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Acanthurus albimento, a new species of surgeonfish (Acanthuriformes: Acanthuridae) from northeastern Luzon, Philippines, with comments on zoogeography

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Abstract

Acanthurus albimento is described as a new surgeonfish from northeastern Luzon from six specimens collected during extensive fish-market surveys in the Philippines. The new species is characterized by a distinctive white band below the lower jaw; many irregular, wavy, thin, blue lines on the head; a brown-orange pectoral fin with a bluish tinge on the outer membrane of the rays and a dark band on the posterior margin; a narrow rust-orange stripe along the base of the dorsal fin; and a large blackish caudal spine and sheath with the socket broadly edged in black. An analysis using the mitochondrial cytochrome c oxidase subunit 1 (COI), supported by an independent multi-locus analysis, suggests phylogenetic affinities with an *Acanthurus* clade that includes *A. auranticavus*, *A. bariene*, *A. blochii*, *A. dussumieri*, *A. gahhm*, *A. leucocheilus*, *A. maculiceps*, *A. mata*, *A. nigricauda*, and *A. xanthopterus*; a clade that shares a suite of color characteristics. Based on the sampling history in the region, the new species may be a limited-range endemic in the westernmost Pacific Ocean, which is unusual for members of this genus. This raises potential questions about drivers of dispersal and long-held assumptions about zoogeographic patterns along the Kuroshio Current.

Key words: taxonomy, ichthyology, systematics, coral-reef fishes, Indo-Pacific Ocean, Whitechin Surgeonfish, Kuroshio Current, phylogenetics, market surveys.

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Introduction

The present paper describes a new species of surgeonfish of the genus *Acanthurus* from Luzon Island, Philippines. It was discovered during a six-year study extensively sampling fish markets of the Philippines to document the extent of exploited fish diversity and establish a database of genetic barcodes (Williams *et al*. 2016). The discovery of an undescribed surgeonfish from this area was surprising based on known dispersal capabilities of the genus, oceanographic features in this region, and the history of ichthyology in the Philippines. Most surgeonfishes of the genus *Acanthurus* are widely distributed in the Indo-Pacific Ocean (Randall 2002). They also exhibit long pelagic larval durations (Fisher 2005) and widespread population connectivity (Rocha *et al*. 2002, Eble *et al*. 2011).

The Kuroshio Current is a dominant oceanographic feature in the northwestern Pacific, forming a northerly flowing boundary current along northeastern Luzon (Fig. 1; Gordon *et al*. 2014) and presumably influences larval dispersal in this region (Magsino & Juinio-Meñez 2002, Ravago-Gotanco *et al*. 2007, Carpenter *et al*. 2011). It also influences zoogeographic affinities of the Coral Triangle ichthyofauna with the very well-studied fish faunas in Taiwan and southern Japan (Randall 1998, Shao *et al*. 1999, Briggs & Bowen 2012). Widespread coastal fish species of northern Luzon typically occur in adjacent coastal regions influenced by the Kuroshio Current.

Although not nearly as well studied as Indonesia, in terms of both historical and contemporary ichthyological collections (Sanciangco *et al*. 2013), the Philippines has been the focus of extensive ichthyological studies beginning in the early 1900s (Smith & Williams 1999). Surgeonfishes of the genus *Acanthurus* are well studied taxonomically, including from numerous Philippine samples examined both from museum specimens and freshly examined specimens in the field (Randall 1956, 1988, 2002, 2011). Recent extensive market surveys in the Philippines (Williams *et al*. 2016) have yielded many new records of species known from the Philippines and discoveries of new species of small and cryptic fishes (e.g. Williams & Carpenter 2015), but this discovery represents an easily distinguishable, large, coastal surgeonfish so far only collected from northeastern Luzon. It is premature to assume that this new species is a limited-range endemic, but the discovery of an eddy in the vicinity of its known range (Gordon *et al*. 2014) raises questions about the potential influence of the eddy on the dispersal of larvae in this area of the Kuroshio Current.

Materials and Methods

The discovery of this new species is part of a series of ongoing fish-market surveys held between 2011 and 2016 for the purpose of building a database of mtDNA barcodes (Ward *et al*. 2009) for all possible fish species marketed in the Philippines (Williams *et al*. 2016). The purpose of this survey is to improve food safety and marketing assurance by developing the capacity to identify fillets or other fish products that cannot be identified through normal taxonomic methods. Fish landings were visited at peak landing times and all fish stalls at each market were visited and each time a specimen (or specimens) of a species was encountered that had not been collected previously, up to three specimens were purchased for processing. The goal is to collect at least three specimens of each species encountered. Each specimen collected was identified to species using a variety of identification guides and taxonomic references (e.g. Carpenter & Niem 2001, Randall 2002, Allen & Erdmann 2012, White *et al*. 2013) and photographed. Tissues were sampled for genetic analysis (preserved in ethanol and M2 buffer of the Autogen prep protocol) and whole-specimen vouchers were fixed in formalin for later preservation at the National Museum of Natural History of the Smithsonian Institution (USNM) and the Philippine National Museum (PNM), where all primary type specimens are deposited. Species accumulation curves, rarefaction, and extrapolation for all market-survey results were analyzed using EstimateS (Colwell 2016). All photographs of fresh specimens were taken by J.T. Williams.

Meristic data and morphometric measurements follow Randall & Earle (1999), with the exception that only posterior gill-raker counts were made. Abbreviations used are standard length (SL) and head length (HL). In the description the counts or measurements of the holotype is given first and, if applicable, the extended ranges of the paratypes are in parentheses. Ratios of proportional measurements are rounded to the nearest 0.05.

Sequencing of the mitochondrial cytochrome c oxidase subunit 1 (COI) follows the Smithsonian protocols of Baldwin *et al*. (2011). The holotype and four paratypes were sequenced, yielding from 562 to 655 base-pair fragments and these were compared with all available COI sequences of congeners obtained from GenBank, with *Zebrasoma scopas* used as an outgroup (Table 1). A maximum-likelihood tree was constructed using MEGA 5.05 software (Tamura *et al*. 2011) under the Hasegawa-Kishino-Yano model, which was determined as optimal by that software. Appropriate models of nucleotide substitution using jModelTest2 (Darriba *et al*. 2012) and Phyml (Guindon & Gascuel 2003) yielded identical maximum-likelihood topology. Confidence in topology was estimated using 1000 bootstrap replicates.

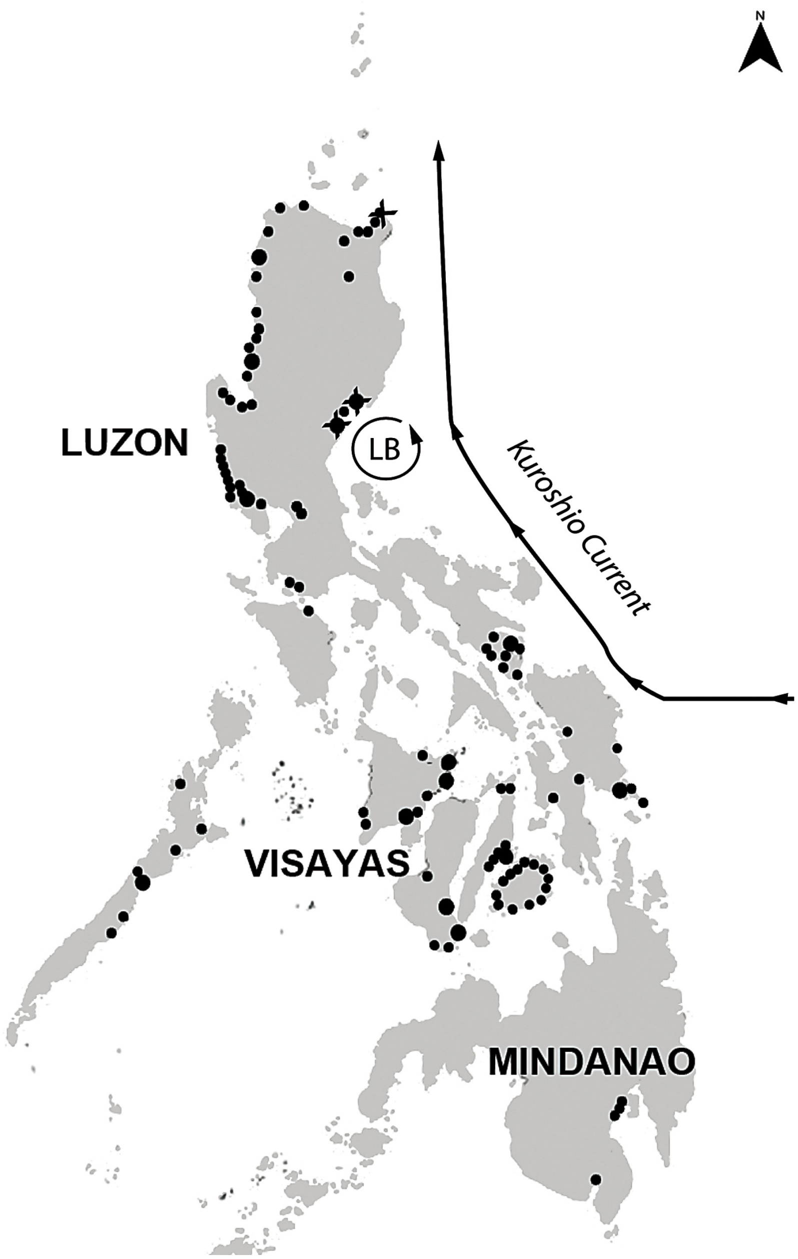

Figure 1. Markets sampled once (small dots) or more (larger dots) with the location of two markets on Lamon Bay (LB) where *Acanthurus albimento* specimens were collected (crossed larger dots). A schematic of the cyclonic eddy in Lamon Bay (LB) is shown relative to the Kuroshio Current.

Fish Market Surveys

Annual fish-market surveys in the Philippines over the period 2011 to 2016 yielded a total of 1038 species from 258 separate collections at 108 fish landings, roadside stalls, and municipal and city markets (Fig. 1). Rarefaction and extrapolation species curves after 258 sampling events over 6 years show an asymptote has not yet been reached and extrapolation indicates that around 1,500 species (95% confidence interval from about 1,400 to 1,600 species) could eventually be sampled from fish markets in the Philippines (Fig 2).

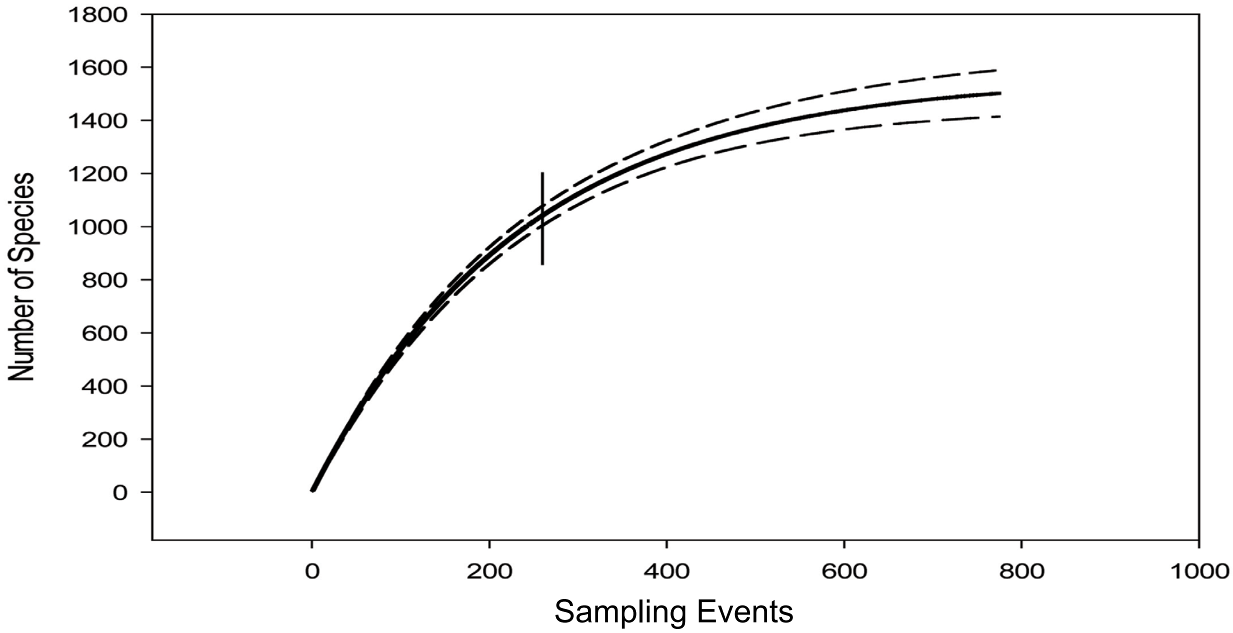

Figure 2. Rarefaction curve (solid line) based on species accumulation of 1038 species after 258 sampling events (vertical line) and extrapolation to three times the sampling events. The 95% confidence intervals are indicated by dashed lines.

TABLE 1

GenBank accession numbers for the species in this study (holotype/4 paratypes for the new species)

Acanthurus achilles	HM034178	*Acanthurus monroviae*	KC623666
Acanthurus albimento n.sp.	KY579689/90/91/92/93	*Acanthurus nigricans*	KY570701
Acanthurus auranticavus	KC623655	*Acanthurus nigricauda*	KY570702
Acanthurus bahianus	JQ840410	*Acanthurus nigrofuscus*	KY570703
Acanthurus bariene	KY570694	*Acanthurus nigroris*	KY570704
Acanthurus blochii	HM034180	*Acanthurus nubilus*	KY570705
Acanthurus chirurgus	JQ841448	*Acanthurus olivaceus*	KY570706
Acanthurus coeruleus	JQ839701	*Acanthurus polyzona*	JQ349663
Acanthurus dussumieri	KY570695	*Acanthurus pyroferus*	KY570707
Acanthurus gahhm	KJ658902	*Acanthurus reversus*	pending
Acanthurus guttatus	KC623660	*Acanthurus sohal*	KJ658909
Acanthurus japonicus	KY570696	*Acanthurus tennentii*	KC623671
Acanthurus leucocheilus	KY570697	*Acanthurus thompsoni*	KY570708
Acanthurus leucopareius	KY570698	*Acanthurus tractus*	JQ840409
Acanthurus leucosternon	EF648259	*Acanthurus triostegus*	KY570709
Acanthurus lineatus	KY570699	*Acanthurus tristis*	KJ679904
Acanthurus maculiceps	pending	*Acanthurus xanthopterus*	KY570710
Acanthurus mata	KY570700	*Zebrasoma scopas*	KY570711

Acanthurus albimento, n. sp.

Whitechin Surgeonfish

urn:lsid:zoobank.org:act:A5AE5F8A-BDBB-4565-9F6A-011776A11056

Figures 3, 4, & 6A; Table 2.

Holotype. PNM 15199 (previously USNM 438093), 252.4 mm SL, Philippines, northeast Luzon, Aurora Province, purchased at Dinadiawan City Market, exact locality unknown (vendor stated it was caught in vicinity of Dinadiawan), depth of capture unknown, field number PHIL-2015-33, tissue voucher number PHIL-483, J.T. Williams, K.E. Carpenter, M.J. Mendiola, and N.A. Flores, 2 August 2015.

Paratypes. USNM 438094, 211.2 mm SL, tissue voucher number PHIL-484 & USNM 438095, 202.8 mm SL, tissue voucher number PHIL-485, same collection information as holotype. USNM 438101, 226.6 mm SL, tissue voucher number PHIL-491 & USNM 438102, 213.5 mm SL, tissue voucher number PHIL-492, both Philippines, northeast Luzon, Aurora Province, purchased at Baler City Market, exact locality unknown (vendor stated it was landed at Castillo and caught in vicinity of Baler), depth of capture unknown, field number PHIL-2015-35, J.T. Williams, K.E. Carpenter, M.J. Mendiola, and N.A. Flores, 4 August 2015. PNM 15200, 205.9 mm SL, Philippines, northeast Luzon, Cagayan Province, purchased from a roadside vendor in Santa Ana, exact locality unknown (vendor stated it was caught off Pacific coast of northeastern Luzon), depth of capture unknown, tissue voucher number PHISH-228, field number PHISH-2016-27, J.T. Williams, M. Santos, and N.A. Flores, 18 May 2016.

Diagnosis. Dorsal-fin rays IX,26–28; anal-fin rays III,25–27; pectoral-fin rays 17; posterior gill rakers 20–22; mouth with 16–18 teeth in upper jaw and 18–20 teeth in lower jaw; body depth 1.95–2.0 in SL; snout 4.35–4.74 in SL; forehead of large adults with pronounced convexity; head length 3.45–3.7 in SL; ninth dorsal-fin spine 1.65–1.85 in HL; caudal-spine length 3.85–5.15 in HL; caudal fin strongly lunate in adults, caudal concavity 3.9–5.6 in SL; color of fresh specimens as follows (Fig. 3): lips brown, upper lip edged narrowly with whitish merging ventrally with distinct white chin band; head brown with numerous distinct, iridescent, blue, wavy stripes, extending as wavy stripes behind and below opercle; indistinct orangish streak in front of eye extending behind eye to behind upper edge of opercle; iridescent blue stripes on base of pectoral fin, outer surface of each

Figure 3. *Acanthurus albimento*, fresh holotype, PNM 15199, 252.4 mm SL, northeast Luzon, Philippines (J.T. Williams).

pectoral ray iridescent blue with posterior fourth of fin darker brown (Fig. 4); body brown with numerous narrow alternating dark and bluish wavy stripes; dorsal fin with distinct rust-orange stripe at base; grey caudal spine, its socket covered with a black oval spot with a whitish border; whitish base of caudal fin, caudal fin with narrow, vertical, light-bluish lines centrally and longitudinal bluish lines covering upper and lower rays.

Description. Dorsal-fin rays IX,28 (26–28), first soft ray unbranched; anal-fin rays III,27 (25–27), first soft ray unbranched; pectoral-fin rays 17; pelvic-fin rays I,5; principal caudal-fin rays 16, upper and lowermost unbranched; upper and lower procurrent caudal-fin rays 5; posterior gill rakers 21 (20–22); vertebrae 9+13.

Scales on body ctenoid, ctenii on mid-body scales typically 17–18 (13–18); lateral line not well defined, approximately following dorsal contour at vertical close to dorsal-fin origin from just behind eye and ending at vertical near mid-part of soft dorsal fin; scaly sheath at base of dorsal and anal fins; small scales covering more than three-fourths of basal part of caudal fin.

Body deep, body depth 2.0 (1.95–2.0) in SL, and compressed, width 1.8 (1.7–2.0) in HL; head length 3.7 (3.45–3.7) in SL; mouth small, length of upper jaw 3.85 (3.9–4.3) in HL; teeth in jaws uniserial, incisiform, spatulate with denticulate edges, and close-set, 18 (16–18) teeth in upper jaw and 20 (18–20) in lower jaw; dorsal profile of head strongly and evenly convex with pronounced convexity on snout (slight to no pronounced snout convexity in 4 smallest paratypes and pronounced convexity in largest paratype); snout length 1.3 (1.2–1.3) in HL; interorbital strongly convex, least width 2.9 (3.0–3.05) in HL; groove extending obliquely anteriorly, and ventrally in front of eye, its length 5.0 (4.7–6.5) times in HL; orbit diameter 4.85 (4.15–4.4) in HL.

Dorsal-fin origin over posterior edge of opercle, predorsal length 2.8 (2.45–2.7) in SL; dorsal fin moderately high, second dorsal-fin spine 2.15 (1.8–3.6) in HL, ninth dorsal-fin spine 1.85 (1.65–1.85) in HL, longest dorsal-fin soft ray 1.65 (1.4–1.65) in HL; pectoral-fin length 1.0 (0.95–1.05) in HL; pelvic-fin length 1.1 (1.05–1.15) in HL, its spine 2.2 (1.95–2.2) in HL; anal-fin origin above seventh dorsal-fin spine, preanal length 1.95 (2.0–2.1) in SL; caudal peduncle depth 2.45 (2.35–2.65) in HL; caudal spine moderately long, 4.0 (3.85-5.15) in HL; caudal fin moderately lunate, caudal concavity 3.9 (4.1–5.6) in SL.

Figure 4. *Acanthurus albimento*, fresh paratype, USNM 438101, 226.6 mm SL, northeast Luzon, Philippines (J.T. Williams).

TABLE 2

Proportional measurement of type specimens of *Acanthurus albimento*, n.sp.
in percent of SL (to nearest tenth of a percent)

	Holotype	Paratypes				
	PNM 15199	USNM 438094	USNM 438095	USNM 438101	USNM 438102	PNM 15200
Standard length (mm)	252.4	211.2	202.8	226.6	213.5	205.9
Body depth	50.8	50.7	51.3	50.3	50.5	50.1
Body width	15.1	15.6	15.1	15.8	14.9	14.3
Head length	27.1	27.7	28.5	27.1	27.8	29.0
Snout length	21.0	23.0	22.9	21.7	21.2	22.0
Orbit diameter	5.6	6.6	6.7	6.2	6.7	6.7
Interorbital width	9.2	9.2	9.3	9.1	9.3	9.8
Upper jaw length	7.1	7.0	7.3	6.4	6.9	6.7
Caudal-peduncle depth	11.1	10.7	11.1	11.5	11.1	10.9
Caudal-peduncle length	13.7	13.0	13.3	12.4	12.4	11.1
Predorsal length	35.5	40.3	40.6	38.7	37.5	37.3
Preanal length	51.7	48.7	50.0	50.0	50.9	47.7
Prepelvic length	34.0	34.8	33.5	32.4	34.5	32.2
Dorsal-fin base	68.6	69.6	69.3	67.7	68.1	67.0
Second dorsal-fin spine	12.6	12.0	13.2	14.5	15.3	8.0
Last dorsal-fin spine	14.8	16.8	17.3	15.9	15.1	15.9
Longest dorsal-fin soft ray	16.6	19.1	20.5	18.0	17.8	17.7
Caudal-spine length	6.8	7.2	5.5	6.7	5.4	6.4
Caudal-fin length	41.6	40.4	41.6	39.0	40.7	37.0
Caudal concavity	25.5	24.6	20.5	19.5	20.7	17.9
Pectoral-fin length	27.2	27.1	27.5	26.0	29.0	28.0
Pelvic-spine length	12.5	13.4	14.6	12.9	13.0	13.3
Pelvic-fin length	24.6	26.5	24.4	23.0	23.8	25.3
Groove in front of eye length	5.4	4.3	5.8	5.2	5.2	6.2

Color when fresh. (Figs. 3, 4 & 6A) Head orangish brown with numerous irregular, narrow, iridescent-blue stripes curving downward anteriorly and mostly horizontal behind eye and on operculum, numbering around 20–25 stripes above chin, becoming fainter and more numerous on body; some irregular bluish lines also on breast with more prominent oblique bluish lines against a dark-orangish background above pectoral-fin base; lips brownish with chin immediately below lips sharply whitish with thin white line extending along posterodorsal margin of upper lip; indistinct diffuse orangish streak extending anteriorly and posteriorly from lower part of eye; body orangish brown anteriorly becoming darker brown posteriorly; scales with bluish white centers, giving appearance of numerous faint, thin, irrgeular, iridescent bluish white lines (that fade to pale when less fresh, and not apparent in areas where scales are missing); caudal spine grey, its socket enclosed in a prominent pale-bordered, black, oval spot that continues forward from spine for distance about equal to eye diameter or less; pectoral fin orangish brown, darker on posterior one-fourth, with bluish lines running along each fin ray and 4–5 oblique thin bluish lines on base; dorsal fin brownish with 3–4 oblique paler streaks over spinous portion and 2–3 indistinct pale stripes on distal one-third of soft part of fin, distinct narrow rust-orange stripe along entire length of base of fin; anal fin brownish with 6–7 thin indistinct dark horizontal stripes along entire length; caudal fin whitish near base, otherwise brownish with 7–9 thin indistinct bluish vertical lines over middle rays and faint bluish indistinct horizontal streaks on membranes between rays in uppermost and lowermost rays.

Color in preservative. Basic color brownish with faded markings as described for fresh specimens.

Etymology. The new species is named *albimento* for its distinctive white chin. The specific epithet is derived from a combination of white (Latin *albus*) and a variation of the word for chin (Latin *mentum*), and is treated here as a noun in apposition.

Comparisons. *Acanthurus albimento* is clearly distinguished from other members of the genus (and the descriptions of their various junior synonyms) by its distinctive white chin, iridescent blue markings on the face and pectoral fin, and rust-orange line at the base of the dorsal fin. The only possible candidate species described from the Philippines is Herre's (1927) *A. mindorensis*, which is poorly documented and the type material is destroyed, thus presently considered invalid (Eschmeyer *et al*. 2017). Nevertheless, Herre's illustration of *A. mindorensis* clearly shows a head shape distinctly different from *A. albimento* and most similar to species with a concave snout profile, such as *A. japonicus* and *A. leucosternon*.

Phylogenetic analysis. Randall (1956) recognized seven natural groups of *Acanthurus* species based on key characters. The taxonomy of *Acanthurus* has subsequently been refined (Randall 1961, 1988, 1993, 2001, Randall *et al*. 2011), and new species added (Randall & Earle 1999). Despite the revisions and additions, the seven Indo-West Pacific groups remain essentially the same as originally proposed (Randall 1956, Randall 2001, Randall & Earle 1999). The set of groups comprise the: 1) barred convict surgeonfish species *A. polyzona* (Bleeker, 1868) and *A. triostegus* (Linnaeus, 1758); 2) short-snouted species *A. nubilus* (Fowler & Bean, 1929), *A. mata* (Cuvier, 1829), *A. thompsoni* (Fowler, 1923), and *A. albipectoralis* Allen & Ayling, 1987; 3) spotted species (mostly with spots at the posterior base of the dorsal and anal fins) *A. guttatus* Forster *in* Bloch & Schneider, 1801, *A. leucopareius* (Jenkins, 1903), *A. nigroris* Valenciennes *in* Cuvier & Valenciennes, 1835, *A. nigros* Günther, 1861, and *A. nigrofuscus* (Forsskål, 1775); 4) broad-striped species *A. lineatus* (Linnaeus, 1758) and *A. sohal* (Forsskål, 1775); 5) small-mouthed species *A. achilles* Shaw, 1803, *A. japonicus* Schmidt, 1931, *A. leucosternon* Bennett, 1832, and *A. nigricans* (Linnaeus, 1758); 6) species with eight dorsal-fin spines *A. chronixis* Randall, 1960, *A. pyroferus* Kittlitz, 1834, and *A. tristis* Randall, 1993; and 7) all remaining species with nine dorsal-fin spines, i.e. *A. auranticavus* Randall, 1956, *A. bariene* Lesson, 1830, *A. blochii* Valenciennes *in* Cuvier & Valenciennes, 1835, *A. dussumieri* Valenciennes *in* Cuvier & Valenciennes, 1830, *A. fowleri* de Beaufort, 1951, *A. gahhm* (Forsskål, 1775), *A. grammoptilus* Richardson, 1843, *A. leucocheilus* Herre, 1927, *A. maculiceps* (Ahl, 1923), *A. nigricauda* Duncker & Mohr, 1929, *A. olivaceus* Forster *in* Bloch & Schneider, 1801, *A. reversus* Randall & Earle, 1999, *A. tennentii* Günther, 1861, and *A. xanthopterus* Valenciennes *in* Cuvier & Valenciennes, 1835.

Sorenson and colleagues (2013) inferred a phylogeny of all surgeonfishes based on multi-locus molecular data from 26 of the known 38 species of *Acanthurus*. They concluded that *Acanthurus* was paraphyletic unless the species of *Ctenochaetus* (9 currently recognized) are included in *Acanthurus*, but it is premature to revise the generic level taxonomy until a more complete and comprehensive systematic study is accomplished. Based on those species sampled for molecular analysis (Sorenson *et al*. 2013), the seven basic groups recognized by Randall

(1956) are each essentially monophyletic with the exception of the short-nosed group (group 2) and the spotted group (group 3). Group 7 represents a monophyletic group only with the inclusion of the short-nosed *A. mata*.

Our maximum-likelihood tree generated from COI sequences of the 35 available species of *Acanthurus* (with *Zebrasoma scopus* as an outgroup) mostly agrees with prior studies (Sorenson 2013: Fig. 2; our Fig. 5). The new species shares a clade of 11 species with most (but not all) other members of Randall's group 7, plus *A. mata*. This clade includes *A. albimento*, *A. auranticavus*, *A. bariene*, *A. blochii*, *A. dussumieri*, *A. gahhm*, *A. leucocheilus*, *A.*

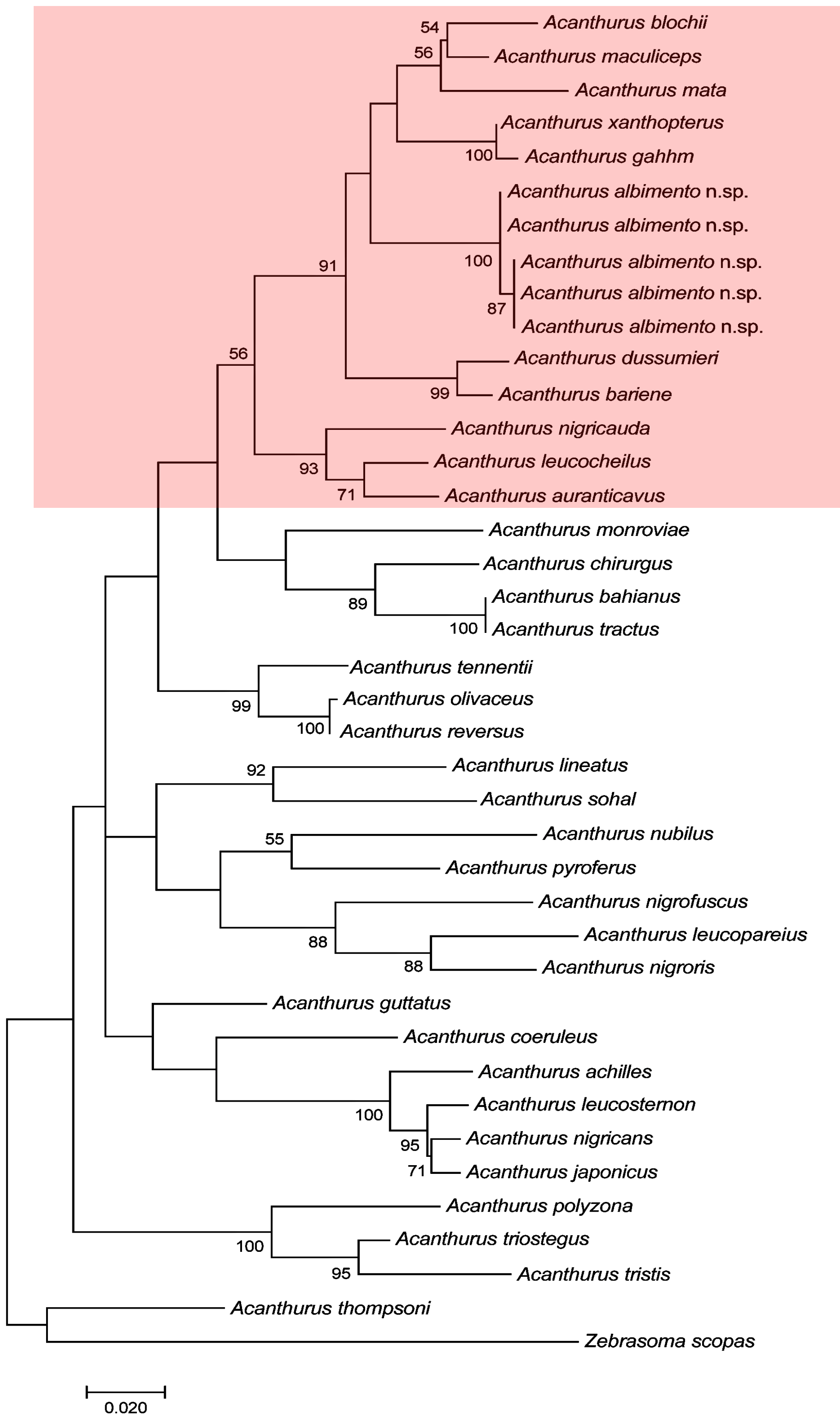

Figure 5. Maximum-likelihood tree containing *Acanthurus albimento* (KSY+G+I model of nucleotide substitution), using available COI sequences of *Acanthurus* on GenBank, with *Zebrasoma scopas* as an outgroup. Bootstrap scores over 50 shown next to nodes and the scale bar refers to substitutions per site. Shaded area represents the 11-species color-based clade.

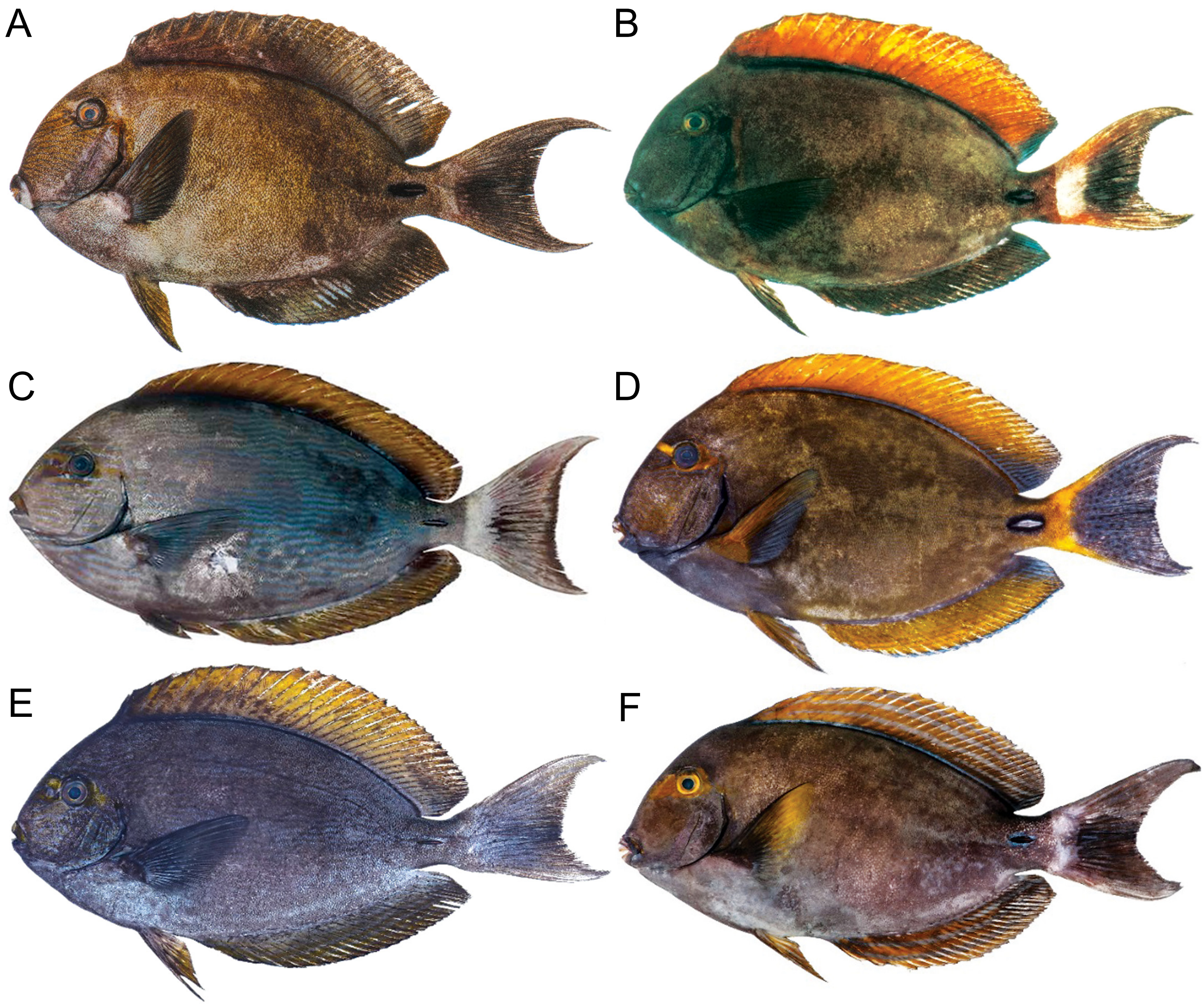

Figure 6. Comparison of group-7-plus *Acanthurus* species: A) *A. albimento*, USNM 438095, 202.8 mm SL (paratype), Philippines; B) *A. bariene*, USNM 431579, Philippines; C) *A. blochii*, USNM 409483, Marquesas Islands; D) *A. dussumieri*, USNM # pending, Loag City Market, Ilocos Norte, Luzon, Philippines; E) *A. mata*, USNM # pending, Subic Bay, Zambales Province, Philippines; and F) *A.xanthopterus*, USNM 403372, Philippines (J.T. Williams).

maculiceps, *A. mata*, *A. nigricauda*, and *A. xanthopterus*. It comprises a set of Indo-Pacific *Acanthurus* species that share a suite of color characteristics, i.e. a generally brown body, a yellow or brown band through or behind the eye, narrow wavy stripes on the sides, and an abruptly whitish base of the caudal fin (Fig. 6).

This color-based, 11-species clade mostly corresponds with Randall's group 7, but with a few notable exceptions. Most notable among these exceptions is *A. mata*, which Randall separated based on its short snout, but it shares both color pattern and genetic affinity with group-7 species. *Acanthurus albipectoralis* is also an exception, sharing the color pattern of the set, but would be assigned to Randall's (1956) short-snouted group. Note that three group-7 species (*A. olivaceus*, *A. reversus*, and *A. tennentii*) are not completely consistent with the suite of color characters and are not part of the 11-species clade enumerated above (Fig. 5). Based on color patterns and Randall's groupings, we predict that future molecular analyses will find that *A. albipectoralis*, *A. fowleri*, and *A. grammoptilus* will be added within the established 11-species clade. Without a complete set of these species in a phylogenetic analysis, it is difficult to predict which are sister species of *A. albimento*. Nevertheless, based on the genetics and the synapomorphy of a pronounced convex forehead in large adults, *A. bariene* and *A. fowleri* are likely candidates.

Zoogeography. The range of a species is typically uncertain when first described from only a few specimens from a localized area. Therefore, the prediction that *A. albimento* will prove to be a remarkable restricted-range species is potentially premature. However, based on what we know of the typical ranges of species of *Acanthurus*, and the fact that the new species is large and distinctive and a member of a genus that has been closely studied, as well as from a region of the world that is fairly well studied, begs an explanation. The genus *Acanthurus* has 39 previously recorded valid species of which 34 are native to the Indo-Pacific region and typically widespread (Randall 2002, 2011). The few exceptions with narrower ranges are two Arabian Peninsula endemics and four species endemic to remote insular areas (Madagascar and Mascarene Islands, Caroline Islands, Hawaiian Islands, and Marquesas Islands plus Tuamotu Archipelago). No *Acanthurus* species are exclusively found in the westernmost part of the Pacific that includes the Coral Triangle (Briggs & Bowen 2012).

The coastal fishes of the Coral Triangle region have been extensively studied (Allen & Erdmann 2012) and, although many small, deepwater, and cryptic species continue to be discovered (e.g. Williams & Carpenter 2015), any new recognition of larger, easily recognizable species tends to be restricted to reevaluating species boundaries among putative populations (e.g. Allen *et al*. 2013). Indonesia, in particular, is very well studied with a rich history of ichthyological discovery, due primarily to the attention of the prolific ichthyologist Pieter Bleeker, who lived in Indonesia from 1842 to 1860 (Carpenter 2007), and described more nominal marine fish species than any other ichthyologist (a total of 1373), with 571 presently valid species (Eschmeyer *et al*. 2010; J.E. Randall has described the most valid species, with presently 929 [J.E. Randall, pers. comm.]). Nearly all of the valid Bleeker species are from Indonesia, which has more species of marine fishes named from it than any other country. Indonesia is also one of the most intensely studied in recent times, with potentially more species of marine fishes than any other country (Allen & Erdmann 2012), although the Philippines has a higher concentration (more species per unit area) than any other region in the world (Carpenter & Springer 2005, Sanciangco 2013).

Extensive ichthyological studies in the Philippines did not take place during the long colonial rule of Spain but instead began in earnest after the American colonial period in the early 1900s with the research vessel *Albatross* expeditions (Smith & Williams 1999). Of the 129 *Albatross* stations sampled in the Philippines from 1908 to 1909, only nine are from the eastern seaboard of the Philippines, and only two of these from eastern Luzon. Northeastern Luzon is very mountainous and the northeastern seaboard in general is prone to typhoon exposure and subsequently is not as accessible and populated as other areas of the Philippines. The fact that *A. albimento* is only recently discovered is likely a function of a lack of visits by ichthyologists to this mountainous region, rather than a chance lack of detection of a wider-spread species in other more extensively studied areas of the Coral Triangle.

Assuming that this large and conspicuous surgeonfish was not detected previously simply by chance, perhaps because it is typically a deepwater species or naturally rare across a much wider range, the questions remaining are: is it in fact restricted to northeastern Luzon, and, if so, why? The first question can be addressed by further sampling, particularly along the eastern seaboard of the Philippines, where market surveys from the current study are scarce (Fig. 1). With only about two-thirds of the species expected to be encountered in markets in the Philippines so far collected (Fig. 3), more extensive sampling in the Philippines is warranted. In addition, ichthyological surveys in the isolated islands to the east of the Philippines may also help determine if this species is more widely distributed along the path of the Pacific North Equatorial Current. If *A. albimento* does prove to be a limited-range endemic then one hypothesis would be that it used to be more widely distributed and its current distribution is a relict one. The alternative is that the species is recently differentiated; a more complete phylogenetic analysis that includes all its potential sister species may help resolve this question. If recently speciated, perhaps its lack of distribution farther north along the path of the Kuroshio Current is a function of time to disperse or lack of tolerance to, and time to adapt to, colder water temperatures. One factor that may limit dispersal farther north, and may have played a role in lineage diversification, is the presence of the Lamon Bay cyclonic eddy dipole (Fig. 1; Gordon *et al*. 2014). This eddy may entrain larvae and prevent easy dispersal north along the Kuroshio Current beyond northeastern Luzon. Phylogeographic studies targeting this region may help determine the potential strength of this factor in lineage diversification in the Philippines. Certainly, the discovery of this large and easily recognizable species suggests that further marine zoological studies are warranted along the eastern seaboard of the Philippines in general and northeastern Luzon in particular.

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