. lemuru* were dominant on Southern Coast of East Java. Gonad Maturity Level and Gonad Maturity Index showed that *S. lemuru* from Bali Strait had a higher number than *S. lemuru* from Southern Coast of East Java. Since *S. lemuru* from both origins had similarities in its morphology and gonad, it was suspected that *S. lemuru* was migrating from Bali Strait to Southern Coast of Malang. Further study should be conducted so that the data could more represent biology profile of *S. lemuru* in southern coast of East Java by adding genetical analysis.

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### Authors' Contributions

**Conception and design of study:** Indra Pramana Putra, Aida Sartimbul, Sri Widyarti;

**Acquisition of data:** Indra Pramana Putra;

**Analysis and/or interpretation of data:** Indra Pramana Putra, Aida Sartimbul, Sri Widyarti.

**Drafting the manuscript:** Indra Pramana Putra;

**Revising the manuscript critically for important intellectual content:** Indra Pramana Putra.

**Approval of the version of the manuscript to be published :** Indra Pramana Putra, Aida Sartimbul, Sri Widyarti

### Competing interests

I declare that I have no significant competing financial, professional or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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