

# SYNTHESIS OF RESEARCH GAPS

---

*State of mangroves in Guyana: An analysis of  
research gaps, and recommendations*



## Acknowledgement

1. Conservation International Guyana (CI Guyana)
2. Environmental Protection Agency (EPA)
3. Guyana Forestry Commission (GFC)
4. Guyana Lands and Surveys Commission (GL&SC)
5. Ministry of Public Infrastructure (MoPI)
6. Ministry of Agriculture (Fisheries Department)
7. National Drainage and Irrigation Authority (NDIA)
8. Ministry of Natural Resources and the Environment (MNRE)
9. National Agricultural Research and Extension Institute (NAREI) Mangrove Department
10. Protected Areas Commission (PAC)
11. University of Guyana (Turkeyen Campus)
12. World Wildlife Fund – Guyana country office

This document was prepared for Conservation International Guyana as part of the Setting the foundations for zero net loss of the mangroves that underpin human wellbeing in the North Brazil Shelf – Large Marine Ecosystem Project, funded by the Global Environment Facility.

# 1. STATE OF KNOWLEDGE OF MANGROVES IN GUYANA

**KEY:**

- High Priority
- Medium Priority
- Low Priority

## 1.1 Brief history, classification, taxonomy, and distribution of mangroves in Guyana

Research Gap #	Priority	Research Gap	Information lacking
1 (a)	Low	Anecdotal/empirical evidence of the early appearance of mangroves in coastal communities	There is sketchy information documented on the very early history of mangroves in the country. A survey particularly in rural areas should be carried out among persons age 50 and above would provide necessary information on early details surrounding mangroves locally.
1 (b)	High	Detailed taxonomy of mangal communities in Guyana	Detailed taxonomies of all mangrove species found locally along with the development of a taxonomic key(s) for their identification locally
1 (c)	High	Comprehensive database of biodiversity of mangroves in Guyana	The data collected from 1(b) would be useful in developing a database which could lead to greater or increased conservation and monitoring efforts.
1 (d)	High	Biochemical and biophysical analyses possibly responsible for distribution of	Observations and comparisons have shown that the distribution pattern of mangroves in the Guianas region, differs from that in other parts of the world. There has been minimal specific research done locally to determine the exact

		mangroves in Guyana	reason for this. Biochemical analyses and biophysical analyses including soil comparisons (hydrology and geology), and plate tectonics would serve as a baseline for finalising reasons behind different distributions.
1 (e)	High	Differences in distribution of mangroves regionally and over time	What is the specific difference in distribution of mangrove species when comparing each region? Is there a difference in densities? How do yearly estimates in distribution of each species differ?
1 (f)	High	Dynamics of mangrove vegetataion linked to geomorphology of the coast	Evaluation of changes in magnitude and frequency of coastal geomorphic processes can show how variable environmental conditions can determine colonisation by mangroves

## 1.2 Legal Framework for Mangroves in Guyana

Research Gap #	Priority	Research Gap	Information lacking
2 (a)	High	Review of policy and legislation related to mangroves use and management in Guyana	There needs to be an overview of the key national policies, plans and legislations that would be related to the use, protection and management of mangrove ecosystems and mangroves specifically. The research can first analyse and assess policies, then offer possible options and recommendations for policy and law reform for consideration by the Government of Guyana.

### 1.3 Flora and Fauna of Mangrove Forests in Guyana

Research Gap #	Priority	Research Gap	Information lacking
3 (a)	Low	Effect of the use of <i>Spartina</i> grass as a means of recruiting mangroves	In each region, efforts should be made to use <i>Spartina</i> grass as a recruiter to determine and compare rates of recruitment and species recruited. Experiments with <i>Spartina</i> grass have been done locally and these results can serve as the precursor to similar studies in each region.
3 (b)	Low	Further studies in each mangrove region to determine flora and fauna present (establishment of a floral and faunal database)	Establishment of a biological database will lend itself to 3 (c) below
3 (c)	Low	Taxonomies of each species for in mangrove sites	Taxonomies per species will aid in differentiation of all species present and learning about 3 (d) below
3 (d)	High	Effect of salinity on variety and abundance of fishes	This would give clearer insight into mangrove fish habitats and their roles as nursery and feeding areas, refuges and migration routes.
3 (e)	High	Temporal patterns of occurrence of flora and fauna in mangrove communities	Once biodiversity indices are established, studies can be done at least twice yearly to determine species occurrence at specific times of the year.
3 (f)	High	Establishing keystone species	Crabs are keystone species of mangrove forests. Their presence has a disproportionately large effect on its environment relative to their abundance.

		of mangrove forests locally	Studies can be done to determine how the presence of these keystone species affects the mangrove ecosystem. Research can also be done to determine how they serve as biological health of mangrove ecosystems.
3 (g)	High	Mapping migratory patterns and behaviours of migratory birds through mangrove forests in Guyana	Migratory patterns can be established and used as ecotourism promotional material; behaviours of migratory birds can contribute to developing life history patterns and dependence on mangrove forests.

### 1.4 Mangroves and Climate Change

Research Gap #	Priority	Research Gap	Information lacking
4 (a)	High	The effect of mangroves on the hydrodynamic processes along Guyana's coast	This information is very important since sea level is on the rise and the total suitability and possibility of mangroves being a crucial defense system is pertinent.
4 (b)	High	Distribution, phenology and abundance of mangrove forests in response to climate change	Climate change is causing a poleward shift in the distribution, phenology, and abundance of several species including mangroves. These changes are visible especially in wetlands. Research carried out on the latter can give useful insight into how biodiversity patterns and ecosystem structure and function are being altered.
4 (c)	High	Local processes contributing to vulnerability of mangroves to sea level rise	Mangroves are sensitive to changes in sea level rise and salinities. These changes can lead to decreased productivity and untimely death. Understanding these processes and their timing can help in reducing vulnerability levels nationwide.

4 (d)	High	Factors contributing to mangrove resilience to sea level rise	Mangroves demonstrate significant resilience to climate change and sea level rise by sediment trapping and retention. Due to the different soil profiles regionally, retention and trapping capabilities can differ greatly. An investigation of this can show which regions are more resilient to climate change and steps that can be taken to effect these. The measurement of sediment accretion would prove to be a useful tool in this regard.
-------	------	---	--

### 1.5 Factors Affecting Mangroves and Their Response to Natural Stresses

Research Gap #	Priority	Research Gap	Information lacking
5 (a)	Low	Relationship between sedimentation and the presence/absence of mangroves	There have been significant strides taken in this research area. However, greater effort needs to be placed into understanding background dynamics e.g. dredging, associated with the presence or absence of mangroves
5 (b)	High	Relationship between coastal development (structural engineering) and the presence/absence of mangroves	Regionally, a characterisation of the shoreline can be done, and GIS mapping can be used to draw relationships between shore structures and other sea defenses. This data would be combined with studies of near shore bathymetry along the Guyanese shoreline.
5 (c)	High	Movement of mud banks and erosion cycle	Erosion is a great threat to Guyana's mangroves and when coupled with other environmental stresses, can prove too hazardous to the life of mangroves. Research in this area would therefore

			help to take precautionary moves before these environmental stresses cause disaster.
5 (d)	High	Mapping and modelling of coastline retreat and advance	The coastline is very important to the preservation of mangroves. Due to cyclic processes, the coastline can either retreat or advance depending on geologic processes and activities. Mapping and modelling of these activities will help in gathering key data which would holistically contribute to mangrove restoration, conservation and protection.

### 1.6 Productivity of Mangrove Ecosystems

Research Gap #	Priority	Research Gap	Information lacking
6 (a)	Medium	Regional studies investigating primary productivity in the form of leaf litter dynamics	Studies of biomass and leaf litter production to establish baseline information perhaps through the use of trial plots and established sites by the Mangrove Department
6 (b)	Medium	From 7a above, a comparison of the variations in primary productivity within each region	A comparative analytical report region by region to assess rates of primary productivity
6 (c)	Medium	Investigation of temporal changes in primary productivity	The influence of time on rates and status of primary productivity



6 (d)	Medium	Assessment of levels of environmental stress interference with primary productivity	Indicators of primary productivity in mangrove forest types e.g. disturbed, undisturbed
6 (e)	Medium	Studies comparing the primary productivity in Guyanese mangroves to regional and global studies	A comparison of the rate of primary productivity locally to that of international scales

### 1.7 Community Participation and Efforts In Conservation

Research Gap #	Priority	Research Gap	Information lacking
7 (a)	Medium	Updated community perceptions of mangroves: benefits and uses	How have perceptions of mangrove forests and their usefulness/ benefits changes since the inception of the GMRP?
7 (b)	Medium	Updated assessment of students and teacher's knowledge of mangroves and	How have students and teacher's knowledge of mangroves and conservation efforts been enhanced since widespread dissemination of information on mangroves through the inception of the GMRP?

		conservation efforts	
7 (c)	Medium	Community involvement: goals and objectives	What do communities require to benefit sustainably from mangrove forests but at the same time contributing to community knowledge and management of these forests?
7 (d)	High	The development of additional management plans for communities adjacent to mangroves	Plans similar to that developed by Kalamandeen (2013) should be developed so as to better effect management of mangrove communities and enhance community participation.

### 1.8 The Rehabilitation and Restoration Of Mangroves In Guyana

Research Gap #	Priority	Research Gap	Information lacking
8 (a)	High	Detailed survival rates and factors affecting their survival at each replanted site in Guyana	There have been several studies done to assess survival rates at replanted sites but a comprehensive study needs to be done to determine survival rates at all replanted sites and comparisons should be done to see if survival rates follow a trend or have increased/decreased over the years.
8 (b)	High	A comparative assessment of the use of hard structures locally to	With the implementation of breakwaters, geotextile tubes, brush dams etc. a comparative assessment should be done to

		effect mangrove as sea defenses	determine levels of effectiveness of each treatment type in promoting the growth of mangroves.
8 (c)	High	Local role of mangroves in reducing wave energy	Studies of change in wave energy reaching the sea defence infrastructure over time as restored forest areas develop
8 (d)	Medium	Effect of herbivory on restoration and subsequent survival of mangroves	Cattle grazing is very dominant in restored mangrove sites. Key documentation of this is needed at each site and a link between herbivory and rates of survival along with effects on restoration is pertinent to developing methods to remedy any situations of exiting herbivory in mangrove forests.
8 (e)	High	Investigation of alternative hard structures to augment mangrove forests	Apart from the alternative hard structures that have been implemented locally, research should be undertaken to determine how geologically similar areas are using other hard structures as support systems to mangroves.

## 1.9 Economic Valuation of Mangrove Forests

Research Gap #	Priority	Research Gap	Information lacking
9 (a)	High	Total Economic Value of mangrove forests in Guyana	This is a high priority research area that can contribute information on cost/benefit analysis, environmental costs and management actions.

## 2. REFERENCES

1. Abdool, Y., DaSilva, P. 1997. **Characteristics for the establishment of a mangrove fringe. (Master of Science Dissertation)**. University of Guyana.
2. Anthony, E, Gratiot, N.. (2012). Coastal engineering and large-scale mangrove destruction in Guyana, South America : averting an environmental catastrophe in the making. *Ecological Engineering*, 47, 268-273. ISSN 0925-8574.
3. Augustinus, P.G.E.F. 1984. **Coastal Erosion and Coastal Accretion between the Estuaries of the Essequibo and the Corentyne Rivers "A contribution to the Coastal Defence of the Cooperative Republic of Guyana"**. University of Utrecht.
4. Bayney, A., Da Silva, P., 2005. **The Effect of Birding on Local and Migrant waterfowl populations along the coast of Guyana.**
5. Bovell O. 2010. **A Situational Analysis of Coastal Mangrove Sites in Guyana (Shell Beach to Mahaica)**
6. Bovell O. 2011. **Guyana Mangrove Nursery Manual**. Guyana Mangrove Restoration Project..
7. Bovell O. 2013. **Technical Assistance for Mangrove Rehabilitation/ Review of Mangrove Research in Guyana**. Landell Mills Ltd.
8. Braun, M.J., Finch, D.W., Robbins, M.B., Schmidt, B.K., 2006. **A Field Checklist of the Birds of Guyana. Biological Diversity of the Guyanas** Publication 1–23.
9. Braun, M.J., D.W Finch, M.B. Robbins and B.K. Schmidt. 2011. **A Field Checklist of the Birds of Guyana**. Smithsonian Institution, Washington, D.C.
10. Braun, M.J., D.W Finch, M.B. Robbins and B.K. Schmidt. 2007. **A Field Checklist of the Birds of Guyana**. Smithsonian Institution, Washington, D.C.
11. Croux, S. 2013. **Application of the concept of Blue carbon to sustainable mangrove management in Guyana**. ESA/PWA, Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project
12. Dalton, H. G. 1855. **The Short History of British Guiana**. Longman, Brown, Green and Longmans, London.
13. Dalrymple, K. 2006. Sea-level Rise Implications for the Coast of Guyana: Sea walls and muddy coasts. Presented Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology (LACCET'2006) "Breaking Frontiers and Barriers in Engineering: Education, Research and Practice" 21-23 June 2006, Mayagüez, Puerto Rico.

14. Da Silva, P. 2014. **Avifaunal diversity in the Guyanese mangrove ecosystem, University of Guyana**. Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project.
15. Da Silva, P. (2015). **Exploring a community's knowledge and use of a coastal mangrove resource: The case of Wellington Park, Guyana**. International Journal of Science, Environment and Technology, Vol. 4, No 3, 2015, 759 – 769
16. DaSilva P. 2015. **Mutual Benefits from Mangrove Reserves in Guyana: Coastal Protection and Avifaunal Habitats** International Journal of Science, Environment and Technology, Vol. 4, No 4, 2015, 924 – 933.
17. DaSilva P. 2015. **Conservation of Mangroves in Guyana: A Study of Teachers' Perceptions, Knowledge, Attitudes and Practices**. Conservation of Mangroves in Guyana: A Study of Teachers' Perceptions, Knowledge, Attitudes and Practices
18. Dookram K., Jaikishun S., Ansari, A. (2017). **A comparison of the effects of mangrove ecosystems (disturbed and undisturbed) on the populations of birds and fishes at Hope Beach, East Coast Demerara, Region 4, Guyana**. International Journal of Agricultural Technology 13(3): 331-342.
19. Duncan, S. 2013. **An Assessment of Planted Mangroves in three areas along the coast of Guyana**. Unpublished.
20. Edwards A. 2013. **Correlation between soil salinity and mangrove populations in Region #5**. Unpublished.
21. EPA Guyana. 2000. **Integrated Coastal Zone Management Action Plan**. Environmental Protection Agency of Guyana, Georgetown.
22. Erskine K. 2011. **Monitoring the level of accretion or erosion in mangrove forest in Annandale, using sediment macro invertebrates as bio- indicators**. Unpublished.
23. GAHEF 1992. **Country Study of Biological Diversity (Draft)**. Liliendal, Greater Georgetown, Guyana.
24. Gopaul S. 2013. **An investigation of Sediment Concentration at the Mouth of Outfalls along the Coastline of Region #5**. Unpublished.
25. GFC. 2004. **Draft Code of Practice for Mangrove Harvesting**. Guyana Forestry Commission, Kingston Georgetown.
26. Giovannozzi, M. and Robertson, R., 2013. **Coastal engineering approaches applied through the Guyana Mangrove Restoration Project to protect existing stands of mangroves to facilitate natural recruitment**. Guyana Mangrove Restoration Project,

- Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project. GFC, and CIDA 1989. Gratiot N.2010. Coastal Erosion along the coast of Guyana. EuropeAid/124705/D/SER/GY Technical Assistance for Capacity Building and Institutional Strengthening of the Sea Defences, Guyana.
27. Harry A. 2013. **The relationship between selected soil parameters and mangrove population densities in region#5.** Unpublished.
  28. Hodge, G. 2008. **A study of the productivity and community composition of mangrove forest along the seacoast of Demerara,** Unpublished.
  29. Hollowell, T., 2009. **Plant Community Structure, Fire Disturbance, and Recovery in Mangrove Swamps of the Waini Peninsula, Guyana,** Centre for Biological Diversity, University of Guyana
  30. Hussain, M.Z. 1990. **Restoration and Expansion of the Mangrove Belt in Guyana. Technical Paper No. 1.** TCP/GUY/8953, FAO, Rome.
  31. Hickey C., Weis T. (2012): **The challenge of climate change adaptation in Guyana,** *Climate and Development*, 4:1, 66-74
  32. Ilieva. 2013. **The socio-economic importance of mangroves in Guyana Ecosystem services valuation,** Ca'Foscari University of Venice, Italy. Poster presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project.
  33. Jaikishun S, Ansari AA, DaSilva P, Hosen A. 2017. **Carbon storage potential of mangrove forest in Guyana.** *Bonorowo Wetlands* 7: 43-54. This
  34. Jaikissoon, S. 2013. **Estimating carbon-storage capacity of mangroves (*Avicennia germinans*, *Laguncularia racemosa*, *Rhizophora mangle*) in Guyana,** Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project.
  35. Johnson-Bhola, L. 2013. **Land tenure issues as a constraint to the sustainable management of Guyana's mangroves,** SEES, University of Guyana, Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project.
  36. Kalamadeen, M. 2013, **Development of a management plan for the Golden Grove-Belfield Mangrove Reserve, lessons learnt in and potential for application to other mangrove reserve areas,** University of Guyana, Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project

37. King T. 2013. **A comparative Assessment of Avifaunal Diversity in the Golden-Grove Belfield and Felicity-Chateau Margot Mangrove Reserves on the East Coast Demerara, Guyana.**
38. Layne B. 2011. **A Comparative Study of Growth of Wildlings and cultivated seedlings of Black Mangroves (*Avicennia germinans*, (L.) on the Seacoast of Demerara.** Unpublished.
39. Liburd F. 2013. **The Assessment of Mangrove Planting Techniques using Open Planting and Encasement.** Unpublished.
40. Machin, J. 2013. **Restoring mangroves in a challenging environment,** Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project.
41. Mangal R. 2013. **An investigation of the physical parameters of water quality associated with mangrove stands along the Western Coast of Berbice (Region 5).** Unpublished.
42. Major R. 2011. **Fishermen use of mangroves & their knowledge of the GMRP.** Unpublished.
43. Murray O. 2012. **An Examination of Mangrove Conservation Awareness amongst Secondary Schools Students in Region Four.** Unpublished.
44. Martyn, E.B. 1934. **A Note on the Foreshore Vegetation in the Neighbourhood of Georgetown, British Guiana, with special Reference to *Spartina Brasiliensis*,** Journal of Ecology 22: 292-298.
45. **National Forestry Action Plan 1990-2000.** Guyana Forestry Commission and Canadian International Development Agency, Georgetown, Guyana
46. Narine Z. 2011. **A study of the Major issues surrounding Red Mangrove bark harvesting in North West District: A comparison with the Code of Practice for Red Mangrove Harvesting.** Unpublished.
47. NMMAP 2010. **National Mangrove Action Plan, Guyana.** Guyana Mangrove Restoration Project.
48. Omacharan P. 2013. **The relationship between adjacent human activity and the presence of coastal mangrove forests in Region #5.** Unpublished.
49. Pastakia, C.M.R. 1987. **Investigation into Dead Mangrove *Avicennia* at Mon chosi, West coast Berbice . Occasional Report No. 4 Mahaica- Mahaicony- Abary Agriculture Development Authority. ATN/SF-2371-GY-SUB-PROJECT: 3p.124.**



50. Pastakia, C.M.R. 1991. **Preliminary Study of the Mangroves of Guyana. (Article B946/89 Contract No: 8912) Final Report.** Aquatic Biological Consultancy Services Limited. European Community.
51. Pastakia, C.M.R and Persaud, N. 1986. **Investigations into dead mangrove corridors at Mon Chosi, West Coast Berbice Occasional Report No:4, MMA/ADA, Onverwagt.** 1987
52. Persaud, H. 2011. **Spatio-Temporal Analysis of Guyana's Coastal Zone (Study site Region # 5 - Mahaica- Berbice).** Guyana Mangrove Restoration Project
53. Primo C. 2017. **Understanding the Litter fall dynamics of Restored and Natural Mangrove Forests (*Avicennia germinans*) along Guyana's Coastline.** Unpublished.
54. Ram, M. 2017. **Impacts of Mangrove Habitat Degradation on fish community structure along Guyana's Coastal Regions.** Unpublished.
55. Robertson, R. 2015. **Importance of *Avicennia Germinans* (Black Mangroves) at Chateau Margot, East Coast Demerara, Georgetown, Guyana.** Guyana Mangrove Restoration Project.
56. Roopsind, A. 2012. **The Golden-grove/Belfield Mangrove Forest Biodiversity Assessment,** Guyana Mangrove Restoration Project. Saywack M. 2013. **Mangrove Management in Guyana: A Case of Climate Compatible Development?.** University of Sussex
57. Sharma, C.A. 2006. **A study of the productivity and community composition of mangrove forest along the seacoast of Demerara, Guyana – Dept. Forestry, University of Guyana.**
58. Smith, E. 2007. **A study of the productivity and community composition of mangrove forest along the seacoast of Demerara, Guyana – Dept. Forestry, University of Guyana.** Thomas-Holder, B. 2013. **Residents readiness to advance mangrove restoration in the Buxton/Friendship area,** University of Guyana, Presented at the Guyana mangrove Forum, April 11-13, Georgetown, Guyana, Guyana Mangrove Restoration Project Tomlinson, P.B. 1986. **The botany of mangroves.** Cambridge, England: Cambridge University Press.
59. Toormam, EA. **Interaction of Mangroves, Coastal Hydrodynamics, and Morphodynamics Along the Coastal Fringes of the Guiana.** Springer Nature 2018, USA
60. Unknown. October 26, 2013. **Community perceptions on mangroves along the coast.** Guyana Chronicle. Page 23.
61. Van Maren M. 2004. **Mangroves and coastal protection in Guyana.** Unpublished
62. Vaughn, Sarah. 2017. **Disappearing Mangroves: The Epistemic Politics of Climate Adaptation in Guyana.** *Cultural Anthropology*. 32. 242-268. 10.14506/ca32.2.07
63. Williams M, Kalamandeen M. 2013. **Assessing the Adaptive Capacity of Coastal Communities in Guyana to Climate Change.** 2: 626 doi:10.4172/ scientificreports.626

64. Williams A., Adrian R. 2002. **The Socio-Economic Context of the Harvesting and Utilisation of Mangrove Vegetation**. Guyana Forestry Commission, Georgetown, Guyana.
65. WWF 2011. **Preliminary List of Species observed during Wetlands Field Surveys**. WWF Guianas.