

Ethnomedicinal appraisal and conservation status of medicinal plants among the Manobo tribe of Bayugan City, Philippines

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Abstract. Dapar MLG, Meve U, Liede-Schumann S, Alejandro GJD. 2020. Ethnomedicinal appraisal and conservation status of medicinal plants among the Manobo tribe of Bayugan City, Philippines. *Biodiversitas* 21: 3843-3855. Manobo tribe is one of the most populated indigenous communities in the Philippines clustered in various parts of Mindanao archipelago with distinct cultural traditions and medicinal practices. This study aims to document the Agusan Manobo tribe medicinal plant uses and knowledge and to assess the conservation status of their medicinal plants found in upland ancestral lands where ethnomedicinal practices still prevail. Ethnomedicinal data were gathered from 95 key informants through semi-structured interviews, focus group discussions, and guided field walks in five selected upland barangays of Bayugan City. Family importance value (FIV) and relative frequency of citation (RFC) were quantified. The conservation status of their medicinal plants was assessed based on the international and national listing of threatened species. A total of 90 species belonging to 82 genera and 41 families were identified as ethnomedicinally important. Highest FIV (98.9) was reported for Piperaceae in treatment for skin diseases and infections. The most cited medicinal plant species was *Piper decumanum* L. (RFC=0.95), which is primarily used in treatment for insect and snake bites. Conservation assessment revealed that the five upland areas of the Agusan Manobo tribe are habitats of endemic, endangered, vulnerable and threatened species. The results of this study present the rich ethnomedicinal knowledge of Agusan Manobo cultural community, which could serve as a useful source of information to improve community healthcare and environmental conservation and management. Local people and the government should actively participate in shared management responsibilities for viable conservation strategies and sustainable use of the cultural community resources.

Keywords: Ethnobotany, Manobo tribe, medicinal plants, Mindanao, Philippines

INTRODUCTION

Recent biodiversity global assessment reported around one million animal and plant species (SDG 2019), and more than 28,000 species (IUCN 2019) are now threatened with accelerating extinction rate more than ever before in human history. Given this emerging biodiversity crisis, ancestral lands governed by indigenous communities are significantly declining at a slower rate (IPBES 2019). The rich knowledge, ecological understanding, resource management, and conservation practices of the locals and indigenous peoples are recognized as imperative partners in environmental management because they act as stewards of their ancestral territories (UNESCO 2019). Indigenous and local knowledge (ILK) is accepted among researchers and policymakers as essential for biodiversity conservation worldwide (Reyes-García and Benyei 2019). Indigenous communities have long experienced, coped, and adjusted to environmental changes over the years (Vinyeta and Lynn 2013). Considering the experience of indigenous people, their knowledge must play an integral role in sustaining global biodiversity and protect world heritage.

An estimated 22% of the world's land surface was acknowledged as indigenous ancestral lands, which

correspond to about 80% of the plant's biodiversity areas (WRI 2005). Despite the indigenous transformation of various cultural knowledge systems and traditional practices in sustaining forest reserves, biodiversity has prevailed in the Philippines (Camacho et al. 2015). The Philippine archipelago is comprised of more than 7,100 islands and islets. This country is considered significantly crucial to global biodiversity due to its exceptional levels of narrow endemism in various ecosystems (Myers et al. 2000; Carpenter and Springer 2005; Posa et al. 2008). Aside from being renowned as a megadiverse country worldwide (Conservation International 2012) and one of the world's eight biodiversity hottest hotspots (Myers et al. 2000), the Philippines is also recognized as culturally megadiverse in ethnicity accounting for 110 divergent ethnolinguistic groups (ILO 2014, PSA 2016). These various indigenous communities have a prominent and unique identity, language, and cultural practices (NCIP 2010).

Mindanao is mostly occupied with 61% of the total number of indigenous peoples (IPs) in the Philippines (UNDP 2010). One of the largest groups of IPs in Mindanao is the Manobo tribe, mainly inhabiting the province of Agusan del Sur known as the Agusan Manobo

(NCIP 2010; NCCA 2015; Reyes et al. 2017). Etymologically, the Manobo term was named after the “Mansuba,” which means river people, coined from the “man” (people) and the “suba” (river). Like other indigenous communities in the country, Agusan Manobo occupied their ancestral lands situated in uplands and hinterlands with harmony for generation, protected their natural resources, and maintained the integrity of their ecosystem (Dapar et al. 2020a). The rich traditional knowledge of indigenous and local people with regards to biodiversity resources is continually supported by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES 2019) and the Convention on Biological Diversity (CBD 2019) of the United Nations. Their critical roles as conservation actors are essential for joint intervention with Indigenous Peoples Organization (IPOs) to strategize biodiversity programs around the globe (Alcorn 2010).

Despite the significant role of indigenous contributions to biodiversity conservation, limited studies have so far been conducted in the Philippines among Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) in documenting relative importance and conservation status of their medicinal plants. Bayugan City, the only component city in the province of Agusan del Sur and known to be occupied with the large number of Agusan Manobo who serve as stewards of their abundant natural resources, remains underdocumented. Hence, it is paramount to evaluate plant resources like medicinal plants among indigenous communities and check for their conservation status as baseline information and justification for future conservation. Thus, this study aims to document ethnomedicinal importance and to assess the conservation status of the medicinal plants used by the Agusan Manobo

in upland areas of Bayugan City, Agusan del Sur, Philippines.

MATERIALS AND METHODS

Study area

The fieldwork was undertaken in the City of Bayugan as the only component city in the province of Agusan del Sur, Philippines, as shown in Figure 1. This landlocked city is located in the coordinates 8° 71'44" N, 125° 74'81" E with type II climate having no dry season but very pronounced wet season with heavy precipitation. It is geographically situated below the typhoon belt near or alongside the eastern coast of Mindanao, which is typically affected by tropical depression and typhoon passing the province of Surigao del Norte and Visayas regions. From the total of 43 barangays of the city, five upland barangays, namely Mt. Ararat (523.7 masl), Mt. Carmel (360.8 masl), Mt. Olive (323.2 masl), New Salem (628.5 masl), and Pinagalaan (523.1 masl), were purposively selected for the reasons of availability, accessibility, and security with the approved consent of the tribal council, provincial administration of Agusan del Sur, the National Commission on Indigenous Peoples (NCIP) of the LGU and CARAGA Administrative Region, and the Provincial Environment and Natural Resources Office (PENRO) of Agusan del Sur, and the Department of Environment and Natural Resources (DENR) of CARAGA. These five study sites partly comprised the 74% forestland areas and 26% alienable and disposable (A&D) areas of the province (PENRO Agusan del Sur 2019). There were three hospitals in the downtown city, which is distant from the five remote barangays of the study, therefore, with poor access to the city healthcare.

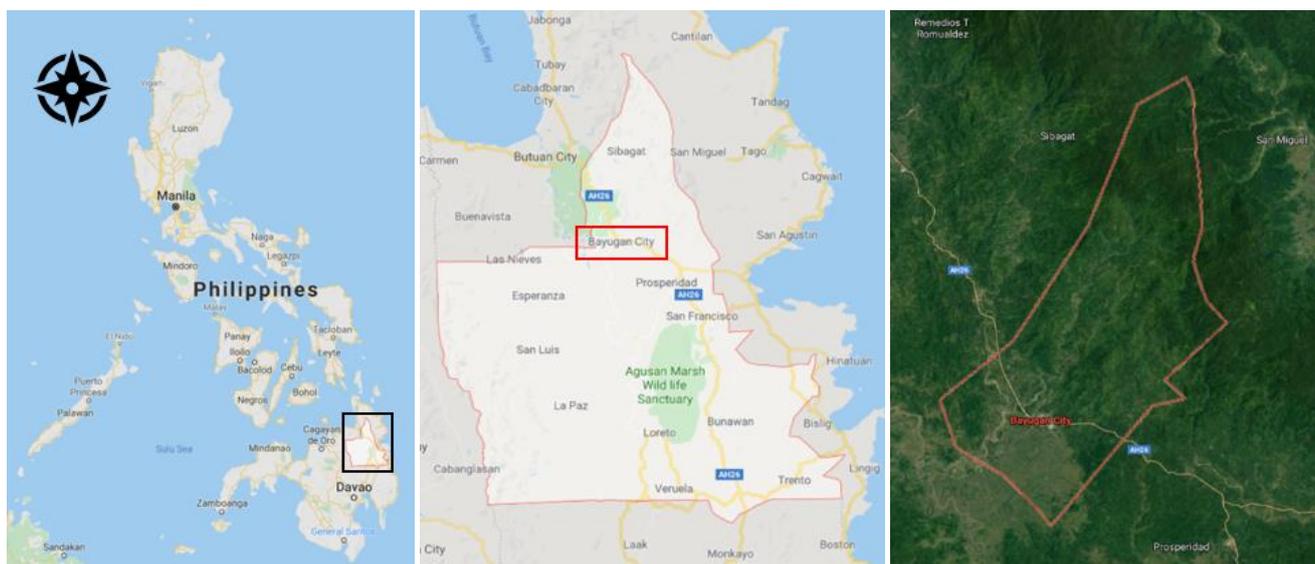


Figure 1. Location map of Bayugan City (C), Agusan del Sur (A, B), Philippines (Maps by Google Earth)

Field survey

Fieldwork was carried out from March 2018 to April 2019. The work consisted of the acquisition of ethics approval, consents, resolution, certification, and permit before the actual interview, field survey, and collections in the selected five upland barangays. Consultative assembly was conducted with the tribal council of elders in cooperation with the city administration to talk about the research intent as wholly academic. After consultations and meetings, the fieldwork was followed by ritual observation resulting in mutual agreement and respect. As approved by the council of elders, the survey and sampling were certified by the NCIP-LGU and NCIP-CARAGA following their by-laws for the welfare and protection of IPs.

A total of 95 purposively and snowball sampled AgusanManobo key informants, more than 10% of the total population of selected barangays, comprising of the tribal council of elders and members, were interviewed using the semi-structured open-ended interview. Key informants were composed of 39 females and 56 males with an age range from 18 to 77 years old and the median age is 38. Ethnomedicinal data were consolidated from the interviews and corner meetings with the key informants. An accurate translation to the Manobo dialect, known as *Minanubu*, with the help of the tribal elders, was secured. Focus group discussions (FGD) among respondents have jointly participated with the respective barangay tribal leaders and the only tribal healer and in cooperation with the city Indigenous Peoples Mandatory Representative (IPMR) as a consultant. FGD is helpful to clarify the main points, ideas, and perceptions on the use of traditional folk medicines, awareness about the conservation of their medicinal plant cultural resources and indigenous knowledge.

Collection and identification

All collected medicinal plants during field walks and sampling were carefully pressed, alcohol-preserved, dried, and mounted on herbarium sheets. Voucher specimens were deposited in the University of Santo Tomas Herbarium (USTH). Recorded vernacular names were compared to the *Dictionary of Philippines Plant Names* by Madulid (2001). Plant identification was verified by Mr. Danilo Tandang, a botanist and researcher at the National Museum of the Philippines. All scientific names were checked for spelling and synonyms, and family classification using *The Plant List* (2013), *World Flora Online* (2019), the *International Plant Names Index* (2019), and *Tropicos* (2019). Medicinal plant species occurrence, distribution, and species identification were further confirmed in the updated *Co's Digital Flora of the Philippines* (CDFP; Pelser et al. 2011 onwards).

Family importance value (FIV)

FIV determines the local importance of the families of medicinal plant species (Ali et al. 2018). This value is calculated based on the number of informants citing the family using the formula: $FIV = (FC/N) \times 100$, where FC is the frequency of citation of the plant family, and N is the total number of informants. FIV ranges in value from 0 to 100, with the most important family having values closer to 100. FIV distinguishes the most important family based on

the number of citation reports of informants and the number of medicinal plant species for treatment.

Relative frequency of citation (RFC)

RFC identifies the local importance of each medicinal plant species (Ugulu et al. 2009). This index is calculated using this formula: $RFC = FC/N$, where FC (frequency of citation) is the number of informants who stated the medicinal plant, and N is the total number of informants. FC assigned the most preferred or more used medicinal plant species. At the same time, RFC determines the traditional importance of plant species in the study site ranging in value from 0 to 1, with the most critical species having values closer to 1.

Conservation status and endemism

Conservation status of the medicinal plants was assessed based on the international data of the IUCN (2019) updated national list of threatened Philippine plants and their categories of the DENR Administrative Order No. (DAO) 2017-01 (DENR Administrative Order 2017) and the consolidated national online flora database of *Co's Digital Flora of the Philippines* (CDFP; Pelser et al. 2011 onwards). The collected medicinal plants were further checked for their occurrence and distribution in the Philippines and to check their endemism.

RESULTS AND DISCUSSION

Characteristics of medicinal plants

During the ethnobotanical survey of medicinal plants, a total of 90 species belonging to 82 genera and 41 families were identified and recorded with medicinal uses, as shown in Table 1. Most of the documented medicinal plants were trees (35%), followed by herbs (33%), shrubs (20%), and climbers (12%), as depicted in Figure 2. Several plant parts are used by Agusan Manobo for various health problems, as shown in Figure 3. The most medicinally most used plant parts are the leaves (39%), followed by roots (22%), stems and barks (12%), while the least used ones are rhizomes (3%), shoots (2%), fruits (2%), flowers (2%), and branches (1%).

Family importance value

Analysis of FIV revealed that Piperaceae has the highest value (98.9), followed by Lauraceae (96.8), Apocynaceae (94.7), and Euphorbiaceae (90.5). These families were highly cited by the informants as frequently used for treatment against skin diseases and infections, cough, wounds, and fever, respectively.

Relative frequency of citation

The highest RFC values were recorded for *Piper decumanum* L. (0.95), followed by *Anodendron borneense* (King & Gamble) D.J.Middleton (0.89), *Micromelum minutum* (G.Forst.) Wight & Arn. (0.81), *Arcangelisia flava* (L.) Merr. (0.81), and *Cinnamomum mercadoi* S.Vidal (0.79). These medicinal plants are highly cited as a treatment for insect and snake bites, pregnancy problems (impotence and sterility), cancer, ulcer, and diarrhea, respectively.

Table 1. List of documented medicinal plants with their conservation status, endemism, medicinal parts, and uses (alphabetically arranged by family)

Scientific name	Voucher No.	FIV	RFC	Conservation status		Endemism (CDFP) ^c	Parts used ^d	Medicinal uses
				IUCN ^a	DENR/CDFP ^b			
Acanthaceae		68.42						
<i>Rhinacanthus nasutus</i> (L.) Kurz	USTH 015622		0.52	NA		NE	Lf	Colds, beriberi, diabetes, diarrhea, fatigue, spasm
Anacardiaceae		63.16						
<i>Mangifera indica</i> L.	USTH 015591		0.20	DD		NE	Fr, Lf	Constipation, cough, diarrhea, stomach trouble
<i>Spondia spinmata</i> (L.f.) Kurz	USTH 015599		0.33	NA		NE	Bk, Lf	Colds, cough, diabetes, fever
Annonaceae		36.84						
<i>Friesodielsia lanceolata</i> (Merr.) Steen.	USTH 015558		0.18	NA		EN	Bk, Lf, Rt	Postpartum care and recovery
<i>Uvaria zschokkei</i> Elmer	USTH 015662		0.17	NA		EN	St	Amoebiasis, hypertension, fatigue
Apocynaceae		94.74						
<i>Alstonia macrophylla</i> Wall. ex G.Don	USTH 015546		0.35	LC		NE	Bk	Animal bites, skin diseases and infections, wounds
<i>Anodendron borneense</i> (King & Gamble) D.J.Middleton	USTH 015639		0.89	NA		NE	St	Arthritis, body pain, cancer, diabetes, fatigue, pregnancy (impotence and sterility), skin diseases, spasm, wounds
Araceae		9.47						
<i>Alocasia zebrina</i> Schott ex Van Houtte	USTH 015614		0.05	NA	VU	EN	St	Snake bites and wounds
<i>Homalomena philippinensis</i> Engl. ex Engl. &K.Krause	USTH 015597		0.04	NA		EN	Rz	Labor and delivery enhancer, rheumatism, wounds
Araliaceae		29.47						
<i>Hydrocotyle vulgaris</i> L.	USTH 015563		0.23	LC		NE	Lf	Diabetes, hypertension
Arecaceae		22.11						
<i>Calamus megaphyllus</i> Becc.	USTH 015608		0.15	NA	NT	EN	Rz	Arthritis, asthma, diarrhea, hypertension
Asteraceae		88.42						
<i>Acmella grandiflora</i> (Turcz.) R.K.Jansen	USTH 015548		0.35	NA		NE	Fw	Skin rashes and itchiness, toothache
<i>Artemisia vulgaris</i> L.	USTH 015619		0.33	LC		NE	Lf	Asthma, body pain, cough, fever, spasm
<i>Bidens pilosa</i> L.	USTH 015582		0.20	NA		NE	Rt	Body pain, diarrhea, fatigue, gas pain and flatulence
<i>Blumea balsamifera</i> (L.) DC.	USTH 015573		0.37	LC	LC	NE	Lf	Cough, fatigue, fever, headache, hypertension, spasm
<i>Chromolaena odorata</i> (L.) R.M.King&H.Rob.	USTH 015632		0.40	NA		NE	Lf	Burns, fever, skin diseases, wounds
<i>Cyanthillium cinereum</i> (L.) H.Rob.	USTH 015587		0.43	NA		NE	Lf, Rt	Animal bites, colds, malaria, measles, skin diseases, spasm, tuberculosis
<i>Erechtites valeriani folius</i> (Link ex Spreng.) DC.	USTH 015666		0.19	NA		NE	Lf	Gas pain and flatulence, stomach trouble, wounds
<i>Mikania cordata</i> (Burm.f.) B.L.Rob.	USTH 015543		0.36	NA		NE	Lf	Animal and insect bites, skin diseases and infections, ulcer, wounds
<i>Pseudelephantopus spicatus</i> (Juss.) Rohr	USTH 015564		0.45	NA		NE	Lf, Rt	Kidney problem, menstrual problem, skin diseases, snakebite, wounds

Athyriaceae		25.26					
<i>Diplazium esculentum</i> (Retz.) Sw.	USTH 015545	0.19	LC	NE	Sh	Diarrhea, fever, postpartum care and recovery	
Boraginaceae		41.05					
<i>Ehretia microphylla</i> Lam.	USTH 015638	0.30	NA	NE	Lf	Allergy, diabetes, hyperacidity	
Byttneriaceae		36.84					
<i>Abroma augusta</i> (L.) L.f.	USTH 015637	0.29	NA	NE	Bk, Lf, Rt	Diabetes, menstrual problem, skin diseases and infection, stomach problem, wounds	
<i>Melochia umbellata</i> (Houtt.) Stapf	USTH 015649	0.24	NA	NE	Lf	Body pain, burns, canker sore, rheumatism	
Campanulaceae		26.32					
<i>Hippobroma longiflora</i> (L.) G.Don	USTH 015583	0.19	NA	NE	Fr	Ascariasis, cancer, constipation	
Caricaceae		72.63					
<i>Carica papaya</i> L.	USTH 015668	0.59	DD	NE	Lf	Body pain, constipation, dengue fever	
Costaceae		75.79					
<i>Hellenia speciosa</i> (J.Koenig) Govaerts	USTH 015578	0.67	NA	NE	Lf, St, Rz	Cough, diabetes, fever, goiter, kidney problem, stomach trouble	
Cyperaceae		32.63					
<i>Rhynchospora colorata</i> (L.) H.Pfeiff.	USTH 015571	0.23	NA	NE	Wh	Chickenpox, gas pain and flatulence, hyperacidity, measles	
Dioscoreaceae		58.95					
<i>Stenomeris borneensis</i> Oliv.	USTH 015537	0.48	NA	NE	Rt	Arthritis, migraine, myoma, rheumatism, spasm, urinary problem	
Euphorbiaceae		90.53					
<i>Euphorbia hirta</i> L.	USTH 015665	0.27	NA	NE	Wh	Colds, dengue fever, fever, skin diseases	
<i>Jatropha curcas</i> L.	USTH 015595	0.44	NA	NE	Lf, Rt	Arthritis, body pain, diarrhea, fatigue, fever, menstrual problem, spasm, tuberculosis	
<i>Jatropha gossypifolia</i> L.	USTH 015586	0.73	LC	NE	Lf, Rt	Body pain, diarrhea, dysmenorrhea, fatigue, fever, menstrual problem, tuberculosis	
<i>Melanolepis multiglandulosa</i> (Reinw. ex Blume) Rchb. & Zoll.	USTH 015621	0.44	LC	NE	Lf	Beriberi, diarrhea, emphysema, fatigue	
<i>Omalthus macradenius</i> Pax & Hoffm.	USTH 015633	0.18	NA	EN	Lf	Skin diseases and infections, wounds	
Fabaceae		56.84					
<i>Bauhinia</i> cf. <i>semibifida</i>	USTH 015575	0.26			Lf, St	Body pain, postpartum care and recovery, rheumatism, spasm	
<i>Mimosa pudica</i> L.	USTH 015570	0.32	LC	NE	Rt	Child sleeplessness, diabetes, dysentery, hypertension, urinary problem	
<i>Ormosia macrodisca</i> Baker	USTH 015625	0.47	LC	NE	Bk, Rt	High cholesterol, kidney problem, nervous breakdown, typhoid fever	
<i>Phanera semibifida</i> (Roxb.) Benth.	USTH 015646	0.06	NA	NE	Lf	Hemorrhage, internal bleeding	

Lamiaceae		84.21						
<i>Callicarpa pedunculata</i> R.Br.	USTH 015661	0.34	NA	LC	NE	Lf	Asthma, body pain, fatigue, muscle pain, spasm, ulcer	
<i>Coleus amboinicus</i> Lour.	USTH 015617	0.34	NA		NE	Lf	Abdominal pain, asthma, cough, gas pain and flatulence	
<i>Coleus scutellarioide s</i> (L.) Benth.	USTH 015644	0.37	NA		NE	Lf	Anemia, asthma, cough, gas pain and flatulence, pneumonia, tuberculosis, ulcer	
<i>Gmelina arborea</i> Roxb. ex Sm.	USTH 015635	0.30	LC		NE	Lf	Gas pain and flatulence, maternal care, stomach bloating, wounds	
<i>Hyptis capitata</i> Jacq.	USTH 015574	0.45	NA		NE	Lf	Diarrhea, gas pain and flatulence, new-born baby care, wounds	
<i>Ocimum basilicum</i> L.	USTH 015630	0.35	NA		NE	Sh	Constipation, cough, diarrhea, menstrual problem, postpartum care and recovery	
<i>Orthosiphon aristatus</i> (Blume) Miq.	USTH 015550	0.46	NA		NE	Fw, Lf	Arthritis, diabetes, diarrhea, hypertension, kidney problem, prostate problem, urinary problem	
<i>Premna odorata</i> Blanco	USTH 015559	0.60	NA	LC	EN	Lf	Colds, cough, diarrhea, fatigue, postpartum care and recovery, rheumatism, wounds	
<i>Teijsmanniodendron ahernianum</i> (Merr.) Bakh.	USTH 015603	0.11	LC		NE	Rt, St	Beriberi, body pain, labor and delivery enhancer, muscle pain, spasm	
<i>Vitex negundo</i> L.	USTH 015562	0.43	NA		NE	Lf	Cough, gas pain and flatulence, headache, postpartum care and recovery	
Lauraceae		96.84						
<i>Cinnamomum mercadoi</i> S.Vidal	USTH 015585	0.76	VU	OTS	EN	Bk, Br, Rt	Amoebiasis, cancer, cough, diarrhea, fatigue, hyperacidity, kidney problem, spasm, urinary problem	
<i>Litsea cordata</i> (Jack) Hook.f.	USTH 015580	0.28	NA		NE	Bk, Rt	Asthma, cough, goiter, myoma, pneumonia, tumor	
<i>Machilus philippinensis</i> Merr.	USTH 015576	0.07	NA	OTS	NE	St	Cough, fatigue	
Lythraceae		34.74						
<i>Lagerstroemia speciosa</i> (L.) Pers.	USTH 015596	0.35	NA		NE	Lf	Body pain, fever, kidney problem, ulcer, urinary problem	
Malvaceae		72.63						
<i>Gossypium hirsutum</i> L.	USTH 015553	0.25	VU		NE	Rt	Body pain, chilling, fever, hemorrhage, postpartum care and recovery	
<i>Sidar rhombifolia</i> L.	USTH 015601	0.69	NA		NE	Lf, Rt	Body pain, chickenpox, cough, kidney, menstrual, prostate and stomach problems, skin infection, wounds	
<i>Urena lobata</i> L.	USTH 015664	0.43	NA		NE	Wh	Animal bites, arthritis, bruises, fracture and dislocation, labor and delivery enhancer, postpartum care and recovery, rheumatism	
Marattiaceae		15.79						
<i>Angiopteris evecta</i> Sw.	USTH 015658	0.11	NA	OTS	NE	Rt	Cramp and spasm, postpartum care and recovery	
Melastomataceae		40.00						
<i>Medinilla teysmannii</i> Miq.	USTH 015581	0.25	NA		NE	Lf	Gas pain and flatulence, muscle pain, sprain and swellings	
<i>Melastoma malabathricum</i> L.	USTH 015588	0.25	NA		NE	Sh	Diarrhea, dysentery, fever, headache, hemorrhoids	

Meliaceae		47.37					
<i>Sandoricum koetjape</i> (Burm.f.) Merr.	USTH 015624	0.41	LC	NE	Bk, Lf	Abdominal pain, diarrhea, skin diseases and infections	
<i>Swietenia mahagoni</i> (L.) Jacq.	USTH 015671	0.30	EN	NE	Bk	Amoebiasis, cough, diarrhea, fever, hypertension	
Menispermaceae		87.37					
<i>Arcangelisia flava</i> (L.) Merr.	USTH 015600	0.81	NA	NE	Rt, St	Diabetes, diarrhea, jaundice, menstrual problem, myoma, skin diseases and infections, tumor, ulcer	
<i>Tinospora crispa</i> (L.) Hook.f. & Thomson	USTH 015566	0.70	NA	NE	St	Arthritis, body pain, diarrhea, malaria, menstrual problem, rheumatism, stomach trouble, ulcer, wounds	
Moraceae		83.16					
<i>Ficus concinna</i> (Miq.) Miq.	USTH 015552	0.54	LC	NE	Bk, Lf, Rt	Arthritis, cancer, cyst, fracture and dislocation, kidney and prostate problems, tumor, wounds	
<i>Ficus fistulosa</i> Reinw. ex Blume	USTH 015561	0.43	LC	NE	Bk, Rt	Asthma, colds, cough, diabetes, fatigue, hypertension, postpartum care and recovery, respiratory problem	
<i>Ficus pseudopalma</i> Blanco	USTH 015636	0.30	NA	EN	Lf, Rt	Diabetes, hemorrhage, hypertension, kidney problem, postpartum care and recovery, spasm, stomach trouble	
<i>Ficus septic</i> Burm.f.	USTH 015623	0.52	LC	NE	Lf, Rt	Asthma, body pain, cataract, fatigue, fever, herpes simplex, muscle pain, skin diseases and infections, stomach trouble, warts	
<i>Morus alba</i> L.	USTH 015549	0.25	NA	NE	Lf	Asthma, colds, cough, muscle pain, pneumonia, spasm	
Muntingiaceae		26.32					
<i>Muntingia calabura</i> L.	USTH 015629	0.15	NA	NE	Lf	Abdominal pain, colds, diarrhea, headache, stomach trouble, ulcer	
Myristicaceae		28.42					
<i>Myristica agusanensis</i> Elmer	USTH 015611	0.17	VU	EN	Bk	Measles, bronchitis and other respiratory diseases	
Pandanaceae		23.16					
<i>Pandanus amaryllifolius</i> Roxb.	USTH 015555	0.18	NA	NE	Lf	Heart, kidney, prostate and urinary problems	
Phyllantaceae		45.26					
<i>Phyllanthus amarus</i> Schumach. & Thonn.	USTH 015590	0.41	NA	NE	Wh	Colds, fever, jaundice, kidney, new-born baby care, stomach and urinary problems	
Piperaceae		98.95					
<i>Piper aduncum</i> L.	USTH 015568	0.26	LC	NE	Lf	Asthma, cough, fracture and dislocation	
<i>Piper decumanum</i> L.	USTH 015544	0.95	NA	NE	St	Arthritis, body pain, cancer, cyst, diarrhea, poisoning, skin diseases and infections, tuberculosis, snake and insect bites, tumor, ulcer, wounds	
<i>Piper cf. nigrum</i> , 'wild'	USTH 015560	0.74			St	Acne, animal bites, body pain, cancer, cyst, diarrhea, gas pain and flatulence, poisoning, skin diseases and infections, tumor, wounds	
Poaceae		57.89					
<i>Eleusine indica</i> (L.) Gaertn.	USTH 015569	0.43	LC	NE	Wh	Arthritis, diabetes, diarrhea, internal bleeding, kidney problem, postpartum care and recovery, spasm	
<i>Imperata cylindrica</i> (L.) P.Beauv.	USTH 015605	0.10	LC	NE	Wh	Chickenpox, diarrhea, fever, measles, toothache, urinary problem,	
<i>Paspalum conjugatum</i> P.J.Bergius	USTH 015627	0.11	LC	NE	Rt	Diarrhea, dysentery, hair loss, wounds	

Rubiaceae		13.68						
<i>Uncaria lanosa</i> Wall.	USTH 015557		0.08	NA	NE	St	Diarrhea, stomach trouble	
Rutaceae		85.26						
<i>Melicope latifolia</i> (DC.) T.G.Hartley	USTH 015540		0.04	NA	NE	Bk	Cough	
<i>Melicope</i> cf. <i>triphyllo</i>	USTH 015659		0.08			St	Carbuncle	
<i>Micromelum minutum</i> (G.Forst.) Wight & Arn.	USTH 015538		0.81	NA	NE	Lf, St, Rt	Arthritis, animal and insect bites, body pain, cancer, rheumatism, skin diseases and infections, swellings, ulcer, wounds	
Solanaceae		13.68						
<i>Capsicum annuum</i> L.	USTH 015626		0.14	LC	NE	Lf	Appetite enhancer, insect bites, skin diseases and infections	
Sparmanniaceae		44.21						
<i>Grewia laevigata</i> Vahl	USTH 015547		0.42	LC	NE	Bk, Lf, Rt	Body pain, diabetes, fatigue, fever, hypertension, labor and delivery enhancer, relapse, spasm	
Urticaceae		64.21						
<i>Dendrocnide luzonensis</i> (Wedd.) Chew	USTH 015572		0.08	NA	EN	Rt	Constipation, cough, fatigue, fever, hormonal imbalance, myoma	
<i>Oreocnid erubescens</i> (Blume) Miq.	USTH 015676		0.14	LC	NE	Lf	Cough, fever, stomach trouble	
<i>Pipturus arborescens</i> (Link) C.B.Rob.	USTH 015673		0.48	NA	NE	Bk, Lf	Anxiety and depression, body pain, fatigue, hyperacidity, skin diseases and infections, wounds	
<i>Poikilospermum acuminatum</i> (Trecul.) Merr.	USTH 015655		0.22	NA	NE	St, Rt	Animal and insect bites, postpartum care and recovery, skin diseases and infections, sore eyes, ulcer	
Verbenaceae		41.05						
<i>Stachytarpheta jamaicensis</i> (L.) Vahl	USTH 015594		0.35	NA	NE	Lf, Rt	Ascariasis, boils, bruises, fever, sprain	
Xanthorrhoeaceae		25.26						
<i>Dianella ensifolia</i> (L.) DC.	USTH 015656		0.15	NA	NE	Lf, Rt	Maternal care, milk production enhancer, postpartum care and recovery	
Zingerberaceae		34.74						
<i>Curcuma longa</i> L.	USTH 015674		0.22	NA	NE	Rz	Arthritis, diabetes, cough, fever, gas pain and flatulence, insect bites, menstrual problem, wounds	

Note: ^aIUCN: NA: Not Assessed, DD: Data Deficient, LC: Least Concern, VU: Vulnerable, EN: Endangered. ^bDENR Administrative Order 2017-11, CDFP: LC: Least Concern, NT: Near Threatened, OTS: Other Threatened Species. ^cCDFP: EN: Endemic, NE: Not Endemic. ^dBk: barks; Br: branches; Fr: fruits; Fw: flowers; Lf: leaves; Rt: roots; Rz: rhizomes; Sh: shoots; St: stems; Wh: whole plants.

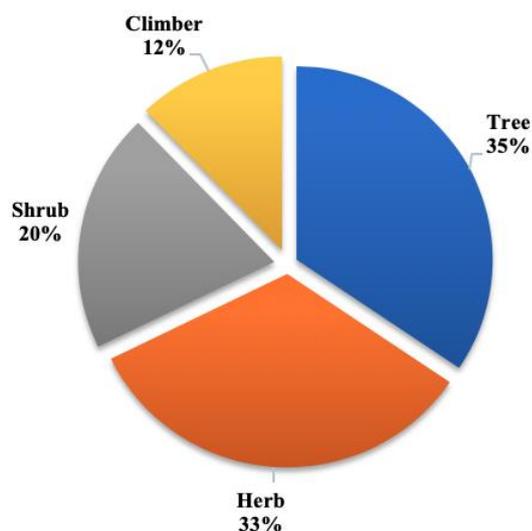


Figure 2. Habit of medicinal plants collected from the five upland barangays of Bayugan City, Agusan del Sur, Philippines

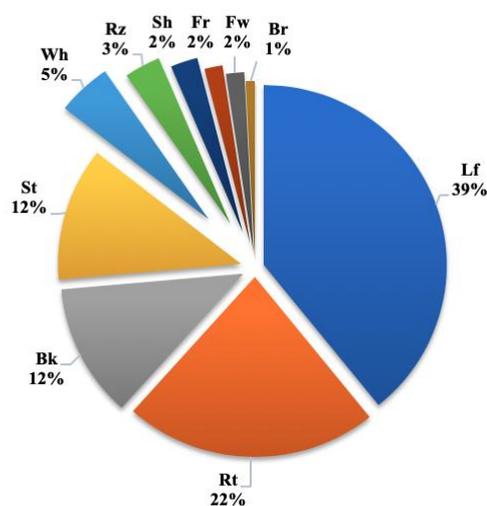


Figure 3. Plant parts used by the Agusan Manobo of Bayugan City, Philippines for medicinal application. Bk, barks; Br, branches; Fr, fruits; Fw, flowers; Lf, leaves; Rt, roots; Rz, rhizomes; Sh, shoots; St, stems; Wh, whole plant

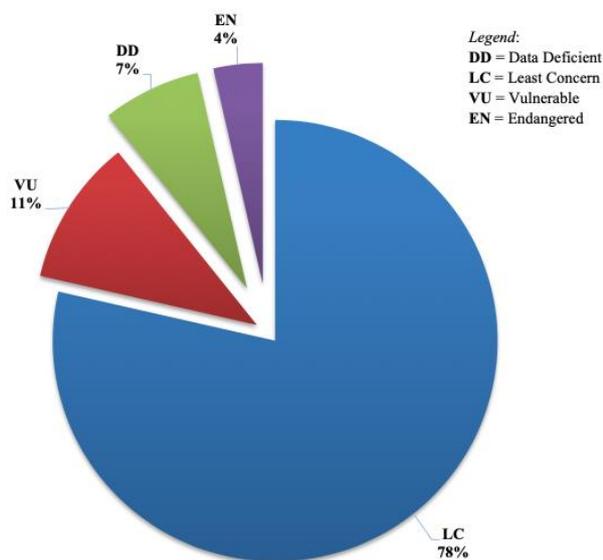


Figure 4. Conservation status of identified medicinal plants based on the International Union of Conservation of Nature (IUCN 2020).

Conservation status and endemism

While most of the medicinal plants identified from the five barangays of Bayugan City were not assessed for their conservation status based on the international (IUCN 2019) lists of threatened species, 38 plant species were recounted in different categories (Table 1; Figure 4). Conservation status of the documented medicinal plants showed 22 species as Least Concern (LC), three species as Vulnerable

(VU), two species as Data Deficient (DD), and a single species as Endangered (EN), namely *Swietenia mahagoni* (L.) Jacq. The national list of threatened species (DENR Administrative Order 2017; CDFP; Pelsler et al. 2011 onwards) revealed three species as Other Threatened Species (OTS), namely *Cinnamomum mercadoi* S.Vidal, *Machilus philippinensis* Merr., and *Angiopteris evecta* Sw; and a Near Threatened (NT) species, namely *Calamus megaphyllus* Becc.

Species distribution in terms of endemism listed 11 species as endemic (12.6%) while the majority of species are distributed in other countries (87.4%), which are assumed to have been introduced or naturalized in the Philippines (CDFP; Pelsler et al. 2011 onwards).

Discussion

Medicinal plants remain a valuable source of medicine in the healthcare system among the Agusan Manobo community in five upland barangays of Bayugan City, Philippines. All medicinal plants were evaluated equally among the Agusan Manobo community, and consistency of folk knowledge was observed.

The highest percentage of using leaves for treating diseases was also previously reported in earlier ethnobotanical studies in the Philippines (Abe and Ohtani 2013; Ong and Kim 2014) and some other countries (Namukobe et al. 2011; Ahmad et al. 2015; Polat et al. 2015). The Agusan Manobo sometimes prepares more than one plant parts like leaves, stems, and bark of the same species and in combination with other species for a synergistic efficiency against certain diseases.

The highest FIVs among the documented medicinal plants could be supported by some related studies of the same family. Piperaceae (pepper family) comprising ca.

1,000 species of herbs distributed in tropical areas of India, Southeast Asia, and Africa (Scott et al. 2008) are known to have potential gastroprotective, antibacterial, antioxidant, and anticancer activities (Rekha et al. 2014). The Piper extracts are widely known, particularly in South Asian medicinal practices as an effective antibacterial and fever-reducing treatment (Scott et al. 2008). These reported bioactivities of *Piper* species may support ethnomedicinal claims of Agusan Manobo for Piperaceae as an effective treatment for skin diseases and infections.

Lauraceae (laurel family) with more than 2,500 species are distributed within the subtropics and tropics of eastern Asia, and South and North America (Simie et al. 2004). This family was found to have potential sources for chemopreventive agents (Shen et al. 2014). Bioactivity investigation of 27 Lauraceae trees by Lin et al. (2007) revealed great potential as cancer chemoprevention agents. Al-Dhubiab (2012) validated the traditional uses of *Cinnamomum burmannii* (Nees & T.Nees) Blume as treatment of diseases like nausea, flatulent dyspepsia, coughs, and chest complains in Mexico. Also, *C. burmannii* exhibited pharmacological activities like analgesic, antibacterial, antioxidant, and antitumor activities (Al-Dhubiab 2012). These findings could support the key informants' highest citation of Lauraceae for cough treatment.

Apocynaceae (dogbane family) consists of ca. 5,350 recognized species in 378 genera (Endress et al. 2018). Plant habits of this family are trees, shrubs, and sometimes herbs or vines, and their characteristic feature is usually the possession of milky sap (Wiert 2006). This family is one of the traditional medicinal families investigated as useful in treatment for boils, burns, and wounds (Patel 2014) as well as several skin problems (Alamgeer et al. 2018). These pharmacological properties could support the common uses of Apocynaceae for wound healing.

Euphorbiaceae (spurge family) consists of ca. 300 genera and ca. 7,500 species of mostly herbs and some shrubs or trees (Rahman and Akter 2013). A total of 16 species belonging to 8 genera of Euphorbiaceae were identified medicinally important aside from the economic value of the family (Ernst et al. 2015). Global medicinal uses of *Euphorbia* L. were reported as an effective treatment for digestive system disorders, skin ailments, respiratory complaints, inflammation, and injuries (Ernst et al. 2015). These findings could support the high citation of Euphorbiaceae among the Agusan Manobo as antipyretic medicinal plant species.

Moreover, this study showed *P. decumanum* has the highest RFC, which reveals new ethnomedicinal information as an antidote for insect and snake bites to date. Recently, *P. decumanum* was evaluated containing alkaloids, flavonoids, saponins, steroids, tannins, and fatty acids, and showed low toxicity when the stem ethanolic extract was subjected to normal lymphocytes from human blood (Dapar et al. 2020b). This species seems to be characterized distinctly as ant-associated *Piper* species (Dyer and Palmer 2004). A significant amount of an amide alkaloid, Piplartine, was also observed in Piper species, which is a potent anticancer agent (Raja et al. 2018).

Several bioactive compounds and essential oils of other *Piper* species as strong agents of antioxidant, antibacterial, antifungal, and effective treatment for insect and snake bites were comprehensively reviewed by Salehi et al. (2009) which does not include the *P. decumanum* yet. An earlier study also revealed that *Piper* species were cited to be the most frequently used medicinal plant species for cuts and wounds among the Agusan Manobo of Sibagat, Philippines (Dapar et al. 2020c). The molecularly confirmed *P. aduncum* folk medicinal plant of Agusan Manobo possess antimicrobial activity and active constituents against pathogenic bacteria and low cytotoxic effect, which supported its wound healing potential (Dapar and Demayo 2017; Dapar et al. 2018; Dapar et al. 2020b). The presence of reported phytochemicals may also support the Agusan Manobo use of *P. decumanum* in treatment for insect and snake bites.

Of all documented species, *Anodendron borneense* remains no record of ethnobotanical and pharmacological investigations. However, a new triterpene ester and other chemical constituents from the aerial parts of *Anodendron paniculatum* A.DC. have been isolated for the first time, which exhibited significant cytotoxic activity against human cancer cell lines (Ho et al. 2018). However, no existing studies of *A. paniculatum* as a potential cure for problems of impotence and sterility as highly cited among the respondents in this study. Hence, the present study recommends further investigation of the biological and biochemical activities of both *Anodendron* species.

Korriem et al. (2013) demonstrated the antihyperglycemic, antihyperlipidemic and antiapoptotic activities of *Micromelum minutum*, which are all related to Microminutinin coumarin ingredient of the plant seeds. Identified chemical constituents for *M. minutum* also have potential biological property containing coumarins as potent cytotoxic agents against the T-lymphoblastic leukemia cell line (Susidarti et al. 2009). This finding supports the ethnomedicinal claims among Agusan Manobo for *M. minutum* as a treatment for cancer.

For *Arcangelisia flava*, its yellow root revealed to have antimicrobial and acidity-stabilizing effects (Heryani and Nugroho 2015) while the stems demonstrated antioxidant and cytotoxic activities (Keawpradub et al. 2005). This plant has been scientifically investigated to contain several alkaloids (Verpoorte et al. 1982). The presence of its primary alkaloid, berberine, has been known to be active antimicrobial and antimalarial agents (Subeki et al. 2005). The presence of these alkaloids may support the tribal claims of *A. flava* as a treatment for ulcers.

Crude methanolic extracts of *Cinnamomum mercadoi* exhibited antibacterial and antioxidant activities (Fuentes et al. 2010) as well as analgesic activity (Torres et al. 2003). Other *Cinnamomum* species like *C. zeylanicum* Breyne and *C. cassia* (L.) J.Presl were reported with antimicrobial activity and antitumor property, respectively, due to the present essential oils (Sharifi-Rad et al. 2017). These results could support the ethnomedicinal uses of *C. mercadoi* by the Agusan Manobo against diarrhea. *C. mercadoi* was also recorded with the highest RFC medicinal tree used among indigenous communities in

Esperanza, Agusan del Sur (Dapar et al. 2020d). *C. mercadoi* has also been reviewed for a number of local medicinal uses and phytochemical investigations as one of the interesting medicinal plants in Southeast Asia (Dapar 2020e).

Biological and biochemical investigations of all reported species under the same genus or family may imply comparable pharmacological activities in treatment against various health problems and conditions. Pharmacological investigations were recently conducted to validate medicinal plants utilized among the locals and tribal communities in Mindanao such as *Gliricidia sepium* (Jacq.) Kunth ex Steud. (Abdulaziz et al. 2019), *Dracontomelon dao* (Blanco) Merr. & Rolfe (Dela Peña 2019), *Cocos nucifera* L. (Uy et al. 2019), *Atuna racemosa* Raf. (Nadayag et al. 2019), and *Allium ampeloprasum* L. (Añides et al. 2019).

The results of this study also revealed the occurrence and distribution of medicinal flora in the upland areas of the Agusan Manobo tribe in Bayugan City. Their ancestral territories are habitats of abundant medicinal plant resources that should be extensively documented and protected. These findings support the issuance of Certificate of Ancestral Domain Title (CADT) by the NCIP and DENR among indigenous communities, which serve as critical components in biodiversity preservation strategy. Indigenous protected areas program should be initiated by the LGU, which confer considerable economic and cultural benefits among the Manobo and other ICCs/IPs. The government should also reinforce the IPs right to use, access, and act as stewards of their ancestral lands. Both local people and the LGU should positively get involved in biodiversity conservation programs and strategies for sustainable protection and management of medicinal plant resources as part of the world's cultural heritage.

This study presents the rich medicinal plant knowledge of Agusan Manobo living in five upland areas of Bayugan City, Agusan del Sur. Anthropogenic activities could be observed in the upland areas such as overexploitation, poaching, logging, and deforestation, hence, a need for conservation policy and strict protection must be implemented by the local government units. It is highly recommended for the Manobo peoples' intervention to actively participate as key informants in governmental programs for conservation to sustain their cultural heritage of traditional medicine and conserve these cultural community resources. Ethnomedicinal appraisal such as this study could pave the way for further pharmacological investigations and clinical studies to validate folk medicinal uses of these plants.

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