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Occurrence of Threatened species in Lake Mainit Key Biodiversity Area: Basis for the Strict Protection Zone of the Proposed Protected Area

Romell A. Seronay[a,b]*, Richie P. Lador[a], Meljan Demetillo[c], Ar-nold Apdohan[b]
[a]College of Forestry and Environmental Science, Caraga State University, Am-payon, Butuan City, Philippines
[b]Center for Research in Environmental Management and Eco-governance, Cara-ga State University, Ampayon, Butuan City, Philippines
[c]Biology Department, College of Mathematics and Natural Sciences, Caraga State University, Ampayon, Butuan City, Philippines
*Corresponding author: romell.seronay@gmail.com

Abstract
Lake Mainit watershed is one of the Key Biodiversity Area (KBA) in the Philippines located in Agusan del Norte and Surigao del Norte provinces with an area of 87,072 hectares. This study was undertaken to determine the extent of the strict protection zone of the proposed Lake Mainit Protected Area by considering the occurrence of threatened species. Threatened species are vulnerable to endangerment soon and regarded as a top priority to be conserved. Standard sampling protocol for the terrestrial biological survey with a total of ten sampling sites within the watershed was used. Geographic Information System mapping was done to determine the distribution of threatened species in the watershed. Result of the Protected Area zoning revealed that the extent of the proposed PA covers 58,003.01 hectares comprising 22,591.84 hectares as strict protection zone and 21,376.65 hectares as a multiple-use zone, both for terrestrial environment and 14,035.12 hectares as multiple use zones for inland waters. The occurrence and distribution of the 54 threatened species of terrestrial flora and fauna was considered in the identification of the strict protection zone boundaries in the proposed PA. In the attainment of biodiversity conservation and protection through PA establishment, identification and distribution of threatened species may be an important consideration to avoid mismatch between protected area land zonation regime and conservation needs of key species. Nonetheless, predicting the occurrence of threatened faunal species in the watershed will help decision-makers to expand the strict protection zone of the Lake Mainit Protected Landscape.
Keywords: Lake Mainit; threatened species; protected area; key biodiversity area; strict protection zone

Introduction

Caraga is one of the regions in Mindanao blessed with natural resources. It is noted for its wood-based economy, its extensive water resources, and its rich mineral deposits (www.psa.gov.ph). On the other hand, the region also contains one of the last ecological frontiers of the Philippines as it hosts diverse biodiversity and unique ecosystems, evidently by having several protected areas and key biodiversity areas (KBA) (BMB-DENR, 2016). The KBA approach was initiated in the Philippines to help the government and stakeholders prioritize conservation action and devise geographically specific strategies that protect the individual species and safeguard representative habitats (Edgar et al. 2008). Lake Mainit KBA is home to many wildlife flora and fauna. It is one of the ecologically and economically important lakes in the Philippines which encompasses two provinces, the province of Surigao del Norte and Agusan del Norte (De Guzman et al. 2013).

Furthermore, the Lake Mainit inland wetland is a sanctuary for resident and migratory waterbird species. The area is also home to Mamanwa indigenous community whose primary source of livelihood is fishing on the surrounding lake (Tomaquin, 2013). The presence of activities which include timber poaching, kaingin, illegal logging, small-scale and large-scale mining, use of agro-chemical fertilizers in rice paddies adjacent to the lake, settlement near the lake and unsustainable fishing practices are

currently threatening the sustainability of the Lake Mainit KBA's ecological integrity. Moreover, poverty and overexploitation are the ultimate drivers of environmental exploitation. Hence, appropriate measures on its protection and sustainable management are imperative (De Guzman et al. 2013). To further protect and conserve the biological resources and sustain ecological integrity, the establishment and management of Protected Areas in Lake Mainit KBA through the National Integrated Protected Areas System (NIPAS) could be an effective strategy. The NIPAS Act designates protected areas to secure the perpetual existence of all native plants and animals in a comprehensive and integrated system. Accordingly, the protected estate covers 11% of the Philippines' land area, but 64% of its key biodiversity areas (KBAs) remain unprotected (Mallari et al. 2016). There is a serious mismatch exists between protected area land zonation regime and conservation needs of key species. Moreover, many Protected Areas in the Philippines do not have substantial information on the distribution of threatened species within the protected area even though the presence of restricted range and globally threatened species are among the criteria of Protected Area Suitability Assessment, a necessary process to assess the area worthy of being protected. This study aims to determine the extent of strict protection zone and multiple use zone of the proposed Protected Area in Lake Mainit KBA considering the distribution of conservation priority species of flora and fauna.

Materials and methods

Standard sampling protocol for the terrestrial biological survey was used. Secondary data from the previous biological assessment conducted in the ten sampling sites within Lake Mainit KBA were utilized. The occurrence of conservation priority species of both flora and fauna were plotted within the timberland of Lake Mainit. The presence of critically endangered, endangered, vulnerable and other threatened species was the basis for the core zone or strict protection zone of the proposed Lake Mainit Protected Landscape and Lakescape. Classification of wildlife species for flora and fauna was based on Department Administrative Order 2017-11 and International Union for Conservation of Nature (IUCN) Red List of Threatened Species, respectively. The criteria established by the stakeholders in Lake Mainit for the identification of the strict protection zone and multiple use zone of the proposed Protected Area were considered.

Results and discussion

Conservation priority species of Lake Mainit KBA

Among the 244 plant species recorded in the ten sampling sites in Lake Mainit KBA, 41 species or 17% were accounted as conservation priority species (Table 1). These comprise four critically endangered species, nine endangered species, 17 vulnerable species, and ten other threatened species (Figure 1). A critically endangered, endangered, and vulnerable species is facing extremely high risk, very high risk and high risk of extinction in the wild, respectively (www.iucnredlist.org). Moreover, Mainit sampling site recorded the highest number of critically endangered species, including *Rafflesia mixta*, a new record for Philippine plants in Caraga Region (Barcelona et al., 2014). Forty percent of the terrestrial flora in lake Mainit KBA are Philippine endemic. As observed, Santiago had the highest number of endemic species as well as conservation priority species. Based on the study of Demetillo and others (2015) on the plant diversity in the eight sampling sites in Lake Mainit watershed, Santiago obtained the highest diversity index. The area of Santiago was considered as secondary old growth forest to a pristine forest with higher altitude.

For the vertebrate fauna, a total of 23 species were classified as conservation priority species among the 197 total number of species recorded in Lake Mainit KBA. Majority of the priority species were birds with 17 species followed by mammals and herpetofauna with three species each. Among the 17 bird species, only the Philippine hawk eagle is considered as endangered, five species as vulnerable and 11 species as near threatened (Figure 1). Philippine sailfin lizard and Mindanao horned frog classified as vulnerable and giant Philippine frog as near threatened were the herpetofauna conservation priority species. Lastly, the flying and non-flying mammals considered as conservation priority species include Philippine forest squirrel, Philippine warty pig, Philippine dawn bat, and white

collared fruit bat. Alegria Budlingin sampling site contained the highest number of fauna conservation priority species.

Table 1: Species richness, endemic species and conservation priority species of Flora and Fauna across sampling sites in Lake Mainit KBA. Locality of the sampling sites: Tbd - Tubod, AlBud - Alegria Budlingin, AlCam - Alegria Camp Edwards, Mnt - Mainit, Ssn - Sison, Sntg - Santiago, TbMi - Tubay Minaasug, TbCa - Tubay Canticol, Ktch - Kitcharao, Jbg - Jabonga.

Parameters	**Sampling Sites Across Lake Mainit KBA**										
	Tbd	**AlBud**	**AlCam**	**Mnt**	**Ssn**	**Sntg**	**TbMi**	**TbCa**	**Ktch**	**Jbg**	**Total**
Terrestrial Flora											
Species Richness	78	70	74	79	74	78	67	66	53	74	244
Endemic Species	30	26	30	30	29	39	33	23	27	33	97
Conservation Priority Species	16	9	12	12	10	20	14	11	17	15	41
Critically Endangered	2	1	0	3	1	2	1	0	2	2	4
Endangered	3	2	3	2	2	3	4	1	5	2	9
Vulnerable	6	5	7	5	4	8	6	8	2	7	17
Other Threatened	5	1	2	2	3	6	2	2	7	4	10
Terrestrial Fauna											
Species richness	74	92	92	64	53	55	33	72	58	78	197
Endemic species	9	8	11	7	9	11	6	15	4	8	29
Conservation priority species	9	13	7	10	3	2	1	10	0	4	23
Endangered	1	1	0	0	0	0	0	1	0	0	1
Vulnerable	3	4	2	3	1	1	0	3	0	2	9
Near Threatened	5	8	5	7	2	1	1	6	0	2	13

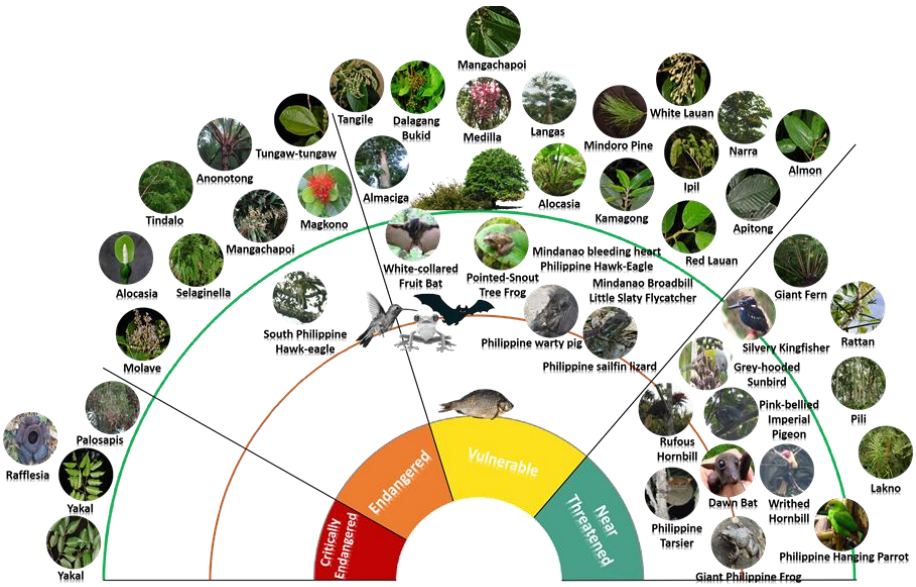

Figure 1 The threatened species of flora and fauna in Lake Mainit Key Biodiversity Area

The biodiversity study in Eastern Mindanao Corridor (EMBC) conducted by the Philippine Eagle Foundation, Conservation International-Philippines, and Department of Environment and the Natural Resources last 2008, they listed at least 48 threatened species in the Mt. Hilong-hilong range with at least 9 species of amphibians, 18 species of birds, 4 species of mammal species, and 17 species of flora. In comparison to the recorded species of EMBC study, there were less threatened species recorded in Lake Mainit KBA. However, a vulnerable sail fin lizard was recently listed in lake Mainit watershed but not listed in the EMBC study. On the other hand, the recorded species from the EMBC study were almost the same species listed in the recent studies in the watershed areas in surrounding Lake Mainit which may indicate a wide range distribution of threatened species and high biodiversity along Mt. Hilong-hilong range. Furthermore, Lake Mainit watersheds are portion of the Mt. Hilong-hilong range.

A total of 54 species of terrestrial flora and fauna were listed as conservation priority species based on the accumulated assessment in Lake Mainit KBA. It should be emphasized that conservation priority species identified is much higher in terrestrial flora with 41 species than terrestrial fauna containing 23 species. Moreover, the risk of extinction in the wild of some terrestrial flora species is also higher than terrestrial fauna. Presently, there are no critically endangered species listed for the terrestrial fauna in Lake Mainit KBA. These findings conform to the global extinction analysis that twice as many plants have gone extinct than birds, mammals, and amphibians combined (*www.sciencemag.org/news/2019/06*). A recent estimate of more than a million species is threatened with extinction based on the review of the global status of biodiversity.

Table 2: The established criteria for the Protected Area zoning of the proposed Lake Mainit Protected Area set by the stakeholders of Lake Mainit KBA

Criteria	**Strict Protection Zone**	**Multiple Use Zone**
Tenurial Status	Timberland	Timberland
CBFM	CBFM Protection Zones	CBFM Production Zones
CADT	Burial Grounds, Rituals and Sacred Places	Hunting Ground, Settlements/ Indigenous People community/ sectors
Elevation/ Topography	1,000 masl >50% slope	< 1000 masl < 50% slope
Local conservation initiatives	Declared as aquatic /or wildlife sanctuaries and local conservation areas (critical habitats) declared by LGU. Declared Critical Watersheds	Open access without tenurial instrument
Conservation priority species	Flora and fauna with conservation priorities (IUCN)	Aquaculture parks/zones declared by LGU/BFAR, Agroforestry Projects
Hazard	High Hazard areas (MGB declared)	Low Hazard
Caves	Major caves, classified caves	unclassified caves
Ecotourism	Ecotourism Areas but with exemptions based PAMB Policies and Regulations	Ecotourism outside the Strict protected Zones

Criteria for PA zoning

Based on the NIPAS Act, the strict protection zone (SPZ) and multiple use zones (MUZ) should be identified within the protected area. The key stakeholders of Lake Mainit KBA established criteria for the zoning during the coordination meeting-workshop for the proposed Lake Mainit Protected Landscape (Table 2). The workshop tends to address the overlapping of various tenurial instrument awarded within the timberland of Lake Mainit watershed. The current existing plans such as Comprehensive Land Use Plan (CLUP) and Forest Land Use Plan (FLUP) of the eight municipalities, Certificate of Ancestral Domain Tenure (CADT), and Lake Mainit Development Alliance plan were harmonized with the zoning of the proposed Protected Area. For example, the forested area identified

by the Local Government Unit as protection or conservation area shall be considered as SPZ, including the local conservation area legislated by the Local Government Unit. Within Lake Mainit KBA, the presence of threatened species such as *Rafflesia mixta* in Cantugas, Mainit Surigao del Norte and *Tarsus syrinchta* in Tubod, Surigao del Norte encouraged the Local Government Units to declare the area as a local conservation area.

Community Based Forest Management Agreement is a production sharing agreement between the Department of Environment Natural Resources and the participating people's organization (POs) for a period of 25 years renewable for another 25 years and shall provide tenurial security and incentives to develop, utilize and manage specific portions of forest lands (DENR Administrative Order No. 96-29). CBFM projects located in the timberland of Lake Mainit watershed classified as protection zones and production zones shall be categorized as SPZ and MUZ, respectively.

Identification of SPZ and MUZ

The output of the stakeholders' workshop highlighted the grouping of the proposed Protected Area into four clusters. The Cluster I composed of PA Zones in the *Rafflesia* area covering Malimono and Sison municipalities. Cluster II located in the eastern portion of Lake Mainit where CADT 307 was awarded in a large part of Jabonga. Cluster III is within the Tarsier Areas in Tubod and partly Alegria municipality. Cluster IV are areas where conservation priority species of flora and fauna situated from Alegria down to Kitcharao, Santiago and Tubay. Cluster Areas were spatially delineated and presented as a basis for zoning (SPZ and MUZ). Most of these Cluster Areas are within the timberland, which consists of various conflicting tenurial instruments. The timberland area of Lake Mainit watershed has 87,072 hectares including the Mineral Production Sharing Agreement (MPSA) area. A MPSA is the agreements that the government grants to a contractor for the right to mine within, but not title over, a contract area. MPSA area however is not included in the proposed PA due to its prior rights.

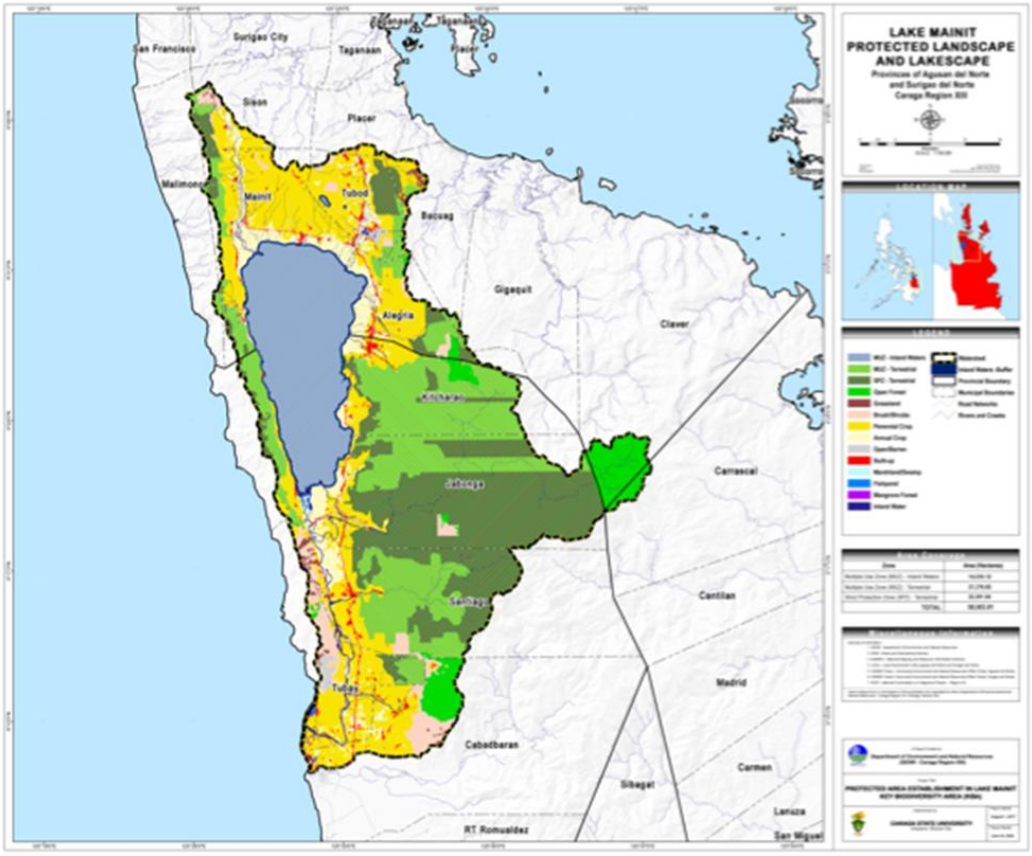

Figure 2 Strict protection zone and multiple use zone boundaries of the proposed Lake Mainit Protected Landscape

The total area of the proposed PA is 58,003.01 hectares comprising 22,591.84 hectares as strict protection zone and 21,376.65 hectares as a multiple-use zone, both for terrestrial and 14,035.12 hectares as multiple use zone for inland waters (Figure 2). Included in the terrestrial SPZ are the conservation priority species, local conservation areas, and protected forest of CBFMA. For the MUZ, production areas of CBFMA and CADT areas were considered. Cluster IV appears to be the most significant area for protection both SPZ and MUZ hugely contributed by CBFMA area. The occurrence of conservation priority species was not the sole basis for identifying the strict protection zone boundaries, but it has been considered in the proposed PA in Lake Mainit particularly in clusters 1, 3 and 4. Conserving biodiversity through protected area establishment and enhancing the existing reserve system by making it more comprehensive, adequate and representative will allow the people to better adapt to impacts of climate change (Lindenmayer et al. 2010).

Conclusion

In the NIPAS Act, the strict protection zone (SPZ) and multiple use zones (MUZ) must be identified within the protected area. The extent of the proposed PA covers 58,003.01 hectares comprising 22,591.84 hectares as strict protection zone and 21,376.65 hectares as a multiple-use zone, both for terrestrial and 14,035.12 hectares as multiple use zones for inland waters. The important role of stakeholders in setting the criteria for the Protected Area zoning of the proposed PA was recognized. The occurrence of the 54 conservation priority species was considered in the identification of the strict protection zone boundaries in the proposed PA. In the attainment of biodiversity conservation and protection through PA establishment, identification and distribution of threatened species may be an important consideration to avoid mismatch between protected area land zonation regime and conservation needs of key species. Nonetheless, predicting the occurrence of threatened faunal species in the watershed will help decision-makers to expand the strict protection zone of the Lake Mainit Protected Landscape.

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References

Barcelona, J.F., Manting, M.E., Abolonio, R.B., Caballero, R.B., Pelser, P.B. (2014). *Rafflesia mixta* (Rafflesiaceae), A New Species from Surigao del Norte, Mindanao, Philippines. *Phytotaxa*, 174 (5): 272–278.

Demetillo, M.T., Lador, R.P., Seronay, R.A. (2016). Floral Assessment in Lake Mainit Watershed, Caraga Region, Mindanao Philippines. *Annals of Studies in Science and Humanities*, *1*(2): 12-28.

Biodiversity Management Bureau (BMB) Department of Environment and Natural Resources (DENR) (2016). Philippine Biodiversity Strategy and Action Plan (2015-2028): Bringing Resilience to Filipino Communities. C. Cabrido (Ed.). Quezon City, Philippines: BMB-DENR, United Nations Development Programme–Global Environment Facility, Foundation for the Philippine Environment.

De Guzman A.B., A.E. Openiano, M. Ologuin, Samson, J. (2015). Socio-Economics, Institutional Support, and Intervention Programs Toward Sustainable Fisheries Management in Lake Mainit, Philippines. *Journal of Environment and Aquatic Resources*, 3: 15-27.

DENR Administrative Order No. 17-11.

DENR Administrative Order No. 96-29.

Edgar, G.J., P.F. Langhammer, G. Allen, T.M. Brooks, J. Brodie, W. Crosse, N. De Silva, L. Fishpool, M.N. Foster, D. Knox, J.E. McCosker, R. McManus, A. Miller & R. Mugo (2008). Key Biodiversity

Areas as Globally Significant Target Sites for The Conservation of Marine Biological Diversity. Aquatic Conservation. *Marine and Freshwater Ecosystems*, 18: 969–983

IUCN (2018). The 2018 IUCN Red List of Threatened Species.

Lindenmayer, D.B, W. Steffen. A.A. Burbidge L. Hughes, R.L. Kitching, W. Musgrave, M.S. Smith, Werner, P.A. (2010). Conservation strategies in response to rapid climate change: Australia as a case study. *Biological Conservation*, 143: 1587–1593.

Mallari N.A., Collar, N.G., McGowan, J.K., Marsden, S.J. (2016). Philippine protected areas are not meeting the biodiversity coverage and management effectiveness requirements of Aichi Target 11. *Ambio*, 45(3): 313–322.

Tomaquin, R.D (2013). Indigenous Religion, Institutions and Rituals of the Mamanwas of Caraga Region. *Asian Journal of Social Sciences, Arts and Humanities*, 1: 18-36.