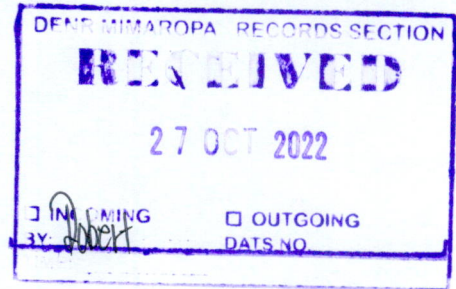




October 26, 2022



**LORMELYN E. CLAUDIO, CESO IV**

Regional Executive Director

(DENR) Environmental Management Bureau – Region 4-B MIMAROPA

DENR by the Bay 1515 L&S Bldg., Roxas Blvd., Manila

**Endorsement Letter**

**Dear Ms. Claudio,**

Good day!

This is to formally endorse the thesis proposal of **Patricia Ashley Paras Rosales**, a 4th-year BS Biology student at Adamson University who will be conducting research entitled **“Diversity Assessment of Mangrove Species in Ipil Water Park, Santa Cruz, Marinduque”**. The student will measure the mangrove trees and collect only the leaves of mangroves to identify the species of mangroves and assess the species richness and relative abundance present in Ipil Water Park, Santa Cruz, Marinduque.

Together with this letter is the approved thesis proposal. This undergraduate thesis proposal is part of the requirements for the degree of Bachelor of Science in Biology. We request to allow the student to conduct research in Ipil Water Park, Santa Cruz, Marinduque.

Thank you very much for your kind cooperation and understanding in this endeavor.

Respectfully,

**Julius John DP. Salamanes**

Thesis Adviser

**Renz Marion B. Gamido**

Co-adviser

Noted by:

**Eleanor S. Austria**

Dean, College of Science

**DIVERSITY ASSESSMENT OF MANGROVE SPECIES IN  
IPIL WATER PARK, SANTA CRUZ, MARINDUQUE,  
PHILIPPINES**

A Thesis Proposal  
Presented to the Biology Department  
Adamson University

In Partial Fulfillment  
of the Requirements for the Degree  
Bachelor of Science in Biology

by  
PATRICIA ASHLEY P. ROSALES

October 19, 2022

## APPROVAL SHEET

This is to certify that this undergraduate thesis proposal, entitled “**Diversity Assessment of Mangrove Species in Ipil Water Park, Santa Cruz, Marinduque, Philippines**” has been prepared and submitted by **PATRICIA ASHLEY PARAS ROSALES**, to fulfill part of the requirements for the degree of Bachelor of Science in Biology, and hereby endorsed for oral defense.

JULIUS JOHN DP. SALAMANES

Adviser

RENZ MARION B. GAMIDO

Co-adviser



## ABSTRACT

Mangroves are a type of trees and shrubs that grow along shores, rivers, and estuaries in the tropics and subtropics. Mangroves protect shorelines from damaging storm and hurricane winds, waves, and floods. They also prevent erosion by stabilizing sediments with their tangled root systems. They maintain water clean and clear by filtering pollutants and trapping sediments originating from land. They also provide human useful products and food for the fisheries, birds, and invertebrates. This study will utilize quantitative methods to identify the species of mangroves and assess species richness and relative abundance. The leaves of mature mangroves will be collected in the study area to assess the diversity of mangrove species. This data will provide an assumption about the status of mangrove species in Ipil Water Park, Santa Cruz, Marinduque. Additionally, it will help to conserve the mangrove species present in Ipil Water Park, Santa Cruz, Marinduque.

**Keywords:** *Ipil Water Park, mangroves, species diversity, taxonomy*



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## INTRODUCTION

### 1 Background of the Study

2 Mangroves are dicotyledonous woody shrubs or trees that are mostly found  
3 in the tropics. The mangroves face physical threats beyond reclamation. Even if  
4 the community remains in their coastal villages and proposes plans to reclaim the  
5 Mangroves, the villagers are still threatened as the mangroves are destroyed, and  
6 the villagers that depend on mangroves are declining like the fisheries. This study  
7 will show the importance of Mangroves and their implication for the living  
8 organisms that are depending on them. They often form a dense intertidal forest  
9 that dominates muddy intertidal shores, frequently consisting of virtually  
10 monospecific patches or bands (Hogarth 2015). Mangroves have been recognized  
11 as an essential line of defense against coastal perturbations such as tropical  
12 storms, tsunamis, and storm surges. About 60–70% of the world's tropical and  
13 subtropical coastlines are secured with mangroves, which are known to be  
14 exceedingly profitable biological systems of colossal environmental esteem.  
15 Despite being delicate and scantily conveyed, these environments are exceedingly  
16 beneficial all over the world (Thatoi and Biswal 2008). Despite of the importance  
17 of mangrove species, mangroves are vanishing at a worldwide misfortune rate of  
18 1–2% per year, and the misfortune rate come to 35% amid the final 20 a long time.  
19 Climate changes (ocean level rise and changed rainfalls) and human exercises  
20 (urban advancement, aquaculture, mining, and overexploitation of timber, angle,  
21 and shellfish) speak to major dangers for mangrove living spaces. Another danger



22 to mangrove living spaces is the overpopulation that is taking place in different  
23 areas in the country.

24 Marinduque is an island province in the Philippines located in Southwestern  
25 Tagalog Region or Mimaropa, formerly known as Region IV-B. Its capital is the  
26 municipality of Boac. Marinduque is located between Sibuyan Sea to the south  
27 and Tayabas Bay to the north. It is west of the Bondoc Peninsula of Quezon  
28 province; east of Mindoro Island; and north of the island province of Romblon.  
29 Mangroves are one of the world's most important ecosystems comprised chiefly  
30 of flowering trees and shrubs that are uniquely adapted to marine and estuarine  
31 tidal conditions. The structure and composition of the mangrove ecosystem are  
32 discussed along with species diversity and distribution at different locations.  
33 Mangroves are widely known for their morphological and physiological adaptations  
34 in coping with salt, saturated soils, and regular tidal inundation, notably with  
35 specialized attributes. There are about 77 species belonging to 21 flowering  
36 plant genera found in mangroves with a relatively high degree of specialization for  
37 the tidal wetland habitat. The islands of mangrove habitats are currently facing  
38 various threats ranging from habitat fragmentation, deforestation, sedimentation,  
39 encroachment, marine and coastal pollution, siltation, and etc. Various  
40 conservation measures including the protection of mangrove habitats are  
41 important to preserve the rich mangrove diversity in the islands Alappatt, J. P.  
42 (2008). Some parts of the Verde Island Passage, the center of the world's marine  
43 biodiversity and a protected marine area, are also located within Marinduque's  
44 provincial waters. The province of Marinduque was ranked number 1 as the 2013

45 Most Peaceful Province of the country by the Philippine National Police and  
46 Philippine Security Forces due to its low crime rate statistics alternately ranking  
47 with the province of Batanes yearly. Santa Cruz is a 1st class municipality in the  
48 province of Marinduque, Philippines. According to the 2020 census, it has a  
49 population of 54,692 people. Santa Cruz is subdivided into 55 barangays. Ipil is  
50 one of the Barangays of Santa Cruz. The province of Marinduque has a total  
51 mangrove area of 3,197.58 ha located along the coastal areas of Santa Cruz  
52 (2,474.32 ha), Torrijos (604.48 ha), and Mogpog (118.78 ha). *Rhizophora* sp. and  
53 *Avicennia marina* are the most species thriving in the province (Salmo et al., 2015).

54       Assessment of the status of mangrove species within Ipil Water Park, Sta.  
55 Cruz, Marinduque can provide baseline data which will serve as basis for their  
56 protection and guide for future interventions. In a wider perspective, the result of  
57 this study would serve as valuable input in formulating integrated conservation  
58 plans and strategies and protection management that would promote diversity  
59 conservation and at the same time address the economic needs of the vulnerable  
60 coastal communities in the context of participatory resource management.  
61 Moreover, there is no study conducted yet about the diversity of mangrove species  
62 in Ipil Water Park, Sta. Cruz, Marinduque.

### 63 **Statement of the Problem**

64       The increasing current issues that affect the mangrove species in Marinduque  
65 provide the researcher the basis to discuss and assess the mangrove species in  
66 Ipil Water Park, Sta. Cruz, Marinduque. Additionally, no study conducted yet about



67 the diversity of mangrove species in Ipil Water Park, Sta. Cruz, Marinduque. This  
68 study is conducted to assess the diversity of mangrove species present in Ipil  
69 Water Park, Sta. Cruz, Marinduque by knowing the total foreshore areas in Ipil  
70 Water Park, Sta. Cruz, Marinduque through counting the shore areas around  
71 Barangay Ipil, the essentiality of the present mangrove species in the  
72 area/community, and the mangrove species richness and relative abundance.

73 The study also wants to provide an assumption regarding the status of  
74 mangrove species in Ipil Water Park, Sta. Cruz, Marinduque. This study will track  
75 the mangrove species protection and management in Ipil Water Park, Sta. Cruz,  
76 Marinduque, which evaluates and monitors the impacts of mangroves in the  
77 area/community.

#### 78 **Objectives of the study**

79 This study generally aims to assess the diversity of mangrove species in Ipil  
80 Water Park, Santa Cruz, Marinduque. Specifically, the study endeavors to:

- 81 1. To collect the species of mangroves in Ipil Water Park, Santa Cruz,  
82 Marinduque.
- 83 2. To identify the species of mangroves in Ipil Water Park, Santa Cruz,  
84 Marinduque.
- 85 3. To determine the species richness and relative abundance of mangroves  
86 in Ipil Water Park, Santa Cruz, Marinduque.

87



88     **Significance of the Study**

89             The diversity assessment on the Mangrove species in Ipil Water Park, Sta.  
90 Cruz, Marinduque would greatly be beneficial to the following mentioned below.  
91 This research would be a useful reference for the researchers who would plan to  
92 make any related study precisely underlying the mangrove species in Ipil Water  
93 Park, Sta. Cruz, Marinduque. This research would also be significant to the  
94 researchers that would enable them to learn and discover new findings relevant to  
95 the status of Mangrove species.

96             The result of this study would serve as a basis for improvement and  
97 accommodation for the DENR to discover conceivable arrangements to address  
98 the status of the mangrove species in Ipil Water Park, Sta. Cruz, Marinduque. The  
99 discovery of the importance of mangroves in the marine food chain dramatically  
100 changed the respective governmental regulation of coastal land use and  
101 development that would use by the DENR for projects, laws and regulations, and  
102 protection management plans for Mangrove species around the country. The result  
103 of this study would serve as valuable input in formulating an integrated  
104 conservation plan and strategies and protection management that would promote  
105 diversity conservation and at the same time address the economic needs of the  
106 vulnerable coastal communities in the context of participatory resource  
107 management in Ipil Water Park, Sta. Cruz, Marinduque.

108             Being the ones who discipline students. The researcher academics working  
109 in the fields of intercultural education and comparative education will be the

110 immediate beneficiaries of this research. The research will provide a significant  
111 contribution to existing knowledge of Mangrove species in the Ipil Water Park, Sta.  
112 Cruz, Marinduque. The University would gain an advantage from the findings of  
113 this study since this provided them with some additional awareness for the diversity  
114 assessment of Mangrove species. These may enable them to formulate some  
115 actions that can help improve and analyze how to deal with students' future  
116 research regarding mangrove species.

#### 117 **Scope and Limitations**

118         The study focuses on the assessment of mangrove species diversity in Ipil  
119 Water Park, Sta. Cruz, Marinduque, Philippines. The study was limited to Ipil Water  
120 Park, Sta. Cruz, Marinduque and only leaves of mature mangrove species will be  
121 included in the sample collection. The research would assess the diversity of  
122 mangrove species in terms of species richness and relative abundance through  
123 the use of quantitative method to gather the variables such as collecting of sample  
124 species from the area and basis of analysis based on the review of related  
125 literature.

126         In making an assessment, the researcher would gather samples of  
127 mangrove to identify the species present in Ipil Water Park, Sta. Cruz, Marinduque  
128 that would lead the study to check and see the diversity of the mangrove species  
129 and establish protection and management in the area/community.

130



## REVIEW OF RELATED LITERATURE

### **Mangrove Characteristics**

The term 'Mangrove' is derived from *manggi-manggi* and *el gurm*, which are Malay and Arabic words respectively, for a type of mangrove tree known as *Avicennia*, which when combined become "*mang-gurm*". While the term mangrove can refer to a species, plant, or forest, it is most commonly used to describe a unique ecosystem Ng, P. K. L., & Sivasothi, N., (1999). Mangrove is applied to four species of trees. They are Red mangrove (*Rhizophora mangle*), Black mangrove (*Avicennia germinans*), White mangrove (*Laguncularia racemosa*), and Buttonwood (*Conocarpus erectus*). Each species of mangrove can tolerate specific environmental conditions which the others cannot. Mangroves occur in tropical and subtropical wetlands all over the world. At one time it was thought that more than 60% of the world's shorelines were lined with mangroves. Coastal development, land reclamation, and erosion throughout the tropics have greatly reduced this coverage Bahamas National Trust, (2008).

Mangrove forests along the tropical and subtropical coastlines of the world are important productive ecosystems that play a crucial role in coastal area protection as well as in maintaining diverse marine ecosystems Veettil et al., (2019). Mangrove forests in Asia are essential for the well-being of coastal communities because over 70% of the human population depends on coastal resources for food and employment Kathiresan and Bingham, (2001). Due to the lengthy coastline and wide range of climate conditions, the Asian region is an ideal



153 habitat for mangrove forests Sandilyan and Kathiresan, (2014). Assessment of the  
154 status of mangrove resources within Ipil Water Park can provide baseline data to  
155 measure the intended project benefits, specifically on diversity, as a result of the  
156 intervention in the future.

#### 157 **Importance of Mangroves**

158         The efficiency of the mangrove and its contribution to the local marine  
159 environment and the human community cannot be underestimated. The  
160 Mangroves ensure and stabilize coastal zones, feed, and support the coastal water  
161 with supplements. These environments are characterized by occasional tidal  
162 flooding, which makes natural variables such as saltiness and supplement  
163 accessibility profoundly variable coming about in special characteristics. Microbial  
164 movement is additionally mindful of major supplement changes inside mangrove  
165 environments Alongi et al. (1993). The mangrove has numerous commercial uses.  
166 "Clutch," a chemical extricate from the red mangrove, is broadly utilized as a  
167 tanning agent for calfskin and red color for fabrics. Moreover, mangroves supply  
168 leaves for tea and solutions, among other things. Tropical coastal ecosystems  
169 such as offshore coral reefs and intertidal mangroves inhabit coastal regions where  
170 23% of the world's population and 50% of the poor people live Small and Nicholls  
171 (2003).

172         Mangroves act as a physical barrier to mitigate the effects of coastal  
173 disasters like tsunamis, hurricanes, and waves. Mangroves create a unique niche  
174 that hosts rich agglomeration of species diversity. The submerged part of

175 mangrove roots, trunks, and branches serve as islands of habitat that may attract  
176 rich epifloral and faunal communities including bacteria, fungi, macroalgae, and  
177 invertebrates. Despite low nutrient levels, mangroves grow efficiently in this  
178 environment (Sengupta and Chaudhuri, 1991; Alongi et al., 1993; Vazquez et al.,  
179 2000; Bashan and Holguin, 2002).

180 Mangroves supply indirect nutrition to coral reefs by breaking down their  
181 fallen clears into tiny particles, called rubbish, on which organisms' dwell—the  
182 protein substance of mangrove rubbish increments as the rot advances. The  
183 coming about rubbish could be a wealthy dinner for the wetland's littlest occupants,  
184 pulling in shellfish, shrimp, crabs, and modest angle, and bookkeeping for the bulk  
185 of their slim down. Despite the uninviting conditions in human terms, mangrove  
186 wetlands have proven to be among the most biologically productive marine  
187 ecosystems. Mangroves are rich in animal life and serve as a nursery ground for  
188 many economically important marine species Bahamas National Trust, (2008).

#### 189 **Threats to Mangrove Communities**

190 Many view mangroves as being dark, impenetrable, stagnant, and insect  
191 ridden. These misconceptions have humans to shun the mangrove wetland and  
192 abuse them through their destructive activities. Man has damaged these fragile  
193 areas through coastal development and associated dredge-and-fill operations,  
194 pollution, and alteration of natural water systems Bahamas National Trust, (2008).  
195 Mangrove forests along the coastlines of Asian countries are under decline in



196 recent years due to various factors such as aquaculture, illegal logging, pollution,  
197 and climate change Ward et al., (2016).

198 Many Asian coastal areas are major tourist attractions and have a high rate  
199 of infrastructure development (e.g., resorts) in terms of number and area. This  
200 factor further increases the vulnerability of mangrove ecosystems if eco-friendly  
201 construction methods are not implemented Hanum et al., (2014). A complete  
202 picture of the factors that affect mangrove community structure will emerge only  
203 by a combination of both short and long-term studies English et al., (1997). The  
204 lack of rigorous evaluation of the flood protection services of coastal ecosystems  
205 encourages short-term over-exploitation and degradation, reducing the quantity  
206 and quality of the goods and services provided Pelayo et al., (2018).

#### 207 **Diversity of Mangroves in the Philippines**

208 The Philippines is an archipelago country made up of 7,107 islands located  
209 completely within the tropics of the Southeastern Coast of Asia. The islands in the  
210 Philippine are considered as one of the top biodiversity "hot spot" areas of the  
211 world, supporting 1.9% of the world's endemic plants and vertebrate species  
212 (Myers et al 2000). According to Calumpang & Menez (1996), the Philippines are  
213 also considered as one of the richest diversity of mangroves in the world. It is  
214 located along the tropical band where mangroves thriving at 13°00'N, 122°00'E.  
215 The country holds at least 50 % (Primavera et al. 2004) of the world's  
216 approximately 65 mangrove species (Kathiresan and Bingham 2001). Mangroves  
217 is a very important area in an ecosystem. It provides human useful products, food



218 to many fisheries, birds, and invertebrates, and provide protection to any coastal  
219 catastrophic events Alongi, (2008).

220 In 1920, the Philippines used to be covered by 400,000–500,000 ha of  
221 mangroves but it declined to around 120,000 ha in 1994 (Chapman 1976; Brown  
222 and Fischer 1918; Primavera 2000). It is due to overexploitation by coastal  
223 residents, as well as conversion to agriculture, salt ponds, industry, and  
224 communities (Primavera, 2000). According to Long and Giri (2011), an estimated  
225 19 % (49,363 ha) of the Philippines' total mangrove area is located within existing  
226 protected area networks (International Union for Conservation of Nature (IUCN)  
227 protected areas categories, I–VI), with the largest area of protected mangroves  
228 located on Palawan.

#### 229 **Development Plan of Mangrove Species in the Philippines**

230 Issues for mangrove rehabilitation and conservation efforts include a lack  
231 of awareness, the complexity of interactions among natural systems, social  
232 systems, and human values across temporal and spatial scales, insufficient  
233 manpower, and a lack of political will to enforce laws (Primavera and Esteban  
234 2008; Farley et al. 2009). In response to mangrove deterioration, mangrove  
235 rehabilitation is being conducted. However, the sustainability of mangrove forest  
236 rehabilitation is not only depending on continuous planting but through the  
237 involvement of the community in the management. The local community can  
238 directly affect the mangrove forest because they are living near the area Daupan  
239 (2016). In addition, the cooperation of the local and national government to the

240 local community is more efficient in securing mangrove conservation due to the  
241 complexity of the mangrove ecosystem Carter et al. (2015).

242 As part of securing social resilience, the community may enhance and  
243 develop their other forms of livelihood like farming (sugar cane and mango as  
244 dominant crops in the area) to lessen the dependence on the mangrove area in  
245 terms of livelihood. Monitoring is very crucial in rehabilitating mangrove areas. In  
246 this case, there must have regular monitoring of the entire mangrove area. Develop  
247 other ecotourism activities like massage spa, souvenir shops, and many others  
248 and develop other approaches to promoting the place like websites and other  
249 means of social media Buncag, M. et al (2019).

#### 250 **Recent Rehabilitation Efforts for Mangrove Species**

251 The population of Mangrove species continues to decline. The People's  
252 Organization adopted existing laws and forest rules and regulations in the  
253 management of mangroves and resources therein in providing any policy within  
254 the organization. Hence, pursuant to Executive Order No. 192 and the Coastal  
255 Environment Program the DENR Administrative Order No. 30, series of 1994 was  
256 the promulgation of the implementing guidelines for the Non-Government  
257 Organization Assisted Community-Based Mangrove Forest Management (NGO-  
258 Assisted CBMFM) for the DENR Buncag, M. et al (2019).

259 Based on Scientific and Ecological Preferences for key considerations in  
260 mangrove rehabilitations in the planting of mangroves, the People's Organization



261 considers the scientific way in which there is one meter apart from each propagule.  
262 They prefer to use propagules in planting than seedlings because propagules are  
263 more resilient to wind and water currents, unlike seedlings. In planting propagules,  
264 they were using a bamboo stick and small size rope for temporary support against  
265 wind and water currents. Furthermore, they highly consider the zonation in planting  
266 in which every species of mangroves is being planted in a specific area based on  
267 its characteristics for the assurance of survival Buncag, M. et al (2019). The  
268 rehabilitated mangrove area was already engaged in ecotourism activities. The  
269 ecotourism activities are a mangrove tour and study tour, research activity,  
270 kayaking, swimming, use of balsa, a floating flat structure made from bamboo,  
271 mangrove planting, and bird watching. Tourism activities serve as another source  
272 of income for People's Organization members as tour guides and boatmen.

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## METHODOLOGY

### 282 **Research Design**

283       This study will use a descriptive research design to assess the diversity of  
284 mangrove species in Ipil Water Park, Sta. Cruz, Marinduque, where it has been  
285 confirmed that there are many mangrove forests. The purpose of descriptive  
286 research is to accurately and thoroughly describe a population, situation, or  
287 phenomenon. This research design will also utilize a quantitative research method  
288 to gather relevant data about the diversity of mangroves in the area or an action-  
289 based strategy. This method includes observation and gathering of samples. Using  
290 this method will help to measure impact and results.

291       The main variable investigated in this research is the diversity of mangrove  
292 species. The study will also include four main procedures namely: a mangrove  
293 species sampling to measure the species richness and relative abundance of  
294 mangrove species, mangroves sample collection, mangrove species identification  
295 to identify the mangrove species present at the study site, and a field survey to  
296 assess the population dynamics and diversity of mangroves.

### 297 **Conceptual Framework**

298       The goal of this study is to assess the diversity of mangrove species in Ipil  
299 Water Park, Santa Cruz, Marinduque that will identify the mangrove species,  
300 species richness and relative abundance.



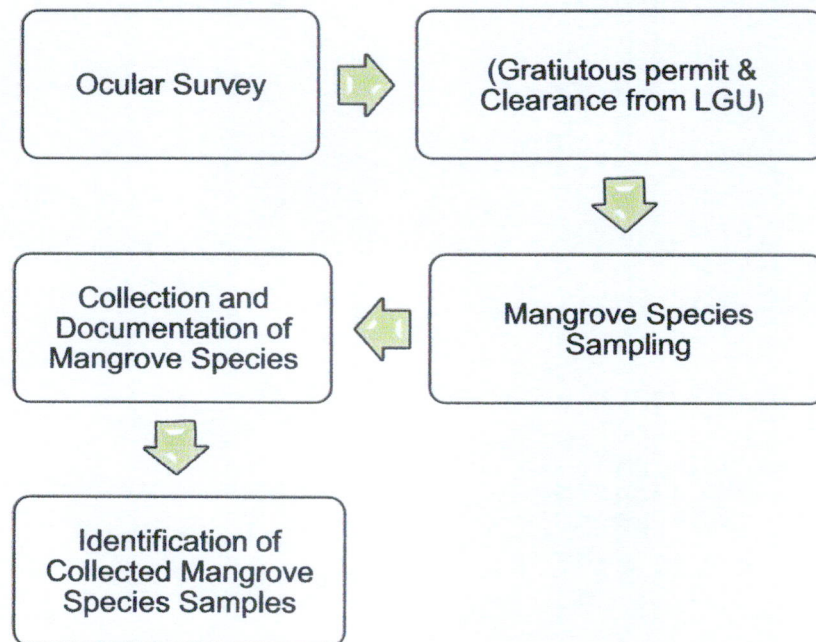


Figure 1. Flow for conducting the diversity assessment of mangrove species in Ipil Water Park, Santa Cruz, Marinduque.

#### Sampling Area

The diversity assessment on the Mangrove species is located and will take place in a specific area in Santa Cruz, Marinduque, specifically Ipil Water Park. The figure below shows the map and land area of Ipil Water Park, Sta. Cruz, Marinduque, and the sampling sites of this research. The province of Marinduque is located about 170 km south of Metro Manila. It is bounded on the north by Tayabas Bay, on the east by the Bondoc Peninsula, on the west by Oriental Mindoro, and on the south by the Sibuyan Sea. The province has a total land area of 95,925 hectares. It is composed of six municipalities such as Boac (the capital town), Buenavista, Gasan, Mogpog, Torrijos, and Santa Cruz. Marinduque's coastal area is made up of around 241,500 ha with a shoreline length of 161 km.

315 Santa Cruz is subdivided into 55 barangays such as Alobo, Angas, Aturan, Bagong  
316 Silang Pob. (2nd Zone), Baguidbirin, Baliis, Balogo, Banahaw Pob. (3rd Zone  
317 Pob.), Bangcuangan, Banogbog, Biga, Botilao, Buyabod, Dating Bayan, Devilla,  
318 Dolores, Haguimit, Hupi, Ipil, Jolo, Kaganhao, Kalangkang, Kamandugan, Kasily,  
319 Kilo-kilo, Kinyaman, Labo, Lamesa, Landy (Perez), Lapu-lapu Pob. (5th Zone),  
320 Libjo, Lipa, Lusok, Maharlika Pob. (1st Zone), Makulapnit, Maniwaya, Manlibunan,  
321 Masaguisi, Masalukot, Matalaba, Mongpong, Morales, Napo (Malabon), Pag-Asa  
322 Pob. (4th Zone), Pantayin, Polo, Pulong-Parang, Punong, San Antonio, San Isidro,  
323 Tagum, Tamayo, Tambangan, Tawiran, Taytay. During the study, the survey will  
324 cover only the estimated area of Ipil Water Park, Sta. Cruz, Marinduque with an  
325 area of about 7 hectares (17.2 acres). Ipil Water Park, Sta. Cruz was chosen as  
326 the Core Zone of Monitoring (CZM) area for this study since Sta. Cruz is one of the  
327 protected areas in Marinduque under the category of Wildlife Sanctuary, Pursuant  
328 to Republic Act. No.7586 known as National Integrated Protected Areas System  
329 (NIPAS) Act of 1992. The researcher will be responsible for selecting the viable  
330 coordinates within the CZM through the distribution of mangroves in the area.



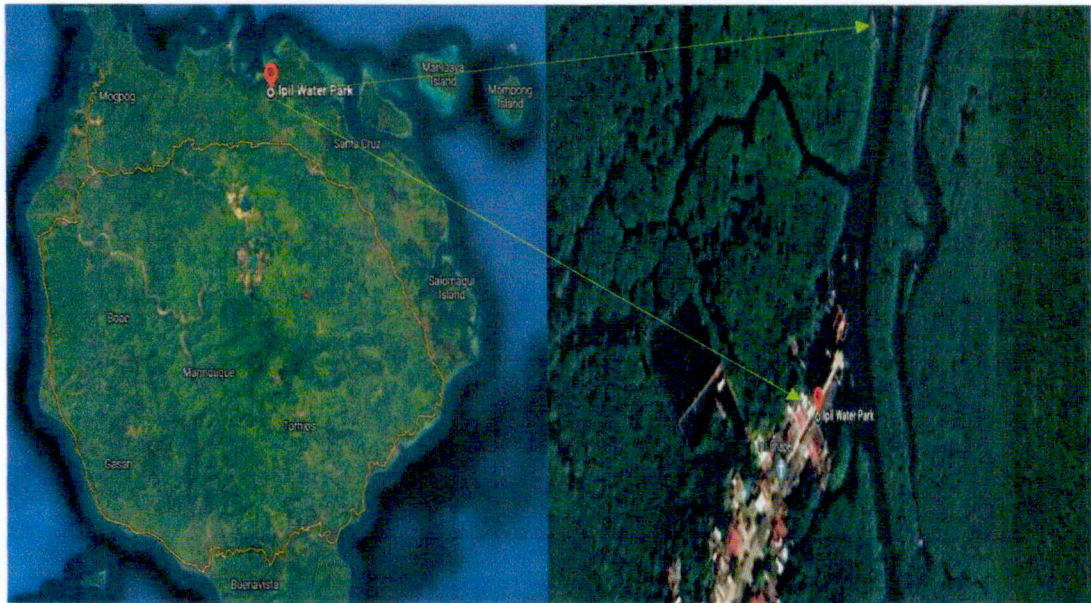


Figure 2. Map of Ipil Water Park, Santa Cruz, Marinduque showing mangrove sampling site.

### **Mangrove Species Sampling**

This study will assess the diversity of mangrove species in Ipil Water Park, Sta. Cruz, Marinduque. All trees within the 7 hectares of the sampling site, with a diameter of equal or greater than  $>10\text{cm}$ , will be identified and measured for diameter at breast height (DBH) and total height (TH). Only mature mangrove species will be included in the sampling. Vegetation structure will be described using tree density, stem density, tree diameter, diameter at breast height (DBH) (cm), and tree height (m) (Patindol et. al., 2019).

### **Mangroves Sample Collection**

The mangrove leaves samples will be taken from the sampling site to identify the different types of mangrove species that are present in the area. The



345 Gratuitous Permit and the Clearance from LGU will be needed for conducting this  
346 study. During the collection process, notes should be kept in a notebook to record  
347 important information about the mangrove species such as place, date, height,  
348 color, the collector's name, mangroves collection number and etc. Tools needed  
349 for collecting are clippers and a sharp knife. GPS will also be used to determine  
350 the location of the sampling site. The researcher will cut the leaves of mangroves  
351 to see the structure and arrangement of the leaves. If there are fruits or flowers  
352 that are seen in the mangrove tree, it will be included in the collection. The  
353 mangrove leaves will be placed in a plastic bags or pails with a few inches of water  
354 in them. The mangrove leaves will stay fresh for a few hours with the help of  
355 moistened newspapers in the plastic bags. It is important to put tags on the  
356 samples to avoid confusion for identifying the plants. Then, the collected samples  
357 should fit in the standard herbarium mounting paper, 11½ x 16½ inches. The  
358 samples should be pressed flat and dried as quickly as possible (Tucker, 2005).  
359 The samples should be put in cardboard and then tie up to easily dry samples.  
360 This process will also be used to avoid damaging the samples.

#### 361 **Mangrove Species Identification**

362 Simple terms are used to describe the characteristics of the mangrove species  
363 such as size, color, shape, surface and etc. of the plant parts such as flower, leaf,  
364 fruit and etc. Using the Field Guide to the Philippine Mangroves of Primavera  
365 (2009) and Field Guide to Mangrove Identification and Community Structure  
366 Analysis by Lebata-Ramos (2013), all species found in each plot will be identified.  
367 Using the both field guides it will be easier to understand the morphological



368 features of mangroves and taxon identification. Moreover, the researcher will also  
369 communicate with the DENR and the locals regarding the identification of  
370 mangrove species in the study site. After the researcher pre-identifying the  
371 mangrove species, the University of the Philippines Diliman will validate and certify  
372 the identification process of the mangrove species.

### 373 **Field Survey for Population Assessment**

374 In assessing the Mangrove species diversity in the area, the researcher will  
375 be using the Simultaneous Multi Vantage Point Count Method wherein a minimum  
376 of two observers are deployed on the vantage points simultaneously to guarantee  
377 an accurate count (Ishihara et al., 2014). Furthermore, the researcher will  
378 coordinate with the local government of Ipil Water Park, Sta. Cruz, Marinduque,  
379 and the rangers and staff of the Mangroves Conservative Program regarding the  
380 permission to deploy the workforce to observe Mangroves Diversity in the study  
381 area. The survey would be conducted at a specific time of 9:00 AM to 5:00 PM -  
382 where the water level is at its best. Suppose the local government of Marinduque  
383 and the Mangroves Conservation Program's rangers and staff allowed the  
384 researcher to recruit the workforce. In that case, the ratio of the execution days of  
385 the field survey will subsequently shorten.

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391 **Gantt Chart**

392 Table 1. Estimated time for conducting this study (2022-2023).

Task	Aug 16- Sept 26	Sept 27- Oct 11	Oct 19- 21	Oct 26- Dec 9	Oct 27- Oct 28	Jan 9-15	Jan 16-20	Jan 30- Mar 24	Mar 24- Apr 21	May 13-20
Chapter 1-3										
Submission of the manuscript to the adviser										
Proposal Defense										
Gratuitous permit & Clearance from LGU										
Ocular Survey										
Sampling										
Identifying mangrove species										
Thesis writing										
Submission of the final manuscript to the adviser										
Final defense										

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