

## Two new *Zingiber* species (Zingiberaceae) from Sorsogon, Philippines

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**ABSTRACT.** Two new species of gingers (Zingiberaceae), *Zingiber aguingayae* Docot and *Z. subroseum* Docot, are described and illustrated here based on recent collections from Mount Bulusan, Sorsogon, Philippines. Our rediscovery of the poorly known *Zingiber bulusanense* Elmer at the same locality not only allowed us to clarify its identity but also gave us stronger assurance that the two new species are indeed undescribed. Evidence from morphological and molecular data using the ITS region supported the placement of both new species and *Zingiber bulusanense* within *Zingiber* sect. *Zingiber*. The conservation status of the two new species were also assessed.

**Keywords.** Critically Endangered, ITS, *Zingiber matutumense*, *Zingiber zerumbet*

### Introduction

*Zingiber* Mill. currently comprises c. 180 species distributed from India to Malesia and to the western Pacific islands (Theerakulpisut et al., 2012; Ardiyani et al., 2017; Zingiberaceae Resource Centre, 2019). The genus is recognised by the more or less sessile anther with an elongated crest which embraces the upper portion of the style (Smith, 1988). In the vegetative state, *Zingiber* can be readily distinguished by the swollen area between the base of the lamina and ligule called a pulvinus (Leong-Škorničková & Newman, 2015). *Zingiber* is currently divided into four sections, *Zingiber* sect. *Cryptanthium* Horan., sect. *Dymczewiczia* (Horan.) Benth., sect. *Pleuranthesis* Benth., and sect. *Zingiber* (Baker, 1894; Schumann, 1904; Theerakulpisut et al., 2012). The sections are supported by morphological and molecular data (e.g. Theerakulpisut et al., 2012), and even with palynological data (e.g. Theilade et al., 1993), except for *Zingiber* sect. *Dymczewiczia* which Theilade et al. (1993) suggested should be included in *Zingiber* sect. *Zingiber* due to the variability of the position of the inflorescence, similarity in pollen morphology, and evidence based on ITS sequence data (Ye et al., 2015; Ardiyani et al., 2017).

*Zingiber* is currently known in the Philippines from 13 species of which nine are endemic and four are widespread and cultivated (see table 1 for the list of species and history of the presence of each *Zingiber* of the Philippines). Blanco (1837) recorded and illustrated the widespread and economically important *Zingiber officinale* Roscoe as *Amomum zingiber* L. in his *Flora de Filipinas*. In 1886, Brown described a species, *Zingiber brevifolium* N.E.Br. (non *Z. brevifolium* K.Schum., 1899), based on cultivated material said to have originated from the Philippines. In 1905, Ridley reported the occurrence of *Zingiber cassumunar* Roxb. (= *Z. montanum* (J.Koenig) Link ex A.Dietr.) in the Philippines, based on the specimen *A.D.E. Elmer* 6255, but in 1919 Elmer identified this specimen as *Adelmeria alba* Elmer (= *Adelmeria oblonga* Merr.). Ridley (1909) published two species, *Zingiber molle* Ridl. and *Z. pubisquamum* Ridl., and reported the occurrence of the widespread and cultivated *Z. zerumbet* (L.) Roscoe ex Sm. in the Philippines. In 1915, Elmer published *Zingiber sylvaticum* Elmer, based on the specimen *A.D.E. Elmer* 9843, which is also one of the syntypes of *Z. molle* (Newman et al., 2004). Elmer (1915) argued that the spikes of *A.D.E. Elmer* 9843 are radical (borne terminal on a separate leafless shoot) and not terminal as indicated in the protologue of *Z. molle*. Also in 1915, Elmer described two species named after their respective type localities, namely *Zingiber apoense* Elmer and *Z. negrosense* Elmer. Later, Elmer (1919) described a species, *Zingiber bulusanense* Elmer, and a variety, *Z. zerumbet* var. *magnum* Elmer, both from Mount Bulusan, Sorsogon. The latter variety was synonymised by Merrill (1923) under *Z. zerumbet* since it was only differentiated by its much larger vegetative size. In the same paper, Merrill listed again the occurrence of *Zingiber montanum* (as *Z. cassumunar*) in the Philippines but noted that he has not seen any material from the Philippines despite mentioning a specimen, *H. Cuming* 1605, from Misamis, Mindanao (Pelser et al., 2011 onwards). Steiner (1959), having examined the material at PNH, listed *Zingiber montanum* (as *Z. cassumunar*) in her list of the Zingiberaceae of Manila, concluding that the species is native to the Philippines, although she mentioned that *Z. montanum* is cultivated around the country. Mood & Theilade (2001) described two species named after their respective type localities, *Zingiber banahaoense* Mood & Theilade and *Z. matutumense* Mood & Theilade. *Zingiber spectabile* Griff., an introduced species from Peninsular Malaysia, is now establishing self-sustaining populations in some parts of the Philippines (e.g. Cuernos de Negros Mountains, Negros Oriental) and thus, becoming a naturalised species.

Specimens of at least seven *Zingiber* taxa were collected during recent botanical explorations of Mount Bulusan in 2018–2019. After careful examination and comparison of these specimens to known *Zingiber* taxa, especially those enumerated by Elmer (1919), the material was identified as *Zingiber officinale*, *Z. spectabile*, and *Z. zerumbet*, all of which are widespread and cultivated in the Philippines, and as *Z. sylvaticum* and *Z. bulusanense*, which are more restricted in distribution. The morphology of two more specimens, however, did not fit any known *Zingiber* taxa occurring elsewhere. Thus, we conclude that these specimens are of undescribed species which are described and illustrated here. Their conservation statuses are also assessed. The sectional placements of the two new species, along with *Zingiber bulusanense*, were also determined using morphological data and through the phylogenetic analysis of ITS sequence data.

**Table 1.** The 15 *Zingiber* species currently known in the Philippines, their distribution status and their records of occurrence in the Philippines. An asterisk (\*) indicates that the species has been recorded from Mount Bulusan, Sorsogon.

Species	Distribution	First recorded in the Philippines
<i>Zingiber aguingayae</i> Docot *	Endemic	here
<i>Zingiber apoense</i> Elmer	Endemic	Elmer (1915)
<i>Zingiber banahaoense</i> Mood & Theilade	Endemic	Mood & Theilade (2001)
<i>Zingiber brevifolium</i> N.E.Br	Endemic	Brown (1886)
<i>Zingiber bulusanense</i> Elmer *	Endemic	Elmer (1919)
<i>Zingiber matutumense</i> Mood & Theilade	Endemic	Mood & Theilade (2001)
<i>Zingiber molle</i> Ridl.	Endemic	Ridley (1909)
<i>Zingiber montanum</i> (J.Koenig) Link ex A.Dietr.	Widespread and cultivated	Merrill (1923)
<i>Zingiber negrosense</i> Elmer	Endemic	Elmer (1915)
<i>Zingiber officinale</i> Roscoe*	Widespread and cultivated	Blanco (1837)
<i>Zingiber pubisquamum</i> Ridl.	Endemic	Ridley (1909)
<i>Zingiber spectabile</i> Griff.*	Widespread and cultivated	here
<i>Zingiber subroseum</i> Docot*	Endemic	here
<i>Zingiber sylvaticum</i> Elmer*	Endemic	Elmer (1915)
<i>Zingiber zerumbet</i> (L.) Sm.*	Widespread and cultivated	Ridley (1909)

## Materials and methods

Herbarium collections, including types and high resolution images of specimens, from BM, BO, E, F, FI, FEUH, G, GH, K, L, MO, NY, P, PNH, S, SING, U, US, USTH, and Z, along with published morphological descriptions of the most similar species, and species occurring elsewhere, were examined and compared to our recently collected specimens. The herbarium acronyms follow Thiers (continuously updated). The extent of occurrence (EOO) and area of occupancy (AOO) were calculated using the Geospatial Conservation Assessment Tool (GeoCAT) (Bachman et al., 2011: [www.geocat.kew.org](http://www.geocat.kew.org)). These data were then compiled to assess their conservation statuses

using the International Union for Conservation of Nature (IUCN) criteria (IUCN, 2016).

Total genomic DNA was extracted from each species using DNeasy Plant Mini Kit (Qiagen®, Germany) following the manufacturer's protocol. Amplification of the ITS region followed Docot et al. (2019). The leaf material sequenced was from recently collected specimens (*Zingiber aguingayae*: R.V.A. Docot et al. 0216, PNH, accession no. 256992; *Z. bulusanense*: R.V.A. Docot et al. 0213, FEUH, barcode 002950; *Z. subroseum*: R.V.A. Docot et al. 0204, PNH, accession no. 256991). PCR products were sent to Macrogen® (Seoul, Korea) for purification and sequencing services. The new sequences were assembled and edited in Codon Code Aligner v. 4.1.1 (Codon Code, 2013) and were aligned using Mesquite v. 3.04 (Maddison & Maddison, 2016) to the sequence data used by Ardiyani et al. (2017) (see table 2 for the complete accession details of the sequences used in this study). Maximum likelihood (ML) analysis of the ITS region was carried out using RaxML-HPC2 v. 8.2.10 (Stamakis, 2014) on CIPRES portal (Miller et al., 2010). Bootstrap support (BS) values were obtained by running 1000 replicates and were categorised according to Kress et al. (2002) standard cut-off values.

## Results and discussion

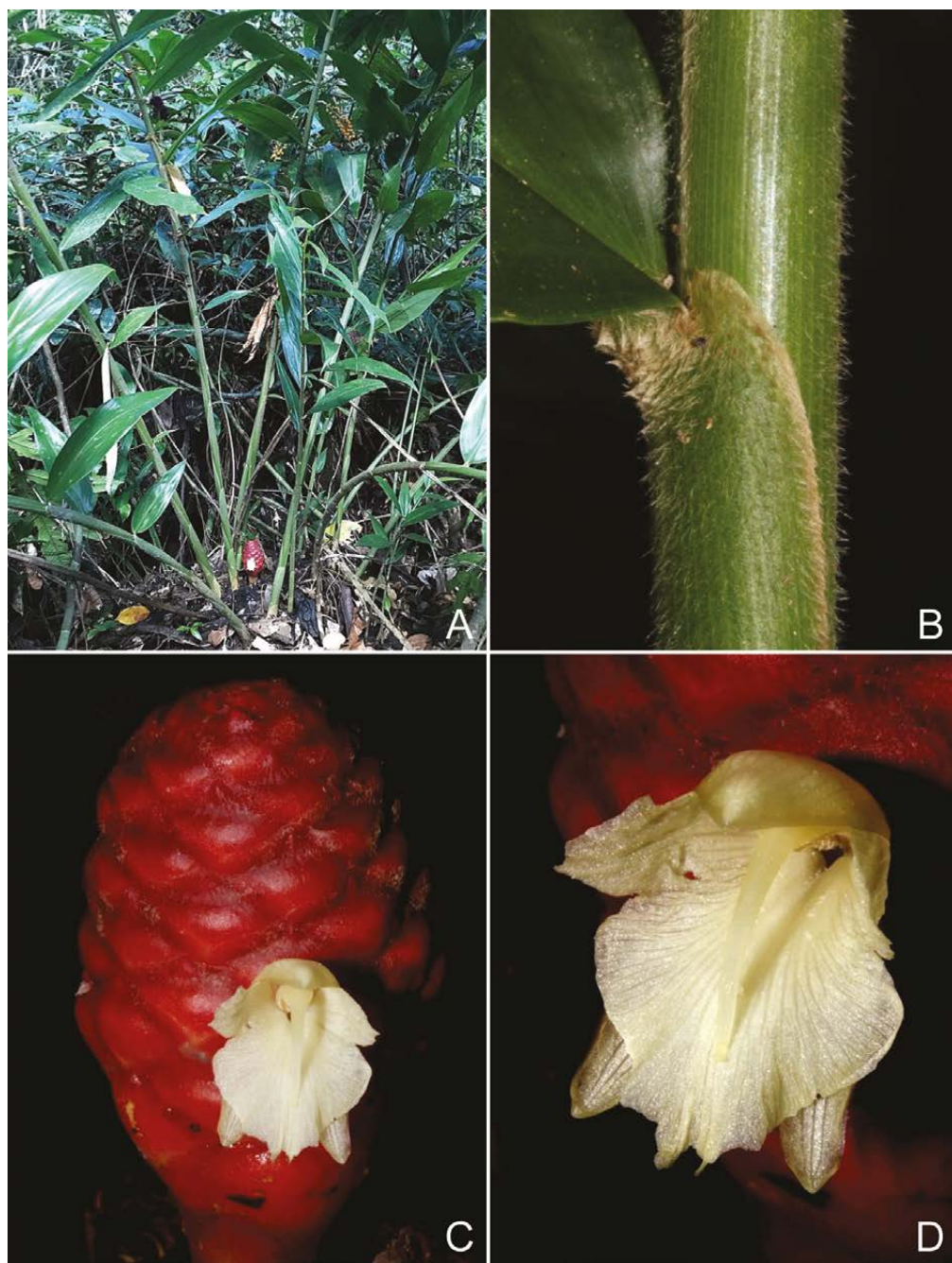
We first compared the new material to the poorly known *Zingiber bulusanense* (Fig. 1), also from Mount Bulusan. The specimen R.V.A. Docot et al. 0213 (FEUH), also collected on Mount Bulusan, perfectly matched the protologue and the syntypes of *Zingiber bulusanense* in the dirty-brown hairs on the sheaths, ovoidly-ellipsoid spike, and the reddish exposed portion of the bract. Elmer (1919) described the basal part of the labellum of *Zingiber bulusanense* as densely veiny and spotted, and the lamina part as hyaline and spotted. Examination of R.V.A. Docot et al. 0213 flowers preserved in alcohol led us to conclude that Elmer was referring to the microscopic spots and veins of the labellum. In fact, even the margin of the bracts, bracteoles and corolla lobes, as well as the stamen, possess these spots which are visible only under the microscope.

Elmer (1919) emphasised that *Zingiber bulusanense* could be distinguished from all known Philippine *Zingiber* species at that time by the brown hairs on the sheaths (Fig. 1B). The two new species described here, however, have white hairs and are not as densely pubescent as *Zingiber bulusanense*. *Zingiber bulusanense* and one of the unknown species have ovoidly-ellipsoid spikes (Fig. 1C) but the colour of the spike of the latter is cream-pink and not red as in *Zingiber bulusanense*. Both *Zingiber bulusanense* and the other unknown species have red spikes but the shape of the spike of the latter is narrowly ovoid (oblong) and not ovoidly-ellipsoid as in *Z. bulusanense*. This unknown species can also easily be distinguished by its yellow flowers rather than the white flowers of *Zingiber bulusanense*.

The topology of the Maximum Likelihood tree produced in this study is congruent with Theerakulpisut et al. (2012) and with Ardiyani et al. (2017). *Zingiber bulusanense* and the two unknown species formed a moderately supported clade (BS

**Table 2.** Voucher information and GenBank accession numbers of the sequences used in this study. GenBank accession numbers in bold text are newly generated sequences.

Species	Distribution/Section	GeneBank Acc. No. (ITS)
<b>Ingroups</b>		
<i>Z. aguingayae</i> Docot	Philippines/ <i>Zingiber</i>	<b>MK811015</b>
<i>Z. barbatum</i> Wall.	Thailand/ <i>Zingiber</i>	DQ064578
<i>Z. bradleyanum</i> Craib	Thailand/ <i>Cryptanthium</i>	DQ064579
<i>Z. bulusanense</i> Elmer	Philippines/ <i>Zingiber</i>	<b>MK811016</b>
<i>Z. capitatum</i> Roxb. (1)	India, Himalaya/ <i>Zingiber</i>	KM983536
<i>Z. capitatum</i> (2)	India, Himalaya/ <i>Zingiber</i>	KM983532
<i>Z. citriodorum</i> Theilade & Mood	Thailand/ <i>Zingiber</i>	DQ064591
<i>Z. coloratum</i> N.E.Br.	Borneo/ <i>Zingiber</i>	AF414498
<i>Z. corallinum</i> Hance	Thailand, China/ <i>Zingiber</i>	DQ064587
<i>Z. ellipticum</i> (S.Q.Tong & Y.M.Xia) Q.G.Wu & T.L.Wu	Yunnan–China/ <i>Pleuranthesis</i>	AF478799
<i>Z. fragile</i> S.Q.Tong	Thailand/ <i>Cryptanthium</i>	DQ064581
<i>Z. gramineum</i> Noronha ex Blume (1)	Indochina, Java, Sumatra/ <i>Zingiber</i>	AF478800
<i>Z. gramineum</i> (2)	Indochina, Java, Sumatra/ <i>Zingiber</i>	DQ064577
<i>Z. isanense</i> Triboun & K.Larsen	Thailand/ <i>Zingiber</i>	DQ064586
<i>Z. junceum</i> Gagnep.	Thailand/ <i>Zingiber</i>	AY424774
<i>Z. longipedunculatum</i> Ridl.	Borneo/ <i>Zingiber</i>	AB097254
<i>Z. montanum</i> (J.Koenig) Link ex A.Dietr. (1)	Cultivated/ <i>Zingiber</i>	DQ064585
<i>Z. montanum</i> (2)	Cultivated/ <i>Zingiber</i>	KJ872221
<i>Z. neesamum</i> (J.Graham) Ramamoorthy	India, Indochina/ <i>Zingiber</i>	KJ872228
<i>Z. newmanii</i> Theilade & Mood	Thailand/ <i>Zingiber</i>	DQ064589
<i>Z. odoriferum</i> Blume (1)	Cultivated/ <i>Zingiber</i>	KF304561
<i>Z. odoriferum</i> (2)	Cultivated/ <i>Zingiber</i>	DQ064575
<i>Z. officinale</i> Roscoe	Cultivated/ <i>Zingiber</i>	KF304562
<i>Z. orbiculatum</i> S.Q.Tong	Thailand/ <i>Cryptanthium</i>	DQ064573
<i>Z. ottensii</i> Valetton (1)	Cultivated/ <i>Zingiber</i>	AJ388298
<i>Z. ottensii</i> (2)	Cultivated/ <i>Zingiber</i>	DQ064582
<i>Z. parishii</i> Hook.f. (1)	Thailand/ <i>Zingiber</i>	DQ064576
<i>Z. parishii</i> (2)	Thailand/ <i>Zingiber</i>	KF304567
<i>Z. pellitum</i> Gagnep.	Thailand/ <i>Dymczewiczia</i>	DQ064574
<i>Z. purpureum</i> Roscoe (syn. of <i>Z. montanum</i> )	Cultivated/ <i>Zingiber</i>	HM236153
<i>Z. rubens</i> Roxb.	Thailand/ <i>Cryptanthium</i>	DQ064580
<i>Z. spectabile</i> Griff.	Sumatra, Malay Peninsula/ <i>Zingiber</i>	AF414499
<i>Z. subroseum</i> Docot	Philippines/ <i>Zingiber</i>	<b>MK811017</b>
<i>Z. sulphureum</i> Burkill ex Theilade	Sumatra, Malay Peninsula/ <i>Zingiber</i>	AF478801
<i>Z. ultralimitale</i> Ardiyani & A.D.Poulsen	Sulawesi/ <i>Zingiber</i>	KU891639
<i>Z. wrayi</i> Prain ex Ridl.	Sumatra, Malay Peninsula, Thailand/ <i>Zingiber</i>	AF478802
<i>Z. zerumbet</i> (L.) Roscoe ex Sm. (1)	Cultivated/ <i>Zingiber</i>	KC582863
<i>Z. zerumbet</i> (2)	Cultivated/ <i>Zingiber</i>	DQ064584
<b>Outgroups</b>		
<i>Kaempferia elegans</i> (Wall.) Baker	China, Indochina, Malesia	AY424764
<i>K. parviflora</i> Wall. ex Baker	India, Indochina	DQ064592



**Fig. 1.** *Zingiber bulusanense* Elmer. **A.** Habit. **B.** Ligule (notice the sheaths with brown hairs). **C.** Inflorescence. **D.** Flower at anthesis. Based on *R.V.A. Docot et al. 0213* (FEUH) from Mount Bulusan, Sorsogon. (Photos: R.V.A. Docot).

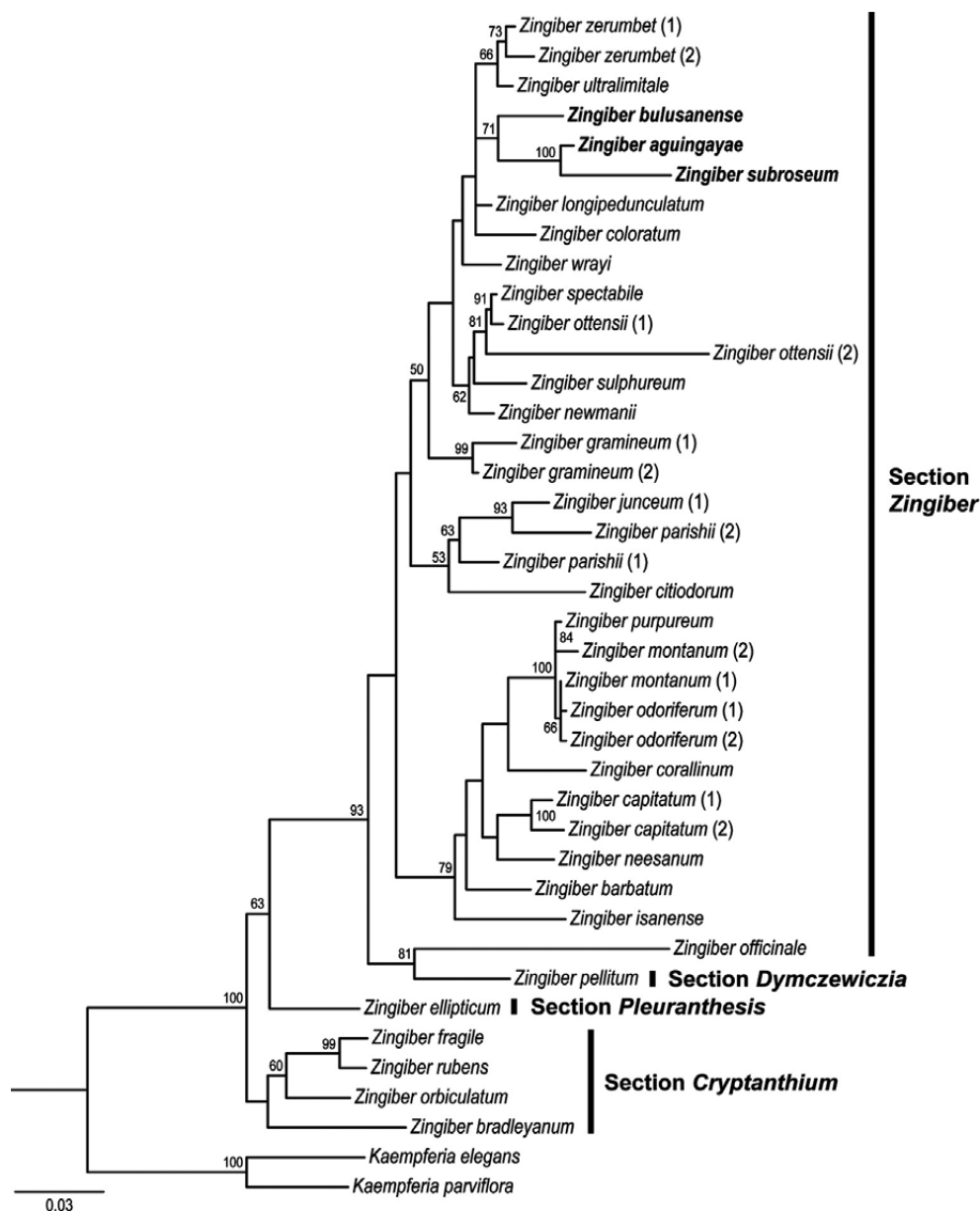
= 71%) within *Zingiber* sect. *Zingiber* (Fig. 2). Moreover, the morphology of the three species also fits the circumscription of *Zingiber* sect. *Zingiber* (e.g. inflorescences borne on radical and erect peduncles; tightly imbricate floral bracts). With this morphological and molecular evidence, we place *Zingiber bulusanense* and the two unknown species within *Zingiber* sect. *Zingiber* and describe the two unknown species as new.

## Taxonomy

### *Zingiber aguingayae* Docot, **sp. nov.**

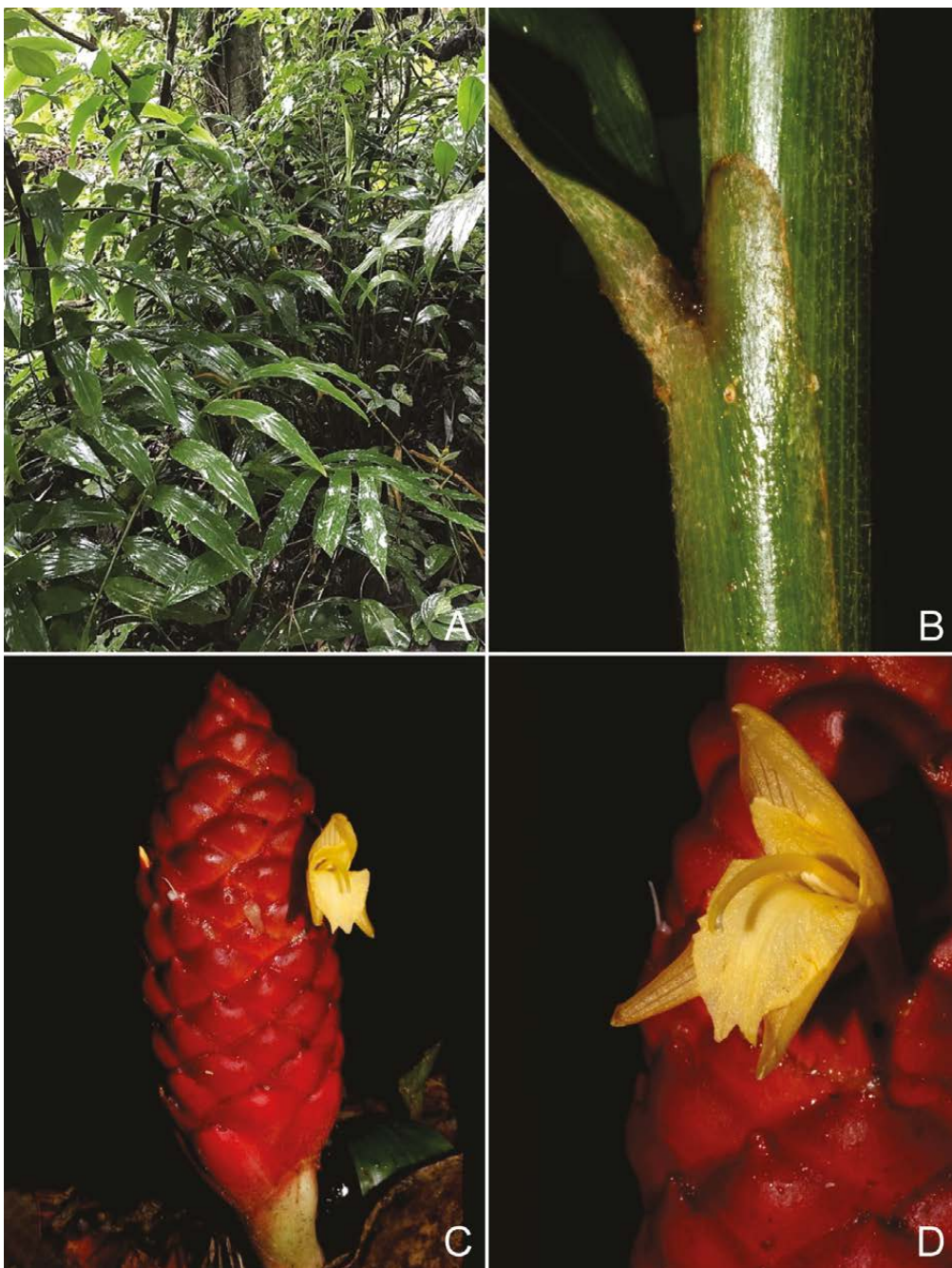
Similar to *Zingiber matutumense* Mood & Theilade but differs in the much longer (2–3 vs 5–6 mm long) and pubescent ligule (vs glabrous); yellow corolla (vs light pink); obovate and yellow labellum (vs light pink and orbicular); and slightly pubescent ovary (vs glabrous) – TYPE: Philippines, Luzon, Sorsogon, Bulusan, Barangay San Roque, Mount Bulusan, 12°45'36.1"N, 124°05'32.1"E, 433 m, 28 October 2018, *R.V.A. Docot et al. 0216* (holotype PNH [accession no. 256992]; isotypes FEUH incl. spirit, L, USTH) (Fig. 3 & 4).

Terrestrial herb. **Rhizome** 1.6–2.2 cm wide, brown externally, yellowish internally. **Leafy shoots** in dense clumps of 4–10 pseudostems, 1–2 m tall, arching to various degrees, base c. 1 cm wide; **sheaths** mid-green, pubescent; **ligule** bilobed, ovate, the lobes equal in size, 9–11 × 5–6 mm, mid-green, pubescent, semi-membranous, apex rounded; **petiole** 5–7 mm long, densely pubescent; **lamina** narrowly ovate, 28–33 × 6–7 cm, plicate, mid-green and glabrous on both sides, light green beneath, base attenuate, apex sharply attenuate, margin entire. **Inflorescences** 2–4 per clump, arising close to the base of the leafy shoot, erect, 28–35 cm long, 1–2 flowers opening at a time; **peduncle** 20–25 cm long, almost half its length partially subterranean; peduncular bracts narrowly ovate, 4–5 × 1.7–2 cm, reddish brown, pubescent, apex rounded; **spike** narrowly ovoid (oblong), 9–13 × 4–5 cm, tapering to an acute apex; **floral bracts** obovate, 3.6–4 × 3.8–4.3 cm, becoming smaller toward the base, the exposed part red, the remaining white, sparsely villose, apex rounded, the tip mucronate, margin entire with spots; **bracteoles** split to the base, wrapped around the flower (appearing tubular), narrowly obovate, 3.8–4 × 1.5–2 cm, white, sparsely villose, apex acute, reddish, margin with spots; **flower** sessile, 5.5–6.3 cm long; **calyx** 18–22 × 9–12 mm, translucent white, with spots in the upper half, sparsely villose, with three inconspicuous teeth at the apex, with a 9–11 mm unilateral incision; **corolla tube** 3–3.5 cm long, whitish yellow, glabrous throughout except the slightly pubescent base; **corolla lobes** yellow, with spots along the margin, glabrous, apex obtuse and cucullate; **dorsal corolla lobe** narrowly ovate, 22–27 × 9–12 mm; **lateral corolla lobes** narrowly linear, 23–25 × 4–6 mm; **labellum** petaloid, 1.8–2.4 × 1.5–2 cm, yellow, central part with spots (under the microscope), apex bifid, incision 3–4 mm; **lateral staminodes** petaloid, obovate, 13–15 × 5–8 mm, apex obtuse to acute. **Stamen** 2.5–3 cm long, filament fully reduced; **anther** 13–16 × 4–6 mm, yellow, with spots beneath, pubescent; **crest** 1.2–1.5 cm long (when stretched), enveloping the upper portion of the style, incurved, yellow, with

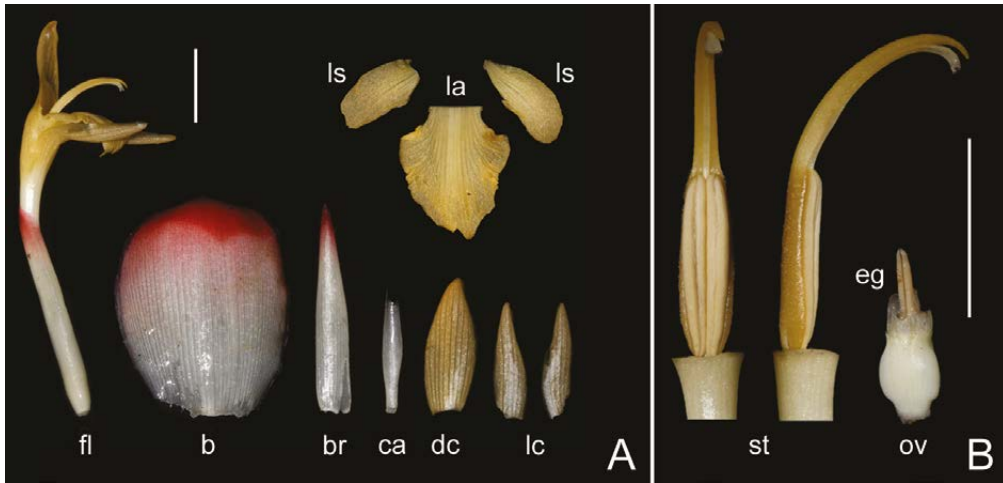


**Fig. 2.** Maximum Likelihood phylogenetic tree of *Zingiber* using ITS sequence data. The four sections of *Zingiber* are indicated. Bootstrap values obtained are presented above the branches. Only bootstrap values higher than 50% are shown. Taxa included in this study for the first time are marked in bold, while additional material downloaded from GenBank is in normal font.





**Fig. 3.** *Zingiber aguingayae* Docot. **A.** Habit. **B.** Ligule. **C.** Inflorescence. **D.** Flower at anthesis. Based on *R.V.A. Docot 0216 et al.* (type) from Mount Bulusan, Sorsogon. (Photos: R.V.A. Docot).



**Fig. 4.** *Zingiber aguingayae* Docot. **A.** Floral dissection (**b.** bract, **br.** bracteoles, **ca.** calyx, **dc.** dorsal corolla lobe, **fl.** flower, **la.** labellum, **lc.** lateral corolla lobes, **ls.** lateral staminodes). **B.** Details of anther and ovary with epigynous glands (**eg.** epigynous glands, **ov.** ovary, **st.** stamen). Based on *R.V.A. Docot 0216 et al.* (type) from Mount Bulusan, Sorsogon. Scale bars = 1 cm. (Photos: R.V.A. Docot).

spots; *theca* opening throughout its length, light yellow, glabrous. **Style** 5–6.5 cm long, whitish yellow, with spots, glabrous; *stigma* c. 1 mm wide, whitish yellow, with spots, ostiole with straight ciliae; *epigynous glands* subulate, 4–5 mm long, yellow; *ovary* subglobose, 7–9 × 4–6 mm, trilocular, axile placentation, white, slightly pubescent. **Fruit** not seen.

**Distribution and habitat.** *Zingiber aguingayae* is only known from the type locality where it inhabits semi-shaded areas of secondary forest at 300–600 m asl.

**Phenology.** Only a few flowering individuals were observed in late October. Some inflorescences were already dried and rotten leading to the conclusion that mass flowering may have occurred early to mid-September.

**Etymology.** The specific epithet is named after *Aguingay*, the legendary mistress of the warrior *Bulusan*, characters from the popular Bulusan-Sorsoganon-Bicol folklore titled ‘Si Bulusan nan si Aguingay’, set in the locality where the species was discovered.

**Provisional IUCN conservation assessment.** Based on the IUCN red list categories and criteria (IUCN, 2016), *Zingiber aguingayae* is categorised as Critically Endangered CR B2ab(iii). The area of occupancy is estimated to be less than 10 km<sup>2</sup> (total area of occupancy is c. 4 km<sup>2</sup>) and it is only known from the one location on Mount Bulusan. Only three subpopulations were observed 200–300 m apart. Fortunately, *Zingiber aguingayae* is within the Bulusan Volcano Natural Park, a 3673-hectare protected

area in the Philippines. Surveys were also conducted to try and find populations on neighbouring mountains (e.g. Pocdol Mountains between the provinces of Albay and Sorsogon) although none was found. A possible threat is the continuous volcanic activity of Mount Bulusan which could wipe out the entire population of the species since it is the 4<sup>th</sup> most active volcano in the Philippines (de la Cruz, 2015). Another threat could be due to anthropogenic activities (e.g. widening of trails) since Mount Bulusan is also one of the most popular mountains in the Philippines for hiking.

*Notes.* The most similar species based on overall morphology is *Zingiber matutumense* of South Cotabato, Mindanao. Although the leafy shoots of both *Zingiber aguingayae* and *Z. matutumense* can reach 1–2 m tall, *Z. aguingayae* can be readily distinguished in its vegetative state by the much longer (5–6 vs 2–3 mm long) and pubescent ligule (vs glabrous in *Z. matutumense*). In floral morphology, both *Zingiber aguingayae* and *Z. matutumense* have narrowly ovoid red spikes. In *Zingiber aguingayae*, the spike is narrowly ovate throughout its reproductive phase. In *Zingiber matutumense*, however, the spike is initially ovoid and then turns narrowly ovoid upon maturity (Mood & Theilade, 2001). The most observable difference between the two species is the colour of the corolla and labellum which is yellow in *Zingiber aguingayae* and light pink in *Z. matutumense*. The shape of the labellum of *Zingiber aguingayae* is obovate (Fig. 4) and in *Z. matutumense* it is orbicular.

Interestingly, a series of photographs uploaded on the website of Co's Digital Flora of the Philippines ([http://www.phytoimages.siu.edu/imgs/pelserpb/r/Zingiberaceae\\_Zingiber\\_matutumense\\_55560.html](http://www.phytoimages.siu.edu/imgs/pelserpb/r/Zingiberaceae_Zingiber_matutumense_55560.html)) from the province of Oriental Mindoro (initially identified as *Zingiber matutumense*) may be actually of *Z. aguingayae* due to its narrowly ovoid spike and yellow flowers. The apex of the labellum based from the photographs, however, is entire (vs bifid in *Z. aguingayae*). If it proves to be identical or within the morphological variation of *Zingiber aguingayae* it will extend its distribution to Oriental Mindoro.

***Zingiber subroseum* Docot, sp. nov.**

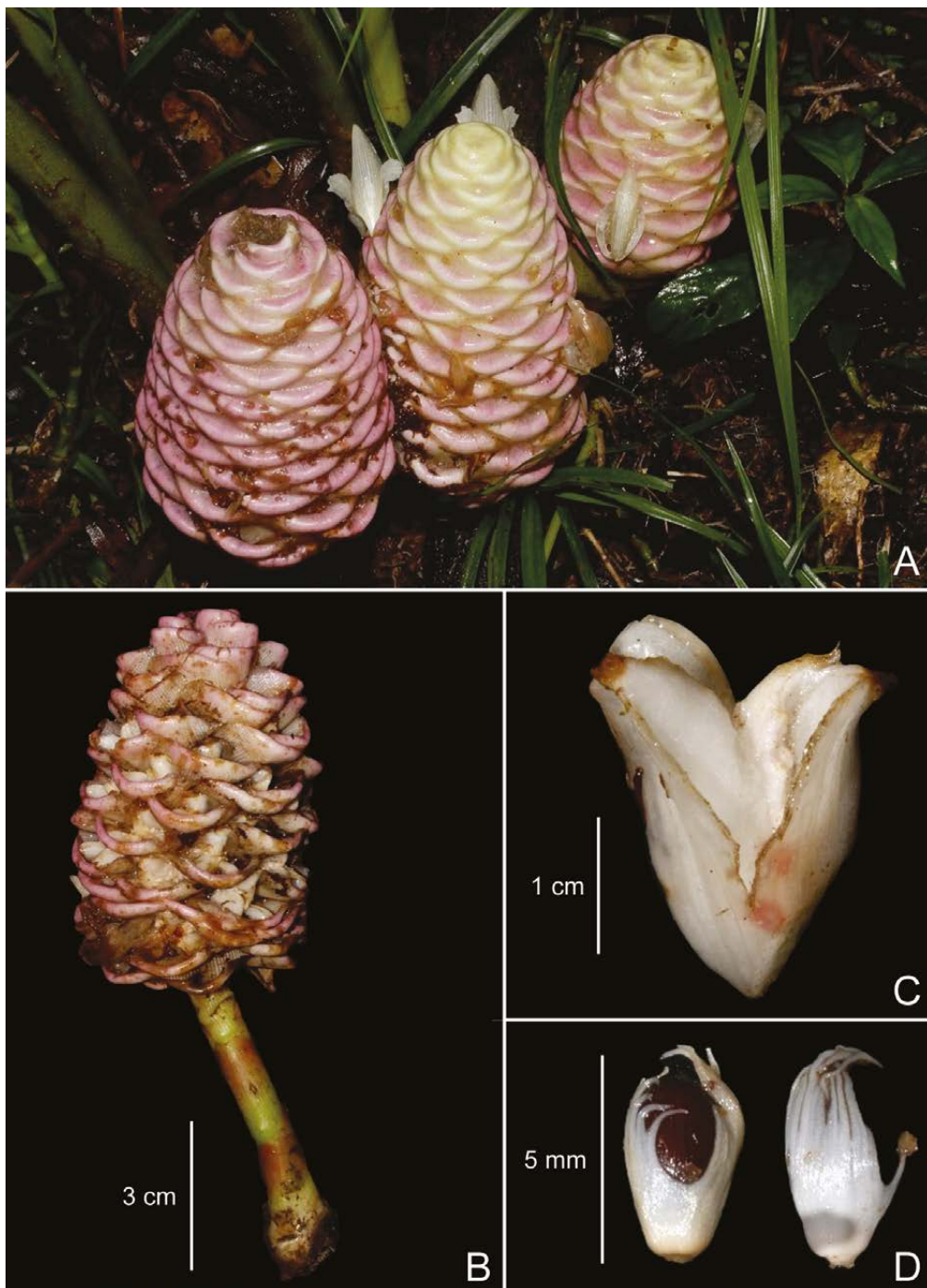
Similar to *Zingiber zerumbet* (L.) Roscoe ex Sm. but distinct in the petiolate lamina (vs sessile); significantly shorter peduncle (9–11 vs 10–30 cm long) and wider spike (8–10 vs 4–6 cm wide); cream-pink floral bract (vs mid green); and cream-pink fruiting spike (vs bright red). – TYPE: Philippines, Luzon, Sorsogon, Casiguran, Barangay Inalgadian, Mount Bulusan, 12°46'49.3"N, 124°03'42.9"E, 993 m, 25 October 2018, R.V.A. Docot et al. 0204 (holotype PNH [accession no. 256991]; isotypes FEUH incl. spirit, L, USTH) (Fig. 5–7).

Terrestrial herb. **Rhizome** 1.5–2 cm wide, fleshy, brown externally, yellowish internally. **Leafy shoots** in a loose clump of 2–5 pseudostems, 1–3 m tall, arching to various degrees, base c. 9 mm wide; **sheaths** mid-green, pubescent, the margin brownish; **ligule** bilobed, ovate, pubescent, semi-membranous, apex rounded, the larger lobe 6–10 × 5–7 mm, reddish brown, the smaller lobe 4–7 × 3–5 mm, light

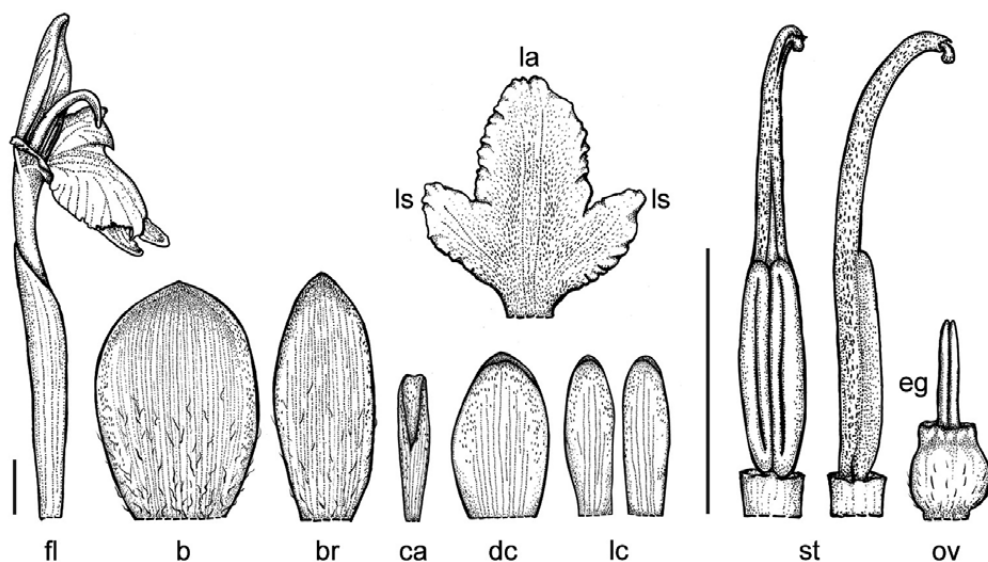




**Fig. 5.** *Zingiber subroseum* Docot. **A.** Habit. **B.** Ligule. **C.** Inflorescence. **D.** Flower at anthesis. Based on *R.V.A. Docot 0204 et al.* (type; A–D) from Mount Bulusan, Sorsogon. (Photos: R.V.A. Docot).



**Fig. 6.** *Zingiber subroseum* Docot. **A.** Inflorescences. **B.** Infructescence. **C.** Fruit. **D.** Seeds. Based on *R.V.A. Docot 0204 et al.* (type; A) and *R.V.A. Docot 0230 et al.* (B–D) from Mount Bulusan, Sorsogon. (Photos: R.V.A. Docot).



**Fig. 7.** *Zingiber subroseum* Docot floral dissection. (**b.** bract, **br.** bracteoles, **ca.** calyx, **dc.** dorsal corolla lobe, **eg.** epigynous glands, **fl.** flower, **la.** labellum, **lc.** lateral corolla lobes, **ls.** lateral staminodes, **ov.** ovary, **st.** stamen). Scale bars = 1 cm. Drawn by K.D. Gutierrez from spirit material of *R.V.A. Docot 0204 et al.* (type) from Mount Bulusan, Sorsogon. **B.** Details of anther and ovary with epigynous glands (**eg.**)

green; *petiole* 4–7 mm long, channelled above, pubescent; *lamina* narrowly ovate, 25–30 × 5–7 cm, plicate, mid-green and glabrous above, light green and slightly pubescent beneath, base rounded when fresh, becoming attenuate when dried, apex sharply acuminate, margin entire, pubescent. **Inflorescences** 1–3 per clump, arising close to the base of the leafy shoot, erect, 24–31 cm long, 1–2 flowers opening at a time; *peduncle* 9–11 cm long; peduncular bracts 5–6 × 1–2 cm, reddish green, pubescent outside, glabrous inside; *spike* ovoidly-ellipsoid, 15–20 × 8–10 cm; *floral bracts* obovate, becoming smaller towards the base, the exposed part cream-pink, turning dark pink upon maturity, the remaining white, sparsely villose, apex obtuse to acute, margin entire and pubescent, with spots; *bracteoles* open to the base, wrapped around the flower (appearing tubular), 3.5–4 × 1.5–2 cm, translucent white, sparsely villose, apex 3-dentate, with spots, pubescent; *flower* 6–7 cm long; *calyx* tubular half of its length from the base, 2–2.5 × 1–1.5 cm when flattened, white, slightly villose, with three inconspicuous teeth at the apex which are tufted with a few hairs, with a 8–10 mm long unilateral incision; *corolla tube* c. 45 mm long, white, with very few hairs in the upper portion, glabrous inside; *corolla lobes* white with translucent veins, with spots along the margin, glabrous, apex obtuse and cucullate; *dorsal corolla lobe* ovate, 2.5–3 × 1.5–1.8 cm; *lateral corolla lobes* narrowly ovate, 25–30 × 4–7 mm; *labellum* ovate, petaloid, 2.6–3.2 × 1.5–2 cm, recurved at anthesis, whitish yellow, glabrous throughout, apex bifid, incision c. 4 mm long; *lateral staminodes* petaloid,

5–8 × 10–17 mm, white. **Stamen** 1.7–2 cm long, filament fully reduced; *anther* 7–9 × 2–2.4 mm; *crest* 1–1.4 cm long (when stretched), enveloping the upper portion of the style, incurved, yellowish white; *theca* opening throughout its length, whitish yellow, glabrous throughout. **Style** 5–7 cm long, white, glabrous; *stigma* c. 1.5 mm wide, white, with spots, ostiole with straight ciliae; *epigynous glands* subulate, 2–3 mm long, yellow; *ovary* subglobose, 5–7 × 3–4 mm, trilocular, axile placentation, white, slightly pubescent. **Fruit** obovoid, dehiscing into three parts, 25–32 × 9–13 mm, white, glabrous; *seed* obovoid, partially covered with sac-like white aril, 5–7 × 3–4 mm, dark brown.

*Distribution and habitat.* *Zingiber subroseum* is only known from the type locality where it inhabits densely shaded primary forest at 700–1000 m asl.

*Phenology.* Flowering individuals were observed in late October while fruiting individuals in early February.

*Etymology.* The specific epithet refers to its cream-pink floral bracts.

*Provisional IUCN conservation assessment.* Based on the IUCN red list categories and criteria (IUCN, 2016), *Zingiber subroseum* is categorised as Critically Endangered CR B2ab(iii). The area of occupancy is estimated to be less than 10 km<sup>2</sup> (total area of occupancy is c. 4 km<sup>2</sup>) and it is only known from the one location on Mount Bulusan. The observed population within the natural park was only of ten individuals over c. 200 m since the species only inhabits shaded high elevation forest. Fortunately, the area where *Zingiber subroseum* was collected (Casiguran side) is still within the 3673-hectare protected area of the mountain. As with *Zingiber aguingayae*, the threats are the same and no populations were observed on neighbouring mountains.

*Notes.* *Zingiber subroseum* is the only Philippine species with a cream-pink spike (Fig. 5C & 6A). The most closely related species based on overall morphology is the widespread and cultivated *Zingiber zerumbet* originally described from Sri Lanka. The leafy shoots of both *Zingiber subroseum* and *Z. zerumbet* can reach up to 3 m tall, although there are some reports that *Z. zerumbet* can reach up to 5 m tall. In the vegetative state, *Zingiber subroseum* can easily be distinguished from *Z. zerumbet* by the petiolate lamina (vs sessile in *Z. zerumbet*). The most noticeable differences between the two species are in the reproductive parts. For example, the peduncle of *Zingiber subroseum* is usually shorter than that of *Z. zerumbet* (9–11 vs 10–30 cm long), and the width of the spike of *Z. subroseum* is wider than that of *Z. zerumbet* (8–10 vs 4–6 cm wide). *Zingiber subroseum* can readily be distinguished from *Z. zerumbet* by the cream-pink flowering and fruiting spike of the former and the mid-green turning bright red upon fruiting of the latter. No common names or uses were reported by our local guides.

*Additional specimen examined.* PHILIPPINES. Luzon, Sorsogon, Casiguran, Barangay Inalgadian, Mount Bulusan, 12°46'49.4"N, 124°03'43.0"E, 996 m, 3 Mar 2019, *Docot 0264* (FEUH, USTH).

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