Prioritizing plants for conservation in forests over limestone in Guiuan Marine Resource Protected Landscapes and Seascapes (GMRPLS), Samar Island, Philippines using a localized conservation priority index (LCPI)

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Abstract

Philippine landscapes and seascapes have been undergoing massive degradation especially with the onset of the Anthropocene epoch. The unique forests over limestone in Guiuan Marine Resource Protected Landscapes and Seascapes in Eastern Samar have never been exempted from ongoing deteriorating conditions leading to the diminishing ecosystem services for the nearby villages. Conservation plan and action are urgent. The current paper determines top-priority plants for conservation using the localized conservation priority index (LCPI), which considers the contexts of the locality. LCPI follows a point scoring procedure recognizing holistic social, cultural, ecological and biophysical variables, such as cultural use, frequency value of occurrences in study plots, species distribution, harvesting risk, and economic use. Research findings indicated *Caryota rumphiana* Mart., *Saribus rotundifolius* (Lam.) *Blume Artocarpus blancoi* (Elmer) Merr., *Shorea negrosensis* Foxw., *Alstonia scholaris* (L.) R. Br., *Calophyllum soulattri* Burm.f., *Artocarpus rubrovenius* Warb., *Nothaphoebe leytensis* (Elmer) Merr., *Shorea astylosa* Foxw., *Palaquium* sp., *Heterospathe intermedia* (Becc.) Fernando, *Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen, *Aquilaria cumingiana* (Decne.) Ridl., *Wallaceodendron celebicum* Koord., *Palaquium luzoniense* (Fern.-Vill.) Vidal, *Mastixia* sp., *Wrightia* sp., Lubi-lubi, Kuyakya and *Neonauclea formicaria* (Elmer) Merr. The leaves, stems, fruits, and flowers are the most-commonly harvested plant parts in high-priority level species, most of which are primarily used for housing and construction. The identified plants were geotagged to intensify onsite protection. The findings are of extreme relevance in providing guidance to protected area staff, local people organizations, and community residents in embarking on urgent conservation action in conserving locally vulnerable biodiversity in order to sustain ecosystem services.

Keywords

plant biodiversity | ecosystem landscape deterioration | forests over limestone | karst landscape | LCPI | threatened plants

Introduction

Samar Island's forests over limestone are recognized with its unique biodiversity (Fernandez et al., 2020, Obeña et al., 2021; Villanueva et al., 2021a, 2021b; Tolentino et al., 2020), particularly the Guiuan Marine Resource Protected Landscape and Seascape (GMRPLS) of Eastern Samar. This landscape and seascape are frequently visited and disturbed by strong typhoons, and storm surges since it is along the Pacific Ocean (Buot et al., 2024). Despite this, it still provides a wide range of ecosystem services that include healthy soils, clean drinking water, climate regulation, recreational and aesthetic benefits (Jenkins and Schaap, 2018; Buot et al., 2022).

Several studies have therefore emphasized the role of protected areas, such as protected landscapes and seascapes, in biodiversity conservation and the prevention of threatened species extinction (Karanth et al., 2010; Oldekop et al., 2016). However, GMRPLS is currently undergoing a catastrophic anthropogenic extinction event, causing deleterious effects to vegetation. These disturbances have the potential to alter species biology, affecting reproduction rates and making re-establishment of plant population difficult (Ribeiro et al., 2015; Ribeiro-Neto et al., 2016). As a result, the diversity of plant resources is declining. If this trend is sustained, a remarkable decrease of the community wellbeing index will be imminent (Buot, 2017; Buot and Buot, 2022, 2023; Buot and Cardenas, 2018; Buot and Dulce, 2019; Buot et al., 2020; Buot et al., 2017).

However, to counteract the reduction in forest resources, biological surveys and inventories in GMRPLS were done to provide insights and fundamental knowledge on the species found therein (Fernandez et al., 2020). Unfortunately, most documented plant resources lack global and national risk assessments, leading to inability to identify which specific plant species are at high risk of extinction (Nic Lughadha et al., 2020). Therefore, prioritizing plants for conservation at the local level which had been recognized as an important strategy in safeguarding biodiversity, is urgent, knowing that not all plant species have been assessed by the IUCN or included on the Philippine red list of threatened species. After all, the local context ought to prevail in decision making. Setting locally based conservation priority indicators has been advocated by several researchers (Sopsop and Buot, 2009, 2011; Chanthavong and Buot, 2019a, 2019b; Villanueva and Buot, 2020; Buot et al., 2024). This will help establish sound and relevant conservation plans (National Research Council 1992) at the village level. The necessity for a priority-setting procedure is motivated by limited conservation resources, which entail selection from a subset of all available species in any given geographical area, based on their perceived vulnerability to extinction or community importance, justifying need for conservation action. It explicitly focuses on which species require conservation attention, with local people playing an active role (Brehm et al. 2010; Buot et al., 2024). By establishing conservation priorities, decision-makers and conservationists consider that some species are more essential than others and that certain species should receive the most protection (Given and Norton, 1993; Vane-Wright et al., 1991).

Incidentally, there has been no attempt to prioritize species for conservation within the protected landscape and seascape of Guiuan, Eastern Samar. Hence, this study attempts to evaluate the localized conservation priority index (LCPI) of species in order to determine the 20 top-priority plants for conservation in GMRPLS. Specifically, this study determines the level of priority of the plants in, provides some notes of the top-priority species for conservation and geotags their occurrences in the field plots to enhance in situ conservation. This localized priority index of the unique

species in GMRPLS is an important step that will help the forest managers, policy makers and local inhabitants in developing appropriate conservation management plan in the landscape and seascape. It will also address the Sustainable Development Goals 1 (no poverty), 4 (quality education), 8 (decent work and economic growth), 11 (sustainable cities and communities), 12 (responsible consumption and production), 13 (climate action), 15 (life on land) and 17 (partnership to achieve goals).

Materials and Methods

The Localized Conservation Priority Index (LCPI)

In determining the priority level of each plant species, we followed the procedures discussed by Buot et al. (2024) without any modification. According to that paper (Buot et al., 2024), the Localized Conservation Priority Index or LCPI is a point scoring method used to sort according to priority level considering the criteria such as harvesting risk, cultural use, economic use, species distribution and frequency value. The sources of information such as plant uses were obtained from survey, websites and indexed scholarly literature.

Scores range from 1-5 for each indicator, 1 for lowest and 5 for highest, where a higher score could indicate a higher vulnerability and hence, higher conservation priority. For the harvesting risk, we consider that one plant part is worth 1 point risk. So, if 5 plant parts (roots, leaves, stems, flowers and fruits) are harvested, then a score of 5 is given. If only 4 parts are harvested, then a score of 4 is given. This is true in decreasing order if only 3, 2 or 1 plant part is harvested. The same is true for the economic and cultural uses criteria. Our source of information here are either published scholarly papers or key informants from the locality. If the plant has 5 economic or cultural uses or more, the score is 5. The score decreases with decreasing number of uses. For the species distribution, we gathered data from the floras (Merrill, 1923-1926; Pelser et al., 2011-onwards; Rojo, 1999) and online databases like the International Plant Name Index (IPNI, 2020), and World Flora Online. The more restricted the distribution of a species, the higher is the score, since the threat is higher. So, if the species is only distributed in Samar, the score given is 5. If it is found in Visayas and Mindanao, whole country (Philippines), Asia and the world (cosmopolitan), the scores are 4, 3, 2 and 1, respectively. The frequency value has been based on the gathered plot data, referring to the occurrence value of each plant in the study site. Frequency values of 0-20 will score 5 as it is rare and will be vulnerable. Frequency values of 21-40, 41-60, 61-80, 81-100 will have scores of 4, 3, 2 and 1, respectively.

A slight modification of the formula used by Villanueva and Buot (2020) was done and the scores of the criteria can be summed up using the formula:

Localized Conservation Priority Index (LCPI) *= Harvesting Risk (HR) + Economic Use (EU) + Cultural Use (CU) + Species Distribution (SD) + Frequency Value (FV)*

To reach a decision as basis for the action, Table 1 was used as a guide in categorizing the levels of conservation priority for every plant species (Villanueva and Buot, 2020). Based on the formula above, the plant can have a maximum of 25 points, with a higher score indicating a higher conservation priority.

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Table 1. Priority scores and priority levels for each plant and the corresponding recommended action to take (Villanueva and Buot 2020).

Score	Priority level	Decision
1-8	Low	Suitable for high impact harvesting
9-16	Medium	Can be harvested with specific quotas
17-25	High	Require strict regulation in harvesting

Geotagging of the Priority plants

Plants identified for priority conservation at GMRPLS were geotagged for awareness and additional protection by park staff and local people as well. Manual geotagging was done using Google Earth application, within the 9 sampling plots in GMRPLS, previously assessed by CONserve-KAIGANGAN project Phase 1.

Results and Discussions

Localized conservation priority index of plants at Guiuan Marine Resource Protected Landscapes and Seascapes

Fernandez et al. (2020) documented a total of 35 major plant species belonging to 16 families at the GMRPLS (Table 2). It presents the plant resources at GMRPLS with the respective common names, scores per indicator and the priority level. Results reveal a total of 10 plants classified as high priority level and 25 plants categorized as medium priority level (Table 2). The low priority level species are suitable for high impact harvesting in the protected landscape. Moreover, among the species recorded, 12 species obtained a harvesting risk (HR) score of 5, indicating that all parts of the plants (roots, stems, leaves, flowers and fruits) are harvested and utilized. The species with the highest harvesting risk are *A. scholaris, C. rumphiana, H. intermedia, S. rotundifolius, C. soulattri, S. negrosensis, W. celebicum, N. leytensis, A. rubrovenius, P. luzoniense, Palaquium* sp., and *A. cumingiana*. On the other hand, the species with the highest score in economic use (EU) are *A. scholaris, C. rumphiana, S. rotundifolius, C. soulattri, S. negrosensis, A. blancoi, A. rubrovenius,* and *A. cumingiana*. These eight (8) species are widely used for a variety of uses, including food, timber, construction materials, fiber, and raw materials for rope, among others. In terms of cultural use (CU), only *C. rumphiana* received a 4-point score, while *A. scholaris, S. rotundifolius,* and *A. cumingiana* obtained a 3-point score. In Samar Island, the leaves of *C. rumphiana* are used as decoration for churches especially, during religious festivities while the resins of *A. cumingiana* are commonly used as incense in ceremonial rites (Table 3). In terms of species distribution (SD), *H. wenzeliana, N. leytensis* and *G. reticulatus* are only found in Visayas and Mindanao. Nine (9) species such as *M. oblongifolium, H. intermedia, S. astylosa, S. negrosensis, W. celebicum, N. leytensis, A. blancoi, A. rubrovenius,* and *N. formicaria* are found in the Philippines, and 12 species such as *A. scholaris*, *C. rumphiana, S. rotundifolius, C. soulattri, M. tanarius, G. gnemon, S. comosa, F. ampelas, F. minahassae, B. glauca, P. luzoniense,* and *A. cumingiana* are found outside the country. Eight (8) species (Lubi, Kuyakya, Bayarong, Atipon, Dalunutan, Amahoyan, Bagnaw, and Bago-eho) are not yet identified and four (4) species (*Wrightia* sp., *Mastixia* sp., *Ficus* sp. and *Palaquium* sp) are only identified up to the genus level and hence, we cannot ascertain yet of their distribution range besides Samar Island (Table 2). In terms of Frequency Value (FV), *Wrightia* sp., *C. rumphiana, S. rotundifolius, Mastixia* sp., *S. astylosa, H. wenzeliana, N. leytensis, A. blancoi,* Lubi, Kuyakya, Dalunutan, Amahoyan and Bagnaw obtained a 5-point score in LCPI, indicating their higher vulnerability to risk due to rare occurrences in GMRPLS (Table 2). Therefore, a concerted conservation effort at the local level must be undertaken to prevent eventual loss of these threatened species.

Table 2. Priority scores and priority levels for each plant species in Guiuan Marine Resource Protected Landscape and Seascape (GMRPLS).

Family/Scientific Name	Common Name	HR	EU	CU	SD	FV	TOTAL SCORE	PRIORITY LEVEL
Annonaceae								
Monoon oblongifolium (C.B.Rob.) B.Xue & R.M.K.Saunders	Lapisan	4	1	2	2	1	10	Medium
Apocynaceae								
Alstonia scholaris (L.) R. Br.	Dita	5	5	3	1	4	18	High
Wrightia sp.	Hamor-awon	4	2	2	2	5	15	Medium
Arecaceae								
Caryota rumphiana Mart.	Pugahan, Tagabunga	5	5	4	1	5	20	High
Heterospathe intermedia (Becc.) Fernando	Banga	5	3	2	2	4	16	Medium
Saribus rotundifolius (Lam.) Blume	Anahaw	5	5	3	1	5	19	High
Clusiaceae								
Calophyllum soulattri Burm.f.	Pamintaogon	5	5	2	1	4	17	High
Cornaceae								
Mastixia sp.	Tul-anan	4	2	2	2	5	15	Medium
Dipterocarpaceae								
Shorea astylosa Foxw.	Yakal	4	4	2	2	5	17	High
Shorea negrosensis Foxw.	Red lauan	5	5	2	2	4	18	High
Euphorbiaceae								
Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen	Apanang	4	3	1	3	5	16	Medium
Macaranga tanarius (L.) Müll.Arg.	Minunga, Binunga	2	2	2	1	3	10	Medium
Fabaceae								
Wallaceodendron celebicum Koord.	Banuyo, Salukigi	5	2	2	2	4	15	Medium
Gnetaceae								
Gnetum gnemon L.	Bago	4	3	2	1	1	11	Medium
Lauraceae								
Nothaphoebe leytensis (Elmer) Merr.	Bagubahi	5	2	2	3	5	17	High
Malvaceae								
Sterculia comosa Wall.	Balinad	3	2	2	1	2	10	Medium
Moraceae								
Artocarpus blancoi (Elmer) Merr.	Antipolo	4	5	2	2	5	18	High
Artocarpus rubrovenius Warb.	Tugop	5	5	2	2	3	17	High
Ficus ampelas Burm.f.	Lanete, Upling-gubat	2	3	2	1	4	12	Medium
Ficus minahassae (Teijsm. & Vriese) Miq.	Hagimit	1	2	2	1	3	9	Medium
Ficus sp.	Dalakit	4	1	2	2	3	12	Medium
Phyllanthaceae								
Bridelia glauca Blume	Anislag	4	3	2	1	2	12	Medium
Rubiaceae								
Neonauclea formicaria (Elmer) Merr.	Hambabalud	4	2	2	2	4	14	Medium

Family/Scientific Name	Common Name	HR	EU	CU	SD	FV	TOTAL SCORE	PRIORITY LEVEL
Sapotaceae								
Palaquium luzoniense (Fern.-Vill.) Vidal	Nato	5	3	2	1	4	15	Medium
Palaquium sp.	Bagotambis	5	4	2	2	4	17	High
Thymelaeaceae								
Aquilaria cumingiana (Decne.) Ridl.	Agar, Lapnisan	5	5	3	1	2	16	Medium
Gonystylus reticulatus (Elmer) Merr.	Batuan	2	1	2	3	4	12	Medium
	Lubi-lubi	2	2	1	5	5	15	Medium
	Kuyakya	2	1	1	5	5	14	Medium
	Bayarong	2	2	1	5	3	13	Medium
	Atipon	2	1	1	5	4	13	Medium
	Dalunutan	2	1	1	5	5	14	Medium
	Amahoyan	2	1	1	5	5	14	Medium
	Bagnaw	2	1	1	5	5	14	Medium
	Bago-eho	2	1	1	5	3	12	Medium

Table 3 presents the top 20 plants for priority conservation in GMRPLS. These top 20 priority species from 12 families have the highest scores in LCPI ranging from 14-20 points.

Ten (10) of the top 20 species have LCPI scores ranging from 17 to 20 points, indicating a high conservation priority level and the need for strict harvesting regulations in GMRPLS forests over limestone. These species are *C. rumphiana, S. rotundifolius*, *A. blancoi*, *S. negrosensis, A. scholaris*, *C. soulattri*, *A. rubrovenius, N. leytensis, S. astylosa*, and *Palaquium* sp. (Tables 2 and 3). The leaves, stems, fruits, and flowers are the most-commonly harvested plant parts most of which are primarily used for housing and construction materials. For example, the locals in Samar usually use the species of *S. rotundifolius*, *A. blancoi*, *S. negrosensis*, *N. leytensis*, *S. astylosa*, and *Palaquium* sp. as lumber and housing materials. *C. rumphiana* and *S. rotundifolius* are used to decorate churches for daily masses and religious festivals. Furthermore, these are used as ornaments to commemorate All Soul's Day. In terms of the species distribution criterion, the only endemic species under high- priority level of GMRPLS are *N. leytensis*, *A. blancoi*, *A. rubrovenius*, *S. negrosensis*, and *S. astylosa*. The geographic distribution of the remaining species is cosmopolitan, and hence, can be found in many places other than Philippines (Table 3). It is noteworthy that only *N. leytensis* has a geographic distribution within the Visayas and Mindanao, thus, having the highest points earned for this criterion. These high-priority level species mostly got 5-points in the frequency value criterion, indicating that species occurrence is low. *C. rumphiana*, *S. rotundifolius*, *A. blancoi*, *N. leytensis*, and *S. astylosa*. *S. negrosensis*, *A. scholaris*, and *C. soulattri* have 4-points score while *A. rubrovenius* has 3-points.

The priority species ranking 11-20 in GMRPLS obtained a score ranging from 14-16 in LCPI, classifying them as medium priority level species and can be harvested with specific quotas. These include *H. intermedia, H. wenzeliana, A. cumingiana, W. celebicum, P. luzoniense, Mastixia* sp., *Wrightia* sp., Lubi, Kuyakya and *N. formicaria.* To ensure the survival of these top 20 priority species, harvesting must be strictly regulated not just in the GMRPLS forests over limestone, but also in Samar Island Natural Park and other places in the Philippines.

The distribution and the conservation status of the top 20 priority plants per LCPI are also shown in Table 3. There are priority species with limited distribution and are threatened species as well per IUCN and DAO 2017-11. *H. wenzeliana* and *N. leytensis* are only found in Visayas and Mindanao, besides Guiuan. *H. wenzeliana* had a 16-point score in LCPI and is classified as critically endangered by the IUCN but has no conservation status per DAO 2017-11. On the other hand, *N. leytensis* obtained an LCPI score of 17 and has no conservation status on either the Philippine red list or the IUCN. It is noteworthy that in GMRPLS, *H. wenzeliana* has only a medium priority level, in contrast to the IUCN's Critically Endangered status. This means that in Samar Island's GMRPLS, people are either not using this resource intensively or they might have tried their best to sustainably manage its population. In contrast, *N. leytensis* which has no current conservation assessment, has a medium priority level at GMRPLS and could vanish anytime in the future if nothing will be done.

H. wenzeliana and *N. leytensis* are just two examples of important species with varying conservation status assessments in IUCN, DAO 2017-11 and LCPI in this study in GMRPLS. More species of similar case can be found in Table 3 and certainly, a lot more in many biodiversity checklists and inventories. This illustrates that conservation status can vary with organization and even with locality, and hence assessments should be localized according to local context, such as the use LCPI in this study. With local assessment, the local government unit and the community can at least start the conservation action to prevent untoward biodiversity loss, disrupting ecosystem services.

Table 3. Uses, distribution and conservation status of the top 20 priority species in Guiuan Marine Resource Protected Landscapes and Seascapes.

Rank	Family/Scientific Name	Uses	Distribution	Conservation status		LCPI
				DAO 2017-11	IUCN	
1	**Arecaecea**					
	Caryota rumphiana Mart.	Food, medicine, fabric and fiber, furniture, plant selling (landscaping, ornamentals, seedling), religious, festival	Cosmopolitan	-	Least concern	20
2	*Saribus rotundifolius* (Lam.) Blume	Food, housing/ construction materials, furniture, accessories for trapping and hunting wildlife, plant selling (landscaping, ornamentals, seedling), material used for boat, religious	Cosmopolitan	Other Threatened Species	-	19
3	**Moraceae**					
	Artocarpus blancoi (Elmer) Merr.	Food, housing/ construction material, fodder and forage, accessories for trapping and hunting, firewood, and charcoal	Within the Philippines	-	Least concern	18
4	**Dipterocarpaceae**					
	Shorea negrosensis Foxw.	Medicine, housing/ construction materials, furniture, fodder and forage, firewood, and charcoal	Within the Philippines	Vulnerable	Least concern	18
5	**Apocynaceae**					
	Alstonia scholaris (L.) R. Br.	Housing/ construction materials, medicine, industrial, plant selling (landscaping, ornamentals, seedling), pulp, ceremonial	Cosmopolitan	-	Least concern	18
6	**Clusiaceae**					
	Calophyllum soulattri Burm.f.	Food, medicine, housing/ construction materials, furniture, handicrafts, accessories for trapping and hunting wildlife, plant selling (landscaping, ornamentals, seedling)	Cosmopolitan	-	Least concern	17

Rank	Family/Scientific Name	Uses	Distribution	Conservation status		LCPI
				DAO 2017-11	IUCN	
7	**Moraceae**					
	Artocarpus rubrovenius Warb.	Food, medicine, housing/ construction materials, furniture, handicrafts, accessories for trapping and hunting wildlife, firewood, and charcoal	Within the Philippines	Other Threatened Species	-	17
8	**Lauraceae**					
	Nothaphoebe leytensis (Elmer) Merr.	Housing/ construction materials	Mindanao and Visayas	-	-	17
9	**Dipterocarpaceae**					
	Shorea astylosa Foxw.	Medicine, housing/ construction materials, furniture	Within the Philippines	Critically Endangered	Endangered	17
10	**Sapotaceae**					
	Palaquium sp.	Housing/ construction materials, fodder and forage, plant selling (landscaping, ornamentals, seedling)	-	-	-	17
11	**Arecaceae**					
	Heterospathe intermedia (Becc.) Fernando	Housing/ construction materials, fodder, and forage, plant selling (landscaping, ornamentals, seedling)	Within the Philippines	-	-	16
12	**Euphorbiaceae**					
	Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen	Housing/ construction materials, fodder and forage, firewood, and charcoal	Mindanao and Visayas	-	Critically Endangered	16
13	**Thymelaeaceae**					
	Aquilaria cumingiana (Decne.) Ridl.	Food, medicine, industrial, fodder and forage, plant selling (landscaping, ornamentals, seedling), religious	Cosmopolitan	Vulnerable	Vulnerable	16
14	**Fabaceae**					
	Wallaceodendron celebicum Koord.	Furniture, plant selling (landscaping, ornamentals, seedling)	Within the Philippines	Vulnerable	-	15
15	**Sapotaceae**					
	Palaquium luzoniense (Fern.-Vill.) Vidal	Housing/ construction materials, fodder and forage, plant selling (landscaping, ornamentals, seedling)	Cosmopolitan	Vulnerable	Vulnerable	15
16	**Cornaceae**					
	Mastixia sp.	Housing/ construction materials, furniture	-	-	-	15
17	**Apocynaceae**					
	Wrightia sp.	Housing/ construction materials, fodder, and forage	-	-	-	15
18	Lubi	Housing/ construction materials, furniture	-	-	-	15
19	Kuyakya	Housing/ construction materials	-	-	-	14
20	**Rubiaceae**					
	Neonauclea formicaria (Elmer) Merr.	Medicine, housing/ construction material	Within the Philippines	-	Least concern	14

Some notes on the top 20 plants for priority conservation

Caryota rumphiana Mart.

This species is the top-priority in GMRPLS obtaining a score of 20-points in LCPI (Figure 1a). It has the highest score in harvesting risk, economic use, cultural use, and frequency value in GMRPLS. This species is used as an ornamental (Tropical Plants Database 2022). It is a raw material for furniture and can be used to make a variety of dishes. The fiber of *C. rumphiana* is used for fish traps, for sewing, for kindling fires, and as wadding (Tropical Plants Database, 2022). In Samar, its leaves are used for church and for fiesta as decoration. The locals also reported that the roots are utilized for herbal medicine. This species is distributed in the areas of Bismarck Arch, Moluccas, New Guinea, Soloman Island, and Sulawesi. In the Philippines, it is recorded in the province of Samar (Pelser et al., 2011 onwards).

Fig 1. Some of the top-priority plants in GMRPLS, a) *Caryota rumphiana*, b) *Saribus rotundifolius*, c) *Alstonia scholaris*, d) *Nothaphoebe leytensis*, and e) *Hancea wenzeliana.* Photos: CONserve-KAIGANGAN.

Saribus rotundifolius (Lam.) Blume

This is the second top-priority species in GMRPLS and is commonly used as an ornamental (Figure 1b). Its leaves are used to decorate churches in Samar and as food packaging. The locals also used this species for wall, roof or ceiling, and flooring purposes. The fruits had been reported to be edible (Tropical Plants Database, 2022; National Parks Board, 2022). This species is distributed in Java, Lesser Sunda Islands, Malay Peninsula, Moluccas, Sulawesi, and Philippines, which include Albay, Benguet, Camarines, Davao, La Union, Laguna, Mindoro, Negros, Palawan, Pampanga, Pangasinan, Polillo, Quezon, Samar, and Zambales (Pelser et al., 2011 onwards).

Artocarpus blancoi (Elmer) Merr.

This species is the third in rank in terms of conservation priority in GMRPLS. It is used as timber for light construction and its fiber as raw material for ropes, pulp, and paper (Brink et al., 2003; Djarwaningsih, 1995). The leaves, fruits, and seeds have been reported edible (Ragragio et al., 2013). In Samar Island, the fruit is consumed by the locals and is also used as bait to capture birds and rats. The Aeta people use this as mosquito repellant and as a trap for hunting (Obico and Ragragio, 2014). This species is endemic to the Philippines and is distributed in the provinces of Batan, Cebu, Bataan, Ilocos Norte, Mindoro, Negros, Palawan and Rizal (Pelser et al., 2011 onwards).

Shorea negrosensis Foxw.

This is the fourth in rank among the top-priority species recorded in GMRPLS. It is primarily used for housing, construction, and furniture material (Sosef, 1993; Garcia et al., 2013; Ghazoul, 2016). It has been reported to have tumor-inhibiting properties (NRCM, 1986; Sosef, 1993) and the locals in Samar use its stem and branches as fuelwood. Key informants observed that the fruits are eaten by birds and wild pigs. This endemic species is distributed in the provinces of Albay, Aurora, Basilan, Biliran, Cagayan, Camarines, Cebu, Isabela, Laguna, Leyte, Nueva Ecija, Polillo, Quezon and Samar (Pelser et al., 2011 onwards).

Alstonia scholaris (L.) R. Br.

This species is the fifth in rank obtaining 18-points LCPI score (Figure 1c). It can be used as a timber and material for light construction. It is also used as ornamental plant (Teo, 2001) and for decoration. In Samar, the species is known to have medicinal properties and is used to treat bone fractures. This species is widely distributed in Andaman Islands, Australia, Bangladesh, Bhutan, Bismarck Arch, Borneo, Cambodia, China, India, Java, Laos, Lesser Sunda Isls, Malay Peninsula, Moluccas, Myanmar, Nepal, New Guinea, Nicobar Islands, Pakistan, Philippines, Solomon Islands, Sri Lanka, Sulawesi, Sumatra, Thailand, and Vietnam. In the Philippines, this species was recorded in Luzon (Abra, Albay, Balabac, Bataan, Batangas, Cagayan, Catanduanes, Ifugao, Ilocos Norte, La Union, Laguna, Mindoro, Mountain Province, NCR, Palawan, Quezon, Rizal), Mindanao (Dinagat and Zamboanga), and Visayas (Negros and Panay) (Pelser et al., 2011 onwards).

Calophyllum soulattri Burm.f.

This species is the sixth in rank among the top-priority plants for conservation in GMRPLS. It is edible and has medicinal properties (NParks, 2009). The timber of *C. soulattri* is used for housing, construction, and boat material (Tropical Plant Database 2023). It is also used as an ornamental (Lemmens, 1993a). This species is widely distributed in Andaman Islands, Australia, Borneo, Cambodia, Java, Lesser Sunda Islands, Malay Peninsula, Moluccas, New Guinea, Nicobar Islands, Pacific Ocean, Philippines, Sulawesi, Sumatra, Thailand, Vietnam. In the Philippines, this species was distributed

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in Batan De Albay, Luzon (Albay, Aurora, Bataan, Bulacan, Busuanga, Cagayan, Camarines Norte, Camarines Sur, Catanduanes, Isabela, Laguna, Mindoro, Mountain Province, Nueva Ecija, Nueva Vizcaya, Palawan, Pangasinan, Quezon, Rizal, Sibuyan, Sorsogon, Ticao, Zambales), Mindanao (Agusan Del Norte, Bukidnon, Davao Oriental, Davao Del Sur, Lanao Del Sur, Surigao), and Visayas (Guimaras, Leyte, Negros and Samar) (Pelser et al., 2011 onwards).

Artocarpus rubrovenius Warb.

The seventh in rank species for priority conservation in can be used for construction and as a material for wood carving. Its bark also has medicinal property (NRMC, 1986; Brink et al., 2003). *A. rubrovenius* is endemic to the Philippines and is distributed in the provinces of Albay, Aurora, Batan, Bataan, Batangas, Camarines, Isabela, Laguna, Mindoro, Pampanga, Quezon, Rizal, and Sorsogon (Pelser et al., 2011 onwards).

Nothaphoebe leytensis (Elmer) Merr.

This species is recorded in GMRPLS and ranked eighth in the top-priority (Figure 1d). The locals use the stem of this species as housing and construction material, while the roots are utilized as traditional medicine. This endemic species is distributed in the provinces of Dinagat, Leyte, Panay, and Samar (Pelser et al., 2011 onwards).

Shorea astylosa Foxw.

This species is ranked ninth in the conservation priority in GMRPLS. It is used as a material for heavy construction and has important medicinal properties as well (NRCM, 1986). Locals in Samar utilize this species for lumber, furniture making, and even food. This species is endemic to the Philippines and is critically endangered (DAO 2017-11). It is distributed in the provinces of Agusan, Biliran, Camarines, Davao, Ilocos Norte, Negros, Quezon, Samar, and Zamboanga, (Pelser et al., 2011 onwards).

Palaquium sp.

This species is ranked tenth with 17-points score in LCPI. In Samar, the locals use this plant as construction material. The fruits are edible and are eaten by birds, monkeys, wild pigs, and deer in Samar. Some *Palaqium* sp. are endemic to the Philippines, and some can also be found in other parts of the world.

Heterospathe intermedia (Becc.) Fernando

This endemic species ranked eleventh in the priority list in GMRPLS. It is grown as an ornamental in Samar and locals use the leaves to make walls and floor coverings. Key informants reported that the fruits are eaten by wild pigs. *H. intermedia* is distributed in the provinces of Agusan del Norte, Biliran, Leyte, Samar Sorsogon, and Surigao del Norte (Pelser et al., 2011 onwards).

Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen

This species ranked twelfth in the priority list in GMRPLS (Figure 1e). The locals in Samar used the stem as housing and construction material, as well as fuelwood or charcoal. In the Philippines, this endemic species is distributed only in the province of Surigao del Norte in Mindanao (Pelser et al., 2011 onwards) and documented in Samar by this study (Fernandez et al., 2020; Villanueva et al. 2021).

Aquilaria cumingiana (Decne.) Ridl.

This species is the thirteenth in rank among the top-priority plants for conservation in GMRPLS. It is commonly called agarwood and is known for its highly priced resins extracted from the bark (Tawan, 2003). The valuable resins are used to make perfumes and aromatics, used for ceremonial incense of rituals and other religious activities (Tawan, 2003; Swee, 2008). Additionally, it is used for furniture and traditional medicine (Tawan, 2003; Swee, 2008; Persoon, 2008; Xu et al., 2013). The locals in Samar Island also use the leaves and roots as an ingredient to make coffee. It is distributed in Borneo, Moluccas and in the Philippines where it has been documented in Luzon (Alabat, Albay, Aurora, Bulacan, Camarines Norte, Camarines Sur, Catanduanes, Laguna, Nueva Ecija, Polillo, Quezon, Sorsogon and Tablas), Mindanao (Agusan del Norte, Agusan del Sur, Bukidnon, Davao del Sur, Lanao del Sur, Maguindanao del Norte, South Cotabato, Tawi-Tawi, Zamboanga del Norte, Zamboanga del Sur), and Visayas (Panay and Samar) (Pelser et al., 2011 onwards).

Wallaceodendron celebicum Koord.

This is the fourteenth species for priority conservation in GMRPLS. The timber of this species is used for furniture (NRCM, 1986). Locals in Samar reported using it in the same way. It is distributed in the areas of Sulawesi and Philippines. Locally, it can be found in the provinces of Aurora, Benguet, Burias, Cagayan, Camiguin de Babuyanes (Mount Camiguin), Cebu, Camarines, Isabela, Masbate, Negros, Quezon, and Samar (Pelser et al., 2011 onwards).

Palaquium luzoniense (Fern.-Vill.) Vidal

This species ranked fifteenth in the priority list in GMRPLS. Commonly known as red nato, it is used to make furniture and cabinets, cigar boxes, and ship planking, as well as veneer and plywood (Lemmens, 1993b). Also, the latex is used to make gutta-percha (Lemmens, 1993b). *P. luzoniense* has been documented in Sulawesi, Indonesia, and the Philippines. In the Philippines it is distributed in the provinces of Aurora, Bataan, Ilocos Sur, Masbate, Mindoro, Rizal, Sibuyan, and Zambales in Luzon; Agusan, Lanao, Surigao, and Zamboanga in Mindanao; and Panay and Samar in Visayas) (Pelser et al., 2011 onwards).

Mastixia sp.

Mastixia sp. ranked sixteenth among the priority species for conservation in GMRPLS. Locals in Samar Island use this as furniture and house construction materials.

Wrightia sp.

This species occupies the seventeenth rank in the priority list for conservation in GMRPLS is *Wrightia* sp. The stem is used by the locals for housing construction purposes while the leaves are fodder for animals.

Lubi

This unidentified species is ranked eighteenth in the priority list in GMRPLSIn Samar, this species is used by locals as lumber and material for furniture making.

Kuyakya

This second unidentified species is ranked nineteenth in priority list for conservation in GMRPLS. The local people use this plant as a material for house construction.

Neonauclea formicaria (Elmer) Merr.

This endemic species ranked 20th in the priority list for conservation in GMRPLS 14-points LCPI score. It is utilized as traditional medicine to cure various illnesses (Demetillo et al., 2019). In Samar, the local people use this species for housing construction. It is distributed in the provinces of Agusan del Norte, Biliran, Bohol, Bukidnon, Cebu, Davao, Guimaras, Misamis Occidental, Negros, Panay, Samar, Surigao del Sur, and Zamboanga del Sur (Pelser et al., 2011 onwards).

Geotagging of priority plants at Guiuan Marine Resource Protected Landscapes and Seascapes

Priority species for conservation need to be protected intensively onsite which can be accomplished by geotagging. Thus, in this study, the top 20 priority plants in the forests over limestone of GMRPLS were geotagged manually employing Google Earth application and making use of the x and y distances within the nine (9) 20m x 20m sampling plots in Pagnamitan, Baras, Ngolos and Sulangan of Guiuan, Eastern Samar, Philippines (Figure 2).

A total of 414 priority plant individuals were geotagged (Figure 3). Plot 2 had the highest number of priority species individuals (N=83), followed by plot 9 (N=76), plot 5 (N=54), plot 3 (N=51), plot 1 (N=49), plot 6 (N=39), plot 4 (N=38), plot 8 (N=19) and the least was in plot 7, with 5 individuals, respectively.

The top two (2) species with the highest number of individuals or count are *H. wenzeliana* (125 individuals) and *A. rubrovenius* (73 individuals). Incidentally, *H. wenzeliana* has also the highest number of individuals in the forests over limestone of Samar Island Natural Park (Buot et al., 2024). There were 12 priority species obtaining the lowest number of individual species. These include *C. rumphiana* (1 individual), *S. rotundifolius* (1 individual), *S. astylosa* (1 individual), Lubi (2 individuals), Palaquium sp. (2 individuals), *Wrightia* sp. (2 individuals), *A. blancoi* (3 individuals), Kuyakya (3 individuals), *Mastixia* sp. (3 individuals), *S. negrosensis* (4 individuals), *P. luzoniense* (4 individuals), and *N. leytensis* (5 individuals). The primary purpose of geotagging is to easily track the location of top-priority species for conservation, and hence, safeguarding the natural habitat, preventing drastic decline of plant population that could lead to eventual island extinction. Moreover, by tracking the location of these top-priority plants in the forests over limestone, park officials or any individual or group for that matter, can directly monitor the specific habitat occurrence of species in the field plots (Janowicz et al.2014; Yan et al. 2019; Sachdeva et al. 2020; Fouedjio et al. 2021; Nowak et al. 2021). Geotagging can save labor, time and resources in finding an important species in the field, especially, for purposes of proper protection and conservation in unique ecosystems, such as the GMRPLS forests over limestone. Additionally, geotagging location of priority species can lead conservationists in sourcing propagules for ex situ conservation such as domestication by village residents in the area.

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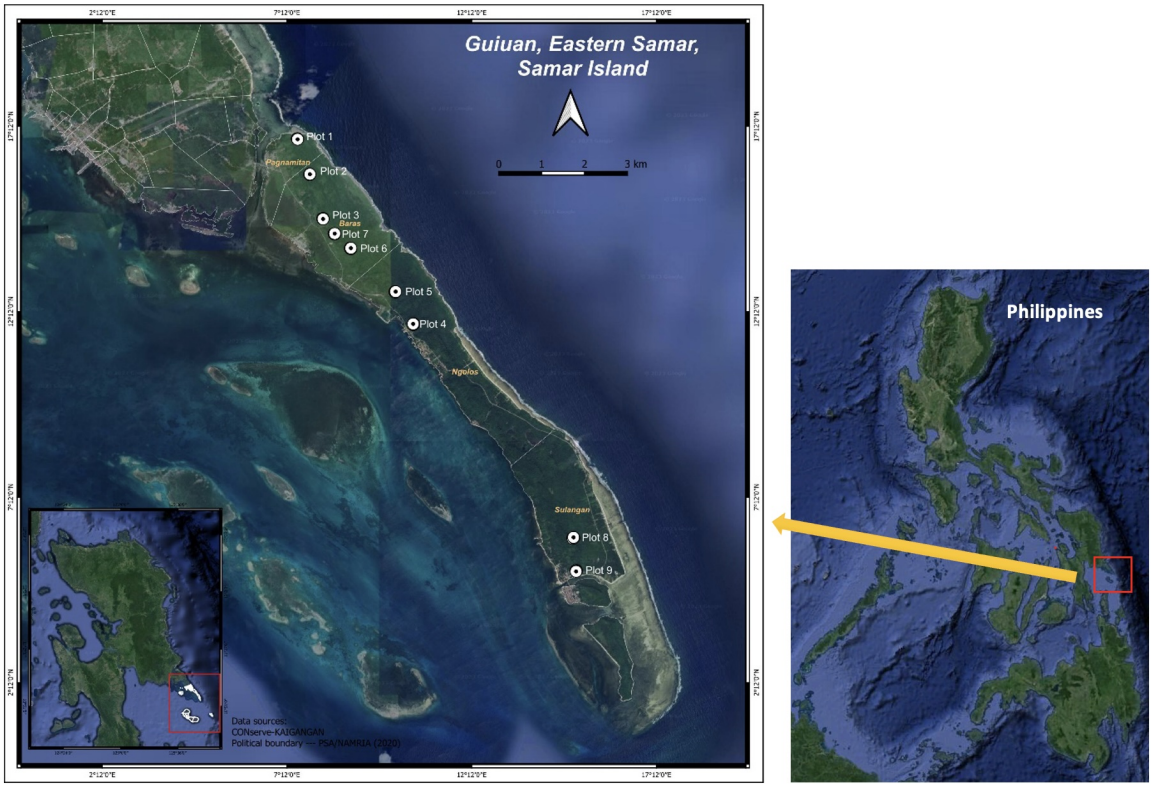

Fig 2. Plot location of the priority plants for conservation in GMRPLS.

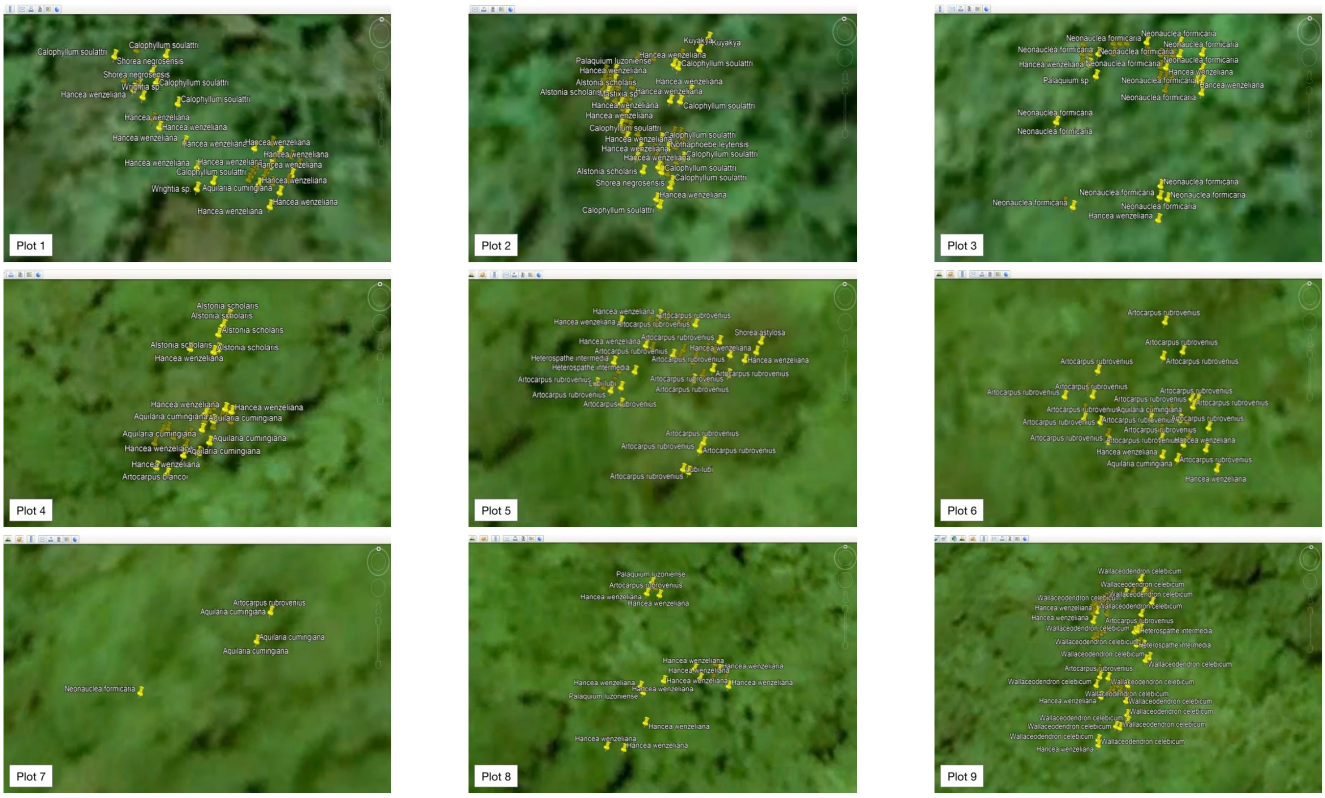

Fig 3. Geotagging the location of the top 20 priority plants in GMRPLS.

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Conclusion and Recommendation

A total of 35 plant species from the forests over limestone of Guiuan Marine Resource Protected Landscapes and Seascapes (GMRPLS) in Guiuan, Eastern Samar, Philippines, had been evaluated to identify the top 20 priority plants using the localized conservation priority index (LCPI). Ten of these priority species, namely, *C. rumphiana, S. rotundifolius*, *A. blancoi*, *S. negrosensis, A. scholaris*, *C. soulattri*, *A. rubrovenius, N. leytensis, S. astylosa*, and *Palaquium* sp., were categorized as needing high-priority level of protection, due to small numbers of individuals occurring in study plots, hence, requiring strict regulation. Almost all plant parts (roots, stems, leaves, flowers, and fruits) of these high-priority level plants are frequently harvested, mostly as housing and construction materials. The top 20 priority plants in GMRPLS had been geotagged to enhance in situ conservation in the forests over limestone. The top two (2) with the highest number of individual priority species in GMRPLS are *H. wenzeliana* (ranked 12th, with 125 individuals) and *A. rubrovenius* (ranked 7th, with 73 individuals). On the other hand, there were three (3) priority species such as *C. rumphiana* (1st rank), *S. rotundifolius* (2nd rank) and *S. astylosa* (9th rank) with only one (1) individual documented in 9 study plots of GMRPLS forests over limestone. The study recommends intensive in situ and ex situ conservation approaches. A village level domestication of the top-priority plants in home gardens or backyards can help conserve the species in a small way. The use of LCPI as a localized strategy to plant biodiversity conservation in forests over limestone in GMRPLS, which is replicable in other localities or in other ecosystems as well, is indeed urgent, since there are many plants which are not yet assessed either by IUCN or by the National Red List Committee. And even if there are current assessments, conservation statuses vary, and can only lead to wrong conservation decision at the local level. Hence, localized conservation assessments based on village level context and data obtained through ground truthing, such as the use of LCPI is relevant.

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