Niche ornamental-marine fishery of Bangsring and the surrounding areas

D G R Wiadnya¹,², A M Hariati² and W E Kusuma¹

¹Ichthyo-fauna – Faculty of Fisheries and Marine Science Universitas Brawijaya, Jl. Veteran 65145 Malang - Indonesia
²Department of Aquaculture Faculty of Fisheries and Marine Science, Universitas Brawijaya, Malang, Indonesia
³Corresponding author: dgr_wiadnya@ub.ac.id

Abstract. Indonesia exported >900 species of marine ornamental organisms, considered the largest together with The Philippines. However, records on catch statistics are negligible — this study conducted along the coastal area of Bangsring (Banyuwangi) and Gerokgak (Bali). The research aimed to identify species diversity, dominant families, and catch composition. Species diversity was estimated through underwater visual census and catch records from three fish collectors in the area. All the species were photographed and deposited at Depository Ichthyologicum Brawijaya, each with a specific accession number. Species identification merely based on morphology and color-stained for transparent osteology. The results of the analysis showed that there at least 106 species out of 483 specimens collected from middlemen. It consisted of 25 families and 59 different genera. The fish sources came from local surrounding West Bali National Park (Pinggiran), Madura Islands (Bunian), and the eastern part of Indonesia (Tanjungan). Unit price at middlemen levels varied between US$ 0.2-3.6 per species, with an average of US$ 0.95±0.95 (n = 106). Three Tanjungan species: Hoplolatilus luteus, Pomacanthus imperator, and Paracanthurus hepatus sold at unit price US$ 8.5. This niche fishery needs specific management measures to control the supply chain apart from its economic contribution to national income.

1. Introduction
Since the early 1950s, international trade in ornamental fishery became a significant income for exporter countries but may lead to a substantial impact on conservation. Exotic color, shape, and adaptability to live in confinement have made these marine ornamental fishes attract hobbyists around the world. The sales of ornamental fish in the U.K. in 1987 were estimated to reach £ 110*10⁶ and $ 738*10⁶ for the U.S. [1]. There were signs that the hobby was increasing since then in both countries. Now, the marine aquarium market received around 4,000 coral reef fish species all over the world [2] without monitoring, control, and statistics recording systems. The U.S. alone imported more than 1,400 species from around 50 families [3]. Moreover, most of these fishes were mainly caught from the wild that threatened biodiversity and conservation. Indonesia and the Philippines are two significant countries exporting marine ornamental fishes to Hongkong [4] and probably to the global market, the rest [5] [6].

Indonesia is located in the heart of the Coral Triangle [7] that extremely rich with reef fish diversity. Given the high productivity of coral reef and at the same time, high population density, community life near the coral reefs depend on this resource as the basis of their income. Aside from the living food fish market [8], fisher also develops technology to extract ornamental fish species for export need. It is driven
by an ever-increasing demand, near reef communities tended to remove the resource unsustainably. Many cases in the past, fishers practiced cyanide and other forms of poisons to exploit fishes from reefs. The coral reef ecosystem is facing severe threats from destructive and over-fishing, respectively.

The ornamental fishery in Indonesia has its niche. The catch statistics is not regularly recorded like commercial fish species for food. The fishing is mainly small-scale and scattered all over the small-island reefs that difficult to control and monitor. Fishers transported the catches through plastic filled with water and oxygen to the middlemen. The fishes then separated based on species and size, repacked and ready for export. Gerokgak (Bali) and Bangsring, the most eastern part of Java Island (Figure 1), are known as the center for middlemen of this ornamental fishery. Following all quarantine procedures and paper works, the firms exported the live fishes through either Surabaya or Bali international airport. Middlemen received ornamental fishes from three different areas: pinggiran (local areas), bunginan (Lesser Sunda Islands), and tanjungan (Eastern part of Indonesia, such as Sulawesi and Lesser Sunda). This study aimed to identify species gathered by middlemen in Bali and Bangsring morphologically.

2. Materials and methods
2.1 Time and places
In May 2018, underwater visual census (dives) were conducted at four sites around the coral reef near Bali Barat National Park close to Bangsring. In every dive site, four divers observed and photographed every fish they met. Each dive lasted for around one hour. All coral reef species were photographed using an underwater SLR camera. The species were identified from the pictures resulted from the camera. From July to September 2019, four samplings were conducted to a middleman in Bangsring and Gerokgak Bali (Figure 1). All the species were purchased from these sources based on their availability to the maximum number of 10 specimens.

2.2 Transport and treatment
Sample of fishes per local name-category was kept alive in plastic bag injected with oxygen for a period of 24-hours during transportation and preparation at the university laboratory. Per local name-category, the sample was unpacked and teemed at cold water (± 5 ºC) up to mortem to minimize scale and fin damage. Each individual was scale-photographed using an SLR camera and labeled per local name-category. All individual pictures stored in folders and named according to their label. Following all identification procedures, all the specimen was wrapped in a plastic bag, labeled with a permanent marker and stored in a refrigerator at temperature -20 ºC.

2.3 Morphological identification
Each fish specimen was identified in three steps: (1) morphological identification based on 13 landmark areas of the fish, (2) body ornament, and (3) nomenclatural validation. Morphological landmark procedure consisted of a combination of body-shape, head, mouth, teeth, barbels, finlets, dorsal fins, pectoral fins, pelvic fins, anal fin, caudal fin, keels, and scutes. FAO species identification guide for fishery purposes [9] [10] [11] [12] was used as a basis for the identification. Body ornament and coloration were matched with the pictorial guide explained in Kuiter and Tonozuka [13] [14] [15].
3. Results and Discussions

Based on pictures resulted from underwater visual observations around West Bali National Park, there were 39 species identified from the areas consisted of 15 different Families. Labridae, Pomacanthidae, and Serranidae were the top three families, each with 11, 7, and 4 species, respectively. A sampling of aquarium fishes from middlemen in Bangsring and Gerokgak resulted in a total of 483 fish specimens. It consisted of 25 different families, 59 genera, and 106 species (Table 1). These fishes came from three separate sources: Pinggiran, Bunian, and Tanjungan. Pinggiran means local species caught from around West Bali National Park. Bunian means all species originally from local species of Madura Island and Tanjungan are species sent from the eastern parts of Indonesia, such as Sulawesi, Papua, and Lesser Sunda. Bangsring (Banyuwangi) and Gerokgak (Bali) can be considered as one of the biggest landing centers for the ornamental fishery in Indonesia [16]. Close to the area is Banyuwangi Marine Port, being the biggest in East Java that possible to transport the species at a lower cost. However, fishers from Madura and eastern Indonesia often sail using the private and small boats (< 30 GT) – for this case, the landing and delivery to middlemen even faster and without any additional on land transportation cost. Also, both sites are secure and on accessible ways to reach Denpasar or/and Surabaya International Airport from where the fish is exported.

Indonesia is home to marine biodiversity, especially coral reef fish species [7]. The latest record on total marine finfish in Indonesia was 3,616 species [17], from which 2,081 species were reef-associated and 133 species being endemic. Overall of 106 species found during the study is considered as the most common species the middlemen sell to exporters in Bali or Surabaya. When given a list of a total of 350 species, all middlemen in both sites recognized the species and knew the local name of all species. The middlemen received fishes from Madura Islands and all over eastern Indonesia on a weekly or at least bi-weekly basis. The species composition was always changing, showing the diverse of the ornamental species from the areas [1] [18]. The most common species were members of the family Labridae, Pomacanthidae, and Pomacentridae (Table 1). This was in line with species members exported to the European Union [18], where Labridae represented 11.3% of the species (20% in this study), and Pomacanthidae represented 6.7% in European Union (this study was 10%).

Table 1 Total species count based on Genera and Family from total 483 specimen collected in Gerokgak and Bangsring

![Figure 1](image-url) Map of the area for diving and fish collection from the middlemen (Gerokgak Bali is just close to the east of West Bali National Park).
| FAMILY       | NO. OF GENERA | NO. OF SPECIES | FAMILY       | NO. OF GENERA | NO. OF SPECIES |
|--------------|---------------|----------------|--------------|---------------|----------------|
| Labridae     | 8             | 21             | Callionymidae| 2             | 2              |
| Pomacanidae  | 5             | 11             | Haemulidae   | 1             | 2              |
| Pomacentridae| 7             | 11             | Pseudochromidae| 1          | 2              |
| Chaetodontidae| 4           | 9              | Caesionidae  | 1             | 1              |
| Acanthuridae | 4             | 8              | Cirrhitidae  | 1             | 1              |
| Serranidae   | 3             | 7              | Lutjanidae   | 1             | 1              |
| Scorpaenidae | 2             | 5              | Malacanthidae| 1             | 1              |
| Tetraodontidae| 3            | 3              | Monacanidae  | 1             | 1              |
| Blennidae    | 1             | 3              | Scaridae     | 1             | 1              |
| Gobiidae     | 2             | 3              | Siganidae    | 1             | 1              |
| Microdesmidae| 1             | 3              | Syngnathida  | 1             | 1              |
| Ostraciidae  | 2             | 2              | Zanclidae    | 1             | 1              |
| Balistidae   | 2             | 2              | TOTAL =      | 59            | 106            |

In 2000, a kg of coral reef fish for aquarium trade may worth US$ 500, whereas, on average, the similar species group for food consumption sold only for US$ 6 [19]. However, this was not directly related to fishermen's income, who sacrificed their energy and risk in the frontline to produce the fish. The fish prices purchased for this study varied between US$ 0.2-3.6 per species, with an average of US$ 0.95±0.95 (n = 103). This figure represented the local prices at landing sites (Bangsring or Gerokgak) transported by the first middlemen near fishing areas. Logically, we may expect that fishers received less price than mentioned above. This has been proven for the trade of Banggai cardinalfish (*Pterapogon kauderni*), endemic species for Sulawesi Island. Local fishers did not primarily rely upon their income from catching this species. About 17% of local fishers in the area went out fishing for the fish when a buyer appeared, and they have no other work to do [16]. Catching ornamental fish species in Indonesia is mainly small-scale and artisanal, with extended supply chain structure before export.

This study found three species (out of total 106 species) that sold for price higher than US$ 8.5. The species were: *Hoplolatilus luteus* (Malacanthidae), *Pomacanthus imperator* (Pomacanthidae), and *Paracanthurus hepatus* (Acanthuridae) (Figure 2). *H. luteus* (12.5 cm TL) was well known in the aquarium trade as Yellow Tilefish with a local name of “exoset kuning”. The species usually caught from Sulawesi, Papua, or Lesser Sunda. *P. imperator* was locally known as “angle batman”, related to ornamental masking surrounding its face. *P. hepatus*, Palette surgeonfish, was locally named as Dori (a character in the film entitled “finding nemo”) and/or letter six. These three fish were, in fact, not very common in the local areas around Bangsring or Bali. However, there was no apparent reason for the high price of the species.
Figure 2 Tanjungan category species: *Hoplolatilus luteus* (A), *Pomacanthus imperator* (B) and *Paracanthurus hepatus* (C) with unit price > US $ 8.5.

Based on the size, except for Tilefish, both Emperor angelfish and Palette surgeonfish were considered immature or even at the juvenile stage [17]. Furthermore, comparing the fish size (length) in the specimen with length-data from the fish base [17] showed that more than 50% of the fish sample was immature. Many aquarium fish species live in aggregation within a small area of the patch reef. Exploiting this aggregation can lead to biological over-fishing of the stock [20]. Unluckily, monitoring data for this biology is still tricky under the current situation in Indonesia.

All fish species for ornamental fishery found in this study have the status of either Least Concern (LC), Data Deficient (DD), or Not Evaluated (NE) under the IUCN red list category [17]. Also, no species are included in the CITES warning list.

4. Conclusion

Based on morphological characters, all the 483 fish specimens were verified to compose of 106 species, 59 genera, and 25 different Families. Labridae, Pomacanthidae, and Pomacentridae were the top three dominant families, although species composition may change from time to time. The fish price at the
middlemen level varied between US$ 0.2-3.6 per species, with an average of US$ 0.95±0.95 (n = 103). Three species: *Hoplolatilus luteus*, *Pomacanthus imperator*, and *Paracanthurus hepatus* higher than US$ 8.5. There were no species under the IUCN red list or CITES category. Considering the specific nature of this ornamental fishery, monitoring records on species, size category, and stock availability need further assessment.

5. References

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