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Mangrove assessment and utilization in Gonzaga, Cagayan Northern Philippines

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Abstract

The status and species composition of mangrove forest is a basic and prerequisite for the management and conservation of mangrove resource. The study was conducted to determine the diversity and species composition of mangrove in Gonzaga, Cagayan, Philippines. There were 18 mangrove species identified. A total of 187 floral mangrove species were counted. The most dominant species found in the two sites, Barangays Caroan and San Jose, are the Pototan *(Bruguiera sexangula)* and Pagatpat *(Sonneratia alba) while* the least dominant species thriving in the two sites are Pedada *(Sonneratia caseolaris)* and Piag-ao *(Xylocarpus moluccensis)*. The index of similarity of two (2) mangrove sites showed a community coefficient value of 0.87. Indicating a high similarity of species composition. A total of 117 respondents were asked about information on the utilization of mangrove. Most of the respondents are familiar with the mangrove species. Along with the utilization component, mangrove is used as shelter or nursery ground of aquatic organism and first line protection from tidal waves, storm surges and other sea related disasters. Likewise, it is being utilized as alternative medicine, as food in composition of vinegar, wine and sweets. Some mangrove tree also bears fruit that are edible as well. The threats to habitat and survival of mangrove species include natural and mand-made factors. Finally, the adaptability and diversity of mangrove species highly depends on favorable ecological and environmental conditions however; the anthropogenic and natural disturbances observed may possess a great threat to mangrove biodiversity.

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Introduction

Cagayan has approximately 3,967.9ha of mangrove areas. These are distributed throughout the municipalities of Abulug, Aparri, Buguey, Calayan, Claveria, Gonzaga, Pamplona, Sanchez-Mira, Santa Ana and Santa Teresita.

The Municipality of Gonzaga is one of the coastal towns of the Province of Cagayan, where some shorelines are thrived by several species of mangroves. Cagayan province These mangroves are protected by the Department of Environment and Natural Resources (DENR) and Bureau of Fisheries and Aquatic Resources (BFAR), to preserve the natural feature of these plants. The municipality of Gonzaga has mangrove forests sporadically located in seven coastal barangays with swamp and brackish areas, which cover an aggregate area of approximately 69.1ha. Generally, the status of the mangrove forests of the municipality is poor with an average of 25% living mangrove trees. Most of the areas manifested severe cutting, heavy erosion and siltation specifically observed in barangays Caroan and San Jose, where the largest tracts of mangrove forest in the municipality are located (Pasion and Tumaliuan, 2015).

Mangroves are tropical types of forest that can be found usually along tidal mudflats and along shallow water in coastal areas extending towards inland rivers, streams and their tributaries where the waters are generally brackish. These plants have special and unique adaptive mechanisms, allowing them to survive and continue thriving through climate change and harsh effects of the environment. Additionally, mangroves neutralize sediment runoff from both natural and human activities. Mangroves are often referred to as carbon sinks.

The Mangrove forest, covered by mangrove trees, act as the primary producer, naturally making direct contact with associated physical and social factors, of the costal environment and marine resources. Mangrove ecosystem provides different coastal protection such as reducing the current of typhoons, storm surges, and tidal waves. The complex structure of the root, the stem and the crown of mangroves serve as physical barriers (Fortez, 2011).

Mangroves play a unique role as the hatching and nursing grounds of some species of crustaceans, fishes, shellfishes, and other marine species, where the physical aerial and submerged roots, eaves, and branches serve as their food source. Even the canopy area of the mangrove serves as the niche of some species of birds, mammals and amphibians, which among them adapt the physical environment of this kind of ecosystem. Mangroves also provide a wider range of wood and non-wood forest products such as firewood, charcoal, poles, timber for housing and furniture materials, fisheries, medicines, recreation, ecotourism, bio-filtration and carbon sequestration.

Mangrove forests are the most productive ecosystems known with high biomass accumulation below the ground. There has been an increasing interest in the important role of mangroves in the global carbon cycle. Mangroves are utilized by local communities all over the world with understanding and appreciation of their values and benefits.

However, the loss of mangrove habitats has severe impacts on local communities, whose livelihood is dependent on forests and fisheries. The loss of world mangroves over the past few decades has mainly been caused by direct conversion of mangrove areas for urban and industrial development, and for aquaculture and agriculture.

The study generally aimed to conduct an assessment of mangroves and its utilization in Gonzaga, Cagayan. Specifically, this study aimed to:

1. Determine the species composition of mangroves found in barangay Caroan and barangay San Jose Gonzaga, Cagayan,
2. Determine the diversity of mangrove species using the following parameters within the selected sites:

a. Basal Area
b. Relative density
c. Relative dominance
d. Frequency

e. Relative frequency
f. Importance/value
g. Index of similarity
3. Determine the various ways in which mangroves are utilized.

Materials and methods

The descriptive method of research was used in the study. This study design was used to obtain accurate information on the assessment of mangrove. It will employ the use of structured questionnaire, interview techniques to elicit information about utilization of mangroves ecosystem.

The study sites were conducted in the municipality of Gonzaga, Cagayan. The mangrove sites occasionally facing along the Pacific Ocean, usually characterized by muddy substratum composed of different plant species. The mangrove species grow in any part in Gonzaga but the researchers only selected two sites. The following sites are; Barangay Caroan and Barangay San Jose of were mangrove tracts are abundant.

A. Securing of Permit

The permit was obtained from the Mayor of Gonzaga, Cagayan Marilyn *S. Pentecostes*, and the Department of Environment and Natural Resources (DENR) personnel to secure approval for the conduct of the study. Likewise, the researchers were asked the approval and consent of the barangay captain for the actual data collection and for gathering information about the utilization of mangrove in the selected barangays.

B. Assessment of the study area

Species composition, Importance Value (IV) and index of similarity was taken using the following formulas

Basal Area = C

C = Circumference of the tree

Relative Dominace = (Individual of species A)/(Total Individuals of all species) x 100

Relative Dominance = (Total basal area of species A)/(Total basal area of species B) x 100

Frequency = (Total quadrats species A occurs)/(Total quadrat sampled) x 100

Relative Frequency = (Frequency value for species A)/(Total value for all species) x 100

Importance Value = relative density + relative frequency + relative dominance

Index Similarity

Community Coefficient = 2C/(S1 + S2)

Where: C = species common to both community

S = number of species present in each community

C. Line transect, plot sampling, and diameter breast height

This was based on the available land-use map provided by Community of Environment and Natural Resources Office Sub-Office of Aparri, Cagayan (CENRO). Field guide in the identification of mangrove species along the mangrove forests of the study period.

The researchers used quadrant and transect to the study. A line perpendicular to the base line was established with 10 x 10 per quadrant. Measuring of the Diameter Breast High (DBH), getting the total of specimen, total height, total number of samplings, of mangrove per quadrat was recorded. A tape measure was used to distinguish it from Diameter Breast High (DBH) of a tree. A meter stick was used to measure the crown cover and height of the tree. The researchers also take pictures of roots, barks, stems, leaves, flowers and fruits of each mangrove species for validation and proper identification using digital camera.

D. Mangrove Utilization Survey

The utilization survey of mangrove respondents of this study were the residents of the two selected Barangays of Gonzaga, Cagayan which the species of mangrove occurs. These Barangays are Caroan and San Jose. At least ten percent of the total population per barangay was the respondents of the study.

The questionnaire used was furnished with the local information particularly related to the socio-economic benefits and ecological importance of mangrove. Actual observations, on the spot verbal and non-structured interviews was employed to further determine the various ways in which mangrove was utilized. In case that the respondent cannot understand the given questionnaire, it is the

researcher's responsibility to explain for clarification by using their local dialect.

For validation of the said activity, the researchers request the approval and consent signed by the Mayor and the Barangay Captain of the two barangays.

Results and discussion

A. Species composition of mangrove found in Gonzaga, Cagayan

Mangrove species was assessed in Barangay Caroan and Barangay San Jose of Gonzaga, Cagayan. Assessments included the determination of the Basal area, Relative density, Relative dominance, Frequency, Relative frequency, Importance value and Index of similarity.

Table 1. Species of Mangrove in Site 1 (Barangay Caroan).

Scientific Name	Local Name	Quadrat
Avicennia officinalis	Api-api	2,3
Rhizophora mucronata	Bakawan babae	1,2,3
Rhizophora stylosa	Bakawan bato	3
Rhizophora apiculata	Bakawan lalaki	1,3
Heritiera littoralis	Dungon	1,2
Bruguierea parviflora	Langarai	2,3
Sonneratia alba	Pagatpat	1,2,3
Sonneratia caseolaris	Pedada	3
Bruguiera cylindrical	Pototan Bc	1,2
Bruguiera gymnorrhiza	Pototan Bg	1,2,3
Bruguiera sexangula	Pototan	1,2,3
Lumnitzera littorea	Tabao	1
Xylocarpus granatum	Tabigi	1
Ceriops tagal	Tangal	1,2

Table 1 of site 1 (Caroan) shows which quadrat are they present. The most common species in quadrant 1,2 and 3 are Bakawan babae *(Rhizophora muctonata)*, Pagatpat *(Sonneraia alba)*, Pototan Bg *(Bruguierea gymnorrhiza),* and Langarai *(Bruguiera parviflora)*, Api-api *(Avicennia officinalis),* and Pototan BS. *(Bruguiera sexangula)* found in quadrat 2 and 3 And the least common species present in only 1 quadrant are Bakawan bato in quadrant 3 ,Tabao in quadrant 1 and tabigi in quadrant 1.

Table 2 of site 2 (Barangay San Jose) shows which quadrant is present. The most common species in quadrant 1, 2 and 3 are Bakawan lalaki *(Rhizophora apicula)*, Culasi *(Lumnitzera rasemosa)*, Pagatpat *(Sonneratia alba),* and Pototan *(Bruguiera sexangula)*. Api-api *(Avicennia officinalis)* is found in quadrat 2 and 3. And the least common species present in only 1 quadrant are Bakawan bato *(Rhizophora stylosa),* in quadrant 1, Lipata/Buta-buta *(Exoecaria agallocha),* in quadrant 2, Langarai *(Bruguiera parviflora),* in quadrant 1, Piag-ao *(Xylocarpus moluccensis),* in quadrant 2, Tabao *(Lumnitzera littorea),* in quadrant 1, Tabigi *(Xylocarpus granatum),* in quadrant 2 and Tangal *(Ceriops tagal)*, in quadrant 1.

Table 2. Species of Mangrove in Site 2 (Barangay San Jose).

Scientific Name	Local Name	Quadrat
Avicennia officinalis	Api-api	2,3
Rhizophora mucronata	Bakawan babae	3
Rhizophora stylosa	Bakawan bato	1
Rhizophora apiculata	Bakawan lalaki	1,2,3
Lumnitzera rasemosa	Culasi	1,2,3
Heritiera littoralis	Dungon	3
Bruguiera parviflora	Langarai	1
Excoecaria agallocha	Lipata/buta-buta	2
Scyphiphora hydrophyllacea	Nilad	3
brownlowia tersa	Maragumon	1,3
Sonneratia alba	Pagatpat	1,2,3,
Bruguiera cylindrica	Pototan BC	2
Bruguiera gymnorrhiza	Pototan BG	1,3
Bruguiera sexangula	Pototan	1,2,3
Xylocsrpus moluccensis	Piag-ao	2
Lumnitzera littorea	Tabao	1
Xylocarpus granatum	Tabigi	2
Ceriops tagal	Tangal	1

From the 6 quadrants that were assessed, there are 18 species of mangrove species. The families are Avicenniatiaceae, Rhizopharaceae, Combretaceae, Steraculiaceae, Rhobiaceae, Tiliaceae, Excoecariaceae, Sonneratiaceae, and Meliaceae the two (2) sites of mangrove stand were dominantly covered with. Pototan (*Bruguiera sexangula)*. This specie gained the highest importance value. On the otherhand, Piag-ao (*Xylocarpus muluccensis)*, Culasi *(Lumnitzera rasemos)*, Api-api *(A. Officinalis)*, Pedada *(Sonneratia caseolaris)* and Tabao (*Lumnitzera littorea),* gained the least important value.

Table 3. Summary data of the two (2) sites of the mangrove stand in Gonzaga, Cagayan.

Mangrove species	No. of trees	No. of Sites found	Basal area (cm^2)	Frequency (%)	Relative frequency (%)	Relative Density (%)	Relative Dominance (%)	Importance value (%)
Api-api	5	2	32.75	133.34	14.04	5.36	3.79	23.18
Bakawan babae	16	2	136.5	133.33	13.91	17.08	16.93	47.92
Bakawan bato	6	2	101.75	66.66	7.02	6.42	12.52	25.96
Bakawan lalaki	15	2	121.25	166.67	17.61	16.07	13.6	47.28
Culasi	6	1	48	66.67	7.14	6.45	4.73	18.33
Dungon	5	2	113.75	100	10.47	5.34	11.78	27.59
Langarai	7	2	83	100	10.47	6.42	9.67	12.56
Buta-buta	3	1	89.5	33.33	3.57	4.3	8.82	14.67
Nilad	4	1	69	33.33	3.57	4.3	6.8	48.59
Maragomon	5	1	33.5	66.67	7.14	5.38	3.3	26.12
Pagatpat	20	2	129.75	200	21.05	21.37	16.46	35.86
Pedada	2		11.25	33.33	3.45	2.13	1.79	7.36
Pototan Bc	11	2	108.75	100	10.47	11.76	13.63	30.67
Pototan Bg	24	2	154	166.67	17.48	25.62	22.17	65.27
Pototan	33	2	135.25	200	21.05	35.26	20.82	77.15
Piag-ao	2	1	29.5	33.33	3.57	2.15	2.91	8.63
Tabao	5	2	88.25	66.66	7.02	5.36	9.24	21.62
Tabigi	8	2	87.25	66.66	7.02	8.57	9.67	25.26
Tangal	8	2	63.75	100	10.47	8.56	5.17	24.26
TOTAL	185		1663.75	197.9	1866.65	196.52	196.52	588.2

Table 4. Index of similarities of the two (2) mangrove sites in Gonzaga, Cagayan.

Site	No. of species /site	No. of common species	Community Coefficient of all sites
Site I	14	14	0.87
Site II	18		

Table 4 shows the index of similarity between the two sites of mangrove vegetation in Gonzaga. Cagayan It shows that the similarity index between the two sites at 0.87 is very high. The high similarity index of the sites is much evident since all the species present in Site I are present in Site II. The high similarity index of mangrove among different vegetation in the same locality is due to environmental factors as cited in the study of Calumpong, 1999.

B. Local Utilization of mangrove

A rapid survey was made to determine the local utilization of mangrove. A questionnaire was used to furnish the local information particularly related to the socio-economic benefits and ecological importance of mangrove. Also, actual observations and on the spot verbal interview to further determine the various ways in which mangrove was utilized. Some of the respondents cannot understand the given questionnaire, thus the researcher's responsibility to explain using their local dialect for clarification.

Table 5 shows that out of 117 respondents, sixty five or 55.5% of the respondents are familiar with Nipa (*Nipa fructicans*). Fifty (50) respondents (42.73%) familiar with Bakawan lalaki (*Rhizophora. apiculata*). Bakawan babae (*R. mucronata*) and Bakawan bato (*R. stylosa*) has closely the same number of respondents (44,42).

Thirty eight (38) or 32.48% of the respondents are familiar with Pagatpat (*Sonneratia alba*). Thirty six (36) or 30.77% of the respondents are familiar with Palaypay (*Acrusticum aureium*). 35 or 29.91% respondents are familiar with Tabigi (*Xylocarpus granatum*). Thirty three (33) or 28.21% of the respondents are familiar with Pototan BG. (*Bruguirea gymnorrhiza*). Thirty one (31) or (26.50%) of the respondents are familiar with Bonsai. Thirty (30) (25.64%) respondents are also familiar with Dungon (*Herittiera littolaris*). Twenty eight (28) 23.93% of the respondents are familiar with Tabao *(Lumnitzera littorea).*

Table 5. Familiarity of mangrove profile of the respondents.

Scientific Name	Local Name	San Jose	Caroan	Frequency	Percent (%)
Avicennia officinalis	Api-api	8	9	17	14.5299
Rhizophora mucronata	Bakawan babae	27	17	44	37.6068
Rhizophora stylosa	Bakawan bato	22	20	42	35.8974
Rhizophora apiculata	Bakawan lalaki	26	24	50	42.735
Pemphis acidula	Bantigi	0	6	6	5.12821
Ceriops decandra	Baras-baras	7	6	13	11.1111
	Bonsai	20	11	31	26.4957
Avicennia alba	Bungalon	5	7	12	10.2564
Osbornia octodonta	Bunot-bunot	11	10	21	17.9487
Lumnitzera rasemosa	Culasi	3	7	10	8.54701
Heritiera littoralis	Dungon	23	7	30	25.641
Camptostemon philippinensis	Gapas-gapas	8	5	13	11.1111
Bruguirea parviflora	Langarai	8	9	17	14.5299
Acanthus sp.	Lagiwiw	12	10	22	18.8034
Excoecaria agallocha	buta-buta	6	5	11	9.40171
Brownlowia tersa	Maragumon	2	9	11	9.40171
Scyphiphora hydrophyllacea	Nilad	5	8	13	11.1111
Nypa fruticans	Nipa	30	35	65	55.5556
Sonneratia alba	Pagatpat	17	21	38	32.4786
Acrostichum aureum	Palaypay	15	21	36	30.7692
Sonneratia caseolaris	Pedada	7	13	20	17.094
Bruguiera cylindrica	Pototan Bc	14	9	23	19.6581
Bruguiera gymnorrhiza	Pototan Bg	18	15	33	28.2051
Bruguiera sexangula	Pototan	8	14	22	18.8034
Xylocsrpus moluccensis	Piag-ao	8	2	10	8.54701
Aegiceras floridum	Saging-saging	11	10	21	17.9487
Lumnitzera littorea	Tabao	18	10	28	23.9316
Xylocarpus granatum	Tabigi	24	11	35	29.9145
Ceriops tagal	Tangal	9	15	24	20.5128
Total					100.000%

Twenty four (24) or 20.51% of the total respondents are familiar with Tanngal *(Ceriops tagal)*. Twenty three (23) or 19.66% of the respondents are familiar with Pototan BC *(Bruguirrea cylindrica)*. Twenty two (22) or 18.18% of the respondents are familiar with Lagiwliw or Ragoyroy (*Acantus sp.*) and Pototan (*B. sexangula*).twenty (20) or 17.09% of the respondents are familiar with Pedada (*Sonneratia caseolaries*). Twenty one (21) or 17.95% are familiar with Bunot-bunot or tawilis (*Osbornea octodonta*) and Saging-saging (*Aegiseras floridum*). There were also Seventeen (17) or 14.53% of the respondents who are familiar with Langarai (*Bruguirea parviflora*) and Api-api *(Aviccenia officinalis)*. 13 respondents or 11.11% of the respondents are familiar with Baras-baras (*C. decandra*) and Gapas-gapas (*Camptostemon philipinensis*).

A total of twelve (12) or 10.26%of the respondents, say that they are familiar with Bungalon *(Avicennia marina)*. Ten (10) or 8.58% of the respondents are familiar with Culasi *(Lumnitzera littera)* and Piag-ao (*Xylocarpus muloccensus*) and there were six (6) or 5.13% who are familiar with Bantigi (*Pemphis acidula*).

Table 7. Total number of respondents who are familiar with mangrove species.

Are you familiar with mangrove species?	Frequency	Percentage
Yes	117	100%
No	0	0%
Total	117	100%

Table 7 shows that all of the respondents (100%) of the said two sites are familiar with mangrove and none of the respondents are not familiar with mangrove. This concludes that the community of Gonzaga, Cagayan are very much aware of the existence of the different mangrove species.

Table 8. Availability of Mangrove Species in the Local Market.

Is Mangrove species available in market?	Frequency	Percentage
Yes	22	18.80%
No	88	75.21%
No Response	7	5.98%
Total	117	100%

Table 8 shows that eighty-eight (88) or 75.21% of the respondents said that mangrove plants are not available in the market. Some of the respondents, twenty two (22) or 18.80% said and noticed the availability of mangrove in the local market. While seven (7) or 5.98% of the respondents have no response because some of them don't know the other uses of the plants.

Table 9. Utilization of Mangrove Species.

The benefits of mangrove species?	Frequency	Percentage (%)
Food	32	27.35
Medicine	42	35.90
Source of Livelihood	49	41.88
Ornamental	27	23.08
Cultural Value	0	0
Other Use (nursery grounds and coastal protection)	78	66.67

Table 9 shows the local utilization of mangrove species. Majority or a total of 78 respondents answered that mangrove plants are used for shelter or nursery grounds of crabs, prawns, shrimps, fishes and other aquatic organisms and as first line protection from tidal waves, storm surges and other sea related disasters. 41.88% or a total of 49 respondents are using mangrove plants as their source of livelihood. In exchange to their services, the local government is paying them for planting and rehabilitating the said plants.

Forty two (42) or 35.90% of the respondents said that mangrove can be used as medicine. Most of them said that the bonsai stem and leaves of the plant can be boiled then ingested by drinking to treat some illnesses such as constipation, diarrhoea, and dysmenorrhea.

Thirty two (32) respondents (27.35%) also stated that non-wood mangrove products can be used as food, alcohol, and sugar. The saps coming from the Nipa specie can be used to make vinegar or wine, while the palm heart is used to make sweets. Some mangrove trees also bear fruit that are edible as well.

27 or 23.08% of the respondents mentioned that mangrove species can be used as ornaments. They used it as a decoration and fence for their houses, while other Mangrove species can be cultured as a bonsai.

Zero percent or no respondent said that mangroves have cultural value.

Table 10. Threat to habitat and survival of mangrove Species.

Threats	Frequency	Percentage (%)
Overharvesting	8	6.84
Indiscriminate cutting	15	12.82
Storm surge	56	47.86
Pest and disease	9	7.69
Fire	0	0
Drought	0	0
Exploitation	6	5.13
Other threats (Improper waste disposal and misappropriation of domestic animals	23	19.66
Total	117	100

Table 10 shows the threats and survival of mangrove. Twenty three (23) respondents have recognized other factors (improper behaviour waste disposal, misappropriation of domesticated animals, accidents along the shoreline) as a big factor that can affect the growth and survival of mangrove.

Storm surge (47.86%) was also recognized by 56 respondents as the biggest threat that can affect the survival of the mangrove species. According to their observation, when there are big waves, the vegetation of mangroves are easily destroyed which can lead to the eventual death of the plant.

Fifteen (15) respondents recognized indiscriminate cutting (12.82%) may also cause the death of mangrove species. harvesting of mangrove species also play a role in the possible destruction of the fauna. Some people from the said municipality are said to be harvesting mangrove plants as source of wood (e.g. timber, charcoal and poles). Overharvesting of mangrove (6.84%) is also a threat as mentioned by eight (8) respondents. Pest and disease (7.69% were also noticed by nine (9) respondents. Based from their observations, one of the reasons why mangrove species can't grow is because of the pests and insects that are present on the plant that causes small holes and spots on the different parts of the plants.

Conclusion

Mangroves are unique ecosystem which offer tremendous values and benefits. Philippine mangroves are very much diverse but facing tremendous threats. Based on the result of the study, it was concluded that the texture of the soil is not a basis for mangroves vegetation, that the quality of water is important to induce growth for the species, that the salinity of the water is an important factor in the growth of the species. This study also concludes that the Mangrove species play an important role in providing adequate levels of Dissolved Oxygen in the area which makes it a good habitat for both marine and aquatic life.

Recommendation

The researchers encourage those future programs to take consideration the following recommendations:

1. Strengthening of the information, education and communication program for the protection and conservation of mangrove areas.
2. The government should implement new mangrove planting guidelines to enhance the survival rate of the mangrove species. There is a need for a more effective awareness campaign on the ecological and socio-economic importance of mangrove forests and other ecosystems.
3. Strict implementation of laws and policies on the preservation and conservation of mangroves should be observed.
4. Guidelines should be established in identifying areas to be declared as mangrove forest reserve.
5. We should also continue to closely engage the local community in the management of resources as it is a more sustainable approach.

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