Inventory of mangroves in Katunggan Coastal Eco-Park, Sultan Kudarat Province, the Philippines

CHERIE CANO MANGAOANG*, ANDRIE BON FLORES**
Department of Biological Sciences, College of Arts and Sciences, University of Southern Mindanao. Kabacan, 9407 North Cotabato, Philippines.
*email: cemangaoang@usm.edu.ph; **abuflores@usm.edu.ph

Abstract. Mangaoang CC, Flores AB. 2019. Inventory of mangroves in Katunggan Coastal Eco-Park, Sultan Kudarat Province, the Philippines. Bonorowo Wetlands 9: 59-64. The coastal wetlands of the Philippines are dominated by mangrove ecosystem and are experiencing different forms of threats particularly anthropogenic activities. The local government unit of Lebak in the Province of Sultan Kudarat and non-government organizations envision of rehabilitating and conserving mangrove forests, but no research has been done. Thus, this study was conducted to document different species of mangrove which will serve as a baseline in developing conservation and rehabilitation strategies. Purposive sampling was done and morphological characteristics of each species were examined for identification. A total of 29 mangrove species belonging to 14 families were identified. Three of which are threatened species including Ceriops zippeliana, Avicennia rumphiana and Camptostemon philippinensis. It was also noted that the local community is aware of the importance of mangroves but not all have concern on the conservation and protection policies being implemented by the government. Despite the decreasing status of Philippine mangroves, local exploitation and anthropogenic pressures, such as aquaculture, are still uncontrolled. Therefore, the presence of threatened species implies that the area needs to be prioritized in terms of conservation and rehabilitation activities with joint effort of both the government and local communities to save and protect this mangrove ecosystem.

Keywords: Baseline, conservation, identification, mangroves, restoration

INTRODUCTION

Rehabilitation and restoration of mangrove ecosystems are being promoted by governments, non-government organizations and aid agencies across different parts of Southeast Asia (Thorhaug 1990; Sukardjo and Yamada 1992; Saenger and Siddiqi 1993; Kaly and Jones 1998) with efforts that have met succession with necessary estimates of planted tree survival (e.g., Lewis 1990; Saenger and Siddiqi 1993; Calumpong 1994; Pomeroy et al. 1996; Primavera and Aghayani 1996; Erftemeijer and Lewis 1999). The degree to which mangrove planting actually facilitates the restoration of diverse and structurally complex forests similar to their natural precursors is little examined, although there is considerable literature on this “catalytic” effect in upland forest plantations (Parrotta and Turnbull 1997).

The Philippines as an archipelago has over 7,100 islands, which is bordered by 36,300 km of coastline along seagrass’ beds, coral reefs and even mangrove forests (Benecario et al. 2016). The biodiversity of mangroves and mangroves as an ecosystem have been increasingly attracting greater interest because it is highly productive but also extremely sensitive and fragile environment (Donoso 2018). Mangroves which is comprised of only 65-69 species are well known for their floral diversity of vascular plants which have several specific adaptations to the vibrant coastal setting (Kathiresan and Bingham 2001). Spalding et al. (1997) and Spiers (1999) stated that less than half of the remaining mangrove ecosystems are now existing to date and continues to be in degraded conditions (UNEP 2004; MAP 2005). The continued decline of the mangrove forests is due to numerous anthropogenic disturbances like conversion to agriculture, aquaculture, tourism, urban development and overexploitation (Alongi 2002; Giri et al. 2008) and even natural disasters. According to studies, 35% of mangroves had been lost from 1980 to 2000 (MA 2005), and the mangrove forests have been declining at a faster rate compared to either coral reefs or tropical forests (Duke et al. 2007). The rapid rise of sea-level could also be the greatest threat to mangroves (Gilman et al. 2008). As a result, important ecosystem goods and services of mangrove ecosystems such as natural barrier of ocean wave, carbon sequestration and the biodiversity contained in mangrove forests will be diminished or lost (Duke et al. 2007) even in the Philippines.

Currently, according to the latest checklist of Philippine mangroves by Primavera (2006), there are at least 32 species known and found in the Philippine coastal areas. Consequently, a mangrove reforestation effort exists in the Province of Sultan Kudarat in Mindanao, Philippines. This is specifically located in the coastal Barangay Taguisa, municipality of Lebak, Sultan Kudarat. Barangay Taguisa in cooperation with the Department of Environment and Natural Resources (DENR) has developed mangrove restoration and conservation programs to protect the area. This mangrove forest covers at least 1000 hectares of...
mangroves but no record of mangrove species had been published. Thus, this study was conducted. The data generated in this study will give a complete list of the species thriving in the area. It will also provide reliable baseline information for determining threatened species which could be used as basis to further strengthen the efforts being done in conservation and protection of this ecosystem.

**MATERIALS AND METHODS**

**Study period and location**

The study was conducted during summer between April-May, 2018 in Katunggan Coastal Eco Park in Sultan Kudarat, one of the provinces in the Philippines situated in the mainland Mindanao. During these months, most of the mangrove species in the area are in flower which helped the researchers in the identification process. Lebak, a municipality in the western Sultan Kudarat which faces the Celebes Sea, harbors both mountainous and coastal areas. Barangay Taguisa (A barangay is referred as the smallest administrative division in the Philippines and is native to the Filipino term village, district or ward), a coastal community of Lebak, is where an eco-park can be found which is part of the 1000-ha mangrove forest (Figure 1). The Katunggan Coastal Eco-park is being managed by the Local Government Unit in partnership with the Department of Environment and Natural Resources (DENR).

**Sampling and inventory of mangrove species**

The inventory of mangrove species was done through purposive sampling and walks on the park and in other parts of the mangrove forest in Barangay Taguisa, Lebak together with staff from the Municipal Environment and Natural Resources Office (MENRO) of the said municipality. Field notes were taken and preliminary identification of mangrove species was done in the area. Morphological characteristics of leaf, flowers, and propagules were noted and used in the identification of species. Key guides such as the Field guide to Philippine Mangroves by Primavera 2006 and other published work were used. Photographic documentation was also employed to further identify the species. Voucher specimens were also collected.

![Figure 1. Map of the study site in Taguisa, Lebak Sultan Kudarat, Mindanao, Philippines](image-url)
| Family                | Species                                      | Common name                | Distribution                                                                 | Ecological status |
|----------------------|----------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------|
| Fern                 | *Acrostichum aureum* L.                     | Lagiwliw, ragoyhoy         | Found in tropical and sub-tropical areas around the world                    | LC                |
|                      | *Acrostichum speciosum* Willd.              | Lagolo, palaypay           | American Samoa; Australia; and Southeast Asia                               | LC                |
| Vascular plants      | *Acanthus ebracteatus* Vahl.                 | Lagiwliw, ragoyhoy         | Widespread across Southeast Asia including the Philippines                    | LC                |
| Acanthaceae          | *Acanthus volubilis* Wall.                  | Lagiwliw, ragoyhoy         | Widespread across Southeast Asia including the Philippines                    | LC                |
| Areceae              | *Nypa fruticans* Wurmb                      | Nipa, sasa                 | Throughout the Philippines                                                   | LC                |
| Avicenniaceae        | *Avicennia alba* Blume                       | Bungalow, apiapi, miapi    | South East Asia, including the Philippines, Australia and the Pacific islands| LC                |
|                      | *(Forsk.)* Vierh                           |                            | Southeast Asia, including the Philippines, Australia, New Zealand, East Africa, India, Pacific Islands | LC                |
|                      | *Avicennia officinalis* L.                  | Bungalow, apiapi, miapi    | Southeast Asia, including the Philippines, New Guinea and southern Australia | LC                |
|                      | *(Forsk.)* Vierh                           |                            | Southeast Asia including the Philippines and Papua New Guinea                 | Vul               |
| Bignoniaceae         | *Dolichodrome spathacea* (L. fil.) K. Schum  | Mangrove trumpet tree      | Southeast Asia, including the Philippines. It is also found in the northeast tip of Australia and Papua New Guinea and Palau | LC                |
| Bombacaceae          | *Camptostemon philippinensis* (S.Vidal) Becc. | Gapas-gapas                | This species is patchily distributed in Indonesia (Borneo and Sulawesi), and the Philippines | En                |
| Combretaceae         | *Lumnitzera littorea* (Jack) Voigt           | Tabao                      | Throughout the Philippines. Also tropical Asia, to Australia and Polynesia    | LC                |
|                      | *(Forsk.)* Vierh                           |                            | Throughout the Philippines. Also tropical Asia, to Australia and Polynesia    | LC                |
| Euphorbiaceae        | *Excoecaria agallocha* Linnaeus              | Buta-buta                  | Throughout the Philippines. Also India, Malaysia and Polynesia                | LC                |
| Lythraceae           | *Pemphis acidula* J.R. & G. Forst.          | Bantigi                    | Throughout the Philippines. Also tropical Africa, tropical Asia.              | LC                |
| Meliaceae            | *Xylocarpus granatum* Koen.                 | Tabigi                     | Throughout the Philippines. Also East Africa, India and some countries in Southeast Asia | LC                |
|                      | *(Lamk.) M. Piag-ao Roem.                   |                            | Luzon (Quezon and Bataan), Palawan, Mindoro, Mindanao and the Sulu Archipelago, Also Madagascar to India through Malaysia to Polynesia | LC                |
| Myrsinaceae          | *Aegiceras corniculatum* (Linnaeus)         | Saging-saging, tinduk-tindukan | Batanes islands to Palawan, Mindanao and Sulu Archipelago. Also Sri Lanka, India to southeastern China through Malaysia to Australia | LC                |
| Rhizophoraceae       | *Bruguiera cylindrica* (Linnaeus) Blume      |                            | Throughout the Philippines. Also India, Southeast Asia through Malaysia and Australia | LC                |
|                      | *(Linnaeus)* Pototan-lalake                  |                            | Throughout the Philippines. Also Africa, Madagascar, Seychelles, Southeast Asia, through Malaysia, Australia and Polynesia | LC                |
|                      | *(Lamk.)* Pototan-busain                    |                            | Throughout the Philippines, India, Southeast Asia, Australia and New Caledonia. | LC                |
| Species                                      | Distribution                                                                 | Threat Level |
|----------------------------------------------|-----------------------------------------------------------------------------|--------------|
| Bruguiera sexangula (Lour.) Poir. Pototan    | Widespread and found in Asia, Northeast Australia, Papua New Guinea, and the Solomon Islands. In China, this species is restricted to Hainan Island, where it is uncommon. | LC           |
| Ceriops zippeliana (Griff.) Ding Hou Baras-baras | Throughout the Philippines. Also India, Southeast Asia, through Malaysia and Australia. | NT           |
| Ceriops tagal (Perr.) C.B. Rob. Tungog, tangal | Throughout the Philippines. Also some parts of Southeast Asia, through Australia and the Pacific Islands | LC           |
| Rhizophora apiculata Blume Bakhawalake        | Throughout the Philippines. Also some parts of Southeast Asia, through Australia and the Pacific Islands | LC           |
| Rhizophora mucronata Lamk. Bakhaw babae       | Throughout the Philippines. Extra-Philippine distribution including tropical Africa, Madagascar and Seychelles | LC           |
| Rubiaceae Scyphiphora hydrophyllacea Gaertn.  | Luzon to Palawan and Mindanao. Also in India, Southeast Asia, Australia and New Caledonia. | LC           |
| Sonneratiaceae Sonneratia alba J. Smith Pagatpat | Widespread in East Africa, Seychelles and Madagascar, India, Sri Lanka and throughout Southeast Asia to tropical Australia, New Caledonia, Palau, the Federated States of Micronesia, Marshall Islands, Papua New Guinea, Solomon Islands, Vanuatu, Kiribati, and China (Hainan Island). | LC           |
| Sonneratia caseolaris (L.) Engl. Pedada       | Throughout the Philippines.                                                 | LC           |

Note: LC: Least Concern, NT: Near Threatened, En: Endangered, Vul: Vulnerable

RESULTS AND DISCUSSION

The survey and documentation of mangrove species in the Katunggan Coastal Eco-Park in Lebak, Sultan Kudarat identified a total of 29 species of mangroves and belonging to 16 genera representing 14 families including: Acanthaceae, Pteridaceae, Myrsinaceae, Avicenniaceae, Bignoniacaeae, Bombacaceae, Rhizophoraceae, Euphorbiaceae, Combretaceae, Arecaceae, Lythraceae, Sonneratiaceae, Rubiaceae and Meliaceae. Among the documented mangrove families, Rhizophoraceae had the most number of species with 8 under 3 genera while the least number of species was in Arecaceae, Bombacaceae, Bignoniacaeae, Euphorbiaceae, Lythraceae, Myrsinaceae, and Rubiaceae with only one species per family. The complete list of species identified per family is presented in Table 1.

Most of the recorded mangroves in the area are widespread across Southeast Asia and its neighboring tropical countries. The area also harbors some threatened mangrove species which at least 3.45% species are considered as Near Threatened (Ceriops zippeliana), 3.45% species is vulnerable (Avicennia rumphiana) and an endangered species Campnostemon phillipinensis is also 3.45% (Figure 2). The remaining 89.65% is considered Least Concern.

The mangrove forest in Katunggan coastal eco-park harbors 29 species of mangroves found in the Philippines and this serves as the baseline data of the site. The high species present in the area can be incorporated with the local government successful efforts in restoring and conserving this ecosystem. Numerous mangrove seedlings and saplings can also be observed in the area which will be the next generation of the mangrove and will be added to their population succession. Though the species number was lower compared to other mangrove ecosystems in the country, such as Pagbilao Bay in Quezon Province which has 37 species (Almazol et al. 2013); Panay with 34 species (Primavera et al. 2004), Guimaras with 30 species (Sadaba et al. 2009) and Davao Gulf with 30 species (Flores 2003), however, it is also considered higher compared to Bohol with 26 species (Mapalo 1992), Samar Island with 22 species (Mendoza & Alura 2001), Ibay in Aklan Province with 22 species (Primavera 2000), Palawan with 22 species (Arquiza 1999), Danao Bay with 20 species (De Guzman 2004), Alabel and Maasim, Sarangani Province with only 12 species (Natividad et al. 2014), Baco North and Laron del Norte with only 11 species (Benecario et al. 2016) and in Hagonoy Davao del Sur with only 7 species (Jumawan et al. 2015).
The mangrove forest in Katunggan coastal eco-park harbors 29 species of mangroves found in the Philippines and this serves as the baseline data of the site. The high species present in the area can be incorporated with the local government successful efforts in restoring and conserving this ecosystem. Numerous mangrove seedlings and saplings can also be observed in the area which will be the next generation of the mangrove and will be added to their population succession. Though the species number was lower compared to other mangrove ecosystems in the country, such as Pagbilao Bay in Quezon Province which has 37 species (Almazol et al. 2013); Panay with 34 species (Primavera et al. 2004), Guimaras with 30 species (Sadaba et al. 2009) and Davao Gulf with 30 species (Flores 2003), however, it is also considered higher compared to Bohol with 26 species (Mapalo 1992), Samar Island with 22 species (Mendoza & Alura 2001), Ibayaj in Aklan Province with 22 species (Primavera 2000), Palawan with 22 species (Arquiza 1999), Danao Bay with 20 species (De Guzman 2004), Alabel and Maasim, Sarangani Province with only 12 species (Natividad et al. 2014), Bacolod, Lanao del Norte with only 11 species (Benecario et al. 2016) and in Hagonoy Davao del Sur with only 7 species (Jumawan et al. 2015).

However, the number of species recorded in this study might be higher if more intensive survey were conducted. The high species present in Katunggan Coastal Eco-park suggests that this area could be one of the most important mangrove ecosystems in Mindanao and even in the country. The comparison between different mangrove areas, only means that few mangrove sites have been explored and documented where in fact most of the natural stands of mangrove can be found in the coastal areas of Mindanao. It is also noted in the study that only one individual of *Pemphis acidula* was documented, this is probably because this mangrove species is locally threatened because of exploitation for decorative purposes such as bonsai. Locally known as bantigue bonsai, this mangrove species is listed in DENR Administrative Order 2017-11 as a threatened Philippine plant. It is also listed in the International Union for Conservation of Nature Red List of Threatened Species where recent records of it being collected, sold and transport are seized (Panay News, 2018). Even in the very alarming rate of anthropogenic disturbances, the fear of losing this threatened ecosystem is near to possibility. And with the fact that it remains unexplored, we may yet lose another treasure trove without even knowing.

Based on observations and field notes of the study, it found that the community is aware of the importance of the mangroves but not all have concerns to the policies being implemented by the government to protect and conserve mangroves. There are still threats visible and can be observed in the area such as arising numbers of agricultural fish ponds and degradation of mangroves or deforestation.

**Conclusion and recommendation**

Mangroves species present in Katunggan Coastal Eco-Park is indeed rich and the data presented here qualifies the support of this claim. Successful restoration and conservation of the local government can be observed in the Katunggan coastal eco-park. These can be supported by the high species present and the observable number of saplings. Awareness on the ecosystem function of mangroves is limited only to the people who stay near the forest and for those who are working in the eco-park. On the other hand, those people who do not involve protection and conservation inflict destruction and disturbances. This became a big problem when implementing conservation efforts in the area.

The species richness of mangrove in the area must serve as baseline information for further enhanced interventions and strong implementation of existing laws for its proper management and conservation. Local government officials and people in the community must work together in the preservation of this threatened ecosystem by performing
each role that will subsequently lead to sustainable use of the resources both the flora and fauna. The result of this study may be useful when developing management plan to give direction in prioritizing interventions for the conservation and appropriate utilization of services that mangrove ecosystem could provide for them. This study recommends conduct of ecological researches on mangrove in the area and in-depth assessment of threats may be considered as well.

ACKNOWLEDGEMENTS

The authors would like to thank the following people for their valuable contributions behind the success of the study: Ben Raye B. Marco, Camelle Jane Bacordo, Ruffa Mae Marfil, Ellen Angelic Biene, Christine Bascos, Christie Kaye Lopez, Crystal Joy Dacutan, Gemma Daçquila, Kezia Atok and Leanne Jay Manceras for helping during the sampling. Dr. Jurgenne Primavera for the verification of the mangrove species. Arnold “Batoy” Astrolabio our tour guide and to the Local Government of Lebak including Hon. Major Dionesio B. Besana of Lebak, their tourism officer Lourdes Shirly Brillos and the Brgy. Captain of Brgy. Taguisa, Hon. Randy Orgo for permitting the study to be conducted together with the locals of the Barangay.

REFERENCES

Almazol AE, Cervanca CR, Buot Jr. IE, Pampilona NM. 2013. Floristic composition and physiogony of Pugbilo mangrove, Quezon Province, Philippines. Intl J Ecol Conserv 7: 25-39.
Alongi DM. 2002. Present state and future of the world’s mangrove forests. Environ Conserv 29: 331-349.
Arquiza YD. 1999. Rhythm of The Sea: Coastal Environmental Profile of San Vincente, Palawan. Coastal Resource Management Project, Department of Environment and Natural Resources, Philippines.
Bencario JB, Torregosa KMY, Orbita, MLS, Orbita RR. 2016. Composition, abundance and distribution of mangroves in Bacolod, Landoan of the North, Mindanao, Philippines. Adv Environ Sci 8 (1): 42-49.
Calumpong HP. 1994. Status of mangrove resources in the Philippines. In Proceedings of the Third ASEAN-Australia Symposium on Living Coastal Resources 1: 215-229.
De Guzman AB. 2004. A fishery in transition: Impact of a community marine reserve on a coastal fishery in Northern Mindanao. IDRC Digital Library, Economy and Environment Program for Southeast Asia (EEPSEA), Singapore.
Donoso CH. 2018. Assessment of mangroves identified as Crocodylus porosus habitat in Del Carmen Siargao Islands. J Sci Technol 4 (1): 29-36.
Duke NC, Meynecke JO, Dittmann S, Ellison AM, Anger K, Berger U, Cannacci S, Diele K, Ewel KC, Field CD, Koedam N, Lee SY, Marchand C, Nordhaus I, Dahdouh-Guebas F. 2007. A world without mangroves? Science 317: 41-42.
Erffemeijer PL, Lewis RR. 1999. Planting mangroves on intertidal mudflats: habitat restoration or habitat conversion. In Proceedings of the ECOTONE VIII seminar enhancing coastal ecosystems restoration for the 21st century, Ranong, Thailand.
Flores J. 2003. Final Report: Status of Mangrove Ecosystem in Davao Gulf, Philippines. Resource and social assessment of Davao Gulf, Philippines. FRMP, Manila.
Gilman EL, Ellison J, Duke NC, Field CD. 2008. Threats to mangroves from climate change and adaptation options: A review. Aquat Bot 89: 237-250.
Giri C, Zhu Z, Tieszen LL et al. 2008. Mangrove forest distributions and dynamics (1975-2005) of the tsunami-affected region of Asia. J Biogeogr 35 (3): 519-528.
Jumawan J, Flores FL, Aragon RT, Villamor J, Sagot JC, Taguse HC, Depamaylo AMV. 2015. Diversity assessment and spatial structure of mangrove community in a rehabilitated landscape in Hagonoy, Davao Del Sur, Philippines. AES Bioflus 7 (3): 475-482.
Ko UL, Jones GP. 1998. Mangrove restoration: A potential tool for coastal management in tropical developing countries. Ambio 27: 656-661.
Kathiresan K, Bingham BL, 2001. Biology of mangroves and mangrove ecosystems. Adv Mar Biol 40: 81-251.
Lewis RR. 1990. Creation and restoration of coastal plain wetlands in Florida. Pages 73-101 in Kusler JA, Kentula ME (eds). Wetland Creation and Restoration: The Status of the Science. Island Press, Washington, D.C.
MA [Millennium Ecosystem Assessment]. 2005. Mille Ecosystems and Human Wellbeing: Synthesis. Island Press. Washington, DC.
Mapalo AM. 1992. Mangrove species distribution in Bohol, Philippines. Ecosys Res Digest 3(2), 55-62.
MAP [Mangrove Action Project]. 2005. Available at: http://mangroveactionproject.org
Mendoza AB, Alura DP. 2001. Mangrove structure on the eastern coast of Samar Island, Philippines. Mendoza AB, Alura DP. 2001. Mangrove structure on the eastern coast of Samar Island, Philippines. In: Stott DE, Mohlart RH, Steinhardt GC (eds.). Sustaining The Global Farm. Selected papers from the 10th International Soil Conservation Meeting held May 24-29, 1999 at Purdue University and the USDA-ARS National Soil Erosion Research Laboratory.
National EMDC, Dalundong AG, Patriarca AB, Banisil MA, Hingabay VS, Pana BHC, Teofilo RCE, Salvatierra LEJ, Dagoc V, Jumawan JH. 2014. Correlation of soil and mangrove diversity in selected sites of Alabel and Maasim, Sarangani Province, Philippines. AAB Bioflus 6 (2): 145-153.
Panay News. 2018. P300T worth of threatened PH plant seized. https://www.panaynews.net/p300t-worth-of-threatened-ph-plant-seized/
Parrotta JA, Turnbull JW, Jones N. 1997. Catalyzing native forest regeneration on degraded tropical lands. For Ecol Manag 99 (1-2):1-7.
Pomeroy RS, Pollinac RB, Predo CD, Katon BM. 1996. Impact evaluation of community based coastal resource management projects in the Philippines. International Center for Living Aquatic Resources Management (ICLARM), Makati City, Philippines.
Primavera JH, Agyapani RF. 1996. Comparative strategies in community-based mangrove rehabilitation programs in the Philippines. ECOTONE V: community participation in conservation, sustainable use and rehabilitation of mangroves in Southeast Asia. Ho Chi Minh City, Vietnam, January 8-12.
Primavera JH. 2000. Development and conservation of Philippine mangroves: institutional issues. Ecol Econom 35(1): 91-106.
Primavera J. 2004. Philippine mangroves: Status, threats and sustainable development. In Mangrove Management and Conservation: Present and Future. United Nations University Press, Tokyo.
Primavera JH, Danala RDB 2006. Field Guide to Philippine Mangroves. Philippine Tropical Forest Conservation Foundation Inc., Manila.
Sadaba RR, Bawneuvo AP, Madas CS, Biñas J, Hortillosa E. 2009. Assessment of the short-term damage in the Guimaras mangrove forests by the M/T Solar I oil spill. University of the Philippines, Visayas. Phil J Nat Sci Oil Spill (Spec. Issue) 71-82.
Saeinger P, Siddiqui NA. 1993. Land from the sea: The mangrove afforestation program in Bangladesh. Ocean Coast Manag 20: 23-39.
Sipling M, Blasco F, Field C. (eds.). 1997. World Mangrove Atlas. The International Society for Mangrove Ecosystems, Okinawa, Japan.
Spiers AG. 1999. Review of international/continental wetland resources. In: Frlnayli CMM, Spiers AG (eds). Global Review Wetland Resources and Priorities for Wetland Inventory, Supervising Scientist Report 144. Canberra.
Sukardjo S, Yamada I. 1992. Biomass and productivity of a Rhizophora mucronata Lamarck plantation in Trith, Central Java, Indonesia. For Ecol Manag 49: 153-200.
Thorthaug A. 1990. Restoration of mangroves and seagrasses-economic benefits for fisheries and mariculture. In: Berger JJ (eds). Environmental Restoration: Science and Strategies for Restoring The Earth. Island Press, Washington, D.C.
UNEP [United Nations Environment Programme]. 2004. Global environment outlook yearbook 2004. United Nations Environment Programme, Nairobi, Kenya.
