First Specimen-based Records of *Canthidermis macrolepis* (Tetraodontiformes: Balistidae) from the Pacific Ocean and Comparisons with *C. maculata*

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*Canthidermis macrolepis* (Boulenger, 1888) is newly recorded from Japan and Micronesia on the basis of nine specimens (206.9–349.8 mm SL), having been previously reported from the northwestern Indian Ocean and northern South China Sea (the latter based solely on DNA barcoding). The species is probably widespread throughout the Indo-West Pacific region but has been confused with *Canthidermis maculata* (Bloch, 1786). Detailed morphological comparisons of both species resulted in the following differences being recognized between them: numbers of body scale rows [38–41 (modally 40) in *C. macrolepis* vs. 40–49 (44) in *C. maculata*], second dorsal-fin rays [25–27 (26) vs. 22–26 (24)], anal-fin rays [22–24 (23) vs. 20–23 (21)], and pectoral-fin rays [14–16 (15) vs. 13–15 (14)]. Sequences of the mitochondrial DNA COI gene determined from the presently-reported specimens of *C. macrolepis*, which also differed in color from similarly sized *C. maculata*, having a uniformly grayish body without spots, were also compared with congeners. The Japanese standard name "Bouzu-mongara" is newly proposed for *C. macrolepis*.

**Key Words:** Japan, Micronesia, *Canthidermis willughbeii*, *Canthidermis rotundatus*.

**Introduction**

The triggerfish genus *Canthidermis* Swainson, 1839 (Tetraodontiformes: Balistidae) is characterized by the following combination of characters: no enlarged osseous scales behind the gill opening; mouth terminal; teeth white, uneven, each one notched; a deep groove below the nostril (just before the eye); no grooves on the cheek; third dorsal-fin spine well developed, extending above the body dorsal profile (Matsuura 1980). In their initial reviews of *Canthidermis*, Berry and Baldwin (1966) and Moore (1967) recognized two valid species, *Canthidermis maculata* (Bloch, 1786) (circumglobal) and *Canthidermis sufflamen* (Mitchill, 1815) (Atlantic). Subsequently, Fedoryako (1979) reviewed *Canthidermis sufflamen* (Mitchill, 1815) (Atlantic), *Canthidermis maculata* (Bloch, 1786) (circumglobal) and *Canthidermis viola* Fedoryako, 1979 (Gulf of Aden) and *Canthidermis willughbeii* (Lay and Bennett, 1839) (eastern Pacific). Among them, *C. rotundatus* and *C. willughbeii* had been considered by Berry and Baldwin (1966) and Moore (1967) as junior synonyms of *C. maculata*. Later, Gill and Randall (1997) redescribed *Canthidermis macrolepis* (Boulenger, 1888) (type locality: Muscat, Oman) as a valid species, under which they synonymized *C. villosus*. Although *C. macrolepis* had been considered restricted to the Red and Arabian seas (Randall 1995; Gill and Randall 1997; Baranes 2005; Psomadakis et al. 2015), Xu et al. (2019) recently recorded it from the northern South China Sea based on DNA barcoding.

Recently, the second and third authors noted that an adult specimen (FAKU 146571, 344.5 mm SL) of *Canthidermis* from Ishikawa Prefecture, Japan, possessed a uniformly grayish body. Furthermore, the gene sequence from the partial Cytochrome Oxidase subunit I (COI) of the specimen matched that of *C. macrolepis* given by Xu et al. (2019), and a published sequence of the species from Eilat, Israel. Subsequent searches of Japanese museum fish collections resulted in seven additional specimens from Japan and a single specimen from Micronesia being found, identical with *C. macrolepis* according to morphology or/and DNA barcoding. These specimens are described herein as the first specimen-based records of *C. macrolepis* from the Pacific Ocean. Detailed comparisons of the species with the related congener, *C. maculata*, and a discussion of the validity and taxonomic status of *C. rotundatus*, *Canthidermis viola* Herre, 1926 and *C. willughbeii* are also given.

**Materials and Methods**

Methods of counts and measurements followed Matsuura (1980, 1981) and Matsuura and Yoshino (2004). Body width
followed Matsuura and Yoshino (2004), and was measured between the pectoral-fin bases; interorbital width followed Matsuura (1981), being the distance between the lateral edges of the supraorbital ridges above the mid-orbit; post-orbital length followed Matsuura and Yoshino (2004), and was measured from the upper end of the gill opening to the nearest point of the orbital edge; and middle caudal-fin ray length followed Matsuura and Yoshino (2004), being the distance between the center of the caudal-fin base to the tip of the middle caudal-fin ray. Upper and lower caudal-fin ray lengths were measured from the center of the caudal-fin base to the tips of both lobes of the doubly emarginated caudal fin in large specimens. Body depth at the second dorsal-fin end was the distance between the bases of the last rays of the second dorsal and anal fins. The pectoral-fin ray count excluded the uppermost rudimentary ray, following Matsuura (1980). The number of body scale rows followed Matsuura (1980), being counted from the upper end of the gill opening to the caudal-fin base, including diagonal rows of small scales just behind the gill opening. The number of head scale rows also followed Matsuura (1980), being counted from the mouth corner to the lower end of the gill opening. Nodule or spinule numbers on the caudal-peduncle scales were represented by the mean numbers of spinules counted on 9 scales located on the approximate midpoint of the left side of the peduncle.

For DNA barcoding, total DNA was extracted from white muscle preserved in 99.5% ethanol, using the Wizard Genomic DNA Purification Kit (Promega Inc.). The partial Cytochrome Oxidase subunit I (COI) gene was amplified using the primers designed by Folmer et al. (1994) (LCO1490: 5′-GGT CAA CAA ATC ATA AAG ATA TTG G-3′; HCO2198: 5′-TAA ACT TCA GGG TGA CCA AAA AAT CA-3′). The PCR proceeded for 30 cycles, with denaturation at 94°C for 15 sec, annealing at 45°C for 15 sec, and extension at 72°C for 30 sec, using the KAPA2G Robust PCR Kit (KAPA Biosystems). The PCR products were purified with ExoSAP-IT Express (Thermo Fisher Scientific) enzyme. Automated sequencing was performed in both directions, using the BigDye terminator sequencing kit (Applied Biosystems), and analyzed on a model 310 Sequencer (Applied Biosystems). All sequences determined here were aligned using Clustal X (Thompson base Collaboration) under accession numbers LC498558–LC498567. The sequence of Balistes capriscus (Gmelin, 1789), a species closely related to Canthidermis villosus (see Santini et al. 2013), was included as an outgroup. From the aligned sequences, a pairwise matrix of genetic distances was prepared using Tamura and Nei’s (1993) model, and a neighbor-joining (NJ) tree (Saitou and Nei 1987) was constructed using MEGA 7 (Kumar et al. 2016).

Standard length is abbreviated as SL. Meristic data only used here are held in the Fish Image Database, Kagoshima University Museum (KAUM–II) or the Image Database of Fishes, Kanagawa Prefectural Museum of Natural History (KPM–NR).

**Canthidermis macrolepis** (Boulenger, 1888) [English name: Largescale Triggerfish; new standard Japanese name: Bouzu-mongara] (Figs 1–4, 6–8; Tables 1 and 2)

**Canthidermis longirostris** Tortonese, 1956: 77, fig. 1 (type locality: Dahlak Island, Red Sea).

**Canthidermis villosus** Fedoryakova, 1979: 985, fig. 1B, C (type locality: Gulf of Aden, 12°29′N, 44°23′E).

**Canthidermis maculatus** non Bloch, 1786: Delbecq 1993: 298, unnumbered figs (Oman; underwate photograph).

**Canthidermis macrolepis** Randall 1995: 393, unnumbered fig. (Red Sea to Gulf of Oman; underwater photograph); Gill and Randall 1997: 27, figs 1–3 (redescription, lectotype designation, *C. longirostris* and *C. villosus* synonymized under *C. macrolepis*); Delbeix 1998: 208, unnumbered figures (Oman and Sudan; underwater photographs); Baranes 2005: 407, fig. 3 (Eilat, Israel; description); Leiske and Myers 2010: 213, unnumbered figure (Egypt, Red Sea; short description); Taquet and Diringer 2012: 622, unnumbered figure (Red Sea and Gulf of Aden; underwater photograph); Clark et al. 2015: 2, fig. 23 (South Red Sea; underwater photograph); Psomadakis et al. 2015: 332, pl. XXXIX, [fig.] 311 (Pakistan; short description); Xu et al. 2019: 109 (South China Sea; listed, based on DNA barcoding); Zajonz et al. 2019: 101 (Socotra Archipelago, Yemen; listed).

**Canthidermis maculata** non Bloch, 1786: Suzuki et al. 2000: 44 (off Hamasaka, Hyogo Prefecture, Japan; in part; listed).

**Specimens examined.** Nine specimens, 206.9–349.8 mm SL. **JAPAN:** FAKU 38281, 266.9 mm SL, off Oki Islands, Shimane Prefecture, 1950’s; FAKU 131436, 298.3 mm SL, off Kasumi, Hyogo Prefecture, K. Miyahara, 6 November 2007; FAKU 135237, 330.0 mm SL, off Kunda, Kyoto Prefecture, Y. Kumaki, 3 October 2012; FAKU 146571, 344.5 mm SL, Enome, Noto-jima Island, Ishikawa Prefecture, S. Ikeguchi, November 2018; KAUM–I. 115632, 298.3 mm SL, off Funama Fishing Port, Kishira, Kimotsuki, Kagoshima Prefecture, 30′10′N, 130°59′E, M. Yamada, set net, 25 May 2018; OMNH–P 2297, 206.9 mm SL, off Iguini, Shin-onsen, Hyogo Prefecture, M. Uno, set net, 21 November 1986; NSMT–P 129777, 308.8 mm SL, north off Nezumi-jima Island, Waku, Shimonoseki, Yamaguchi Prefecture, 34°18′2′N, 130°51′34′E, T. Sonoyama, set net, 13 December 2016; NSMT–P 130622 (formerly KSHS 4394), 288.1 mm SL, obtained at Kochi City Central Fish Market, Kochi Prefecture (precise locality unknown), T. Yamakawa, 13 October 1962. **MICRONESIA:** NSMT–P 23948, 276.2 mm SL, north Pacific Ocean, 12°05′N, 154°28.0′E, Y. Suda, RV Soyo-maru, 3 June
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1985.

**Photograph examined.** KAUM–II 71, 53 cm TL, Kusagaki Islands, Kagoshima Prefecture, Japan, line-fishing, 1 March 2016.

**Diagnosis.** A species of *Canthidermis* is distinguished from congeners by the following combination of characters: second dorsal-fin rays 25–27; anal-fin rays 22–24; pectoral-fin rays 14–16; body scale rows 38–41; head, body and vertical fins uniformly gray to brown, without spots in large specimens >ca. 100 mm SL.

Fig. 1. Fresh specimens of *Canthidermis macrolepis* from Japan at different growth stages. A, OMNH-P 2297 (image cataloged as KPM-NR 3192), 206.9 mm SL, Hyogo Prefecture; B, NSMT-P 129777, 308.8 mm SL, Yamaguchi Prefecture; C, FAKU 135237, 330.0 mm SL, Kyoto Prefecture; D, FAKU 146571, 344.5 mm SL, Ishikawa Prefecture; E, KAUM–I. 115632, 317.2 mm SL, Kagoshima Prefecture. Photos (A, B and E) by T. Suzuki, NSMT and KAUM, respectively.
Description. Morphometrics and selected meristics shown in Tables 1 and 2. Dorsal-fin rays III+25–27; second dorsal-fin soft rays all branched, except anterior 2 rays. Anal-fin rays 22–24, all branched, except anterior 2 rays. Pectoral-fin rays 14–16. Body scale rows 38–41; head scale rows 26–30. Vertebræ 7+11 (based on X-ray photographs of examined specimens except KAUM–I. 115632).

Body relatively elongate, well compressed, covered with rhomboidal, plate-like scales; scales with a central spine-like ridge, immediately preceding many small nodules or spinules arranged in a diamond-shaped patch [number of nodules or spinules variable depending on location of scale and body size, usually greatest (ca. 25–27) on scales on center of caudal peduncle]. Head dorsal and ventral profiles convex. No longitudinal or diagonal grooves on cheek. Eye relatively small, rounded; interorbital space narrow, slightly convex. Developed groove just before eye, below nostrils. Mouth small, terminal, with thin fleshy lips; teeth incisiform.

Fig. 2. Fresh specimen of Canthidermis macrolepis (53 cm TL; not retained) from Kusagaki Islands, Kagoshima Prefecture, Japan. Image cataloged as KAUM–II 71. Photo by J. Ohtomi.

Fig. 3. Preserved specimens of Canthidermis macrolepis. A, FAKU 38281, 266.9 mm SL, Shimane Prefecture, Japan; B, NSMT-P 23948, 276.2 mm SL, Micronesia; C, FAKU 131436, 298.3 mm SL, Hyogo Prefecture, Japan.

Fig. 4. Distributional map of Canthidermis macrolepis. Stars and circles indicate present and previous records, respectively. Closed and open stars indicate specimen- and photograph-based records, respectively.
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Notched on edges; each upper jaw with 4 teeth in outer series, 3 teeth in inner series; each lower jaw with 4 teeth in a single series. Gill opening small, slit-like, slightly oblique, located behind and below eye, just above pectoral-fin base; no enlarged osseous scales behind gill opening.

Origin of 1st dorsal-fin spine of 1st spinous dorsal fin above pectoral-fin base; 1st dorsal-fin spine long, stout, anteriorly covered with numerous tubercles; 2nd dorsal-fin spine about half to three-fourths length of 1st spine; 3rd dorsal-fin spine shorter and more slender than 2nd spine, but projecting prominently above dorsal contour of body when fin opened. Soft dorsal and anal fins similarly shaped, gently falcate in a small specimen (OMNH-P 2297, 206.9 mm SL), strongly falcated and pointed in large specimens; 4–6th dorsal-fin ray longest; 1st anal-fin ray below 5th dorsal-fin ray; 4th or 5th anal-fin ray longest. Pectoral fin rounded; uppermost ray rudimentary, 3rd or 4th ray longest. Pelvic dewlap not developed; encasing scales movable dorsoventrally, attached to posterior end of pelvis. Caudal fin doubly emarginate, with rounded margin in a small specimen (OMNH-P 2297), long pointed tips in large specimens. Caudal peduncle long, depressed and moderately deep.

**Coloration of fresh specimens** (Figs 1, 2). Head and body uniformly gray to brown, paler ventrally, without markings; coloration of all fins similar to that of body, second dorsal, anal and caudal fins darker.

**Coloration of preserved specimens** (Fig. 3). Head, body and all fins uniformly brown to tan, without markings.

**Distribution.** *Canthidermis macrolepis* is currently recorded from widespread locations in the Indo-West Pacific,
including the Red Sea, Arabian Sea, northern South China Sea, Japan, and Micronesia (see synonym list; this study: Fig. 4). In Japanese waters, the species has been collected off Yamaguchi, Shimane, Hyogo, Kyoto and Ishikawa prefectures on the Japan Sea coast; and Kagoshima and Kochi prefectures on the Pacific coast. It has also been recorded (KAUM–II 71, photograph only) from the Kusagaki Islands (30°50'N, 129°25' E), Kagoshima, Japan. Among the specimens examined, OMNH–P 2297 (Hyogo) was listed as *C. maculata* in Suzuki et al. (2000).

The species has previously been regarded as restricted to the Red and Arabian seas (Gill and Randall 1997; Taquet and Diringer 2012), although it may have been confused

![Fig. 7. Relationship between number of spinules per caudal-peduncle scale and standard length (mm) in *Canthidermis macrolepis* (stars) and *C. maculata* (triangles) (A); photographs of caudal peduncle scales in Japanese specimens of *C. macrolepis*, showing growth related changes (B, C). B, FAKU 38281, 266.9 mm SL; C, FAKU 135237, 330.0 mm SL. Bars indicate 5 mm.](image1)

![Fig. 8. Neighbor-joining tree based on sequence variations of the partial mitochondrial DNA COI gene. Sequences indicated by catalog numbers of specimens (shown by asterisks, determined here) or INSDC/BOLD registration numbers (determined in previous studies: see text). Numbers at branches indicate bootstrap probabilities following 1,000 bootstrap replications. Scale bar equals 0.02 of Tamura and Nei's (1993) distance.](image2)

| Second dorsal-fin rays | Anal-fin rays |
|------------------------|--------------|
| 22 23 24 25 26 27      | 20 21 22 23 24 |
| *C. macrolepis*        |              |
| C. maculata            |              |
| 2 18 57 20 2           | 7 47 42 3    |
| Pectoral-fin rays (one/other sides) | |
| 13/13 13/14 14/14 14/15 15/15 15/16 | |
| *C. macrolepis*        |              |
| C. maculata            |              |
| 2 2 67 12 8            | 12 8         |
| Body scale rows        |              |
| 38 39 40 41 42 43 44 45 46 47 48 49 | |
| *C. macrolepis*        |              |
| C. maculata            |              |
| 1 1 6 1               | 16 17 12 8 2 3 |
with *C. maculata* throughout much of its distributional range (e.g., eastern Indian and western Pacific oceans). Photographs of individuals of *Canthidermis* from various Pacific Ocean localities, showing an absence of any spotted pattern (e.g., Kuiter 1998; Allen et al. 2003; Kuiter and Tozouza 2004; Allen and Erdmann 2012; Clark et al. 2015) may have included *C. macrolepis*.

Like its congeners, *C. macrolepis* is a schooling pelagic species found in reef, coastal and deep-sea pelagic environments (Debelius 1998; Taquet and Diringer 2012). Most of the Japanese specimens examined here were collected by set net in coastal areas.

Instances of *C. macrolepis* and *C. maculata* collected together in Japanese waters include NSMT-P 129777 (308.8 mm SL) and NSMT-P 129778 (215.3 mm SL), respectively, from Hyogo Prefecture (set net), suggesting that adults of the two species were schooling together. In contrast, although juvenile *C. maculata* are common in Japan (see Comparative materials), large specimens (>200 mm SL) of *C. macrolepis* were found only during intensive examinations of numerous museum specimens of *Canthidermis* from many Japanese localities. Reproductive areas or the main distributional range of Pacific *C. macrolepis* may, in fact, be far from Japan, with pelagic juveniles failing to reach coastal Japanese waters.

**Remarks.** The validity of species of *Canthidermis* overall is equivocal. Fedoryako (1981) recognized five nominal species as valid, including *C. maculata, C. macrolepis, C. rotundatus, C. sufflamen* and *C. willughbeii*. However, Clark et al. (2015) followed Eschmeyer (1998) in regarding only, *C. maculata, C. macrolepis and C. sufflamen* as valid. Although Mundy (2005) questionably treated *C. rotundatus* as valid, based on Randall and Mundy (1998), and Fricke et al. (2019) tentatively regarded both *C. rotundatus* and *C. willughbeii* as valid, the status of both nominal species remains uncertain. A single specimen (NSMT-P 65574) of *Canthidermis*, collected off Guatemala (eastern Pacific), was found to have 23 second dorsal-fin rays, 21 anal-fin rays, 13 pectoral-fin rays, 22–24 anal-fin rays, 23–26 first dorsal-fin rays, 26–30 second dorsal-fin rays, 26–30 head scale rows, 26–30 body scale rows, 26–30 pectoral-fin rays, 26–30 anal-fin rays, 26–30 dorsal-fin rays.

### Table 2. Meristic and morphometric data from specimens of *Canthidermis macrolepis, C. maculata* and *C. cf. willughbeii* (expressed as percentages of standard length).

| Localities                     | *C. macrolepis* | *C. maculata* | *C. cf. willughbeii* |
|-------------------------------|-----------------|---------------|---------------------|
|                               | Japan and Micronesia | West Pacific and Suriname | Guatemala |
| Number of specimens           | 9 mode          | 101 mode      | 1                   |
| Dorsal-fin rays               | III-25–27       | III-22–26     | III-23              |
| Anal-fin rays                 | 22–24           | 20–23         | 21                  |
| Pectoral-fin rays             | 14–16           | 13–15         | 14 (both sides)     |
| Body scale rows               | 38–41           | 40–49         | 44                  |
| Head scale rows               | 26–30           | 24–34         | 31                  |
| Standard length (mm)          | 206.9–349.8     | mean          | 11.0–276.5          |
| Body depth (% SL)             | 27.9–46.9       | 32.3–51.5     | 40.1                |
| Greatest body depth           | 32.9–57.0       | 36.9–64.8     | 45.2                |
| Body depth at 2nd dorsal-fin end | 14.9–18.2     | 13.9–18.7     | 15.9                |
| Body width                    | 13.2–22.5       | 13.8–25.6     | 18.3                |
| Head length                   | 26.0–39.7       | 31.0–44.0     | 35.2                |
| Snout length                  | 17.1–20.5       | 17.4–21.1     | 19.5                |
| Orbit diameter                | 4.6–12.1        | 5.9–15.2      | 8.8                 |
| Interorbital width            | 11.9–14.7       | 12.2–22.7     | 14.9                |
| Postorbital length            | 7.6–9.0         | 7.9–14.0      | 10.0                |
| Gill opening length           | 4.7–9.4         | 6.8–11.0      | 8.4                 |
| Snout to 1st dorsal-fin origin| 28.4–43.8       | 32.2–50.5     | 38.0                |
| Snout to 2nd dorsal-fin origin| 54.5–65.9       | 59.3–74.1     | 65.2                |
| Interdorsal space             | 20.6–27.6       | 22.5–31.2     | 25.3                |
| Snout to anal-fin origin      | 60.8–75.7       | 62.4–78.9     | 70.2                |
| 2nd dorsal-fin base length    | 26.9–31.9       | 27.8–35.4     | 31.1                |
| Anal-fin base length          | 22.3–27.5       | 25.2–29.0     | 26.0                |
| 1st dorsal-fin spine length   | 11.0–22.3       | 12.1–25.0     | 17.5                |
| Longest 2nd dorsal-fin ray length | 20.0–33.0   | 20.2–32.3     | 26.7                |
| Longest anal-fin ray length   | 18.7–30.7       | 19.9–29.9     | 26.0                |
| Longest pectoral-fin ray length | 9.6–16.3      | 12.6–21.6     | 15.4                |
| Upper caudal-fin ray length   | 25.1–29.1       | 21.8–29.0     | 24.9                |
| Lower caudal-fin ray length   | 23.9–30.6       | 21.6–30.0     | 24.9                |
| Middle caudal-fin ray length  | 19.8–25.3       | 18.9–26.1     | 22.0                |
| Caudal-peduncle length        | 12.0–22.8       | 10.6–17.9     | 14.7                |
| Caudal-peduncle depth         | 8.3–12.8        | 10.8–14.6     | 12.4                |


eral-fin rays and 37 body scale rows, such being largely consistent with Fedoryako’s (1981) redescription of C. willaghbi (see Table 2). In contrast, no specimens examined here were identified as C. rotundatus (sensu Fedoryako 1981). As pointed out by Randall and Mundy (1998) and Mundy (2005), a worldwide revision of Canthidermis is necessary to resolve the taxonomic situation. Notwithstanding, according to Fedoryako (1981) and Gill and Randall (1997), C. macrolepis is clearly distinguished from all congeners by having fewer body scale rows (35–40 vs. 39–58).

The described specimens were identified as C. macrolepis, being distinct from the closely similar congener, C. maculata, on the basis of the following combination of counts: body scale rows 38–41 (modally 40) vs. 40–49 (44) in the latter; second dorsal-fin ray 25–27 (26) vs. 22–26 (24); anal-fin rays 22–24 (23) vs. 20–23 (21); and pectoral-fin rays 14–16 (15) vs. 13–15 (14) [data for C. maculata based on examined specimens (see below); Table 1]. Similar differences were also mentioned in Fedoryako (1981). Although Sawayak et al. (2014) gave meristic counts for C. maculata as: second dorsal-fin rays ii+21–26; anal-fin rays i+2–18; and lateral line scales 48–70, such counts differed from previous (and present) studies, and may have included errors. Similarly, Hayashi (1993, 2000, 2002), Hayashi and Hagiwara (2013) and Fujita and Matsuura (2014) gave unusually high anal-fin ray counts (20–27) for C. maculata.

Canthidermis macrolepis and C. maculata are very similar to each other in overall body appearance, their body proportions evidently changing with growth in both species (Berry and Baldwin 1966; Gill and Randall 1997). However, C. macrolepis may have slightly lesser body depth at the end of the second dorsal fin <14.9–18.2% SL in the present specimens (206.9–349.8 mm SL), compared with similarly sized C. maculata (15.9–18.7% SL in 203.9–276.5 mm-SL specimens); Fig. 5.

Moreover, the examined specimens of C. macrolepis apparently differed from similarly sized specimens of C. maculata in having a uniformly grayish to brownish body, lacking light spots (Fig. 6). However, Clark et al. (2015) included many underwater photographs of Indo-Pacific C. maculata adults, which indicated that lack of a spotted pattern was typical of adults of the species, and noted that a spotted pattern was apparently a coloration phase of young and juvenile individuals. In contrast, Garcia et al.’s (2017) photograph of a large adult specimen (335 mm SL) of C. maculata from the northeastern coast of Brazil showed a light spotted pattern. Underwater photographs of C. macrolepis have indicated a uniformly grayish body without spots (see Randall 1995; Debelius 1998). Similarly, Baranes’s (2005: fig. 3) 299 mm-SL specimen of C. macrolepis from the Red Sea had a uniformly brownish body. Fedoryako (1981) described small preserved specimens (<100 mm SL) of C. villosus (= C. macrolepis) as possessing a beige body with a coarse reticulated pattern, and large light spots on the second dorsal, anal and caudal fins, compared with uniformly beige larger specimens (>100 mm SL). Identifications of underwater photographs of uniformly grayish-bodied Canthidermis in the published literature (e.g., Kuitter 1998; Allen et al. 2003; Kuitter and Tonozuka 2004; Allen and Erdmann 2012; Clark et al. 2015) may have to be reviewed.

The caudal fin of C. maculata and C. macrolepis become doubly emarginate with growth. Specimens of the former (<ca. 150 mm SL) possess a rounded caudal fin without pointed upper and lower lobes, compared with larger specimens, which possess a doubly emarginate caudal fin with both lobes pointed and the middle margin concave (Fig. 6). Canthidermis macrolepis has a similar trend of growth-related changes in caudal-fin shape. Furthermore, large C. macrolepis tend to have strongly falcate, pointed second dorsal and anal fins (Fig. 1), compared with a rounded fin contour in small specimens. The number and arrangement of nodules or spinules on the body scales is highly variable between individuals, but generally increase with growth in C. macrolepis and C. maculata (Fig. 7). Moreover, according to Fedoryako (1981) and Gill and Randall (1997), the spots apparent in small juvenile C. macrolepis (<ca. 100 mm SL) disappear with growth.

Genetic divergence between C. maculata and C. macrolepis also supports the validity of the two species. In the NJ tree inferred from COI sequences (526 bp), three monophyletic groups were recovered with high bootstrap probabilities (83–98%), one group including the specimens presently identified as C. maculata, and another, C. macrolepis (Fig. 8). The third monophyletic group comprised sequences deposited in INSDC as C. sufflamen. The sequence divergences (uncorrected p-distance) among C. maculata, C. macrolepis, and C. sufflamen were 0.019–0.029, being greater than those within each species (<0.017).

Among the nominal species included in the synonymy of C. maculata (see Berry and Baldwin 1966; Moore 1967), Canthidermis viola Herre, 1926 (originally described from the Cagayan Islands, Sulu Sea, Philippines) resembles C. macrolepis. Herre (1926) described the 300 mm-TL holotype of C. viola as possessing “III-III-23” (=III-26) dorsal-fin rays, “III-20” (=23) anal-fin rays and 42 body scale rows, a combination of counts reminiscent of C. macrolepis. Moreover, his drawing of C. viola (Herre 1926: pl. 1) showed a uniformly grayish body and fins, lacking spots.

Common in Japan, C. maculata has the Japanese name “Ami-mongara” (“ami”: net-like markings; “Mongara”: Japanese common name for triggerfishes) [see Jordan et al. (1913) as C. rotundatus]. Judging from the drawings, accounts of “Ami-mongara” given in Nakabo’s “Fishes of Japan” (Hayashi 1993, 2000, 2002; Hayashi and Hagiwara 2013) had been correctly identified as C. maculata. There being no current Japanese name for C. macrolepis, the name “Bouzu-mongara” (“bouzu” referring to the rounded head profile and uniformly colored body in adults) is proposed here, on the basis of KAUM–I. 115632.

Comparative materials examined. Canthidermis maculata: 101 specimens, 11.0–276.5 mm SL: JAPAN: Chiba Prefecture: *KPM-NI 31828, 18.1 mm SL; *KPM-NI 31829, 11.0 mm SL; KPM-NI 48951, 46.5 mm SL. Tokyo: NSMT-P 35271, 85.5 mm SL; NSMT-P 110913, 175.9 mm SL; NSMT-P 110914, 150.5 mm SL; NSMT-P 110915, 150.0 mm SL; NSMT-P 110916, 143.6 mm SL. Kanagawa
Pacific Ocean records of *C. macrolepis*

**WESTERN PACIFIC OCEAN:** KPM-NI 51985, 214.6 mm SL; KBO 8195, 99.1 mm SL; BSKU 8197, 131.4 mm SL; BSKU 126986, 276.5 mm SL; BSKU 126969, 256.7 mm SL; NSMT-P 130613 (formerly KSHS 20809), 234.4 mm SL; NSMT-P 133114 (formerly KSHS 19873), 103.6 mm SL; NSMT-P 133115 (formerly KSHS 5779) 120.6 mm SL; NSMT-P 133116 (formerly KSHS 5778), 122.8 mm SL; NSMT-P 133117 (formerly KSHS 19873), 159.9 mm SL; NSMT-P 133118 (formerly KSHS 5997), 187.8 mm SL.

**MICRONESIA:** NSMT-P 77143, 99.0 mm SL.

**PHILIPPINES:** KAUM-I. 56376, 235.7 mm SL; KPM-NI 10233, 46.2 mm SL; KPM-NI 10234, 33.4 mm SL; KPM-NI 10235, 22.8 mm SL; KPM-NI 18130, 56.7 mm SL; WAKAYAMA Prefecture: KUN-P 43669, 24.3 mm SL; OMNH-P 25176, 87.6 mm SL; KOCHI Prefecture: BSKU 8195, 99.1 mm SL; BSKU 8197, 131.4 mm SL; BSKU 126986, 276.5 mm SL; BSKU 126969, 256.7 mm SL; NSMT-P 130613 (formerly KSHS 20809), 234.4 mm SL; NSMT-P 133114 (formerly KSHS 19873), 103.6 mm SL; NSMT-P 133115 (formerly KSHS 5779) 120.6 mm SL; NSMT-P 133116 (formerly KSHS 5778), 122.8 mm SL; NSMT-P 133117 (formerly KSHS 19873), 159.9 mm SL; NSMT-P 133118 (formerly KSHS 5997), 187.8 mm SL.

**CENTRAL SOUTH PACIFIC OCEAN:** KPM-NI 18788, 260.8 mm SL; KPM-NI 18789, 235.9 mm SL, south of Kiribati and Gilbert islands, 32°01' S, 177°50' E.

**NORTH WESTERN PACIFIC OCEAN:** KPM-NI 51985, 214.6 mm SL; 22°N, 130°E. **SURNAME:** NSMT-P 77143, 99.0 mm SL.

**LOCALITY UNKNOWN:** *KAUM-I. 37545, 42.6 mm SL; *KAUM-I. 37546, 41.0 mm SL.

**Canthidermis cf. willughbei:** NSMT-P 65574, 84.9 mm SL, 35 mile west of Champerico, Guatemala, 14°18’N, 92°48’W, 21 March 1963.

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