Ornamental marine fish from the southern coast of Cilacap Central Java

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Abstract. Cilacap has a high potential for marine fisheries. However, no scientific data is available on the potential of marine ornamental fish from that area. Here we reported the preliminary study of the potential of marine ornamental fish from the southern coast of Cilacap with particular emphasis on species richness. A survey method with incidental sampling was conducted. Fish samples bought from the fish collector in Sentolo Kawat Village, District of South Cilacap, at Cilacap City. The fish samples were collected in April, May, and July 2019. Taxonomic identification of the fish samples was referring to the available reference and validated to the data in FishBase. Identification based on color pattern and meristic characters by considering geographic ranges of the specimen placed the samples into 28 species, 12 families, and four orders. Chaetodontidae was the most abundant family with nine species. Most fish belonged to Perciformes. We obtained a lower number of species compared to the previous study for the south coast of Java. It could be due to the narrower sampling areas and limited sampling periods. Nevertheless, our result provides information about the potential of marine ornamental fish in Cilacap as among promising income sources for the Cilacap Regency. However, government intervention is necessary for the sustainable use of ornamental fish in the area.

1. Introduction
Cilacap Regency Central Java, Indonesia, is located at 108°4’30” - 109°30’30” E and 7°30’ - 7°45’20” S. The southern border of the Cilacap Regency is the Indian Ocean, thus making this regency has a fishing area about 5,200 km². Therefore, Cilacap Regency has a high potential for marine fisheries [1].

Marine fisheries sector of the Cilacap Regency is supported by various infrastructures, such as sea fishing harbor, seven docks, 11 fish auctions centers, and four shipyards. Reliable infrastructures make Cilacap Regency has a valuable captured fisheries production of 13,175,586.2 kg in 2016 [1]. That fish productions were only counted for consumed fish [2–4] and shrimps [5,6]. However, there was no production data on marine ornamental fish from Cilacap Regency [1]. Meanwhile, the preliminary survey proved that marine ornamental fish collection and trade had occurred in Cilacap Regency (personal observation and communication with the first collector).

Marine ornamental fish trade in Indonesia began three decades ago [7]. The popularity of marine ornamental became higher in recent years since international trade was developed [8]. Recent reports, which collected information from export data, proved that Indonesia supplied the second-highest amount of marine ornamental fish in international trade [9] but contributed a higher number of species than the Philippine [10,11]. Numerous reports provided data on fish species from the Eastern Indonesia region.
Limited data came from a collection in Western Indonesia, but only from Thousand Islands and Karimunjawa Islands [12–14].

Previous study from has noted that 21 fish species sold in the international aquarium trade from Indonesia [15], which was much lower than the data in the earlier study[10], despite both studies did not refer to any specific localities in Indonesia. Therefore, no data was available from the southern coast of Cilacap [1]. Collection and trades of marine ornamental fish from Cilacap is continuously running (personal observation). Therefore, scientific research about marine ornamental fish that are collected and traded in Cilacap Regency is needed to provide scientific data for managing these marine resources. The present research aims to know the taxonomic diversity of marine ornamental fish that are collected and traded from the Cilacap Regency. This data is essential for the sustainable fisheries of these resources in the Cilacap Regency.

2. Research Methods
2.1. Sampling site
The present study used a survey method with incidental sampling. Fish samples were bought from the first middleman in Sentolo Kawat Village, District of South Cilacap at Cilacap Regency Central Java (Figure 1). The middleman was chosen because they are continuously collect and sell ornamental fish from Cilacap waters.

![Figure 1. Schematic map of Cilacap Regency with Sentolo Kawat Village as a sampling site (modified from Google Map)](image)

2.2. Sample collection and preservation
Fish samples were collected five times in April, May, and July 2019. Fresh individuals were photographed using an 8-megapixel camera. Direct photographing was performed to keep the original color and color pattern of each sample. Afterward, the fish samples were preserved in ethanol 70%.

2.3. Identification
The taxonomic status of each sample was gained through conventional identification based on morphological characters. The diagnostic characters used in this study were body color, color pattern, meristic characters (fin rays, spines, and linea lateral position and form), and geographic distribution of each species. The obtained data were compared to species characteristics available in the identification book [16]. In the case of juvenile samples, and no pictures are available in the identification book [16],
the identification process was also referring to FishBase [17]. The FishBase data were also used for the verification of identification results for all species [17].

2.4. Data analysis
The data on taxonomic diversity was analyzed mathematically as species richness, which was referred to as the total number of species collected during the study. Data on species richness was listed in a table; data on the family level was shown in the bar chart, while data on order level was presented in the pie chart.

3. Results
A sum of 179 individuals of marine ornamental fish species obtained during the sampling. Morphological identification and combined with geographic range information of each species placed the fish samples into 28 species, 12 families, and four orders. A detail data on species, family, and order are presented in Table 1.

Table 1. Ornamental fish species collected and traded from marine waters around Cilacap Regency

| Order            | Family          | Species                          |
|------------------|-----------------|----------------------------------|
| Anguilliformes   | Muraenidae      | Gymnothorax enigmaticus          |
|                  |                 | Gymnothorax undulatus            |
| Perciformes      | Acanthuridae    | Acanthurus nigricauda            |
|                  |                 | Acanthurus xanthopterus          |
| Apogonidae       | Chaetodontidae  | Ostorhinus chrysotaenia          |
| Scaridae         |                 | Chaetodon vagabundus             |
| Scaridae         |                 | Chaetodon auriga                 |
| Scaridae         |                 | Chaetodon ephippium              |
| Scaridae         |                 | Chaetodon collare                |
| Scaridae         |                 | Chaetodon decussatus             |
| Scaridae         |                 | Chaetodon adiargastos            |
| Scaridae         |                 | Chaetodon melanotus              |
| Scaridae         |                 | Chaetodon lunula                 |
| Tetraodontiformes| Ostraciidae     | Heniochus diphreutes             |
| Tetraodontiformes| Siganidae       | Siganus spinus                   |
| Tetraodontiformes| Siganidae       | Siganus vermiculatus             |
| Tetraodontiformes| Scorpaenidae    | Dendrochirus zebra               |
| Tetraodontiformes| Scorpaenidae    | Pterois antennata                |
| Tetraodontiformes| Scorpaenidae    | Pterois miles                    |
| Tetraodontiformes| Scorpaenidae    | Dendrochirus brachypterus        |

3
On the family level, Chaetodontida was the richest family with nine species, followed by Scorpaenidae with four species. The remaining families had members ranges from 1-2 species. A detail data about the total number of species for each family was shown in Figure 2.

![Figure 2. Family according to the number of species](image)

Perciformes were the biggest order, which was 75% obtained fish in this study. The three remaining orders had only counted for 8.33% family, respectively. Data on total family per order can be seen in Figure 3.

![Figure 3. Fish order according to the number of families](image)

4. Discussion
The obtained number of species was far below expectation since we did not obtain species that was found during the survey. For example, *Hippocampus kuda* was found during the survey but did not obtain during this study. It could be due to that the *H. kuda* population in Cilacap waters has been
declined. This argument arose based on the fact that _H. kuda_ has been listed as vulnerable species since 2012 by the International Union for Conservation of Nature "IUCN” [18]. However, the data showed an interesting finding of _Chaetodon ephippium_, _C. adiergatos_, _C. melanotus_, and _Dendrochirus brachypterus_, which were not found in Taman Manulusu, Ujung Genteng and Pelabuhan Ratu southern coast of West Java (Nuryanto et al. unpublished data).

Although we found only 28 species, the number indicated that high species diversity of marine ornamental fish was collected and traded from Cilacap waters. The data also proved that Cilacap has a high potential for marine ornamental fish resources. Even though the sampling has only been done on the west monsoon season, the data showed a high species richness. The higher species richness has been presumed will be obtained if the sampling were conducted throughout the year.

The data showed a higher number of ornamental fish in Cilacap compared to the previous report [15], which noted that Indonesia only supplies a total of 21 ornamental fish species in the international aquarium trade. However, the total number of species in this study was much lower than species number on another report [10], which counted the sum of 997 fish species exported from Indonesia in the international aquarium trade. The sampling area and time are presumed as the cause of the different data to the previous study [10], which reported export data from all over the Indonesia region and for several year data.

The result result in high species diversity in Caetodonthidae was similar to the previous study from Seribu Island [19]. This similarity proved that Caetodonthidae is one of the rich families in Perciformes, and many species of Caetodonthidae are well-known as ornamental fish species. According to web data [17], marine Caetodonthidae in Indonesia was up to 65 species. Therefore, it was reasonable that many sample species from Caetodonthidae.

It was surprising that four species of Scorpaenidae were obtained, while we could only obtain one species of Pomacentridae, two species of Acanthuridae, and two species of Labridae. Scorpaenidae was not as rich as Pomacentridae, Acanthuridae, and Labridae [17]. These phenomena could be due to a matter of sampling technique performed by the fishermen and the movement capability of the fish. The member of Pomacentridae, Acanthuridae, and Labridae can move faster than the member of Scorpaenidae. Therefore, the member Scorpaenidae were easier to be captured using nets than the member of Pomacentridae, Acanthuridae, and Labridae. Therefore, a higher number of species of Scorpaenidae had been collected than the member of Pomacentridae, Acanthuridae, and Labridae.

This study proved that Perciformes is the dominant order. This finding was a reasonable discovery for Indonesia’s marine waters since Perciformes composed the main constituent of the Indonesias marine fish communities. So far, 82 fish families had been established under Perciformes from Indonesia. In species level, Perciformes contributes to 62% to the total species of Indonesia’s marine fish species [17]. Therefore, it was a common phenomenon that we collected more Perciformes during the study and provides additional data to supports the dominance of Perciformes over other fish orders.

In terms of locality, there was no comparable recent study that has been done on marine ornamental fish in Indonesia. Earlier studies were performed about fish communities in several geographic areas across Indonesia [19–24]. Comparison to those previous studies indicated that the obtained species were fewer than those studies. The low species richness is reasonable as the scope of this study is different from the previous one. The scope of this study was only on marine ornamental fish that are sold in the aquarium trade, while the previous studies have a broader scope that was all fish communities in the areas. However, the data from this study are essential for the management of ornamental fish fisheries in Cilacap since there is no data available as a basis for sustainable fisheries in that region.

This research focused on marine ornamental fish collected and traded in Cilacap Regency, and no similar study had been done in Cilacap. The result provided the first scientific record of marine ornamental fish in Cilacap Regency. Lack of marine ornamental fish data made no government control, yet, on marine ornamental fish collection and trading in Cilacap Regency. Therefore, these data could be used as a starting point for the Government of Cilacap to start on controlling marine ornamental fish collection and trading in Cilacap Regency and also for making police in diversification on income source for fishermen in Cilacap Regency.
5. Conclusion
A high number of ornamental fish species were collected and traded in Cilacap Regency. The collection and trade of ornamental fish in Cilacap regency need to be controlled by the government to ensure sustainable fisheries of the resources.

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