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MORPHOMETRIC AND MERISTIC CHARACTERISTICS OF THE BARONANG FISH *Siganus canaliculatus* (Park, 1797) AS A BASIS FOR BIOSYSTEMATICS IN THE SPERMONDE ARCHIPELAGO

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ABSTRACT

The fish *Siganus canaliculatus* (Park, 1797) is a coastal fishery commodity in the Spermonde Archipelago that holds ecological value and serves as an important herbivorous fish in seagrass ecosystems, as well as possessing high economic value. This study aims to analyze morphometric and meristic characters as a basis for biosystematics to support accurate taxonomic identification and evaluation of the population structure of this fish in the Spermonde waters. A total of 50 fish were collected from the Paotere Fish Landing Site during January–February 2026. Morphometric analysis was conducted by measuring 25 body characters, following the protocol of Randall & Kulbicki (2005). Meristic analysis included counting the number of spines and rays in all fins, as well as supporting characters such as the number of longitudinal scales and gill rakers. Data variation was then tested using Principal Component Analysis (PCA) to identify the primary distinguishing characters. The results of the study showed that *S. canaliculatus* has a standard length (SL) ranging from 101.1–165.2 mm with a homogeneous laterally compressed body shape. Meristic characters were stable in the number of dorsal fin spines (13) and pectoral fin rays (15–18). PCA analysis revealed that morphometric diversity is dominated by size factors (PC 1 at 99.03%), with anterior body dimensions (Pre-dorsal Length and Pre-anal Length) serving as the most distinct differentiating variables. The low variation in body shape indicates a population that tends to be uniform in the Spermonde Archipelago. This study provides updated biometric data specific to the *S. canaliculatus* population in the Spermonde Archipelago in 2026. The use of PCA analysis contributes scientifically to establishing the Pre-dorsal and Pre-anal parameters as key indicators for distinguishing fish stocks. This data serves as a crucial tool for sustainable fisheries resource management and the strengthening of the marine biosystematics database in South Sulawesi.

Keywords: Morphometrics; meristics; *Siganus canaliculatus*; biosystematics; Spermonde Archipelago

INTRODUCTION

One group of fish that plays a crucial role in coastal ecosystems is the family Siganidae, particularly the species *Siganus canaliculatus* (Park, 1797). This species is known as the baronang or rabbitfish, characterized by a flattened body, venomous spines on its fins, and color patterns that vary depending on its habitat (Abidin et al., 2024). The baronang is generally found in seagrass beds (Latuconsina et al., 2020). Seagrass beds serve as foraging areas, nurseries, and protection from predators for the baronang, which ecologically belongs to the herbivore group in the aquatic food chain (Syukur et al., 2017).

The baronang fish *Siganus canaliculatus* (Park, 1797) possesses the characteristic morphology of the Siganidae family, with a moderately compressed, slender body (depth 2.3–2.8 times standard length/SL), an average total length of 15.8–16.1 cm (range 11.8–19.4 cm), and a standard length of 12.8–13.9 cm, accompanied by a body height of 39–58% SL (average 52%) and a slender body width of 11–19% SL (average 16%). The head is scaleless with a somewhat pointed snout, a small terminal mouth with fine cutting teeth, small ctenoid scales forming 16–26 rows between the lateral line and the first dorsal fin spine, and a color pattern ranging from grayish-green to yellowish-brown with 100–200 blue-white pearl-like spots the size of a matchhead on the back and sides of the body (Sahabuddin & Iqbal Burhanuddin, Asmi Citra Malina, 2015).

Based on this, the objective of this study is to analyze the morphometric and meristic characteristics of the baronang fish *Siganus canaliculatus* (Park, 1797) from the Spermonde Archipelago as a basis for biosystematics to support taxonomic identification, population variation, and resource management in the Spermonde Archipelago.

Morphometry is a method of measuring the shape and size of an organism's body—including fish—using quantitatively measurable traits, such as total length, head length, body height, fin length, and body width. Morphometric analysis is typically used to determine variations in body shape among populations, phylogenetic relationships, species identification, and the effects of the environment on fish growth. In fisheries research, morphometric data is crucial as it helps explain differences in traits between species and across different habitats

(Tabaika, 2022). Meanwhile, meristics is the study of countable body parts in fish, such as the number of fin rays, the number of scales along the lateral line, the number of fin spines, or the number of vertebrae. Meristic characters are generally used in fish identification and classification because they are relatively stable compared to morphometric characters. Meristic analysis is often combined with morphometric analysis to strengthen the species identification process and to examine fish population variations within a given aquatic area (Sadewi et al., 2018).

Morphometric and meristic measurements are necessary because these two methods can be used to determine body shape, the number of specific body parts, and differences in characteristics among fish. Morphometric analysis helps assess the size and proportions of a fish's body, while meristics is used to count body parts such as the number of fins, fin rays, or scales. This data is crucial for species identification, population grouping, taxonomic studies, and understanding the environmental impacts on fish growth. Through morphometric and meristic measurements, researchers can gain a clearer understanding of phylogenetic relationships and character variation within a fish species (Kusumanigrum et al., 2021).

MATERIALS AND METHODS

Time and location of Research

A total of 50 *Siganus canaliculatus* specimens were collected during January–February 2026 from the Paotere Fish Auction Site (TPI), Gusung Village, Makassar, South Sulawesi, Indonesia. This location was selected because it serves as the primary landing site for catches from the waters of the Spermonde Archipelago. Measurements Morphological analysis was conducted at the Marine Biology Laboratory, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar. Morphological characteristics were identified through two main approaches: morphometric and meristic.

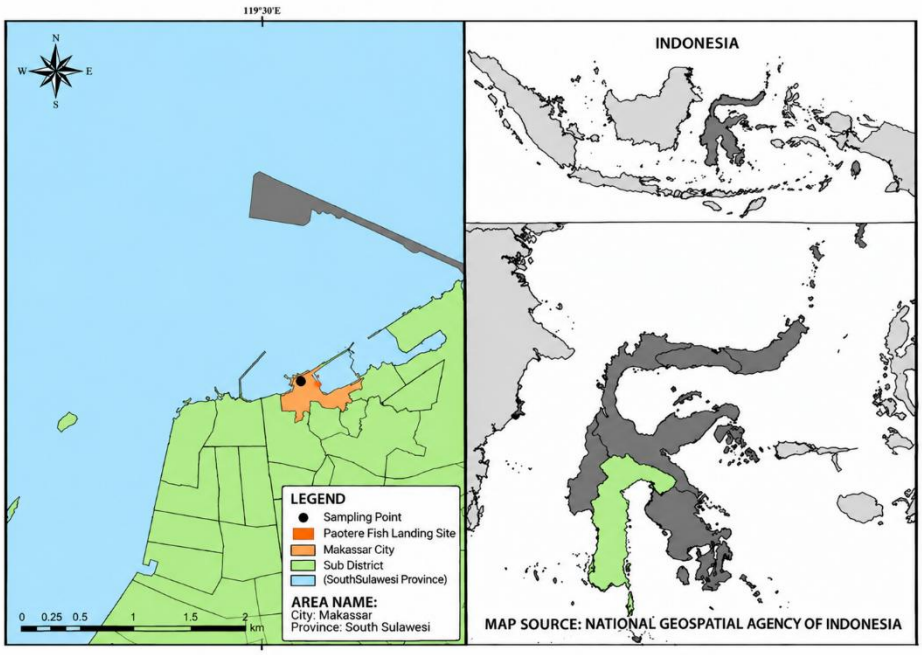


Figure 1. Location of *Siganus canaliculatus* sampling at Paotere Fish Auction Site, Makassar.

Laboratory Procedures

Morphological analysis was conducted at the Marine Biology Laboratory, Faculty of Marine Sciences and Fisheries, Hasanuddin University, Makassar. Morphological characteristics were identified using two main approaches: morphometric and meristic. The measurement process for *Siganus canaliculatus* began with specimen preparation. This stage included cleaning the fish bodies, spreading the fins, documenting the samples, and assigning codes or labels to each sample. After preparation was complete, specimens were immersed in a 7% formalin solution for five days to preserve tissue condition. The samples were then rinsed with running water for three days to reduce residual formalin. Subsequently, the specimens were re-immersed in 70% alcohol for seven days as a preservation step, ensuring the samples remained in good condition and ready for both morphometric and meristic measurements.

Morphometric and meristic analysis

Morphometric measurements were conducted meticulously following the protocol of Randall & Kulbicki (2005) (Figure 2). Measurements were taken using a Vernier caliper with a precision of 0.01 mm. For meristic analysis, the number of spines and soft rays on the dorsal, anal, pectoral, caudal, and ventral fins was counted. Additionally, the number of scales in the longitudinal row (above the lateral line) and the number of gill rakers in the first gill arch were counted. The caudal fin is forked. Conventional morphometric measurements were standardized using the formula %SL = Body length/Standard length × 100%. The standardized data were then analyzed using principal component analysis to identify the distinguishing characteristics of *Siganus canaliculatus* within a population.

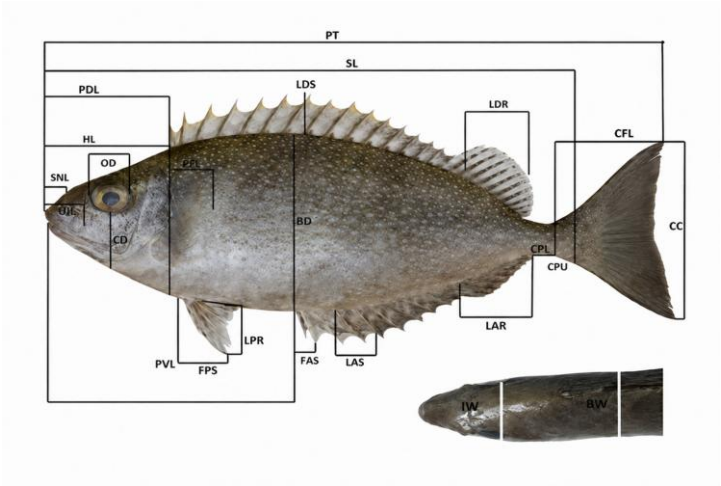


Figure 2. External morphology of *Siganus canaliculatus* showing the observed morphometric characters: (TL) total length, (SL) standard length, (BD) body depth, (BW) body width, (HL) head length, (SNL) snout length, (OD) orbital diameter, (IW) interorbital width, (CD) cheek depth, (UJL) upper jaw length, (CPD) caudal peduncle depth, (CPL) caudal peduncle length, (PDL) predorsal length, (PAL) preanal length, (PVL) prepelvic length, (FDS) first dorsal spine, (LDS) longest dorsal spine, (LDR) longest dorsal ray, (FAS) first anal spine, (LAS) longest anal spine, (LAR) longest anal ray, (CFL) caudal fin length, (CC) caudal cavity, (PFL) pectoral fin length, (FPS) first pelvic spine, and (LPR) longest pelvic rays.

RESULTS AND DISCUSSION

Morphological Description

The species *Siganus canaliculatus* has a medium body size classified as subadult, with a total length (117.9–194.2% SL) and standard length of 101.1–165.2 mm (average 139.5 mm). The body shape is relatively tall and flattened, with a body height of 39.1–57.9% SL (52.3%), while the body width is smaller, indicating a body that is not very thick (1.2–18.5% SL).

The head is proportional to the body, with a head length of 26.2–39.6% of total body length (32.4%). The snout is relatively short (7.9–27.2% SL; 12.2%), while eye diameter (6.6–12.2% SL; 10.6%) and interorbital distance (7.0–13.7% SL; 10.7%) indicate a fairly large and well-proportioned eye. Cheek depth ranges from 10.4–18.4% of total body length (15.8%), and upper jaw length from 6.8–12% of total body length (9.1%).

The caudal peduncle is relatively slender, with a height of 5.8–9.6% SL (8.0%) and a length of 3.3–8.3% SL (5.8%). The predorsal length ranges from 24.2–41.2% of SL (32.3%), the preanal from 41.7–80.1% of SL (66.9%), and the prepelvic from 27.1–47.9% of SL (37.3%), indicating that the fins are proportionally positioned along the body.

The fins are well-developed, with the first dorsal fin measuring 5.8–11.8% of total body length (SL) (9.3%) and the longest dorsal fin ray measuring 10.4–17.3% of total body length (SL) (14.0%). The anal fin has a first spine of 6.7–13.9% SL (10.5%) and the longest rays of 8.7–15.8% SL (12.3%). The caudal fin is relatively long (19.5–41.4% SL; 33.4%) with a caudal notch of 1.1–7.3% SL (0.8%), while the pectoral fins are quite long (17.4–29.2% SL; 23.5%). The pelvic fins are also well-developed, with the first spine measuring 12.2–21.1% of total body length (16.8%) and the longest ray 11–20.6% of total body length (16.6%). Overall, the morphometric characteristics show relatively little variation, indicating a fairly homogeneous population with the typical

baronang body shape—flattened, tall, and possessing well-developed fins to support swimming and maneuvering in its habitat.

Based on the results of the Principal Component Analysis (PCA) in Figure 4, it is evident that several morphometric characters play a role in distinguishing the observed specimens. Of all the parameters analyzed, the PAL and BD traits showed the greatest contribution as the primary distinguishing features of *Siganus canaliculatus*. Differences in the values of these two traits indicate variations in body shape among specimens, and thus can be used as a basis for identifying the morphological patterns of the species under study.

Table 1. Morphometric measurements of *Siganus canaliculatus* from the waters of Spermonde

Character	*Siganus canaliculatus* N=50 Range (Rean)
Morphometric	
Total length	161.2±19.1 (117.9–194.2)
Standard Length	139.5 ± 16.2 (101.1–165.2)
%SL	
Body depth	52.3 ± 4.8 (39.1–57.9)
Body width	15.8 ± 1.7 (11.2–18.5)
Head length	32.4 ± 3.6 (26.2–39.6)
Snout length	12.2±2.7 (9.2–27.2)
Orbital diameter	10.6 ± 1.2 (6.6–12.2)
Interorbital width	10.7 ± 1.6 (7.0–13.7)
Cheek depth	15.8 ± 1.9 (10.4–18.4)
Upper-jaw length	9.1 ± 1.0 (6.8–12)
Caudal peduncle depth	8.0 ± 0.8 (5.8–9.6)
Caudal peduncle length	5.8 ± 1.2 (3.3–8.3)
Predorsal length	32.3 ± 3.2 (24.2–41.2)
Preanal length	66.9 ± 8.6 (41.7–80.1)
Prepelvic length	37.3 ± 4.2 (27.1–47.9)
First dorsal spine	9.3 ± 1.5 (5.8–11.8)
Longest dorsal spine	16.2 ± 2.3 (11.1–20.8)
Longest dorsal ray	14.0 ± 1.6 (10.4–17.3)
First anal spine	10.5 ± 1.5 (6.7–13.9)
Longest anal spine	15.3 ± 2.2 (10.2–19.9)
Longest anal ray	12.3 ± 1.8 (8.7–15.8)
Caudal fin length	33.4 ± 4.8 (19.5–41.4)
Caudal concavity	2.8 ± 1.7 (1.1–7.3)
Pectoral fin length	23.5 ± 3.3 (17.4–29.2)
First pelvic spine	16.8 ± 2.1 (12.2–21.1)
Longest pelvic ray	16.6 ± 2.1 (11–20.6)



Figure 3. Morphology of *Siganus canaliculatus*

Coloration

Siganus canaliculatus is generally yellowish-brown to greenish in color, with the back darker than the sides of the body and the belly tending to be paler or whitish. In some individuals, there is a grayish color on the sides of the body. The head is relatively the same color as the body, but slightly darker on the dorsal side. The area around the eyes appears lighter, with the eye diameter clearly defined and contrasting with the body color.

The fins are generally yellowish to transparent. The dorsal and anal fins may exhibit a pale yellowish to greenish color with a slight dark shadow along the hard rays. The *pectoral* and *pelvic* fins tend to be more transparent or pale yellow. The *caudal fin* is generally yellow to pale yellow, sometimes with a slightly darker gradient along the edges. In some individuals, the fin color may appear brighter, especially in habitats with clear water conditions.

Principal Component Analysis (PCA)

Principal Component Analysis (PCA) was used to identify the main patterns of morphometric variation within the *Siganus canaliculatus* population. The results of the analysis are visualized as a loading plot in Figure 4.

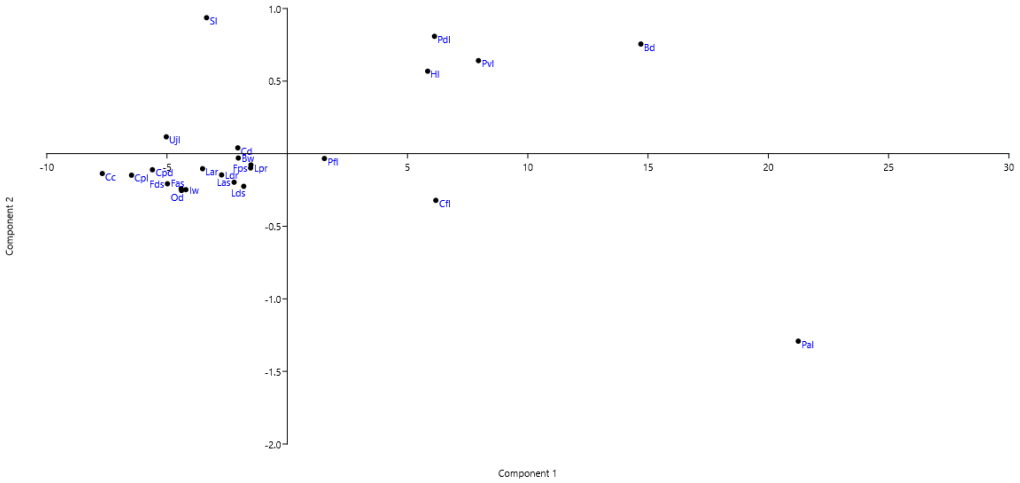


Figure 4. Principal component analysis (PCA) loading plot of the morphometric characters of *Siganus canaliculatus*

In (Figure 4), *Siganus canaliculatus* exhibits significant differences in the Bd and Pal components, which likely represent body parts that vary more markedly than other characteristics, causing them to stand out prominently on the loading plot. Biologically, these differences may occur because fish from different habitats experience different environmental pressures, such as current velocity, substrate type, seagrass density, and different swimming or foraging strategies, indicating the presence of morphometric clustering among populations. A study (Latuconsina et al., 2024) explains that in semi-enclosed bays, truss-based morphometrics also indicate clustering based on morphometric similarities across seagrass habitats. This means that body shape variation in this species is indeed often related to habitat conditions and spatial isolation, rather than merely random variation. Thus, if Bd and Pal are far from other groups on the graph, this likely reflects stock differences or local adaptations to the environment.

Table 2. Comparison of meristic data for *Siganus canaliculatus*, *Siganus sutor*, and *Siganus guttatus*

Species	DFS	DFR	AFS	AFR	VFS	VFR	PFR	CFR	Source
Siganus canaliculatus	13	10–11 (10)	7–8 (7)	9	2	3	15	18–19 (19)	This study
Siganus sutor	13	10	7	9	-	-	17(17-18)	18	(Andrefouët et al., 2020)
Siganus guttatus	13	10	9	9	-	-	17(!7-18)	18	(Andrefouët et al., 2020)

Based on the data presented in the table, there are relatively specific differences in meristic characteristics among the three species of rabbitfish, namely *Siganus canaliculatus*, *Siganus sutor*, and *Siganus guttatus*. In general, the three species share the same basic number of Dorsal Fin Spines (DFS), with 13 spines, and Anal Fin Rays (AFR), with 9 rays. However, upon closer examination, *S. canaliculatus* exhibits slightly greater variation in the number

of Dorsal Fin Rays (DFR), ranging from 10–11, and Anal Fin Spines (AFS), ranging from 7–8, whereas the other two species tend to be more consistent, with 10 DFR.

The most noticeable differences are found in the number of pectoral fin rays (PFR) and caudal fin rays (CFR). *S. canaliculatus* has 15 pectoral fin rays, fewer than *S. sutor* and *S. guttatus*, which have 17–18 rays. Meanwhile, *S. guttatus* has the highest number of caudal fin rays, with 18 rays, while *S. canaliculatus* has 18–19 rays and *S. sutor* has 18 rays. These data indicate that although the three species belong to the same genus, each species possesses a unique fin structure configuration that serves as a distinctive taxonomic characteristic.

Table 3 . Dominant Morphometric Characters in the Principal Components (PC) of *Siganus canaliculatus* from the Spermonde region.

Morphometric Characteristics	PC 1 (99.03%)	PC 2 (0.42%)	PC 3 (0.12%)
Pre-dorsal Length (Pdl)	23.05	-1.58	0.45
Pre-anal Length (Pal)	09.45	0.07	-0.12
Lower Jaw Length (Lar)	08.02	0.09	00.15
Head Length (Hl)	7:15	00.04	-0.05
Standard Length (Sl)	-4.2	-0.15	00.08
Eigenvalue	49.51	00.21	0.06
Cumulative Variance (%)	99.03	99.45	99.57

The results of the PCA analysis in Table 3 show that the morphometric characteristics of *Siganus canaliculatus* exhibit varying degrees of variation across different body parts. The PC 1 value, which reached 99.03%, indicates that most of the differences in body shape among specimens are influenced by several primary characteristics, particularly Pre-dorsal Length (Pdl), Pre-anal Length (Pal), Lower Jaw Length (Lar), and Head Length (Hl**).** The Pre-dorsal Length (Pdl) character has the highest value, making it the primary differentiator among individuals. Differences in the length of the section before the dorsal fin are believed to be related to the fish's growth process, habitat conditions, and adaptive capacity to its living environment. Fish inhabiting habitats with differing current conditions and food availability generally exhibit distinct body shapes. Research (Sahabuddin & Iqbal Burhanuddin, Asmi Citra Malina, 2015), also explains that morphometric variations in baronang fish can be influenced by environmental conditions and differences in aquatic regions. The Pre-anal Length (Pal) trait also contributes significantly to the formation of morphometric variations. Size differences in this region may occur due to swimming patterns and the fish's behavioral habits within their habitat. Fish living in areas with strong currents generally have a slimmer body shape compared to those in calm waters. Additionally, factors such as age, growth, and environmental conditions—including temperature and food availability—also influence the development of the fish's body shape. According to (Suwarni et al., 2020), morphometric characteristics in *S. canaliculatus* may vary across different water bodies due to environmental influences and the population's adaptive capacity to its habitat. A relatively high Lower Jaw Length (Lar) value indicates that lower jaw length is one of the key characteristics distinguishing specimens of *S. canaliculatus*. Differences in lower jaw size are generally related to feeding habits, food type, and the fish's ability to adapt to its living environment. As herbivorous fish, the development of the jaw in baronang is strongly influenced by grazing on seagrass and algae in coastal habitats. Environments with varying food availability can cause jaw shape and size to develop differently among populations. Additionally, growth factors and food competition can also influence the development of the fish's jaw structure. According to (Latuconsina et al., 2024), variations in morphometric characters in the head and jaw regions of fish can result from trophic adaptations and differences in aquatic habitat conditions. The Head Length (Hl) character also demonstrates size variations among *S. canaliculatus* specimens. These differences in head length are generally related to growth processes, environmental conditions, and the fish's ability to adapt to its habitat. In addition to genetic factors, food availability and water quality can also influence the development of the fish's head. In habitats with different food, the shape and size of the fish's head often exhibit certain variations as a form of adaptation. Research (Abidin et al., 2024) explains that the morphometric characteristics of the heads of marine fish can change in response to the ecological and environmental conditions in which the organisms live.

CONCLUSION

This study provides baseline biometric data for *Siganus canaliculatus* from the waters of the Spermonde Archipelago, based on observations of 25 morphometric characters and several meristic characters in 50 fish. In general, the rabbitfish examined had a standard length of 101.1–165.2 mm, a laterally compressed body shape, and relatively little variation in body proportions, suggesting that the population is relatively uniform. The meristic characters also showed a fairly consistent pattern, particularly 13 dorsal-fin spines and 15–18 pectoral-fin rays. The stability of these characters underscores the value of meristic data in supporting the identification of *S.*

canaliculatus and distinguishing it from other Siganidae species. PCA results showed that morphometric variation was largely associated with body size, with PC1 explaining 99.03% of the variation. Pre-dorsal length and pre-anal length contributed the most, making them potential preliminary indicators for characterizing rabbitfish populations in this region. Thus, this study contributes baseline biometric data that can serve as a reference for taxonomic identification, population-structure monitoring, and the management of *S. canaliculatus* fisheries in the Spermonde Archipelago.

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