Promoting endemic *Bambusa* spp. (*B. merrilliana* and *B. philippinensis*) as sources of edible bamboo shoots in the Philippines

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ABSTRACT

"Bayog" (*Bambusa merrilliana*) and "Laak" (*Bambusa philippinensis*) are two endemic bamboo species in the Philippines. There are no English common names or other names through which they have been known other than these two respective vernacular names. Bayog is found in all the three major island groups (Luzon, Visayas, and Mindanao) of the country and has been very useful for making furniture and ropes, and in construction of buildings. This species was originally named as *Gigantochloa merrilliana* Elmer, then *Dendrocalamus merrillianus* (Elmer) Elmer, and then *Bambusa vulgaris* var. *luzonensis* Kneucker, and finally *Bambusa merrilliana* (Elmer) Rojo & Roxas. On the other hand, Laak is found only in Mindanao. In the late 1970s, it became popular because the poles were used as propping material for the heavy bunches of Cavendish bananas in plantations in Davao province. Later, the species was introduced to Luzon. Laak was originally named *Guadua philippinensis* Gamble, then transferred to *Bambusa,* and then as *Sphaerobambos philippinensis* (Gamble) S. Dransf., and finally recombined as *Bambusa philippinensis* (Gamble) McClure. These two endemic species predominantly grow in natural stands. A survey conducted in 1998 revealed that these bamboo species are good sources of edible shoots. Shoots of Bayog are mainly consumed by Filipinos from the North (Ilocos, Isabela) where there are still natural stands of bamboos. The shoots of Laak are likewise utilized in many food recipes in the South (Mindanao). The use of these endemic species is basically for genetic conservation as food source. In addition, both species are being promoted not only as food for health and wellness but also for their vital role in the environment. This paper aims to review the importance of Bayog and Laak as sources of edible shoots. It will introduce and highlight Bayog and Laak as important endemic commodities, determine the abundance of Bayog and Laak, review their nomenclature, execute a proximate analysis of the two species including the cyanide content, and gather insights on their continued utilization.

INTRODUCTION

Bamboo shoots are common food sources in the Philippines especially during the wet season, and collectively, a very important renewable community resource in this time of changing climate.

Many names are given to bamboo shoots in the local languages and dialects among indigenous peoples in the Philippines, reflecting that they are indeed used as food sources (Caasi-Lit et al., 2010a). The continuing survey of the local names especially among the native peoples opened up an interesting and continuing research that showed how the local species had already been used as a food source in the past even before Spain colonized the Philippines in the 16th century. Several names were given, with "labong", "rabong", and "dabong" as the most common names, coming from the three most widely spoken languages - "Tagalog", "Ilocano", and "Bisaya", respectively. Going around the country and asking people in the market the name for bamboo shoot gives us an idea that bamboo shoots had long been utilized as food. Table 1 shows a number of names for bamboo shoot around the country.

Depending on the predominant species in the province, these two most common species are mainly the source of bamboo shoots in the market (Caasi-Lit et al., 2000). A recent survey revealed that natural bamboo stands are dwindling (BAS, 2016). There is an urgent need to replenish these natural stands as a continuous source of bamboo shoots. The National Greening Program of the Department of Environment and Natural Resources paved the way to plant more bamboo around the country. These can be the source of bamboo shoots in the future.

There are only five endemic erect bamboo species in the Philippines according to Rojo et al. (2000). Only Bayog, *Bambusa merrilliana* (Elmer) Rojo & Roxas; Laak, *Bambusa philippinensis* (Gamble) McClure; and Buho, *Schizostachyum lumampao* (Blanco) Merrill are found in natural stands. The other two, Merrill bamboo (*Bambusa merrillii* Gamble) and *Schizostachyum textorium* (Blanco) Merrill are doubtful as they are not found anymore in the field. In the previous survey (Caasi-Lit et al., 2010a) and based on published literature, only Bayog and Laak are recorded as sources of edible bamboo shoots. Buho or *S. lumampao* is found all over the country. However, this bamboo is not used as a food source because the culms are very thin and there is not much edible portions from the shoots. An attempt was made to process the shoots of Buho and the results showed that it is also possible to use this as a food source when no other bamboo species is available in the area.

Between Bayog and Laak, Bayog is the more widely used because it is all over the country, being found as already mentioned in all three major islands. On the other hand, Laak or *Bambusa philippinensis* is found only in Mindanao, particularly in Davao, although it was introduced in the 1990s in many areas in Luzon and the Visayas.

This paper aims to introduce and highlight Bayog and Laak as important endemic commodities and as good sources of edible bamboo shoots, determine the abundance of Bayog and Laak in the country and review their nomenclature, execute a proximate analysis of the two species including the cyanide content, and gather insights on the findings of this study.

METHODOLOGY

A literature review of Bayog and Laak was conducted and summarized to serve as baseline information on the origin of the species, their distribution, and their important uses as edible bamboo shoots. The previous survey in 1999 (Caasi-Lit et al 2010a) was included in the continuing survey that was conducted in several side trips around the country. Proximate analysis

was done to compare the chemical properties of fresh bamboo shoots of the two species. Moisture, fat, fiber, and nitrogen free extract contents were determined using AOAC (1980) methods. Nitrogen content was determined using micro-Kjeldahl digestion of samples followed by a colorimetric assay based on Bertholet reaction as proposed by Nkonge and Balance (1982). The protein content was calculated as % N x 6.25.

RESULTS AND DISCUSSION

Bamboo genetic resources with emphasis on Bayog and Laak

Based on the previous survey, there are several species of bamboo as edible sources of bamboo shoots. Table 1 shows the common and uncommon bamboo species used as food (Caasi-Lit 1999). In this earlier survey of 26 provinces, the top six most popular edible species in decreasing order were: *Bambusa blumeana*, *Bambusa merrilliana*, *Bambusa vulgaris*, *Gigantochloa levis*, *Dendrocalamus asper*, and *Bambusa philippinensis*. Kayali or *Gigantochloa atter* is not as popular for food as its relative, *G. levis*. This is probably because it is found only in a few provinces. However, we found a number of natural stands of *G. atter* when we conducted a bamboo shoot training in Balatan, Camarines Sur in 2015. The participants did not know this species and its potential as a food source. The non-conventional food source includes *Schizostachyum* spp. and the climbing bamboo, *Dinochloa* spp. When resources are scarce for the conventional species, these non-conventional species are used as source of edible shoots according to Batugal (1975). The predominant species of bamboo in the natural stand are usually the available bamboo shoots in the market (Caasi-Lit et al., 2010a).

Results of the continuing survey after 1999 revealed that Bayog stands are found in 20 more provinces (Figure 1). The white circles ◯ represent the places where Bayog stands are found. Based on both surveys, Bayog clumps are almost all over Luzon but most predominant in northern and southern Luzon, eastern Visayas and eastern Mindanao. As a food source, Bayog predominates in Ilocos, Cagayan, Isabela, and Tuguegarao in the Luzon region, and in Leyte and Samar in the Visayas region. Laak, on the other hand, is found originally only in the Davao provinces: Davao Oriental and Davao del Norte. This was introduced to Laguna during the bamboo project on "Kawayan: Yaman ng Laguna" by former Governor Joey Lina. This species was taken to Sta. Cruz and asexually propagated and distributed in all the municipalities of Laguna and other provinces. Around 14 provinces are listed where this bamboo species is now planted as shown by the white circle with blue rays ☼ in Figure 1. However, the potential of Laak as food source in these provinces is not yet explored as most of these provinces have either *B. blumeana* and *B. merrilliana* as the predominant bamboo species for edible bamboo shoots. Other bamboo species and Laak remained the source of bamboo shoots in Davao province.

The list since 1999 is limited as there is no funding support for the continuing survey, only relying on the availability of official trips from other externally funded projects. It is recommended that there should be a comprehensive country-wide survey on the distribution of Bayog and Laak, and even other species for edible bamboo shoots.

Table 1. Checklist of common and non-conventional Philippine bamboo species used as food with emphasis on Bayog and Laak (modified from Caasi-Lit, 1999).

SCIENTIFIC NAME	COMMON NAMES		PERCENT OF 26 PROVINCES (Caasi-Lit 1999)	TOTAL PROVINCES PRESENT (SURVEY 2000-2016)
	FILIPINO/ TAGALOG	OTHER NAMES		
A. Commonly Used as Food Source				
Bambusa blumeana	Kawayan-tinik	Spiny bamboo Batakan (Cebuano) Tunokon (Cebuano) Kagingking (Ceb) Siitan (Ilokano)	88	
Bambusa philippinensis	Laak		11	14
Bambusa vulgaris	Kawayan-kiling	Marubal (Bikol) Lunas (Bisaya) Taywanak (Bisaya)	77	
Bambusa vulgaris cv. *vittata*	Kawayan-dilaw	Yellow bamboo	8	
Bambusa merrilliana	Bayog	Bayatakan (Bisaya) Kabugawan (NSamar)	42	46
Dendrocalamus asper	Bukawe	Botong (Bikol, Ceb) Patong (Bisaya) Giant bamboo	31	
D.latiflorus	Botong	Ma-chiku (Japanese/Chinese)	8	
Gigantochloa atter	Kayali	Kayali (Bisaya)	12	
G. levis	Bolo	Kawayan-tsina (Tag) Kabolian (Bikol)	39	
B. Not Commonly Used as Food Source				
Schizostachyum brachycladum	Buhong dilaw	Bagakay (Bisaya)	-	
S. lima	Anos	Sumbiling (Tagbanua)	-	
S. lumampao	Buho	Bagakan (Bisaya)	11	
Dinochloa sp.	Bikal		8	

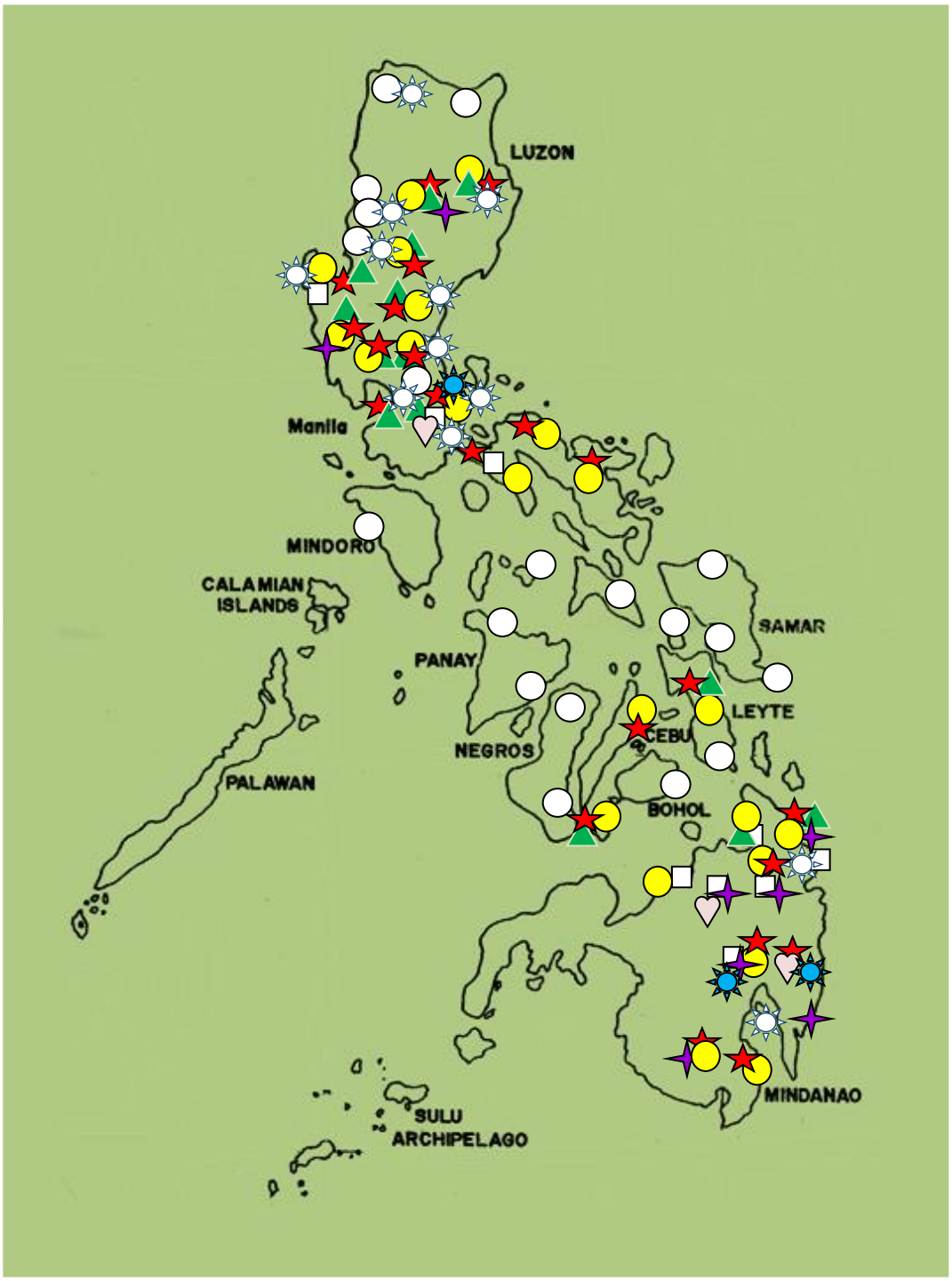

Figure 1. Map showing general locations of the different edible bamboo species in the Philippines with emphasis on Bayog and Laak (modified from Caasi-Lit et al. 2010). *B. blumeana* (★), *B. merrilliana* (● ○), *B. vulgaris* (▲), *D. asper* (✦), *G. levis* (□), *G. atter* (♡), *B. philippinensis*(✹ ☼). White circles ○ and white sun with rays ☼ are survey after 1999.

Bayog, *Bambusa merrilliana*

Bayog is an important endemic bamboo species in the Philippines. It is widely distributed in the country and grows well in low and medium lying areas especially near bodies of water (lakeshore, seashore, streams, creeks, rivers, etc). In addition, its habitat also includes the area in between mangrove forest and beach forest, although it can also thrive at higher elevations. Bayog is well-adapted to the various types of vegetation in low-lying areas and tolerates changes in salinity and seasonal fluctuations in water availability. They turn yellow during long dry spells. It is the slowest growing bamboo which makes it the sturdiest bamboo species in the country and is thus popular and useful for construction and furniture making. In the olden days when metal nails were not yet invented, thin slices of the culm of Bayog were used as ropes in building houses. The mature culms are used as stilts for bahay-kubo or nipa hut and sheds. Curved culms are also used as yoke to fit onto the neck of carabao or cattle for pulling carts or plows. Bamboo shoots of this species are the favorite of many people in the northern part of the country and in places where they are most prevalent.

The historic account on the identification and nomenclature of Bayog is shown in Table 2. It was Elmer (1908) who first identified Bayog as *Gigantochloa merrilliana* and the date 1913 in all the literatures should be corrected to 1908 for its identification. This was not included in the pioneering works on bamboo by Fr. Manuel Blanco (Blanco, 1837) who identified seven bamboo species with *Bambusa blumeana* (Kawayang tinik) as one of the species identified as *Bambus pungers* (Blanco). Bayog is almost similar to Kawayang tinik and thus may be given the same identification. In 1915, Elmer erected a new combination naming Bayog as *Dendrocalamus merrilliana* (later amended as *merrillianus*). Elmer said that this species is the same species as *Dendrocalamus parviflorus* Hack (Elmer, 1915). Later, this name was adapted by Merrill (1923) and like Gamble, Merrill enumerated 24 species and recognized the five species identified by Blanco as native bamboos including *B. blumeana* Santos (1986). Dransfield & Widjaja (1995) also adopted the same synonyms. Surprisingly, Kneucker (1915) identified Bayog as a separate variety of spiny bamboo, viz., *Bambusa blumeana* var. *luzonensis*, which was used by Piñol et al. in 1991. In 2000, Rojo and Roxas published a new combination as *Bambusa merrilliana*. They noted that Bayog belongs to genus *Bambusa* as suggested by Dr. Elizabeth Widjaja because Bayog possesses spines on its branchlets which is not a character of *Dendrocalamus*. Virtucio and Roxas (2003) only used the name *Bambusa* sp. 1 because they were not sure of its scientific name, but later, Roxas (2012) went back to using *Bambusa merrilliana* in her published handbook of bamboo species. Recent work by Vorontsova et al., (2016) reported that the accepted name for *Bambusa blumeana* var. *luzonensis* is *Bambusa spinose* Roxb. Its identification has to be studied thoroughly and establish the correct name of this species.

The type locality of Bayog is in Leyte as shown in this old manuscript of Elmer (1908).

> "Type specimens T283. A.D.E. Elmer. Palo, Province of Leyte, Leyte, January 1906. Tall and graceful. Forming forests in deep fertile soil of the Bangon River. Quite common and its stems are used by the natives for diverse purposes. Distinguished from *G. verticellata* Moore by its shorter foliage which is only one half as wide and with entirely rounded leaves, not narrowly alternate. Named after Mr. E.D. Merrill"

Table 2. Historical accounts on the identification and nomenclature of Bayog, *Bambusa merrilliana*.

Year	Basionym/Synonyms	Reference/Remarks
1837		Fr. Manuel Blanco first identified seven bamboo species in only two genera (*Bambus* and *Bambusa*) and did not include Bayog in the list. Bayog was identified as *Bambus pungers* by Blanco and the latter as *Bambusa blumeana* by Schultes f.
1908	*Basionym* *Gigantochloa merrilliana* Elmer	Elmer, A.D.E 1908. A century of new plants. Leaflets of Philippine Botany 1: 273. The date 1913 in all the literature should be corrected to 1908.
1910		Dr. James S. Gamble enumerated 24 species of bamboo from the works of Fr. Blanco.
1915	*Synonyms* *Dendrocalamus merrilliana* (Elmer) Elmer 1915	Elmer, A.D.E. 1915. Two hundred new species. Leaflets of Philippine Botany 7: 2675. Elmer said that this species is the same species as *Dendrocalamus parviflorus* Hack as cited in the Philippine Journal of Science III, C. 161.
1915	*Bambusa blumeana* var *luzonensis* Hack	Kneucker, A. 1915. AllgemeineBotanischeZeitschriftfürSystematik, Floristik, Pflanzengeographie (Allg. Bot. Z. Syst.) 21: 127.
1923	*Dendrocalamus merrillianus*	Merrill, E.D. 1923. An enumeration of Philippine Flowering Plants. 1. Bureau of Printing. Manila. 530pp. Like Gamble, Merrill enumerated 24 species and recognized the five species identified by Blanco as native bamboos including *B. blumeana*.
1986	*Dendrocalamus merrillianus*	Santos, J.V. 1986. Philippine Bamboos (*Dendrocalamus merrillianus p16-17*). In. Guide to Philippine Flora and Fauna. Natural Resources Management Center, Ministry of Natural Resources and University of the Philippines. 256p.
1991	*Bambusa blumeana* var *luzonensis* Hack	Pinol, A., S. Sinohin, C. Roxas, L. Gonzales and N. Cortiguerra. 1991. Bayog (*Bambusa blumeana* var. *luzonensis* Hack) and Kauayan (*Bambusa blumeana* Schultes). Research Information Series Ecosystems 3(12):1-17.
1995	*Dendrocalamus merrillianus*	Dransfield S & EAWidjaja (Editors), 1995. Plant Resources of South-East Asia No 7. Bamboos. Backhuys Publishers, Leiden. 189pp.
2000	*Bambusa merrilliana* (Elmer) Rojo&Roxas 2000 comb nov	Rojo JP, CA Roxas, FC Pitargue Jr & CA Briñas. 2000. Philippine Erect Bamboos: A Field Identification Guide. Los Baños, Laguna, Philippines: Forest Products Research and Development Institute. xii + 162p.Rojoet al. (2000) noted that Bayog belongs to genus Bambusa as suggested by Dr. Elizabeth Widjaja. Bayog possesses spines on its branchlets which is not a character of *Dendrocalamus*.
2004	*Bambusa* sp. 1 (formerly *Dendrocalamus merrillianus*)	Virtucio FD & CA Roxas. 2003. Bamboo Production in the Philippines. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources, College, Laguna. 202pp.
2012	*Bambusa merrilliana*	Roxas, C.A. 2012. Handbook on Erect Bamboo Species Found in the Philippines. Ecosystems Research and Development Bureau. Department of Environment and Natural Resources. College Laguna 116p.
2016	*Bambusa spinosa Roxb*	Vorontsova, M. S., L. G. Clark, J. Dransfield, R. H. A. Govaerts & W. J. Baker. 2016. World Checklist of Bamboos Rattans. International Network of Bamboo and Rattan Technical Report. 37: [i–vi] 1–454

Laak, *Bambusa philippinensis*

Laak became an important bamboo species in Davao when it was found to be prolific and suitable as propping material for heavy developing banana fruits. Davao province and the adjacent provinces are great locations for many banana plantations in the country. In the 1970s when banana export was favorable, banana companies needed a lot of props and bamboo was the cheapest. The search for a good material, along with the timely ban on saplings (young trees), led to the adoption of Laak as the major propping material for the banana plant (Caasi, 1988; Rikken, 1994). Laak was found to be abundant in natural stands, and resulted in the extraction of this species in almost all areas in Davao. This was discovered as an endemic species in the Philippines by a group of experts in 1988 (Pancho and Obien, 1988; Schlegel & Tangan, 1994). It is only found in the provinces of Davao and other nearby provinces. They grow best in low and medium altitude and can tolerate growing near creeks and streams. They grow extra large in forests with abundant moisture. Bamboo shoots of this species are consumed mostly in the southern part of the country. In the 1990s, planting materials were brought to Luzon and some parts of the Visayas. This spread to other parts of the Philippines when this species was propagated in the project "Kawayan: Yaman ng Laguna" by the provincial government of Laguna. An inventory of this species after its introduction around the country is needed. This will assess whether this species is being utilized especially as a food source.

The historic account on the identification and nomenclature of Laak is shown in Table 3. Like Bayog, Laak was not mentioned by Blanco in his work on bamboo in 1837. This was identified by Gamble as *Guadua philippinensis* in 1913 belonging to the old world bamboo. In 1973, this was synonymized by McClure and gave the name *Bambusa philippinensis* (Gamble) McClure. Dransfield (1989) erected a new genus, *Sphaerobambos* and changed the name of Laak to *Sphaerobambos philippinensis*. Dransfield and Widjaja (1995) adapted the same name as well as those using the species for publication. Later, Rojo and Roxas (2000) reported a new combination and changed the name to *Bambusa philippinensis*. They noted that the new combination is credited to McClure. Furthermore, Widjaja (1990) believes that it does not belong to *Sphaerobambos* as the genus belongs to scrambling bamboos. However, according to the Plant List (plantlist.com), the accepted name of Laak is *Sphaerobambos philippinensis*. A comprehensive study is needed to confirm the identity of Laak.

The type locality of Laak is shown in this old transcript of McClure (1973).

> "*Guadua philippinensis* Gamble, an Old World species of diverse, as yet incompletely known, affinities, is known only by the type-collection (C. V. Piper 475). This collection was made on 15 May 1911, at Mati, District of Davao, island of Mindanao. No information concerning the ecological setting of the plant has come to light."

Both of these bamboo resources have greatly contributed to the lives of the Filipino people and the Philippine landscape. In the case of Bayog, this species should be planted where it was first collected. In the last survey after the Supertyphoon Yolanda, there are no more clumps of Bayog in Palo, Leyte and even in the adjacent areas. With the swampy nature of Leyte, it is evident that Bayog grows well in this kind of habitat and had once dominated this area in the past. Clumps of Bayog are already very far from Palo, Leyte.

Table 3. Historical accounts of the identification and nomenclature of Laak, *Bambusa philippinensis*

Year	Basionym/Synonyms	Reference/Remarks
1837		Fr. Manuel Blanco first identified seven bamboo species in only two genera (*Bambus* and *Bambusa*) and did not include Bayog in the list. Laak was not included in the list.
1910		Gamble, J.S. 1910. The bamboos of the Philippine Islands. Philippine Journal of Science V (4):267-281.
1913	Basionym *Guadua philippinensis* Gamble	Gamble, J.S. 1913. Some additional bamboos of the Philippine Islands. Philippine Journal of Science VII (4): 203-206.
1973	*Synonyms* *Bambusa philippinensis* (Gamble) McClure	McClure, F.A. 1973. Genera of bamboos native to the New world (Gramineae-Bambusoideae). (TR Soderstrom, editor). Smithsonian Contribution to Botany No. 9: xii + 148p.
1988	*Bambusa philippinensis*	Pancho, JV & SR Obien. 1988. New records of bamboo for the Philippines. Philippine Agriculturist 71(2): 199-228. Caasi, M.C. 1988. Propagating Laak bamboo *(Bambusa philippinensis)* by incubation method for livelihood and environmental protection in Davao province. Sylvatrop, Philippine Forestry Research Journal 13(1&2), 37-48.
1989	*Sphaerobambos philippinensis* (Gamble) S. Dransfield	Dransfield, S. 1989. *Sphaerobambos*, a new genus of bamboo (Gramineae-Bambusoideae) from Malesia. Kew Bulletin 44 (3): 425-434.
1994	*Sphaerobambos philippinensis*	Rikken, g. 1994. Propping Life with Bamboo. A case study of self-help approach to natural resource management featuring the Davao Bamboo Development Cooperative. Asian Social Institute and Deutsche Gesellschaft fur TechnischeZusammenarbeit (GTZ) GmbH. Malate Philippines 70p.
1995	*Sphaerobambos philippinensis*	Dransfield S & EA Widjaja (Editors), 1995. Plant Resources of South-East Asia No 7. Bamboos. Backhuys Publishers, Leiden. 189pp.
2000	*Bambusa philippinensis* (Gamble) McCLure	Rojo JP, CA Roxas, FC Pitargue Jr & CA Briñas. 2000. Philippine Erect Bamboos: A Field Identification Guide. Los Baños, Laguna, Philippines: Forest Products Research and Development Institute. xii + 162p. Noted that the new combination is credited to McClure and Widjaja (1990) believes that it does not belong to Sphaerobambos as the genus for scrambling bamboos.
2004	*Bambusa* sp. 2 (scientific name is still unknown)	Virtucio FD & CA Roxas. 2003. Bamboo Production in the Philippines. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources, College, Laguna. 202pp.
2012	*Bambusa philippinensis* (Gamble) McClure	Roxas, C.A. Handbook on Erect Bamboo Species Found in the Philippines. Ecosystems Research and Development Bureau. Department of Environment and Natural Resources. College Laguna 116p.

Characteristics of young shoots of Bayog and Laak

A preliminary study was conducted by Ricohermoso et al. (2015) and Anarna et al. (2017) on morphology-based diagnostics of edible young shoots, post-edible juvenile, and pre-mature stage of eight Philippine bamboos which was used to identify and differentiate between

species. The study also provided additional information which can be useful for taxonomists, researchers, students, and bamboo enthusiasts. A dichotomous key was generated to separate species using the young shoots, especially the detailed characters of the culm sheath. The general appearance of the culm sheath and the size, shape, structures, and characteristics of its blade, auricle and ligule are considered as the best guide for identification of bamboo species, which are characteristics that are most distinct in young bamboo shoots (http://www.odishabamboo.org/flower.php).

Bayog, *Bambusa merrilliana*

The young shoots (Figure 2A-2C) are covered with light grayish-green culm sheaths with very stiff, appressed, and very fine short hairs at the abaxial side. Like any other species, the adaxial side of the sheaths is always smooth and shiny. The culm sheaths are deciduous and coriaceous, very tightly embracing the shoots (Figure 2A). The lower portions of sheaths are shorter and narrower while the upper portions are longer and wider; usually, the apex is not upcurved towards the middle. The blades are short and triangular, and the transverse posture of the blade is undulating. The upper portion of the blade consists of reddish-brown bristles. The ligules are prominently distinct with ear-like appendages. The auricles are lobed with visible reddish-brown hair. The young shoots of Bayog are almost similar to its relative, Kawayang tinik (*B. blumeana*), except for the prominent yellow-brown outlines at the exposed sides of the culm sheaths that turn light brown when dried. When peeled, it is velvety with the distinct nodes and alternating "eyes" in one line opposite each other in every node (Figure 2B). The young shoots, when halved, are solid from base to tip except for the small holes in the middle (Figure 2C).

Laak, *Bambusa philippinensis*

The edible young shoots of Laak (Figure 2D-2F) are about 30 to 45 cm and hollow inside, cylindrical, jointed, and tapering like an elongated cone, wide at the base and pointed at the top. The shoots are tightly enveloped with very hairy culm sheaths with a purple tinge at the base (Figure 2D). When peeled, the joints or nodes of the shoots are visible with a distinct white outline (Figure 2E). Each node is enveloped with a light green culm sheath with patches of orange, rough outside with plenty of hairs and smooth and shiny inside. The blades are triangular with distinctively pointed sharp tips and ear-like structures at the sides. The ligules are curved with wavy hairy edges holding the blade elegantly. The auricles are visibly lying at the sides of the ligules with the prominent reddish-brown bristles. This structure is perhaps the most conspicuous in the young shoots. Blades from the upper sheaths are almost touching each other. The young shoots, when cut into halves, have ivory-colored inner cores (Figure 2F). The shoots are hollow and inside are flakes known as culm salt.

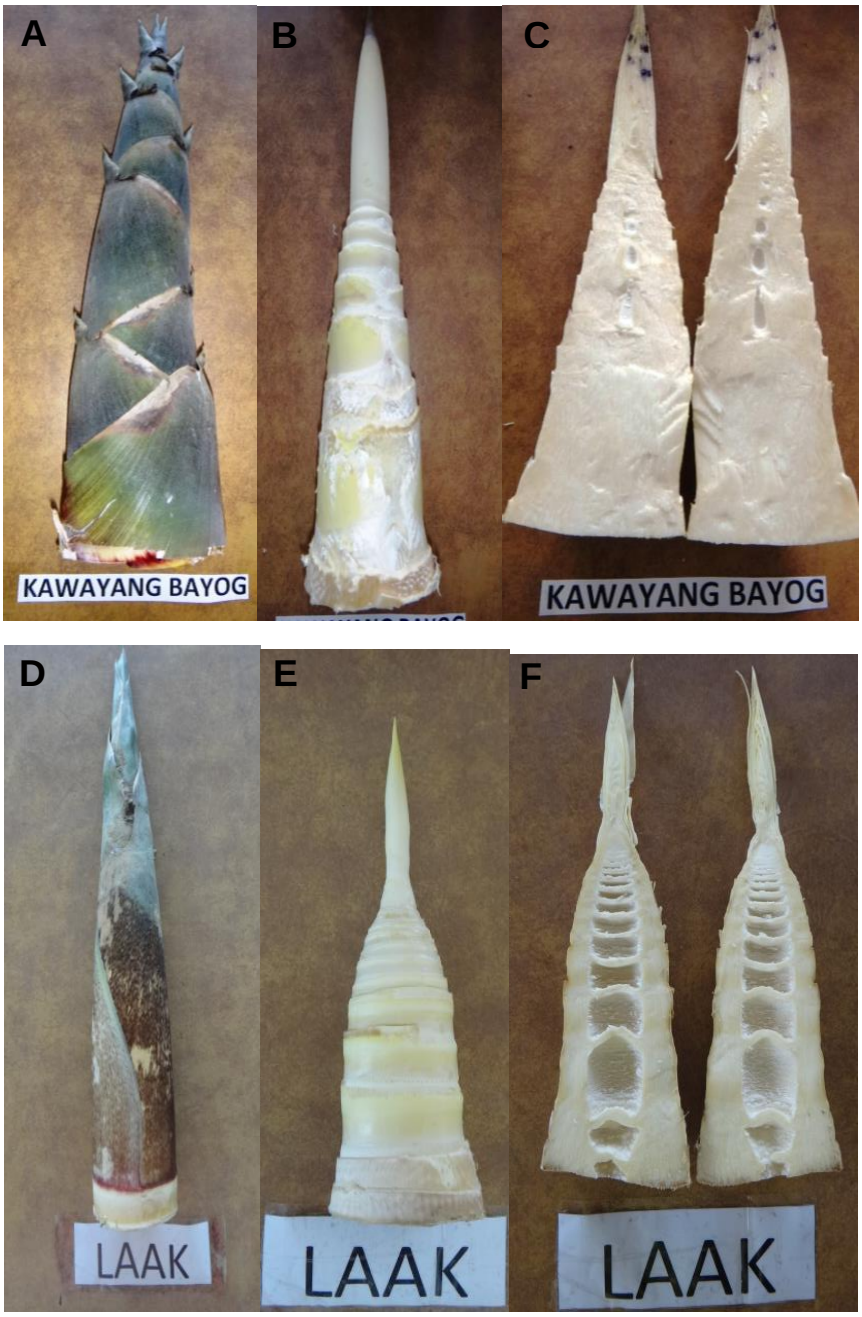

Figure 2. Young shoots of Bayog, *Bambusa merrilliana* (A-C) and Laak, *B. philippinensis* (D-F) with and without peelings and when cut into halves.

Nutritional Assessment of Bayog and Laak shoots using proximate analysis

Table 4. Nutritional assessment of Bayog and Laak shoots using proximate analysis.

Parameters	*B. merrilliana* (Bayog)	*B. philippinensis* (Laak)
% Moisture	91.46±0.28[a]	91.07±0.19[a]
% Fat	1.01±0.03[b]	0.54±0.05[c]
% Protein	2.29±0.01[d]	2.94±0.16[e]
% Ash	0.87±0.03[f]	1.20±0.00[g]
% Fibre	0.88±0.08[h]	1.07±0.23[h]
% NFE	3.49±0.20[i]	3.32±0.20[i]

Comparative analysis of the nutritional value of Bayog and Laak showed that Laak has significantly higher protein, ash (mineral), and fiber content while Bayog has higher fat content. Moisture and nitrogen free extracts are comparable for both Laak and Bayog. Table 4 summarizes the result of the proximate analysis of the two endemic bamboo species, Bayog and Laak. Chongtham et al. (2011) reported the nutritive value of edible bamboo shoots from different parts of the world. Moisture content ranged from 89.4 – 90.7%, protein content from 1.49 – 4.04%, fat content from 0.39 – 0.50%, ash content from 0.89 – 1.01%, and fiber content from 2.65 – 4.24%. The nutritive value of Philippine endemic species of bamboo are comparable to other edible bamboo shoots around the world. Laak and Bayog have higher fat content and lower fibre content (out of range) compared to the study of Chongtham (2011). This comparison translates the importance and potential of Philippine endemic bamboos species in terms of their nutritional value. The wide range and difference of nutritive values of Laak and Bayog with other edible bamboo shoots can be explained by differences in maturity upon harvesting, different physiological conditions, and genetic diversity of bamboos. Cyanogenic glycoside, specifically taxiphyllin, is considered the main anti-nutritional factor of bamboo shoots. Cyanogenic glycosides are hydrolyzed with the help of β-glucosidase enzymes in the stomach, producing cyanohydrin and sugars. Cyanohydrin readily decomposes to hydrogen cyanide, which is toxic to humans and animals, and ketones/aldehydes (Moller and Seigler, 1999). Caasi-Lit et al (2010b) reported that Kauayan-kiling (*Bambusa vulgaris* var *vulgaris*) contains the highest amount of cyanide (77.84mg/kg) in bamboo shoots from the Philippines while Laak registered 64.93 mg/kg cyanide content. The World Health Organization (WHO) recommends only 10 mg/kg body weight cyanide consumption to avoid toxicity in humans (Cumbana et al., 2007); therefore, for an average adult (60 kg) it will take around 9.24 kg of Laak shoots to cause fatality. Several studies, however, suggest that pre-processing of bamboo shoots like soaking, boiling, drying, and fermentation can reduce cyanide content by up to 60-90% (Caasi-Lit et al 2010a; Rawat et al., 2015).

SUMMARY AND CONCLUSION

This study was conducted to promote Bayog and Laak as good sources of food or as a vegetable in the Philippines. These important endemic bamboo resources in the country are

abundant, especially Bayog which is found all over the country and with its type locality in Palo, Leyte. With the destruction of forests, rivers and plains in this area, this natural resource has become extinct in the locality. Bayog, therefore, should be conserved in this place. Replanting of Bayog in the area may be beneficial as this place is always visited by many typhoons annually. Together with mangroves, bamboo can be an important renewal resource for many communities in low-lying areas, not only in Leyte but also in other parts of the country.

The identity of the two species is problematic as shown in the historical accounts for nomenclature. Several names are used in literature and this becomes confusing for research and other purposes. For Bayog, it is possible that it has more than one species. According to some bamboo enthusiasts, Bayog has spines on its lower branches just like the Kawayang Tinik. For Laak, it is not clear when it was adapted in Mindanao. A comprehensive study is required to establish the correct identity of both the species.

Bamboo shoots of Bayog and Laak undoubtedly are nutritious substitutes as a food source. Nutritional assessment using proximate analysis showed that the shoots of Philippine endemic bamboo species Laak and Bayog have comparable nutritive values with other species of the world, but have higher fat and lower fiber content. Comparative analysis of the two endemic species showed that Laak has superior protein, fiber and mineral content, while Bayog has higher fat content.

At present, research and development on bamboo shoots as food is sporadic in the Philippines. There is a need to study and strengthen bamboo shoots R &D in the country. With a rich source of bamboo in the Philippines, bamboo shoots can be promoted as a healthy food, in addition to boosting the economic development of the region. Bamboo shoots from the Philippines can also be exported to countries like Japan, Australia, and Europe which have very high demand for this fiber-rich, low calorie food.

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