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Chlorophthalmus vulcanus, a new species of greeneye from La Réunion, southwestern Indian Ocean (Teleostei: Chlorophthalmidae)

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Abstract

The Réunion greeneye *Chlorophthalmus vulcanus* n. sp. is described from La Réunion, southwestern Indian Ocean, based on a specimen collected in 2003 off the west coast of the island at 300-400 m depth. The species is characterized by the combination of the following characters: total dorsal-fin rays 11, total anal-fin rays 8; total pectoral-fin rays 15; hump absent before dorsal fin; one small, rounded projection on lower jaw symphysis; teeth on outmost patches of lower jaw very small; teeth on tongue absent; gill rakers 4+18; head length 31.3% of SL; snout length 8.3% of SL; horizontal orbit diameter 12.3% of SL; snout length in horizontal orbit diameter 1.5; upper jaw length 12.6% of SL; predorsal fin length 36.5% of SL; prepectoral fin length 32.1% of SL; lateral-line scales 57; scale rows above lateral line 5; pectoral-fin length 30.4% of SL; first pelvic-fin ray situated under 6th dorsal-fin ray. An identification key to the species of *Chlorophthalmus* is presented.

Keywords: Greeneye, Chlorophthalmidae, New species, Mascarenes, Identification key, Geographical distribution.
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Introduction

The greeneyes of the family Chlorophthalmidae Garman 1899 are medium sized benthic fishes, which occur worldwide in tropical and warm temperate marine waters on the upper continental slope, in the Indo-Pacific at depths of 200-605 m, in the Atlantic at 50-1,000 m (Merrett 1990; Thompson 2003; Bineesh et al. 2014; Gomon 2015; Fujiwara et al. 2019:). Greeneyes feed on benthic invertebrates like small crustaceans and squid, and are known to be synchronous hermaphrodites, developing ovaries and testicles at the same time; their larvae are pelagic and may be found near the surface (Bauchot 1987; Gomon 2015). The family is currently arranged in the order Aulopiformes (Laan et al. 2014; Nelson et al. 2016). It includes two valid genera (Fricke et al. 2020): *Chlorophthalmus* Bonaparte 1840 (see below), and *Parasudis* Regan, 1911 (with two valid species in the Atlantic Ocean).

The genus *Chlorophthalmus* is characterised within the family by a combination of the following characters: lateral-line scales greater than 46; scale rows above lateral line greater than 3; snout profile straight or slightly concave; snout length in horizontal orbit diameter 1.0-1.8; anterior part of lower-jaw teeth exposed; vomerine teeth of moderate size; palatine teeth minute, restricted to anterior half of bone; posterior tip of upper jaw not extending beyond vertical through eye center; origin of dorsal fin posterior to vertical through pelvic-fin origin; anus very close to pelvic-fin base; light organ present near anus (Mead 1966; Sato and Nakabo 2002; Fujiwara et al. 2019; this study). It has a circum-global distribution and includes a total of 18 valid species (Fricke et al. 2020): *Chlorophthalmus acutifrons* Hiyama 1940 (Hiyama 1940: 171, figs. 2, 3A, Kumano-Nada, Japan, depth 500 m: syntypes: whereabouts unknown) from the eastern Indian Ocean and western Pacific; *C. agassizi* Bonaparte 1840 (Bonaparte 1840: fasc. 28, punt. 144, Pl. 121, fig. 2: Italy, western Mediterranean Sea; syntypes at ANSP, MNHN and USNM) with a circum-global distribution [junior synonyms include *C. chalybeius* (Goode 1881) (Goode 1881: 484, as *Hyphalonedrus chalybeius*; off New England, U.S.A., depth 120-142 fathoms;

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syntypes at MCZ and USNM, following Mead 1966]; *C. albatrossis* Jordan & Starks 1904 (Jordan and Starks 1904: 579, pl. 1, fig. 1; Sagami Bay, Japan; holotype: USNM 51446) from the western Pacific; *C. atlanticus* Poll 1953 (Poll 1953: 86, fig. 36; 45 miles west of Ambrizette, Angola, 12°08'S 7°16'E, depth 240-270 m; holotype: IRSNB 147) from the eastern Atlantic; *C. borealis* Kuronuma & Yamaguchi 1941 (Kuronuma and Yamaguchi 1941: 272; off Choshi, Japan; holotype: whereabouts unknown) from the northwestern Pacific; *C. brasiliensis* Mead 1958 (Mead 1958: 362, figs. 1-2 (off northern Brazil, 1°51'N, 46°50'W, depth 200 fathoms; holotype: USNM 156892) from the western Atlantic; *C. corniger* Alcock 1894 (Alcock 1894: 133, pl. 6, fig. 5; Bay of Bengal, 13°51'12"N 80°28'12"E, depth 145-250 fathoms. lectotype: ZSI F13713, as selected by Bineesh et al. 2014:516) from the northern Indian Ocean; *C. ichthyandri* Kotlyar & Parin 1986 (Kotlyar and Parin 1986: 369, figs.; southeastern Pacific, above Nazca and Sala y Gomes ridges, ca. 25°40'S, 85°27'W, depth 350 m; holotype: ZIN 47261) from the southeastern Pacific; *C. imperator* Fujiwara, Wada & Motomura 2019 (Fujiwara et al. 2019: 397, figs. 1-3; Daikakuji Seamount, Emperor Seamount Chain, 32°13'47"N 172°50'48"E - 32°15'39"N 172°53'17"E, depth 596-605 m; holotype: KAUM-I. 120091) from the central North Pacific; *C. mascarensis* Kobyliansky 2013 (Kobyliansky 2013: 381, figs. 1-2; Submarine rise north of Saya de Malha Bank, northern Mascarene Ridge, 9°24.6'S, 60°08.3'E, depth 430-350 m; holotype: ZMMU 23090) from the western Indian Ocean; *C. mento* Garman 1899 (Garman 1899: 253, pl. 54, figs. 1-1c; Gulf of Panama, 7°16'45"-7°33'12"N 79°16'-79°56'30"W, depth 210-286 fathoms; syntypes in MCZ and USNM) from the eastern Pacific; *C. nigromarginatus* Kamohara 1953 (Kamohara 1953: 5, figs. 3A, 4, as *Chlorophthalmus acutifrons nigromarginatus*; Mimase fish market, Kochi Prefecture, Japan; holotype: BSKU 1541) from the western Pacific; *C. pectoralis* Okamura & Doi 1984 (Okamura and Doi 1984: 173, pl. 120; off Cape Ashizuri, Tosa Bay, Japan, depth about 350 m; holotype: BSKU 30020) from the western Pacific; *C. productus* Günther 1887 (Günther 1887: 193, pl. 50, fig. D; off Matuku Island, Lau group, Fiji Islands, depth 315 fathoms; syntypes at BMNH) from Fiji; *C. proridens* Gilbert & Cramer 1897 (Gilbert and Cramer 1897: 406, pl. 36, fig. 2; Hawaiian Islands, 21°08'N-21°09'N 157°43'W-157°53'W, depth 351 and 298 fathoms; holotype: USNM 47715) from the Hawaiian Ridge; *C. punctatus* Gilchrist 1904 (Gilchrist 1904: 15, pl. 35; off Lion's Head, South Africa, depth 154 fathoms; syntypes at SAM) from South Africa; *C. vityazi* Kobyliansky 2013 (Kobyliansky 2013: 376, figs. 4-5; off northwestern Madagascar, 12°24.8'S, 48°26.2'E, depth 480 m; holotype: ZMMU P-23092) from the southwestern Indian Ocean; *C. zvezdae* Kotlyar & Parin 1986 (Kotlyar and Parin 1986: 374, fig.; Nazca Ridge, 25°39'S, 84°37'W. Holotype: ZIN 47265) from the southeastern Pacific.

During an exploration of slope fishes off the west coast of La Réunion, a fish specimen was procured that turned out to be an undescribed species of *Chlorophthalmus*. The new species is described in the present paper.

Material and Methods

Biometrical counts and measurements follow Kobyliansky (2013) and Fujiwara et al. (2019). The standard length (SL) is measured from the middle of the anterior tip of the premaxilla to the end of the caudal-fin base. The genus and species classification follow Fricke et al. (2020); citation of references follows Fricke (2020).

The specimen is deposited in the fish collection of the Muséum d'Histoire Naturelle, Saint-Denis, La Réunion, France (MNHRE), former acronym MHNRUN. Other museum abbreviations follow Fricke and Eschmeyer (2020).

Comparative materials: *Chlorophthalmus agassizi* Bonaparte 1840: SMNS 3948 (2), Mergellina, Napoli, Italy, 40°50'N 14°14'E. — SMNS 4521 (3), Mesina, Sicily, Italy, 38°11'N 15°33'E. — SMNS 9377 (3), Menorca, Balearic Islands, Spain, 39°50'N 4°19'E.

Chlorophthalmus corniger Alcock 1894: USNM 305989 (2), Somalia, 11.2117°N 47.3086°E, 276 m depth.

Figure 1. *Chlorophthamus vulcanus* n. sp., MHNRE 2020.1.1, holotype, 185.8 mm SL, southwestern Indian Ocean, La Réunion, ca. 9 km west of Saint-Gilles-les-Bains. Lateral view. Photograph by Gregory Salvan, Muséum d'Histoire Naturelle, Saint-Denis.

Chlorophthalmus vityazi Kobyliansky 2013: MNHN 2014-1759 (1), off northwestern Madagascar, 14°49'53.4"S 46°59'8.988"E, 446-390 m depth. — MNHN 2014-1759 (1), off northwestern Madagascar, 12°32'7.8" S 48°12'27"E, 485-468 m depth.

Results

Systematic ichthyology: The present paper follows the classifications provided by Nelson et al. (2016) and Laan et al. (2014):

Superclass Gnathostomata
Class Actinopterygii
Subclass Neopterygii
Division Teleostei
Order Aulopiformes
Family Chlorophthalmidae Garman 1899
Genus *Chlorophthalmus* Bonaparte 1840

***Chlorophthalmus vulcanus* new species**

(Figs. 1-4, Table 1)

Common name: Volcano greeneye

Synonymy: *Chlorophthalmus* sp. Fricke et al. 2009: 24 (off Saint-Paul, La Réunion).

Holotype: MHNRE 2020.1.1, 185.8 mm SL, southwestern Indian Ocean, La Réunion, ca. 9 km west of Saint-Gilles-les-Bains, ca. 31°03'32"S 55°08'08"E, 300-400 m depth, Patrick Durville, 14 Nov. 2003.

Diagnosis: Characterized within the genus *Chlorophthalmus* by a combination of the following characters: total dorsal-fin rays 11, total anal-fin rays 8; total pectoral-fin rays 15; hump absent before dorsal fin; one small, rounded projection on lower jaw symphysis; teeth on outmost patches of lower jaw very small; teeth on tongue absent; gill rakers 4+18; head length 31.3% of SL; snout length 8.3% of SL; horizontal orbit diameter 12.3% of SL; snout length in horizontal orbit diameter 1.5; upper jaw length 12.6% of SL; predorsal fin length 36.5% of SL; prepectoral fin length 32.1% of SL; lateral-line scales 57; scale rows above lateral line 5; pectoral-fin length 30.4% of SL; first pelvic-fin ray situated under 6th dorsal-fin ray.

Description: Measurements and proportions are given in Table 1.

D ii,9; A iii,5; P1 ii,12,i; P2 i,7,i. Gill rakers 4 + 18. Lateral-line scales 57. Scales above lateral line 5. Scales below lateral line 6. Scales between anus and anal-fin origin 16. Pre-adipose scales 19. Predorsal scales 14. Prepelvic scales 22.

Figure 2. *Chlorophthamus vulcanus* n. sp., MHNRE 2020.1.1, holotype, 185.8 mm SL, southwestern Indian Ocean, La Réunion, ca. 9 km west of Saint-Gilles-les-Bains. Detail of tip of snout seen from above. Photograph by Gregory Salvan, Muséum d'Histoire Naturelle, Saint-Denis.

Figure 3. *Chlorophthamus vulcanus* n. sp., MHNRE 2020.1.1, holotype, 185.8 mm SL, southwestern Indian Ocean, La Réunion, ca. 9 km west of Saint-Gilles-les-Bains. Detail of belly seen from below. Photograph by Gregory Salvan, Muséum d'Histoire Naturelle, Saint-Denis.

Table 1. *Chlorophthalmus vulcanus* n. sp., La Réunion, southwestern Indian Ocean. Measurements and proportions.

	MHNRUN P-610 bis Measurement [mm]	Proportion [% of SL]
Standard length	185.8	
Head length	58.1	31.3
Head depth	29.0	15.6
Postorbital length	21.4	11.5
Body depth at dorsal-fin origin	40.1	21.6
Body depth at anal-fin origin	25.1	13.5
Body width	29.2	15.7
Snout length	15.4	8.3
Upper jaw length	23.4	12.6
Maxillary depth	6.8	3.7
Horizontal orbit diameter	22.8	12.3
Vertical orbit diameter	19.0	10.2
Horizontal pupil diameter	7.2	3.9
Anterior interorbital width	7.6	4.1
Posterior interorbital width	12.6	6.8
Least interorbital width	5.9	3.2
Caudal-peduncle length	29.7	16.0
Caudal-peduncle depth	14.4	7.8
Anus to anal-fin origin length	47.0	25.3
Pre-adipose fin length	149.0	80.2
Dorsal to adipose-fin length	58.8	31.6
Predorsal-fin length	67.8	36.5
Dorsal-caudal length	97.8	52.6
Dorsal-fin base length	27.1	14.6
Longest dorsal-fin ray length	41.2	22.2
Preanal-fin length	145.0	78.0
Anal-caudal length	34.8	18.7
Anal-fin base length	12.4	6.7
Longest anal-fin ray length	23.3	12.5
Prepectoral length	59.6	32.1
Pectoral-fin length	56.5	30.4
Prepelvic-fin length	82.1	44.2
Pelvic-fin length	37.2	20.0
Pelvic-fin base length	9.6	5.2
Pectoral to pelvic-fin length	18.2	9.8
Pelvic to anal-fin length	60.8	32.7

Body slender, cylindrical, compressed at caudal peduncle; maximum depth at dorsal-fin origin. Snout pointed in lateral view, semicircular in dorsal view, its profile weakly convex (Fig. 2). Dorsal surface of snout tip without spines or projections. Anterior and posterior nostrils slit-like and more-or-less triangular (circular), respectively,

Figure 4. *Chlorophthamus vulcanus* n. sp., specimen collected by local fishermen in 2008 off Saint-Paul, La Réunion, at 550 m depth. Standard length unknown. Lateral view, fresh colouration. Photograph by Patrick Durville.

Table 2. Comparison of *Chlorophthalmus vulcanus* n. sp. with Indian Ocean species of the genus. Data based on Bineesh et al. (2014), Fujiwara et al. (2019), Gomon (2015), Hiyama (1940), Kuronuma and Yamaguchi (1941), Mead (1966), Okamura (1984), Poll (1953), and own examinations.

	C. vulcanus n.sp.	*C. acutifrons*	*C. agassizi*	*C. corniger*	*C. mascarensis*	*C. vityazi*
Lateral-line scales	**57**	**50-54**	**50-55**	**47-49**	**53-56**	**49-50**
Scale rows above lateral line	**5**	**7.5-8.5**	4.5	**3.5**	6	5
Gill rakers	4 + 18	2-4 **+ 15-16**	3-4 + **19-22**	**5** + 17-21	**3 + 19-20**	**2-3** 16-19
Teeth on outmost tooth patches on lower jaw	very small	small	very small	small	**large thorn-shaped**	small
Projections on lower jaw symphysis	1 small, rounded	none	none	**2 strong spines**	**2** small, rounded	**none**
Teeth on tongue	absent	absent	**present, small**	**present**	**present**	absent
Position of beginning of pelvic fin under dorsal-fin ray base	6th	6th	5th or 6th	5th or 6th	**7th or 8th**	5th or 6th
Hump before dorsal-fin	absent	**present**	absent	absent	absent	absent
Proportions (% of SL):						
Head length	31.3	28.3-32.3	27.0-33.5	**34.3-40.1**	30.3-33.9	**32.0-33.7**
Snout length	8.3	**9.1-12.0**	8.4-10.0	7.8-10.8		
Horizontal orbit diameter	12.3	**7.8-9.7**	8.6-14.5	11.0-15.0		
Upper-jaw length	12.6	12.4	11.6	12.7-16.7		
Maxillary depth	3.7	4.0	1.4	3.0-4.0		
Predorsal fin length	36.5	36.0-37.9	34.6-39.1	**39.5-42.5**	37.6-41.7	**37.8-39.7**
Prepectoral fin length	32.1	30.1	31.1	32.8-39.6	31.5-33.1	31.6-33.6
Distance anus to anal-fin origin	25.3	25.3	23.9	17.3-25.7	21.7-24.9	
Pectoral-fin length	30.4	29.0-31.0	21.4	**21.7-26.2**	**25.7-29.0**	28.1-31.0
Snout length in horizontal orbit diameter	1.5	1.1	1.6-1.7	1.3-1.4	**1.1-1.2**	**1.2**

latter much larger; closely positioned just forward eye, slightly below horizontal level of snout tip. Eye very large with diameter significantly greater than snout length, upper profile included in head profile in lateral view. Interorbital region slightly concave in midline; least interorbital very narrow, width less than pelvic-fin base length. Preopercle slightly rounded with a shallow concavity behind lower half of eye. Upper portion of opercle bluntly pointed, lower portion rounded. Anus close to pelvic-fin base, hidden by pelvic fin when depressed. Perianal light organ present. Mouth terminal. Upper jaw long, posterior end of maxillary somewhat rounded, reaching to between vertical through anterior margin and anterior margin of pupil; with 1-2 rows of villiform teeth, tooth band and size, respectively, becoming narrower and smaller posteriorly. Anterior tip of lower jaw extending beyond that of upper jaw, with two tooth patches including ca. 4-5 irregular rows of thorn shaped teeth, its size becoming larger anteriorly, its tips weakly curved posteriorly, without enlarged posterior teeth; jaw symphyses without villiform teeth. Vomer without teeth. Anterior half of palatine with minute pointed teeth in 2 rows, tapering to single row posteriorly. Two pores on lower-jaw symphysis. Gill rakers long, with pointed tips.

Dorsal fin triangular, positioned anteriorly, its origin anterior to vertical through pelvic-fin origin; 3rd dorsal-

Table 3. Comparison of *Chlorophthalmus vulcanus* n. sp. with western Pacific Ocean species of the genus. Data based on Fujiwara et al. (2019), Kamohara (1953), Kuronuma and Yamaguchi (1941), Okamura and Doi (1984), and own examinations.

	C. vulcanus n. sp.	*C. albatrossis*	*C. borealis*	*C. imperator*	*C. nigromarginatus*	*C. pectoralis*	*C. productus*
Lateral-line scales	57	52-59	50-58	**49-51**	**49-54**	**51-52**	58
Scale rows above lateral line	5	**7-8.5**	**8-9**	6	**6.5**	**7.5**	**8**
Gill rakers	4 + 18	**3** + 18-19	3-4 + 14-18	**3 + 19-22**	3-4 + **11-16**	**2-3** + 18-19	**2 + 15**
Teeth on outmost tooth patches on lower jaw	very small	small	small	**large, thorn-shaped**	small	small	small
Projections on lower jaw symphysis	1 small, rounded	**none**		**2 moderate**	**none**	**3 moderate**	**none**
Teeth on tongue	absent	**present**		absent	**present**	**present**	**present**
Position of beginning of pelvic fin under dorsal-fin ray base	6th	**4th**	**4th**	**4th-5th**	**4th**	**4th-5th**	**1st**
Hump before dorsal-fin	absent	absent	absent	absent	absent	absent	absent
Proportions (% of SL):							
Head length	31.3	**26.2-30.4**	**23.5-27.0**	**26.7-28.9**	29.4-31.4	**32.1-32.6**	30.3-30.8
Snout length	8.3	**6.2- 7.9**	**6.4- 7.8**	**6.9- 7.7**	8.2	7.5	8.5
Horizontal orbit diameter	12.3	10.4-12.5	**8.7-10.4**	**11.9-12.9**	10.0	12.0	11.1
Upper-jaw length	12.6	**12.7**	**11.7**	11.7-13.2	13.7	11.9	14.4
Maxillary depth	3.7	**3.2**	**1.8**	3.1- 3.8	2.8	2.5	2.7
Predorsal fin length	36.5	33.7-38.1	**42.6**	34.2-36.6	36.8-37.0	36.6-39.2	33.9
Prepectoral fin length	32.1	**26.9-29.9**	**29.7**	**27.3-29.8**	29.4	32.1-33.1	28.2
Distance anus to anal-fin origin	25.3	**20.7**		**27.3-29.9**	24.7		
Pectoral-fin length	30.4	**22.6-27.9**	20.3	**21.0-24.9**	**23.5**	29.9	24.4
Snout length in horizontal orbit diameter	1.5	**1.4**	**1.3**	**1.6-1.8**	**1.1**	1.5	**1.3**

Table 4. Comparison of *Chlorophthalmus vulcanus* n. sp. with central and eastern Pacific Ocean species of the genus. Data based on Fujiwara et al. (2019), Garman (1899), Gilbert and Cramer (1897), Kotlyar and Parin (1986), Randall (1997), and own examinations.

	C. vulcanus n.sp.	*C. ichthyandri*	*C. mento*	*C. proridens*	*C. zvedzdae*
Lateral-line scales	57	**47-51**	57-59	**50-53**	**49-50**
Scale rows above lateral line	5	5	7	4.5	5
Gill rakers	4 + 18	**2-3 + 20-24**	**6 + 21**	**2-3 + 21-23**	**3 + 24**
Teeth on outmost tooth patches on lower jaw	very small	**large, thorn-shaped**	small	**large, thorn-shaped**	**large, thorn-shaped**
Projections on lower jaw symphysis	1 small, rounded	**2, pointed**			**2 humps**
Teeth on tongue	absent	**present**	**present**		**present**
Position of beginning of pelvic fin under dorsal-fin ray base	6th	**5th**	**2nd-3rd**	**4th-5th**	**5th**
Hump before dorsal-fin	absent	absent	absent	absent	absent
Proportions (% of SL):					
Head length	31.3	29.8-32.7	27.3	29.4-32.2	29.6
Snout length	8.3	8.4-10.0		8.0- 8.8	**9.8**
Horizontal orbit diameter	12.3	11.1-13.0		**13.1-14.7**	**9.8**
Upper-jaw length	12.6	12.4-14.8			12.0
Maxillary depth	3.7	**1.6- 2.6**		3.8- 4.9	**2.**6
Predorsal fin length	36.5	35.9-39.1		36.3-37.9	35.9
Prepectoral fin length	32.1	28.7-31.1		30.0-32.0	29.1
Distance anus to anal-fin origin	25.3	23.2-28.2			23.9
Pectoral-fin length	30.4	25.7-29.0			**20.7**
Snout length in horizontal orbit diameter	1.5	**1.3**	1.4		**1.0**

fin ray longest; 1st and 2nd dorsal-fin rays unbranched, other rays with 2 or 3 branches. Pectoral fin base low, just behind pointed portion of opercle; tip of fin pointed, extending to between vertical through last dorsal-fin ray base and tip of depressed pelvic fin. Pelvic fin short, its tip pointed; 2nd and 3rd rays longest. Anal fin short, its base much shorter than longest anal-fin ray length; 4th ray longest; 1st to 3rd rays unbranched, other rays with 2 or 3 branches. Adipose fin small, behind vertical through anal-fin origin. Caudal fin forked, tips pointed. Body covered with deciduous cycloid scales, scale pockets distinct; scale margins weakly serrated. Anterior extent of pre-dorsal scales not reaching to level of posterior margin of eyes. Head without scales, except for

Table 5. Comparison of *Chlorophthalmus vulcanus* n. sp. with Atlantic Ocean species of the genus. Data based on Goode (1881), Mead (1958), Poll (1953), Sulak (1986), Shcherbachev (1981), and own examinations.

	C. vulcanus n.sp.	*C. atlanticus*	*C. brasiliensis*	*C. punctatus*
Lateral-line scales	57	**50-53**	**51-56**	**50-56**
Scale rows above lateral line	5	**6.5-7.5**	**7-8**	**7**
Gill rakers	4 + 18	**5 + 20-21**	3-4 + **20-23**	**2** + 18-19
Teeth on outmost tooth patches on lower jaw	very small	small	small	small
Projections on lower jaw symphysis	1 small, rounded			
Teeth on tongue	absent			
Position of beginning of pelvic fin under dorsal-fin ray base	6^{th}	**5^{th}**	**4^{th}-5^{th}**	**3^{rd}-4^{th}**
Hump before dorsal-fin	absent	absent	absent	absent
Proportions (% of SL):				
Head length	31.3	**27.4-29.0**	28.7-31.4	**26.0-27.0**
Snout length	8.3	6.7	**9.0-10.0**	8.0- 8.5
Horizontal orbit diameter	12.3	9.8	**10.1-11.4**	**9.6**
Upper-jaw length	12.6	12.8	12.3-13.7	**10.5**
Maxillary depth	3.7	2.7	2.7	
Predorsal fin length	36.5	36.2	35.4-37.8	**31.6-33.2**
Prepectoral fin length	32.1	30.8	**28.1-31.5**	
Distance anus to anal-fin origin	25.3	23.4	26.6	
Pectoral-fin length	30.4	**23.4-26.2**	**21.1**	**22.0-22.6**
Snout length in horizontal orbit diameter	1.5	1.5	**1.3**	**1.1-1.2**

cheek and a few scales on lower operculum; scales on isthmus and thorax smaller. Scales absent on all fins.

Colour when fresh (Fig. 4)**:** Body rose, with irregular brown blotches, lower sides white, belly and lower sides densely covered with black pigment spots. Lower jaw anteriorly dark grey. Anal region and light organ black. Dorsal fin translucent. Adipose fin dark grey. Anal fin translucent. Caudal fin translucent, basal with two grey blotches, distal margins dark grey. Pectoral fins translucent.

Colour in preservative (Fig. 1)**:** Body dark brown, lower sides with somewhat paler blotches, belly and lower sides densely covered with black pigment spots. Oral cavity and tongue yellowish, tongue with two dark grey lines, lower jaw anteriorly dark grey. Anal region and light organ black (Fig. 3). Dorsal fin basally clear, distal two-thirds grey, anterior and distal margin blackish. Adipose fin dark grey, anterior margin whitish. Anal fin yellowish. Caudal fin yellowish, distal margins dark grey. Pectoral fins yellowish, pelvic fins dark grey, tips whitish (Fig. 3).

Etymology: The name of the new species, *vulcanus* (Latin) stands for Vulcan, the Roman God of Fire (including the fire of volcanos), referring to the type locality on the slope of the La Réunion volcano. The species name is to be treated as a noun in apposition.

Distribution: La Réunion (Mascarene Islands). Only known from two specimens which were collected off the west coast of the island.

Comparisons: The new species is member of a complex lacking a hump before dorsal fin, with small teeth on the outmost patches of the lower jaw small, and 5 or less scale rows above the lateral line; this groups also includes the species *C. agassizi*, *C. corniger* and *C. vityazi*. All the other species do not share this combination of characters; either they have a hump (*C. acutifrons*), large, thorn-shaped teeth on the outmost patches of the lower jaw (*C. ichthyandri*, *C. imperator*, *C. mascarensis*, *C. proridens*, *C. zvedzdae*), or 6 or more scale rows about the lateral line (all other species). The new species is distinguished from *C. agassizi* by having 57 lateral-line scales (vs. 50-55 in *C. agassizi*), 18 gill rakers on the lower arch (vs. 19-22), the presence of one small, rounded projection on the lower jaw symphysis (vs. none), tongue teeth absent (vs. small teeth present), pectoral-fin length 30.4% SL (vs. ca. 21.4% SL), and snout length in horizontal orbit diameter 1.5 (vs. 1.6-1.7); it differs from *C. corniger* by 57 lateral-line scales (vs. 47-49 in *C. corniger*), 5 scale rows above the lateral line (vs. 3.5),

4 gill rakers on the upper arch (vs. 5), a single small, rounded projection on the lower jaw symphysis (vs. two strong spines), tongue teeth absent (vs. present), head length 31.3% SL (vs. 34.3-40.1% SL), predorsal length 36.5% SL (vs. 39.5-42.5% SL), pectoral-fin length 30.4% SL (vs. 21.7-26.2% SL), and snout length in horizontal orbit diameter 1.5 (vs. 1.3-1.4); and from *C. vityazi* by having 57 lateral-line scales (vs. 49-50 in *C. vityazi*), 4 gill rakers on the upper arch (vs. 2-3), a single small, rounded projection on the lower jaw symphysis (vs. none), head length 31.3% SL (vs. 32.0-33.7% SL), predorsal length 36.5% SL (vs. 37.8-39.7% SL), and snout length in horizontal orbit diameter 1.5 (vs. 1.2). It is compared with all species in the genus in Tables 2-5. For an easier identification, a key to the species of the genus *Chlorophthalmus* is provided below.

Remarks: This interesting deep-water specimen was collected during deep fishing tests for the aquarium in Saint-Gilles-les-Bains, La Réunion. A second specimen was collected in 2008 by local fishermen off Saint-Paul, also on the west coast of La Réunion, at 550 m depth (Fig. 4); unfortunately, the specimen was not preserved, but the photograph provides a record of the fresh colouration.

It is interesting that although the new species occurs in the western Mascarenes, it is apparently not closely related to *C. mascarensis* from the northern Mascarene Ridge; that species belongs to a different complex of species with enlarged outer lower jaw teeth. The most similar species occur in Madagascar (*C. vityazi*), the northern Indian Ocean (*C. corniger*), and circum-global in the tropics, but in the Indian Ocean rather in equatorial regions (*C. agassizi*).

The genus *Chlorophthalmus* is still in need of revision; the identity of some species (e.g. *C. borealis, C. zvedzdae*) needs to be confirmed (e.g. see Okamura 1984; Fujiwara et al. 2019). For future reference and possible revisionary works on the genus, we here provide a key to the species of the genus *Chlorophthalmus* based on current knowledge.

Key to the species of the genus *Chlorophthalmus* Bonaparte 1840

1a. Hump present before dorsal fin……..*C. acutifrons*
(eastern Indian and western Pacific oceans)
1b. Hump absent before dorsal fin……2
2a. Teeth on outmost patches of lower jaw large, thorn-shaped……3
2b. Teeth on outmost patches of lower jaw small……...7
3a. Scale rows above lateral line 6……*C. mascarensis*
(northern Mascarene Ridge)
3b. Scale rows above lateral line 4.5-5……...4
4a. Horizontal orbit diameter 9.8-13.0% of SL……..5
4b. Horizontal orbit diameter 13.1-14.7% of SL……*C. proridens*
(Hawaiian Ridge)
5a. Scale rows above lateral line 5; teeth on tongue present; maxillary depth 1.6-2.6% of SL……...6
5b. Scale rows above lateral line 6; teeth on tongue absent; maxillary depth 3.1-3.8% of SL……*C. imperator*
(Emperor Seamount Chain)
6a. Projections on lower-jaw symphysis pointed; horizontal orbit diameter 11.1-13.0% of SL; snout length in horizontal orbit diameter 1.3……..C*. ichthyandri*
(Nazca and Sala-y-Gomez ridges)
6b. Projections on lower-jaw symphysis humped; horizontal orbit diameter 9.8% of SL; snout length in horizontal orbit diameter 1.0……..*C. zvedzdae*
(Nazca Ridge)
7a. Scales above lateral line 3.5-5……...8
7b. Scales above lateral line 6-8……...11

8a. Lower-jaw symphysis with 2 strong spines; scale rows above lateral line 3.5; gill rakers on upper arch 5; head length more than 34% of SL.....*C. corniger*
(northern Indian Ocean)
8b. Lower-jaw symphysis with 1 small know or without projections; scale rows above lateral line 4.5-5; gill rakers on upper arch 2-4; head length less than 34% of SL……..9
9a. Lateral-line scales 49-55; lower-jaw symphysis without projections…….10
9b. Lateral-line scales 57; lower-jaw symphysis with 1 small, rounded projection……*C. vulcanus* n. sp.
(La Réunion)
10a. Tongue with small teeth; snout length in horizontal orbit diameter 1.6-1.7; distance anus to anal-fin origin ca. 24……*C. agassizi*
(circumglobal)
10b. Tongue without teeth; snout length in horizontal orbit diameter 1.2; distance anus to anal-fin origin 28.1-31.0……...*C. vityazi*
(off western Madagascar)
11a. Snout length in horizontal orbit diameter 1.1-1.2……12
11b. Snout length in horizontal orbiut dianmeter 1.3-1.5……13
12a. Gill rakers 3-4 + 11-16; head length 29.4-31.4% of SL; predorsal length 36.8-37.0% of SL……*C. nigromarginatus*
(western Pacific)
12b. Gill rakers 2 + 18-19; head length 26.0-27.0% of SL; predorsal length 31.6-33.2% of SL .... ……..*C. punctatus*
(South Africa)
13a. Gill rakers on upper arch 2-4……14
13b. Gill rakers on upper arch 5-6…….....18
14a. Gill rakers on lower arch 14-19 (including middle raker) ……15
14b. Gill rakers on lower arch 20-23 (including middle raker) ……*C. brasiliensis*
(western Atlantic)
15a. Pelvic fin beginning under level of 1st dorsal-fin ray; snout length more than 8% of SL; upper-jaw length more than 14% of SL. ..... ……..*C. productus*
(Fiji)
15b. Pelvic fin beginning under level of 4th-5th dorsal-fin ray; snout length less than 8% of SL; upper-jaw length less than 13% of SL……16
16a. Predorsal-fin length more than 41% of SL; horizontal orbit diameter less than 10.4% of SL; maxillary depth less than 2% of SL; snout length in horizontal orbit diameter 1.3……*C. borealis*
(northwestern Pacific)
16b. Predorsal-fin length less than 40% of SL; horizontal orbit diameter more than 10.4% of SL; maxillary depth more than 2% of SL; snout length in horizontal orbit diameter 1.4-1.5……17
17a. Three moderate projections on lower-jaw symphysis; head length 32.1-32.6% of SL; prepectoral length 32.1-33.1% of SL……*C. pectoralis*
(western Pacific)
17b. No projections on lower-jaw symphysis; head length 26.2-30.4% of SL; prepectoral length 26.9-29.9% of SL……...……*C. albatrossis*
(western Pacific)
18a. Lateral-line scales 50-53; beginning of pelvic fin situated under level of 5th dorsal-fin ray; snout length in horizontal orbit diameter 1.5……*C. atlanticus*
(eastern Atlantic)
18b. Lateral-line scales 57-59; beginning of pelvic fin situated under level of 2nd to 3rd dorsal-fin ray; snout length in horizontal orbit diameter 1.4……*C. mento*
(eastern Pacific)

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Literature cited

Alcock A.W. 1894. Natural history notes from H. M. Indian marine survey steamer Investigator, Commander C. F. Oldham, R.N., commanding. Series II., No. 11. An account of a recent collection of bathybial fishes from the Bay of Bengal and from the Laccadive Sea. Journal of the Asiatic Society of Bengal 63(2): 115-137.

Bauchot M.-L. 1987. Chlorophthalmidae. Eperlans. In: W. Fischer, M.-L. Bauchot, M. Schneider (Eds.). Fiches FAO d'identification des espèces pour les besoins de la pêche. Méditerranée et Mer Noire - Zone de Pêche 37. Volume 2: Vertébrés. FAO, Rome. pp: 1043-1046.

Bineesh K.K., Akhilesh K.V., Gomon M.F., Abdussamad E.M., Pillai N.G.K., Gopalakrishnan A. 2014. Redescription of *Chlorophthalmus corniger*, a senior synonym of *Chlorophthalmus bicornis* (family: Chlorophthalmidae). Journal of Fish Biology 84: 513-522.

Bonaparte C.L. 1840. Iconografia della fauna italica per le quattro classi degli animali vertebrati. Tomo III. Pesci. Roma, fasc. 27-29, puntata 136-154.

Fricke R. 2020. References in Eschmeyer's catalog of Fishes, electronic version (3 February 2020). San Francisco, CA (California Academy of Sciences). Available at http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (last accessed 9 February 2020).

Fricke R., Eschmeyer W.N. 2020. *Guide to fish collections in Eschmeyer's catalog of Fishes*, electronic version (3 February 2020). San Francisco, CA (California Academy of Sciences). Available at http://researcharchive.calacademy.org/research/ichthyology/catalog/collections.asp (last accessed 9 February 2020).

Fricke R., Eschmeyer W.N., van der Laan R. 2020. Eschmeyer's catalog of Fishes, electronic version (3 February 2020). San Francisco, CA (California Academy of Sciences). Available at http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (last accessed 9 February 2020).

Fricke R., Mulochau T., Durville P., Chabanet P., Tessier E., Letourneur Y. 2009. Annotated checklist of the fish species (Pisces) of La Réunion, including a Red List of threatened and declining species. Stuttgarter Beiträge zur Naturkunde A, Neue Serie 2: 1-168.

Fujiwara K., Wada H., Motomura H. 2019. A new species of the greeneye genus *Chlorophthalmus* (Teleostei: Chlorophthalmidae) from the central North Pacific. Zootaxa 4555(3): 396-406.

Garman S. 1899. Fishes. In: Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands ... by the U. S. Fish Commission steamer "Albatross," during 1891 ... No. XXVI. Memoirs of the Museum of Comparative Zoology 24: 1-431.

Gilbert C.H., Cramer F. 1897. Report on the fishes dredged in deep water near the Hawaiian Islands, with descriptions and figures of twenty-three new species. Proceedings of the United States National Museum, 19(1114): 403-435.

Gilchrist J.D.F. 1904. Descriptions of new South African fishes. Marine Investigations in South Africa 3, 1-16.

Gomon M.F. 2015. Family Chlorophthalmidae. In: C.D. Roberts, A.L. Stewart, C.D. Struthers (eds.). The fishes of New Zealand. Volume 2. Wellington. pp: 547-550.

Goode G.B. 1881. Fishes from the deep water on the south coast of New England obtained by the United States Fish Commission in the summer of 1880. Proceedings of the United States National Museum 3(177): 467-486.

Hiyama Y. 1940. Descriptions of two new species of fish, *Raja tobitukai* and *Chlorophthalmus acutifrons*. Japanese Journal of Zoology 9(1): 169-173.

Jordan D.S., Starks E.C. 1904. List of fishes dredged by the steamer Albatross off the coast of Japan in the summer of 1900, with descriptions of new species and a review of the Japanese Macrouridae. Bulletin of the United States Fish Commission 22(for 1902): 577-630.

Kamohara T. 1953. A review of the fishes of the family Chlorophthalmidae found in the waters of Japan. Japanese Journal of Ichthyology 3(1): 1-6.

Kobyliansky S.G. 2013. Two new species of green eyes of the genus *Chlorophthalmus* (Chlorophthalmidae, Aulopidae) from the continental slope and submarine rises of the western tropical part of the Indian Ocean. Voprosy Ikhtiologii, 53 (4), 381-388. [In Russian. English translation appeared in Journal of Ichthyology 53(6): 373-379.

Kotlyar A.N., Parin N.V. 1986/ Two new species of *Chlorophthalmus* (Osteichthyes, Myctophiformes, Chlorophthalmidae) from submarine mountain ridges in the south-eastern part of the Pacific Ocean. Zoologicheskii Zhurnal 65(3): 369-377. [In Russian, English summary.]

Kuronuma K., Yamaguchi M. 1941. Description of a new iniomid fish from Choshi, Japan. Dobutsugaku Zasshi 53(5): 272-274.

Laan R. van der., Eschmeyer W.N., Fricke R. 2014. Family-group names of recent fishes. Zootaxa 3883(2): 1-230.

Mead G.W. 1958. Three new species of archibenthic iniomous fishes from the western North Atlantic. Journal of the Washington Academy of Sciences 48(11): 362-372.

Mead G.W. 1966. Family Chlorophthalmidae. In: Fishes of the northwestern Atlantic Ocean. Memoirs of the Sears Foundation on Marine Research 1(5): 162-189.

Merrett N.R. 1990. Chlorophthalmidae (Chlorophthalminae). In: J.-C. Quéro, J.-C. Hureau, C. Karrer, A. Post, L. Saldanha (eds.). Check-list of the fishes of the eastern tropical Atlantic. Volume 1. UNESCO, Paris etc. pp: 351-352.

Nelson J.S., Grande T.C., Wilson M.V.H. 2016. Fishes of the world. Fifth edition. John Wiley and sons, Hoboken, N.J.: 707 p.

Okamura O. 1984. *Chlorophthalmus acutifrons*. In: O.Okamura, T. Kitajima (eds.). Fishes of the Okinawa Trough and the adjacent waters. Volume 1. Tokyo. pp: 171-347.

Okamura O. 1985. *Chlorophthalmus nigromarginatus* Kamohara. In: O. Okamura (ed.). Fishes of the Okinawa Trough and the adjacent waters. Volume 2. Tokyo. pp: 647-753.

Okamura O., Doi M. 1984. *Chlorophthalmus pectoralis* Okamura et Doi, spec. nov. In: O. Okamura, T. Kitajima (eds.). Fishes of the Okinawa Trough and the adjacent waters. Volume 1. Tokyo. pp: 173-175.

Poll M. 1953. Poissons. 3. Résultats Scientifiques d'Exploration Océanographique Belge de l'Afrique et du Atlantique Sud, Bruxelles 4(2): 1-258.

Randall J.E. 2007. Reef and shore fishes of the Hawaiian Islands. Sea Grant College Program, University of Hawai'i, Honolulu. 546 p.

Sato T., Nakabo T. 2002. Paraulopidae and *Paraulopus*, a new family and genus of aulopiform fishes with revised relationships within the order. Ichthyological Research 49(1): 25-46.

Shcherbachev Yu.N. 1981. Preliminary review of the Indian Ocean Chlorophthalmidae (Myctophiformes). [In Russian.] In: N.V. Parin (ed.), Fishes of the open ocean. Moscow (for 1980). pp: 47-67.

Thompson B.A. 2003. Chlorophthalmidae. Greeneyes. In: K.E. Carpenter (ed.). The living marine resources of the Western Central Atlantic. Volume 2: Bony fishes part 1 (Acipenseridae to Grammatidae). FAO species identification guide for fishery purposes and American Society of Ichthyologist and Herpetologists Special Publication. pp: 915-916.