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NATIONAL PROTECTED AREA SYSTEMS PLAN FOR TRINIDAD AND TOBAGO



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CONTENTS

1. Introduction to the 2018 Systems Plan 15

1.1. Global Context for Protected Natural Areas 15

1.2. National Context for Protected Natural Areas 17

1.3. National Policy and Legislative Framework 20

1.4. The Existing Protected Areas 22

2. Scope 26

3. Analysis of National Parks/Protected Areas System - Current Situation 28

3.1. Policy Review 28

3.2. Legislative Review 32

3.3. Institutional Review 34

3.4. Biological Review 36

3.5. Livelihoods and Ecosystem Services Review 41

3.6. Current Status of the PNAs System 45

4. Designing the National Protected Areas System – The Approach. 67

4.1. National Policy Directives 67

4.2. Units of the Protected Natural Areas System 68

4.3. Technical Design Criteria 70

5. Recommendations for the 2018 National Parks/Protected Areas System 75

5.1. Terrestrial Trinidad 79

5.2. Marine and Coastal Trinidad 129

5.3. Terrestrial Tobago 138

5.4. Marine and Coastal Tobago 146

5.5. Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago 158

6. Development Strategy for the National Parks/Protected Areas System 161

6.1. Implementing the NPASP 161

6.2. Financing the NPASP 162

6.3. PNAs Management and Civil Society Engagement 165

6.4. Private Protected Areas 166

6.5. Remaining Gaps 166

7. Literature Cited 169

8. Appendix I. Gap Analysis Methodology 182

9. Appendix II. PNAS by Designation 185

LIST OF TABLES

Table 1. Species richness, endemism, national and global threat status of selected taxa from Trinidad and Tobago……..36
Table 2. Extent of vegetation communities and percent under formal protection in Trinidad. (Reproduced from GORTT (2010))……37
Table 3. Non-forest ecosystem types present in Trinidad and Tobago. 40
Table 4. Status of Wildlife Sanctuaries in Trinidad*. 50
Table 5. Status of Forest Reserves in Trinidad. 53
Table 6. Status of Environmentally Sensitive Areas in Trinidad. 59
Table 7. Status of Coastal Prohibited Areas in Trinidad 60
Table 8. Status of Nature Reserves in Trinidad. 61
Table 9. Status of Wildlife Sanctuaries in Tobago* 65
Table 10. Status of Forest Reserves in Tobago. 66
Table 11. Status of Marine Protected Areas in Tobago. 66
Table 12. National Protected Areas Categories in Trinidad and Tobago and the IUCN equivalents 69
Table 13. Proposed Terrestrial Scientific Reserves in Trinidad. 82
Table 14. Proposed Terrestrial Special Conservation Reserves in Trinidad. 83
Table 15. Proposed Terrestrial National Parks in Trinidad. 87
Table 16. Proposed Terrestrial Natural Landmarks or Monuments in Trinidad. 90
Table 17. Proposed Terrestrial Habitat or Species Management Reserves in Trinidad. 92
Table 18. Proposed Riverine Corridor Habitat or Species Management Reserves in Trinidad. 101
Table 19. Proposed Terrestrial Landscape or Seascapes in Trinidad. 104
Table 20. Proposed Terrestrial Sustainable Use Reserves in Northern Trinidad. 107
Table 21. Proposed Terrestrial Sustainable Use Reserves in Central Trinidad. 111
Table 22. Proposed Terrestrial Sustainable Use Reserves in Southern Trinidad. 120
Table 23. Proposed Coastal and Marine National Parks (Marine Protected Areas) in Trinidad. 130
Table 24. Proposed Marine and Coastal Natural Landmarks or Monuments in Trinidad. 130
Table 25. Proposed Coastal and Marine Habitat or Species Management Reserves in Trinidad. 131
Table 26. Proposed Marine Landscape or Seascapes in Trinidad. 133
Table 27. Proposed Coastal and Marine Sustainable Use Reserves in Trinidad. 134
Table 28. Proposed Terrestrial Scientific Reserves in Tobago 139
Table 29. Proposed Terrestrial Special Conservation Reserves in Tobago. 139
Table 30. Proposed Terrestrial National Parks in Tobago. 140

Table 31. Proposed Terrestrial Natural Landmarks or Monuments in Tobago. 140
Table 32. Proposed Terrestrial Habitat or Species Management Reserves in Tobago. 141
Table 33. Proposed Terrestrial Sustainable Use Reserves in Tobago. 142
Table 34. Proposed Coastal and Marine National Parks (Marine Protected Areas) in Tobago. 147
Table 35. Proposed Coastal and Marine Habitat or Species Management Reserves in Tobago 149
Table 36. Proposed Coastal and Marine Landscape or Seascapes in Tobago. 154
Table 37. Proposed Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago 160

LIST OF FIGURES

Figure 1. Current protected areas in Tobago. 22
Figure 2. Current Protected Areas in Trinidad 23
Figure 3. Chaguaramas Peninsula 24
Figure 4. Relationship between the percentage of remaining forest cover of PNAs in Trinidad and (A) edge-to-area ratio and (B) road density. 46
Figure 5. Percent cover in declared Forest Reserves on Trinidad, 2014. 48
Figure 6. Proposed additional Terrestrial PNAs for Trinidad and the current Forest Reserves, Wildlife Sanctuaries and ESAs. 79
Figure 7. Proposed Terrestrial PNAs in North-west Trinidad 124
Figure 8. Proposed Terrestrial PNAs in South-west Trinidad 125
Figure 9. Proposed Terrestrial PNAs in North-east Trinidad. 126
Figure 10. Proposed Terrestrial PNAs in South-east Trinidad. 127
Figure 11. Proposed Terrestrial PNAs in East-central Trinidad 128
Figure 12. Proposed coastal and marine PNAs in East-central Trinidad 135
Figure 13. Proposed coastal and marine PNAs in northern- central Trinidad 135
Figure 14. Proposed coastal and marine PNAs in northern-west Trinidad. 136
Figure 15. Proposed coastal and marine PNAs in north-west peninsular, Trinidad 136
Figure 16. Proposed coastal and marine PNAs in south-west Trinidad 137
Figure 17. Proposed coastal and marine PNAs in south-west peninsular, Trinidad 137
Figure 18. Proposed Terrestrial PNAs in South-west Tobago. 144
Figure 19. Proposed Terrestrial PNAs in Central Tobago. 144
Figure 20. Proposed Terrestrial PNAs in Northern Tobago. 145
Figure 21. Proposed Coastal and Marine PNAs for Tobago. 146
Figure 22. Proposed Coastal and Marine PNAs in South-west Tobago. 156
Figure 23. Proposed Coastal and Marine PNAs in Central Tobago. 156
Figure 24. Proposed Coastal and Marine PNA in Northern Tobago. 157
Figure 25. Recommended Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago. 159

LIST OF BOXES

Box 1. Protected Areas.....15

Box 2. Convention on Biological Diversity 16

Box 3. Ecosystem Services 19

Box 4. Ecological Resilience 19

Box 5. Ecological Connectivity 26

Box 6. Viable Populations 31

Box 7. Endemism.....37

Box 8. Biogeography 38

Box 9. Edge Effects.....47

LIST OF ACRONYMS

CBD	Convention on Biological Diversity
CBO	Community-based Organization
CDA	Chaguaramas Development Authority
CoWLA	Conservation of Wild Life Act
DNRF	Department of Natural Resources and Forestry (THA)
EBSAs	Ecologically or Biologically Significant Marine Areas
EEZ	Exclusive Economic Zone
EMA	Environmental Management Authority
ESA	Environmentally Sensitive Area
ESS	Environmentally Sensitive Species
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
HMR	Habitat Management Reserve
IBA	Important Bird Area
IFPAMTT	Improving Forest and Protected Areas Management in Trinidad and Tobago
IUCN	International Union for Conservation of Nature
MPA	Marine Protected Area
NBSAP	National Biodiversity Strategy and Action Plan
NECC	National Environment Conservation Council
NEP	National Environmental Policy
NFP	National Forest Policy
NGO	Non-Governmental Organization
NL	National Landmark
NPAP	National Protected Areas Policy
NPASP	National Protected Areas Systems Plan
NP	National Park
NWP	National Wildlife Policy

LIST OF ACRONYMS (CONTINUED)

OOWDS	Open-ocean waters and Deep Sea
PES	Payment for Ecosystem Services
PNA	Protected Natural Area
PoWPA	Programme of Work on Protected Areas of the CBD
SCR	Special Conservation Reserve
SIDS	Small Island Developing State
SMR	Species Management Reserve
SUR	Sustainable Use Reserve
FD	Forestry Division
THA	Tobago House of Assembly

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EXECUTIVE SUMMARY

This National Protected Areas Systems Plan (NPASP) was commissioned under the Global Environment Facility (GEF) funded project, Improving Forest and Protected Areas Management in Trinidad and Tobago (IFPAMTT). The goal of the Protected Natural Areas (PNAs) Systems Plan is to identify areas within the national jurisdiction of Trinidad and Tobago, that would enable the protection of the country's biodiversity to be consistent with the recently adopted national policies of forest, protected areas and wildlife (GORTT 2011b, c, 2013b). In this context, the objectives of the Systems Plan are to ensure the long-term conservation of biodiversity of the country, and so provide the people of Trinidad and Tobago with the opportunity to benefit from and enjoy that biodiversity. It uses the information gathered from previous proposals on PNA designation for Trinidad and Tobago to recommend a revised suite of PNAs for Trinidad and Tobago. This information includes the 1980 Trinidad and Tobago Systems Plan (Thelen & Faizool 1980), and the World Bank-funded Protected Areas Project (Fairhead & Leach 2003), as well as recent information from biodiversity assessments for the country (e.g. Mohammed et al. 2015; White et al. 2015; Baksh-Comeau et al. 2016; Amon et al. 2017), stakeholder consultation and current PNAs planning techniques (Dudley 2008; Geldmann et al. 2015).

The NPASP used a gap-analysis approach and focused on the characteristics of representation, resiliency, redundancy and realism within and among the PNAs to design the recommended system. In designing the PNAs, the ecosystem-management approach was explicitly used, and the design focuses on ensuring ecological connectivity and climate resiliency, where historical land-use and current ownerships allow. The plan places an emphasis not only on important terrestrial areas, but explicitly includes marine and freshwater ecosystems, which had been under-represented in the previously proposed PNAs plans.

This NPASP uses the official accepted, seven categories of protection recommended under the National Protected Areas Policy (GORTT 2011c), which are based on the internationally accepted standards of the International Union for Conservation of Nature (IUCN) (Dudley 2008). In this regard, in Trinidad the NPASP assigns the recommended PNAs to these seven categories as follows: 1 Scientific Reserve, 7 Special Conservation Reserves, 5 National Parks, 6 Natural Landmarks, 32 Habitat or Species Management Reserves, 6 Protected landscape/seascapes and 33 Sustainable Use Reserves. In Tobago, the recommended categories are: 1 Scientific Reserve, 1 Special Conservation Reserve, 6 National Parks, 1 Natural Landmark, 17 Habitat or Species Management Reserves, 3 Protected landscape/seascapes and 6 Sustainable Use Reserves. This NPASP is the first to propose

open-ocean waters and deep-sea (OOWDS) PNAs in Trinidad and Tobago. Four new OOWDS are recommended, all to be managed as Sustainable Use Reserves.

The new system plan identifies 136 PNAs across Trinidad and Tobago. Of these, 92 are terrestrial/freshwater (79 in Trinidad, 13 in Tobago), 40 are coastal/marine (18 in Trinidad, 22 in Tobago) and four are deep-sea marine areas. In total, approximately 1933 km^2 (1866 km^2 in Trinidad, 67 km^2 in Tobago) of the country's land mass are covered by terrestrial/freshwater PNAs. The coastal and marine areas are approximately 580 km^2 (14 km^2 in Trinidad and 566 km^2 in Tobago) in size. Open-ocean waters and deep-sea marine areas cover 15,600km^2 of Trinidad and Tobago's Exclusive Economic Zone. Thus, 38% of the country's land mass is protected by terrestrial/freshwater PNAs and coastal, marine and OOWDS PNAs protect 22% of Trinidad and Tobago's EEZ. While this former percentage value may seem high, it should be noted that this includes 39 Sustainable Use Reserves, which are equivalent in management objectives to the former forest reserves (of which there were 36 such reserves).

The successful implementation of the PNAs system plan requires several preconditions. The identification of mechanisms for the designation of the new PNAs in national legislation is an important first step. As noted elsewhere (Leach & Fairhead 2001; Nelson 2018), the revision/passage of enabling national legislation for natural resources management in Trinidad and Tobago, has been a critical stumbling block in the implementation of previous plans. In this document, we briefly identify the key steps to facilitate the implementation of the Systems Plan, including legal establishment, financial considerations, local area management plans, PNA stakeholder management teams and PNAs personnel. Ultimately, the operationalization of a functional PNA Systems Plan for the country, will require a political commitment to enable the prioritization of these legislative, financial and personnel resources to make the PNAs system a reality.

The format of the NPASP has been deliberately designed to reflect the layout used in the 1980 protected areas systems plan (Thelen & Faizool 1980). We took this approach to allow forest management personnel, conservation professionals, and other stakeholders to directly compare these documents, since the former plan is the most popularly known and applied of the recent protected areas plans devised for the country. While we use the general format of the 1980 systems plan, we have tried to signpost within this document where advances in conservation planning, spatial and ecological modelling and current conservation prioritization methodology, were used to build on the selection, design and spatial arrangement of protected areas in this plan. Nevertheless, there is much useful historical data and site descriptions that remain relevant today, and we have not repeated these in this plan, but we point the reader to Thelen and Faizool (1980) where appropriate.

It is our hope that this approach makes the identification and designation of the PNAs as transparent as possible. In several cases, we have diverged from the previous plans, where issues such as ownerships, stakeholder conflict or development pressure make the designation of a given PNA unrealistic, at this time. In this regard, we recognize that future opportunities may enable designation of such areas. Conversely, where there has been overwhelming stakeholder support for the designation of a given area, we have tried, where possible, to include these areas, where there was sufficient biological information to warrant their protection (e.g. sea-turtle nesting beaches). Here, the authors strongly recommend that this Systems Plan be considered a starting point for PNAs designation and management in Trinidad and Tobago, not a fixed end-point.

1. INTRODUCTION TO THE 2018 SYSTEMS PLAN

1.1. GLOBAL CONTEXT FOR PROTECTED NATURAL AREAS

Protected natural areas (PNAs) have been a lynch-pin of global biodiversity conservation efforts since the 1960s (Borrie et al. 1998). Since that time, the extent of the world's terrestrial protected areas (including national parks, wildlife sanctuaries and reserves) has increased dramatically and now cover approximately 15% of the world's land surface (Geldmann et al. 2015). Increasingly, emphasis is being placed on the design, establishment and management of marine protected areas (Christie et al. 2015; Gill et al. 2017), as the protection of these biomes has lagged behind that of terrestrial ecosystems (Guarderas et al. 2008).

The efforts to develop PNA systems which can serve as refugia for the world's biodiversity, have become more critical as human utilization of the natural world as a source of products (e.g. timber, wild game, fish, fruits, nuts and other non-timber forest products), recreation, and livelihoods continue to grow (Chaudhary & Kastner 2016; Pauly & Zeller 2016; Wilting et al. 2017). Today, over 40% of global biodiversity loss is due to the impacts of food consumption (Wilting et al. 2017). This growing reliance on natural resources is reflected in the quantities and value of these resources, thus, for example, globally, annual revenue from capture fisheries is estimated at US$80-85 billion (Dyck & Sumaila 2010), while legal global trade in wildlife in 2012 was valued at US$ 2.8 billion dollars, and that of plants and forestry products was valued at US$ 71 billion dollars (Chan et al. 2015). These natural ecological communities also provide irreplaceable ecosystem services such as pollination, carbon sequestration, ground water recharge, soil creation and erosion prevention and storm protection (Dudley et al. 2011), which have become the growing focus of efforts to monetize their value. These numbers speak to the value of biodiversity globally (Costanza et al. 2014). Beyond these goods and service values, biodiversity remains important for religious, cultural and social reasons, providing important national icons, as seen, for example, in the designation of national birds, and the use of animal and plant motifs in

Box 1. Protected Areas

"A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." (IUCN Definition 2008)

The International Union for the Conservation of Nature (IUCN) is the global lead in protected areas science, policy and management. There are about 200,000 terrestrial and marine protected areas globally, covering about 15% of the world's land surface and 3% of the world's oceans.

cultural festivities (Wunderle 2008). Increasingly, there is growing evidence of the positive value of protected areas on human health and wellbeing (Pullin et al. 2013; Romagosa et al. 2015).

In spite of this value, the world's natural areas are under increasing threat. Current loss of tropical forest is 1.3 percent per year (WWF 2016), with average annual forest loss across Neotropical protected areas at 0.1% (Spracklen et al. 2015). Most fisheries in the Neotropics are now being harvested at or above levels that are considered sustainable (Pauly & Zeller 2016; Pelicice et al. 2017). Similarly, a comprehensive assessment of over 14,000 populations of vertebrates suggest that on average, these populations have declined by 58% since 1970 (WWF 2016). Coastal marine ecosystems are particularly threatened, with three quarters of all the world's coral reefs now in danger (WWF 2016). Natural freshwater ecosystems are also significantly threatened, with recent reports suggesting that currently the greatest biodiversity declines are occurring in these environments (WWF 2016). Indeed, the designation of a site as a PNA is not a guarantee of protection of biodiversity, with recent assessments of the world's protected areas suggesting that only 24% of these areas were soundly managed and able to protect the biodiversity they were established to conserve (Leverington et al. 2010).

It is in the context of this tension between the goods and services that natural ecosystems provide and the over-use and degradation of their capacity to provide these goods and services, that protected areas have become such a key tool for conservation and sustainable livelihoods. Today, the establishment of a national system of PNAs which are legally designated and effectively managed, are a legal obligation of several international treaties to which Trinidad and Tobago are signatory. For example, the Aichi target 11 (Box 2), of the Convention on Biological Diversity (CBD) Strategic Plan for 2011-2020, commits Party countries to specific targets for terrestrial, freshwater and marine protected area coverage, design and management (Woodley et al. 2012). Similarly, the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, also requires the designation and management of PNAs which are important wetland habitats for biodiversity conservation (Matthews 1993). At the regional level, the Specially Protected Areas and Wildlife

Box 2. Convention on Biological Diversity

The CBD came into effect at the Earth Summit in Rio de Janeiro in 1992, with the objective of the conservation and sustainable use of biological diversity. 168 countries are signatories of the CBD.

The CBD's Aichi Biodiversity Targets (2011 – 2020) were agreed in 2010, including Target 11, to manage conservation areas effectively and equitably. Under this target, signatories agreed that protected areas should cover at least 17% of the world's terrestrial areas and 10% of marine areas by 2020.

(SPAW) protocol of the Cartagena Convention, also identifies the management of PNAs as one of its 4 key programme elements. This international treaty promotes PNA designation, management and financing within the Caribbean region (Vanzella-Khouri 1998). Finally, PNAs are central to achieving the UN's Sustainable Development Goals (SDGs) in particular those on biodiversity and oceans, and they facilitate the achievement of multiple other SDGs including those associated with poverty reduction, ensuring clean water and hunger elimination, to name a few (Singh et al. 2017). These international frameworks provide important context and impetus for the establishment and management of PNAs globally, and in particular, within Small Island Developing States (SIDS), such as Trinidad and Tobago (Nelson 2018).

1.2. NATIONAL CONTEXT FOR PROTECTED NATURAL AREAS

At the national level, for any system of PNAs to serve as a viable repository for the living diversity of a country, then these systems must not only hold viable, representative components of a country's diversity, but they must also function within the context of traditional/nationally accepted mores for the use and management of nature. This national-level context includes not only the biological diversity itself, but the cultural and economic history of the country, as well as the existing and potential opportunities for management and conservation of these resources.

Trinidad and Tobago is among the most biologically diverse countries in the Caribbean with over 3639 species of plants (including 2407 native species) (Baksh-Comeau et al. 2016), 600 species of terrestrial vertebrates and 1100 species of recorded invertebrates (Starr 2010). In the coastal and marine environment, the country is similarly endowed with a diverse marine environment occupied by a range of communities including sea-grass beds, fringing coral reefs, and diverse marine substrates, within three global marine ecosystem types (Spalding et al. 2007; Kenny 2008). Many of these ecosystems, for example, the deep marine ecosystems within Trinidad and Tobago's exclusive economic zone (EEZ), remain areas of active biological exploration, while simultaneously being important areas of economic development (Amon et al. 2017).

The intensity of impacts of anthropogenic disturbance on natural habitats on SIDS such as Trinidad and Tobago, are a reflection of historical land-use and development patterns, human demography and the shifting patterns of human economies. On these islands, with their limited land area, this signal of historical anthropogenic disturbance has long-term implications for options for PNA designation and management. Biodiversity loss on Trinidad and Tobago is driven by multiple historic and current anthropogenic land-uses, including oil and gas production, quarrying, agriculture, tourism, timber production and urbanisation (Leach & Fairhead 2001; GORTT 2010; Juman &

Ramsewak 2013b; Deacon et al. 2015; Nelson 2018). Key ecosystems have become substantially degraded as a result. Historically, forest cover on both Trinidad and Tobago were significantly reduced after the British colonised the island in 1797 and 1814, respectively.

Today, Trinidad and Tobago's human population stands at 1.3 million people (World Bank 2017), and in the period since the second world war, the economy has transitioned from one which was primarily agricultural to one that is primarily based on the export of oil, gas and petro-chemicals. In terms of human consumption patterns, per-capita GDP for the country in 2016 stood at US$16,240 billion (World Bank 2017), contributing to its consumption patterns taking the form of what one would expect for a middle-income country. This high human density and middle-income consumption patterns, together with its relatively limited land-landmass and high biodiversity make PNA designation a challenge.

An important element affecting the design and management options for protected areas is the issue of land ownership. In Trinidad, approximately half of the land in the country is publicly owned, while in Tobago, almost 70% is in the public domain (Stanfield et al. 1993). Private land ownership on both islands is often the source of much uncertainty and conflict, often leading to long-term informal ownership (Driver 2002; Griffith-Charles 2011). The constitutional status of private land in the country limits the role of the state in limiting the right of the private citizen on such lands except in certain specific circumstances. In the context of PNAs, the pattern of such land alienation (e.g. in Trinidad, where much of the land in South Oropouche or in Tobago, where most of the lands in the south-west of the island have been alienated), means that the opportunities to establish national PNAs in these areas are limited and legislatively complex.

Currently, forest cover on both islands is showing a downward trend (GORTT 2010). On Trinidad, natural forest cover is estimated at approximately 45% (GORTT 2010), while on Tobago, Helmer et al. (2012) estimated all forested area to cover 85% of the island. In Tobago, hard coral cover has declined by 33% since the 1980s (IMA 2016) and in recent years, coral reefs have experienced the worst bleaching in 25 years, with over 85% bleaching (Wilkinson & Souter 2008). Similarly, the islands' freshwater ecosystems have also been affected by anthropogenic impacts including point and diffuse chemical pollution, over-extraction of surface and ground water, solid waste pollution, eutrophication, damming of stream flows and over harvesting of freshwater species for food and the aquarium trade (Phillip 1998; Magurran & Phillip 2001; Bass 2003; Leotaud 2006; Deacon et al. 2015; Rolshausen et al. 2015).

Despite the current levels of habitat degradation, Trinidad and Tobago's natural environments are invaluable in terms of their provision of ecosystem services (Box 3) and livelihoods. For example,

annual flood protection provided by forest cover is estimated to vary between US$16 and US$268 per ha in Trinidad, depending upon the degree of forest loss (Brookhuis & Hein 2016). Reef-related tourism in Tobago is estimated to bring in a total annual revenue of between US$101 and $130 million (Burke et al. 2008). Birdwatching is also particularly valuable on both islands; for example, a study of local visitors to the Caroni Swamp in Trinidad, found this source yielded a profit of at least US$10,1294 yr^1 for tour operators at that site (MacKoon 2013). Similarly, estimates of the benefits of marine turtle conservation have been estimated to be worth up to US$749,800 to international visitors in Tobago alone (Cazabon-Mannette et al. 2017). Efforts are currently underway to improve valuation of these goods and services provided by Trinidad and Tobago's natural environment, to the local economy (e.g. Rawlins & Westby 2013; Ghermandi 2015), and successive governments have recently showed strong interest in including such ecological accounting in national planning and budgeting processes (Rawlins 2015).

Box 3. Ecosystem Services

"Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth." (Millennium Ecosystem Assessment, 2001).

These ecosystem services contribute more than twice the global GDP to human health and wellbeing. It is estimated that globally the annual cost of lost ecosystem services due to land use change is $US4.3–20.2 trillion.

An ecologically resilient (Box 4) PNAs system in Trinidad and Tobago can provide sustained goods and ecosystem services to the people of the country and will maintain a representative sample of the country's biological diversity. The development of such a system requires an approach that recognizes the historical socio-economic, policy, and technical

Box 4. Ecological Resilience

Natural and human disturbances, such as fire, drought, deforestation or invasive species, can have multiple impacts on ecosystems, such as habitat degradation and biodiversity loss, altering an ecosystems' ability to function.

Resiliency is the capacity of an ecosystem to respond and recover to such disturbances. It can be measured as the time taken to return to the pre-disturbance state. An ecosystem can undergo a regime shift if the perturbation reaches a threshold, above which the ecosystem cannot recover.

context in which PNAs need to be developed. Specifically, an understanding of the national precedents for protected areas policy and the resulting legislative context, institutional frameworks, current scientific best practice, existing and potential uses, and perceived value of biodiversity all need to be considered when developing a protected area system for the country.

1.3. NATIONAL POLICY AND LEGISLATIVE FRAMEWORK

The diverse endowment of species and ecological communities of Trinidad and Tobago has been the focus of many attempts to establish areas to conserve and manage these elements of biological diversity of the country. Trinidad and Tobago has a long history of protected areas management, with the western hemisphere's first legally established forest reserve at the Main Ridge in Tobago, designated in 1765 for watershed protection (Ramnarine 1998). Since that time, over 50 protected areas have been formally declared under the Forest Act (Chap 66:01), Conservation of Wildlife Act (Chap 67:01), Environmental Management Act (Chap 35:05 - Act No 3 of 2000) (Environmentally Sensitive Areas Rules), and the Marine Preservation and Enhancement Act (Chap 37:02).

Five important milestones in the evolution of national thinking on the role, value and configuration of the country's PNAs since the 1970s, have included the:

- National Parks Systems Plan (Organization of American States (OAS) 1978)
- National Parks Systems Plan Policy (1980)
- Tropical Forestry Action Plan (TFAP) (1991), and
- National Parks Draft Management and Physical Plan (1996) (World Bank)
- The recent trio of natural resource policies adopted by the Government of the Republic of Trinidad and Tobago - National Protected Areas Policy (2011), National Forest Policy (2011) and National Wildlife Policy (2013)

This system of protected areas has been gradually evolving to reflect the changing concerns, uses and values placed by the national community on the biodiversity and the goods and services these ecological systems provide. For example, the 1978 OAS-funded plan, reflected the country's interest in placing more emphasis on recreation and nature conservation in natural areas. This 1978 system plan identified 61 potential areas for designation as PNAs, which would provide simultaneously opportunities for recreation as well as protection of representative elements of the islands' terrestrial biodiversity.

Further, the designated protected areas have been added to over time and across multiple pieces of legislation (e.g. the Forest Act, Conservation of Wildlife Act, State Lands regulations, Chaguaramas

Development Authority (CDA) Act and Environmental Management Authority (EMA) Environmentally Sensitive Areas (ESA) regulations) (Ramlogan 2013). This has led to a growing concern among managers, policy planners, and other stakeholders that multiple designations of the same protected area has led to conflicting management approaches (Granderson 2011).

In parallel, there has been a series of attempts to refine the protected areas policy framework of the country, to make these consistent with international standards for protected areas, and to incorporate advances in the science and management of such natural areas (GORTT 2011c). There have been also multiple attempts to improve the protection afforded by the legally designated protected areas and formalize a national system of protected areas. These attempts have included national committees, draft policies, plans and legislation.

Additionally, rapidly changing environmental and socio-economic conditions surrounding the perceived value, state of degradation and isolation, and potential future uses of these areas have led to a call for a rationalization of these areas (Fairhead & Leach 2003; Granderson 2011). In some cases, due to the degree of habitat change and loss of biodiversity elements, some previously protected areas may require de-gazetting, as their former conservation value may be irretrievably compromised (Toppin-Allahar 1991).

As a result, the existing legally designated protected areas do not represent the entire picture with regard to national attempts to protect the country's biodiversity and landscapes. However, to date, none of these attempts have resulted in significant changes to the formal system of protected areas for the country.

In this context, the new National Protected Areas Systems Plan (NPASP) is a key outcome of the "Improving Forest and Protected Area Management in Trinidad and Tobago" GEF project (2015-2019). It builds on these previous attempts to rationalize the protected natural areas of the country, by using these plans as an initial framework, and improves on their potential for long-term viability, and creates a system that is in-step with existing international norms for protected areas design, designation and management. Consistent with the new national policies, it is explicitly anticipated that the new system should lead to benefits to national stakeholders, including improved opportunities for community participation in management and sustainable livelihoods through more resilient flows of goods and services from these protected areas.

1.4.THE EXISTING PROTECTED AREAS

Today, Trinidad and Tobago's existing protected areas consist of a mix of legally designated areas which include 36 forest reserves, 13 wildlife sanctuaries, 3 environmentally sensitive areas and 1 marine protected area (Figures 1 and 2). These have been established under the State Lands Regulations (Chap. 57:01), the Conservation of Wildlife Act (Chap 67:01), Environmental Management Act (Chap 35:05), and the Marine Preservation and Enhancement Act (Chap. 37:02). In addition, up to 74 specific areas have been previously proposed within all the previously cited plans for protected areas, developed since the 1970s (Thelen & Faizool 1980; CFCA 1998; GORTT 2011c).

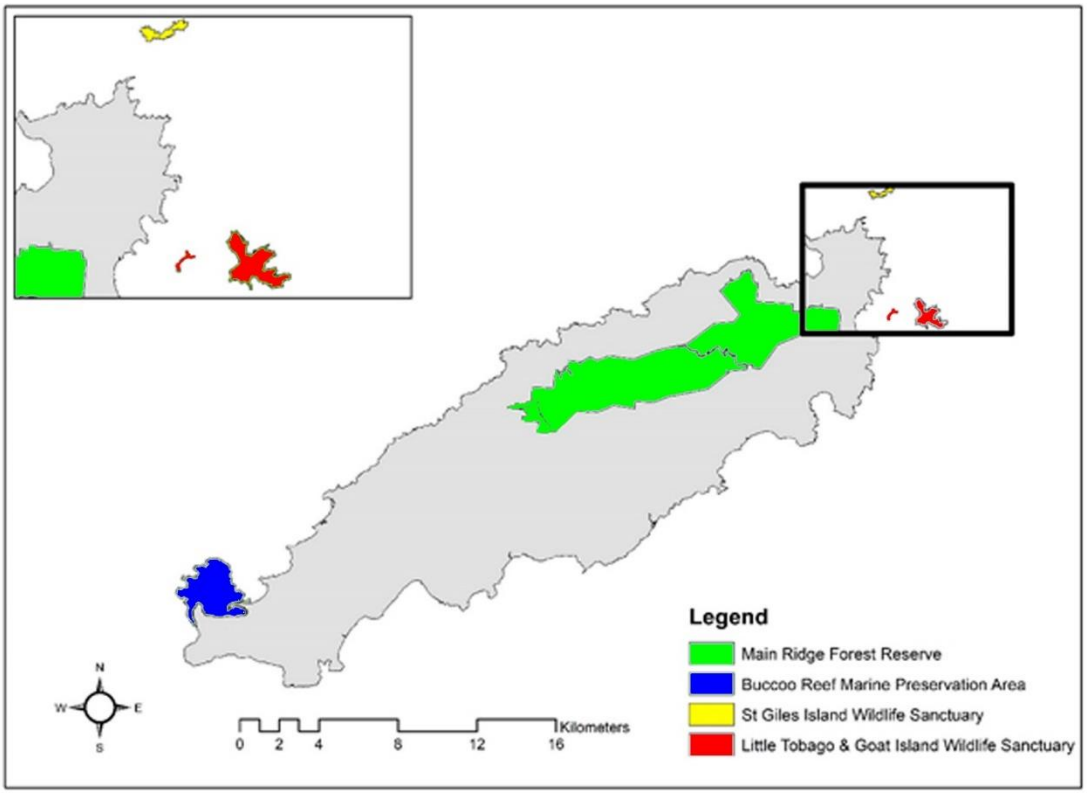


Figure 1. Current protected areas in Tobago.

It is worthwhile noting that although the Forest Reserves form the backbone of the country's de facto protected area system, previous PNA plans for the country (e.g. Thelen & Faizool 1980) do not explicitly address the role of these reserves as part of the national system of protected areas. This often confuses the discourse on PNAs in the country, as national and international reporting on the number of protected areas managed at a national level, usually includes these reserves as official PNAs. However, since the global framework for protected area designation and management are the IUCN categories, it worth noting that these IUCN categories explicitly refer to areas established

primarily for conservation. Arguably, the ambiguity in de facto national management vs. official status then leads to confusion in the accounting of PNAs in the country.

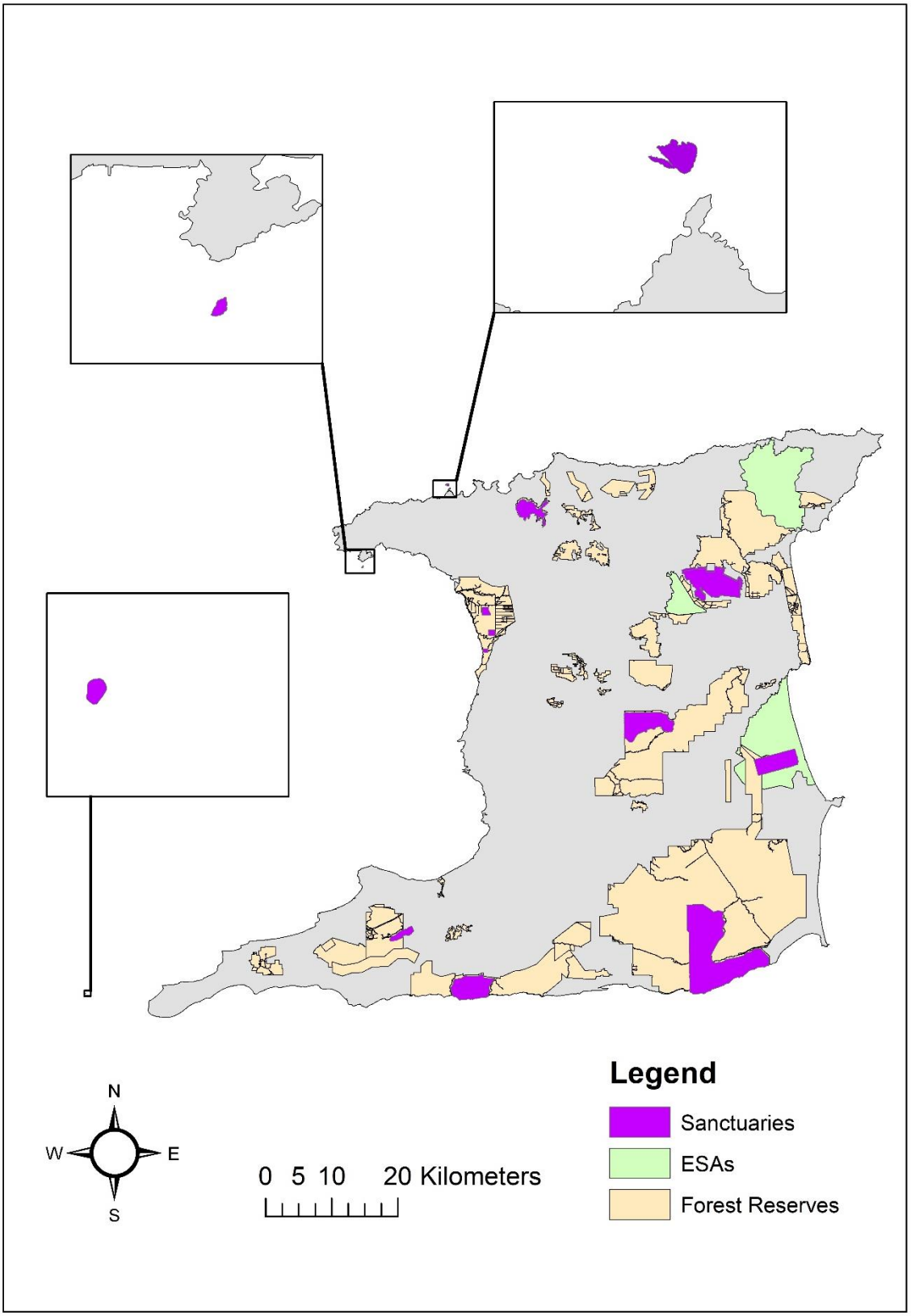


Figure 2. Current Protected Areas in Trinidad

Certain areas in the country have complex socio-political histories that affect their designation, management and development as PNAs. An example of this is the Chaguaramas peninsula (Figure 3) and its surrounding islands, which historically served as important operational centres during the Second World War, and through various bilateral agreements remain the focus of national defence assets. In this context, although this is a critical site for national biodiversity conservation, its management remains tightly wrapped up with national defence strategy as well as plans and proposals to develop this area for recreation and light industry. This, together with the establishment of a unique management system for the site, which isolates it from the rest of the country's national forest management system, makes the management of this PNA stand apart from the rest of the existing national PNAs system.

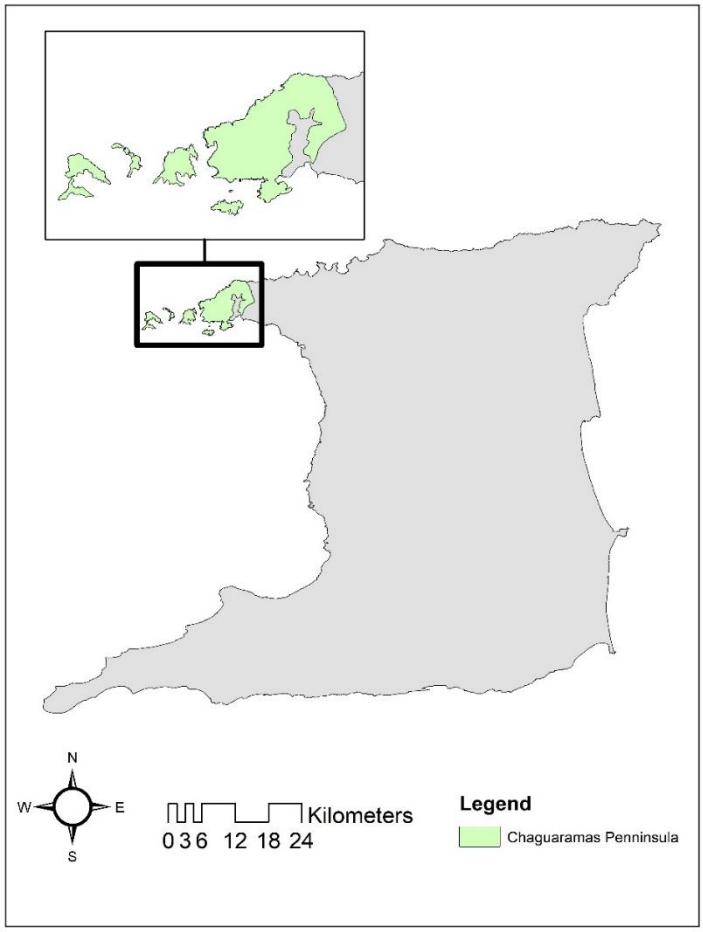


Figure 3. Chaguaramas Peninsula

Many potential sites for protection in Trinidad and Tobago have not yet been afforded legal protected area status. For example, in the last two decades there has been growing interest in the conservation of historically important turtle nesting beaches. While nesting turtles have been protected by existing national legislation (GORTT 1980b), the enforcement of this legislation

together with ambiguities in the law have led to weak enforcement. Since the late 1980s, however, growing community interest, efforts by the Forestry Division and NGO pressure have made the conservation of important turtle nesting beaches a national conservation focus. However, despite growing calls for specific designation of such nesting beaches, many remain unprotected by national conservation legislation.

Another historical example of the failure to designate and manage potential PNAs is reflected in the "Nature Reserve" system (see section 3.6) proposed and managed by the Forestry Division in the 1940s. Originally identified as important relicts of the original forest ecosystems present on Trinidad at the time, these areas were considered "diagnostic" of the forest communities at these locations. They were often sites along forest access roads (Thelen & Faizool 1980), however, even by 1980, the previous systems plan recognized that these areas were too small to be viable areas to protect the ecosystem properties that the Division originally identified as unique. None of the 11 areas received formal protection beyond their inclusion in existing forest reserves, and where they remain intact, and meet the other criteria we address in section 4, they have been included in the broader protected areas proposed in this plan (see section 3.6).

At the international level, several national obligations under the Convention on Biological Diversity (CBD) and its various programmes of work have committed the country to the expansion and improved management of its PNAs, in particular marine areas, which remain underrepresented in the existing, legally-established framework. The CBD recommends that 17% of a nations' terrestrial areas and 10% of marine areas should have formal protected area status. This obligation has been officially adopted at the national level as a policy objective by the Government of the Republic of Trinidad and Tobago, through its National Wildlife Policy (2013) and National Protected Areas Policy (2011).

Thus, despite efforts in the last 50 years to grow the national PNAs system, there remain many gaps and opportunities for improvement of the existing system.

2. SCOPE

The scope of this NPASP was defined under the GEF/FAO project: "GCP/TRI/003/GFF Improving Forest and Protected Area Management in Trinidad and Tobago (IFPAMTT)". This project identified the terms for the development of the NPASP, firstly through a literature review of "key" documents relevant to historical efforts to develop a national PNAs system for the country. These were to include the OAS 1978 and 1980 systems plan and the related policy documents, the 1991 Tropical Forestry Action Programme (TFAP) documents, and the 1996 World Bank-funded revised parks and protected areas project (Fairhead & Leach 2003). The new NPASP was required to use the recently adopted National Protected Areas Policy (GORTT 2011c), and use the relevant IUCN guidance on PNAs designation to assist with the development of the proposed PNAs system.

Another key criterion established for the NPASP was that it should examine all existing, previously and currently proposed areas and make an assessment on the level of protection that should be afforded for each PNA. It was also envisaged that the NPASP would, where necessary, recommend the de-listing/degazetting of proposed or existing protected areas, where those areas have become so compromised that they are no longer able to conserve the biodiversity they were originally designated, or proposed, to protect (Toppin-Allahar 1991). Where this is the case in this document, this NPASP strongly recommends a site-level assessment and stakeholder consultation on these specific de-listings, before they are undertaken.

The IFPAMTT project also required that the proposed NPASP should explicitly address the issue of connectivity of individual PNAs within the national system. This approach is in line with current thinking about the importance of ensuring landscape-level connectivity (Box 5) between PNAs, to improve population viability, increase resiliency to environmental change and maintain broad-scale and longer term ecological patterns and processes. In addition, the IFPAMTT project envisaged that this NPASP should make recommendations for strategies that would support the

Box 5. Ecological Connectivity

The degree of landscape connectivity determines the movement potential of organisms between habitat patches. Structural connectivity, based on physical properties includes patch size, distance between patches, road density and land-use type.

Functional or realized connectivity is the actual movement of individuals between patches, including their survival during dispersal. Connectivity determines the amount of gene flow, extinction risk, and potential for adaptation to environmental change of a population. The use of 'habitat corridors' can increase landscape connectivity.

establishment of the PNAs within the system. In this context, this NPASP considers the existing legislative, administrative and institutional context for PNAs management in the islands, and recommends strategies for the implementation of the proposed system.

The proposed NPASP in this document represents the culmination of these priorities and reflects as much as possible the feedback from individual focus groups, stakeholder meetings and public consultations held over 9 months of 2017, during the drafting of this plan. The outcomes of the various stakeholder consultations are reported in the project documents of the IFPAMTT project (Shim 2017).

3. ANALYSIS OF NATIONAL PARKS/PROTECTED AREAS SYSTEM - CURRENT SITUATION

A critical analysis of the grey and published literature relevant to the biota, policy and legislative framework, and institutional arrangements in Trinidad and Tobago, was used as the backdrop to the development of the new NPASP. This provided the biological, socio-economic and cultural context for the design designation, and management of the NPASP. In this way, the review also serves as a mechanism to identify key processes, services, and areas already identified by previous authors as important to the NPASP, and allow for the identification of gaps in these works, relevant to PNAs establishment and management in Trinidad and Tobago.

In the discussion that follows, we highlight the key findings in the four areas we identified as relevant to understanding the historical context for the NPASP (policy, legislation, institutional arrangements, and the biological resources relevant to the PNAs system). These are based on a desk-based survey of the relevant literature available at the time of this study.

There have been numerous methodological developments relevant to protected areas design and management since the earlier Systems Plan (Thelen & Faizool 1980) was first published. Details of the technical approach used to design the proposed NPASP are presented at Section 4.

3.1. POLICY REVIEW

Trinidad and Tobago has a long history of pioneering protection of natural areas, since the Young Commission's recommendation for the establishment of a forest reserve on Tobago's Main Ridge in 1765 (Ramnarine 1998). For most of the twentieth century, the terrestrial natural areas of the two islands were managed under the 1942 forest policy (Leach & Fairhead 2001). This policy framed the management of the forest resources of the country for approximately 70 years (GORTT 2011b), serving as the national policy template for all terrestrial natural areas at that time. While this policy primarily emphasised the management of forest for timber production and utilization, it also established a programme of forest reservation and articulated the need to protect representative elements of the country's flora and fauna and ecosystem services such as soil, water and wind protection (Ramnarine 1998). This policy served to formalize a process begun at the turn of the twentieth century, with the designation of the first forest reserves in Trinidad under the State Lands regulations. This nascent national forest system ultimately became the nucleus for the establishment and management of the country's 36 forest reserves (Joseph 1999) and 13 wildlife

sanctuaries (Bacon & ffrench 1972). These reserves and sanctuaries have served as the lynchpin for biodiversity protection in the country since that time. However, it should be noted that although the post-independence period has seen a flurry of national policy innovations relevant to PNAs (GORTT 2006b, 2011b, c, 2013b), there have not been any additional forest reserve or wildlife sanctuary designations, since 1962.

In parallel, the management of the living natural resources in the marine environment around Trinidad and Tobago prior to 1970, was primarily utilitarian in focus. Here, exploitation was governed by an open access policy (Mohammed & Lindop 2015). Thus, although some protection was afforded to marine turtles and corals (GORTT 1980b), in practice, this policy framework has not led to the establishment of formal marine PNAs around these islands. This lack of development of Marine Protected Areas (MPAs) may reflect the gradual way in which the State has extended its management jurisdiction, only pushing this to 22.2 km (12 nautical miles) from the coast in 1975 (through an amendment of the Fisheries Act of 1916), and then to 200 nautical miles in 1984 (GORTT 1986a; Mohammed & Lindop 2015). Throughout this time, the only marine area in the country formally designated for protection was the Buccoo Reef in Tobago (GORTT 1996a).

Notably, until recently there remained a significant national policy gap with respect to freshwater ecosystems. In these ecosystems, although there has been an emphasis on their hydrological management for extractive uses (e.g. WRA 2001; GORTT 2005), a holistic policy which focuses on the protection and management beyond the water provisioning service, was largely absent. This lack of a policy framework had an important impact on the remaining extent of freshwater ecosystems, their state of degradation and their native biodiversity. Exploitation of the biodiversity in these freshwater ecosystems includes their utilization for food and the aquarium trade (Phillip 1998; Bass 2003), and they are important as recreation focal points (Leotaud 2006; Deacon et al. 2015). The historical lack of a policy framework that explicitly addresses freshwater ecosystems and their biodiversity has led to over-harvesting of many important food and aquarium species and widespread pollution, canalization, and removal of riparian communities (Deacon et al. 2015). This historical lacuna in the policy framework has had implications for the future conservation of some watersheds, for example, greatly limiting the opportunities for PNAs designation in representative parts of watersheds such as the South Oropouche, due to historical alienation of most land in this watershed. Nonetheless, the development of the National Wildlife Policy (GORTT 2013b) and National Protected Areas Policy (GORTT 2011c) now provide specific reference to conservation of biodiversity in freshwater ecosystems, and prioritise designation and conservation of important watersheds and freshwater communities.

Since protected areas policy ultimately affects the access to, and utilisation of resources held in trust by the State (Nelson 2018), national patterns of PNA establishment and management need to be considered in the broadest policy context. In Trinidad and Tobago, recent explicit national policy frameworks that have had an impact on the PNAs policy discourse, include the National Development Strategy (2016-30) (GORTT 2016) and the National Spatial Development Strategy (GORTT 2013a). These policies provide the Government's most recent articulation of the value and role of natural areas and biodiversity in national development. Important sectoral policies which have a direct impact on PNAs, their biodiversity and management in Trinidad and Tobago include those that relate to the energy and minerals sectors (e.g. the National Minerals Policy (GORTT 2015)), and those which govern physical development on both islands (e.g. the Northern Range Hillside Development Policy (GORTT 1976)).

At the level of the environmental sector, the development of the overarching National Environmental Policy (NEP) in 1998, subsequently revised in 2005 (GORTT 2006b), placed the protection of biodiversity through PNAs establishment and management, squarely in the mainstream national policy dialogue. The articulation of the value of the precautionary approach to national environmental management, provides a clear umbrella under which the designation of PNAs and a NPASP can exist. Further, the NEP specifically endorses the role of PNAs in the conservation and management of biodiversity nationally (GORTT 2006b).

However, while the NEP articulated the value of PNAs and their role in biodiversity protection, failure to address institutional and legislative arrangements flowing from these policy statements, has meant that the NEP's implementation in the context of PNAs, has had mixed results. In large part, the lack of development of PNAs that enable the protection of biodiversity envisaged by the NEP, reflects the inherent policy conflicts involved in changing the enabling legislation, and the institutional and administrative arrangements that support PNAs (Leach & Fairhead 2001). This remains an active area of stakeholder dialogue at the time of this writing, and remains a key un-resolved national policy issue.

At the PNA-specific policy level, national consideration of a system of protected areas has received high-level attention since the 1970s, with the decision of the Cabinet to establish a National Environment Conservation Council (NECC). The NECC proposed the establishment of a PNAs system that included three national parks at Navet, Hollis and Caroni Swamp as well as the creation of a statutory body for their management (GORTT 2011c). However, this was not implemented. In the ensuing decade, following the output of an OAS-funded project on PNAs, the Cabinet approved a policy for the creation and management of a national park system (GORTT 1982), which was also never implemented. At the start of the 1990s, the Inter-American Development Bank and

subsequently the World Bank, funded a project to improve protected areas and wildlife management in the country. This project prioritised the establishment of PNAs at Matura, Maracas, Main Ridge – Tobago, Nariva and Speyside and establishment of new management arrangements for PNAs in the country (CFCA 1998). However, this final project was also not implemented due to resistance to any of the proposed organizational arrangements for PNAs management (GORTT 2011c).

The last 8 years have seen significant changes in the policy context within which PNAs in Trinidad and Tobago have been managed. The acceptance of new national policies on PNAs, forest and wildlife management (GORTT 2011b, c, 2013b) by the Government of Trinidad and Tobago, have provided an important new framework for biodiversity protection. This framework places an emphasis on stakeholder engagement in PNAs management, transformation of the agency/(-ies) responsible for management, as well as the designation of new, resilient, representative PNAs, which serve as repositories for viable populations (Box 6) of the country's native species (GORTT 2011c). These policies provide a detailed road-map and indicators for assessing progress with their implementation. If implemented, these policies could provide an important step to meeting the country's broader NEP goals as well as obligations under the Convention on Biological Diversity (CBD) (and its programme of work on Protected Areas [PoWPA]), SPAW Protocol of the Cartagena Convention, and the Ramsar Convention.

Box 6. Viable Populations

A viable population is defined as a self-sustaining population that can respond to stochastic events such as natural or human disturbance, without going extinct. A minimum viable population is the smallest size population that has a specified probability of survival over a given time period, typically 90% over 100 years.

Population Viability Analysis (PVA) refers to a suite of modelling techniques that predicts the probability of population survival and extinction, often in relation to environmental variability, threats or different management actions.

In summary, the past decade has seen a flurry of activity in the development of the policy framework relevant to PNAs designation and management. If implemented in full, the overarching national policy (the NEP) and the national policy on protected areas (GORTT 2011c), do provide a clear road map for biodiversity protection in the country. However, the primary roadblock to PNAs designation and management in Trinidad and Tobago appears to be the unresolved issue of the future of the organizational arrangements for PNAs administration and management.

3.2. LEGISLATIVE REVIEW

The dominant form of protected areas in Trinidad and Tobago - Forest Reserves - are designated via the national State Lands regulations. In this regard, the power over all State land in the country is exercised by the President, through the Commissioner of State Lands (GORTT 1999b). In addition, the approval for any building or development in designated nature reserves and forests reserves is further regulated under the Town and Country Planning Act, Chap. 35:01. As noted earlier, there are 36 designated forest reserves across both islands.

At the management level, the laws governing PNAs management in the terrestrial environment include the primary legislation governing management of forests, forest products and forest reserves - the Forest Act Chap 66:01 (GORTT 1999a) and the Forest (Prohibited Areas) Order (GORTT 2006a). The power to manage these forests is conferred by the President to the Conservator of Forests under the State Lands Act Chap. 57:01. These pieces of legislation, together with the Conservation of Wildlife Act Chap 67:01 (GORTT 1980a), which provides the primary law governing the harvest and protection of wildlife as well as the designation of Wildlife are the main framework for managing the existing terrestrial PNAs system in Trinidad and Tobago.

As pressures from illegal activities in the Forest Reserves and Wildlife Sanctuaries have intensified (Ramlogan 2013), the Forestry Division has since the 1980s, designated all the wildlife sanctuaries and certain areas identified informally as “nature conservation reserves”, as prohibited areas. This prohibition is a power granted under the Forest Act, and allows the Division to exercise, in theory, greater control over access to the relevant protected area.

It should be noted that the Environmental Management Act Chap 35:05, provides the Environmental Management Authority (EMA) through its Environmentally Sensitive Areas (ESA) and Environmentally Sensitive Species (ESS) rules for the designation of PNAs and threatened species (GORTT 2000). However, the effectiveness of the designations under these ESS and ESA rules has, to date, been limited. This is due to inherent weaknesses in the Forest Act Chap 66:01 and Conservation of Wildlife Act Chap 67:01, which supersede these Rules as primary legislation (Leach & Fairhead 2001).

In the context of PNAs and the NPASP, the inability to use these pieces of primary legislation to achieve the levels of protection and management envisaged under the National Protected Areas Policy, underline the weaknesses of these laws. These weaknesses have in part led to several drafts of replacement bills for forest, wildlife and PNAs management. However, to date, no significant changes to the existing primary legislation have been enacted in the past 2 decades. The revisions of the Protected Areas, Forest, and Wildlife Policies accomplished in the period 2011-2013, were to

provide the policy framework for undertaking the required revisions to the primary legislation (Ramlogan 2013); however, these new bills remain un-enacted.

In the marine environment, the primary legislation affecting biodiversity conservation and PNAs there, include the Fisheries Act Chap 67:51 (GORTT 1980b), the Marine Preservation and Enhancement Act Chap 37:02 (GORTT 1996a), the Territorial Sea Act Chap 1:51 (GORTT 1986c), the Three Chains Act (Tobago) (GORTT 2006c), and the Continental Shelf Act (GORTT 1986b). It should be noted here that as of this writing, only one marine protected area has been formally designated under any national regulations, the Buccoo Reef, which was designated under the Marine Preservation and Enhancement Act Chap 37:02 (GORTT 1996a). Aside from this PNA designation, the primary protection enforced in the near-shore marine area has been the restriction of fishing gear-type across different marine zones within the country's Exclusive Economic Zone (EEZ).

A key nuance in the legislative arrangements for PNAs in Trinidad and Tobago is the locus of the Tobago House of Assembly Act (GORTT 1996b), which provides the THA with the capacity to legislate for the protection of biodiversity and natural areas locally, as well as manage and administrate these rules independently from Trinidad. To date, there has been no effort to legislate separate PNAs regulations for Tobago.

Notably, there is no specific legislation for the establishment of national parks in Trinidad and Tobago. However, with the transference of the north-western Chaguaramas peninsula back to national control in the 1970s, the Chaguaramas Development Authority (CDA) was created as an entity for management of this area (GORTT 1972). This legislation explicitly allowed for the establishment of a park within the peninsula, by the publication of a management plan for the area (GORTT 1972). As noted previously, the superposition of defence priorities and national physical development of this peninsula for light-industry and recreation, has meant that the actual management of this north-western peninsula for biodiversity conservation has been limited. Interestingly, the CDA regulations provide for the publication of a management plan for the area which can give effect to the designation and management of the area (or areas within the jurisdiction of the CDA), consistent with the NPAP (2011). However, this has not occurred as of this writing.

As can be seen by the preceding review, the establishment of a national system of protected areas is regulated by a plethora of national laws and regulations. Thus, the designation and management of a harmonised system of PNAs, will require extensive harmonisation across multiple pieces of legislation, as has been reviewed in the National Protected Areas Policy (GORTT 2011c).

3.3.INSTITUTIONAL REVIEW

In Trinidad, the primary management agency for terrestrial protected areas is the Forestry Division. The Division is led by the Conservator of Forests/Director of Forestry, who for the purposes of the Conservation of Wildlife Act is also termed the Chief Game Warden (GORTT 1980a). The organization's established positions consist of 915 staff, including 21 professional positions and 274 technical positions (Ramnarine 1998). The Division administers the management of the forests on Trinidad through a system of regional conservancies, each led by an Assistant Conservator of Forests. In the context of PNAs and biodiversity conservation, the Division's structure includes a National Parks Section and Wildlife Section, the former led by an Assistant Conservator of Forest and the latter by a Wildlife Biologist. The Wildlife Section and the relevant Conservancies, are responsible for the day to day management of the areas designated by the Wildlife Act as Wildlife Sanctuaries. Similarly, some of the areas identified under the 1980 systems plan (Thelen & Faizool 1980), have been the focus of management by the Forestry Division for recreation, and as informal national parks and recreational natural areas including Matura, Aripo Savannas, Caura, Cleaver Woods, and San Fernando Hill to name a few. These are under the management of the Division's National Parks Unit in conjunction with the relevant Conservancy.

Due to the unique history of the Chaguaramas peninsula, firstly as a US naval station in the 1940s and its subsequent return to the Government of Trinidad and Tobago, a unique entity was established to manage this area – the Chaguaramas Development Authority (CDA). This peninsula and its nearby islands hold some of the best representations of dry forest communities in the country. In this regard, a large proportion of the area has been nominally managed as a park by the CDA, however, its continued role as a location for the national military and coast guard bases, and recent efforts by the CDA to increase commercial activity in the area, represents a challenge to its "park" designation. The CDA's official structure includes the position of park planner and the protection of the natural landscape in the peninsula remains a core function of the personnel at the agency. However, the technical capacity for PNAs management for biodiversity conservation, within the CDA remains limited. As a result, the efficacy of the current management on the protection of the biodiversity within the peninsula, and the potential impact of current uses and proposed physical developments on the area, remain un-quantified.

Although the Environmental Management Act Chap 35:05, provides the Environmental Management Authority (EMA) with sweeping powers for the management of biodiversity, as indicated above, these appear limited due to the subsidiarity of the Act's Rules. In this context, it should be noted that the organizational structure of the EMA, has limited personnel specifically assigned to

biodiversity conservation. Most of the organization's 170 personnel remain focused on the administration of the certificates of environmental clearance process, and the enforcement and compliance associated with this function (GORTT 2011a). In this regard, the organization has very limited internal capacity for the management of PNAs.

In Tobago, the management of the environment is exercised through two Divisions of the Tobago House of Assembly (THA). The Division of Food Production, Forestry and Fisheries' Department of Natural Resources and Forestry (DNRF) implements the Forest Act and Conservation of Wildlife Act, and has been administratively a separate Conservancy, administered by an Assistant Conservator of Forests who nominally reports to the Conservator or Forests, but who administratively reports to the Administrator of the Division of Food Production, Forestry and Fisheries of the THA. This Division's Department of Marine Resources and Fisheries also implements the Marine Preservation and Enhancement Act Chap 37:02 (GORTT 1996a), while the Division of Environment and Quarries' Department of Environment is charged with implementation of the Environmental Management Act and its Rules. This includes the ESS and ESA rules, which potentially can directly affect PNAs management on the island.

While the Forestry Division, CDA and THA have the primary management responsibility for the PNAs in the country, the fragmented and inter-leaved legislative framework also allows for other government agencies and ministries to have a role in protected natural areas management. This list includes the Town and Country Planning Division (TCPD), the various regional corporations established under the local government regulations, the Fisheries Division and National Trust to name a few. In our review, we have not reviewed the capacity for management resident within all of these latter agencies with roles tangentially related to PNAs management. For a detailed analysis of this, the reader is directed to the National Protected Areas Policy (2011) which provides a detailed analysis of this situation. Importantly, we note the recommendation of the NPAP to undertake a transformation of the existing agencies to develop one national institution for PNAs management. The implementation of this policy decision has been heavily debated since the adoption of the policy and remains an active area of negotiation between the stakeholders, at this writing. In this regard, we note here that throughout our review of the PNAs in the country, the lack of this administrative and management clarity has historically been the primary cause for the lack of implementation of previous plans for protected areas in the past 40 years.

It should be noted here that there is a small body of wider literature on protected areas in Trinidad and Tobago, relevant to both the policy process and social aspects surrounding the issue of PNA management. For example, the historical process surrounding PNA policy in Trinidad has been reviewed in depth by Leach and Fairhead (2001) and the importance of engaging communities in

PNA management is highlighted by Granderson (2011). Similarly, Nelson (2004), provides data on a national survey of public attitudes to nature, which indicates that at that time there was approximately 75% support among the interview population for the establishment of a national park system for the country. These are important reference points in the context of understanding current pressures affecting institutional evolution outside of the governmental sector, relevant to PNAs management in Trinidad and Tobago. Thus, there has been a maturing discourse on the role of CBOs and NGOs in leading PNAs management in Trinidad and Tobago (EMA 2008; CANARI 2016). As the capacities within these CBOs and NGOs develop, their roles in PNAs management can have a transformational effect on the effectiveness of PNAs management in the country.

3.4. BIOLOGICAL REVIEW

With a combined terrestrial surface area of 5128 km^2, the biodiversity of Trinidad and Tobago is exceptional given the islands' small size (Starr 2010). The high degree of species richness reported for both islands (Table 1) would by itself, be an important justification for protection of the country's biodiversity.

Table 1. Species richness, endemism, national and global threat status of selected taxa from Trinidad and Tobago

Taxon	Number of species	Number of endemic species	Number of globally threatened species	Number of Environmentally Sensitive Species
Mammals	110	1	1	2
Birds	484	3	8	2
Amphibians	37	9	8	1
Reptiles	100	18	6	5
Freshwater Fish	66	3	1	-
Marine Fish	1013	-	25	-
Invertebrates	1128	-	-	-
Cnidaria	57	-	10	-
Vascular plants	3639	108	53	-

Sources: Starr (2010), Phillip (1998), Nelson and Devenish-Nelson (unpublished data), Avibase (2017), Murphy (1997), Boos (2001), Murphy and Downie (2012), IUCN (2017), Baksh-Comeau et al. (2016).

However, in addition to the species-level diversity across the country's terrestrial plants, animals and invertebrates (Goodwin & Greenhall 1961; Murphy 1997; ffrench 2012; Baksh-Comeau et al. 2016; Starr 2017) referred to previously, many of the islands' species are endemic (Box 7), including an

estimated 59 plant (Van den Eynden et al. 2008), 6 amphibian (AmphibiaWeb 2017) and 3 bird species (Birdlife International 2017).

At the ecosystem-level, the country's communities are no less diverse, with 17 types of forest across 3 eco-regions on Trinidad and 6 distinct forest communities on Tobago (Table 2) (Beard 1944; Beard 1946; Nelson 2004).

Box 7. Endemism

When a species is restricted to a specific location, such as an island, habitat type or defined area, it is termed endemic. Endemism can evolve in a species as a result of geographic isolation or as a response to changes in environmental condition. Due to their geographic isolation, islands often have high numbers of endemic species. Since endemic species have restricted distributions, they can face higher levels of extinction risk than more widespread species.

Table 2. Extent of vegetation communities and percent under formal protection in Trinidad. (Reproduced from GORTT (2010)).

Vegetation Formation (Beard 1946)*	**Crown Lands (Beard 1946) (ha)**	**Protected Areas (ha)**	**Percent in Protected Areas (ha)**	**Natural Ecosystem (Ramlal 1994) (ha)**
DSF: Deciduous Seasonal Forest	1804	1094	61	1508
ESF: Evergreen Seasonal Forest	120732	84602	70	96442
ESF & LMF	8716	3835	44	8492
ESF & MaF	317	271	86	137
ESF & SESF	18563	14908	80	14235
ESF & SGC	1770	1136	64	1170
EW: Elfin Woodland	48	0	0	48
HS: Herbaceous Swamp	7023	944	13	4310
LMF: Lower Montane Rain Forest	16451	8766	53	16101
LMF & MF	1421	825	58	1419
LMF & SMF	1290	3	0	1268
LW: Littoral Woodland	738	220	30	235
MaF: Marsh Forest	1526	973	64	452
MaF & Sav	13	0	0	0
MaF & TP	527	342	65	149
MF: Montane Rain Forest	277	0	0	278
MgW: Mangrove Woodland	5580	2467	44	4016
PF: Palm Forest	1312	0	0	1059
Sav: Savanna	455	63	14	50
SESF: Semi Evergreen Seasonal Forest	20521	15361	75	12787
SESF & LMF	278	254	91	278
SMF: Seasonal Montane Forest	1585	0	0	1585
SwF: Swamp Forest	529	131	25	446
TOTAL	**211478**	**136197**	**64**	**166466**

*The interpretation of Beard (1949) used here is verbatim from GORTT (2010).

Among the freshwater aquatic habitats, the fish communities in Trinidad alone have been classified into at least five unique biogeographic assemblages (Kenny 1995) (Box 8). Here, we also direct readers to Thelen and Faizool (1980) for their review of biota in the existing protected areas system.

Understanding the underlying drivers that maintain this species and community diversity, is critical to the design of a PNAs system that can maintain these patterns. Today, we understand that some of the processes that led to this high species richness (Table 1) include the relatively recent (on an evolutionary scale) land-bridge connection to the South American mainland and the close proximity of the islands to the mainland (Kenny 1995).

Box 8. Biogeography

Biogeographic zones are determined by patterns of species distributions. Species and ecological communities vary in geographic space according to gradients such as elevation, latitude, area and isolation. Over time, species evolve in response to changes in geographic features, including oceans, mountains and rivers, resulting in the formation of distinct species and communities. Due to their isolation, islands are often composed of distinct biogeographic communities.

Given its geological history, Trinidad and Tobago sits in the biogeographic zone of tropical coastal South America, but also has elements of the Lesser Antilles ecological communities, such as observed in some of Tobago's dry forest species.

The islands' pattern of biodiversity reflects a combination of the relic communities of this continental flora and fauna and, in the case of Trinidad, natural species colonization from the mainland (Kenny 1995). Further, high levels of topographic complexity, steep elevation gradients, edaphic diversity and micro-climatic variation on both islands, promote the pattern of habitat heterogeneity seen on both islands (Table 2). The country's marine ecosystems, though less well studied than its terrestrial ecosystems, are no less diverse with over 950 species of marine fish (Kenny 2008), 198 marine algae (Duncan & Lee Lum 2006), 41 species of coral (Miloslavich et al. 2010), and 5 species of sea turtles (Murphy 1997).

Another important aspect of PNAs system design for the country, is understanding national-level patters of extinction risk. Thus, in addition to the high degree of richness and uniqueness at the species and ecosystem levels, an important fraction of Trinidad and Tobago's species, are considered globally at risk of extinction. Thus, over 70 species from this country are listed as threatened on the IUCN Red List (IUCN 2017), and ten of these have been listed as environmentally sensitive under current national legislation (Table 1). Thus, all five sea turtles found in the waters of Trinidad and

Tobago are globally threatened (IUCN 2017) and are nationally designated as Environmentally Sensitive Species (EMA 2014).

Migratory species also represent another important component of the country's biodiversity. These species require special consideration due to their seasonal habitat requirements, and sensitivity to human activity due to their movement across large geographic regions. Such species include a diverse range of taxonomic groups including: insects, seabirds, shore birds, waterfowl, migratory passerines, sea-turtles, whales, and commercial fish species (ffrench 2012; Joseph et al. 2012). Several of these groups are the focus of international treaties (e.g. Ramsar and the SPAW protocol), which commit the country to protection of these species and their habitats. An example of such high profile migrant species' habitats includes the internationally important nesting sites for the Leatherback turtle *Dermochelys coriaceae* in Trinidad (Joseph et al. 2012).

The country's protected areas provide habitat for many endemic and threatened species (e.g. the Trinidad Piping-guan, *Pipile pipile* in Matura ESA (White et al. 2015) and the Bloody Bay Poison Frog, *Mannophryne olmonae* in Tobago Main Ridge Forest Reserve (Lehtinen et al. 2016). However, not all species of conservation concern are thought to be well represented in these PNAs. For example, over half of all endemic vascular plant species are not thought to occur in currently declared protected areas (Van den Eynden et al. 2008).

At the ecosystem level, Trinidad and Tobago supports a diverse number of ecosystem types (GORTT 2010), including several of national and international importance. However, not all habitats are well represented, both in the scientific literature and in terms of their protected area status (e.g. freshwater systems, see the Policy Review above). For example, the edaphic savannahs in Trinidad are now restricted to two small areas (Table 2) and both are heavily degraded (EMA 2008). Similarly, in Tobago, while coral reefs provide significant economic value for tourism, fisheries and coastal protection (Burke et al. 2008), only a small proportion of these reefs have received any formal protection.

To date, three Environmentally Sensitive Areas (ESAs) have been designated, covering pre/montane forest (Matura ESA), edaphic savannah (Aripo Savanna ESA) and freshwater swamp (Nariva ESA). While a substantial area of forest lands are under formal protection as Forest Reserves or Wildlife Sanctuaries (Table 2), continued degradation due to squatting, fire and quarrying (GORTT 2010), has significantly altered quality and extent of these forests (Nelson and Devenish-Nelson unpublished data). Similarly, the marine environment has suffered degradation due to overexploitation, pollution, bleaching and climate change (GORTT 2010). For example, seagrass beds (*Thalassia testudinum*, *Halodule wrightii* and *Halophila* sp) around both Trinidad and Tobago have declined

significantly since assessments began in 2002, with some areas suffering declines of over 50%, or in some cases disappearing completely (IMA 2016).

One key challenge to PNAs development was the paucity of data on vegetation and faunal community structure for Tobago. For instance, the seminal work on the vegetation of the island (Beard 1944) does not provide a comprehensive map of the forest ecosystems on the island, nor does Nelson (2004) address this island in his ecoregional mapping. Similarly, although Kenny (1995) provides an interesting biogeographic framework for understanding freshwater fish distribution on Trinidad, this work is not repeated for Tobago. Nonetheless, some general remarks can be made about the floral and faunal communities on the island (Table 3).

Table 3. Non-forest ecosystem types present in Trinidad and Tobago.

Ecosystem Type	Trinidad	Tobago
Karst Landforms		
Caves	X	X
Springs, Sinkholes	X	
Freshwater		
Antillean/North coast	X	
Unstable Relic	X	
Stable Relic	X	
Colonizing	X	
Marine and Coastal		
Sandy Beaches	X	X
Pebble or Shingle beaches	X	
Rocky shores	X	X
Coastal cliffs	X	X
Mud flat	X	
Coral reef	X	X
Sponge reef		X
Seagrass	X	X
Subtidal sandy bottom	X	X
Subtidal mud bottom	X	X
Subtidal rocky bottom	X	X
Marine seeps	X	?
Coastal Shelf	X	X

Sources: Kenny (1995), Philip (1998), GORTT (2010).

Although Tobago was once connected to mainland South America and thus shares some continental biodiversity, it is structurally different to Trinidad, given its' smaller size and farther distance from the colonizing influence of the Orinoco (Mohammed et al. 2015). Indeed, the Antillean influence on biodiversity is evident in Tobago. For example, freshwater macroinvertebrate communities are most similar to Grenada (Bass 2003) and freshwater fish communities to Barbados (Mohammed et al.

2015), whilst dry forest floristic affinities suggest a transition zone between Antillean and South American (Oatham & Boodram 2006a). Similarly, Tobago's marine ecosystem lies primarily in the Tropical North-western Atlantic province and the Southern Caribbean ecoregion of Spalding *et al.*'s (2007) marine biogeographic realms, while Trinidad in contrast, lies in the Guianan ecoregion of their North Brazil Shelf province. Despite hosting the country's first PNA (Main Ridge Forest Reserve), its only MPA, and two of the country's 13 wildlife sanctuaries, the biota of Tobago remains inadequately protected. For example, as has been argued by Day and Chenoweth (2004), the karst ecosystems on the island, remain unrepresented in the existing PNAs system.

Today, a large proportion of the available literature on protected areas in Trinidad and Tobago consists of species-specific taxonomic descriptions and distribution records. To a lesser extent, the ecology and natural history of some specific PNAs are addressed. Some areas such as Caroni Swamp, Nariva Swamp, Buccoo Reef and Aripo Savannas (Juman 2005; Plair et al. 2008; Bhagratty et al. 2013; e.g. Alemu 2014; La Daana et al. 2014; Auguste et al. 2015; Hosein et al. 2017) have received more attention and, to a lesser extent, Matura and Tobago Main Ridge Forest Reserves (e.g. Alemu et al. 2007; White et al. 2015). For example, recent studies describe species distributions at the Aripo Savannas Scientific Reserve and the Matura ESA (Auguste et al. 2015; White et al. 2015). The ecological importance of the Nariva and Caroni Swamps are noted in several studies (Gibbes et al. 2009; e.g. Baksh-Comeau et al. 2016), while the consequences of human impacts are also subject to research, such as on the Buccoo Reef (Lapointe et al. 2010) and the Main Ridge Forest Reserve (Lefevre & Rodd 2009).

In general, the published data on the biota of Trinidad and Tobago suggests that its species richness of terrestrial ecosystems is comparatively well described, while its marine and freshwater-aquatic ecosystems are much less so. Yet for most species, estimates of population size and metapopulation dynamics, as well as their response to climate change, alien invasive species (AIS), movement biology or the impact of habitat fragmentation and isolation on population level and community level process are either non-existent or exist as baselines with relatively high margins of error. These gaps present a great challenge to PNAs planning on both islands, and represent important opportunities for applied research in the country.

3.5. LIVELIHOODS AND ECOSYSTEM SERVICES REVIEW

As noted previously, the natural ecological communities of the islands provide critical ecosystem services to local communities. These ecosystem services include many that are known to be significant for supporting human health and well-being, such as carbon sequestration, watershed

protection and soil formation (Dudley et al. 2011). Although many of these functions are yet to be quantified for Trinidad and Tobago's ecosystem services, global estimates (e.g. $125 trillion/yr.) suggest that the potential economic value of these ecosystems should not be underestimated (Costanza et al. 2014).

One ecosystem function that is comparatively well understood is watershed protection. Watershed protection is a key function of many terrestrial PNAs (Postel & Thompson 2005). In Trinidad, models suggest that upper watershed deforestation can substantially lower flood protection downstream, with intact natural forest estimated to be valued at up to US$268 annually per ha (Brookhuis & Hein 2016). Additionally, forests provide protection from erosion; the value of the Northern Range for protection against erosion is estimated at up to TT$ 3.7 billion per year, which is up to 2.3% of the 2014 GDP (Girvan 2015). In Tobago, the cost of replacing the water supply provided by the Main Ridge Forest Reserve was estimated at between US$ 5.2 to 7.2 million annually (Girvan 2015). These findings highlight the importance of designating PNAs for protecting major watersheds across the country. In developing a PNAs system for the country, the establishment of a representative suite of protected areas, which ensure conservation of watershed function across the upper, middle and lower watersheds of the country's important river systems should be an important target. Such a target would allow for maintenance of ecosystem services provided by these ecological communities across the landscape.

Pollination is another critical ecosystem service provided by ecological communities. Estimates globally suggest that the value to agriculture alone is worth €153 billion annually (Gallai et al. 2009). Recent studies in the Nariva Swamp have documented the importance of this ecosystem service to local communities there (Ghermandi 2015), and provide an important marker of the contribution of such PNAs to Trinidad and Tobago's national development. The value of pollination for Trinidad and Tobago's agriculture sector was estimated at TT$ 65 million in 2012 (Girvan 2015). Research at Aripo Savannas suggests that in this unique ecosystem, restricted range species such as the orchid *Otostylis brachistalix*, may now be suffering from the loss of natural pollinators at this site (Nelson and Devenish-Nelson, unpublished data). That the loss of such pollinations services can have a knock-on effect in these natural ecosystems, remains an important conservation concern and, an important impetus for the development of a viable PNAs system across the country.

Natural habitats and their wildlife support multiple livelihood sectors in Trinidad and Tobago. For example, the fishing industry relies on natural environments to provide services such as nursery habitats for juvenile fish and shellfish (IMA 2016). An important example of such nursery function is seen in the Caroni Swamp which is considered an important nursery for the Gulf of Paria fishery (Mohammed 2008). Similarly, the exploitation of local freshwater fish and conch for the aquarium

trade and subsistence use (Pemberton & Fridie 2001), relies on the country's riverine ecosystems to provide a complex series of conditions during the life-history of these exploited species. Agriculture contributes to 0.5% of Trinidad and Tobago's GDP, providing important livelihoods for many communities around PNAs (e.g. Pemberton & Fridie 2001; Van den Eynden et al. 2007; Van den Eynden 2018). This sector relies on multiple ecosystem services provided by these PNAs, such as pollinators to improve yields, local insect, bird and bat species to control insect pests, as well as plant communities surrounding waterways to provide protection against soil erosion and water provision.

The utilisation of timber and non-timber forest products by rural communities to provide income, has traditionally been an important raison d'être for the country's forest reserves (Nelson 2018). The further development of livelihoods based on sustainable exploitation of such forest products for the production of small-scale craft materials, medicinal products, and artwork remain an important area in which PNAs have a role. It is notable that despite the interest in these livelihood options, the full potential for these types of industries is yet to be realised in the Caribbean (John 2005).

Similarly, the non-consumptive livelihood opportunities provided by ecotourism-based activities have a long history in Trinidad and Tobago. From coral reef tours, to birdwatching and turtle nesting viewings, these activities based on natural attractions have been developing over the past 60 years in the islands as means of providing substantial income to local communities (Nelson et al. 1999). This non-consumptive use has been highlighted as an important means by which the unique habitats, endemic or threatened species and high species richness can be used to attract tourists from around the world (Ramdial 1980; Waylen et al. 2009; Cazabon-Mannette et al. 2017). A quarter of households surveyed from communities around the Matura ESA are employed directly into ecotourism or protected habitats (Van den Eynden 2018). In this context, PNAs such as Buccoo Reef, Main Ridge Forest Reserve, North-east Tobago MPA, Matura National Park, Nariva Swamp and Caroni Swamp represent important lynch-pins of the PNAs system for supporting tourism-based livelihoods.

Maintaining natural areas is essential for human health and wellbeing of the population, and this is reflected across Trinidad and Tobago through the widespread usage of the country's remaining natural areas for recreation. For example, Chaguaramas Peninsula is a critical resource for local communities in the north-west of Trinidad, offering recreational opportunities such as swimming and hiking trails, with the accompanied health and wellbeing benefits that these activities provide. Similarly, San Fernando Hill National Landmark (NL) provides opportunities for communities to interact with natural areas, in spite of the heavily industrialised and urbanised nature of this part of the Cipero watershed. Communities in north-east Trinidad actively use their natural environment for

recreation, with over 60% having visited the region's protected beaches and 30% having visited the Matura ESA (Van den Eynden 2018). In Tobago, the Buccoo Reef is an important focal point for both local and international recreation through traditional 'sun, sea and sand' tourism, to ecotourism (Burke et al. 2008). In addition, this south-western part of Tobago benefits from the increased hedonistic values of properties in this part of the island, largely due to the environmental benefits provided by the remaining natural landscape. In Trinidad, river-based recreation, epitomised by the "river lime" is a widespread form of recreation throughout the country (Deacon et al. 2015), being an important social activity, which again relies on the environmental amenities provided by the dwindling number of rivers and watersheds which remain unpolluted, and where stream-flows and quality have not been compromised by upper-watershed degradation.

Culturally, the people of Trinidad and Tobago find inspiration from the aesthetics of the country's ecosystems. For example, Carnival costumes are regularly inspired by wildlife species (e.g. Hill 1985) and the folklore, literature and art of the country often draws heavily on natural environments (e.g. Besson 1989). Another important cultural aspect of natural resource use is that of hunting. This widespread pursuit, with over 10,000 registered hunters on Trinidad alone (Nelson, unpublished data), as well as illegal hunters (Van den Eynden et al. 2007), relies on intact habitats that are able to support viable populations of game species. An estimated third of households surrounding the Matura ESA have at least one person engaged in hunting activities, with 9% of households relying on hunting for income (Van den Eynden 2018). In this context, PNAs such as Trinity Hills/VMR, Matura ESA, Central Range and Southern Watershed forest reserves and wildlife sanctuaries, are vital for long-term sustainability of this pastime. Currently, evidence suggests that some game species (e.g. wild hog) may be below critical thresholds to ensure long-term viability (Nelson *et al.*, unpublished data). In this context, the role of the PNAs system to provide refugia for populations of the game mammals on the island, remains an important justification for the overhaul of the existing system to ensure that these natural areas can support viable populations of these species.

In general, literature quantifying ecosystem services and livelihoods is lacking for Trinidad and Tobago, but this is an area of growing research interest. In this regard, the recently completed Livelihoods Assessment conducted under the IFPAMTT project for the Matura ESA (Van den Eynden 2018), is to be undertaken for the five other pilot PNAs. Similarly, the IFPAMTT Socio-economic Assessment, which uses a novel methodology for the first time in the Caribbean, specifically quantifies the contribution of forests and non-forest environments to living standards (Bakkegaard et al. 2016).

In terms of the designation and management of PNAs, the NEP provides guidance by highlighting the role of the country's natural areas and biodiversity in its development and the need to ensure their protection.

3.6.CURRENT STATUS OF THE PNAS SYSTEM

The NPASP project was constrained to undertake the design of the PNAs system using a desk-based review of the currently available data. In this context, we undertook to assess the status of the current terrestrial PNAs (including the wildlife sanctuaries, forest reserves, prohibited areas and ESAs) of both islands, using a spatial analysis of the 2014 aerial photography provided by the Ministry of Planning and Development. Here we deviate from Thelen and Faizool (1980) who did not specifically address the status of all the legally designated Forest Reserves. However, we point readers to Thelen and Faizool (1980) for a full description of the geomorphological and geologic features of the existing protected areas network. For the marine and freshwater ecosystems, we reviewed the published information, including the country's most recent CBD reports. In many cases there was little published data available for these ecosystems, and in these cases, we met with local stakeholders to ascertain their views on the status of these existing areas and historically recommended areas that were never protected. The reports of these stakeholder meetings are recorded in the IFPAMTT stakeholder reports (Shim 2017). In this section we provide a summary of the results of the analysis we conducted, and the reader is directed to Tables 4-11 for the specific details we found for each of the currently legally designated PNAs.

3.6.1. TRINIDAD

The current state of the legally proclaimed terrestrial PNAs system of Trinidad, varies widely between these areas. Across the terrestrial Wildlife Sanctuaries on Trinidad, the natural cover ranges among these from 27% in Valencia to 99% in Trinity Hills and the Northern Range sanctuaries (Table 4). Analysis of the 2014 remote sensing data suggests that remaining natural forest cover of Forest Reserves on Trinidad ranges from a minimum of 7% in San Pedro Forest Reserve to almost 100% in Paria and Las Cuevas Forest Reserves (Table 5). Across the three terrestrial ESAs on Trinidad, the percentage forest cover at Aripo Savannas, Matura and Nariva was 74%, 99% and 43%, respectively (Table 6). The remote sensing analysis suggests that the major reasons for the loss of natural forest cover across many of the terrestrial PNAs include squatting (agricultural, residential and marijuana), oil and gas exploration, anthropogenic fire, road rights-of-way and timber plantation management.

An important conservation design issue is the degree of fragmentation of the remaining natural areas. Fragmentation has many effects on natural systems, including isolation of wildlife populations and increasing mortality among plant and animal species adapted to the conditions that exist in the "interior" of these ecosystems. In our analysis of status of the current PNAs, we used two indicators of fragmentation, edge-to-area ratio and road density, as these have been shown to be related to the degree of fragmentation in terrestrial ecosystems (Cabeza et al. 2004; Laurance et al. 2009). Our analyses of these indicators for the PNAs across Trinidad and Tobago, suggest that those smaller PNAs and those with high road density (e.g. Morne L'Enfant Wildlife Sanctuary, Longdenville and Freeport-Mission), are more likely to be degraded (Figure 4). This is consistent with current theory that small PNAs are vulnerable to impacts of edge effects (Woodroffe & Ginsberg 1998) (Box 9).

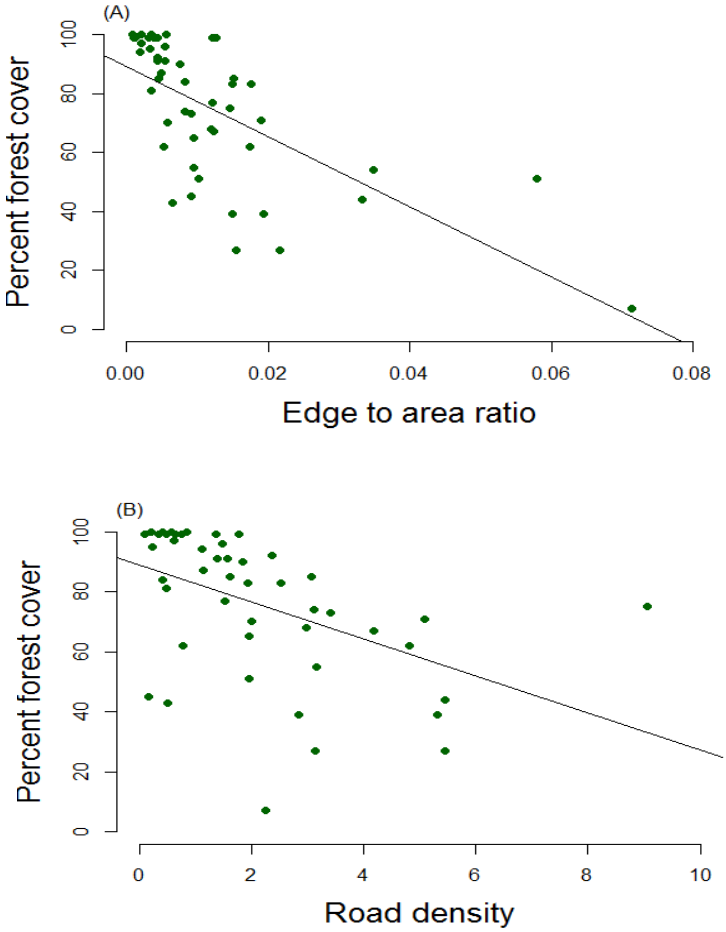


Figure 4. Relationship between the percentage of remaining forest cover of PNAs in Trinidad and (A) edge-to-area ratio and (B) road density.

Box 9. Edge Effects

Ecological community composition or species dynamics are often altered at the boundaries of habitats. Such boundaries can be natural or created due to human activity. Changes in abiotic conditions at habitat boundaries can include an increase in light availability, air temperature or changes to soil moisture.

The ecological impacts of such changes at these edges include an increase in the abundance of invasive species, a shift from highly specialist to generalist species, increased fire risk or higher pollution levels. Smaller protected areas suffer more from edge effects than larger reserves due to a higher edge-to-area ratio.

However, small forest fragments often play a vital role in PNA systems, providing landscape connectivity and protection of unique ecosystems (Laurance 2004), as well as provision of ecosystem services for local communities (Mitchell et al. 2014). It should be noted, that a number of (small) reserves have suffered substantial degradation, to the point of warranting possible de-gazetting, such as Morne L'Enfant Wildlife Sanctuary. In general, among the larger PNAs in the current system on Trinidad, many remain in relatively good condition in terms of the fragmentation metrics we used. However, we also identified important large PNAs that have become so degraded as to warrant de-gazetting (e.g. Valencia Wildlife Sanctuary).

It is important to note that a caveat of our methods is that forest cover is not necessarily an indication of an intact ecosystem. The concept of the 'empty forest' (Redford 1992) is well established in tropical ecology, and its observes that forest ecosystems can appear structurally intact, but may still lack component wildlife species due to over-hunting and other anthropogenic disturbance. Such disturbance is not discernible from the remote sensing approach we used. As noted above, the hunting of wildlife for commercial exploitation, food, sport and subsistence use is deeply ingrained in the culture of Trinidad and Tobago, and there remains intense hunting pressure on the native vertebrates (Nelson 1996; Nelson et al. 2010). In this context, the "empty forest" paradigm provides an important dimension to PNAs planning, as it highlights the need to look at multiple aspects of the system being protected, beyond simple structural diversity.

In this context, our examination of the status of PNAs in Trinidad suggest that while 70% of the wildlife sanctuaries (Table 4) on or around Trinidad remain with more than half of their original cover, important sanctuaries such as Valencia have been irreversibly compromised. Among the 35 forest reserves (Table 5), those which have remained relatively isolated from existing hotspots of human development, are at high elevation and are large in size, have been the ones to experience

the lowest levels of disturbance (e.g. Blanchisseuse, Matura, and Yara forest reserves). Generally, the majority (21 of 35 forest reserves on Trinidad) have experienced 10% or greater loss of natural forest cover (Table 5). Six of these thirty-five forest reserves on Trinidad have lost more than 50% of their natural cover (Figure 5).

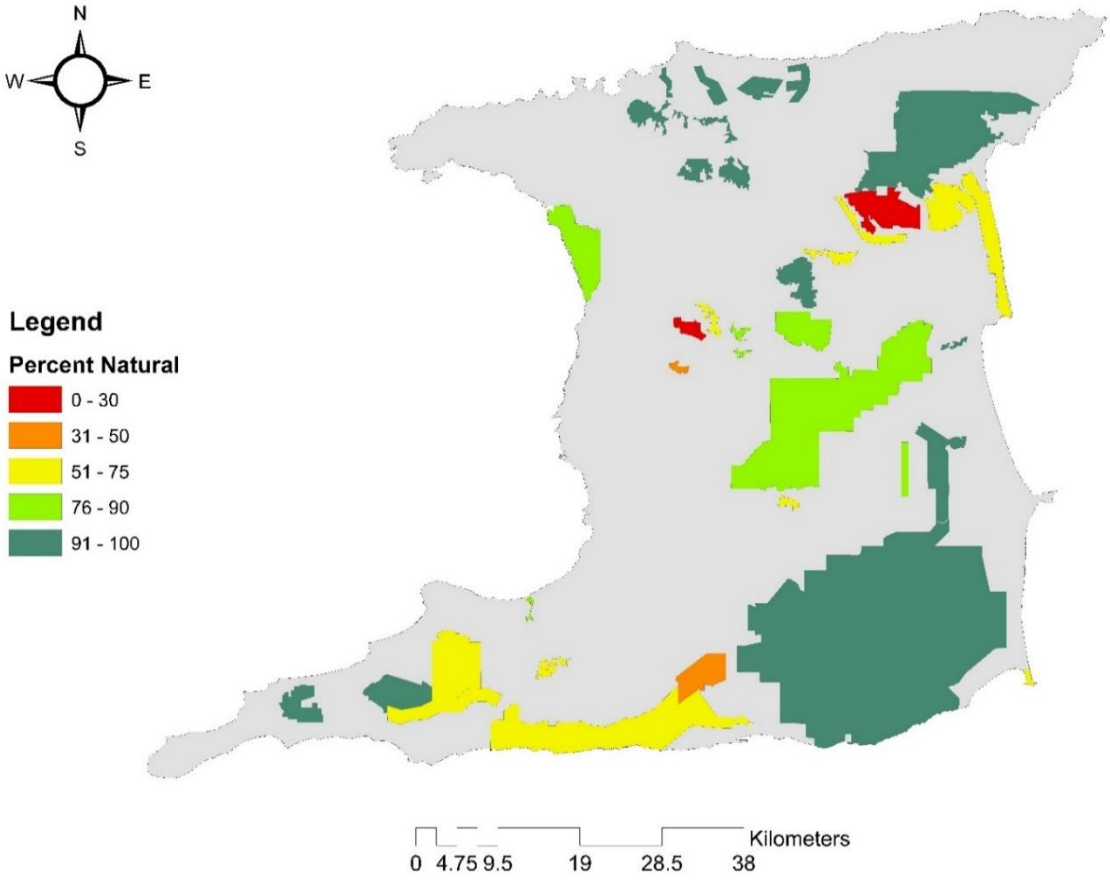


Figure 5. Percent cover in declared Forest Reserves on Trinidad, 2014.

The three recently designated Environmentally Sensitive Areas (ESAs) all are under various degrees of management activity (Table 6). The Matura ESA is embedded in what is currently the Matura Forest Reserve and the un-demarcated St. David's Reserve and appears to retain 99% natural cover. This site has been the focus of recent research and protected areas planning (Van den Eynden et al. 2007; White et al. 2015; Lewis 2016). Similarly, the Aripo Savannas ESA with 74% natural cover, although historically heavily affected by aggregate mining, agricultural squatting and homesteading, has also been the focus of integrated PNAs planning (EMA 2008). Finally, the Nariva ESA represents a complex protected area, having been the focus of extensive agricultural squatting for rice and other

forms of farming in the 1990s. Since that time, there have been several projects attempting to restore the area and regulate the homesteading and farming in this area (Carbonell et al. 2007; World Bank 2012). Despite these efforts, these sites remain heavily impacted by annual anthropogenic fires (in the case of Aripo Savannas and Nariva), and illegal hunting (in the case of the Matura ESA).

As indicated previously, the Forestry Division in the 1940's designated 11 small areas as "Nature Reserves". Although these designations did not have formal protection, the agency typically managed these areas to maintain their natural character. However, our review of these areas reveals that most of them have been subjected to continued degradation and increasing isolation since Thelen and Faizool's (1980) assessment (Table 8).

These "Nature Reserves", ESAs and Wildlife Sanctuaries exemplify the issue of multiple overlapping designations. Each of these classes often overlap each other in many of the terrestrial PNAs. This has historically arisen as an attempt to systematically increase management intervention for sites where the defining characteristics have been perceived as being systematically degraded by human activities at these sites. The upshot has been conflicting perceptions across all stakeholders, including the managers, of the roles and relationships between these designations.

The final class of existing protected areas on Trinidad that we examined were the coastal Prohibited Areas (Table 7). These included three sandy beaches on the eastern and north-eastern portion of Trinidad – Fishing Pond Beach, Matura Beach, and Grande Riviere Beach. Designated under the Forest Act (Chap. 66:01), these sites account for slightly less than 21 kilometres of coastal strip, which are seasonally designated as prohibited areas, to protect nesting marine turtles. Of these three sites, the latter two have become globally recognised as some of the most important leatherback turtle (*Dermochelys coriacea*) nesting sites in the Caribbean (Joseph et al. 2012). In this regard, these beaches have also become important ecotourism and livelihood generation focal points for the local communities around these PNAs (Waylen et al. 2009). While subject to natural beach disturbances from storm surge and other seasonal weather phenomena, these three sites appear to be in relatively good condition, based on the literature. These sites also illustrate the potential for informal arrangements between civil society and government for PNAs management (e.g. Nature Seekers).

Table 4. Status of Wildlife Sanctuaries in Trinidad*.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 1980	Condition at 2017
Bush-Bush	1554	1968	Large freshwater swamp and wildlife spp. diversity. Important historical biological research site.	Substantial human disturbance and usage, fire damage in dry season. Not considered significant.	Fire from nearby dry season agriculture, hunting, encroaching agricultural squatting and marijuana cultivation on Bush-Bush island. Remaining natural forest: 45%. Nearest reserves: Embedded in Nariva ESA and contiguous with eastern edge of Nariva Windbelt Reserve.
Caroni Swamp	200	1953	Best national mangrove representation and important fish nursery and wildlife habitat.	Little human interference. Some wildlife species affected by poaching.	All mangrove habitat. Some natural dieback. No human disturbance visible. Remaining natural forest: 83%. Embedded in Caroni Forest Reserve. No other reserves within 10km. Threats identified in 1980 are relevant and increasing in intensity (poaching of protected species and illegal fishing).
Central Range	2153	1934	None	Timber, forest management & hunting depleted wildlife.	Extensive exotic bamboo colonization on southern edge of Sanctuary. Degraded forest in the central part of Sanctuary. Teak in middle third and along south-eastern quadrant. Remaining natural forest: 81%. Embedded in Central Range Forest Reserve and nearest reserves Tumpuna and Todds Rd South Forest Reserves.
Kronstadt Island/ Cronstadt Island	5	1940	None	Significant human disturbance due to quarrying and residence.	Threats to the site remain as at 1980. Half the island's natural vegetation cleared for quarrying & permanent human presence at site. Remaining natural forest: 54%. Nearest reserve: No marine protected area within 10km.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 1980	Condition at 2017
Morne L'Enfer	338	1958	none	Oil exploration and forest management depleted wildlife.	Highly fragmented and isolated due to oil exploration, fire and hunting. Signs of persistent fire damage across small fragments. Remaining natural forest: 44%. Embedded in Morne L'Enfer Forest Reserve; nearest reserves Siparia and Erin Forest Reserves.
Northern Range	936	1935	Highest point and good representation of montane and lower montane habitats and spp.	Undisturbed. Inadequate size for wildlife protection.	Forest relatively undisturbed. Threats from hunting, and encroachment along trails to north and south. Some marijuana clearings present. Most disturbance from storm precipitated landslips, and increased threat from El Niño driven anthropogenic fires. Remaining natural forest: 99%. Nearest reserves: Las Cuevas and Northern Range Reserve C.
Saut D'Eau	10	1935	Breeding and roosting for brown pelicans (*Pelecanus occidentalis*) and other seabirds.	Substantial hunting and poaching.	Current threats from direct harvesting of birds and eggs by fishermen and significant fire damage. Remaining natural forest: 51%. Nearest reserve: no marine protected area within 10km.
Soldado Rock	6	1934	Rocks of Eocene and Paleocene, seabird roosting and nesting habitat.	Substantial hunting and poaching.	Current threats from direct harvesting of birds and eggs by fishermen and oil-spills from nearby oil exploration infrastructure. No tree cover present. Low creeping shrubs and grasses present. Nearest reserve: no marine protected area within 10km.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 1980	Condition at 2017
Southern Watershed	1874	1934	Good representation of accurel/mousara association.	Significantly altered by squatting, oil exploration and teak plantations.	Significantly threatened by agricultural squatting, and teak plantation. Significant annual fire risk from teak plantation and squatters. Remaining natural forest: 70%. Nearest reserve: surrounded on east and west by Southern Watershed Reserve. However, most of this is teak and separated from reserve by 2 roads.
Trinity Hills	8246	1934	Good representation of crappo-guatacare, and habitat for wildlife and historical importance.	Some altered by oil exploration and timber extraction and hunting.	Main fragmentation caused by gas and road right of way bisecting PNA in half. Fire damage from encroachment on eastern side of Victoria-Mayaro Reserve. Threats from hunting and fragmentation by oil and gas infrastructure. Remaining natural forest: 99%. Nearest reserve: surrounded on 3 sides by the Victoria-Mayaro Reserve.
Valencia	2785	1934	Prime example of crappo-guatacare, and habitat for wildlife.	Hunting, inadequate law enforcement, agriculture and quarrying have destroyed resource.	Highest fragmentation indices of all wildlife sanctuaries due to quarrying, hunting, squatting for housing and agriculture. Remaining natural forest: 27%. Nearest reserve: Aripo ESA.

*Table uses conditions at 1980 from Thelen and Faizool (1980) and follows their format, with condition at 2017 added for this plan.

Table 5. Status of Forest Reserves in Trinidad.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Arena	1545	19??	Excellent representation of the tropical shelter-wood system.	Reserve in relatively good condition. Most squatting on NW and SE edges. Remaining natural forest: 91%. Nearest reserve: Longstretch and Tumpuna Forest Reserves.
Arima	747	1922	Mosaic of naked-indian-incense-poui forests, lower montane and crappo-debass forest types.	Mostly intact though some fire damage to eastern end. Becoming increasingly isolated to north due to fire damage and deforestation in surrounding land. Remaining natural forest: 99%. Nearest reserve: Tacarigua, Northern Range A, Northern Range B, Northern Range C, Yara, Blanchisseuse, Paria and Las Cuevas Forest Reserves.
Blanchisseuse	866	1959	Mosaic of lower montane and crappo-debass forest types.	Forest in good condition, some squatting but unclear of the purpose. Remaining natural forest: 100%. Nearest reserve: Paria and Yara Forest Reserves.
Brigand Hill	143	1925		Reserve in good shape. Remaining natural forest: 99%. Nearest reserve: Central Range Forest Reserve.
Cap de Ville	2326	1953		In generally good condition spatially, although lots of high grading. Remaining natural forest: 92%. Nearest reserve: Cedros Forest Reserve; contiguous with Erin and Morne L'Enfant.
Caroni Swamp		1936	Largest intact mangrove ecosystem on the western coast.	
Cedros	1353	1958		The three largest fragments are in good condition. Remaining natural forest: 91%. Nearest reserve: Cap de Ville and Erin Forest Reserves.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Central Range		1935	Representative of the Crappo-cocorite and Crappo-carat formations as well as a small sample of the relatively rare Acurel-figuer forest formation. One of 3 surface-water reservoirs (Navet) on the island of Trinidad.	Mostly under forest cover with two primary fragments of natural forest. Most significant degrading activity at the site due to teak plantation in southern third of reserve. Remaining natural forest: c. 80%. Nearest reserves: San Pedro, Tumpuna, Ecclesville, Brigand Hill and Nariva Windbelt Forest Reserves.
Ecclesville	515	1934		Southern 1/5 of reserve very high-graded and squatted. Extensive squatting in three-sixths of the reserve. Upper northern reserve boundary heavily degraded by squatting. Upper 1/3 and eastern boundary in best shape. Remaining natural forest: 84%. Nearest reserve: VMR, Nariva Windbelt and Central Range Forest Reserves.
Erin	2106		Encompasses the Erin Savannas, one of only two remaining natural savanna ecosystems in the country.	Half of the mapped area is not declared FR but state land. State land parcel is highly fragmented and appears already leased. Remaining natural forest: 67%. Nearest reserve: Contiguous with Morne L'Enfant and Cap de Ville; Southern Watershed, Siparia and Cedros Forest Reserves.
Freeport-Mission	190	1958		Highly degraded. More than 1/3 of this area has been leased. Remaining natural forest: 39%. Nearest reserve: McNair, Todds Rd North, Todds Road South, Longdenville and Central Range Forest Reserves.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Godineau	91	1939	Mangrove and freshwater marsh.	Parcels are tiny, fragmented and linear. Remaining forest appears in good condition. Remaining natural forest: 85%. Nearest reserve: Southern Watershed, Morne L'Enfant, Siparia and Erin Forest Reserve.
Las Cuevas	236	1961		Forest intact, early squatting damage along northern boundary. Remaining natural forest: 100%. Nearest reserve: Northern Range B, Northern Range C and Yara Forest Reserves
Long Stretch	2842	1933	Marsh forest.	Most of the eastern reserve is completely lost to squatting and quarrying. The southern fragments are all pine plantations. Remaining natural forest: 55 %. Nearest reserve: Valencia Wildlife Sanctuary and Arena and Tumpuna Forest Reserves.
Longdenville	535	1953		Highly degraded. Remaining natural forest: 27%. Nearest reserve: McNair, Todds Rd North, Todds Road South and Freeport-Mission Forest Reserves.
MacNair	361	1934		One large fragment eastern side degraded. Small size and high degree of isolation from larger forest fragments on the landscape. Remaining natural forest: 68%. Nearest reserve: Longdenville, Todds Rd North and Todds Road South Forest Reserves.
Manzanilla	3116	1955		Reserve fragmented due to agriculture; three large fragments remain. Northern fragment almost isolated from rest of reserve. Remaining natural forest: 62%. Nearest reserve: Matura, Melajo, Valencia, Long Stretch, Brigand Hill and Central Range Forest Reserves.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Matura	12893	1923	Lower montane and crappo-mora and crappo-debasse forest formations, and the Antillean and stable relict fish fauna.	South western end of reserve has significant squatting. Rest of reserve in comparatively good shape. Remaining natural forest: 97%. Nearest reserve: St. David, Valencia, Melajo and Manzanilla Windbelt Forest Reserves.
Melajo	2203	1954		Reserve highly fragmented due to quarrying and squatting for housing and agriculture. Remaining natural forest: 65%. Nearest reserve: Matura ESA, Manzanilla Windbelt Reserve, Valencia Wildlife Sanctuary and Long Stretch Reserve.
Morne L'Enfant	3693			Tiny parcels, average size 10 ha. High graded and severe fire damage. Remaining natural forest: 62%. Nearest reserve: Contiguous with Erin on south and Cap de Ville on west.
Nariva Windbelt	2508	1953		Most damage on southern boundary. Most squatting on northeast and around western side of reserve close to the wildlife sanctuary. Remaining natural forest: 95%. Nearest Reserves VMR, Ecclesville, Central Range and Brigand Hill Forest Reserves.
Northern Range C	96		Lower montane forest formations.	Forest mostly intact. Some loss around access trails but negligible. Remaining natural forest: 99**%.** Nearest reserve: Northern Range B, Northern Range A, Las Cuevas and Tacarigua Forest Reserves.
Paria	741			Forest in great condition. A few minor gaps from hunters/squatting. Remaining natural forest: 100%. Nearest reserve: Blanchisseuse and St. David Forest Reserves.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Rochard Douglas	1885	1942		Forest fragmented into four large fragments. Remainder in squatting or teak. Remaining natural forest: 39%. Nearest reserve: Contiguous with Rochard Douglas; VMR.
San Pedro	199	1943		Most damaged reserve to date. Mostly teak cover, where any is present. Remaining natural forest: 7%. Nearest reserve: Central Range and VMR.
Siparia	385	1928	Lowland dry habitats.	Central part of reserve relatively intact. High degree of fragmentation for such a small reserve. Remaining natural forest: 71%. Nearest reserve: Godineau, Erin and Southern Watershed Forest Reserves.
Southern Watershed	9924	1931	Last best representations of accurel/mousara forest associations in the south.	Natural forest on western side of reserve is greatly threatened by small scale squatting. Central part of reserve dominated by teak. Clear fire damage affecting forest stature. Remaining natural forest: 51%. Contiguous with Rochard Douglas and nearest reserves VMR, Siparia and Erin Forest Reserves.
Tacarigua	770	1959		Southern 1/3 of reserve severely damaged by fire. North-eastern quadrant covered in mature pine. Reserve almost completely isolated by anthropogenic development on 3 sides. Central portion of reserve in good shape. Remaining natural forest: 96%. Nearest reserve: Arima, Northern Range A, Northern Range B, Northern Range C, Yara, Blanchisseuse and Las Cuevas.
Todds Road North	182	1929		One large fragment on eastern side degraded. Remaining natural forest: 90%. Nearest reserve: Todds Rd South, Mc Nair and Tumpuna Forest Reserves.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 2017*
Todds Road South	87	1929		One large northern fragment. Lots of balizier and bamboo present evidence of fires and marijuana. Remaining natural forest: 83%. Nearest reserve: Todds Rd North, McNair and Tumpuna Forest Reserves.
Tumpuna	2195			Clear felling and plantation forestry at this site. 1/3 of site under pine plantation. Plantation not mapped in this assessment. Remaining natural forest: 87%. Nearest reserve: Arena and Central Range Forest Reserve.
Valencia	2785	1958	Prime example of crappo-guatacare, and habitat for wildlife.	Heavily fragmented due to quarrying, and squatting for housing and agriculture. Remaining natural forest: 27%. Nearest reserve: Aripo ESA.
Victoria Mayaro	52427	1954		Lots of boundary errors associated with state land parcels of varying shapes not properly designated as FR. Several random forest inholdings, by private citizens in site. Increasing forest lost on western side of reserve. Remaining natural forest: 94%. Nearest reserve: Rochard Douglas and Eclesville Forest Reserve.
Yara	641			Forest in good shape, some squatting but not clear purpose. Remaining natural forest: 99%. Nearest reserve: Blanchisseuse, Las Cuevas, Northern Range A, Northern Range B and Northern Range B Forest Reserves.

* This information was not included in the 1980 plan, thus condition and recommendations at 1980 are not presented.

Table 6. Status of Environmentally Sensitive Areas in Trinidad.

PNA Name	Area (ha)	Establishment Date	Outstanding Features	Condition at 2017*
Aripo	1792	2007	Largest remaining natural savanna ecosystem on Trinidad, as well as an important remnant of the palm marsh and marsh forest.	A lot of degradation along the northern tip and western boundary of the reserve. Deforestation on the Valencia has now cut off the eastern side of reserve. Remaining natural forest: 74%. Nearest reserve: Valencia WLS, Long Stretch and Arena Forest Reserves.
Matura	9001	2004	Crappo-Debasse association Forest and Serrette–Bois Gris association.	Central forest in very good shape. Most degradation around main access trail at south of ESA and forest trails in Grande Riviere and Matelot. Some high grading in north-eastern 1/8th. Remaining natural forest: 99%. Embedded in St David and Matura forest reserves. Nearest reserve: Manzanilla Windbelt and Melajo Forest Reserves.
Nariva	11343	2002	Crappo-carrat, Crappo-blackheart, evergreen herbaceous swamp and palm marsh forest communities. Largest intact freshwater marsh ecosystem in the country.	Squatting on eastern and northern boundaries of ESA. Squatting in Wildlife Sanctuary. Remaining natural forest: 43%. Nearest reserve: Ecclesville 480m, Embedded in Nariva Windbelt, VMR 4.5km, Central Range 1.3km, Brigand hill 540m, Manzanilla Windbelt 2.8km.

*Since ESAs were established post the 1980s plan, the condition and recommendations at 1980 are not presented.

Table 7. Status of Coastal Prohibited Areas in Trinidad

Name	Length (km)	Establishment Date	Outstanding natural features	Condition in 2017
Matura	8.85	1990	Habitat for nesting leatherback turtles	Beach remains in good condition. Threats from coastal development, beach alterations and waste disposal.
Fishing Pond	10.46	1990	Habitat for nesting leatherback turtles	Beach remains in good condition. Threats from coastal development, beach alterations and waste disposal.
Grande Riviere	1.5	1997	Habitat for nesting leatherback turtles	Beach remains in good condition. Threats from coastal development, beach alterations, waste disposal, and artificial light pollution.

Table 8. Status of Nature Reserves in Trinidad.

Name	Area (ha) 1980	Outstanding natural features	Condition in 1980	Recommendations in 1980	Condition in 2017
Blue Basin	0.8	Mountain pool and waterfall	Present squatting and agricultural activities within the catchment area affecting the quality of the area and heavy, uncontrolled use is causing degradation of the site.	Areas should be greatly expanded to include the whole of the watershed and the immediate coastlands and be managed as a Natural Landmark.	This site was proposed in 1980 as part of a larger National Landmark but was never declared. Most of southern 3rd of proposed reserve (1162ha) degraded by agricultural squatting. Remaining natural forest: 73%. Nearest reserve: Northern Range B Forest Reserve and Chaguaramas NP.
Brickfield No. 1	31	Typical example of the crappo-guatecare-carat forest type	Relatively undisturbed except for fire damage on outer edges.	Area should be managed as a Forest Reserve.	This area is already part of the declared Central Range Forest Reserve. 26ha remains intact but surrounded by teak plantation and ribbon development.
Brickfield No. 2	26	Secondary evergreen seasonal forest	Area damaged regularly by fires	Area should be managed as a Forest Reserve, however special consideration should be given to the native flora and fauna of the area.	This area is already part of the declared Central Range Forest Reserve. Small isolated degraded fragment surrounding by teak plantation forestry and becoming encroached by agricultural squatting towards west of reserve.

Name	Area (ha) 1980	Outstanding natural features	Condition in 1980	Recommendations in 1980	Condition in 2017
Brickfield No. 3	9	Typical example of a crappo-guatecare-carat forest type	No special disturbance	Area should be managed as a Forest Reserve, however special consideration should be given to the native flora and fauna of the area.	This area is already part of the declared Central Range Forest Reserve. Still forested at the area, but encroached by agricultural squatting towards north and south of reserve.
Long Stretch	17	Typical example of marsh forest	Areas relatively undisturbed	Area should be maintained as a part of the Aripo Savannas Scientific Reserve.	This area is already part of the declared Long Stretch Reserve. Less than 1.5ha natural forest remains. Entire area degraded by squatting.
Mahagual	93	Typical example of an acurel-moussara-jiggerwood forest type	Area damaged regularly by fire and teak plantation occupies a small portion of the nature reserve.	Area should be expanded and managed as part of a larger Nature Conservation Reserve.	This area is already part of the declared Southern Watershed Forest Reserve. Still under natural vegetation but surrounded by teak plantation on all sides. Visibly affected by annual fires.
Melajo	143	Typical example of Mora forest on flat terrain	A large portion of the area destroyed by fire.	Area should be expanded and managed as part of a larger Nature Conservation Reserve.	This area is already part of the declared Melajo Forest Reserve. Less than 40ha of natural vegetation remains. Degraded due to quarrying and agricultural squatting.
Morne Diablo	162	Typical example of an acurel-moussara-jiggerwood forest type	The forest has been exploited but not depleted significantly.	Area should be expanded and managed as part of a larger Nature Conservation Reserve.	This area is already part of the declared Southern Watershed Forest Reserve. More than 50% transformed into teak plantation and agricultural squatting to northern 1/3.

Name	Area (ha) 1980	Outstanding natural features	Condition in 1980	Recommendations in 1980	Condition in 2017
Mt. Harris	18	Typical example of a crappo-fineleaf-cocorite forest type	Area relatively undisturbed.	Area should be managed as part of a Scenic Landscape.	This area is already part of the declared Central Range Forest Reserve. Ribbon development along the western edge of reserve.
Rochard Douglas	21	Typical example of a purpleheart-bois lissette forest type	No special disturbance.	Area should be managed as a Forest Reserve.	This area is already part of the declared Rochard Douglas Forest Reserve. Encroached on all sides by teak plantation and degraded by fire. Agricultural squatting in northern half of reserve.
Tamana Hill	132	Highest point in the surrounding area with two natural caves with large populations of bats	Forest exploited to some extent.	Area should be managed as a Natural Landmark.	This area is already part of the declared Central Range Forest Reserve. Intact, apart from one section of squatting in the central area.

*Table uses conditions at 1980 from Thelen and Faizool (1980) and follows their format, with condition at 2017 added for this plan.

3.6.2. TOBAGO

In Tobago there are two wildlife sanctuaries established under the Conservation of Wildlife Act (Chap. 67:01), Little Tobago and St. Giles Island. These represent the only wildlife sanctuaries around Tobago; there are no areas on the main island of Tobago established as wildlife sanctuaries. These offshore islands are among the most important seabird breeding locations in the country (Lowrie et al. 2013) and in the case of Little Tobago, an important ecotourism site. It should be noted that these island wildlife sanctuaries, and Little Tobago in particular, have been recorded as having important remnant and relatively intact dry forest ecosystems on them (Oatham & Boodram 2006a). Such dry forest ecosystems have been very poorly represented in the protected area systems of the southern Caribbean (Oatham & Boodram 2006b), and in this regard, represent an important component of the NPASP. Their insular nature means that there is limited access to these wildlife sanctuaries, and as a result, they have suffered less from the drivers of degradation found on mainland PNAs, such as anthropogenic fire and physical development. However, illegal harvesting of birds and eggs remains a significant threat to these islands' fauna.

On the main island of Tobago, there is one 4,000 ha Forest Reserve, the Main Ridge Forest Reserve. This PNA is the oldest reserved forest in the Western Hemisphere, having been established by royal decree in 1765. In 2007, the Main Ridge Forest Reserve was proposed as an ESA, but to date this decision has not resulted in the formal designation of this site. It is also a tentative UNESCO World Heritage Site (UNESCO 2017). Currently, unlike many of the forest reserves on Trinidad, there is no production forestry being undertaken in the Main Ridge Forest Reserve. With its management primarily for watershed protection and for ecotourism, the site already functions as a de facto National Park. A reflection of this status is that the Main Ridge Forest Reserve is one of the most important terrestrial locations on Tobago for ecotourism, with its Gilpin Trail being a key ecotourist attraction. Its location at the headwaters of the Goldsborough River also makes it a critical PNA in terms of its provision of surface and ground water recharge on the island. Finally, this Forest Reserve is an important habitat for several endemic species native to Tobago, including plants such as *Duguetia tobagensis,* and vertebrates such as the Bloody Bay Poison frog *Mannophryne olmonae* and Ocellated Gecko, *Gonatodes ocellatus*.

Despite being damaged by hurricane Flora in 1963, the Main Ridge Forest Reserve retains some of the best examples of lower montane rainforest and xerophytic rain-forest on Tobago. Consistent with its large size, it suffers from relatively little fragmentation and natural forest cover in this reserve is estimated to be over 90%. The interior of northern Tobago currently has comparatively low development pressure from agriculture, housing and tourism, thus this reserve has not suffered

the disturbance more prevalent in southern Tobago or in the terrestrial PNAs on its sister island of Trinidad.

Tobago also hosts the country's only formally protected marine area, the Buccoo Reef Marine Preservation Area. Established under the Marine Preservation and Enhancement Act (Chap 37:02), the Buccoo Reef was also proposed as an ESA in 2004, but was never declared due to boundary uncertainties. This coral reef system is one of the most heavily visited marine recreation sites in Tobago and while this brings in important revenue for local communities (Burke et al. 2008), it also presents a challenge due to the negative impacts of this high volume of tourists on this reef system. Despite its protection, like many coral reefs globally, it is under severe threat from nearshore pollution, coastal development and importantly from climate change (IMA 2016). Recent estimates indicate that this reef is severely stressed and its live coral now reduced to 19% (Jackson et al. 2014). Notably, recent studies have indicated that coral in Buccoo Reef may be more resilient to coral bleaching events than those in the north of the island (Alemu & Clement 2014).

Table 9. Status of Wildlife Sanctuaries in Tobago*.

PNA Name	Area (ha) 1980	Establishment Date	Outstanding Features	Condition at 1980	Condition at 2017
Little Tobago	101	1928	Bird habitat and location of Bird of Paradise	Little habitat disturbance due to introduced spp. and substantial hunting.	Relatively intact and a good representation of dry forest community, minimal disturbance mostly due to introduced species. Remaining natural forest: >95%. Nearest reserve: no marine protected area within 10km.
St. Giles Island	29	1968	Habitat for seabirds	undisturbed	Threats to the site remain as at 1980. Scrubby vegetation intact. Nearest reserve: no marine protected area within 10km.

*Table is reproduced from Thelen and Faizool (1980), with condition at 2017 added for this plan.

Table 10. Status of Forest Reserves in Tobago.

PNA Name	Area (ha)	Establishment Date	Outstanding Features	Condition at 2017
Main Ridge	4000	1765	Oldest forest reserve in the western hemisphere. *Byrsonima spicata- Licania biglandulosa* forest association, *Manilkara bidentata- Guettarda scabra* forest association and *Carapa guianensis - Andira inermis* forest association.	Forest in good condition, with minimal disturbance. Remaining natural forest: unable to be estimated from remote sensing imagery due to cloud cover. Nearest reserves: No terrestrial protected area within 10km.

Table 11. Status of Marine Protected Areas in Tobago.

PNA Name	**Area (ha)**	**Establishment Date**	**Outstanding Features**	**Condition at 2017**
Buccoo	700	1973	Only MPA in the country. Largest coral reef system in country; coastal mangroves, lagoons, seagrass beds, reef flats, fore-reefs and back-reefs.	Coral cover 19% (2012). Threats from coral bleaching events, land-based pollution, coastal development, tourism.

4. DESIGNING THE NATIONAL PROTECTED AREAS SYSTEM – THE APPROACH.

4.1.NATIONAL POLICY DIRECTIVES

The NPASP explicitly uses the objectives of the country's overarching national policies, as the foundational objectives for the system. These policy documents provide a clear roadmap for the management of the living resources of the country, and articulates a value system by which the government and people of the country would assess its development options. This is important, as the development of the protected areas system explicitly calls for the country to make choices about which elements of its natural endowment are to be set aside, utilised and sustainably managed. The most important policy documents in this regard include the National Environmental Policy (NEP), the Protected Areas Policy, the National Forest Policy and the National Wildlife Policy.

The NEP sets the goals for the country that are relevant to the development of the NPASP, which:

- Conserve the vitality and diversity of the natural environment through the conservation of ecological systems and the biodiversity within;
- Empower stakeholders, including communities, to care for their own environments by providing opportunities to share in managing their local resources and the right to participate in decision-making

The NEP further indicates that development, should not be at the expense of other groups, nor threaten the existence of other species. It also commits the country to an environmental justice ethic, which demands that the benefits and costs of resource use and environmental conservation should be shared fairly and equitably among different communities and between current and future generations. It directs that communities should be given an opportunity to share in managing their local resources and the right to participate in decisions, through co-management of natural resources.

Finally, a critical value articulated by the NEP is the Precautionary Principle. This principle commits the Government to a policy principle, that if there are threats of serious irreversible environmental damage, lack of full scientific certainty will not be used as a reason for postponing measures to prevent environmental degradation. In this context the NPASP, provides a clear demonstration of the national commitment to this principle, by ensuring that the living resources of the country are protected in a manner that ensures their conservation into perpetuity.

At the sub-sectoral level, The National Protected Areas Policy (NPAP) provides the main policy framework for the NPASP. It not only identifies the main goals of the PNAs (e.g. protection of biodiversity, promotion of international cooperation, provision of ecosystem services, building climate resilience and meeting international conservation obligations), but it also importantly adopts the creation of the NPASP as a critical management goal for the country. The National Forest Policy (NFP) also commits the country to specific targets for terrestrial ecosystem conservation, for example, it commits the country to development of a national forest system plan, for all forests on State and private lands and specifically articulates the need for a protected areas system that ensures conservation of critical habitats including ecological corridors and buffer areas. It also commits the country to conservation of diversity in all its forms in the forests, as well as ecological monitoring and protection of these forest ecosystems and their management for sustainable use and livelihoods.

Finally, the National Wildlife Policy (NWP) specifically articulates that it was formulated in a manner that require that it, the NFP and the NPAP, be considered an integrated system of policies. These three policies articulate 15-16 principles and values which broadly overlap and place an emphasis on ecosystem management, the precautionary principle, sustainable use, conservation of biodiversity in all its forms, integration of ecosystem goods and services in the management of these resources, and community participation in the management process.

These policy documents provide the fundamental framework for establishment of the design and establishment of the NPASP. All four policies discussed here stress the need for adopting a precautionary approach in management, and highlight that the conservation of the biodiversity of the country is a national priority.

4.2.UNITS OF THE PROTECTED NATURAL AREAS SYSTEM

Successive attempts to design and designate PNAs in Trinidad and Tobago have reflected the evolution of thinking at the global level, about the way such areas are defined and managed. Here, the evolution of the IUCN criteria for protected area categories is relevant, as this framework has since the late 1970s, been the global standard against which PNAs for conservation have been assessed (Dudley 2008; Stolton et al. 2013). In this regard, it should be noted that the NPASP explicitly uses the current IUCN guidelines (Dudley 2008; Stolton et al. 2013) for designation of the PNAs, and uses the term protected natural area throughout to mean “protected area” (Box 1).

In the designation of units within the NPASP, we follow the National Protected Areas Policy (2011) in assigning proposed areas to the seven classes proposed by this policy. Recognizing that at the national level in Trinidad and Tobago, the Government has adopted specific nomenclature for the various PNAs within the national jurisdiction (GORTT 2011), we provide a comparison of both systems to illustrate where there is congruence between the national and IUCN designations (Table 12).

Table 12. National Protected Areas Categories in Trinidad and Tobago and the IUCN equivalents

National Protected Areas Policy Categories	IUCN Protected Area Categories System (2008)	Description
Scientific Reserve	Ia Strict Nature Reserve	Largely intact ecosystem, free from significant direct intervention and capable of achieving conservation objectives with little intervention.
Special Conservation Reserves	Ib Wilderness Area	High degree of intactness and large enough to protect ecological processes, free from excessive human use.
National Park	II National Park	Representative examples of major environmental features, to a great degree in a natural state or with potential for restoration, sufficient in size to maintain ecological function with minimal intervention.
Natural Landmarks	III Natural Monument or Feature	Natural geological, geo-morphological and cultural features, with associated important biodiversity.
Habitat or Species Management Reserve	IV Habitat/Species Management Area	Harbour a particular target species, usually under threat, and/or habitats often fragments of ecosystems suitable for restoration.
Protected landscape/seascape	V Protected Landscape/Seascape	Distinct scenic quality with associated habitat, a balanced interaction between people and nature, potential for ecological restoration.
Sustainable Use Reserve	VI Protected area with sustainable use of natural resources	Large, with parts of area in natural condition, under sustainable management or extractive use, compatible with nature conservation and managed responsibly.

We note that although the nomenclature of the NPAP does not follow the IUCN system of protected areas verbatim (Dudley 2008), it does follow this system broadly. Thus, in terms of the characteristics and objectives of the seven categories in the national system, they are equivalent to the IUCN system. Under this classification system, Scientific Reserves are considered the highest level of protection under the system and the least human intervention, with the PNAs designated as Sustainable Use Reserves being those areas where extractive use of biodiversity and other resources may take place, in a manner that does not compromise the biodiversity at these sites.

4.3.TECHNICAL DESIGN CRITERIA

The development of any PNAs system should take into consideration the biological, socio-cultural and economic environment within which these PNAs will exist, and "future-proof" these areas, where possible, to ensure that irreplaceable biological, pedological and geological entities, patterns and processes are not lost. Trinidad and Tobago's existing PNAs (i.e. its forest reserves, wildlife sanctuaries, and marine protected areas) provide an important starting point on which to build a resilient system, as many remain important reservoirs of biodiversity and geodiversity. In addition, previous attempts to design protected areas for the country have provided baselines for the identification of sites that would ensure representation of the range of the important and unique biological and geomorphological systems, present on the islands.

This new NPASP uses these foundations to build the list of proposed protected areas that are consistent with the internationally recognized IUCN Protected Areas classification system. The use of the IUCN system was explicitly adopted in the National Protected Areas Policy (2011), and the new plan follows through with this commitment. It is underpinned by the best available scientific knowledge and methods available at the time of writing. The existing and previously designated PNAs were assessed using a gap analysis of terrestrial, freshwater and marine ecosystems. These PNAs were measured against the following design characteristics, to determine their ability to ensure long-term conservation of biodiversity:

1. Representation – the PNAs should conserve all the species, ecosystems, geomorphological and pedological, elements, patterns and processes in the country.

2. Resiliency – each of the PNAs and the system as a whole, should protect elements, patterns and processes known to sustain the system. This approach examines a PNA's size, shape, and connectivity with other areas, and its ability to maintain viable populations. Currently understood long-term patterns and processes of disturbance and recovery are explicitly considered in the design.

3. Redundancy – the new PNAs system should, where possible, ensure that sufficient redundancy exists among the PNAs to ensure that if a catastrophic natural or anthropogenic disturbance occurs in any single PNA, that none of the species, ecosystems, geomorphological and pedological, elements, patterns and processes in the system, will be lost.

4. Realism – The design, designation, and management of the proposed natural areas should also reflect the economic, socio-cultural and technical-capacity realities of the country. In this context, the planning and design team explicitly acknowledge the realities within which the new PNAs system must be managed. For example, the designation of PNAs boundaries, their integration of private lands, the levels of complexity of proposed management systems, and the realized- and opportunity-cost implicit in these PNA designations, all form part of this realism design-element.

To ensure the integration of these four design- "Rs" in the NPASP, the design team took the following approaches to utilising these design elements in the selection and assessment of the potential of each unit in the NPAP, to contribute to the overall goals of the system:

4.3.1. REPRESENTATION – BIOLOGICAL, GEOLOGICAL AND SOCIO-ECONOMIC

To ensure the system of existing and proposed reserves in the new NPASP contain elements of most of the species, ecosystems and genetic diversity in the country, we used GIS-based remote sensing and current GIS data on local biodiversity hot-spots, geology, pedology, benthic, and climatic patterns to conduct a gap analysis. Our examination of species-level diversity included the use of stacked species distribution modes, and an explanation of our methodology is provided at Appendix I. The gap analysis also included current published information on patterns of endemism, and ecological community distribution for terrestrial, freshwater and marine systems, where such data was available. This allowed identification of important locations that have not been previously identified by earlier plans, for national-level biodiversity protection. The gap analysis included all the areas already identified in the 1980 Systems Plan (Thelen & Faizool 1980) as well as the three other previous attempts to define protected areas for the country (NECC 1973; Tyler 1999). It also used updated remote sensing data to determine their current status, with specific attention to degrees of deforestation and other signs of degradation since they were first identified/designated as protected areas. In the gap analysis, we used digital copies of the latest geology and pedology of Trinidad and Tobago to ensure that important geological and soil classes were included in the NPASP.

We used a literature review to understand current reported and developing patterns of use of biodiversity by local communities, and so use this information to understand which areas were considered important by these communities. We also used public consultation and stakeholders focus groups to help identify areas considered by these users/local experts as important priorities for PNA listing.

4.3.2. REDUNDANCY –

There will be several unique areas and species that are protected in the new PNAs system, and which by definition, will have no duplicate. However, where feasible, the new system places a premium on ensuring that PNAs within the new system serve as duplicates of the species, ecosystems and processes protected elsewhere in the system. This is important given the expectation that long-term climatic changes will see increased disturbance from drought, anthropogenic forest fire, sea level rise and storm/hurricane damage (Taylor et al. 2007; Cashman et al. 2009; Scott et al. 2012; Karmalkar et al. 2013). Any one of such disturbances could be catastrophic to a single reserve in the NPASP.

The strategy in the design of the new PNAs system will be to identify a minimum target of three PNAs within the PNAs system that represent the same ecological community, and so provide this ecological redundancy. Importantly, even in 1980, Thelen and Faizool report that in their assessment of the remaining representation of the forest communities of the country, that of the 26-natural forest "fasciations" (Beard 1944; Beard 1946) at least five of these were not represented adequately in their system. Noting that there have been significant changes and continued degradation in the remaining natural areas since their report (Toppin-Allahar 1991; e.g. see GORTT 2010), we acknowledge that this redundancy goal will be "aspirational" given the constraints of the remaining natural areas.

4.3.3. RESILIENCY –

Climate change, over harvesting, alien invasive species, rapid urbanization, unplanned development (e.g. squatting) and agricultural intensification have been, and will for the foreseeable future, remain key threats to the PNAs system. This will include an integration of current understanding of threat levels and known vulnerabilities of assessed biological entities in the country. Ensuring the resiliency of the PNAs in the new system will require the selection of the location, shape and importantly, connectivity of the PNAs be explicitly planned in their design. This will reduce the degree of edge-effect, improve edge-to-interior ratios, and ensure that meta-populations of wildlife and plants in these ecosystems are able to move across the landscape in response to climate change, and recolonize disturbed areas or places where disease or over exploitation have led to local loss of these animals and plants.

In this regard, a key element of the design of the new PNAs will be on the use of riverine corridors of trees between 50-250m wide to ensure connectivity (as much as possible) between PNAs in the new

system. Relatedly, we also explicitly considered the opportunity for trans-boundary protected areas in the marine realm, when designing the deep sea marine areas. We also undertook the use of umbrella species population viability analyses (PVA) to model the response of these vertebrate species to various level of connectivity, size and location of the PNAs in the system. The details of the methodology are reported at Appendix I.

4.3.4. REALISM

The authors recognize that the current NPASP represents the third attempt in the past three decades to re-design of the country's PNA system. These previous plans were never implemented. Recognizing that the design of the NPASP is only truly effective if the plan leads to the actual designation of a revised PNA system, we explicitly address this issue in our design considerations. Arguably, the key issue affecting the establishment of the PNAs system is the decision of the fate of the management agency. While we are unable to directly address this issue here, we note that the establishment of the PNAs also requires consideration of other social issues such as patterns of human ownership, development and traditional use patterns in and around the proposed PNAs system.

To design the NPASP, GIS/spatial modelling of current trends in urbanization and land-ownership patterns were used to identify locations for the PNAs that reduced the potential for conflict. It is important to recognize that on small islands like Trinidad and Tobago, the designation of PNAs inevitably mean opportunity costs for local communities.

One consideration in the design of the PNAs was the use of zoning (e.g. consistent with the Man and the Biosphere zoned use pattern) within and around the new PNAs, to buffer the potential anthropogenic impacts. This approach was also an important consideration for the design of corridors to ensure PA connectivity. An important element in the design will be to explicitly account for the ability of human populations to have appropriate access to natural areas, and this criterion will be used to add to the system, even where minimum targets for ecological redundancy have been met.

In this regard, the new PNAs will, where possible, explicitly take into account issues of traditional use, access and uniqueness, to assign each of the new PNAs to a relevant protection class that reflects the intentions of the National Protected Areas Policy (2011) and which uses the IUCN Protected Areas classification system as a guiding framework.

4.3.4.1. ECOSYSTEM MANAGEMENT

PNAs in the new system were designed to be as realistic as possible in their assumptions about short/medium term human disturbance. This requires incorporating a landscape-scale approach to planning and zoning of the PNAs system, which explicitly recognizes that managing these areas will require a holistic ecosystem-level approach to conservation. This means explicitly accounting for current land ownership, development patterns, trends in consumptive and non-consumptive use and future known drivers (e.g. climate change), and political practicality. In this regard, we focus on the lessons of ecosystem management paradigm in our recommendation for the management of the PNAs in the system (Section 6 of this NPASP). Finally, given the emphasis placed by the enabling policy framework on stakeholder consultation and engagement in management of the PNAs, we focus on the role of local communities and non-State actors in site-level management of the PNAs where this is possible and desirable.

5. RECOMMENDATIONS FOR THE 2018 NATIONAL PARKS/PROTECTED AREAS SYSTEM

The review of the status and distribution of the current legally established PNAs suggests that under the existing system, there are important ecosystem types that were not adequately protected through the network of Wildlife Sanctuaries, Forest Reserves or ESAs, in Trinidad and Tobago. The NPASP makes broadening the representation of the country's biodiversity within the PNAs, a priority. Maintaining this terrestrial, freshwater and marine biodiversity requires that these PNAs are demographically and functionally connected, and able to cope with natural disturbances such as storms, drought, landslides, flooding etc.

To address the issue of representation within the marine realm, for example, the new NPASP proposes four Open-Ocean Waters and Deep-Sea (OOWDS) PNAs in Trinidad and Tobago. This represents the first time that such ecosystems have been added to the country's PNA system. The NPASP also builds on national conservation experience and incorporates new priorities in the coastal zone by increasing the number of seasonally-protected turtle nesting beaches from three (Matura, Grande Riviere and Fishing Pond) to a total of nine on Trinidad and seven seasonally-protected beaches on Tobago.

Similarly, the historical design of the island's previous terrestrial PNAs while in several cases protecting important upper watersheds of both islands, did not adequately cover the middle and lower parts of many watersheds. Specifically, they were not designated to protect freshwater diversity in watersheds such as the South Oropouche, the Maraval, and Santa Cruz. As a result, in these watersheds, gradual alienation of public lands has led to the removal of the natural cover and change in the water quality and as a consequence, dramatically reduced the opportunity for new PNAs establishment in these areas. Currently, most watersheds on Trinidad which lie south of the Caroni and west of the Ortoire watersheds, have received little or no protection. In Tobago, aside from those headwaters protected by the Main Ridge, few watersheds have received formal protection (e.g. the Sandy River and Courland River watersheds) to allow conservation of their freshwater biodiversity. This remains a significant constraint for the NPASP, as the lack of State land for designation severely limits the current opportunities for conflict-free designation of new PNAs, to cover these ecosystems. In this regard, the development of a framework for conservation agreements/easements with private landowners to encourage conservation in these mid- and lower-watershed areas must be a core strategy to conserve these systems. Recommendations for some initial approaches to address this conservation gap are introduced at Section 6 of this NPASP.

In terms of the biogeography of the freshwater ecosystems on Trinidad, while the existing reserve system provides some protection for all Kenny's (1995) biogeographic zones, in several cases this representation is inadequate to maintain the processes that underlie these biogeographic patterns. To this end, the NPASP adds three new PNAs in the colonising biogeographic zone (Chatham SMR, Coromandel HMR and Los Blanquizales SMR) identified by (Kenny 1995), to support the processes that maintain this biogeographic zone.

In the terrestrial ecosystems across both islands, the previous forest reserve and wildlife sanctuary system allowed for conservation of a diverse range of terrestrial forest ecosystems on Trinidad (with a few glaring exceptions e.g. El Cerro del Aripo and the cloud forest ecosystems therein). However, the intervening half century since their designation has seen a rapid transformation of many of these reserves (see Section 3 of this report), and in some cases, the loss of the forest communities at these sites represent irreplaceable losses (e.g. the edaphic marsh forests of the former Valencia Wildlife Sanctuary are now practically lost from the PNA system). In the case of Tobago, despite the history of the establishment of the Main Ridge as a reserve, that reserve remains the only terrestrial PNA on the main island of Tobago. In this regard, other terrestrial ecosystems on Tobago (e.g. lowland forest communities, coastal mangrove and seasonal forests) have remained inadequately represented in the national PNAs system. To address these gaps in the existing terrestrial PNAs, several new terrestrial areas have been identified for both Tobago and Trinidad.

In the case of Tobago, with new areas proposed in Tobago at Lowlands and Kilgwyn for instance, to include lowland karstic formations identified as important ecosystems requiring protection (Day & Chenoweth 2004), and further PNAs at Starwood, Merchiston and the Goldsborough watershed to protect other lowland forest ecosystems. In Trinidad, the formal inclusion of the forest areas in Chaguaramas and certain islands within the Bocas (e.g. Chacachacare and the northern half of Huevos Islands) within the NPASP allows for improved representation of the dry forest ecosystems, which have been identified as a regionally important forest community requiring improved protection (Oatham & Boodram 2006b; Nelson et al. 2018).

In the almost 40 years since the drafting of the last systems plan (Thelen and Faizool 1980), our understanding of the patterns of distribution of biodiversity in the various ecosystems across the islands, has been rapidly improving (Devenish et al. 2007; Murphy & Downie 2012; e.g. Alemu 2014; Auguste et al. 2015; Mohammed et al. 2015; White et al. 2015; Baksh-Comeau et al. 2016; Amon et al. 2017). These studies provide a body of evidence which highlights the gaps in the coverage and viability of the existing PNAs system. For example, recent studies of plant biodiversity and distribution (Van den Eynden et al. 2008; Baksh-Comeau et al. 2016; Spiers et al. unpublished)

indicate that areas such as the eastern Northern Range provide important habitats for Trinidad's endemic plants, yet have not been adequately protected under the existing Forest and Conservation of Wildlife Acts or ESA rules. In this case, the NPASP proposes new PNAs to protect the Heights of Aripo and Hollis watersheds, where the geology, elevation and precipitation patterns support high levels of species richness, uniqueness and provides refugia for high elevation species and communities.

Similarly, across both islands, many of the existing protected areas are rapidly becoming isolated islands of natural habitats surrounded by a human dominated landscape, in which built-up, ribbon development is making this landscape increasingly impervious to terrestrial wildlife. Here, maintenance of connectivity is a fundamental weakness of the current PNAs system. In particular, the relative isolation between PNAs in the south, central and north of Trinidad represents a significant challenge for the long-term viability of species populations and resiliency for future environmental changes. In this regard, the recommended PNAs in the new systems plan include seven riverine corridors that will serve to encourage dispersal and maintain ecological connectivity between PNAs in the new NPASP. These riverine corridors will also serve to improve watershed functions in the relevant watersheds and improve climate resiliency for the forest communities concerned.

Historically, approximately 1/3 of the wildlife sanctuaries in the country were within the near-coastal islands (Bacon & ffrench 1972), established to protect seabirds. Many of these remain important seabird habitats, and with these birds experiencing globally significant declines due to climate change, oceanic pollution and deliberate and accidental take by humans (Paleczny et al. 2015), these island PNAs are of even greater importance today and should remain an important priority for the NPASP. As a result, Little Tobago and St Giles in Tobago continue to warrant their listing as species conservation reserves, given the large numbers of breeding Red-billed tropicbirds (*Phaethon aethereus*), Brown booby (*Sula leucogaster*) Red-footed booby (*Sula sula*) and Audubon's shearwater (*Puffinus lherminieri*), to name a few species (D. Narang, pers. comm. and Lowrie et al. 2013). Around Trinidad, Saut d'Eau and Soldado Rock remain important nesting sites for Sooty terns (*Onychoprion fuscatus*) and brown pelicans (*Pelecanus occidentalis*), respectively (Nelson and Devenish-Nelson, unpublished data and Lowrie et al. 2013)). The latter is also an important roosting site for magnificent frigate birds (*Fregata magnificens*). In this regard, the NPASP continues to prioritze protection of these near-shore island areas, by expanding the list of these island Species Conservation Reserves, with five islands/island-groups designated around Trinidad and six islands/island-groups designated around Tobago.

One key area in which the current NPASP deviated from the previous systems plan (Thelen and Faizool 1980) is in the designation of Sustainable Use Reserves (SURs). Thelen and Faizool 1980 did not include the 36 forest reserves as unique entities in the previous systems plan, as these were beyond the purview of that plan and managed by the Forestry Division and DNRF under the Forest Act (Chap: 66:01). In the current NPASP, one key objective is to harmonize all the PNAs (including the forest reserves) with the National Protected Areas Policy (GORTT 2011c), and its proposed nomenclature for protected areas. Under the NPAP, the classification "SUR" was adopted to represent sites where multiple use management was the dominant usage of the site (Table 12). This definition broadly meets the current management approach in the forest reserves. In this regard, the NPASP provides a brief assessment of each of the 32 SURs on Trinidad and six SURs on Tobago and makes broad recommendations for their management. In several cases, the NPASP makes changes to the boundaries to the SURs, to make them consistent with the other six classes of protection provided under the NPAP.

In this regard, the designations are made to avoid overlap or multiple designation of the same area. The NPAP identifies the issue of multiple protected designations as a source of management ambiguity, and the current NPASP, tries to rationalize these issues by providing new boundaries across the seven potential classes of protection provided to the PNAs.

5.1.TERRESTRIAL TRINIDAD

The recommended terrestrial areas for the new NPASP provide increased connectivity and coverage of the terrestrial areas in Trinidad and Tobago. The new areas added to the existing system of forest reserves, wildlife sanctuaries and ESAs are represented at Figure 6. Notable here is the addition in the terrestrial parts of Trinidad of the forest areas of Chaguaramas, the inclusion of State lands in the upper Diego Martin valley and along the north coast towards Maracas, as new areas. This inclusion is generally consistent with the 1974 Chaguaramas management plan (GORTT 1974) for the terrestrial part of the north-western peninsula. The addition of new areas between Chaguaramas and El Tucuche is designated to address the need to maintain ecological connectivity between the drier forests of the western peninsula and the eastern parts of the Northern Range. This approach also allows for protection of watershed and other ecosystem services in the valleys west of Maracas, which have not previously been formally protected.

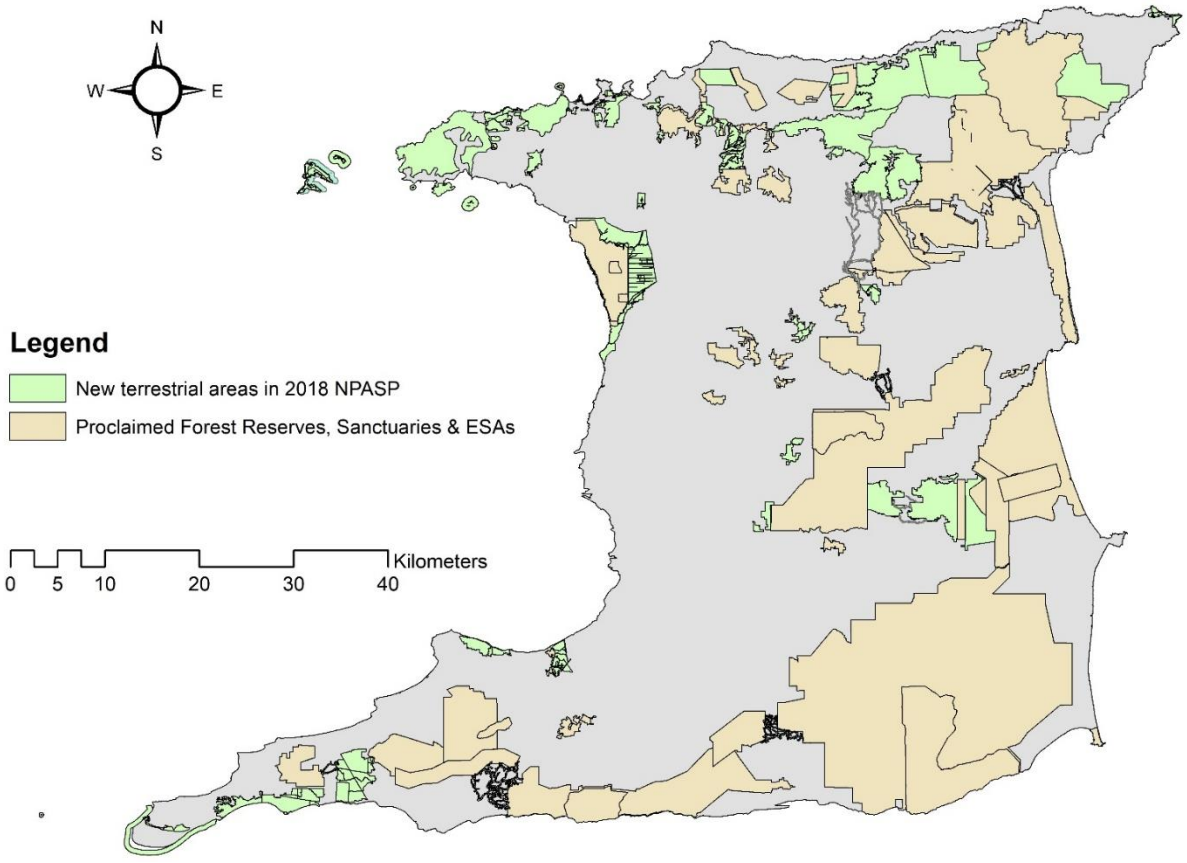


Figure 6. Proposed additional Terrestrial PNAs for Trinidad and the current Forest Reserves, Wildlife Sanctuaries and ESAs.

Another key feature of the additions made to the PNAs on Trinidad include the designation of the forests in the Madamas river valley as a Scientific Reserve. This is the highest level of protection afforded under the NPAP and is only afforded to this one site on the island. This designation was undertaken because at this time Madamas currently supports the remotest and least disturbed forest ecosystems in the country (Devenish et al. 2007). The intention is to protect this area as a representation of the pre-Columbian landscape and ecosystems of the Northern Range.

Another notable feature in the eastern Northern Range is the designation of State lands around Hollis Watershed and along the Heights of Aripo massif as Special Conservation Reserves. The Hollis Watershed area was one of the first areas identified for protection as early as 1972 by the government's first committee on protected areas. However, it was never formally protected. This designation recognizes this recommendation and the value of the site for watershed function and biodiversity conservation. Similarly, the iconic El Cerro del Aripo, the island's highest point, has, until now, not been formally protected. The forests on this landscape host several endemic and rare species and ecosystems (Harding 1995; Baksh-Comeau et al. 2016; Torresdal et al. 2017). Its designation also recognises the importance of these mountainous areas in providing climate resilience for these forest ecosystems in the face of projected climate change.

In the central part of the island, important additions are made to the forests around the former Ecclesville Forest Reserve and Nariva Windbelt Reserve. The new areas here, as well as the proposed extension to the south-eastern part of the Central Range reserve, are recommended to improve the ecological connectivity between the forests of the Nariva Swamp National Park and the Central Range Sustainable Use Reserve.

Along the west coast of the island, the NPASP recommends the expansion of the areas under protection in the Caroni Swamp National Park. In addition, it recommends the designation of Species/Habitat Management Reserves at Rousillac and Godineau (the former representing a new protected area and the latter an expanded version of the previously designated Godineau Forest Reserve). These areas present important sites for conservation of mangrove and adjacent freshwater marsh ecosystems and species, as well as migratory and resident waterfowl (Bacon 1970; Ramsundar 2005; Juman & Ramsewak 2013a).

Finally, in the south-west, the new NPASP establishes new Species/Habitat Management Reserves at Coromandel, Chatham and Los Blanquizales. These new reserves are recommended to protect the ecological patterns described by Kenny (1995), and to compensate for the loss of the forest cover within the former Morne L'Enfant Wildlife Sanctuary, which has become greatly degraded in the past half century.

The NPASP also provides protection to several protected landscapes previously identified by Thelen and Faizool (1980), and which have retained some of the character identified by those authors at the time they were proposed. In addition to these areas, the current NPASP also includes the Paria-Madamas Coastal Trail as one of unique character, deserving of conservation as a Protected Landscape.

Another unique feature of the NPASP is the recommendation to designate important riverine corridors as Species/Habitat Management Reserves. These areas were recommended according to best scientific practice to improve the viability of the reserves that they connect, by improving the opportunity for dispersal of wildlife and plants and to enhance climate resiliency.

In order to fulfil the mandate of the NPASP to provide a comprehensive review of the national protected areas system, the new PNAs designated include all the former forest reserves, wildlife sanctuaries and ESAs and have reassigned them across the new classes of protection adopted by the new national policy on protected areas (GORTT 2011c). The result of this re-designation has meant that on Trinidad, the terrestrial PNAs were assigned to the seven categories as follows: 1 Scientific Reserve, 7 Special Conservation Reserves, 5 National Parks, 6 Natural Landmarks, 32 Habitat or Species Management Reserves, 6 Protected landscape/seascapes and 33 Sustainable Use Reserves.

The following tables 13-22, outline the names of the protected areas in the NPASP, their level of protection, describe their current status, important features and recommended management of these sites (Tables 13-22). Figures 8 to 11 show the recommended system of terrestrial protected areas on Trinidad, with PNAs from the existing system indicated in orange and new PNAs in pink (Figures 8-11). These figures are for illustration only. The exact PNA boundaries will be established by the Commissioner of State Lands as guided by the High-level Ministerial Committee (See section 6.1).

Table 13. Proposed Terrestrial Scientific Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Madamas Forest (19 in Figure 7)	3,582	Proposed in this plan First proposed as a National Park by Thelen & Faizool (1980) Not previously designated in law	Least disturbed forest habitat in eastern Northern Range of Trinidad Undisturbed nature, remoteness, and lack of current access Mammalian diversity and importance for protection of plant species richness	Serrette-bois gris, Crappo-debasse and Crappo-Mora formations Globally critically endangered endemic species (e.g. Trinidad piping-guan *Pipile pipile* (Pawi) Antillean freshwater fish fauna	Hunting, potential for oil/gas exploration, development of road access and related ribbon development	Remoteness and lack of disturbance make this area ideal for highest level of protection under new PNAs system

Table 14. Proposed Terrestrial Special Conservation Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Caura Forest (12 in Figure 7)	547	Proposed in this plan Includes the area previously designated Northern Range Reserve C, and extends to include State lands adjoining previous Northern Range Reserve C	Connectivity between Las Cuevas, Yara and El Tucuche Special Conservation Reserves Forest mostly intact as of 2017 Climate change resiliency for lower elevation forest	Montane formations, Topography Climate refugia	Hunting, agricultural encroachment from nearby villages	Manage Northern Range Reserves A, B & C and use current TCPD land-use policy on development above 700ft, to conserve all State Lands above 700 ft. Manage new SCR, in addition to those below that elevation already in existing reserves (Northern Range A, B & C) as a unit
El Tucuche Forest (8 in Figure 7)	1118	Proposed in this plan Includes Northern Range B as well as 1.35 km^2 extension to north west of current reserve, north-east of Maracas Bay watershed, over ridge to western Quebrada watershed and also includes second 0.5 km^2 extension of	Climate change resiliency for lower elevation forest Relatively undisturbed	Critically endangered golden tree frog Second highest peak in Trinidad Representation of montane forest communities	Climate change, encroachment at lower elevation	Iconic landmark is an ideal candidate for SCR designation under new PNAs system Proposed extensions to NW & SW provide for lower montane community resiliency in response to climate change

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		south-west, into St Joseph watershed				
Heights of Aripo (16 in Figure 7)	2899	Proposed in this plan. Not previously designated in law Links Northern Range Reserve A in west with Madamas SR to north and Hollis Watershed SCR to south	Protects more than half of the country's seasonal montane forests and representative portions of its premontane and montane forest formation Relatively undisturbed Provides connectivity and climate refugia for high elevation ecological communities Watershed protection function for headwaters of Arima, Aripo, Guanapo, Madamas, Paria and Marianne rivers	Country's highest peak, El Cerro del Aripo Critically endangered endemic golden tree frog and Trinidad piping-guan (Pawi) *Pipile pipile*	Climate change, encroachment at lower elevation	Iconic Cerro del Aripo landmark is an ideal candidate for SCR designation under new PNAs system
Hollis Watershed (20 in Figure 7)	2689	Proposed in this plan This area is not previously designated in law The previously proposed Hollis Wildlife Sanctuary was not declared	Watershed protection function for Aripo and Quare rivers Predicted plant biodiversity hotspot Improve ecological connectivity between	Relatively rare seasonal montane forest Large proportion of terrestrial vertebrate diversity	Hunting, agricultural encroachment	Critical function for watershed protection means it is an ideal candidate for designation under new PNAs system

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
			Matura and Heights of Aripo terrestrial ecosystems	Trinidad piping-guan (Pawi) *Pipile pipile*. One of largest artificial water impoundments on island		
Las Cuevas (9 in Figure 7)	230	Proposed in this plan Consistent with previously declared Las Cuevas Forest Reserve	Relatively intact forest cover Vital link between low and high elevation forest ecosystems Protection for Yarra and Quebrada watersheds Climate change resiliency	High elevation forest ecosystems Antillean fish fauna	Climate change, hunting, agricultural encroachment at lower elevations	Designated as SCR to ensure landscape connectivity between Yara SCR and Caura SCR Level of protection reflects existing lack of disturbance, land-capability, topography and value for climate resiliency
San Jose Forest (15 in Figure 7)	321	Proposed in this plan Includes previously designated Northern Range Reserve A	Relatively intact Connectivity between Heights of Aripo SCR and extended Tacarigua SUR Climate change resiliency	Lower montane forest formations Stable relict fish fauna	Hunting, agricultural encroachment	The relatively intact nature at the time of listing was taken into consideration for this designation
Yarra Forest	1208	Proposed in this plan	Relatively intact	Plant and animal diversity	Squatting	Increase ecological connectivity between

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
(11 in Figure 7)		Includes area originally designated as Forest Reserve and 5.6 km^2 extension to west which links this SCR to Las Cuevas SCR	Vital link between low and high elevation forest ecosystems Watershed protection for Yarra and Marianne River watersheds Climate change resiliency	Antillean fish fauna		Yarra SCR and Las Cuevas SCR

Table 15. Proposed Terrestrial National Parks in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Caroni Swamp (1 in Figure 7)	5892	Proposed by this plan First proposed as a National Park by Thelen & Faizool (1980) Includes area formerly designated as Caroni Swamp Forest Reserve and area designated as Caroni Wildlife Sanctuary	Largest intact mangrove ecosystem on western coast of Trinidad Heavily used for recreation and livelihoods	Mangrove ecosystem Nesting colony of Trinidad's national bird, scarlet ibis Coastal protection Nursery for near-shore fisheries in the Gulf of Paria Migratory shore birds Recreational and livelihood utilisation	Agricultural encroachment, hunting, land-based pollution	MAB zoning approach and sustainable management of site to maintain ecological function Rationalise zoning within PNA by making sanctuary areas larger and using MAB zoning approach, to simplify management
Chaguaramas (4 in Figure 7)	4335	Proposed by this plan First proposed as a National Park by Thelen & Faizool (1980) Includes terrestrial area currently designated under Chaguaramas Development Authority Act, which was designated for	Largest representation of dry forest communities on Trinidad Diverse range of current uses and cultural significance	Semi-evergreen seasonal forests Important ecological and cultural landscape (historical use as a naval station during World War II)	Fire, fragmentation, ecological isolation (reserve almost completely isolated from rest of Northern Range), hunting, un-sustainable recreation	MAB approach zoned management for multi-stakeholders utilisation Areas above 700ft contour be managed to recover to natural forest cover (consistent with the national hillside development policy) Lowland areas be managed to protect nationally important

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		management as forest areas under the Chaguaramas Development Plan (1974)		Locally important and threatened species (e.g. red howler monkeys, white fronted capuchins)		species and ecosystems, while permitting sustainable development in peninsula Re-establishing connectivity with eastern Northern Range most important planning issue, next to fire management. Proposed areas mirror proposal for forest areas under CDA management plan of 1974, with the addition of areas around Scotland Bay and the upper watershed of the Cuesa river
Nariva Swamp (15 in Figure 11)	10335	Proposed by this plan First proposed as a National Park by Thelen & Faizool (1980). The area proposed here includes the Cocos Bay Scenic Landscape by Thelen & Faizool (1980). Includes area demarcated as Nariva ESA.	Largest intact freshwater marsh ecosystem in country Landscape connectivity between southern and northern lowland forests	Freshwater marsh and lowland forest ecosystems (crappo-carrat, crappo-blackheart, evergreen herbaceous swamp, and palm marsh forest communities) Locally threatened species (e.g. blue and gold macaw, West Indian	Agricultural squatting, hunting, agricultural fires,	MAB approach zoned management for multi-stakeholders utilisation Manage to ensure connectivity with western, southern and northern forest through riverine corridors

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
			Heavily used for recreation and livelihoods	manatee, red-bellied macaw, red-howler monkey and white-fronted capuchin) Important migratory bird stop-over site Recreational and livelihood utilisation		
Matura Forest (3 in Figure 9)	9,000	Proposed in this plan Includes proposed Matura National Park (Thelen and Faizool 1980) and central part of previously un-demarcated St. David's Forest Reserve, defined by boundaries of Matura Environmentally Sensitive Area	Relatively undisturbed lower montane formations Nationally and globally important vertebrate populations Hotspot for plant species endemism	Seasonal formations, lower montane formations Endemic plant species Antillean and stable relict fish fauna Critically endangered endemic species, the Trinidad piping-guan (Pawi)	Hunting, agricultural encroachment	Connect through new reserves at Heights of Aripo, Madamas and Hollis Maintain connectivity with rest of Northern Range reserves and with Manzanilla Windbelt and Melajo SUR Site should be managed to maintain key ecological function, while providing ecosystem services and recreation

Table 16. Proposed Terrestrial Natural Landmarks or Monuments in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Blue Basin (6 in Figure 7)	1162	Proposed by this plan Identified as a candidate natural landmark by Thelen and Faizool (1980) This site was proposed but not declared	Watershed function Recreational opportunities Maintain connectivity between western Northern Range and the rest of the PNAs system in the Northern Range	Blue Basin pool Important recreational location Important for headwater protection in the Diego Martin and Maraval watersheds	Agricultural squatting, fire, unclear land tenure	Include all State lands around this landmark Site consists of 420 parcels, of which include at least 188 private inholdings Manage to maintain connectivity with Chaguaramas and rest of Northern Range Encourage sympathetic private land management through conservation easements.
Cumberland Hill (3 in Figure 7)	242	Proposed by this plan Identified as a candidate natural landmark by Thelen and Faizool (1980) This site was proposed but not declared	Historic and landscape value Potentially important climate change refugia	Fort George historic site Watershed functions for western Port of Spain	Fire	Manage as a zoned PA for recreation and upland forest connectivity
Devil's Woodyard	1	Proposed by this plan	Geological features	Active mud volcanoes	Agricultural & infrastructural development	Include any State Lands around this geological feature and acquire private land or enter conservation easement

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
(Not on map)		Identified as a candidate natural landmark by Thelen and Faizool (1980) This area is not previously declared				agreement to ensure conservation of this geological feature
Pitch Lake (Not on map)	15	Proposed by this plan Identified as a candidate natural landmark by Thelen and Faizool (1980) This area is not previously declared	Unique geological phenomenon and historical and aesthetic characteristics	Largest natural deposit of asphalt in the world	Asphalt extraction	Maintain for geological importance
San Fernando Hill (Not on map)	15	Proposed by this plan Identified as a candidate natural landmark by Thelen and Faizool (1980) This area is not previously declared	Prominent landscape feature Important recreational site	Prominent land feature and national icon Important recreational site at the heart of the city of San Fernando	Heavy recreational use	Manage as a recreational area

Table 17. Proposed Terrestrial Habitat or Species Management Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Arena Forest HMR (7 in Figure 11)	1537	Proposed by this plan Identified by Thelen and Faizool (1980) as a potential recreational park Previously designated as Arena Forest Reserve under Forest Act Boundary proposed is that of previously designated Forest Reserve	Relatively intact Representation of tropical shelter-wood system Landscape and wildlife connectivity across central part of Trinidad Watershed protection around Caroni-Arena Dam	Excellent representation of tropical shelter-wood system, and lowland forests Caroni-Arena Dam	Squatting, agricultural encroachment, hunting, ecological isolation	Change boundaries to ensure connectivity with Tumpuna and Long Stretch Reserves
Arima Forest HMR (14 in Figure 7)	741	Proposed by this plan Previously designated as Arima Forest Reserve under Forest Act Boundary proposed is that of the previously designated Forest Reserve	Relatively intact Watershed protection Climate resilience and landscape connectivity for Northern Range headwaters	Mausica, Oropuna, Arouca and Arima rivers Mosaic of naked-indian-incense-poui forests, lower montane and crappo-debass forest types and related fauna	Fire, agricultural squatting, ecological isolation to north	PA boundary redesign is critical Current shape is inappropriate Connectivity with Northern Range forests
Aripo Savannas HMR	1792	Proposed by this plan Identified by Thelen and Faizool (1980) as a	Largest remaining natural savanna ecosystem on Trinidad	Unique & locally rare animal species and endemic plants (e.g.	Fire, squatting, quarrying, illegal hunting,	Maintain connection with Long Stretch and reserves to the south

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
(21 in Figure 7)		potential Scientific Reserve Currently designated as Aripo Savannas ESA and a Prohibited Area Boundary proposed is that of previously designated ESA		moriche palm, sundew, *Rhynchospora aripoensis*, red-bellied macaw *Ara manilata*, moriche oriole) Remnant of palm marsh and marsh forest previously protected by Valencia Wildlife Sanctuary (which has been down-graded to a SUR, due to squatting and habitat loss)	ecological isolation	Southern link to Long Stretch only viable connection since deforestation in Valencia has now cut off eastern side of reserve
Blanchisseuse Forest HMR (17 in Figure 7)	871	Proposed by this plan Previously designated as Blanchisseuse Forest Reserve under the Forest Act Boundary proposed is that of previously designated Forest Reserve	Relatively intact Landscape connectivity for lower montane and crappo-debasse forest types Watershed protection High elevation habitats and species Climate change refugia	Paria and Blanchisseuse rivers Lower montane and crappo-debass forest types and their related fauna	Squatting, illegal hunting	Connect to nearby forest reserves to protect wildlife populations viability and climate resilience

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Bush-Bush SMR (14 in Figure 7)	3444	Proposed by this plan Proposed by Thelen and Faizool (1980) to be included in Nariva National Park Previously designated as Bush-Bush Wildlife Sanctuary designated under Conservation of Wildlife Act Boundary proposed is larger than that of previously designated Wildlife Sanctuary (1554 ha).	Nucleus of a zoned man-and-biosphere reserve, within the Nariva Swamp National Park	Historically important biological site due to the pioneering work done by the TRVL in the 1960s Large vertebrates (e.g. ocelot, red howler monkeys and white fronted capuchins) but site is too small to protect viable populations	Squatting, marijuana cultivation, fire, illegal hunting, small size of currently designated area	Located within Nariva Swamp National Park as core area of larger MAB type PNA design Improve law enforcement and prevent forest fires and agricultural squatting as key management strategies Increase size to 1/3 of Nariva National Park, and re-align orientation of SMR to include more Crappo-carrat, palm-swamp and herbaceous swamp formations in core area
Cap-de-Ville Forest HMR (5 in Figure 8)	2326	Proposed by this plan Previously designated as Cap-de-Ville Forest Reserve under the Forest Act Boundary proposed is that of previously designated Forest Reserve	Representation of Crappo-blackheart Watershed protection	Guapo watershed Good representation of native wildlife	High-grading, agricultural squatting and oil exploration, degradation in contiguous PNAs	Re-designate to protect wildlife and forest types compensate for habitat degradation in eastern half of surrounding Erin HMR and adjoining Morne L'Enfer SUR

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Central Range SMR (9 in Figure 11)	2153	Proposed by this plan Previously designated as Central Range Wildlife Sanctuary under Conservation of Wildlife Act (Chap. 67:01) Boundary proposed is that of previously designated Wildlife Sanctuary	Relatively intact Watershed protection Refuge for iconic wildlife species	Crappo-cocorite and Crappo-carat formations and small sample of relatively rare Acurel-figuer forest formation Navet, Tumpuna, Talparo, Cunapo and Cumuto rivers Nationally important wildlife species (e.g. game species and red-howler monkey)	Fragmentation due to teak plantation, hunting, fire, agricultural squatting	Manage as one of most important SMRs for watershed protection in Central Range. Restoration of plantations after harvest of teak plantations to natural forest.
Chatham SMR (4 in Figure 8)	1715	Proposed by this plan Previously un-demarcated State Land	Protection of upper watersheds of Cap-de-Ville River and Cemetiere River Watershed protection and climate resilience for ecosystem services and Kenny's (1995) colonizing biogeographic aquatic zone	Crappo-blackheart formations	Fire, agricultural encroachment, climate change	Manage to ensure protection of ecosystem goods and services, importantly watershed function.
Coromandel HMR (1 in Figure 8)	1489	Proposed by this plan	Lower watershed protection and	Herbaceous swamp, mangrove & crappo-blackheart formations	Fire, agricultural encroachment, climate change	Manage to ensure protection of ecosystem goods and

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		Previously un-demarcated State Land	climate resilience for ecosystem services Migratory species and Kenny's (1995) colonizing biogeographic aquatic zone			services, importantly watershed function.
Erin Forest HMR (6 in Figure 8)	2106	Proposed by this plan Previously identified by Thelen and Faizool (1980) as a candidate Scientific Reserve Previously designated as Erin Forest Reserve under Forest Act Boundary proposed is that of previously designated Forest Reserve	One of only two remaining natural savannas in the country	Important refugia for savanna plants and iconic species (e.g. red-bellied macaw, *Ara manilata*)	Agricultural squatting, fire, unsure land tenure	Manage to ensure protection of ecosystem goods and services
Godineau Swamp SMR (10 in Figure 8)	480	Proposed by this plan Previously designated as Godineau Swamp Forest Reserve under the Forest Act (Chap 66:01)	Mangrove and freshwater marsh management Conservation of fish and migratory species	Scarlet ibis (*Eudocimus ruber*)	Unsure land tenure, oil exploration, road development,	Attempt acquisition of state lands to east of river Increases size of current Godineau Swamp Forest Reserve by adding approximately 390 ha of

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
			Conservation of Scarlet ibis roosting/nesting site			State lands east of current reserve to existing reserve Recommended for inclusion in PNA system by stakeholders.
Los Blanquizales SMR (2 in Figure 8)	166	Proposed by this plan Previously un-demarcated State Land	Watershed protection and climate resilience for ecosystem services, Migratory species, and Kenny's (1995) colonizing biogeographic aquatic zone	Herbaceous swamp & mangrove formations Migratory shore birds/waterfowl	Fire, agricultural encroachment, climate change	Manage to ensure protection of ecosystem goods and services Wildlife conservation action to ensure protection of migratory species.
Navet Watershed HMR (9 in Figure 11)	2555	Proposed by this plan Identified by Thelen and Faizool (1980) as a Nature Conservation Reserve	Watershed protection Representative of lowland forest community	Crappo-fine-leaf forest community Historically important as one of first sites identified for conservation in 1972	Fragmentation due to teak plantation, hunting, fire, agricultural squatting	Manage as core area for protection of ecosystem goods and services especially watershed services.
Roussillac Swamp SMR (Not on map)	460	Proposed by this plan	Protection of wetland and shoreline for coastal protection, and for migratory species and mangrove swamp system	Combination of mangrove and herbaceous swamp ecosystem	Hunting, housing development, industrial development, water pollution.	Protect wetland and tidal range between the high and low water marks for conservation of habitat for migratory shore-birds Due to ribbon development, long-term management of

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
						this site may be a challenge due to climate change and lack of area for landward migration of vegetation.
Southern Watershed SMR (8 in Figure 8)	1874	Proposed by this plan Identified by Thelen and Faizool (1980) as a Nature Conservation Reserve Previously designated as the Southern Watershed Wildlife Sanctuary under Conservation of Wildlife Act (Chap 67:01) since 1934 Boundary proposed is that of previously designated Wildlife Sanctuary Embedded in Southern Watershed SUR	One of the best representations of accurel/mousara forest associations along the southern coast of Trinidad. Watershed protection	Population refugia for game mammals and locally important and threatened wildlife (e.g. Red howler monkeys *Alouatta seniculus*, ocelots Leopardus pardalis and tayra *Eira barbara*)	Agricultural squatting, fire, hunting, teak plantation expansion/operations. Ecological isolation due to unmanaged plantation fires.	Manage as core area for protection of ecosystem goods and services especially watershed services and wildlife This PNA is rapidly becoming ecologically isolated due to forest operations Connectivity with natural forest in eastern 1/5 of Southern Watershed SUR must be maintained Priority to maintain 1 km wide natural forest corridor between these 2 sites
St Andrew's Forest HMR	12,011	Proposed by this plan Includes previously un-proclaimed State lands, which were informally managed by the Forestry Division as the western	Previously part of one of the 9 un-demarcated State forests (St. David's) Relatively intact	Seasonal formations, lower montane formations Endemic plant species	Agricultural squatting, timber management	This designation recognizes habitat management systems already adopted by the Forestry Division, including the existing pine plantations

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		part of the un-demarcated St. David's reserve and Matura Forest Reserve	Landscape connectivity Provision of a buffer and connectivity for the Matura NP, Madamas SR and Hollis SCR. Climate resilience & watershed protection for 3 eastern Trinidad watersheds.	Population refugia for game mammals and locally important and threatened wildlife (e.g. Red howler monkeys *Alouatta seniculus*, ocelots Leopardus pardalis and tayra *Eira barbara*) Habitat for globally critically endangered endemic species (Trinidad piping-guan *Pipile pipile* Pawi)		Does not include Matura Forest NP but includes western portions of un-demarcated St. David's Reserve and Matura Forest Reserve, to west of Matura Forest NP. Provides an eastern buffer-zone for higher level of protection afforded Matura Forest NP, and Hollis SCR and Madamas SR, respectively.
Tamana Caves SMR (9 in Figure 11)	178	Proposed by this plan Identified by Thelen and Faizool (1980) as a potential national landmark This area is part of the declared Central Range Forest Reserve	Rare cave ecosystems that have limited representation in Central Trinidad	Cave systems and associated fauna in the Tamana Hill Natural Landmark	Agricultural encroachment, ecological isolation,	Promote sympathetic private land management around the officially designated SMR, to ensure ecological connectivity for cave dwelling species at this site.
Trinity Hills SMR (4 in Figure 10)	11,560	Proposed by this plan Identified by Thelen and Faizool (1980) as a	Relatively intact	Accurel-gommier, Crappo-mora and Crappo-carat forest associations	Deforestation associated with oil and gas exploration, and	New boundary enables more viable wildlife populations given intensive hunting

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		potential Scientific Reserve Previously designated as Trinity Hills Wildlife Sanctuary under Conservation of Wildlife Act (Chap 67:01). Boundary extended under new designation to improve its ecological design Embedded within the Victoria-Mayaro SUR	Refugium for game mammals in south east Trinidad	Game mammals and native wildlife (e.g. Red howler monkeys *Alouatta seniculus*, ocelots Leopardus pardalis and tayra *Eira barbara*, white fronted capuchins, tamandua) Geographic formation Pilote and Moruga rivers Culturally significant	squatting. Illegal and over-hunting, agricultural fires	pressure within Victoria-Mayaro SUR

Table 18. Proposed Riverine Corridor Habitat or Species Management Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Upper Quarahoon River Corridor (A in Figure 8)	61	Proposed by this plan	To provide ecological connectivity between Cedros Forest SUR and Chatham SMR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Cedros Forest SUR and Chatham SMR NPAs	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.
Upper Erin River Corridor (B in Figure 8)	587	Proposed by this plan	To provide ecological connectivity between the Erin Forest Habitat Management Reserve and Southern Watershed SUR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Erin Forest Habitat Management Reserve and Southern Watershed SUR	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.
Upper Rock River Corridor	213	Proposed by this plan	To provide ecological connectivity between	Location of this corridor, ownership	Removal of tree cover, fire,	Manage to restore tree cover along entire

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
(C in Figure 10)			the Victoria-Mayaro SUR and Rochard Douglas SUR	patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Victoria-Mayaro SUR and Rochard Douglas SUR	hunting, agricultural encroachment, point pollution	designated area and prevent hunting and vegetation removal.
Upper Cushe Corridor (D in Figure 11)	101	Proposed by this plan	To provide ecological connectivity between the Central Range SUR and Ecclesville SUR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Central Range SUR and Ecclesville SUR	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.
Upper Cumuto/El Rincon Corridor (F in Figure 11)	140	Proposed by this plan	To provide ecological connectivity between the Tumpuna SUR and Tamana Caves SMR and Central Range SUR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
				connectivity between the Tumpuna SUR and Tamana Caves SMR and Central Range SUR		
Aripo/El Mamo Corridor (E in Figure 7)	580	Proposed by this plan	To provide ecological connectivity between the Hollis SCR and Aripo Savannas HMR, Arena HMR and Long Stretch SUR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Hollis SCR and Aripo Savannas HMR, Arena HMR and Long Stretch SUR	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.
Rio Grande Corridor (G in Figure 9)	122	Proposed by this plan	To provide ecological connectivity between the Manzanilla SUR and Melajo SUR, and St. Andrews Forest HMR	Location of this corridor, ownership patterns and current level of human disturbance, make it currently the best location for provision of landscape-level connectivity between the Manzanilla SUR and Melajo SUR, and St Andrews Forest HMR	Removal of tree cover, fire, hunting, agricultural encroachment, point pollution	Manage to restore tree cover along entire designated area and prevent hunting and vegetation removal.

Table 19. Proposed Terrestrial Landscape or Seascapes in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
North Coast Road Protected Landscape (7 in Figure 7)	1350 ha (est.)	Identified by Thelen and Faizool (1980) as a potential Scenic Landscape. This includes the scenic road from the Saddle to Maracas Bay	Scenic coastal landscape Increasing transformation of forest landscape to non-tree agriculture and ribbon development	Considered one of most scenic road vistas in the country and leading to most heavily used beach in the country	Coastal development, agricultural squatting, ribbon development and transformation tree-crop cover to non-tree crops or non-forest cover.	Protect State lands and natural forested landscape features that define vistas Promote sympathetic private land management through conservation easements and similar agreements around officially designated protected seascape, to ensure conservation of aesthetic characteristics. TCPD, Commissioner of State Lands & Forest department to collaborate on promoting sympathetic landscape management by all State and private stakeholders
Maracas Bay Forests Protected Landscape (7 in Figure 7)	745	Proposed by this plan Part of this area was proposed by Thelen and Faizool (1980) as a potential National Park Current proposal focuses on designation of State lands	Scenic coastal road and steep-sided forest covered uplands	Vistas from the Saddle to Maracas Bay	Coastal development, agricultural squatting, coastal erosion	Protect State lands and natural forested landscape features that define vistas Promote sympathetic private land management through conservation easements and similar agreements around officially designated protected seascape, to ensure conservation of aesthetic characteristics. TCPD, Commissioner of State Lands & Forest department to collaborate on promoting sympathetic landscape

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		within Thelen and Faizool's (1980) original area				management by all State and private stakeholders
Mt Harris Protected Landscape (9 in Figure 11)	400 (est.)	Identified by Thelen and Faizool (1980) as a potential Scenic Landscape	Scenic overland road access through lowland forest.	Provides an opportunity to drive through rolling lowland forest	Agricultural encroachment	Forest department and Commissioner of State Lands to collaborate to prevent development/ alienation or incompatible forest management activities on the lands within this designated landscape
Paria-Madamas Coastal Trail Protected Seascape (Not on map)	500 (est.)	Proposed by this plan	Scenic coastal trail	Vistas from Morne Poui Bay to Catchipa, east of Madamas Bay	Coastal development, agricultural squatting, coastal erosion	Protect State lands and natural forested landscape features that define vistas Promote sympathetic private land management through conservation easements and similar agreements around officially designated protected seascape, to ensure conservation of aesthetic characteristics TCPD, Commissioner of State Lands & Forest department to collaborate on promoting sympathetic landscape management by all State and private stakeholders.
Toco-Matelot	1,000 (est.)	Identified by Thelen and Faizool (1980) as a potential Scenic	Scenic coastal landscape	Vistas from Andre Point in the east to	Unsympathetic urbanization, ribbon development	Protect State lands and natural forested landscape features that define vistas

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Protected landscape (Not on map)		Landscape Reserve		Santiago Bay in the west Rugged landscape and mix of agricultural landscape scenic ocean views through steep sided valleys	and transformation tree-crop cover to non-tree crops or non-forest cover.	Promote sympathetic private land management through conservation easements and similar agreements around officially designated protected seascape, to ensure conservation of aesthetic characteristics. TCPD, Commissioner of State Lands & Forest department to collaborate on promoting sympathetic landscape management by all State and private stakeholder

Table 20. Proposed Terrestrial Sustainable Use Reserves in Northern Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Cumuto Extension (Not on map)	235	Proposed by this plan East of Arena Forest HMR, and south of the Long Stretch SUR This area is part of Long Stretch Forest Reserve that has not been proclaimed	Formalizes current management of site as multiple use forest area	Crappo-cocorite formation	squatting, fire	Designation recognizes management systems already adopted by national forest management agency
Long Stretch (5 in Figure 9)	2842	Proposed by this plan Identified by Thelen and Faizool (1980) to be included in Aripo Savannas Scientific Reserve Previously designated as Long Stretch Forest Reserve under Forest Act	Maintain physical connectivity with Aripo Savannas for wildlife dispersal, and climate resilience	Primarily Caribbean pine plantation	Quarrying, housing, squatting, fire, plantation and exotic species	Designate and manage for pine plantations and to maintain physical connectivity with Aripo Savannas HMR
Mount Hope (2 in Figure 7)	85	Proposed by this plan Includes previously un-proclaimed State lands, which have been	Previously one of 9 un-demarcated State forests	Mostly secondary forest	Surrounded by private land, squatting,	Designation recognizes management systems already adopted by the national forest management agency

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		informally managed by the Forestry Division as a forest reserve	Watershed protection and soil conservation		marijuana cultivation, fire	
N.R.R.P.	717	Proposed by this plan. Includes previously un-proclaimed State lands, which have been informally managed by the Forestry Division as a forest reserve	Previously one of 9 un-demarcated State forests	Habitat management activities by forest management agency	Fire	Designation recognizes management systems already adopted by the agency
Paria (18 in Figure 7)	994	Proposed by this plan Previously designated as Paria Forest Reserve under the Forest Act Current designation modifies the reverse "E" shape of original reserve, to meet design criteria to minimize edge effects	Forest ecosystem largely un-fragmented Watershed protection Climate resilience for low-elevation forest	Paria river Seasonal formations, lower montane formations	Squatting, hunting, anthropogenic fire	Develop connectivity with nearby reserves New SUR is contiguous with Madamas Forest Scientific Reserve to east, and its western boundary modified to achieve a roughly rectangular shape, with its long axis oriented north-south
River Estate (5 in Figure 7)	659	Proposed by this plan. Includes previously un-proclaimed State lands, which have been	Previously one of 9 un-demarcated State forests	Seasonal formations	Squatting, hunting, anthropogenic fire	Designation recognizes management systems already adopted by the agency

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		informally managed by the Forestry Division as River Estate Reserve.	Maintaining ecological connectivity between the forests of the Chaguaramas peninsula and the rest of the island.			
St. David (2 in Figure 9)	3240	Proposed by this plan Includes previously un-proclaimed State lands, which were informally managed by the Forestry Division as part of un-demarcated St. David's Reserve and Matura Forest Reserve	Previously one of 9 un-demarcated State forests Relatively intact Landscape connectivity Provision of a buffer for the Matura NP	Seasonal formations, lower montane formations Endemic plant species	Agricultural squatting	Designation recognizes management systems already adopted by the Forestry Division Does not include Matura Forest NP but includes an eastern portion of un-demarcated St. David's Reserve and Matura Forest Reserve, to the east of Matura Forest NP, so forming an eastern buffer-zone for the higher level of protection afforded Matura Forest NP
Tumpuna (8 in Figure 11)	2150	Proposed by this plan Previously proclaimed as the Tumpuna Forest Reserve	Recognizes existing management systems applied to the natural and plantation forests that are managed	Seasonal forest formations	High-grading, pine plantation, squatting	Designation recognizes management systems already adopted by the agency Extend to make continuous with Central range FR and Arena

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
			by the Forestry Division Watershed protection			
Valencia (4 in Figure 9)	2785	Proposed by this plan Includes previously designated Valencia Wildlife Sanctuary under the Conservation of Wildlife Act (Chap 67:01)	Recognizes future potential of site to be restored Relative rarity of remaining patches of marsh forests, and its importance as a conduit on landscape for wildlife dispersal	Contains the remaining representation of evergreen marsh forest on the island	Ecological isolation, fire, squatting, quarrying, genetic isolation and demographic constraints	Re-forestation Down-listing to SUR from equivalent of wildlife sanctuary status (Species Management Reserve) due to significant amounts of deforestation and habitat fragmentation which have occurred at this site since the early 1970s, due to illegal aggregate extraction Potentially de-reserve after intensive biological survey and DNA/specimen collection campaign, and stakeholder consultation.

Table 21. Proposed Terrestrial Sustainable Use Reserves in Central Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Basin Hill (Not on map)	270	Proposed by this plan. Previously undeclared. Designation requested by the Forestry Division	Formalizes the management of this reserve, consistent with its previous management as a forest reserve	A very small reserve with some representation of Crappo-carrat association.	Agricultural squatting	Squatting along boundary and northern 1/3 of PNA may require boundary redefinition, squatter relocation or de-reservation due to its small size. Options to connect with other state forests appear limited without private land acquisition Fragment currently isolated. Could connect to Central Range SMR using riverine forest restoration
Brigand Hill (16 in Figure 11)	143	Proposed by this plan. Includes previously declared Brigand Hill Forest Reserve	Relatively intact Formalizes the management of this reserve, consistent with its previous management as a forest reserve	Acurel-Moussare formation	Surrounded by private land on eastern boundary thus increasingly isolated ecologically; fire.	Needs ecological assessment. Connect to Central Range SMR through gallery forest corridor Should be managed to maintain its current ecosystem and biodiversity goods and services.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Central Range (9 in Figure 11)	13147	Proposed by this plan Previously designated as the Central Range Forest Reserve under the Forest Act (Chap 66:01) This proposal excludes areas designated as Tamana Caves SMR, Navet Watershed HMR and Central Range SMR, which are afforded higher levels of protection. Includes an extension of 981 ha of State land, along south eastern boundary towards Cunapo Southern Main Road, between Cushe and Navet**,** to improve landscape connectivity	Relatively intact. Watershed protection: one of three surface water reservoirs on the island (Navet) Protection of freshwater and terrestrial biodiversity Multi-stakeholder use Maintaining landscape connectivity between the southern and northern forests.	Nine major watersheds: Carapo, Cunapo, Cumuto, Poole, Nariva, Navet, L'Ebrange, Tumpuna and Talparo Locally important species (e.g. game species, red howler monkeys, Kenny's (1995) Stable Relict biogeographic aquatic zone)	High-grading of timber resources, teak plantation management, agricultural squatting, fire	Enlarge and integrate with original Central Range FR Change boundary to adjust shape and select best habitat for wildlife, geodiversity and ecosystem service protection

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		between Central Range and Ecclesville SUR.				
Cola Hill (6 in Figure 11)	304	Proposed by this plan Includes previously un-proclaimed State lands, which were informally managed by the Forestry Division as a forest reserve.	Formalizes management of this reserve, consistent with previous informal management by the Forestry Division as a forest reserve	Crappo-cocorite forest community	Edge effects, site highly fragmented and increasingly isolated due to agricultural settlement	Managed to maintain ecosystem and biodiversity goods and services, within Talparo watershed
Ecclesville (12 in Figure 11)	2587	Proposed by this plan Previously designated as Ecclesville Forest Reserve under the Forest Act (Chap 66:01). Current proposal extends the western side of reserve to include all State lands on its western boundary to Cunapo road, and so	Location along east-central part of the island is critical for maintaining landscape connectivity between northern and southern forests Climate resilience for forest and wildlife populations	The geographic location of this reserve is important. In its proposed extended form it maintains ecological connectivity between the Central Range and Nariva forests, greatly improving their potential for climate resiliency and overall viability of wildlife populations in the	Agricultural squatting, high grading of commercial timber in forest, dry season fire.	State portions with Nariva and Central Range need to be connected as a priority to maintain ecological connectivity, between these forests and Central Range SUR and ensure watershed protection in Nariva watershed and ecological resiliency in the face of future climate change

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		increase the reserve by 2,076 ha.		central part of the country. Crappo-cocorite forest community		
Freeport (1 in Figure 11)	188	Proposed by this plan Previously designated as Freeport Forest Reserve under the Forest Act (Chap 66:01)	The current designation is made to encourage restoration of forest at the site, while ensuring sustainable use of the remaining natural resources.	Crappo-cocorite forest community	Unclear land tenure, agricultural squatting, fire, small size	Site is highly degraded, ecologically isolated and greatly threatened by multiple forms of human disturbance. Ecological assessment required to determine restoration or de-reservation. Site may have an important future as an urban recreational site, but its remaining ecological value is in question
Longdenville (2 in Figure 11)	535	Proposed by this plan. Previously designated as Longdenville Forest Reserve under the	One of the 36 originally designated forest reserves in the country.	Kenny's (1995) Un - stable Relict biogeographic aquatic zone	Agricultural expansion, squatting, fire	Site is highly degraded, ecologically isolated and greatly threatened by multiple forms of human disturbance. Ecological assessment required to determine

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		Forest Act (Chap 66:01)	Restoration of forest and wildlife at the site.			restoration or de-reservation. Site may have an important future as an urban recreational site, but its remaining ecological value is in question
Manzanilla Windbelt (7 in Figure 9)	3116	Proposed by this plan Previously designated as Manzanilla Windbelt Reserve under the Forest Act (Chap 66:01)	Relatively intact Landscape position makes it a critical part of the PNAs system, providing connectivity between southern and northern forests Coastal and watershed protection	Littoral forest - palmiste-balatta. Important landscape location to maintain connectivity between eastern coastal forests and northern range	Agricultural squatting, coastal erosion, hunting	Restoration of forest and wildlife, while ensuring sustainable use of the remaining natural resources.
McNair Ravine Sable (3 in Figure 11)	361	Proposed by this plan. Previously designated as McNair Ravine Sable Reserve under the Forest Act (Chap 66:01)	Restoration of forest at the site, while ensuring sustainable use of the remaining natural resources	Original forest degraded by anthropogenic disturbance	Ecological isolation, small size, linear design, fire, pine plantation	Conservation value highly diminished due to degradation and isolation. Improve riverine corridors and rationalize use. Check spatial alignment for possible link with nearby reserves

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Melajo (6 in Figure 9)	2203	Proposed by this plan Previously designated as Melajo Forest Reserve under the Forest Act (Chap 66:01)	One of the 36 originally designated forest reserve Large area and important connectivity for southern and northern forests along in eastern Trinidad Watershed protection Climate resiliency	Crappo-guatacare formation, game species populations & Kenny's (1995) Stable Relict biogeographic aquatic zone	Quarrying and squatting for housing and agriculture	Restoration of forest and wildlife, while ensuring sustainable use of the remaining natural resources Boundaries on eastern side need re-surveying Improve riverine corridors and rationalize use. Check spatial alignment for possible link with nearby reserves
Nariva Windbelt (13 in Figure 11)	2082	Proposed by this plan Northern half of the previously designated Nariva Windbelt Reserve, is now designated as part of the Nariva Swamp National Park. The new SUR extends western boundary of previously	The new extension adds 1665 ha to the SUR, which serves a crucial ecological and landscape function to ensure connectivity between the Victoria-Mayaro SUR, the Nariva Swamp NP and the forests to the West and central part of Trinidad.	Critical landscape position, providing ecological connectivity between northern and southern forests of the country.	Squatting, plantation, agriculture	State portions between this and Ecclesville need to be declared as part of reserve Southern boundary between Nariva Windbelt and VMR **is most important connection in the country between northern and southern forests**.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		designated Nariva Windbelt Reserve to make it contiguous with eastern boundary of new Ecclesville SUR				
San Pedro (11 in Figure 11)	199	Proposed by this plan Previously designated as San Pedro Reserve under the Forest Act (Chap 66:01)	Current forestry division management of the site as a teak plantation.	No natural forest remaining	Teak plantation	Recommend delisting - need to verify connectivity issue
Tacarigua (13 in Figure 7)	1569	Proposed by this plan Previously designated as Tacarigua Forest Reserve under the Forest Act (Chap 66:01). Propose extending existing reserve to include remaining un-demarcated State lands on eastern side	Maintain its historical designation as a PNA Importance for local forest goods and services Watershed protection.	Naked-Indian-incense-Poui forest formation and lower montane forests. Important to maintain climate resiliency and watershed function.	Fire, pine plantation, squatting for agriculture and housing	Reforestation and promotion of sustainable use of the natural resources and watershed protection activities. Fire suppression actions important.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		of Tacarigua valley, north of existing forest reserve, to eastern ridge line and north to be contiguous with San Jose SCR, previously designated as "Northern Range Reserve A".				
Todd's Road (North) (4 in Figure 11)	182	Proposed by this plan Previously designated as Todd's Road (North) Forest Reserve under the Forest Act (Chap 66:01)	Recognizes need to maintain current management as a PNA, because of its importance for local forest goods services and to ensure sustainable use of natural resources	Crappo-cocorite forest formation. Protection of Talparo and Cunupia watershed functions.	Small size, ecological isolation, fires, squatting, marijuana cultivation	Small size and relatively isolated position on the landscape, relative to other protected natural areas (PNAs), makes it a relatively challenging site in terms of long term ecological viability
Todd's Road (South) (5 in Figure 11)	87	Proposed by this plan Previously designated as Todd's Road (South) Forest	One of the 36 formally designated forest reserves Maintain its current management as a PNA, and so ensure	Crappo-cocorite forest formation Protection of Talparo and Carapo watershed functions	Small size, ecological isolation, fires, squatting, marijuana cultivation	Small size and relatively isolated position on the landscape, relative to other protected natural areas (PNAs), makes it a relatively challenging site

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		Reserve under the Forest Act (Chap 66:01)	sustainable use of natural resources			in terms of long term ecological viability

Table 22. Proposed Terrestrial Sustainable Use Reserves in Southern Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Cedros Forest (3 in Figure 8)	1353	Proposed by this plan. Previously designated as Cedros Forest Reserve under Forest Act (Chap 66:01)	Relatively intact Formalizes management of reserve, consistent with previous management as a forest reserve	Critical ecosystem and biodiversity goods and services	Agricultural encroachment, quarrying, ribbon development, un-sustainable timber extraction	Should be managed to maintain its current ecosystem and biodiversity goods and services Manage to maintain connectivity with new Chatham SMR and Coromandel HMR
Morne L'Enfer (7 in Figure 8)	422	Proposed by this plan Includes former areas previously declared as Morne L'Enfer Forest Reserve and Morne L'Enfer Wildlife Sanctuary.	Restoration of forest and wildlife	Crappo-blackheart forest formation.	Fire; oil and gas exploration, squatting	Restoration of forest and wildlife, while ensuring sustainable use of the remaining natural resources. Site greatly degraded by historical and current oil and gas exploration and dry season fires
Piparo Extension (10 in Figure 11)	485	Proposed by this plan Includes previously un-proclaimed State lands, which have been informally managed by the	Previously one of 9 un-demarcated State forests	Crappo-carrat forest formation	Squatting	Designation recognizes management systems already adopted by the agency

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		Forestry Division as a forest reserve.				
Rochard Douglas (2 in Figure 10)	1885	Proposed by this plan Previously designated as Rochard Douglas Reserve under the Forest Act (Chap 66:01)	Critical for maintaining landscape connectivity for wildlife populations in south of the country Watershed protection	South Oropouche watershed	Squatting, teak plantation	Maintain current management as a PNA, because of importance for local forest goods and services, and to ensure sustainable use of the natural resources May be a challenge to link with other PNAs but important due to forest types. State boundaries on eastern and west-central parts of reserve may be in error
Siparia (9 in Figure 8)	385	Proposed by this plan Previously designated as Siparia Reserve under the Forest Act (Chap 66:01)	Relatively intact Restoration of forest and wildlife at the site, while ensuring sustainable use of the natural resource Landscape connectivity	The only mid-watershed PNA in the South Oropouche drainage	Isolated by urbanization and dissected by roads, erosion, teak plantation	Degree of isolation of site an important ecological issue Ownerships are uncertain. Many parcels in Cadastral suggest parcelling by Commissioner of State Lands but not title. The forest department and Commissioner of State Lands & TCPD must meet on these

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
						areas and come to an agreement on surveying and formal designation or de-reserving. If de-reserved, effort should be made to the biodiversity present as these lowland dry habitats are rapidly disappearing.
Southern Watershed (8 in Figure 8)	7964	Proposed by this plan Previously designated as Southern Watershed Forest Reserve under the Forest Act (Chap 66:01). Excludes area designated as Southern Watershed SMR (1874 ha).	Maintain its historical designation as a PNA Importance for local forest goods and services. Watershed protection	Historically an important silvicultural demonstration location for teak plantations. Heavily managed for timber production. Ecological corridor between south-western and south-eastern forests.	Fire, small scale squatting, teak plantation	Reforestation and promotion of sustainable use of the natural resources. Site is critical for maintaining ecological connectivity between forests in south east of the country and remaining fragments in south west. Seasonal fires in teak plantations, agricultural expansion, and oil exploration pose a significant threat to management for ecosystem services.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Victoria Plantations	701	One of 9 un-demarcated State forests managed by the Forestry Division.	Recognizes management systems already adopted by the agency	Managed for timber production, recreational hunting and NTFPs		Designation recognizes management systems already adopted by the agency
Victoria-Mayaro Forest (3 in Figure 10)	41346	Proposed by this plan Previously designated as Victoria-Mayaro Forest Reserve under the Forest Act (Chap 66:01) Excludes area designated as new Trinity Hills SMR (11560 ha)	Largest forest reserve in the country Important location with respect to the central and eastern forests Remaining natural areas along the south coast Connection with Nariva Windbelt SUR one of most important landscape features on the island from a wildlife demographic and genetic standpoint	Managed for timber production, recreational hunting and NTFPs. This is the largest remaining lowland forest ecosystem in the country.	Oil and gas exploration and production	Several boundary demarcation issues associated with state land parcels of varying shapes not properly designated as reserve, require attention. Several forest inholdings, by private citizens in site represent management challenge. State lands next to Rio Claro road need to be protected as the highest priority activity to ensure connection with Windbelt reserve maintained through wildlife crossings.

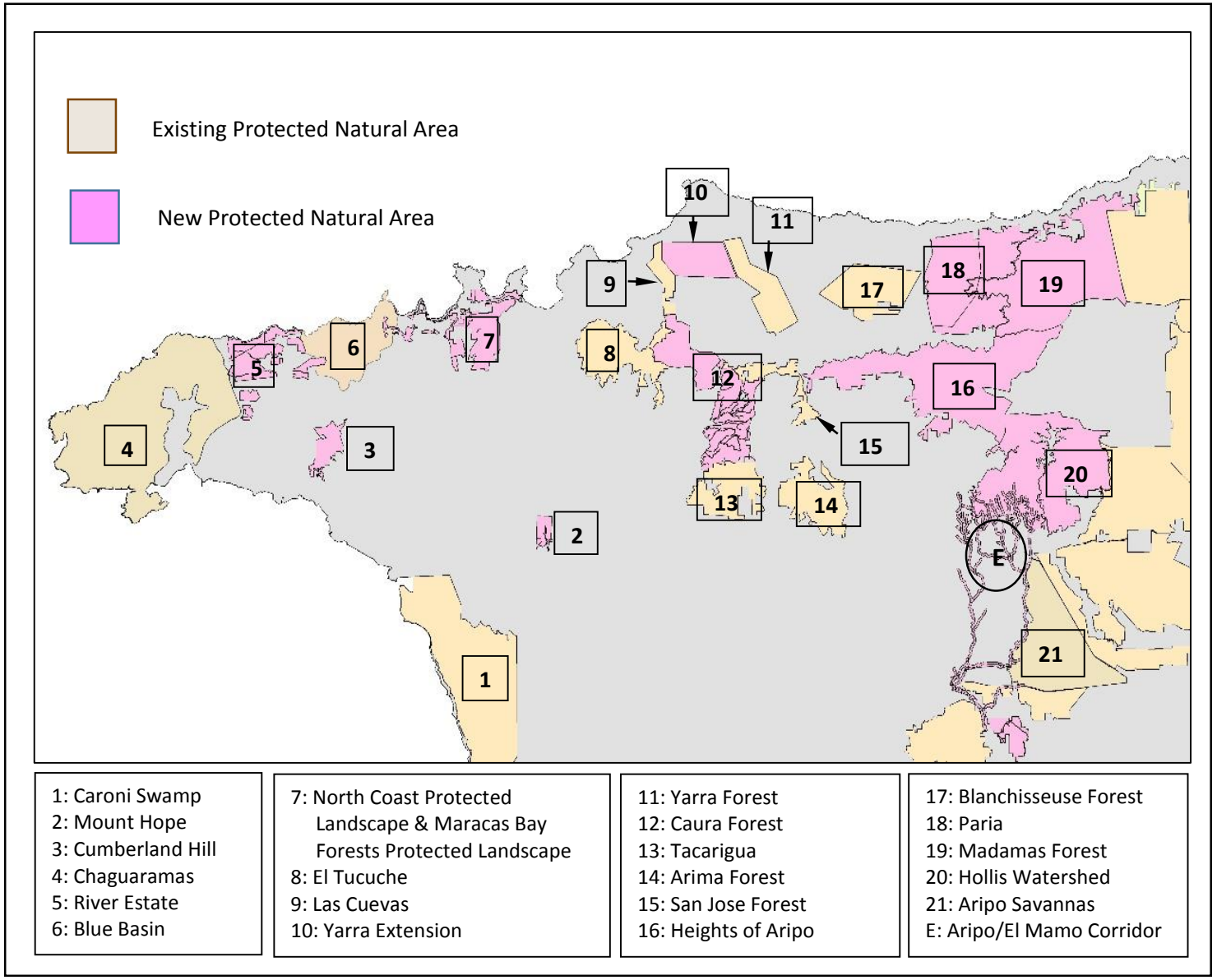


Figure 7. Proposed Terrestrial PNAs in North-west Trinidad

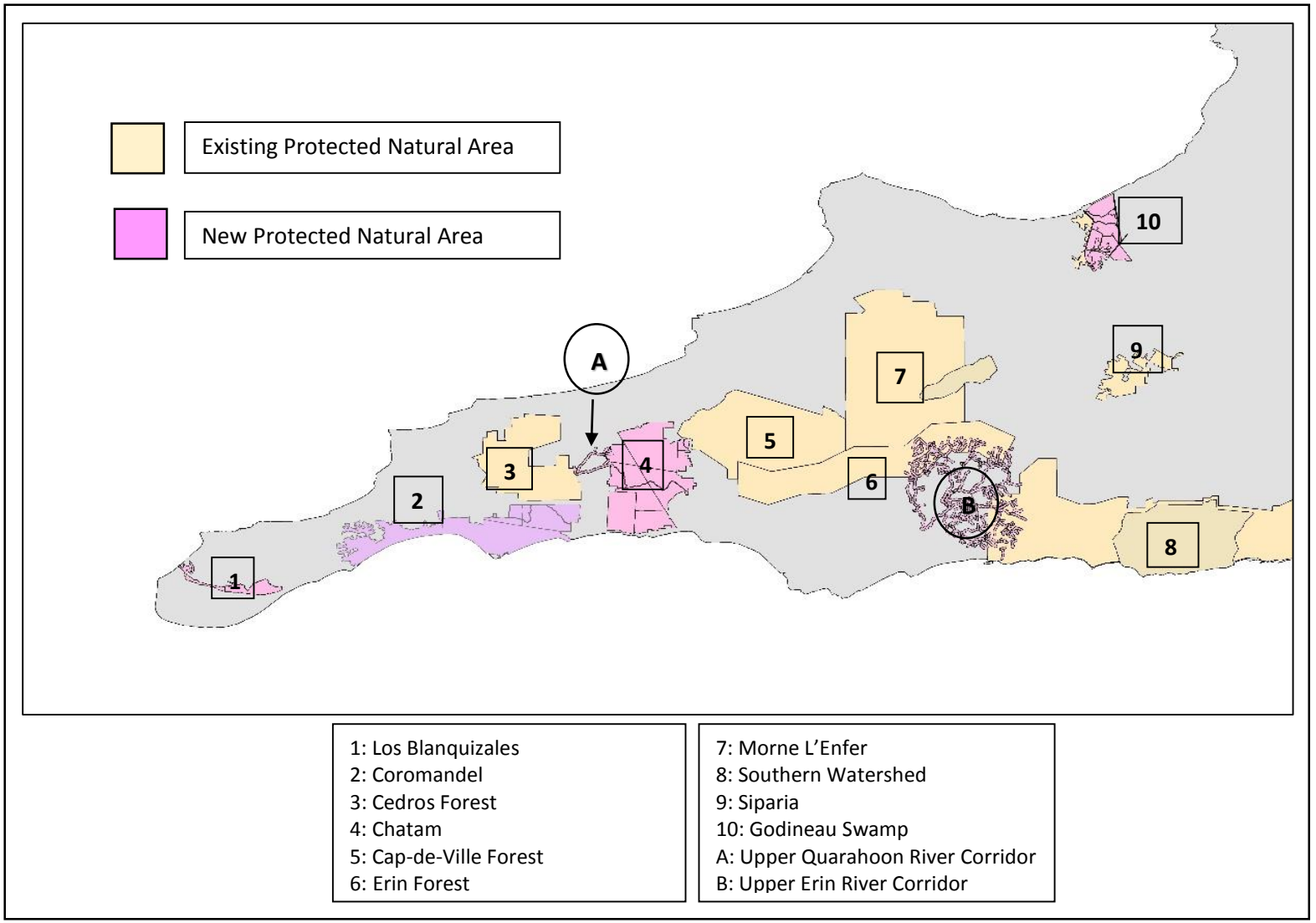


Figure 8. Proposed Terrestrial PNAs in South-west Trinidad

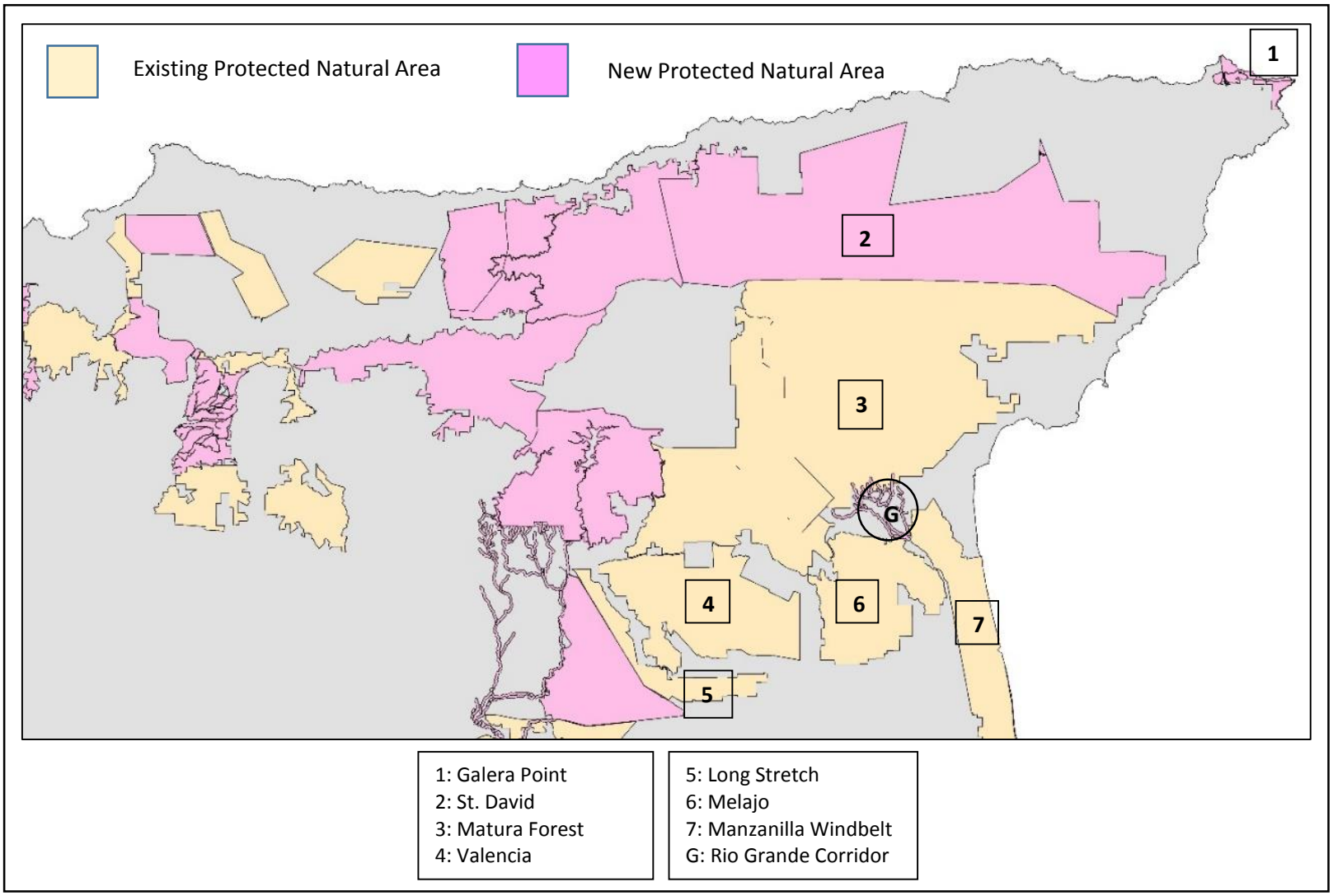


Figure 9. Proposed Terrestrial PNAs in North-east Trinidad.

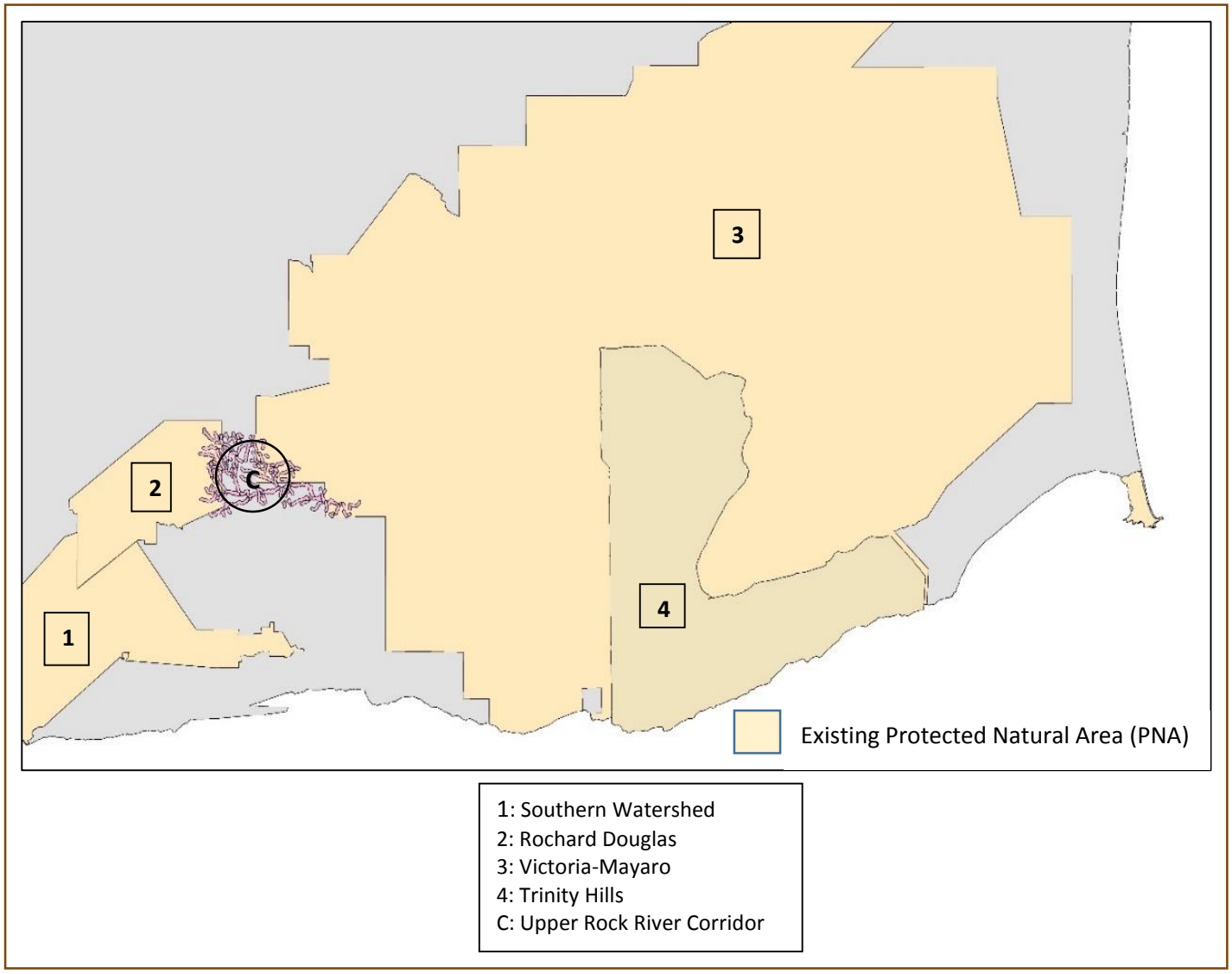
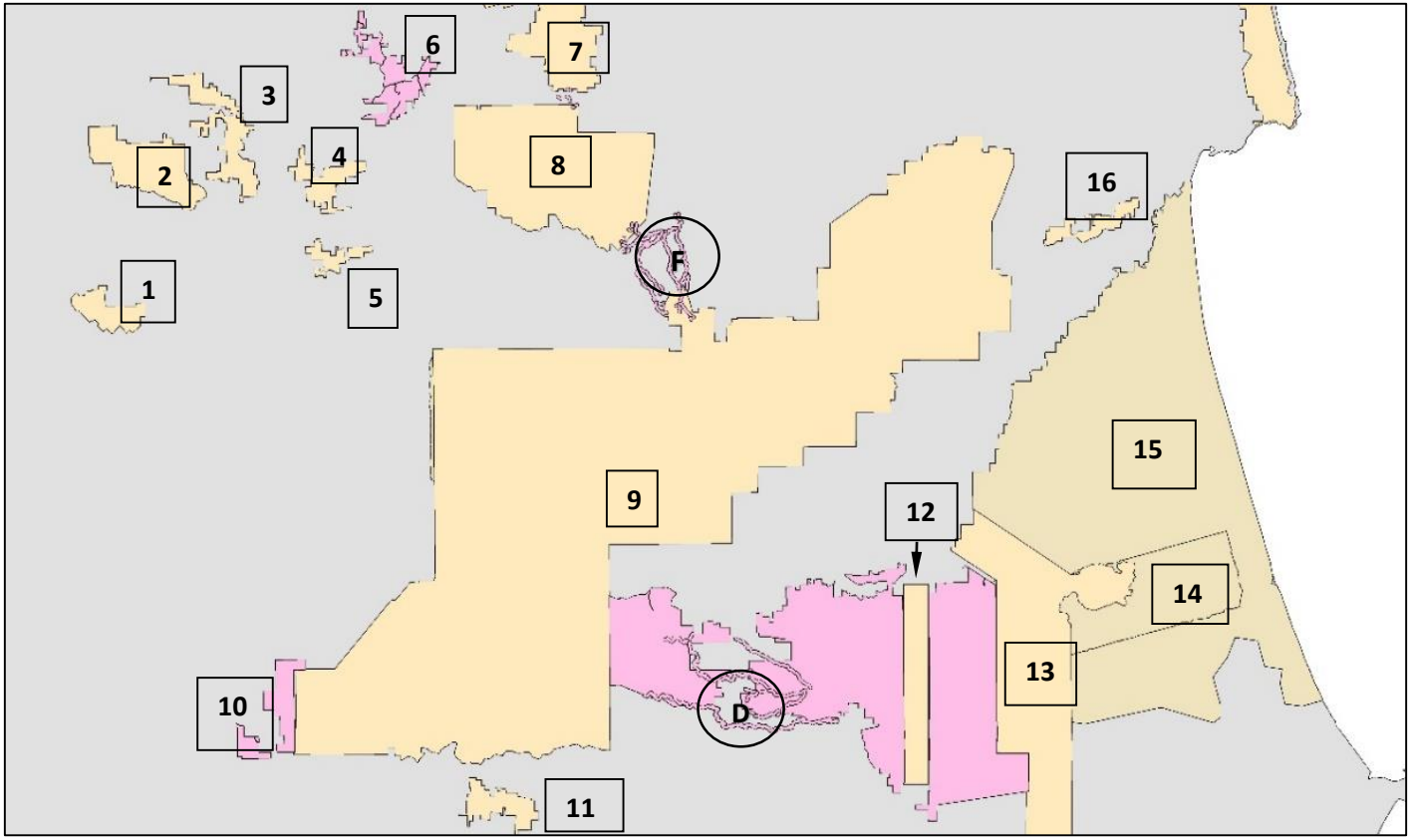


Figure 10. Proposed Terrestrial PNAs in South-east Trinidad.



1: Freeport
2: Longdenville
3: McNair Ravine Sable
4: Todd's Road North
5: Todd's Road South
6: Cola Hill

7: Arena Forest
8: Tumpuna
9: Central Range – includes Central Range Wildlife Sanctuary, Navet Watershed, Tamana Caves and Mt. Harris Protected

10: Piparo Extension
11: San Pedro
12: Ecclesville
13: Nariva Windbelt
14: Bush Bush
15: Nariva Swamp

16: Brigand Hill
D: Upper Cushe Corridor
F: Upper Cumuto / El Rincon Corridor

Figure 11. Proposed Terrestrial PNAs in East-central Trinidad

5.2. MARINE AND COASTAL TRINIDAD

In Trinidad, unlike Tobago, there were historically no near-coastal marine protected areas, aside from the wildlife sanctuaries at Soldado Rock, Saut D'Eau and Krondstat islands. The latter wildlife sanctuary has since its designation been greatly modified due to mining activity on approximately half of the island. Under the NPASP, Krondstat remains within the systems plan, however given its disturbance, it has been recommended to be down-listed to a Sustainable Use Reserve.

The NPASP recommends the establishment of several new PNAs around the coastal and near-shore marine environment around Trinidad. These areas include a proposed National Park at Chacachacare Island, an important dry forest ecosystem, a site of important historical significance due to its previous use as a leper colony, its use by revolutionaries during the Venezuelan war of Independence and its history as a whaling station.

In addition, the NPASP recommends protection of important landmarks and coastal landscapes, including the Galera Point Natural Landmark and the Marine Seascape at Icacos point. These headlands are iconic landforms at either ends of the island and are included in the NPASP to protect the landforms and the species that rely on these systems (Kenny 1978, 2002; St. Omer & Barclay 2002). In the case of Galera, the PNA here includes protection for the reef system and beachfront at Salybia Bay, up to 200m from the high-tide mark.

The largest number of near coastal marine protected areas include many that are seasonally protected as Species Management Reserves, for conservation of nesting marine turtles. The NPASP protects nine such beaches around the island of Trinidad. Several of these areas were identified during public consultations for the NPASP, and their inclusion here is a reflection of the strength of public concern and interest for nesting marine turtles in the country.

Finally, the coastal islands remain important sites for conservation of migratory and resident sea-birds (Lowrie et al. 2013, Nelson and Devenish-Nelson, unpublished data). Globally these species have been in decline in recent years, and the NPASP recognizes the regionally important role played by the coastal islands around Trinidad, as roosting and nesting sites for these sea birds. In this regard, a total of five island reserves have been designated around Trinidad specifically for this purpose.

Tables 23 to 27 list the recommended marine and coastal sites and figures 12 to 17 show the recommended system of coastal and marine protected areas on Trinidad, with PNAs indicated in green. These figures are for illustration only. The exact PNA boundaries will be established by the Commissioner of State Lands as guided by the High-level Ministerial Committee (See section 6.1).

Table 23. Proposed Coastal and Marine National Parks (Marine Protected Areas) in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Chacachacare Island	399	Proposed by this plan. Previously managed under the Chaguaramas Development Authority Act	Relatively intact. Some of best examples of dry forest ecological community in the country Cultural significance and recreational use	Historically, ecologically and recreationally significant site. Important dry forest ecosystem unit within proposed PNA system.	Recreation, dry-season anthropogenic fire.	Recent lack of human disturbance makes it an ideal location for the protection of the ecological communities.

Table 24. Proposed Marine and Coastal Natural Landmarks or Monuments in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Galera Point	186	Proposed by this plan Identified as a candidate natural landmark by Thelen and Faizool (1980) This area is not previously declared	Beach, landscape and geological features from Forest Point south east of Pt. Galera, to Galera and west to Reefs Point	Important geological feature Best example of reef in Trinidad Seagrass beds Coastal endemic plants *(e.g. Metastelma* sp.)	Coastal development, climate change	Include all state lands to Toco Main Road to ensure protection of this geological feature and the nearshore environment up to 200m from high-tide mark sea-wards.

Table 25. Proposed Coastal and Marine Habitat or Species Management Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Islands reserves						
Centipede Island	2	Proposed by this plan Saut D'eau and Soldado Rock identified by Thelen and Faizool (1980) as potential nature conservation reserves Saut D'eau and Soldado Rock originally designated wildlife sanctuaries under the Conservation of Wildlife Act (Chap 67:01)	Protection of migratory and resident roosting and nesting seabirds, island plant communities and near-shore marine habitats	Brown pelicans (*Pelecanus occidentalis*): Centipede Island, Northern Huevos, Saut D'Eau, Magnificent frigatebirds (*Fregata magnificens*), sooty terns (*Onychoprion fuscatus*) and brown boobies (*Sula leucogaster*): Soldado Rock	Direct harvesting of birds and eggs, anthropogenic fire, oil spills (Soldado Rock)	For each island, designation to include island and 200m from high-tide mark towards the sea (area of PNA presented here does not include this 200m marine buffer in the area estimate).
Northern Huevos Island	33.5					
Saut D'Eau Island	10					
Soldado Rock	6					
Nelson and the Five Islands	3.5					

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Beach reserves						
Blanchisseuse Bay	2	Proposed by this plan	Conservation of migratory, nesting marine turtles	Environmentally Sensitive Species (leatherback, green, olive ridley, loggerhead, and hawksbill turtles)	Coastal erosion and beach alteration, coastal development, land-based pollution, artificial lighting, climate change	Include the land from the high-water to low-water mark at each seasonally designated site
Fishing Pond Beach	16	Grande Riviere and Fishing Pond were previously designated Prohibited Areas				Seasonal designation from the 1st of March to the 31st of August each year
Grande Tacarib Beach	4	Rincon/Matura includes all of declared prohibited area for Matura Beach and most of Fishing Pond Beach				
Grande Riviere Beach	2.8					
Madamas Beach	2	Proposed new beaches, include based on stakeholder recommendations at national consultations and/or the Sea turtle recovery action plan for the Republic of Trinidad and Tobago (WIDECAST 2010)				
Manzanilla Beach						
Paria Bay	3.2					
Petit Tacarib Beach	0.6					
Rincon/Matura Beach	29					

Table 26. Proposed Marine Landscape or Seascapes in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Icacos Point Protected Seascape	700	Proposed by this plan Part of the area identified by Thelen and Faizool (1980) as a potential Nature Conservation Reserve	Scenic coastal landscape	Vistas from Los Gallos Point along Columbus Bay, Punto de Arenal in the west, through to Icacos and Quemado Point and to Galfa Point on South Coast	Coastal development, agricultural squatting, coastal erosion	Protect State lands and beaches (from high-water seaward out to 500m) that define vistas Promote sympathetic private land management through conservation easements and similar agreements around officially designated protected seascape, to ensure conservation of aesthetic characteristics TCPD, Commissioner of State Lands & Forest department to collaborate on promoting sympathetic landscape management by all State and private stakeholder

Table 27. Proposed Coastal and Marine Sustainable Use Reserves in Trinidad.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Krondstat Island	**5**	Proposed by this plan Identified by Thelen and Faizool (1980) to be included in Chaguaramas National Park Previously designated a wildlife sanctuary under Conservation of Wildlife Act	Future restoration of the habitat of the island due to extraction of barite minerals and mining of more than half of the island	Seasonal deciduous forest	Mining	Its current value as a wildlife sanctuary is currently greatly compromised by historical mining activity Assess possibility of habitat restoration or degazetting Designation of northern Huevos Island and Centipede Islands as SMRs, is recommended in part to compensate for loss of this island as a reserve

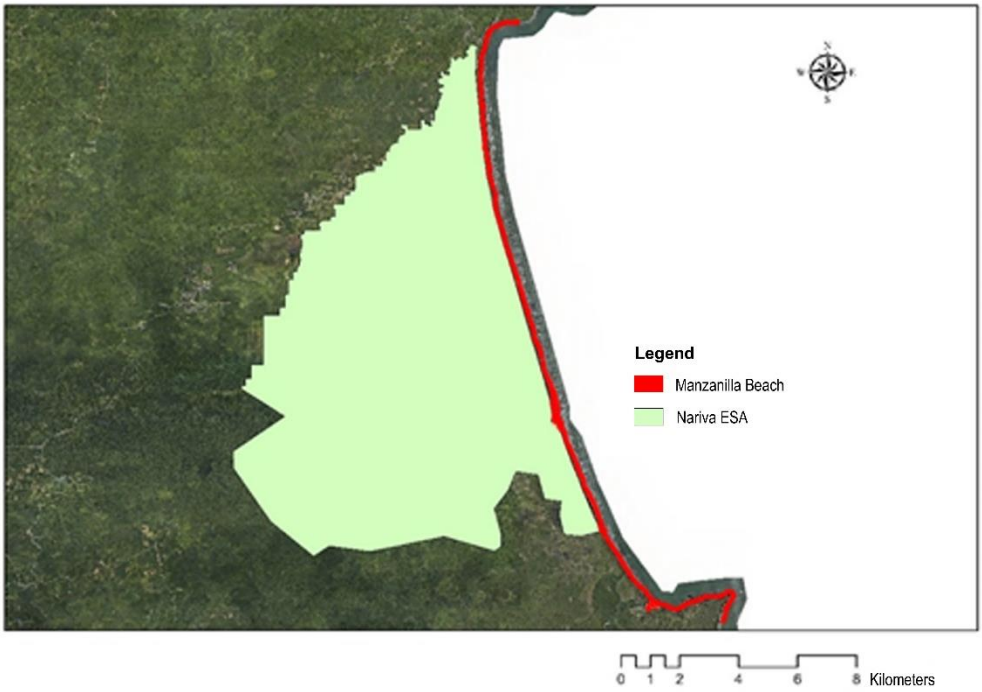


Figure 122. Proposed coastal and marine PNAs in East-central Trinidad

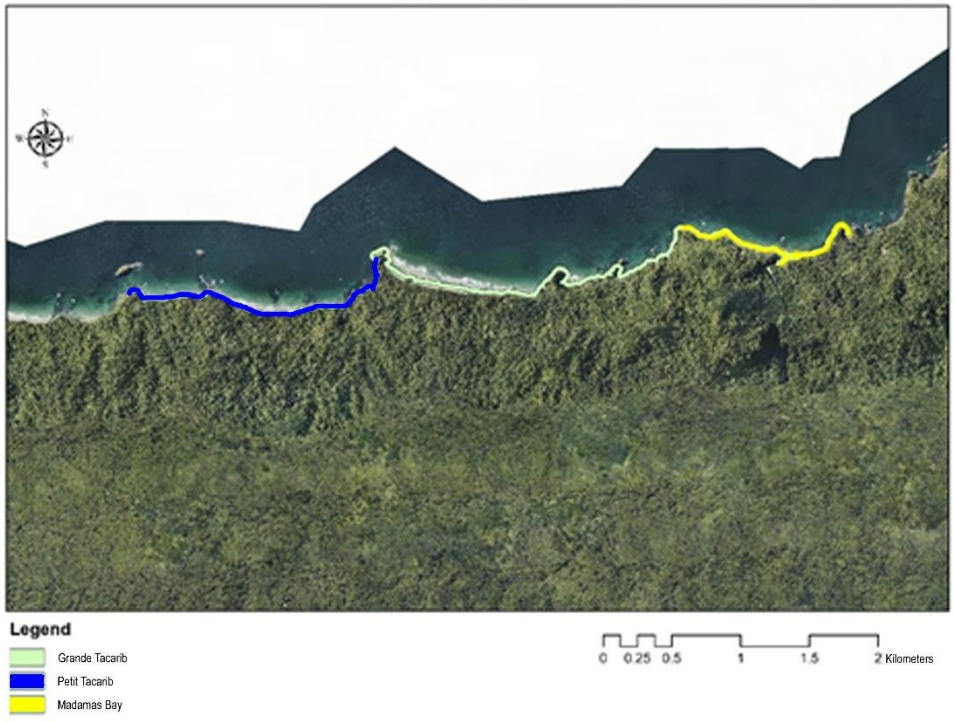


Figure 13. Proposed coastal and marine PNAs in northern-central Trinidad

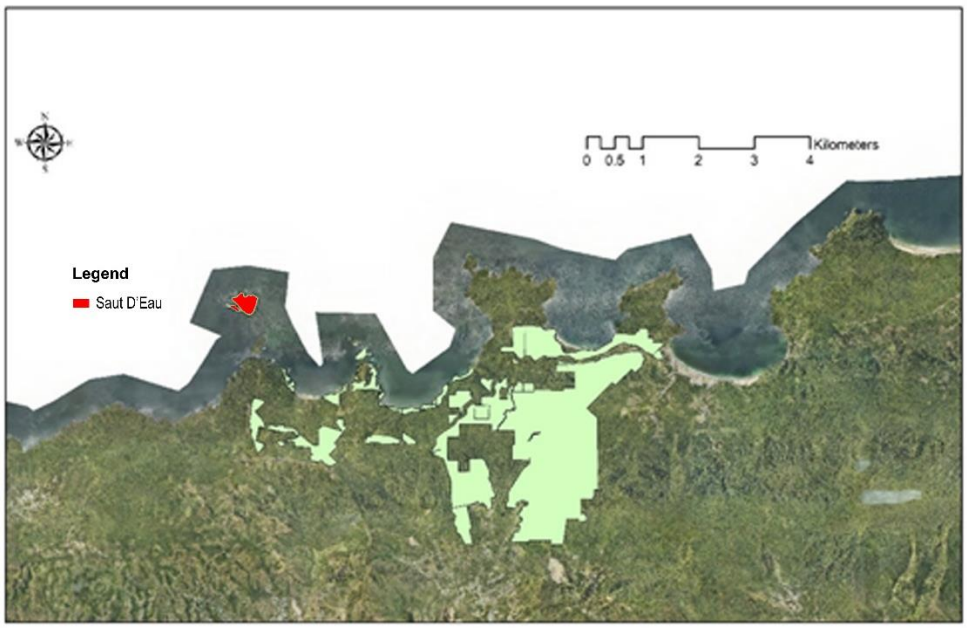


Figure 14. Proposed coastal and marine PNAs in northern-west Trinidad

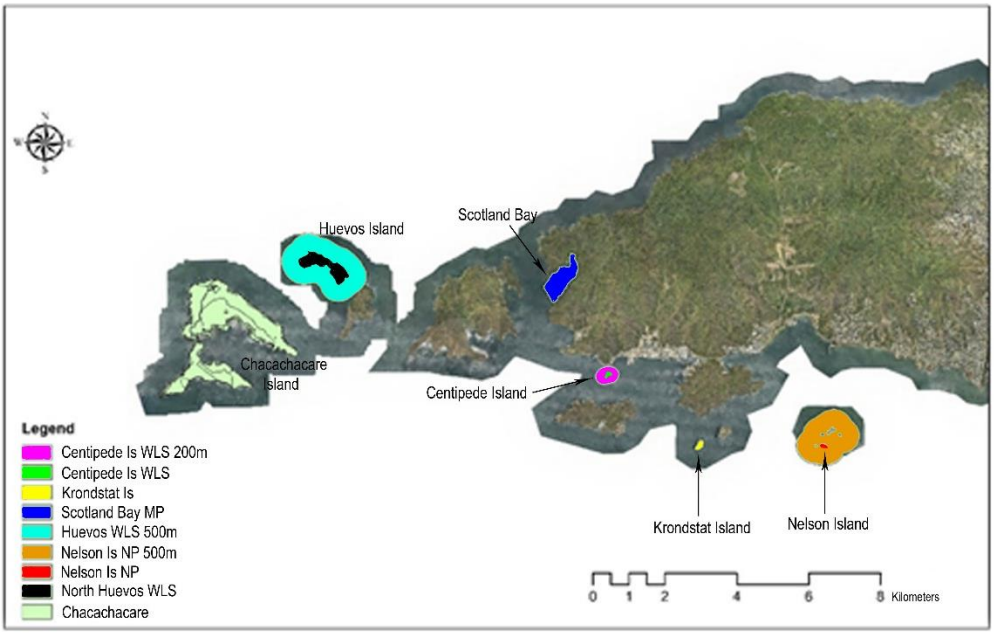


Figure 15. Proposed coastal and marine PNAs in north-west peninsula, Trinidad

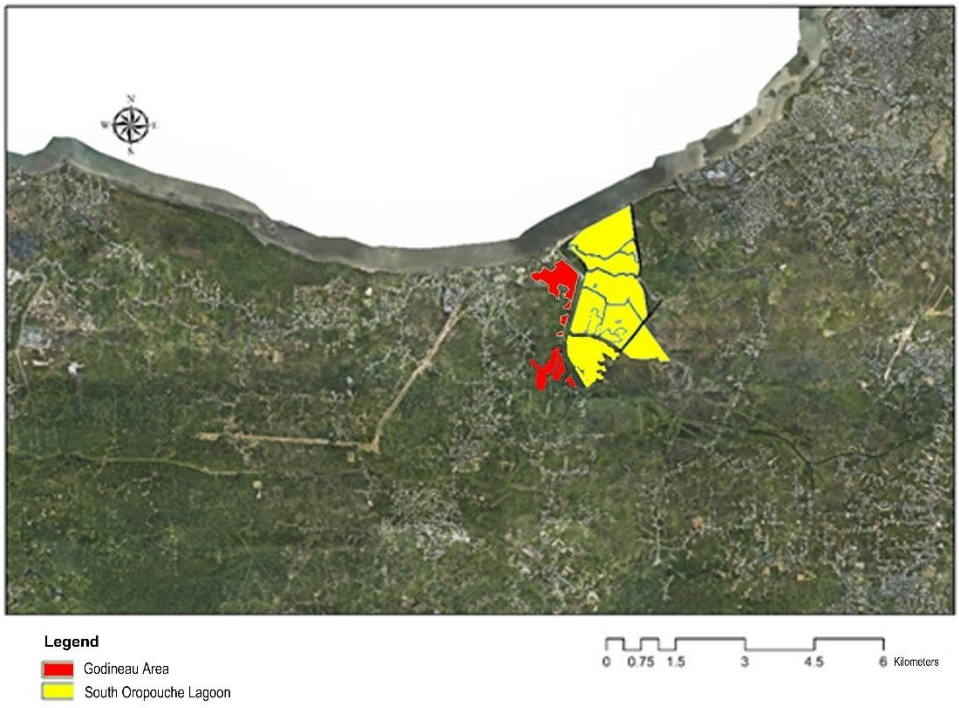


Figure 16. Proposed coastal and marine PNAs in south-west Trinidad

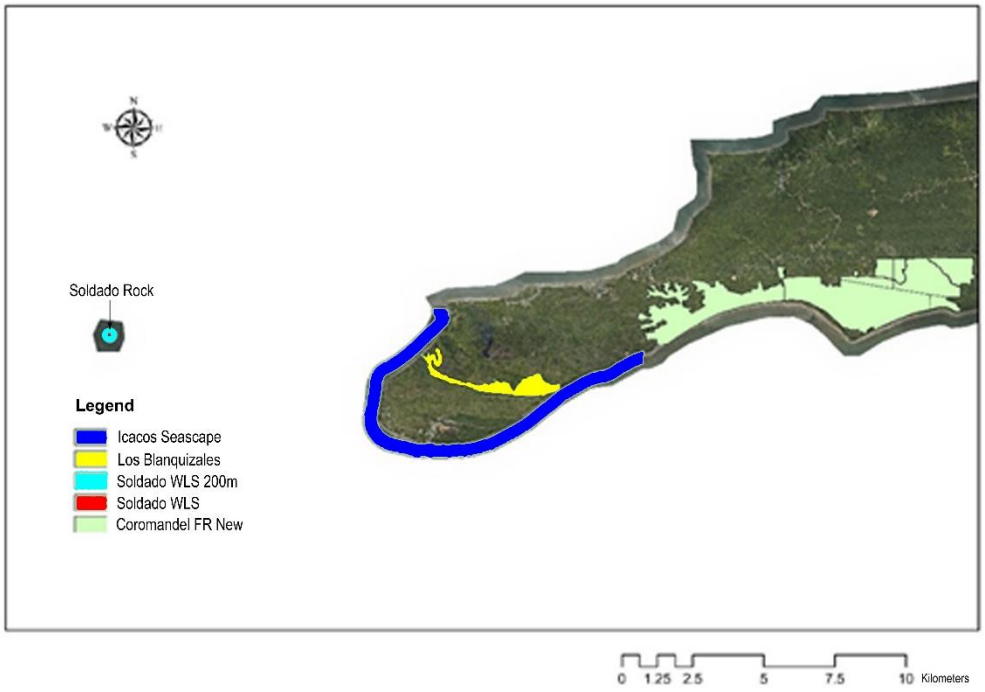


Figure 17. Proposed coastal and marine PNAs in south-west peninsula, Trinidad

5.3.TERRESTRIAL TOBAGO

In Tobago, the NPASP designates a total of 13 areas (Tables 28-33). Of these areas, the sustainable use reserves are the greatest number (6). The proposed new areas increase the surface area of land covered by these terrestrial PNAs on mainland Tobago to 6,669 ha, or approximately 22% of the island, an increase of a little over 9%. The new PNAs provide greater protection to lowland forest ecosystems not previously represented in the PNAs system (e.g. deciduous, semi-evergreen and evergreen forest ecosystem types as well as coastal wetlands).

The new terrestrial PNAs in Tobago place a greater emphasis on providing protection of coastal beaches, as these were identified by local stakeholders as critical for marine turtle protection. At the highest level of protection, are the Scientific Reserves (the Southern Main Ridge) and the Goldsborough Watershed Special Conservation Reserve. These areas are given the highest level of protection to afford protection of the forest ecosystems at these sites, and the wildlife there. They also provide critical watershed protection for one of the most important watersheds on the island.

The opportunities for further habitat protection in the southern 1/3 of Tobago are greatly limited due to the degree of human development in these areas and the lack of large state properties with natural cover on them. Although these areas are not formally represented in the systems plan, the management agencies are encouraged to collaborate with the private sector to improve the ecosystem services in these southern watersheds.

Table 28. Proposed Terrestrial Scientific Reserves in Tobago

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Southern Main Ridge	1564	Proposed in this plan Includes southern portion of previously designated Main Ridge Forest Reserve	Watershed protection Protection of endemic species Relatively intact	Some of best examples of lower montane rainforest and xerophytic rain-forest on Tobago Species endemic to Tobago including the tree *Duguetia tobagensis,* and the Bloody Bay Poison frog *Mannophryne olmonae*	Hunting, climate change	This portion of the Main Ridge is at its nearest point approximately 1km from the Bloody-Bay-Parlatuvier Main Road, and so relatively difficult to access. There are very few trails here and no significant use for recreation. Management activities should emphasise protection activities and research and monitoring value of this site. Assessment is required to determine whether trails could be made exempt from all or part of the Scientific Reserve

Table 29. Proposed Terrestrial Special Conservation Reserves in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Goldsborough Watershed	1284	Proposed in this plan	Watershed protection Protection of forest species	Some of best examples of lower montane rainforest and xerophytic rain-forest on Tobago Suite of native mammals	Housing development	No timber/harvest to be proposed. Protection from agricultural encroachment and dry season fires. Recommended for inclusion in PNA system by stakeholders

Table 30. Proposed Terrestrial National Parks in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Northern Main Ridge	2401	Proposed in this plan Includes northern portion of previously designated Main Ridge Forest Reserve	Watershed protection Ecotourism value Protection of endemic species Relatively intact	Some of best examples of lower montane rainforest and xerophytic rain-forest on Tobago Species endemic to Tobago including the tree *Duguetia tobagensis,* and the Bloody Bay Poison frog *Mannophryne olmonae*	Uncontrolled recreational activities, hunting	Balance protection of watershed with livelihoods from tourism activities

Table 31. Proposed Terrestrial Natural Landmarks or Monuments in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Flagstaff Hill	88	Proposed in this plan	National landmark and recommended during stakeholder consultation	Dry evergreen forest	Fire	Manage site as a National Landmark

Table 32. Proposed Terrestrial Habitat or Species Management Reserves in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
L'Anse Fourmi HMR	446	Proposed in this plan	Connectivity with the Main Ridge Reserve and climate resilience of forest in the Bloody Bay River	Representation of lowland rainforest and topography	Agricultural encroachment, hunting	Important to maintain connectivity with the Northern Main Ridge
Merchiston HMR	103	Proposed in this plan	Dry forest ecosystems on Tobago have not previously been protected. This PNA is designated for its potential to protect remnant forest.	Topographic location and dry forest ecosystem	Fire, hunting, agricultural encroachment and tourism development	Initial survey of site for quality of remaining forest and this proposed listing is based on remote sensing and land-ownership data.
Starwood HMR	64	Proposed in this plan	Listed for protection of semi-evergreen seasonal, deciduous seasonal and lowland rainforest	Topographic location and mix of 3 lowland forest ecosystems	Fire, hunting, agricultural encroachment	Initial survey of site for quality of remaining forest and this proposed listing is based on remote sensing and land-ownership data.

Table 33. Proposed Terrestrial Sustainable Use Reserves in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Ft Granby & Granby Point	46	Proposed in this plan	Wetland and dry evergreen forest remnant National monument Potential turtle nesting beach	National monument	Housing development, agriculture	Coordination between state management agencies and local communities and NGOs to afford seasonal protection of beach for marine turtles, and to undertake restoration/management of wetland and proximate dry evergreen forest remnant.
Minister River & Bay	68	Proposed in this plan	Relatively good condition wetland and dry forest Nesting turtles	Important wetland and dry forest Crab habitat and nesting loggerhead turtle	Proposed hotel development, road and housing development, crab harvesting, agriculture	Area is currently private land, zoned for agriculture. Options to designate appear limited without private land acquisition. THA could consider incentives to encourage private landowners to keep land under forest Recommended for inclusion in PNA system by stakeholders
Petit Trou & Lowlands Conservation Area	191	Proposed in this plan	Wetland Karst floristic community Importance for migratory bird species.	Wetlands and mangrove Important crab habitat	Proposed marina development, land based pollution, reduced water supply due to nearby hotels, crab harvesting	Area is currently, zoned for tourism and/or agriculture. Options to designate appear limited without private land acquisition. THA could consider incentives to encourage landowners to keep land under forest and encourage restoration of native habitats

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Kilgwyn Conservation Area	95	Proposed in this plan	Good example of littoral forests and swamp Importance for migratory bird species	Littoral and mangrove swamp Seagrass beds (degraded)	Physical development, coastal erosion, airport expansion	Should be designated, but will need re-assessment if proposed runway is built Recommended for inclusion in PNA system by stakeholders
Louis D'Or Conservation Area	25	Proposed in this plan	Wetland Importance for migratory /resident bird species.	Wetland	Housing development and potential domestic pollution arising from development Isolation from watershed and interruption of hydrological system due to physical development	Undertake assessment of the status of the wetland to determine its potential to persist given the physical development around the area If listed, to develop interpretive opportunities at site, given ease of access and proximity to housing development
Hillsborough Dam Watershed	294	Proposed in this plan	Protection of watershed function. Connectivity with Southern Main Ridge SR and Goldsborough SCR	Good representation of lowland forest and xerophytic rainforest	Agricultural encroachment, dry season fires and hunting	Undertake survey of boundaries and biological assessment of site. Management of agricultural encroachment and fire suppression

Figures 18 to 20 show the recommended system of terrestrial protected areas on Tobago. These figures are for illustration only. The exact PNA boundaries will be established by the Commissioner of State Lands as guided by the High-level Ministerial Committee (See section 6.1).

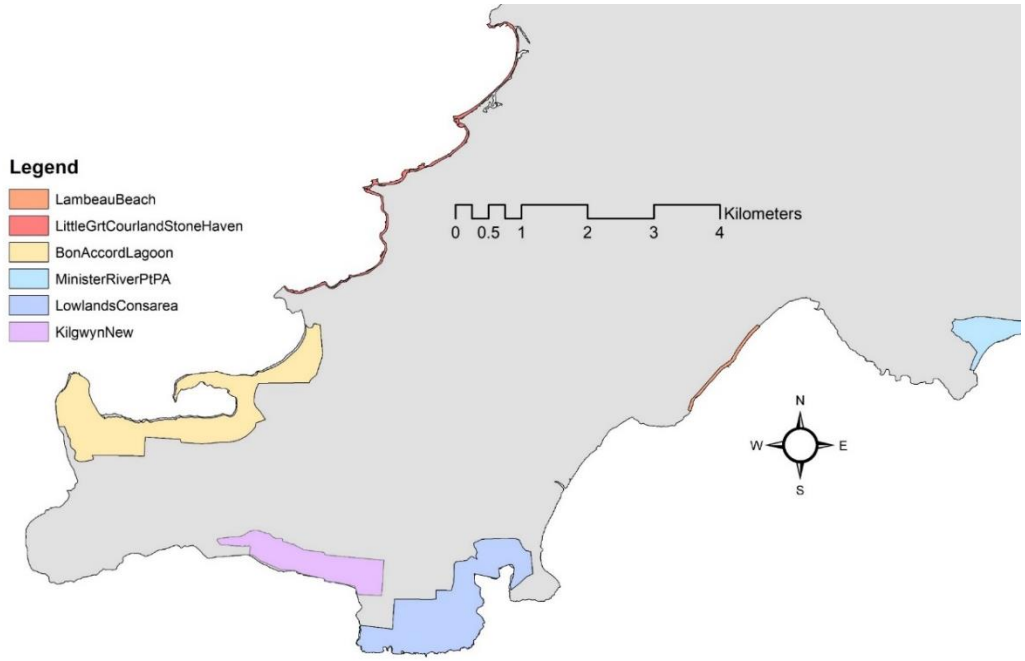


Figure 19. Proposed Terrestrial PNAs in South-west Tobago.

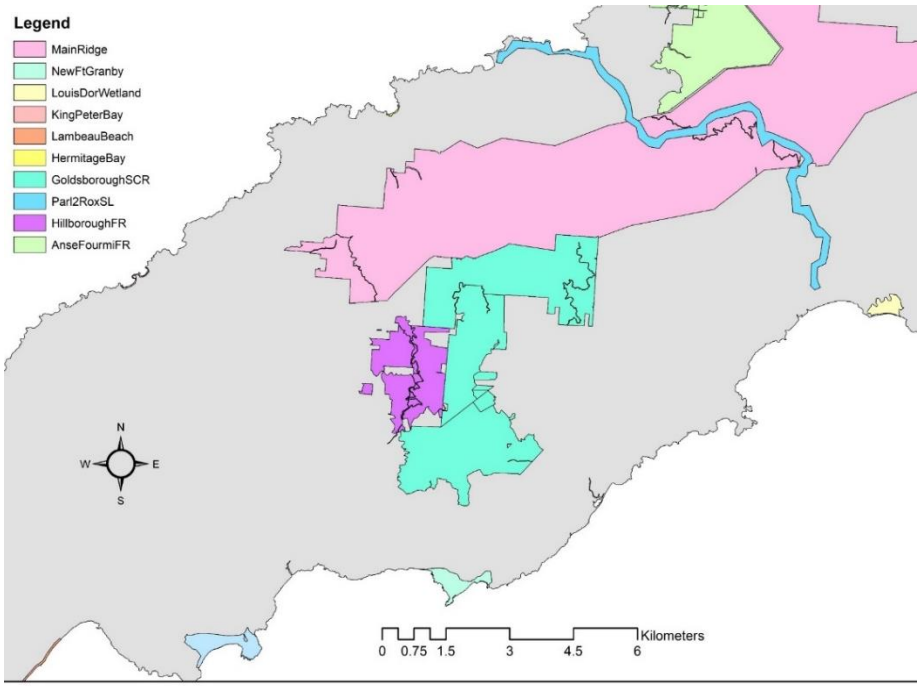


Figure 20. Proposed Terrestrial PNAs in Central Tobago.

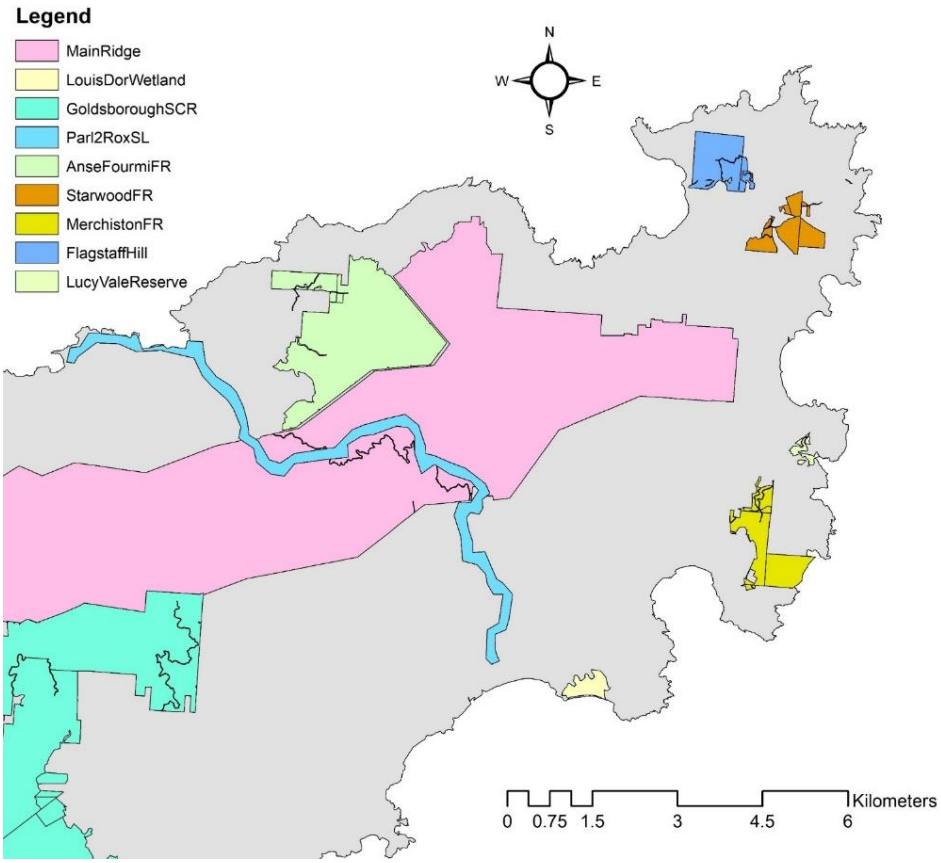


Figure 21. Proposed Terrestrial PNAs in Northern Tobago.

5.4.MARINE AND COASTAL TOBAGO

The coastal marine protected areas in the new NPASP, increase the number of PNAs in the coastal zone around Tobago from three areas (Buccoo Marine Preservation and Enhancement Area, Little Tobago Wildlife Sanctuary and St. Giles Wildlife Sanctuary) to 22 areas (Tables 34-36). It increases the area covered by protected areas from 840 ha to 56,917 ha, an approximately 68-fold increase in near-shore coastal protection for this island. The marine protected areas are divided across 3 designations as afforded by the National Protected Areas Policy categories (Protected Landscapes and Seascapes, Species/Habitat Management Reserves and National Parks). The largest groups are the species/habitat management reserves (16 areas), which are set aside to protect coral and sponge reefs, wetlands, dry forest communities and their wildlife including crabs, fish, turtles and seabirds. The North-east Tobago protected seascape is the largest PNA and within it hosts 5 other PNAs (Figure 21). It is envisaged that these would be managed in a zoned manner similar to the MAB reserve pattern, with the highest levels of protection afforded to the Species Conservation Reserves within the seascape.

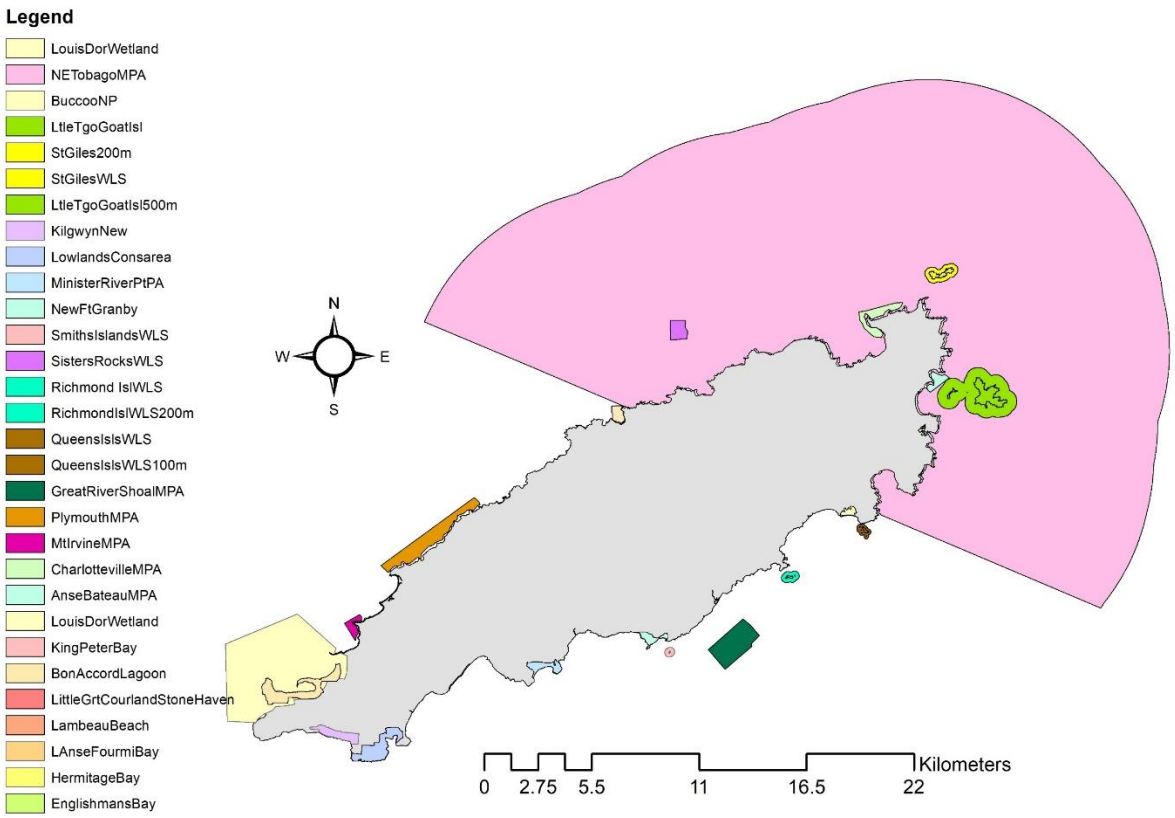


Figure 18. Proposed Coastal and Marine PNAs for Tobago.

Table 34. Proposed Coastal and Marine National Parks (Marine Protected Areas) in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
L'Anse Bateau	52	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012 Embedded within NE Tobago MPA	Coral reef relatively intact	Coral reef Seagrass bed Shark and manta-ray habitat	Climate change, fishing	Develop stakeholder management group and management plan which fits in the context of the wider NE Tobago MPA
Plymouth	334	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012	Coral Reef	limestone substrate forming a reef	High anthropogenic disturbance, climate change, fishing	Develop local stakeholder management group and management plan for site
Mt Irvine	48	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012	Turtle nesting habitat Recreational use	Beach and scenic landscapes	Near-shore coastal development and uncontrolled recreation	Mt Irvine Back Bay should be designated for special scientific and natural heritage interest Most active nesting beaches be prohibited during hours of darkness during nesting season
Englishman's Bay	45	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012	Coral reef Potential turtle nesting beach	Turtle nesting habitat	Climate change, fishing and potential for near-shore coastal development	Proposed to include a marine component but this has deteriorated so level of protection can be lowered Recommended for inclusion in PNA system by stakeholders

Charlotteville MPA	120	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012 Embedded within NE Tobago MPA	Coral reef	Coral reef	Climate change, fishing and near-shore coastal development	Develop stakeholder management group and management plan which fits in the context of the wider NE Tobago MPA

Table 35. Proposed Coastal and Marine Habitat or Species Management Reserves in Tobago

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Little Tobago & Goat Island	101	Proposed in this plan Proposed as part of a larger National Park by Thelen & Faizool (1980) Includes area formerly designated as Little Tobago Wildlife Sanctuary Proposed MPAs by Coral Cay Conservation in 2012 Included in buffer zone of NE Tobago MPA	Relatively intact Breeding seabirds Ecotourism site Coral reef conservation	Breeding Red-billed tropicbirds (*Phaethon aethereus*), Brown booby (*Sula leucogaster*) and Red-footed booby (*Sula sula*), and Audubon's shearwater (*Puffinus lherminieri*) Dry forest ecosystem Coral reef ecosystem	Harvesting of seabirds and eggs, tourism, introduced species	Conservation of seabird nesting islands should remain an important priority for NPASP Recommended for inclusion in PNA system by stakeholders Unclear whether Goat Island is a part of the previously declared Little Tobago Wildlife Sanctuary and if so should be de-gazetted due to severe habitat degradation
Lucy Vale	10	Proposed in this plan	Wetland	Wetland habitat	Agricultural encroachment, seasonal fires	Undertake assessment of the status of the wetland to determine its potential to

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
						persist given the physical development around the area.
Queen's Island	5	Proposed in this plan	Sea bird roosting site	Coral reef & seabird colony	Harvesting of seabirds and introduced species	Include 100m buffer around island. Undertake assessment of the status of the use by seabirds of the site as a roosting/seasonal nesting site.
Richmond Islands	3	Proposed in this plan	Sea bird nesting site	Coral reef & seabird colony	Harvesting of seabirds and eggs, introduced species	Include 200m buffer around island. Undertake assessment of the status of the use by seabirds of the site as a roosting/seasonal nesting site.
Sisters Rocks	2	Proposed in this plan Proposed MPAs by Coral Cay Conservation in 2012 Embedded within NE Tobago MPA		Coral reef & seabird colony	Harvesting of seabirds and eggs, tourism, introduced species	Include 200m buffer around islands. Undertake assessment of the status of the use by seabirds of the site as a roosting/seasonal nesting site
Smith's Islands	0.6	Proposed in this plan	Sea bird nesting site	Red-billed tropicbirds (*Phaethon aethereus*), Brown booby (*Sula leucogaster*) and Red-	Harvesting of seabirds and eggs	Include 100m buffer around island. Undertake assessment of the status of the use by

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
				footed booby (*Sula sula*) roosting		seabirds of the site as a roosting/seasonal nesting site
St. Giles Islands	29	Proposed in this plan Proposed as part of a larger National Park by Thelen & Faizool (1980) Includes area formerly designated as St. Giles Wildlife Sanctuary Embedded within NE Tobago MPA	Sea bird nesting site	Red-billed tropicbirds (*Phaethon aethereus*), Brown booby (*Sula leucogaster*) and Red-footed booby (*Sula sula*) nesting site	Harvesting of seabirds and eggs	Include 200m buffer around islands. Undertake assessment of the status of the use by seabirds of the site as a roosting/seasonal nesting site.
Great River Shoal	321	Proposed in this plan Proposed MPA by Coral Cay Conservation in 2012	Protection of coral community at the site	Coral reef and rocky system Queen Conch habitat	Fishing	Not considered a priority area by stakeholders

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
King Peter Bay	2	Proposed in this plan	turtle nesting beach	Turtle nesting habitat	Disturbance of seasonal nesting turtles and their nests	Designate as a seasonally protected area during turtle nesting season Work with local NGOs and CBOs to develop local stakeholder management group and management plan for site
Great Courland Bay/ Little Courland Bay/ Stone Haven Bay	22	Proposed in this plan	Priority turtle nesting beach	Turtle nesting habitat	Disturbance of seasonal nesting turtles and their nests	Stone Haven is private land but owner expressed interest in the area being included in PNA plan
Lambeau Bay	7	Proposed in this plan	Turtle nesting beach	Turtle nesting habitat	Near-shore physical development and artificial lighting. Disturbance of seasonal nesting turtles and their nests.	Designate as a seasonally protected area during turtle nesting season Work with local NGOs and CBOs to develop local stakeholder management group and management plan for site
L'Anse Fourmi Bay	0.13	Proposed in this plan	Priority turtle nesting beach	Turtle nesting habitat	Disturbance of seasonal nesting turtles and their nests	Designate as a seasonally protected area during turtle nesting season

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
						Work with local NGOs and CBOs to develop local stakeholder management group and management plan for site.
Hermitage Bay	0.3	Proposed in this plan	Priority turtle nesting beach	Turtle nesting habitat	Disturbance of seasonal nesting turtles and their nests	Designate as a seasonally protected area during turtle nesting season Work with local NGOs and CBOs to develop local stakeholder management group and management plan for site.
Englishman's Bay	1.26	Proposed in this plan	Priority turtle nesting beach	Turtle nesting habitat	Disturbance of seasonal nesting turtles and their nests	Designate as a seasonally protected area during turtle nesting season Work with local NGOs and CBOs to develop local stakeholder management group and management plan for site.

Table 36. Proposed Coastal and Marine Landscape or Seascapes in Tobago.

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
North-East Tobago MPA	53,340*	Proposed in this plan Not previously designated in law	Near-shore marine systems Sustainable livelihoods Wetland	The largest near-shore MPA in country protecting a complex seascape of offshore islands, coral reefs, sponge reefs and sandy beach Important recreational, fishing and ecotourism mosaic	Coastal development, overfishing	Stakeholders favour a "trust" mechanism for managing NE Tobago. Initial activities should focus on development of an overarching management plan with zoning for this PNA, since it overlaps multiple PNAs, of different levels of protection
Parlatuvier-Roxborough	240	Proposed in this plan Area previously included in Thelen & Faizool (1980)	Unique driving experience	Panoramic vistas	Physical human development and seasonal fires.	Protect State lands and natural forested landscape features that define vistas
Buccoo Reef and Bon Accord Lagoon	2234	Proposed in this plan Area includes that previously designated a Marine Preservation Area by the Fisheries Act	Coral reef Largest freshwater marsh in Tobago Heavily utilised for tourism	Coral reef and mangrove One of largest remaining seagrass beds in Tobago Habitat for critically endangered hawksbill turtle Migratory birds	Large-scale coastal development, pollution, tourism, climate change	Integrate with Bon Accord Lagoon & Buccoo marshes in a MAB-zoned design using the National Park boundary (larger than Ramsar Site) Much of surrounding land is privately owned and discussions with THA about potential

Name	Area (ha)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
		Proposed MPA by Coral Cay Conservation in 2012				management options would be useful

*Area includes embedded PNAs: L'Anse Bateau, Charlotteville, Little Tobago and Goat Island, St. Giles Islands and Sisters Rocks.

Figures 22 to 24 show the recommended system of marine and coastal protected areas on Tobago. These figures are for illustration only. The exact PNA boundaries will be established by the Commissioner of State Lands as guided by the High-level Ministerial Committee (See section 6.1).

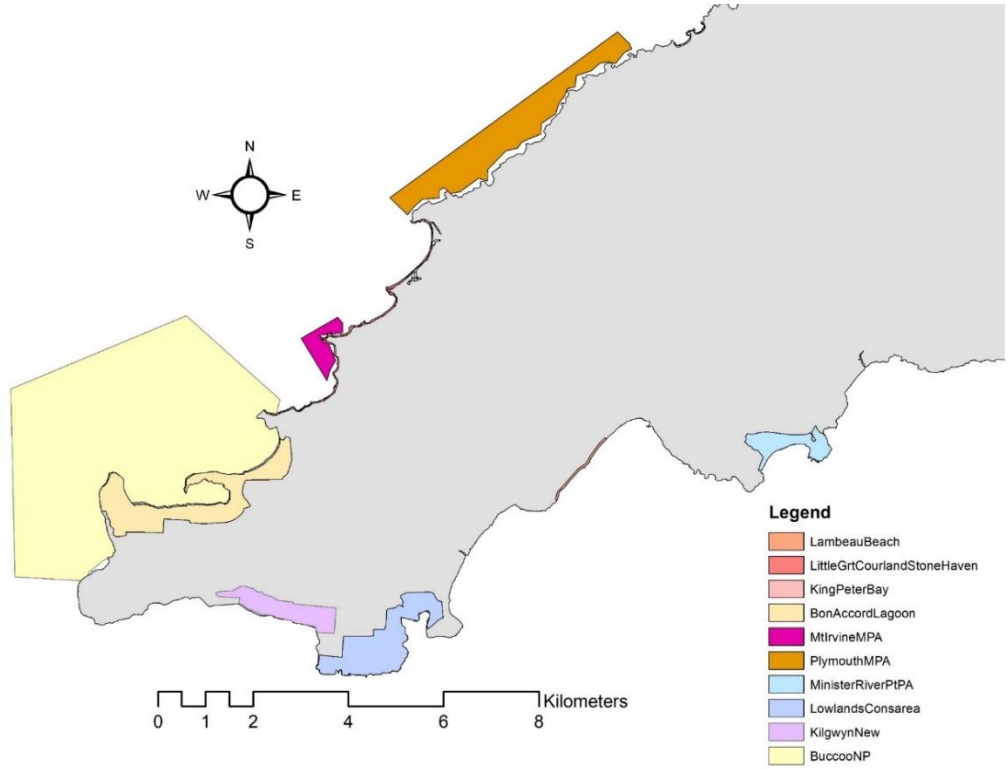


Figure 19. Proposed Coastal and Marine PNAs in South-west Tobago.

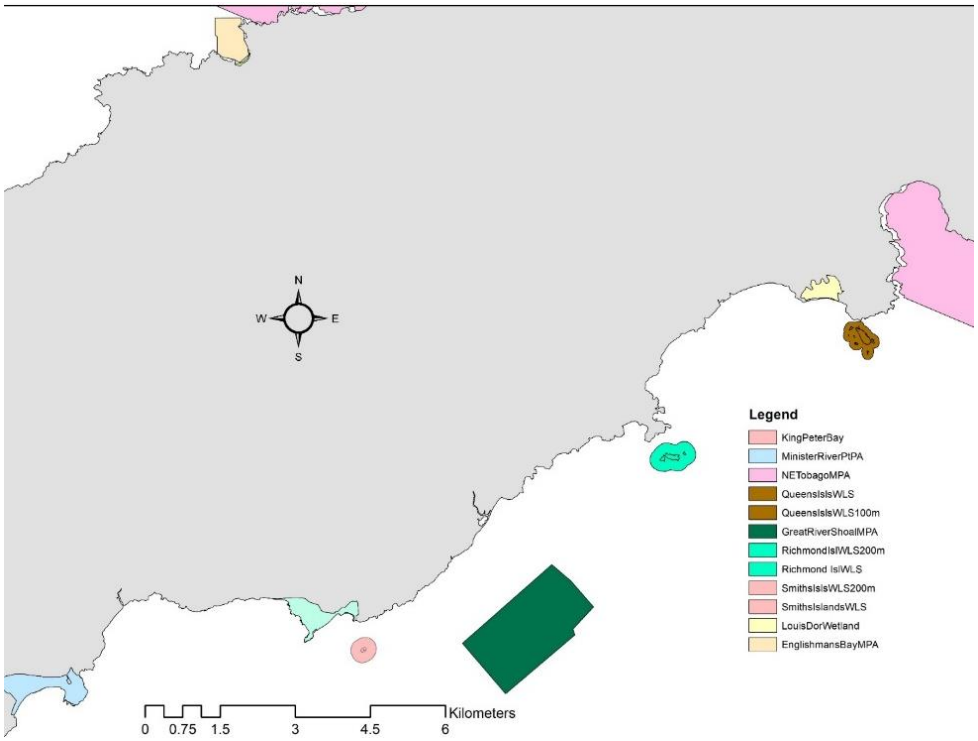


Figure 20. Proposed Coastal and Marine PNAs in Central Tobago.

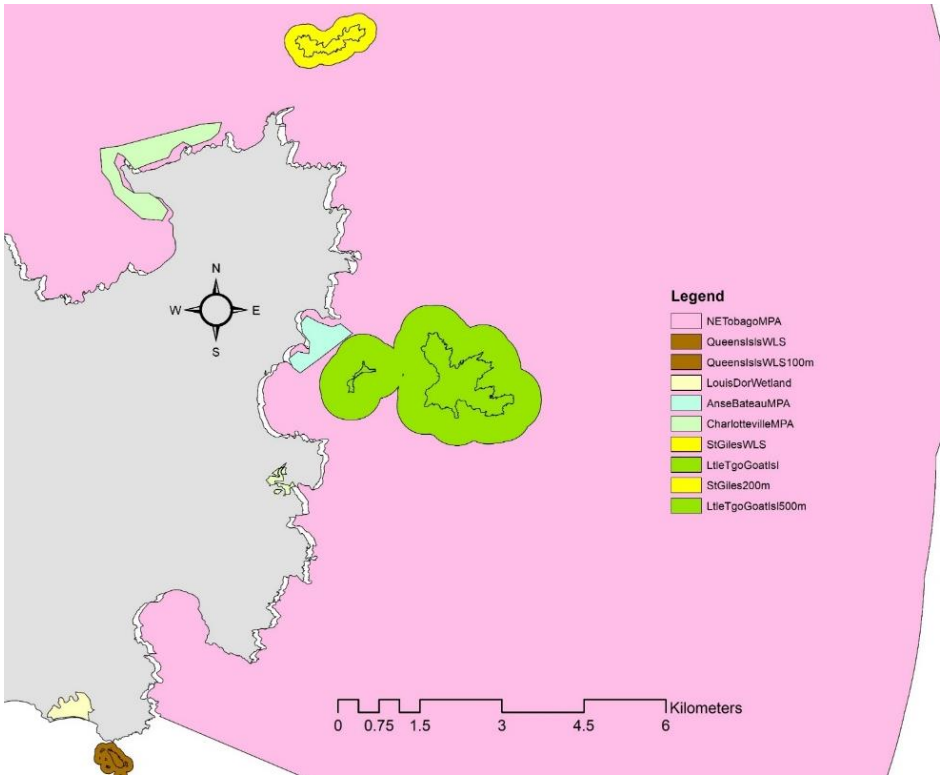


Figure 21. Proposed Coastal and Marine PNA in Northern Tobago.

5.5.Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago

Among the ecosystems recommended under previous PNA plans for Trinidad and Tobago, the open oceanic and deep-sea areas of the country, have perhaps received the least attention. Although there has been growing economic interest in exploitation of fossil fuels from these sites, comparatively little biological data has been collected for these areas, compared to terrestrial areas in the country. Recent work has indicated that at the sea-bed these ecological communities are diverse, unique systems deserving protection (Amon et al. 2017). These marine areas have traditionally been of interest for fisheries and as routes of navigation, and are active areas of interest globally for improved natural resources management and conservation (e.g. the CBD programme on Ecologically or Biologically Significant Marine Areas [EBSAs] (CBD 2018)).

In the new TTPASP, four new protected areas have been proposed, which include the Caribbean Arc SUR, Eastern Caribbean SUR, Atlantic Ocean SUR and Orinoco-Guyanan SUR (Table 37, Figure 25). These areas have been chosen to reflect broad-scale ecosystem diversity (Spalding et al. 2007), areas already identified as ecologically or biologically significant areas (CBD 2018), provide representation of a range of bathymetric characteristics, biological productivity (Miloslavich et al. 2010; Amon et al. 2017), and provide ecological connectivity across the marine communities in these ecosystems.

In total these areas amount to approximately 21% of the EEZ claimed by Trinidad and Tobago and thus, provide a basis for the country to exceed its obligations under the Aichi targets for marine conservation under the CBD (Woodley et al. 2012). The boundaries of the proposed areas explicitly follow concession boundaries for oil/gas exploration, which have not been assigned by the Ministry of Energy and Energy Industries as of the time of this writing. These boundaries were explicitly chosen to reduce conflict with the oil and gas industry, which is currently the most active stakeholder in this ecosystem. This decision adheres to the “realism” design criteria adopted in this plan.

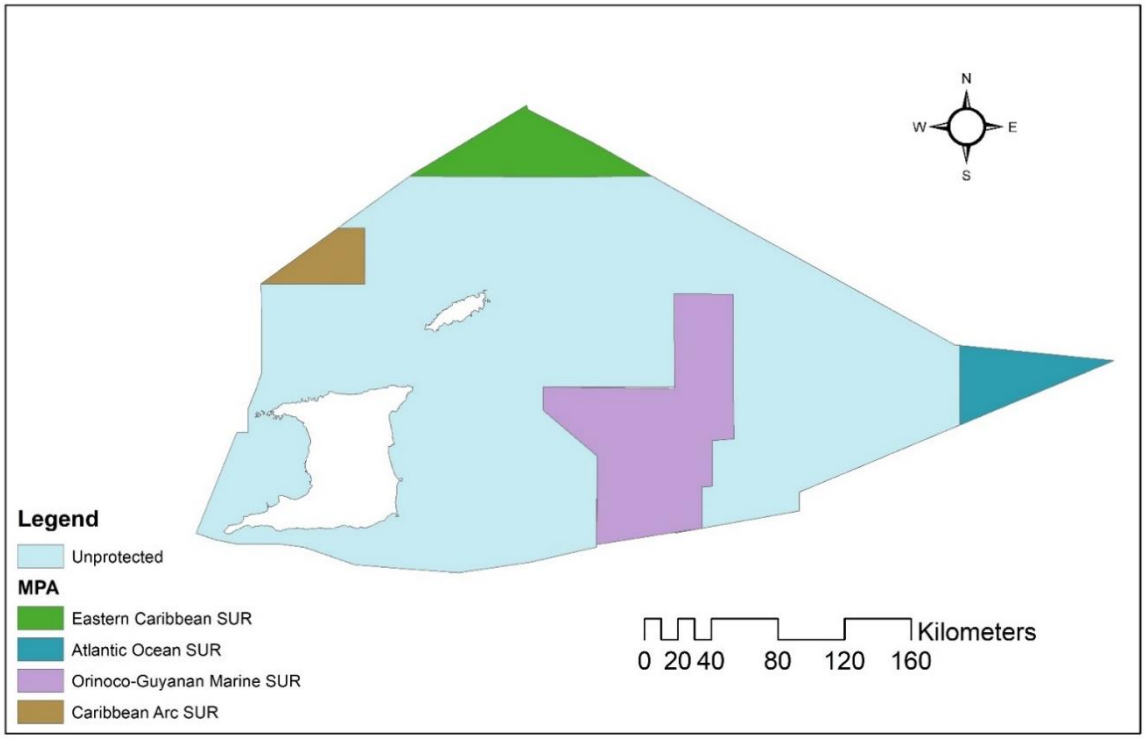


Figure 22. Recommended Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago.

Table 37. Proposed Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago

Name	Area (km^2)	Establishment History	Primary reason for designation	Outstanding Features	Threats	Recommendations
Caribbean Arc SUR	1,295	Proposed in this plan	Protection of migratory species, unique sea-bed biological communities, maintenance of ecological connectivity and processes, sea-bed geological formations To meet agreed CBD/Aichi marine PNA targets	Migratory species (e.g. whales, sea turtles, seabirds), sea bed communities and geological formations	Un-regulated deep-sea mining, oil spill, un-regulated high-seas fishing, solid waste pollution	Management agencies (Commissioner of State Lands, Ministry of Energy, forest and fisheries departments from national government and THA), Coast Guard, and Ministry of Foreign Affairs should establish a working group to coordinate management of these Sustainable Use Reserves, and periodically consider evidence for higher levels of protection in areas identified.
Eastern Caribbean SUR	3,034					
Atlantic Ocean SUR	2,188					
Orinoco-Guyanan Marine SUR	9,105					

6. DEVELOPMENT STRATEGY FOR THE NATIONAL PARKS/PROTECTED AREAS SYSTEM

6.1.IMPLEMENTING THE NPASP

The scale of this NPASP necessarily requires a multi-stakeholder approach to its designation, legal establishment and management. In this context, the history of protected areas planning in Trinidad and Tobago provides several important lessons. As the NPAP indicates (GORTT 2011c), the inability to implement the previous approved systems plan (Thelen & Faizool 1980), or any of the subsequent plans stumbled on the issue of the institutional arrangements and legislative mandate to designate and manage any new PNAs. As of this writing of the NPASP, these issues remain highly contested.

This NPASP proposes important changes to the number, size, management objectives and spatial arrangement of the protected areas across the country. While the IFPAMTT has undertaken several national workshops to provide opportunities for the stakeholders to participate in the process of identification and design of the PNAs, the changes recommended here represent a fundamental change to the historical system of forest reserves, wildlife sanctuaries and ESAs.

The first step to implementation of the NPASP should be the convening of a high-level national steering committee comprised of a Ministerial committee which would make recommendations to the Cabinet on the implementation of the NPASP. This committee ideally should include the Minister of Finance, Minister of Energy and Energy Industries, Minister of Agriculture Land and Fisheries, Minister of Planning and Development, Attorney General and the Chief Secretary of the THA. These political stakeholders will determine the strategic legislative, financial and organizational approaches and decision-making required to implement the NPASP.

At the operational level, the currently approved national policy on protected areas had suggested a Board of the proposed national protected areas authority, as the locus for role (GORTT 2011c). Given the lack of enabling legislation, the high-level Ministerial steering committee would determine the most efficient/effective way to direct the existing management agencies (THA's DNRF, Ministry of Energy and Energy Industries, Commissioner of State Lands, Forestry Division, Fisheries Division, EMA and CDA), to take the steps to implement the NPASP on the ground.

The NPASP provides general direction on the size, connectivity and shape of the recommended PNAs. To give effect to these PNAs on the ground, the relevant management agencies would need to undertake site-level boundary demarcation surveys of the new PNAs within the NPASP. In parallel to this activity, the Cabinet appointed high-level Stakeholder Committee should direct the establishment of local PNA committees comprising the stakeholders (State management agencies,

community-level CBOs, NGOs, private landowners and traditional users of the sites), to act as local-level PNA advisory boards. This approach ensures that the development of the PNAs and their management takes into consideration the historical uses of the sites, as well as the needs and expectations of the local communities and traditional users. These site-level committees will also provide a conduit for information transfer between the managers of each of the PNAs and the local communities.

The next formal step in the process of designation of the PNAs, would involve the legal establishment of the physical PNA entities in law, by the State. The NPAP (GORTT 2011c) envisaged the establishment of the PNAs using its recommended classification system, through new national protected areas legislation. Since there is still no existing legislation at the time of this writing, new enabling legislation to facilitate such designation remains one option. Another option, which was used historically to establish the Forest Reserves, would be to use the State Lands Act (Chap: 67:01), which empowers the President to designate the use of public lands and delegate the responsibility for their management. In this regard, the President as a regulation under the State Lands Act (Chap: 67:01) could establish the NPAP. In this context, the seven protection categories could be legally established as a regulation under this Act and, the specific sites then established under this regulation.

Once the areas are formally established, the national steering committee and the management agencies will need to develop site level management plans for each of the 136 PNAs in this system, bearing in mind each different designation implies different management goals and objectives. At the national level, there are good participatory models for undertaking such plans, such as that prepared by the Caribbean Natural Resources Institute (CANARI) for the Aripo Savannas ESA (EMA 2008). Such participatory site-level management plans can improve buy-in by the local stakeholders, with respect to the management of the PNAs and it is recommended that such an approach be adopted for the elements of the NPASP, where feasible and relevant. Once drafted, the implementation of each of these site level plans signals the beginning of the actual functioning of the entities that make up the national protected areas system.

6.2. FINANCING THE NPASP

The management of the PNAs established under the NPASP will require significant initial financial investments. This will be needed to establish PNA boundaries, individual site-level management plans (including habitat management and species recovery), development of recreational and/or interpretive infrastructure (e.g. signage, board-walks, trails) and/or visitor facilities (where

appropriate), law enforcement facilities, fire towers (where appropriate), administrative facilities, and research and monitoring plans. Beyond these hard costs, the management of the areas and the general administration of the national protected areas system will require personnel to undertake the various public education, law enforcement, community engagement, financial management, monitoring and species/habitat management programmes. In the development of the IFPAMTT project, the project drafting team identified several key elements of the financial sustainability of that project (Nelson 2013), which remain relevant to the funding strategies that are relevant to all the PNAs within the NPASP.

An important component identified in that document was the role of the Green Fund to support the establishment of the NPASP. The Green Fund represents the most direct taxation method in place nationally, for earmarking financial support of environmental management in the country. Given that the establishment of a system of protected areas as envisaged by the NEP (GORTT 2006b), is a cornerstone of the country's environmental policy, the use of some proportion of the Green Fund to establish and endow the protected areas system is a logical use of these funds and furthers the national environmental policy agenda. It is recommended that the government take steps to use some portion of the Green Fund to undertake the activities necessary to establish the PNAs identified under this NPASP, and to create an endowment for the PNA system.

At the institutional level, the Environmental Fund of the EMA presents an important local model for financial administration within and among the PNAs of the NPASP. Establishment of such an institutional fund for the PNAs within the NPASP was envisaged by the NPAP. However, with the institutional, governance and management arrangements for PNAs undecided, the implementation of such a fund as recommended by the NPAP (GORTT 2011c), may be problematic without changes in the current management structure. If this issue remains unresolved, the implementation of an independent fund for the NPASP that can function in the existing management constraints, will require a unique financial solution. This may require a specific project to road-map the approach required for the development and financing of this fund.

At the operational level within the protected areas system, key financial issues that require consideration include the establishment and funding of personnel responsible for law enforcement, management, monitoring and public engagement at the PNAs. Currently these functions are financed by the State through the DNRF in Tobago and the Forestry Division in Trinidad. With the NPASP proposing many new PNAs, the degree of personnel and financial resources provided to these organizations, as well as their organizational structure need to be reviewed in the context of the expanded responsibilities, policy mandates imposed by the national Forest, Wildlife and Protected Areas policies (GORTT 2011c, b, 2013b), and the implications of the greatly increased

number of PNAs which may fall under their jurisdiction if the NPASP is implemented. Further thought should also be given to the need for delegating these management responsibilities to other State actors (e.g. Coast Guard and Fisheries Division given the expanded marine PNAs) and CBO/NGO organizations (See discussion in 6.3 below) where appropriate.

At the individual PNA level, the aggressive implementation of cost recovery activities including user-fees for ecotourism, licenses/permits for entry and tour operations, parking, resource extraction where permissible in PNAs, inspection, and fines, need to be devised. These fees should represent the actual economic cost of administration of the relevant programmes, and contribute directly to the fund which supports the PNAs. The institutionalisation of a user fee system is critical to the viability of the NPASP, in particular those sites which historically have had high levels of visitor usage.

In addition, the use of paperless systems of permits/ for these services and online purchases should be used to ensure efficient, cost-effective and user-centric, delivery of services. The management agencies and the Cabinet-appointed steering committee should also aggressively promote the engagement of the private sector in tourism development at those PNAs where appropriate and promote corporate sponsorships for the PNAs. Finally, the use of concessionaires to deliver services at each of the PNAs where such services are consistent with the PNA designation, should be used to ensure cost effective, high-quality services are delivered to the public at these sites.

One emerging area that should feature in the sustainable financing of the PNAs is the use of payments for ecosystem services (PES), to support the NPASP. The ecosystem services for which there are substantial models for payment are watershed function and carbon sequestration of natural ecosystems. There are several recent examples of such schemes in Central and South America (Martin-Ortega et al. 2013; Grima et al. 2016), and the Cabinet-appointed steering committee should direct the management agencies to develop a formal plan to develop pilot schemes for the PNAs within the NPASP. Indeed, a recent study has documented the success of a pilot PES scheme for fire management in the Caura Valley (Rawlins & Westby 2013). Benefits from implementation of such a scheme could also be used to not only support individual PNAs, but also to promote management activities by adjacent local communities and private landowners, whose activities may have important influences on successful PNA management.

The economic viability of the PNAs should also be linked to the ability of the PNAs to provide sustainable livelihoods to adjacent local communities. Where appropriate, the individual PNAs should support revenue-generating activities in near-by communities including branded ecotourism

products, wildlife farming, home-stay tourism, local handicraft based on non-timber forest products from the PNAs, and small-scale industries

6.3.PNAS MANAGEMENT AND CIVIL SOCIETY ENGAGEMENT

In Trinidad and Tobago, there has been a rapidly maturing level of public engagement in the environmental sector. This can be seen in the growing levels of public awareness of the threats facing the biodiversity of the country, interest in recreation in natural areas, and concern for iconic threatened wildlife (Nelson 2004; Waylen et al. 2009; Granderson 2011). In addition, the people of the country have had a historically strong utilitarian relationship with the living natural resources, as exemplified by the sustained interest in hunting of wildlife and the commercial exploitation of timber and coastal fish resources (e.g. Van den Eynden 2018).

In this context, the management and governance of the PNAs in the new national System can only be successful with the full engagement of civil society and importantly, the stakeholders who will be directly affected by the designation and management of the PNAs. Such stakeholders include the traditional users of these natural areas and their species and ecosystems, as well as national, regional and international stakeholders who have a shared interest in the conservation of the living natural heritage of the country.

The value of such stakeholder leadership in management of PNAs in Trinidad and Tobago now has good models, which highlight the value of this approach. Specifically, the lessons of the marine turtle conservation actions in north-eastern Trinidad are a testament to the potential for civil society to simultaneously benefit from conservation of wildlife at a PNA, while directly leading to recovery of the species and habitat at the site. Thus, the work of Nature Seekers at Matura and the Grande Riviere Nature Tour Guides Association, in conserving and protecting nesting marine turtles at the Matura and Grande Riviere beaches, demonstrate the value of local community groups in improving site level management of protected areas.

Here the value of delegated responsibility for management of the specific PNAs, to local CBOs/NGOs can provide cost effective management solutions to conservation of the biodiversity at these PNAs. This approach can provide an opportunity for building community support for the new PNAs and reinforcing the potential benefits of functioning PNAs to local communities. The integration of local communities, CBOs and NGOs in the governance and management of the individual PNAs should be at the heart of the management of the PNAs in the NPASP.

6.4.PRIVATE PROTECTED AREAS

During the process of public consultations, particularly in Tobago, stakeholders expressed a keen interest in the designation of private lands as protected areas under the NPASP. At a national level, historically there have been several private holdings across the country that have been managed by their respective owners/trustees as nature reserves (e.g. Asa Wright Nature Centre, Grafton Estate). Some, such as the Asa Wright Nature Centre, continue to make significant contributions to conservation of the natural areas under their ownership, and to other aspects of conservation (e.g. conservation education and advocacy) at the national level (Nelson et al. 1999).

Despite this history of private-citizen interest in establishment of protected areas, the designation of such areas is not currently possible without promulgation of enabling legislation. The framework recommended by the NPAP provides sound guidance on the approach to enable private landowners to become part of the national network of protected areas (GORTT 2011c). Ideally, the development of such enabling legislation should allow for a range of engagement options by private landowners in the management of their properties to compliment the national conservation priorities within the watershed/ecosystems where their properties exist. Such conservation-easement approaches have been used elsewhere in the wider Caribbean (Mello et al. 2010; Castro-Prieto et al. 2017) to enable conservation at a broad landscape level. Utilising the opportunities presented by such potential public-private partnerships, represents an important cost-effective approach to ensuring conservation of threatened species, maintenance of landscape-level ecosystem services and boosting public buy-in to the value of the NPASP. Such conservation-easement approaches could be financed through parallel implementation of PES schemes in the relevant watersheds/landscapes.

It is recommended that in the development of priorities for implementation of this plan, the relevant State agencies should begin dialogue with interested private citizens who may have an interest in such conservation agreements. It should be noted that such official designation lies on the higher end of the spectrum of engagement complexity that may be used to engage private entities in the conservation of PNAs at the national level and will require enabling legislation.

6.5.REMAINING GAPS

The NPASP represents the outcome of a process that included assessment of existing status of species, ecosystems and processes in existing PNAs, identification of gaps in the existing system and placing these in the context of stakeholder desires and expectation, as well as the realities of ownership and access patterns to natural areas in the country. As a result, the NPASP represents a

compromise across many dimensions of biological and social issues affecting PNAs designation. In this regard, there are inevitable gaps in the coverage of ecosystems and species in the country.

In some cases, the lack of sufficient biological data on species and community distribution limited the confidence we can have in the coverage provided by the NPASP. Examples of this are the deep-sea ecosystems or the habitats of marine migratory species. Here, we can only have limited confidence in the coverage provided by the OOWDS in the NPASP. However, in the case of the OOWDS in particular, it is expected that the future growth in scientific information from this part of the national territory will provide evidence for new PNAs or changing the PNA designation of the areas currently recommended in this zone (Table 34).

In other cases, the lack of available State lands limited the options for designation of new protected areas. This was the case for areas of southern Tobago and central and south-western Trinidad, where the lack of such opportunities meant limited coverage of mid-watershed communities or riverine communities. While we have tried to highlight the role of riverine corridors in maintaining the landscape connectivity of the PNAs, the seven riverine corridors recommended here are a minimal approach to ensure the connectivity of wildlife and plant populations terrestrially. Given the innovations in management required to ensure that these corridors function as envisaged, these areas are recommended as a first step. If the management agencies are able to make these PNAs work, there should be a future effort to encourage development of other such riverine corridors across the landscape of both islands, particularly where these can allow for connectivity between upland forest ecosystems and estuarine areas where protected areas of mangrove or marsh communities may occur. As a result, the future designation of riverine corridors or new mid-watershed PNAs should be a priority.

For some ecosystems, while there is clear evidence of the need for their protection, the degree of current human activity and impact in these ecosystems make their designation at this time problematic. For example, the mudflats along the west coast of Trinidad, south of the Caroni National Park to San Fernando. These areas are important area for migratory shorebirds and have been identified as Important Bird Areas (IBAs) (Birdlife International 2017). However, the high intensity of industrial development, land reclamation and other forms of human disturbance make these areas challenging to designate at this point. However, it is recommended that the management agencies review the status of these mud flats to determine the feasibility of their designation as seasonally protected species management areas, in the near future.

Finally, there were some cases where there remained State lands which appeared intact in terms of their forest cover, and whose ownership by the State would make them ideal candidates for

designation. Examples of such areas are those State lands to the north of the Hollis SCR and south of the Madamas Scientific Reserve. This area is of the highest priority for designation in the near future given its central location in the remaining north-eastern forests of Trinidad. We have not designated it here since it remains surrounded by PNAs that will have a high level of protection, are well away from current areas of human development, and are thus perhaps the least threatened of the remaining natural areas on Trinidad.

We have been mindful of not “locking up” all the lands in the country in PNAs, given the extent of the NPASP being recommended here, and as a result we have been conservative in the designation of more land as PNAs. Nonetheless, should the current PNAs system be formally established, these remaining areas should be priorities for future expansion of the NPASP.

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APPENDICES

8. APPENDIX I. GAP ANALYSIS METHODOLOGY

Ensuring that the NPASP provides the best possible coverage of the ecosystems, species, genetic diversity, as well as maintaining broad-scale ecological patterns and processes, requires an understanding of where the current system requires addition or modification, to ensure these characteristics are maintained. The way we approached this challenge was to conduct a gap analysis.

Our gap analysis used the data in the published literature and unpublished data provided to us by stakeholders, to examine the attributes of representation, redundancy, resiliency and realism, within the existing Reserves, Sanctuaries, Marine Preservation and Enhancement Area, ESAs and Prohibited Areas. These data were identified through the literature review and from discussions with stakeholders. These studies included analyses of endemic species hotspots, migratory species stop-over sites, ecosystem classifications, inter-population genetic differentiation, climate change impacts and mapping of natural resource use.

We also modelled the species richness of key taxa across the PNA network in Trinidad and Tobago, as a means to fill in some of the "representation" data gaps. This method allowed us to identify areas of high biodiversity and uniqueness. Here, we created stacked species distribution models (SSDMs) to predict species richness using available species occurrence data. Data for modelling patterns of species richness were obtained from a variety of sources, including the Global Biodiversity Information Facility (GBIF) and a review of the relevant literature (see section 3.4). GBIF is the leading provider of open access biodiversity data, collated from hundreds of museums, herbariums, other research institutions and citizen science projects. These data are widely used for modelling, planning and management studies (e.g. Shrestha et al. 2010; del Rosario Avalos & Hernández 2015; Gray et al. 2016). However, such data are known to be subject to errors and spatial and sampling biases (Boakes et al. 2010). To address this issue, we used a threshold of spatial uncertainty of less than 10 km^2 and the 'target species' approach (Phillips et al. 2009) to create a bias layer using total sampling effort for a given taxa. Elevation and potential evapotranspiration (see Nelson 2004) were used as predictor variables for the SSDMs, that were created using the Maxent modelling environment (Phillips et al. 2004). SSDMs were produced by summing the predictions from the individual species models (Calabrese et al. 2014), producing a map of predicted species richness for a given taxa.

Another important element of the gap analysis was to determine metrics that adequately describe the current state of the existing PNAs in Trinidad and Tobago. Here, basic measures of all PNAs were determined, including their size (km^2) and spatial location. Remote sensing analysis of the 2014 Aerial Photography (Lands and Surveys Division) was conducted in ArcGIS 10.4.1 as a means to estimate important PNA metrics. The percentage of all remaining natural forest cover in the current terrestrial PNAs was determined using manual (i.e. visual) classification (Horning 2010) of the satellite imagery, to estimate the level of disturbance for each PNA. Here, we defined forest cover as the presence of more than 50% woody vegetation in a 0.1 ha cell. For each PNA, the edge-to-area ratio was also calculated as the remaining forest cover (m^2) in 2014 divided by the total length (m) of a given fragment. This was used as our index of fragmentation for a given PNA (Woodroffe & Ginsberg 1998). Road density, as a function of the total PNA area (km/km^2) surrounding each terrestrial PNA, was estimated as a measure of disturbance (Sanderson et al. 2002). Isolation and connectivity was estimated as the matrix of distances (km) to all nearest PNAs within 10km and was measured for all PNAs.

Among the greatest gaps in the previous protected areas plan was the conservation of coastal nearshore marine, and deep-sea/oceanic natural areas. We assessed representation in deep marine ecosystems using currently published ecosystem level classification of marine ecosystems in the southern Caribbean (Spalding et al. 2007). To address gaps in the nearshore coastal environment we used a combination of stakeholder consultation, published and unpublished literature on the extent of sea-grass beds, coral formations and other marine benthic features. In this, we received the assistance of the Director of Trinidad and Tobago's Institute of Marine Affairs (IMA), and the UWI's Department of Biological Sciences marine biologists, who provided their advice on the state of knowledge of these systems. We also used publicly available mapping of existing energy concession zones in the deep marine environment, which are published by Trinidad and Tobago's Ministry of Energy and Energy Industries. We used these data to define boundaries for proposed deep-sea MPAs, this reflects our approach of "realism" in new PNAs design, which minimises conflict for the new PNAs by ensuring that the areas proposed are not currently the focus of deep-sea energy exploration or mining.

To estimate the capacity of the PNAs system to hold on to the biodiversity at a given site, we used Population Viability Analysis (PVA) to determine the degree of resiliency of the current PNA system for protecting large vertebrate terrestrial species. We acknowledge that this methodology has its biases, since it inherently adopts an umbrella species approach to species conservation in a given PNA. This approach has weaknesses as it may not adequately address species that have unique

habitat requirements, are migratory or have unique life histories. We have tried to compensate for these weaknesses by including elements of uniqueness and redundancy within the proposed system.

The PVA method assesses a species' extinction risk over a given time period (usually 100 years). Large species often have large home range requirements and are often the first species to be lost from an ecological community (Cardillo et al. 2005). Thus, these species are appropriate to use as a proxy for the long-term likelihood of a given PNA supporting an intact ecological community (Gaston et al. 2008). Demographic data for the PVA models were obtained from the published literature. As is standard practice (White 2000), data from mainland South American populations were used when local data did not exist for a species. A range of PVA scenarios were run, from a best-case scenario with the original (i.e. complete) forest cover and between PNA dispersal to a worst-case scenario, with actual estimated forest cover and no inter-PNA dispersal. Scenarios were also run with high, low and no hunting. PVA models were run in the software package R, based upon the methods of the VORTEX programme (Lacy 1993).

A critical element of the Gap Analysis was the determination of the opportunity for new PNAs designation. Where the shape, size, connectivity and location of the existing PNAs were inadequate to ensure conservation of the important characteristics we identified above, we proposed new areas to improve the landscape and portfolio-effect of the NPASP as a whole. To do this, we assigned ownership of all PNAs based on GIS-based cadastral sheets provided by the University of the West Indies St Augustine's Department of Geoinformatics. This was necessary, since the current PNA system often includes lands that have been leased (e.g. to the oil and gas industry, or historically leased for agriculture) for uses which are often inimical to PNAs management. To reduce the potential conflict that would arise from new PNAs designation in sites already identified for alternative land uses, we used the cadastral sheets to prioritise lands that still remain under state ownership, as sites for new PNAs or for expansion or boundary alteration of existing PNAs. This approach was central to the "realism" criterion in PNAs design approach used in the NPASP.

9. APPENDIX II. PNAS BY DESIGNATION

Table A1. Summary of designations of all proposed Protected Areas in Trinidad and Tobago.

Protection	Terrestrial		Coastal/Marine		Trinidad	Tobago	Total
	Trinidad	*Tobago*	*Trinidad*	*Tobago*			
Scientific Reserve	1	1			1	1	**2**
Special Conservation Reserve	7	1			7	1	**8**
National Parks	4	1	1	5	5	6	**11**
National Landmarks & Monument	5	1	1		6	1	**7**
Habitat/Species Management Reserve	18	3	14	14	32	17	**49**
Riverine Corridor Habitat or Species Management Reserves	7				7		**7**
Protected Landscape/Seascape	5		1	3	6	3	**9**
Sustainable Use Reserves	32	6	1		33	6	**39**
Total	**79**	**13**	**18**	**22**	**97**	**35**	**132**

Table A2. Designations of new Terrestrial Protected Areas in Trinidad (except Sustainable Use Reserves).

Scientific Reserves	Special Conservation Reserves	National Parks	Natural Landmarks and Monuments	Habitat or Species Management Reserve	Landscapes or Seascapes
Madamas Forest	Matura Forest	Caroni Swamp	Blue Basin	Arima Forest	Maracas Bay Forest
	Yarra Forest	Nariva Swamp	Cumberland Hill	Aripo Savannas	Paria-Madamas
	Heights of Aripo	Chaguaramas	Devil's Woodyard	Blanchisseuse	
	Hollis Watershed		Pitch Lake	Cap-de-Ville	
	El Tucuche		San Fernando Hill	Central Range	
	Northern Range		Tamana Hill	Navet Watershed	
	Reserves B & C			Erin Forest	
				Southern Watershed	
				Tamana Caves	
				Trinity Hills	

Table A3. Designations of new Terrestrial Sustainable Use Reserves in Trinidad.

Arena	Ecclesville	McNair Ravine Sable	Piparo Extension	Tacarigua
Basin Hill	Freeport	Melajo	River Estate	Todd's Road (North)
Brigand Hill Forest	Godineau Swamp	Morne L'Enfer	Rochard Douglas	Todd's Road (South)
Cedros	Las Cuevas	Mount Hope	San Pedro	Tumpuna
Central Range Forest	Long Stretch	N.R.R.P	Siparia	Valencia
Cola Hill	Longdenville	Nariva Windbelt	Southern Watershed	Victoria Plantations
Cumuto Extension	Manzanilla Windbelt	Paria	St. David	Victoria-Mayaro Forest

Table A4. Designations of new Coastal and Marine Protected Areas in Trinidad.

National Parks	**Natural Landmarks and Monuments**	**Habitat or Species Management Reserve**	**Sustainable Use Reserves**
Chacachacare	Galera Point	Grande Riviere Beach Madamas Beach Manzanilla Beach Petit Tacarib Beach Grande Tacarib Beach Rincon/Matura Beach Fishing Pond Beach Saut D'Eau Island Soldado Rock Centipede Island Northern Huevos Island	Krondstat Island

Table A5. Designations of new Terrestrial Protected Areas in Tobago.

Scientific Reserves	**Special Conservation Reserves**	**National Parks**	**Natural Landmarks and Monuments**	**Habitat or Species Management Reserve**	**Sustainable Use Reserves**
Southern Main Ridge	Goldsborough Watershed	Northern Main Ridge	Flagstaff Hill	Anse Fourmi	Ft Granby & Granby Point
				Merchiston	Minister River & Bay
				Starwood	Petit Trou & Lowlands Conservation Area Kilgwyn Conservation Area Louis D'Or Conservation Area Hillsborough Dam

Table A6. Designations of new Coastal and Marine Protected Areas in Tobago.

National Parks	Habitat or Species Management Reserve	Landscapes or Seascapes
Anse Bateau MPA	Little Tobago & Goat Island	North-East Tobago MPA
Englishman's Bay MPA	Lucy Vale Bay	Buccoo Reef and Bon Accord Lagoon
Plymouth MPA	Queen's Island	
Mt Irvine MPA	Richmond Islands	
	Sisters Rocks	
	Smith's Islands	
	St. Giles Islands	
	Great River Shoal	
	King Peter Bay	
	Great Courland Bay	
	Little Courland Bay	
	Stone Haven Bay	
	Lambeau Bay	
	L'Anse Fourmi Bay	
	Hermitage Bay	
	Englishman's Bay	

Table A7. Designations of new Open-Ocean Waters and Deep-Sea PNAs in Trinidad and Tobago

Sustainable Use Reserve
Caribbean Arc SUR
Eastern Caribbean SUR
Atlantic Ocean SUR
Orinoco-Guyanan Marine SUR