

## *Paragobiodon kasaii*, a New Gobiid Fish from Japan and Palau

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**Abstract** The gobiid fish *Paragobiodon kasaii* is described as a new species from five specimens collected from coral (*Pocillopora eydouxi* Edwards and Haime) from reefs in 10–15 m in the Ryukyu Islands, Japan. Underwater photographs of this new species were also provided from Japan and Palau. Of the five other species of the genus known from Japan, it is most similar to *Paragobiodon lacuniculus* (Kendall and Goldsborough), with which it shares a pale body and black median fins. It differs in having the first dorsal pterygiophore formula 3/II II I I 0/9 instead of 3/ I II I I 0/9, the origin of the first dorsal fin posterior to the upper base of the pectoral fins, the origin of the pelvic fins directly below the lower base of pectoral fins, and in having translucent instead of black pectoral fins.

**Key words:** Gobiidae, *Paragobiodon*, new species, Japan, Palau.

The species of *Paragobiodon* (Perciformes, Gobioidae, Gobiidae) form a group of small fishes that inhabit the subtropical to tropical regions of the western Pacific and Indian Oceans, and live as commensals on branches of coral of species of the genera *Pocillopora*, *Seriatopora* and *Stylophora* in coastal coral reefs. *Paragobiodon* can be recognized by having the following combination of characters: body oval and compressed; dorsal profile of head steep and strongly convex; body with large scales; head and nape naked, with fleshy papillae; sensory canal pores of head well developed, sensory papillae of cheek reduced; gill opening narrow, ending ventrally nearly at level of last pectoral ray; pelvic fins joined to form a cup-like disc, the pelvic frenum well developed; the first dorsal pterygiophore formula usually 3/ I II I I 0/9, or 3/II II I I 0/9; second dorsal and anal fins with I, 8–10 rays; pectoral fins with 19–23 rays (Akihito et al., 2002; Prince Akihito et al., 1984; Randall, 2005; Suzuki and Shibukawa, 2004; present study).

*Paragobiodon* was established by Bleeker

(1873) for the type species *Gobius echinocephalus* Rüppell 1830, now known to contain the following five valid species (Larson and Murdy, 2001): *Paragobiodon echinocephalus* (Rüppell, 1830), *P. lacunicolus* (Kendall and Goldsborough, 1911), *P. melanosomus* (Bleeker, 1852), *P. modestus* (Regan, 1908), and *P. xanthosomus* (Bleeker, 1852).

Five valid species and one unnamed species of *Paragobiodon* were reported by Suzuki et al. (1995) and Suzuki and Shibukawa (2004) from Japan. In this paper, *Paragobiodon* sp. sensu Suzuki et al. (1995) is described as *Paragobiodon kasaii*.

### Materials and Methods

Type specimens of the new species are deposited in the Bernice P. Bishop Museum, Honolulu (BPBM), the National Museum of Nature and Science, Tokyo (NSMT) and the Osaka Natural History Museum (ONHM).

Lengths of specimens are given as standard length (SL). Methods of counting and measure-

Table 1. Proportional measurements of the type specimens of *Paragobiodon kasaii* as % of the standard length

|                                       | Holotype       |                | Paratypes      |               |                  |
|---------------------------------------|----------------|----------------|----------------|---------------|------------------|
|                                       | OMNH-P<br>5000 | OMNH-P<br>8291 | OMNH-P<br>8292 | BPBM<br>41053 | NSMT-P<br>105715 |
| Standard length (mm)                  | 19.2           | 18.1           | 11.7           | 15.0          | 19.8             |
| Sex                                   | female         | male           | young          | male          | male             |
| Body depth (at P <sub>2</sub> origin) | 28.2           | 26.8           | 27.2           | 30.4          | 27.9             |
| Body depth (at A origin)              | 25.7           | 25.3           | 26.4           | 27.2          | 24.0             |
| Body width                            | 25.7           | 25.3           | 24.4           | 25.3          | 26.4             |
| Head length                           | 33.7           | 32.6           | 32.5           | 34.8          | 35.1             |
| Head width                            | 26.2           | 25.8           | 27.2           | 26.6          | 28.4             |
| Snout length                          | 8.2            | 7.9            | 10.2           | 9.5           | 8.2              |
| Orbit diameter                        | 8.9            | 8.9            | 11.0           | 9.5           | 7.5              |
| Interorbital width                    | 8.7            | 7.1            | 10.6           | 7.3           | 7.2              |
| Upper-jaw length                      | 12.9           | 12.1           | 13.0           | 13.9          | 13.0             |
| Caudal-peduncle depth                 | 15.8           | 16.3           | 16.7           | 16.5          | 16.8             |
| Caudal-peduncle length                | 20.3           | 21.1           | 20.3           | 21.5          | 19.2             |
| Predorsal length                      | 38.1           | 36.8           | 40.7           | 38.0          | 37.5             |
| Preanal length                        | 56.4           | 57.4           | 58.5           | 56.3          | 60.1             |
| Prepelvic length                      | 30.2           | 32.6           | 30.9           | 32.3          | 33.2             |
| Base of dorsal fins                   | 46.0           | 47.9           | 45.5           | 46.2          | 46.2             |
| Longest first dorsal spine            | 14.9 (III)     | 15.5 (III)     | 14.2 (III)     | 15.2 (V)      | 14.4 (III)       |
| Longest dorsal ray                    | 17.3 (7th)     | 21.1 (7th)     | 16.3 (6th)     | 20.3 (7th)    | 16.8 (7th)       |
| Base of anal fin                      | 22.8           | 24.7           | 22.0           | 24.1          | 20.2             |
| Longest anal ray                      | 14.4           | 19.7           | 17.9           | 18.7          | 15.4             |
| Caudal-fin length                     | broken         | 21.6           | broken         | 22.2          | broken           |
| Pectoral-fin length                   | 24.8           | 27.4           | 29.3           | 27.8          | 23.1             |
| Pelvic-fin length                     | 20.3           | 18.4           | 22.8           | 21.5          | 21.2             |

ments follow Suzuki and Randall (2009). Fin-ray branching, location of origin of each fin, number and distribution of the scales, and the cephalic sensory system of head were described from preserved material stained with cyanine blue solution. Information on the vertebrae, and the pattern of interdigitation of the dorsal-fin proximal pterygiophores and the neural spines (P–V) were obtained from radiographs. Information about the procurrent caudal rays, gill rakers, teeth and were obtained from one paratype stained with alizarin red. The terminology of P–V and cephalic sensory pores follow Akihito (1984). Descriptions of the fresh, preserved and live coloration are based on color slides, the Image Database of Fishes of the Kanagawa Prefectural Museum of Natural History (KPM-NR) (<http://research.kahaku.go.jp/zoology/photoDB/>) and Suzuki and Shibukawa (2004). Morphometric data presented in Table 1 are given as percentages of the standard length. In the description, data for the holotype

are given first, followed by the data for the paratypes in parentheses when different.

***Paragobiodon kasaii* sp. nov.**

[Japanese name: Kasai-darumahaze]

(Figs. 1–3; Table 1)

*Paragobiodon* sp.: Suzuki et al, 1995: 1 (Iriomote Island, Yaeyama Islands, the Ryukyu Islands, Japan, 12 m, underwater photo by Masao Kasai).

*Paragobiodon* sp.: Akihito et al., 2002: 1185 (Iriomote Island, Yaeyama Islands, the Ryukyu Islands, Japan).

*Paragobiodon* sp. A: Suzuki and Shibukawa, 2004: 162 (Iriomote Island, Yaeyama Islands, the Ryukyu Islands, Japan, 4–6 m, underwater photo by Korechika Yano).

**Holotype.** OMNH-P 5000, female, 19.2 mm, Japan, the Ryukyu Islands, Iriomote Island, Hatoma, 24°28'19.17"N, 123°48'33.82" E, 15 m, hand net, Masatomi Suzuki and Toshiyuki Suzuki, 7 Aug. 1993.

**Paratypes.** OMNH-P 8291, male, 18.1 mm, cleared and stained, Japan, the Ryukyu Islands,

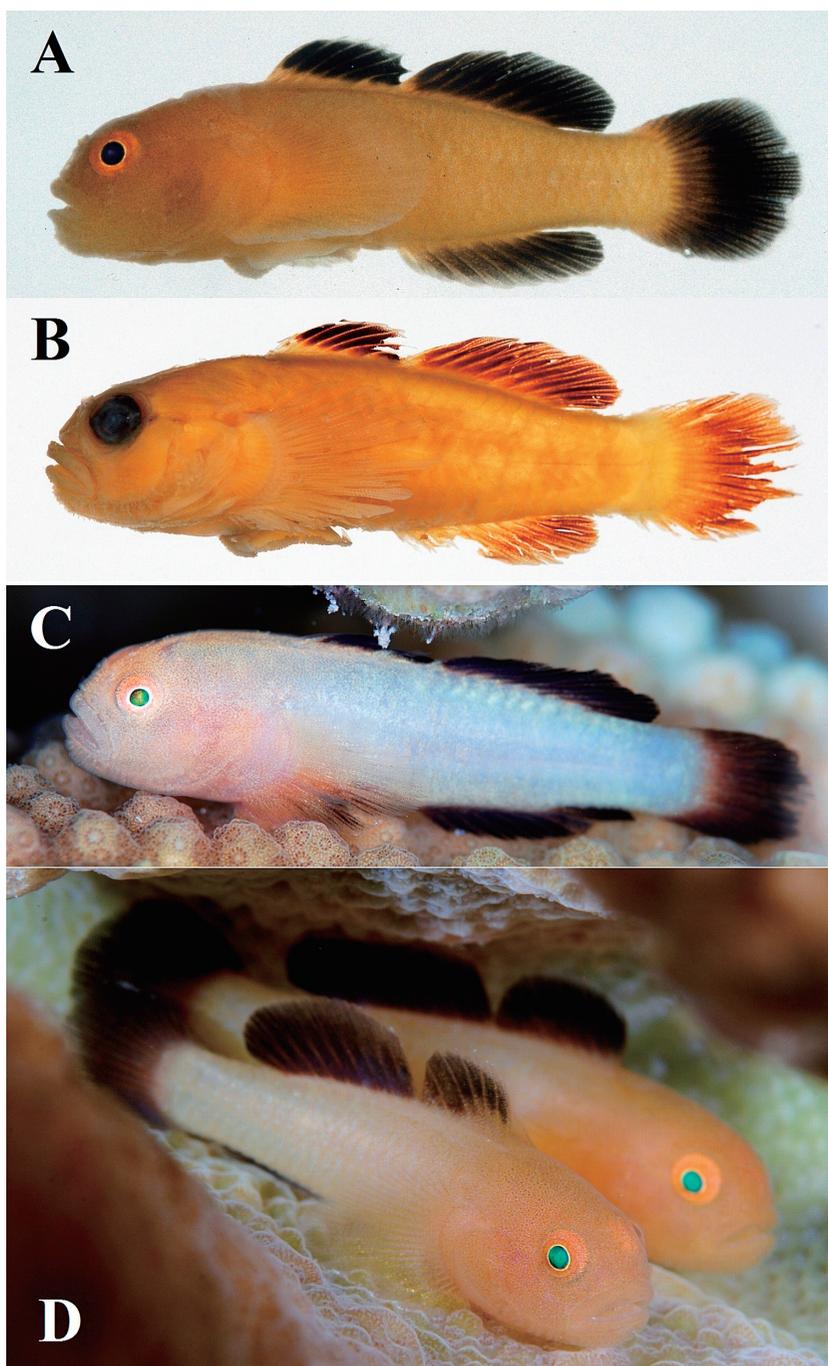


Fig. 1. *Paragobiodon kasaii* sp. nov. — A, Holotype (fresh specimen), OMNH-P 5000, female, 19.2 mm SL, Iriomote Island, the Ryukyu Islands, Japan; B, holotype (preserved in alcohol), photo by T. Suzuki; C, underwater photo, KPM-NR 44888, Iriomote Island, the Ryukyu Islands, Japan, 5 m depth, host coral *Pocillopora eydouxi*, 15 June 2010, photo by Masao Kasai; D, underwater photo, KPM-NR 44882, Ngemlis Reef, Ngis Island, Palau, 6.5 m depth, host coral *P. eydouxi*, 7 March 2011, photo by Jiro Sakaue.

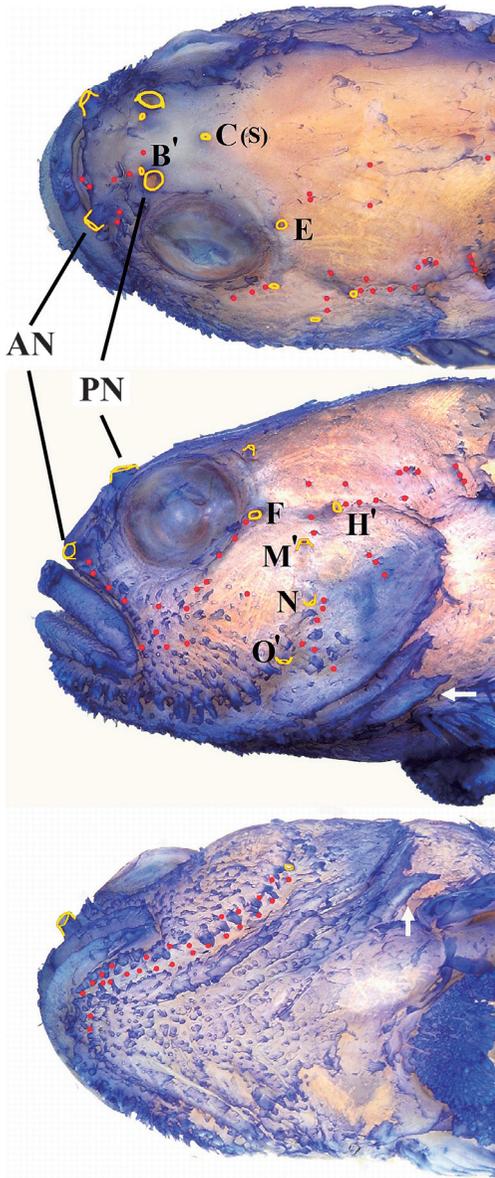


Fig. 2. Head of holotype of *Paragobiodon kasaii* sp. nov. showing cephalic sensory pores and papillae. Dorsal, lateral, and ventral views of head, showing sensory papillae (red dots), sensory-canal pores (open yellow circles, indicated by uppercase letters) and the fleshy papillae of head. AN and PN (open yellow circles) indicate anterior and posterior nares, respectively. Arrows show the position where the gill membrane is attached to the isthmus. Specimens were stained with cyanine blue. Photo and retouch by T. Suzuki.



Fig. 3. Paratype of *Paragobiodon kasaii* sp. nov., OMNH-P 8292, juvenile, 11.7 mm SL, Iriomote Island, Ryukyu Islands, Japan. — A, Fresh specimen; B, preserved in alcohol, photo by T. Suzuki.

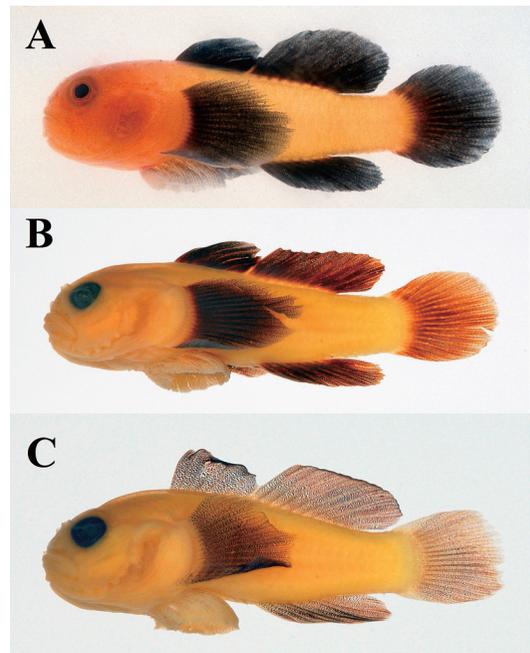


Fig. 4. *Paragobiodon lacunicolus* (Kendall and Goldsborough, 1911), Iriomote Island, the Ryukyu Islands, Japan. — A, OMNH-P 15294, fresh specimen, male, 12.4 mm SL; B, OMNH-P 15294, preserved in alcohol; C, OMNH-P 15287, an alcohol-preserved specimen, juvenile, 9.7 mm SL, photo by T. Suzuki.

Iriomote Island, Brasu, 24°26'8.38"N, 123°49'8.27"E, 10 m, hand net, M. Suzuki and T. Suzuki, 2 Aug. 1993; OMNH-P 8292, juvenile, 11.7 mm, BPBM 41053 (formerly OMNH-P 8293), male, 15.0 mm, and NSMT-P 105715 (formerly OMNH-P 8294), male, 19.8 mm, all with same data as holotype.

*Comparative material.* *Paragobiodon lacunicolus*: Chichi Island, Ogasawara Islands, Japan: OMNH-P 15282, male, 18.1 mm SL, M. Suzuki and T. Suzuki. Iriomote Island, Yaeyama Islands, the Ryukyu Islands, Japan: OMNH-P 15283–15295, 5 males, 7 females, and 1 juvenile, 9.7–13.5 mm SL, M. Suzuki and T. Suzuki.

*Photograph Records from Image Database of Fishes.* The Ryukyu Islands, Japan: Amami-Oshima Island, KPM-NR 62018, 10 m depth, 25 Aug. 2001, Kimihiro Yamazaki; Ie Island, Okinawa Islands, KPM-P 10328, 5 m, 10 Sep. 1994, Masataka Kawata; Okinawa Island, KPM-NR 80341, 8 m, 6 Oct. 2002, Yasuyuki Sugimori; Irabu Island, Miyako Islands, KPM-P 68028 (5 m, 29 July 2001) and KPM-NR 69911 (8 m, 1 Aug. 2003), Yoko Kobayashi; KPM-NR 82149, 16 m, 13 Aug. 2003, Nobuyuki Kobayashi; Ishigaki Island, Yaeyama Islands, KPM-NR 81688 and 81693, Junichi Nakamoto; Iriomote Island, KPM-NR 44888, 5 m, 15 June 2010, Masao Kasai. Palau: Ngemlis Reef, Ngis Island, KPM-NR 44882, 6.5 m, 7 March 2011, Jiro Sakaue.

*Diagnosis.* A species of *Paragobiodon* with P-V 3/II II I I 0/9; the origin of the first dorsal fin posterior to the upper base of pectoral fins, origin of pelvic fins directly below the lower base of pectoral fins; head and body light reddish yellow; median fins black; paired fins translucent.

*Description.* Dorsal-fin rays VI+I, 9; anal-fin rays I, 8; pectoral-fin rays 21 (19 in one; 20 in one; 22 in one paratype); pelvic-fin rays I, 5; branched caudal rays 9+8 (the smallest paratype 8+7); segmented caudal rays 9+8; scales in longitudinal series on body 23 (24 in three; 25 in one paratype), the last scale overlapping end of hypural plate; transverse scale rows 8 (7 in four paratypes); predorsal scales 0; median preopercular scales 0; P-V 3/II II I I 0/9; vertebrae 10+16=26.

Dorsal profile of head steep and strongly convex. Maxilla reaching posterior to a vertical at anterior edge of orbit (not reaching slightly in one paratype). Ventral end of gill opening extending to level of second lower pectoral-fin ray (white arrows of Fig. 2). Anterior nostril tubular (AN of Fig. 2), at level of lower edge of orbit; posterior nostril (PN of Fig. 2) dorsoposterior, at bony edge of orbit, with a distinct rim. Fleishy papillae covering much of ventral side of head and cheek.

Anterior oculoscapular canal with pores B', C(s), E and H'; preopercular canal with M', N and O' (one paratype missing pore N). The pattern of the cephalic sensory system is illustrated in Fig. 2.

The following characters are described based on the cleared and stained paratype (OMNH-P 8291). Procurent caudal rays+branched caudal rays v+9+8+v. Gill rakers 1+5. Inwardly curved conical teeth in both jaws. Upper jaw with outermost row of 12 medium-sized, slightly spaced teeth, grading to smaller posteriorly; three to five irregular inner rows of small teeth, grading to smaller posteriorly and inner. Lower jaw with outermost row of 16 medium-sized, slightly spaced teeth, grading to smaller posteriorly; three to four irregular inner rows of small teeth, grading to smaller posteriorly and inner; a row of four enlarged teeth on anteriormost and innermost part of upper jaw, grading to smaller posteriorly.

Scales ctenoid, none on head, nape, preopercular and preopercular regions, midventral abdomen, and along base of dorsal and anal fins.

Origin of first dorsal fin one scale posterior to a vertical at the upper base of pectoral fins; first dorsal fin subrectangular, lower than second dorsal fin; the third spine longest (the fifth spine longest in one paratype), not filamentous, and not reaching posterior to second dorsal fin when adpressed; sixth dorsal spines (fifth and sixth spine in three paratypes) reaching posterior to base of first segmented ray of second dorsal fin (origin of second dorsal fin in one paratype) when adpressed; first dorsal fin attached to base of second

dorsal fin via a low membrane. The third segmented ray of second dorsal fin longest (seventh ray longest in one paratype); the last not reaching end of caudal peduncle when adpressed. All dorsal and anal soft rays branched, the last to base; distal margins of second dorsal and anal fins slightly concave. Anal fin lower than second dorsal fin (equal in one paratype); its origin at a vertical through origin of second dorsal fin (base of first segmented ray in two paratypes); seventh segmented anal ray longest (sixth ray longest in one paratype); the last ray not reaching end of caudal peduncle when adpressed. Posterior margin of pectoral fin rounded; lower margin straight; all segmented rays except lowermost branched (all rays branched in one paratype); pectoral fins reaching posteriorly to a vertical through base of third segmented rays of second dorsal fin (fourth ray base in three paratypes). Origin of pelvic fins directly below the lower base of pectoral fins; all segmented rays branched; pelvic fins joined medially, forming a sucking disc; the frenum and basal membrane complete, well developed; pelvic fins not reaching posterior to anus when adpressed (reaching anus in four paratype). Posterior margin of caudal fin rounded; all segmented rays branched.

Color of holotype when fresh (Fig. 1A). Background color of head and body light reddish yellow, and head brownish; median fins black except light reddish yellow base; paired fins translucent. Color of juvenile paratype shown in Fig. 3A; median fins medium gray.

Color of holotype in alcohol (Fig. 1B). First dorsal fin faded to dark grayish brown; other median fins faded to reddish brown. Color of juvenile paratype shown in Fig. 3B; median fins faded.

Color when alive (Figs. 1C and 1D). Head bright yellow orange to yellowish white and body pale yellow to bluish white; median fins black except bright yellow orange to bluish white base; paired fins translucent; lower half of pectoral fin rarely brown to blackish.

*Distribution.* Presently known from the Ryukyu Islands, Japan at the following islands:

Amami-Oshima, Ie Island, Okinawa Island, Irabu Island, Ishigaki Island, and Iriomote Island, and Ngis Island, Palau (Fig. 1D).

*Habitat.* *Paragobiodon kasaii* occurs on coral reefs of bays at the reef edge, or on the reef slope at depths of 2–16 m. Individuals live as commensals on the branches of species of coral of the genus *Pocillopora*, almost *Pocillopora eydouxi* Edwards and Haime, 1860 (Suzuki and Shibukawa, 2004).

*Etymology.* The specific name, *kasaii*, honors Mr. Masao Kasai, who first discovered the new species and photographed it underwater.

*Remarks.* *Paragobiodon kasaii* differs from all other congeners in having P-V 3/II II I I 0/9, the origin of first dorsal fin posterior to the upper base of pectoral fins, the origin of pelvic fins directly below the lower base of the pectoral fins, a light reddish yellow head and body, black median fins, and translucent paired fins.

*Paragobiodon kasaii* is most similar to *Paragobiodon lacunicolus*, differing in having P-V 3/II II I I 0/9, vs. 3/I II I I 0/9 in *P. lacunicolus*; origin of first dorsal fin posterior to the upper base of pectoral fins, vs. usually directly over the upper base of pectoral fins; and origin of pelvic fins directly below the lower base of pectoral fins, vs. before the lower base of pectoral fins; translucent pectoral fins, vs. black fins (see Figs. 1 and 4).

*Paragobiodon kasaii* is mostly found on branches of the coral *Pocillopora eydouxi* which has broad spaces between the branches; whereas *Paragobiodon lacunicolus* is typically seen on branches of *Pocillopora meandrina* Dana, 1846, with narrow spaces between the branches.

The smallest paratype differs from the holotype and the other paratypes in pale coloration of the median fins (see Fig. 3). It was collected at the same coral with the holotype and the other paratypes (except OMNH-P 8291), and it has the same meristic data and proportions of body and fins; the differences are probably the result of changes with growth.

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