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# International Journal of Multidisciplinary Research and Growth Evaluation.

## Analysis of Biological Aspects of Goldband Goatfish (*Upeneus molluccensis*) Landed at PPI Beba, North Galesong District, Takalar Regency

Sariana <sup>1\*</sup>, Andi Asni <sup>2</sup>, Kasmawati <sup>3</sup>, Muhammad Ikhsan Wamnebo <sup>4</sup>

<sup>1</sup> Student, Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Science, Universitas Muslim Indonesia, Makassar, Indonesia

<sup>2, 3</sup> Lecturer, Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Science, Universitas Muslim Indonesia, Makassar, Indonesia

<sup>4</sup> Lecturer, Department of Aquaculture, Faculty of Fisheries and Marine Science, Universitas Muslim Indonesia, Makassar, Indonesia

\* Corresponding Author: Sariana

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### Abstract

This study evaluates essential biological aspects of the goldband goatfish (*Upeneus molluccensis*) landed at Beba Fish Landing Base (PPI Beba), North Galesong District, Takalar Regency, South Sulawesi. *Upeneus molluccensis* is an economically valuable demersal fish inhabiting tropical and subtropical shelf ecosystems, primarily over muddy and sandy-mud substrates. Continuous and intensive fishing pressure threatens stock sustainability, necessitating detailed biological assessments for rational fishery management. Field sampling was conducted over two months (April to June 2026) across 16 sampling trips using standard biostatistical sampling methods. A total of 227 specimens were analyzed for length-weight relationships, gonadosomatic status, Gonad Maturity Stages (GMS / TKG), sex ratio, and length at first maturity (Lm50). Results revealed a fork length range of 12.0 cm to 22.1 cm and total body weight ranging from 58 g to 240 g. The length-weight equation was derived as  $W = 0.0634 \cdot L^{2.6446}$  ( $R^2 = 0.8728$ ,  $r = 0.9342$ ). Student's t-test demonstrated that the growth coefficient  $b = 2.6446$  was significantly lower than 3 ( $t_{count} = 2.35 > t_{table} = 1.97$ ,  $p < 0.05$ ), indicating a negative allometric growth pattern (length increases faster than weight). The overall sex ratio comprised 93 males (40.97%) and 134 females (59.03%), yielding a ratio of 1 : 1.44. Chi-Square testing confirmed a significant deviation from the expected 1 : 1 theoretical ratio ( $\chi^2_{count} = 7.41 > \chi^2_{table} = 3.84$ ,  $df = 1$ ,  $p < 0.05$ ). Male specimens were predominantly immature (GMS I: 63 ind / 88.73%; GMS II: 26 ind; GMS III: 5 ind), whereas females exhibited advanced maturity (GMS I: 8 ind; GMS II: 23 ind; GMS III: 81 ind / 94.19%; GMS IV: 20 ind; GMS V: 1 ind). Using the Spearman-Kärber method, length at first sexual maturity (Lm50) for female *U. molluccensis* was calculated as 14.25 cm FL (length class 14.0–14.9 cm), which aligns closely with global biological reference values. These findings provide baseline parameters essential for implementing mesh size regulations, catch limits, and seasonal closures to ensure sustainable exploitation in Takalar coastal waters.

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**Keywords:** *Upeneus molluccensis*, Goldband Goatfish, Length-Weight Relationship, Sex Ratio, Gonad Maturity Stage, First Maturity (Lm50), PPI Beba

### Introduction

Indonesia is the world's largest archipelagic state, possessing over 17,499 islands and a maritime territory spanning 3.25 million km<sup>2</sup> of territorial seas and 2.55 million km<sup>2</sup> of Exclusive Economic Zone (EEZ) (KKP, 2020). The vast marine realm harbors highly diverse demersal and pelagic fisheries resources that serve as major drivers of socioeconomic development and protein security across coastal communities.

In South Sulawesi Province, capture fisheries production reached 492,159 tons in 2023, reflecting steady annual growth (Nugroho *et al.*, 2024)<sup>[6]</sup>. Takalar Regency, situated in southwestern South Sulawesi, heavily relies on marine fisheries. Six of its nine districts are coastal, including North Galesong District, where the Beba Fish Landing Base (PPI Beba) operates as a primary regional hub for landing demersal catches.

The goldband goatfish (*Upeneus molluccensis* Bleeker, 1855), locally known as ikan kuniran or biji nangka, is a commercial demersal species belonging to the family Mullidae. It is widely distributed across the Indo-West Pacific, inhabiting soft sandy and muddy bottoms at depths between 10 and 80 meters. Due to its high local consumption demand and moderate market value, fishing pressure by small-scale bottom gillnets (jaring insang dasar) has intensified rapidly. Continuous exploitation without adequate management risks growth and recruitment overfishing (Azizah *et al.*, 2015; Juandi *et al.*, 2016)<sup>[4]</sup>.

In Islamic environmental ethics, marine resources are recognized as vital provisions granted by Allah SWT, demanding responsible stewardship (khalifah) and sustainable utilization. As declared in QS. An-Nahl (16:14):

"And it is He who subjected the sea for you to eat from it tender meat and to extract from it ornaments which you wear..."

Therefore, rigorous empirical study of biological aspects including length-weight relationships, sex ratio, maturity distribution, and size at first maturity (Lm50)—is essential to establish baseline reference points for sustainable management. This study aims to quantify these parameters for

*U. molluccensis* landed at PPI Beba, North Galesong.

## Materials and Methods

### 1. Research Site and Sampling Period

This research was conducted from April 1 to June 1, 2026 at Beba Fish Landing Base (PPI Beba), Tamasaju Village, North Galesong District, Takalar Regency, South Sulawesi (Coordinates: 5°15' S, 119°22' E). Morphometric and gonadal examinations were executed at the Biology Laboratory, Faculty of Fisheries and Marine Science, Muslim University of Indonesia, Makassar.

### 2. Sampling and Measurement Protocol

Random sampling was conducted twice weekly across 16 sampling trips, collecting 12–15 fish samples per trip from small-scale bottom gillnet vessels operating in the Makassar Strait and Takalar coastal waters. A cumulative total of 227 fresh specimens were preserved in ice coolboxes and analyzed. Fork Length (FL) was measured using a measuring

board to the nearest 0.1 cm (1 mm precision). Total body weight (W) was recorded using a digital electronic scale accurate to 0.5 g. Each specimen was dissected via ventral incision to identify gonadal sex and macro-morphological Gonad Maturity Stage (GMS I–V) according to Effendie (1997) criteria.

## Data Analysis Methods

### 1. Length-Weight Relationship (LWR)

The LWR was evaluated using the power function (Effendie, 2002)<sup>[2]</sup>:

$$W = a \cdot L^b \Rightarrow \log W = \log a + b \cdot \log L$$

where W = weight (g), L = fork length (cm), a = intercept, and b = slope (growth exponent). Hypotheses regarding isometric growth (H0: b = 3) versus allometric growth (H1: b ≠ 3) were evaluated using Student's t-test:

$$t_{\text{count}} = |b - 3| / S_b$$

where S<sub>b</sub> is the standard error of slope coefficient b.

### 2. Sex Ratio Analysis

The proportion of males to females was calculated as P = (A / B) × 100%. Deviation from the theoretical 1:1 ratio was assessed using the Chi-Square test (Walpole, 1992)<sup>[11]</sup>:

### 3. Size at First Sexual Maturity (Lm50)

The size at which 50% of female fish attain gonad maturity (GMS ≥ III) was estimated using the Spearman-Kärber method (Udupa, 1986)<sup>[10]</sup>:

$$m = X_k + (d / 2) - d \cdot \sum p_i \quad Lm50 = 10m$$

where X<sub>k</sub> = log value of last length class mid-point, d = log class interval width, and p<sub>i</sub> = proportion of mature females in class i.

## Results and Discussion

### Catch Characteristics & Size Distribution

*Upeneus molluccensis* landed at PPI Beba are harvested by bottom gillnets (mesh size ~1.5–2.0 inches) deployed in coastal demersal grounds of the Makassar Strait. Operations follow one-day trips (setting at dusk, hauling at dawn). Specimen lengths ranged from 12.0 cm to 22.1 cm FL with body weights from 58 g to 240 g.

### Sex Ratio

Out of 227 sampled individuals, 93 were males (40.97%) and 134 were females (59.03%), establishing a sex ratio of 1 : 1.44 (Table 1).

**Table 1:** Chi-Square Test for Sex Ratio of *U. molluccensis*

| Sex    | Observed (O) | Expected (E) | (O - E) <sup>2</sup> / E |
|--------|--------------|--------------|--------------------------|
| Male   | 93           | 113.5        | 3.7026                   |
| Female | 134          | 113.5        | 3.7026                   |
| Total  | 227          | 227.0        | $\chi^2 = 7.405$ count   |

Because  $\chi^2_{\text{count}} = 7.41 > \chi^2_{\text{table}} = 3.84$ , the sex ratio significantly departs from equality (p < 0.05). Female dominance is attributed to reproductive behavioral

differences, where mature females become less mobile and more susceptible to bottom gillnet capture (Pavlov *et al.*, 2014)<sup>[7]</sup>.

### Gonad Maturity Stages (GMS / TKG)

Gonad maturity distribution revealed distinct patterns between sexes (Table 2). Male specimens were heavily dominated by GMS I (63 ind / 88.73%), whereas female

specimens were concentrated in GMS III (81 ind / 94.19%) and GMS IV (20 ind / 100%).

$$\chi^2 = \sum [(O_i - E_i)^2 / E_i]$$

**Table 2:** Distribution of Gonad Maturity Stages (TKG)

| TKG Stage | Male Ind % | Female Ind % | Total (ind) |
|-----------|------------|--------------|-------------|
| TKG I     | 63 88.73%  | 8 11.27%     | 71          |
| TKG II    | 26 53.06%  | 23 46.94%    | 49          |
| TKG III   | 5 5.81%    | 81 94.19%    | 86          |
| TKG IV    | 0 0.00%    | 20 100.00%   | 20          |
| TKG V     | 0 0.00%    | 1 100.00%    | 1           |
| Total     | 94 41.4%   | 133 58.6%    | 227         |

The prevalence of mature females (GMS III & IV) indicates active spawning grounds within coastal waters accessible to PPI Beba fishermen during the April–June period. Length-Weight Relationship (LWR)

Regression analysis for 227 specimens yielded the LWR parameters (Table 3):  $a = 0.0634$ ,  $b = 2.6446$ , and  $R^2 = 0.8728$  ( $r = 0.9342$ ).

**Table 3:** Length-Weight Regression Statistics

| Parameter               | Value   | Statistical Inference             |
|-------------------------|---------|-----------------------------------|
| Sample Size (n)         | 227     | Total individual sample           |
| Intercept (a)           | 0.0634  | $\log a = -1.1979$                |
| Slope Exponent (b)      | 2.6446  | Growth coefficient                |
| Std Error of b (Sb)     | 0.1513  | Regression std error              |
| t-calculated (tcount)   | -2.3482 | $ t  = 2.348 > t_{table} (1.970)$ |
| Determination ( $R^2$ ) | 0.8728  | 87.28% variance explained         |
| Growth Pattern          |         | Negative Allometric ( $b < 3$ )   |

Since  $t_{count} = 2.348 > t_{table} = 1.971$  ( $p < 0.05$ ), growth is significantly negative allometric ( $b < 3$ ), meaning length increases faster than body mass, typical for elongated demersal Mullids (Saputra *et al.*, 2009)<sup>[8]</sup>.

Size at First Sexual Maturity (Lm50)  
Spearman-Karber calculations for female *U. molluccensis* are detailed in Table 4.

**Table 4:** Spearman-Karber Lm50 Analysis for Females

| Length Class (cm)                 | Midpoint (Xi) | Total (ni) | Mature (ri) | Proportion (pi) |
|-----------------------------------|---------------|------------|-------------|-----------------|
| 14.0 - 14.9                       | 14.5          | 22         | 17          | 0.773           |
| 15.0 - 15.9                       | 15.5          | 20         | 16          | 0.800           |
| 16.0 - 16.9                       | 16.5          | 22         | 15          | 0.682           |
| 17.0 - 17.9                       | 17.5          | 25         | 17          | 0.680           |
| 18.0 - 18.9                       | 18.5          | 15         | 11          | 0.733           |
| 19.0 - 19.9                       | 19.5          | 9          | 9           | 1.000           |
| 20.0 - 20.9                       | 20.5          | 6          | 6           | 1.000           |
| 21.0 - 21.9                       | 21.5          | 11         | 9           | 0.818           |
| Sum of Proportions ( $\sum p_i$ ) |               |            |             | 6.486           |

With  $X_k = \log(21.5) = 1.3324$  and  $x = \log(15.5) - \log(14.5) = 0.02896$ :

4. Length at first sexual maturity (Lm50) for females is 14.25 cm FL.

The estimated Lm50 = 14.25 cm FL falls into the 14.0–14.9 cm size class, demonstrating excellent agreement with FishBase global reference figures (~14.0 cm TL). Male Lm50 could not be computed due to the predominance of immature GMS I stage individuals (mean FL = 18.19 cm).

### Conclusion and Suggestions

#### Conclusion

- Growth of *U. molluccensis* is negative allometric ( $b = 2.6446 < 3$ ), with  $W = 0.0634 \cdot L^{2.6446}$  ( $R^2 = 0.8728$ ).
- Overall sex ratio is unbalanced (1 : 1.44, females 59.03%), significantly deviating from 1:1 ( $p < 0.05$ ).
- Females are dominated by mature GMS III (81 ind), whereas males are dominated by immature GMS I (63 ind).

#### Suggestions

To avoid harvesting immature individuals, mesh sizes of bottom gillnets should be regulated so that minimum length at capture ( $L_c$ ) exceeds 14.25 cm. Future research should cover full annual cycles to capture seasonal spawning dynamics.

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