Diet Composition and Feeding Habits of the Gobiid Fish *Eleotris fusca* in the Ummiding River, Polewali Mandar, West Sulawesi

Adiara Firdhita Alam Nasyrah[1], Muhammad Nur[1], Azmiatul Khairat[2], Tikawati[1], Sri Winda Amaliah[3]

[1)]Aquatic Resources Study Program, Department of Fisheries, Sulawesi Barat University
Jl. Prof Baharuddin Lopa, Majene, West Sulawesi 91412
[2)]Aquaculture Study Program, Department of Fisheries, Sulawesi Barat University
Jl. Prof Baharuddin Lopa, Majene, West Sulawesi 91412
3)Aquatic Research Management, IPB University, West Java, Indonesia
e-mail: adiarafirdhita.alamnasyrah@unsulbar.ac.id

Recieved: December 6, 2025; Accepted: February 7, 2026

Abstract

Eleotris fusca is one of the amphidromous goby fishes lives in Ummiding river, West Sulawesi. Amphidromous goby has a complex life cycle compared to other fishes. The adults lives in river for growth and reproduction, meanwhile the eggs and larvae are transported downstream to the estuary. After completing their larval development, they migrate back to freshwater. The presence of prey strongly influences the migration and growth of *E. Fusca* in nature. This study aims to reveal the diet composition and feeding habits of *E. Fusca*. Sample collected using an electrofishing unit in Ummiding river, West Sulawesi, throughout three months from October to December 2023. A total of 90 fishes captured with total length range 32-81 mm. The diet composition of *E. fusca* consisted in three types of prey, such as insect larvae, phytoplankton and zooplankton. Ratio of length intestinal explained *E. fusca* category as carnivorous and tends to has feeding strategy in generalist with the dominant prey Hemiptera from insect larvae.

Keywords: amphidromous goby, carnivorous, *E. fusca*, Ummiding river, Hemiptera

Introduction

The Mandar River is one of the major river systems in West Sulawesi Province, originating in the mountainous Tutar District and flowing through several districts of Polewali Mandar Regency before discharging into Mandar Bay. At approximately 150 km, it is one of the longest rivers in West Sulawesi (Tasrif *et al.* 2022). The river provides diverse freshwater habitats that support a rich fish community dominated by amphidromous gobies (Nur et al. 2021; Nurjirana *et al.* 2020; Nasyrah *et al.* 2025). A key habitat for gobies in West Sulawesi is the Ummiding River, Pao-pao pao Village, Alu District, Polewali Mandar Regency (Tikawati *et al.* 2024; Nasyrah *et al.* 2025).

Amphidromous gobies were very commercially in West Sulawesi especially post larval stage, locally known as *penja.* This seasonal fishery plays an important socio-economic role, as *penja* is widely harvested, consumed, and marketed in both fresh and dried forms by local communities (Nur *et al.* 2018). These fishes exhibit a complex amphidromous life cycle in which adults inhabit rivers for growth and reproduction, while eggs and larvae are

transported downstream to estuarine and marine environments. After completing larva develop-ment in the sea, juveniles migrate back into freshwater habitats (Simanjuntak, *et al.* 2021; Hasan, 2022). During the migration to river, post larvae was intensively exploited by local fishers. This case makes penja a high economic value for fisheries resources, but also raises concerns regarding the long-term sustainability of wild goby populations.

Eleotris fusca is one of the dominant species in Ummiding River (Nasyrah *et al.* 2024). *E. fusca* is not just a commercially valuable food fish it also has significant potential as an ornamental species due to it's appealing morphology and color. Given its economic significance and conservation issues, the domestication of *E. fusca* stands out as a viable approach to establishing a new aquaculture product while aiding conser-vation via a captive breeding and restocking initiative in West Sulawesi. However, the success of domestication depends on a comprehensive understanding. Maeda and Tachihara (2004) described the instream distribution and feeding habits of *E. fusca* in the Teima River, Okinawa, while Mennesson *et al.* (2015) revealed its amphi-dromous life cycle using otolith analyses. In West Sulawesi, studies have investigated the reproductive biology (Nasyrah *et al*. 2025) and habitat characteristics (Nasyrah *et al.* 2024) of *E. fusca*. Information on the diet composition and feeding habits of *E. fusca* in the Ummiding River is still lacking. Therefore, this study aims to fill the gap from previous research on the effort to domesticate goby in West Sulawesi to support the conser-vation and domestication of this species.

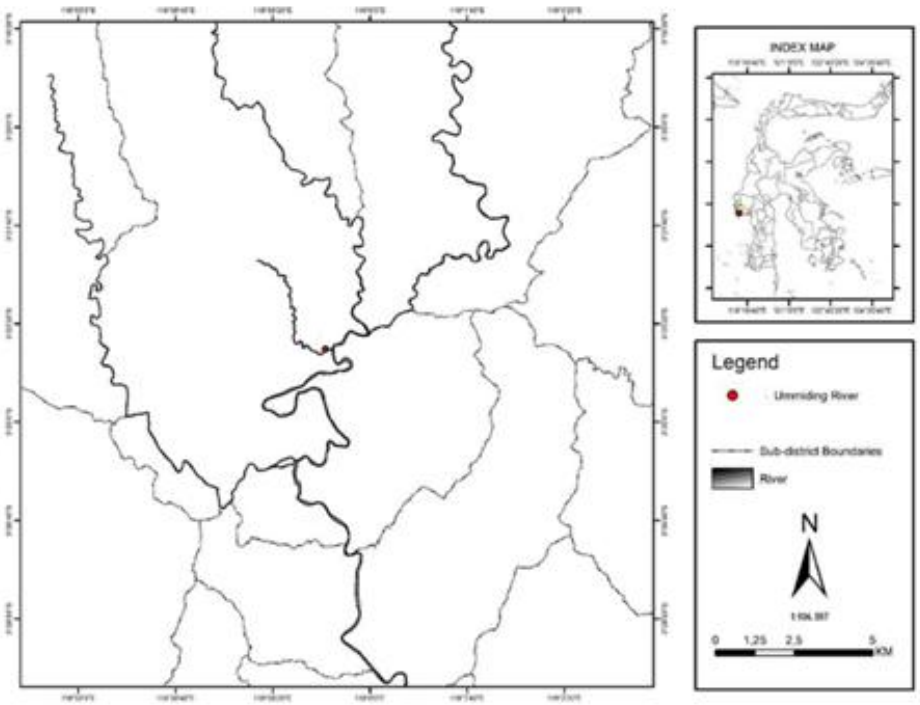

Figure 1. Map of sampling site in Ummiding River

Materials and methods

Study sites

E.fusca were sampled each month from October to December 2023 in the Ummiding River, Pao-pao Village, Alu Regency, Polewali Mandar, West Sulawesi (Figure 1). Meanwhile, sampling analysis started from May to June 2024 in the Fisheries Laboratory, UPA Integrated Laboratory, Sulawesi Barat University

Sampling collection

This research uses an exploratory survey method by purposively selecting three locations along the Ummiding River, which is suspected to have a high abundance of *E. fusca*. Sampling was conducted using a backpack electrofishing unit. The fish caught were preserved in sample bottles containing a 10% formalin solution for further analysis in the laboratory.

Measurements and dissection of fish samples

E. fusca samples were measured for length using a caliper with an accuracy of 0.1 mm and weighed using a digital scale with an accuracy of 0.0001 g. Samples were then cleansed from formalin using running water, dried with tissue, and dissected. Dissection start from the anus to the upper abdomen, up to the rear of the operculum, and then from the ventral side to the lower abdomen.

Diet composition analysis

Each dissected digestive tract was preserved in a clip plastic bag containing 4% formalin. The digestive tract samples were analyzed to determine the fish's diet. To determine the ratio of intestinal length, the length of the digestive tract is measured. The measured digestive tract then placed in petri dish to examine the contents.

The volume of the contents from digestive tract is measured to determine the total contents volume using the syringe method. The digestive tract contents were identified under a monocular microscope with 4x10 magnification, referring to Needham and Needham (1962), Pennak (1978), Clifford (1991), and Vuuren et al. (2006). After identification, the contents were counted and the volumes measured for further analysis.

Data analysis

Ratio of intestinal length

Feeding habits were determined the fish as herbivore, carnivore, and omnivore based on the correlation between the ratio of intestinal length and total length, referring to the formula described by Muthiah (2021) :

$$RIL = \frac{\text{Intestine length}}{\text{Total length}}$$

RIL = intestine length/fish total length; fish belonged to carnivore if RIL < 1, herbivore if RIL> 3, and omnivore if RIL = 1–3.

Diet Composition

The diet composition was analyzed using the index of preponderance based on the following formula Natarajan and Jhingran (1961). Where V_i is the percentage volume of

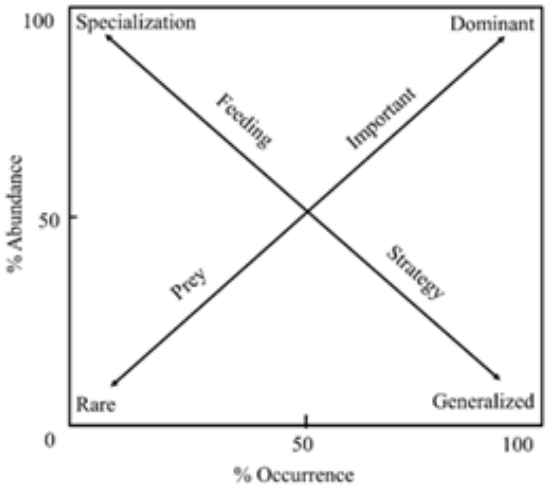

Figure 2. Feeding strategy plot modified from Coestello by Amundsen (1996)

the specific prey (%) and O_i is the percentage occurrence of the specific prey (%).

$$Ii = \frac{\text{Vi x Oi}}{\sum \text{Vi x Oi}} \text{ x 100 \%}$$

Feeding Strategy

Feeding strategy were obtained by linking a specific percentage of the abundance of food organisms and the percentage frequency of occurrence using charts Costello (1990) modified Amundsen (1996) (Figure 2).

The plot provides information on the prey's importance and feeding strategy. Frequency occurrence and prey abundance using the formula Masuda *et al.* (1984).

$$\text{Pi} = \frac{\sum \text{Si}}{\sum \text{St}} \text{ x 100\%}$$

where Pi is the prey-specific abundance of prey *i*; S_i is the stomach content composed of prey *i*, and S_{ti} is the total stomach content in only those fish with prey *i* in their stomachs.

Results

Ratio of intestinal length E. fusca

A total of 90 individuals *E. fusca* from Ummiding river from October to December 2023 were collected during the sampling time. Total length of *E. fusca* was 32 – 81 mm with the ratio of intestinal length (RIL) being 0.42 – 0,53 mm, indicating a carnivore inclination RIL < 1). The ratio of intestinal length com-position of distribution is shown in Table 1.

Table 1. Ratio of intestinal length E. fusca in Ummiding river

Sampling time	Total length ranges (mm)	Intestinal length ranges (mm)	Total length average (mm)	Intestinal length average (mm)	Ratio of intestinal length
October	32 - 81	5 - 40	54,6 ± 12,5	23,5 ± 10,5	0,4178
November	49 - 80	11 - 62	60,8 ± 8,9	32,7 ± 9,6	0,5341
December	42 - 78	10 - 60	55 ± 8	25 ± 9	0,4602

Table 2. Diet composition of E. fusca in Ummiding river

Category	Food organism	Sampling time		
		October	November	December
Insect larvae	Hemiptera	+	+	+
	Lepidoptera	+	+	+
	Trichoptera	+	+	+
	Ephemeroptera	+	+	+
	Diptera	+	+	+
	Coleoptera	-	+	-
	Hirudinae	+	+	+
	Oligochaeta	+	-	-
	Insect fragments	+	+	+
Phytoplankton	*Phormidium*	+	+	+
	Gomphonema	+	-	-
	Meridion	+	-	-
	Oscillatoria	+	-	-
	Naviculla	+	+	+
	Coelosphaerium	+	-	-
	Aphanizomenon	+	+	+
	Microthamnion	+	+	-
	Cyclotella	-	+	-
	Dinoflagellata	-	+	-
	Ceratium	-	+	+
	Diatoma	-	+	-
	Lyngbya	-	+	-
	Straurastrum	-	+	-
	Synedra	-	+	+
	Rhizoclonium	-	+	-
	Melosira	-	+	-
	Periphyton	+	-	-
Zooplankton	*Cladocera*	+	+	+
	Ostracoda	+	-	-
	Tricladida	+	-	-
	Arthropoda	+	-	-

Note: + present, - absent

Table 3. The preponderance index (IP) of diet composition E. fusca in Ummiding river

Category	IP (%)		
	October	November	December
Insecta larvae	69,90	94,62	90,28
Phytoplankton	19,45	5,08	6,79
Zooplankton	10,66	0,30	2,93
Total	100	100	100

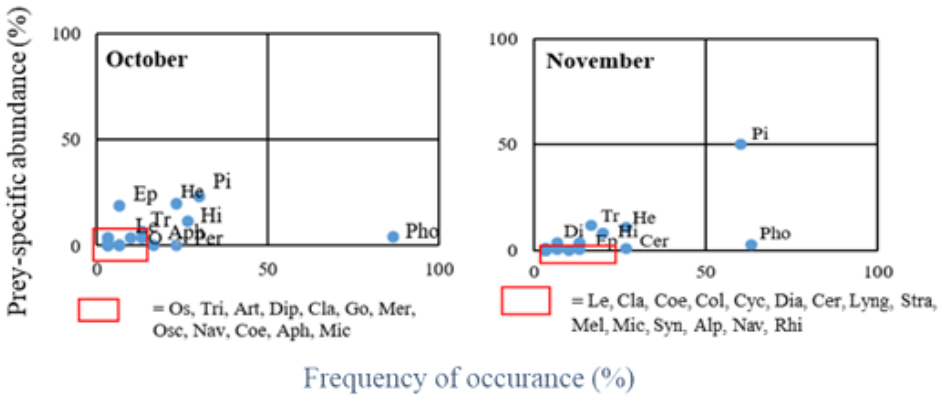

Figure 3. The feeding strategy of E. fusca in Ummiding river from October to November 2023

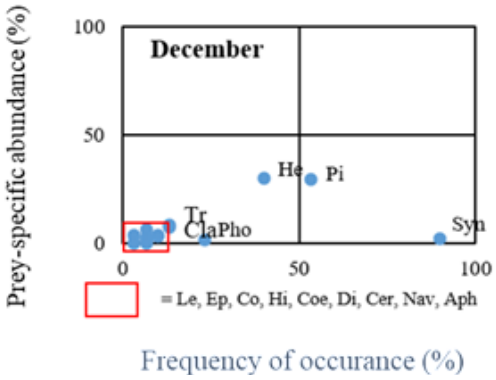

Figure 4. The feeding strategy of E. fusca in Ummiding river in December 2023

Note: *Hemiptera* (He), *Oligochaeta* (Ol), *Lepidoptera* (Le), *Tricoptera* (Tr), *Ephemeroptera* (Ep), *Ostracoda* (Os), *Tricladida* (Tr), *Arthropoda* (Art), *Diptera* (Dip), Insecta fragments (Pi), *Cladocera* (Cla), *Hirudinea* (Hi), *Phoridium* (Pho), *Gomphonema* (Go), *Meridion* (Mer), *Oscillatoria* (Osc), *Navicula* (Nav), *Coelosphaerium* (Coe), *Aphanizonemon* (Aph), *Microthamnion* (Mic), Perhypiton (Per), *Coleoptera* (Col), *Cyclotella* (Cyc), Diatoma (Dia), *Lyngbia* (Lyng), Staurastrum (Stra), *Melosira* (Mel), *Synedra* (Syn), *Rhizoclonium* (Rhi), *Ceratium* (Cer)

Diet composition

The various food items of *E. fusca* in Ummiding river from October to December 2023 were identified and listed in Table 2

Index Preponderance

The preponderance index value of diet composition *E. fusca* in Ummiding river shown in Table 3

Feeding strategy

The feeding strategy of *E. fusca* in Ummiding river from October to December 2023 shown in Figure 3 & 4

Discussion

The research results the RIL value of *E. fusca* collected in Ummiding river ranges from 0,42 to 0,53 mm, which means it has carnivorous feeding habits (RIL <1), based on the statement by Zuliani *et al.* (2016), where fish with RIL <1 are generally carnivorous, RIL = 1–3 are omnivorous, and RIL >3 indicate herbivorous traits. Similarly, Maeda & Tachihara (2004) studied the feeding habits of *E. fusca* in the Teima River, Okinawa Island, Japan, and categorized it as carnivorous. Analysis of the digestive tract contents shows *E. fusca* consumes three prey groups of organisms throughout three months in Ummiding river. The three prey items were insect larvae, phytoplankton and zooplankton. Insect aquatic larvae such as Ephemeroptera, Trichoptera, Lepidoptera, Diptera, Hemiptera and Coleoptera, as well as the Annelida group (Oligochaeta and Hirudinea). The phytoplankton group was Bacillariophyceae (*Gomphonema, Meridion, Navicula, Cyclotella, Diatoma, Synedra, Melosira*), Chlorophyta (*Microthamnion, Staurastrum, Rhizoclonium*), Cyanobacteria (*Phormidium, Oscillatoria, Coelosphaerium, Aphanizomenon, Lyngbya*), and Dinoflagellata (*Ceratium*). In addition, several zooplankton groups, such as *Cladocera*, *Ostracoda*, *Tricladida*, and

Arthropoda, were also found in the digestive tract. Similar findings were reported of *E. fusca* in Cisolok and Cimandiri estuaries, Palabuanratu, were phytoplankton in Bacillariophyceae (*Cymbella*, *Navicula, Nitzschia, Surirella, Synedra*) and zooplankton in Rotifera (*Notholca*) that benthic were identified in its gut contents and commonly found on the bottom or in the water column (Prabowo, 2022). In another estuary in Palabuhanratu, Cimaja estuary, Amaliah *et al.* (2022) explained amphidromous gobies using benthic Bacillariophyceae such as *Tabellaria* and *Surirella* as main prey. Furthermore, Khartiono *et al.* (2024) also described goby in Biak river, Central Sulawesi as a benthic feeder, such as Bacillariophyceae (*Cymbella* and *Bacillaria*) found in their gut contents.

The presence of benthic organisms indicates that *E. fusca* utilizes food resources both in the bottom water as well as in the water column. The diversity of phytoplankton indicates that although *E. fusca* has a short intestine, it also consumes a certain amount of plant-based food sources thus, it can be classified as an omnivore with a carnivorous tendency. The benthic prey consumed by *E.fusca* were certainly in line with the habits of these fish, where during the migration process to the estuary, the first thing they do is settle on the bottom of the water before moving upstream (Maeda and Tachihara, 2005; Prabowo, 2022). This statement is supported by the fact gobies are commonly found on the bottom of water bodies, whether on rocky substrates (Keith *et al.* 2014) with clear waters using their pelvic fins (Khartino *et al.* 2024). Additionally, Jabbar *et al.* (2025) and Nasyrah *et al.* (2024) reported the Ummiding river is a fast-flowing river with substrates dominated by rocky sand and crystal clear water, emphasizing that the Ummiding river became a suitable habitat for *E. fusca.*

The diet composition is an important aspect in understanding fish ecology because it reflects food preferences, resource availability in the habitat, and adaptation strategies used to support its growth and survival (Nasyrah *et al.* 2024). Index of Preponderance (IP) was used to determine the categories of main, secondary, and additional foods, allowing us to identify the dominant types of food in the feeding habits of *E. fusca.* Based on the IP value of the diet composition, the findings showed that insect larvae constituted the bulk of food consumed (84,93%), phytoplankton (10,44%), and zooplankton showed the least-consumed diets (4,63%). The dominance of insect larvae, particularly from Hemiptera, in the digestive tract indicates a match between the fish's diet and the abundance of food in its environment. Aisyah (2025) described that insect larvae is many in Ummiding River, West Sulawesi. Furthermore, it's also suspected that the abundance of vegetation on both sides of the river serves as a habitat that supports the abundance of insects, making it the main food source for *E. fusca.*

On the other hand, phytoplankton is used as a secondary food with a lower IP value, indicating phytoplankton was not the main food, rather, it is believed to be merely ingested along with other organisms or consumed as an additional energy source when the availability of insect larvae decreases. Meanwhile, zooplankton were found at the lowest value in the diet composition of *E. fusca*, indicating these organisms were occasionally consumed. Based on the results of this research *E. fusca* was carnivorous with omnivorous tendencies, indicated by insect larvae as the primary food, and the result of the ratio intestinal length (RIL) value obtained that *E. fusca* is classified as a carnivore.

E. fusca from October to December 2023 in Ummiding river develops a generalist feeding strategy. Various types of food were found in the digestive tract, but there was a tendency for particular foods to be more dominant in specific months (Figure 3&4). In October, phytoplankton genus *Phormidium* were more frequently consumed, while in November, the most common food was insect fragments. Afterwards, in December the food was dominated by Hemiptera and insect fragments. This different dominated prey each month indicate the food availability in Ummiding river. *E.fusca* tends has strategy as generalists preference, with the dominant prey Hemiptera. A similarly, in Amaliah *et al.* (2022) findings, gobies in Cimaja estuary, Palabuanratu have a feeding strategy that tends to be generalist. The larval amphidromous that migrate to freshwater have adaptations to adjust the prey availability, using the prey as energy to migrate to upstream and grow. The presence of benthic organisms, plankton, and unidentified prey in their diet composition indicates these fish do not rely on a specific type of food. Fish with various types of prey named as opportunistic, with adaptations to adjust the food availability in nature (Amaliah *et al*. 2022), according to Effendie (2002), they are more easily adapted to artificial feed during the domestication process. In line with it, Prabowo (2022) describes *E.fusca* in Cisolok and Cimandiri estuarine, Palabuanratu tends to has opportunistic feeding strategy belongs to prey availability. The opportunistic and flexible feeding pattern of *E. fusca* provides opportunities in domestication efforts.

Conclusions

A total of 90 individuals of *E.fusca* were collected in Ummiding river throughout three months from October to December 2023. The diet composition of the *Eleotris fusca* comprised three prey items such as insect larvae, phytoplankton and zooplankton. The ratio of intestinal length explained *E.fusca* to categorized as carnivorous and the feeding strategy tends to generalist with dominant prey insect larvae, Hemiptera.

References

Aisyah. 2025. Studi kualitas air habitat Ikan Gobi (*Eleotris fusca* Forster, 1801) di Sungai Ummiding, Polewali Mandar

sebagai dasar domestikasi ikan asli (*Skripsi*) Universitas Sulawesi Barat.

Amaliah SW, Affandi R, Simanjuntak CPH, Baihaqi F, Annida SB, Prabowo T, Romdon A. 2022. Diet composition and feeding strategy of larvae and juveniles of green riffle goby, *Stiphodon elegans* in Cimaja Estuary, Indonesia. *2ND-ISARM-2022. IOP Conf. Series: Earth and Environmental Science* 1260 (2023) 012009.

Amundsen PA, Gabler HM, Staldvik FJ. 1996. A new approach to graphical analysis of feeding strategy from stomach contents data modification of the Costello (1990) method. *Journal of Fish Biology*. 48(4): 607–614.

Clifford HF. 1991. *An Illustrated Guide Aquatic Invebrates of Alberta*. The University of Alberta Press.

Costello MJ. 1990. Predator feeding strategy and prey importance: a new graphical analysis. *Journal of Fish Biology*. 36(2): 261–263.

Effendie MI. 2002. *Biologi Perikanan*. Yayasan Pustaka Nusatama, Yogyakarta

Jabbar FBA, Yuniati D, Mahfud CR, Samudra B, Rahmawati, Aulia R, Imran M, Isra M, Annisa N. 2025. Physicochemical water quality of *Macrobrachium asperulum* natural habitats in Ummiding and Batetangnga Rivers, West Sulawesi, Indonesia: a baseline study for aquaculture development. *The 1st International Animal Science and Fisheries Conference (IASFC 2025). IOP Conf. Series: Earth and Environmental Science* 1603 (2026) 012046

Hasan V. 2022. Mengenal Ikan Gobi air tawar. *Artikel Ilmiah Populer Universitas Airlangga*. https://unair.-ac.id/mengenal-ikan-gobi-air-tawar/

Khartiono LD, Gani A, Wuniarto E, Herjayanto M, Ndobe S, Bakri AA, Nurijana, Senggagau B, Wisto, Ali W. 2024. Food habits of Blue Neon Goby *Stipodhon semoni* Weber, 1895 (Gobii-formes:Gobiidae) in Biak River Bang-gai Regency, Central Sulawesi. *JPPI.* 30(1): 1-6.

Keith P, Hoareau TB, International R, Consultants W, Lord C, Gimonneau G. 2014. Characterisation of post-larval to juvenile stages , metamorphosis and recruitment of an amphidromous goby, *Sicyopterus lagocephalus* (Pallas) (Teleostei: Gobiidae: Sicydiinae) Characterisation of post-larval to juvenile stages, metamorphosis and r. January 2008. doi:10.1071/MF08116.

Maeda K, Tachihara K. 2005. Recruitment of amphidromous sleepers *Eleotris acanthopoma, Eleotris melanosoma, and Eleotris fusca* into the Teima River, Okinawa Island. *Ichthyol Res.* 52(4):325–335. doi:10.1007/s10228005-0289-z.

Maeda K, Tachihara K. 2004. Instream distributions and feeding habits of two species of sleeper, *Eleotris acanthopoma and Eleotris fusca*, in the Teima River, Okinawa Island. *Ichthyological Research*, 51(3), 233–240. https://doi.org/10.1007/s10228-004-0224-8

Masuda H, Amaoka K, Araga C, Uyeno T, Yoshino T. 1984. *The fishes of the Japanese Archipelago* (1st ed.). Tokai University Press.

Mennesson MI, Tabouret H, Pécheyran C, Feunteun É, Keith P. 2015. Amphidromous life cycle of *Eleotris fusca* (Gobioidei: Eleotridae), a widespread species from the Indo-Pacific studied by otolith analyses. *Cybium : Revue Internationale d'Ichtyologie*. 32: 249-260.

Muthiah LI. 2021. Identifikasi saluran pencernaan dan jenis makanan Ikan Lempuk (*Gobiopterus* sp.) di Ranu Grati, Kecamatan Grati, Kabupaten Pasuruan, Jawa Timur (Skripsi). Universitas Brawijaya.

Nasyrah AFA, Lestari D, Nur F, Nur M, Aisyah, Rahmat, Putri AK, Amaliah SW. 2024. Habitat Study of Goby (*Eleotris fusca* Forster, 1801) in Ummiding River Waters, Polewali Mandar as a basis for domestication. Seminar Nasional PKP. 182-189.

Nasyrah AFA, Lestari D, Nur F, Nur M. 2025. The reproductive biology of Goby Amphidromous Dusky Sleeper (*Eleotris fusca* Forster, 1801) in Ummiding River, Polewali Mandar, West Sulawesi. *Jurnal Ilmiah AgriSains*, *26*(3), 141–152. https://doi.org/10.22487/-jiagrisains.v26i3.2025.141-152

Natarajan AV, Jhingran AG. 1961. Index of preponderance—a method of grading the food elements in the stomach analysis of fishes. *Indian Journal of Fisheries*. 8(1), 54–59.

Needham JG, Needham PR. 1962. *A Guide to the Study of Freshwater Biology*. Holden Day, Inc, San Francisco.

Nur M, Fajriani, Tenriware, Simanjuntak CPH, Nasyrah A-FA, Kautsari N. 2021. Fish fauna of the Batetangnga River, West Sulawesi, Indoneisa. *E3S Web Conf.,* 322: 1-6.

Nur M, Omar SBA, Dahlan MA. 2018. Struktur ukuran dan tipe pertumbuhan ikan penja di Perairan Sungai Karema, Provinsi Sulawesi Barat. *Jurnal SAINTEK Peternakan dan Perikanan*. 2(1):43–47.

Nurjirana, Afrisal M, Sufardin, Haris A, Burhanuddin AI. 2020. Diversity and distribution freshwater ichthyofaunal of West Sulawesi. *IOP Conference Series: Earth and Environmental Science*. 486, 1 (2020),012079. DOI: https://doi.org/-10.1088/1755-1315/486/1/012079.

Pennak RW. 1978. *Freshwater Invertebrates of the United States* (2nd Ed.) John Wiley & Sons, New York.

Prabowo T. 2022. Komposisi spesies, kelimpahan dan ekologi makanan larva dan yuwana ikan amphidromous di Estuari Cisolok dan Cimandiri Teluk Palabuhanratu (Tesis). Bogor: IPB University.

Simanjuntak CPH, Baihaqi F, Prabowo T, Annida SB, Sulistiono, Ervinia A. 2021. Pola rekrutmen ikan amfidromus air tawar (Pisces: Gobiidae, Eleotridae) di Muara Sungai Cimaja, Teluk Palabuhanratu. *Jurnal Iktiologi Indonesia*. 21(3):321-337. https://-doi.org/10.32491/jii.v21i3.595

Tasrif AA, Lopa RT, Maricar F. 2022. Zooning regulation in the Mandar River Buffer Zone, Tinambung Subdistrict, Polewali Mandar Regency. *Jurnal RAB Construction Research.* 7(2): 104–115.

Tikawati, Omar SBA, Nur M. 2024. Length-weight relationship and condition factor of threadfin goby *Sicyopterus longifilis* de Beauford, 1912 (Teleostei: Sicydiinae) at Ummiding and Matama Rivers, West Sulawesi, Indonesia. *Biodiversitas,* 25: 2074-2085.

Vuuren JV, Pieterse S, van den Berg AJH, Rensburg JVP. 2006. *Easy identification of the most common freshwater algae*. Department of Water Affairs and Forestry.

Zuliani, Z., Z. A. Muchlisin, N. 2016. Nurfadillah. Kebiasaan Makanan dan Hubungan Panjang Berat Ikan Julung - Julung (*Dermogenys* Sp.) di Sungai Alur Hitam Kecamatan Bendahara Kabupaten Aceh Tamiang. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah,* 1 (1): 12-24.