

Frontier Nicaragua Environmental Research

REPORT 3

Biodiversity Assessment of Isla Juan Venado Nature Reserve

FRONTIER



UNIVERSIDAD
NACIONAL
AUTÓNOMA DE
NICARAGUA - LEÓN

Frontier Nicaragua
2006

Frontier Nicaragua Environmental Research

REPORT 3

Biodiversity Assessment of Isla Juan Venado Nature Reserve

Muurmans, M. & Fanning E. (ed.)

Frontier Nicaragua and Darwin Initiative

**MARENA-León
UNAN – León
Nicaragua**

**Society for
Environmental
Exploration
United Kingdom**

León 2006

Universidad Nacional Autonoma de Nicaragua (UNAN)-León

UNAN is the largest university in Leon, established as a centre for learning and research in the arts and the physical, natural, earth, marine, medical and human sciences. The University is surveying and mapping the flora and fauna of Nicaragua and is conducting research into the maintenance and improvement of the environment and the sustainable exploitation of Nicaragua's natural resources.

MARENA-Leon

MARENA is a governmental organisation responsible for Reserva Natural Isla Juan Venado and has been working in this reserve to establish and facilitate an effective management system for this area. MARENA-Leon is in charge of the management of all nature reserves within the department of Leon, Nicaragua

The Society for Environmental Exploration (SEE)

SEE is a non-profit company limited by guarantee, formed in 1989. The Society's objectives are to advance field research into environmental issues and implement practical projects contributing to the conservation of natural resources. Projects organised by SEE are joint initiatives developed in collaboration with national research agencies in co-operating countries.

Frontier Nicaragua Forest Research Programme (NRF FRP)

The Society for Environmental Exploration has been conducting research into environmental issues since January 2004 under the title of Frontier Nicaragua. Biological field surveys were conducted in the in Reserva Natural Isla Juan Venado in collaboration with UNAN León and MARENA-Leon.

FOR MORE INFORMATION:

Edmundo Torres Godoy (Vice Rector)
UNAN-León
León, Nicaragua
Tel: +505 311 50 83 ext. 1076
E-mail: etorres@unanleon.edu.ni

Society for Environmental Exploration
50-52 Rivington Street, London, UK
Tel: +44 20 76 13 30 61
Fax: +44 20 76 13 29 92
E-mail: research@frontier.ac.uk

MARENA-Leon
Leon, Nicaragua
Tel: +505 311-3776
E-mail: mareleon@ibw.com.ni

Frontier Nicaragua
E-mail: frontiernicaragua@yahoo.co.uk

TABLE OF CONTENTS

<i>List of Figures</i>	v
<i>List of appendices</i>	v
<i>List of abbreviations</i>	v
<i>Executive summary</i>	vi
<i>Foreword</i>	vii
<i>Acknowledgements</i>	viii
1. INTRODUCTION	1
1.1 Location	1
1.2 Geology and history	2
1.3 Conservation	2
1.4 Climate	2
1.5 Aims and objectives of Frontier Nicaragua and The Darwin Initiative	3
2. STUDY SITES	4
3. RESULTS	7
3.1 Mammals	7
3.1.1 Methods	7
3.1.2 Results	8
3.1.3 Discussion	9
3.2 Birds	9
3.2.1 Methods	10
3.2.2 Results	10
3.2.3 Discussion	14
3.3 Reptiles and Amphibians	14
3.3.1 Methods	15
3.3.2 Results	15
3.3.3 Discussion	17
3.4 Lepidoptera	17
3.4.1 Methods	18
3.4.2 Results	18
3.4.3 Discussion	18
4. DISCUSSION	19
5. CONCLUSIONS AND RECOMMENDATIONS	20
6. REFERENCES	21

LIST OF FIGURES

Figure 1.	Location Isla Juan Venado Nature Reserve	1
Figure 2.	Study site locations within Isla Juan Venado Nature Reserve	4

LIST OF TABLES

Table 1.	Base camp locations and habitat types	4
Table 2.	Description of trap sites	5
Table 3.	Description of mist-net locations	5
Table 4.	Summary of effort for all taxa within Isla Juan Venado	6
Table 5.	List of mammal species recorded within Isla Juan Venado	9
Table 6.	List of bird species recorded within Isla Juan Venado	10
Table 7.	List of reptilian species recorded within Isla Juan Venado	16
Table 8.	List of amphibians recorded within Isla Juan Venado	17
Table 9.	Summary of species inventory between FN FRP and Management Plan	18

LIST OF APPENDICES

Appendix 1.	Images of the Isla Juan Venado Nature Reserve
--------------------	---

LIST OF ABBREVIATIONS

MARENA:	Ministerio de Ambiente y Recursos Naturales
NR FRP:	Nicaragua Forest Research Programme
SEE:	Society for Environmental Exploration
UNAN-León:	Universidad Nacional Autónoma de Nicaragua

EXECUTIVE SUMMARY

Isla Juan Venado Nature Reserve lies in the north-west region of Nicaragua, in the Leon province, covering an area of 2,934 ha and mainly comprised of mangrove forest. There have been very few studies undertaken in the area and little is known of its exact biodiversity value.

Isla Juan Venado was given Nature Reserve status in 1983, which increased protection for the area against infringements. The reserve is currently managed by MARENA (Ministerio de Ambiente y Recursos Naturales). In January 2005, Frontier Nicaragua began to conduct a baseline biodiversity survey of the reserve. Funded by voluntary Research Assistants, the survey was conducted over two 10-week fieldwork 'phases', allowing variations in species and habitats to be investigated. Zoological surveys were carried out throughout the reserve, including trapping, timed and opportunistic collections and observations.

This report serves to detail the findings of the FN FRP biodiversity survey of the Isla Juan Venado Nature Reserve. It provides an inventory of fauna compiled throughout all phases of fieldwork, highlighting records of particular interest. These inventories are compared, where possible, to those of the Management Plan for the Isla Juan Venado Nature Reserve, in order to assess whether these biodiversity assessments are comprehensive and highlight potential areas for further research.

Isla Juan Venado Nature Reserve has significant conservation value on local, national and international levels with several critically endangered species inhabiting the reserve. With regard to fauna surveys, the reserve is home to 195 species of birds, reptiles, amphibians and mammals, of which 14 species hold particular interest for their conservation and biological value. These include CITES listed and critically endangered Leatherback (*Dermochelys coriacea*) sea turtle as well as *Aratinga canicularis*. Therefore a specific conservation programme has been initiated for sea turtles within the area to increase protection of these species.

The information collected will be used for management planning by MARENA-Leon. The survey results will also form a baseline for future monitoring work.

FOREWORD

The Isla Juan Venado Nature Reserve in the Northwest Pacific Coast of Nicaragua is one of the 76 national parks and protected areas in the country. The reserve is important for biodiversity conservation due to the presence of mangrove forests and tropical dry forest, yet there is minimal scientific information as to the flora and fauna. Frontier Nicaragua (FN), a collaboration between Universidad Nacional Autónoma de Nicaragua, León and the UK based Society for Environmental Exploration (SEE), has conducted a baseline biodiversity survey of the area. The survey was completed over two 10-week field phases (dry and wet season) with help of voluntary research assistants.

While the general importance of the area for conservation has been appreciated for a number of years, the findings presented in this report are the results of the first comprehensive biological investigation in some unstudied areas within the reserve. These findings provide baseline information on the biological values of the different habitats within the reserve as a basis for management planning and long-term monitoring.

The aim for this report is to contribute to efforts to study and understand the unique ecosystems of the Isla Juan Venado Nature Reserve, adding important information to our understanding of biodiversity and opening doors to continued research and conservation efforts. Further, it is intended that this information will contribute to the existing management plan for the reserve, and to the development of thorough and well-informed conservation practices and monitoring programmes to ensure that future generations living in, working in and visiting the area will see it for the beauty that it is today.

Maggie Muurmans

Research Coordinator

Frontier Nicaragua Coastal and Forest Research Programme

ACKNOWLEDGEMENTS

This report is the culmination of the advice, co-operation, hard work and expertise of many people. In particular we would like to acknowledge and thank the following people:

MARENA-Leon

Director IJV	Ramiro Balladares
Area Director IJV	Mr. Raul Cruz
Acting Director IJV	Carmen Carillo

All park guards working in Isla Juan Venado Nature Reserve

UNAN-LEÓN

Vice Rector	Dr. Edmundo Torres
Head of Biology	Ms. Claudia de Silva

SOCIETY FOR ENVIRONMENTAL EXPLORATION

Managing Director:	Mrs. Eibleis Fanning
Programme manager (Operations)	Ms. Patricia Davis
Programme manager (Development):	Mr. Paul Rubio
Programme Officer:	Ms. Natasha Calderwood

FRONTIER-NICARAGUA

Research Coordinators:	Ms. Mechteld (Maggie) Muurmans
Assistant Research-Coordinators:	Ms. Julie Post
Logistics Manager:	Mr. Andrew Farmer
Research Assistants:	Ms. Tessa Bartlett, Mr. Julian Cottee, Ms. Jo Garrad, Ms. Cecile Geoffray, Mr. Benjamin Harrison, Mr. Sven Janssen, Ms. Carolyn Lumsden, Ms. Samantha Mc.Candless, Mr. Nick Porter, Mr. Oliver Prince, Ms. Helen Scott, Ms. Helena Underhill, Mr. Justin Welsh, Mrs. Kerry Welsh, Mr. Jason Wright.

ENTOMOLOGY MUSEUM OF LEÓN

Director/Entomologist	Dr. Jean-Michel Maes
-----------------------	----------------------

TAXONOMIST SMALL MAMMALS

Taxonomist	Dr. Lenin Obando
------------	------------------

UNIVERSITAREA PROTEGIDA

Director	Dr. Olin Cohan
Student Co-ordinator	Ms. Ofelia Arteaga Gallido

FAUNA AND FLORA INTERNATIONAL

Project Coordinator	Jose Urteaga
---------------------	--------------

We would also like to express gratitude to the community of Las Peñitas, Salinas Grandes and La Garita area for their warm welcome and hospitality, not to mention logistical support. Finally, many thanks to the survey team for their extreme hard work and dedication.

1. Introduction

Nicaragua is the largest country in Central America situated almost exactly between North and South America. Because of this placement, it has formed a wildlife corridor that for millions of years has let the flora and fauna of the two neighbouring continents to mingle resulting in a diverse range of flora and fauna.

The tropical dry forest in Central America used to extend along the Pacific coast from sea level from Guatemala to Costa Rica (Murphy & Lugo 1995), previous studies have shown that these forests have been reduced to less than 0.1% of their original range. The forests of Nicaragua consist of some of the remaining tropical dry forest fragments within this region. These forests have all been given protection, and are decreed as conservation areas, established as nature reserves or national parks (Gillespie et al. 2000). There have been few comparative or quantitative studies on the diversity and structure within such forest fragments in Central America, and with the conservation value of these forests under question, an assessment of species diversity would provide valuable information for setting conservation priorities (Gillespie et al. 2000). Other forest types that exist within this area are Upland pine forests, Lower Mountainous Broadleaf forests and within the rainy zone tropical forest and lowland rainforest (Berman & Wood 2003).

Nicaragua possesses a system of Protected Areas that shelters a wide range of ecosystems supporting thousands of floral and faunal species. There are approximately 12000 classified floral species beside another 5000 not classified yet. Furthermore there are more than 1400 classified faunal species.

1.1 Location

Isla Juan Venado Reserve lies at the northwest of Nicaragua in the Leon province covering an area of 2.934 ha (figure1). The area is dominated by mangrove forests and a extensive estuary with some areas of savannah, tropical dry forest, coastal habitats and agricultural land. A 20 km beach provides nesting area for five species of marine turtles. The nearest major settlements is the colonial city of Leon (20 km) and Managua (120 km). There have been few studies undertaken in the area and little is known of the exact biodiversity value. The current management plan lacks an inventory list of mammal species inhabiting the reserve.

Figure 1. Location Isla Juan Venados Nature Reserve (SOURCE: MARENA)



1.2 Geology and History

Nicaragua is geologically the youngest country in Central America. It lies at the point of subduction where the Cocos Plate slides underneath the Caribbean plate at a rate of 100mm per year. The uplifting of the Caribbean plate created the Central American isthmus and connected North and South America (Berman & Wood 2003).

1.3 Conservation

In the terrestrial area of Isla Juan Venado 195 species of fauna had been identified and confirmed prior to the FN FRP biodiversity study, including 135 species of birds, 24 mammals and 36 herptiles. To date 14 of these have been included on the IUCN Red List (IUCN, 2001), listed as critically endangered, endangered, vulnerable or lower risk, with some species having insufficient data to classify them. One of the most important species of fauna in Isla Juan Venado is the Leatherback marine turtle (*Dermochelys coriacea*) which is in danger of extinction (IUCN 2000). This species uses the island within the estuary as one of its nesting areas. The leatherback turtle shares the region with a number of other charismatic species which includes white tail deer (*Odocoileus virginianus*), black iguana (*Ctenosaura similis*), Green iguana (*Iguana iguana*) and olive ridley turtle (*Lepidochelys olivacea*). The region also hosts a number of native and migratory birds.

The marine coastal zone of the area contains a number of species including 52 species of fish, 47 species of crustaceans and mollusc. Species included the scarce *Anadara grandis* and rare *Cypraea annettae aequinoctialis*.

1.4 Climate

Weather patterns follow a classical dry tropical model, with between 1,150 mm and 1,300 mm rainfall per annum (falling almost exclusively in the wet season from May to November). Temperatures range from 26° C to 29°C in the wet season and from 32°C to 42°C in the dry season (Leonardi, 2001)

1.5 Aims and objectives of Frontier Nicaragua and The Darwin Initiative

Frontier Nicaragua Forest Research Programme started to be involved in environmental research and capacity building from April 2005 in Isla Juan Venado Nature Reserve in collaboration with The Darwin Initiative, SELVA and UNAN-Leon.

The Frontier-Nicaragua Forest Research Programme (FN FRP) has four major aims;

- To conduct baseline biodiversity research in selected forest areas of Nicaragua.
- To provide information on the biological value and conservation importance of selected forest areas, to assist the development and implementation of management plans for these sites;
- To conduct socio-economic surveys within local communities, in order to assess current threats to, and benefits derived from, the forest area;

The objective of the biodiversity assessment of Isla Juan Venado Nature Reserve was:

To develop a system of long term monitoring of the biodiversity status of selected forest areas in Nicaragua. Specifically, each survey conducted would typically include the following research elements;

Systematic fauna trap site: standard trap nights and times searches

- **Mammal survey;** Collection of small mammals (rodents) by trapping, and bats by mist-netting of roost sites and feeding areas. Also, observation of large mammal species to produce a list of mammals found in the reserve.
- **Bird survey;** observation of the bird species throughout the different habitats represented in the reserve, to produce as comprehensive as possible a list for the area.
- **Amphibian and reptile collection;** bucket-pitfall trapping and opportunistic collection of amphibians and reptiles.
- **Butterfly survey;** Collection of butterflies using canopy traps and sweep nets. Also, opportunistic collection of butterfly species in order to produce as complete as possible a species list for the reserve.

In July 2005, Frontier Nicaragua, funded by the Darwin Initiative, implemented an intensive capacity building programme, tailored for nature reserve personnel. This 190-hour course in “Conservation Management” would provide the participants with tools to improve the management of the nature reserve.

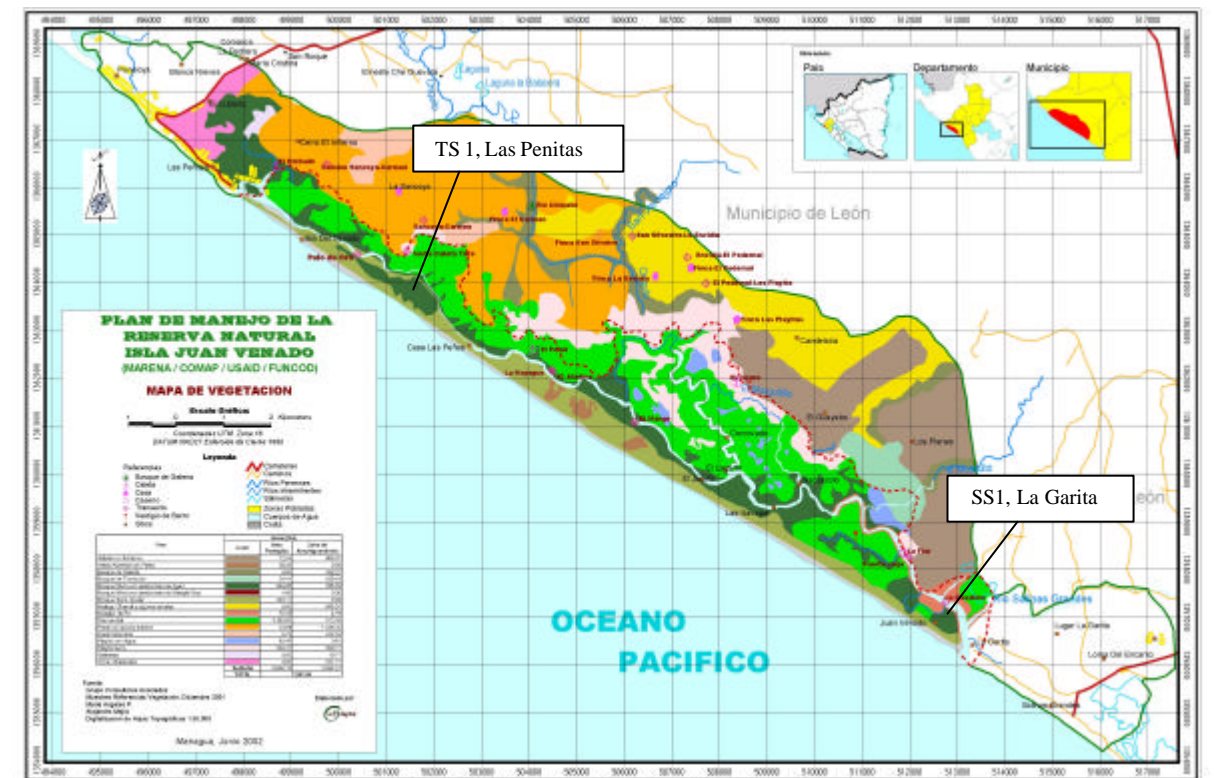
The overall project purpose was to design and implement a training programme in conservation skills and monitoring techniques to build the capacity of local and regional institutions to sustainably manage and monitor resources in the Pacific North region of Nicaragua. In particular, the project sought:

- To develop and implement a tailor-made “Conservation Management” course with the local and regional NGOs SELVA (La Asociacion somos Ecologistas en lucha por la vida y el ambiente), LIDER (Luchadores Integrados al Dsearrollo de la Region), the Autonomous University of Leon (UNAN-Leon), and the Ministry of Environment and Natural Resources (MARENA) to train Nature Reserve rangers in patrolling, law enforcement, survey and monitoring, eco-tourism initiatives, and local community awareness.
- To devise and implement terrestrial and coastal monitoring schemes for threatened, endangered and critically endangered species within three protected areas of Nicaragua’s Pacific North region: Isla Juan Venado (2,934 ha), Estero Padre Ramos (9,157 ha), and Volcan Cosiguina (13,168 ha)

2. STUDY SITES

Two areas of the reserve were selected for study (see figure 2). The sites were selected on the recommendations of reserve personnel, who considered them to be areas in need of investigation. Both sites comprised of coastal and tropical dry forest, with both semi-disturbed and disturbed habitat contained within them. Surveys were conducted during the dry season (April – August) 2005, over two ten week phases; which allowed for se-supply and research volunteer changeover in the interim.

Figure 2. Study site Locations within Isla Juan Venado Nature Reserve (Map: MARENA)



Biodiversity research was undertaken during the following survey dates: 8th April – 3rd May 2005, (TS1: 13th–24th May), 28th July – 6th August 2005.

Table 1. Base camp locations and habitat types

Base Camp Site	Latitude	Longitude	Habitat type
Ranger station Las Penitas	12°21'34.0"	087°01'00.3"	Coastal/Marine
Trap site 1 Las Penitas	12°20'49.4"	087°00'08.4"	Semi-disturbed dry forest
Study site La Garita	12°16'17.5"	086°52'36.0"	Tropical dry forest

Trap Site 1 (TS1) was positioned in a tropical dry forest location in (see figure 1) close to the community of Las Penitas. Duration and Co-ordinates are set out in Table 1. The trap site was conducted in an area of the reserve not previously studied by MARENA-Leon or UNAN-Leon. Park rangers appointed this site as an area of high abundance in species, but had no recorded evidence as to which species inhabited this site.

Study Site 1 (SS1) was placed in the tropical dry forest near the community of La Garita (see figure 1). The site chosen was, approximately 50m away from both salt water (ocean) and fresh water (stream) sources. Park rangers appointed this site as an area of which they would like to obtain more species information. At this site three mist nets were set up in order to catch and identify bat species (see table 3 for summary of mist-net locations). No bucket pitfall or Sherman traps were placed in this area, with most recorded observations at SS1 being classed as opportunistic.

Throughout the reserve, opportunistic observation and night walks were conducted to increase species inventory lists. Table 4 describes a summary of effort for all taxa within the reserve for the survey period.

One night walk was conducted in the area, but no nocturnal wildlife was observed. The whole area proved to be very disturbed during day and night time. Locals were observed hunting for wildlife or cutting trees. Many locals have been observed with logs, freshly cut within the reserve.

Table 2: Description of Trap sites

Trapsite	Date	Duration	No. of Pitfall Traps Used	Co-ordinates	Habitat type
TS1	17-24 th May	5 nights	11	N12°20'49. 4" W087°00'08. 4"	Tropical dry forest

Table 3. Description of Mist-net locations

Mistnet No.	Location	Co-ordinates	Habitat	No. of species	No. of Individuals	Netting hours
Bat 1	La Garita	12°16'25. 6" 086°52'53. 7"	Dry	1	3	22..5
Bat 2	IJV-south	12°16'25. 5" 086°52'53. 6"	Dry	0	0	18.7
Bat 3	IJV-south	12°16'25. 6" 12°52'53. 5"	Dry	1	2	13..5

Table 4. Summary of effort for all taxa within Isla Juan Venado

Survey Type	Effort Unit	TS1	Opportunistic	Total
Bucket Pitfall	No of trapping nights	55	-	55
Sherman traps	No of trapping nights	40	-	40
Bird walks	No of observation man-hours	10	25	35
Butterfly sweep netting	No of man-hours	5	17	22
Canopy traps	No of trapping days	30	-	30
Herp searches	No of man-hours	5	2	7
Bat Mist netting	No of net-metre-hours	-	61	61

3. Methodologies and Analysis

3.1 Mammals

There are 176 mammals (including marine) known to exist in Nicaragua, over half of which are bats and other small mammals. To date 42 species of mammal have been included on the IUCN Red List (IUCN, 2001), listed as critically endangered, endangered, vulnerable or lower risk with some species having insufficient data to classify them.

Mammals constitute an essential part of the Nicaraguan fauna and are found in most habitats. Bats are one of the most diverse groups of small mammals, and are generally understudied. Small mammals are relatively easy to catch, handle, and identify. They have short life spans and changes in species diversity, density, and community composition over time are relatively easy to detect.

Small mammals are important parts of all ecosystems they are found in because they are central to the food-chain, feeding on vegetation and invertebrates and being predated upon by larger mammals, reptiles and birds. They often function as seed dispersers and are therefore important for plant regeneration.

Small mammals can be used as an ecological indicator group. Data from repeated surveys could indicate the general state of an area and thereby contribute to the management of these areas (Schulze & Seavy, 2000; Raxworthy & Nussbaum, 1994). Mammals are threatened by many different factors. Habitats and features important to many mammals are being cleared or degraded or fragmented, leading to total loss of populations, or resulting in small non-viable populations. Humans often heavily hunt mammals for food, skins and for the pet-trade, which further threaten the existence of some species and populations.

The aim of FN FRP mammal survey was to produce as comprehensive as possible a list of large and small mammals for Isla Juan Venado, and assess their conservation value. In particular, it aims to study the lesser-known groups (rodents, shrews and bats), which can be used as ecological indicators, and species which are known to be endangered at a national or international level (IUCN, 2001).

3.1.1 Methods

Four methods were used in the mammal survey;

- Trapping of small mammal species using live-traps (direct - bucket pitfall and sherman traps).
- Bat-netting (direct - mist nets)
- Opportunistic observation large and small mammal species
- Indirect observation: tracks and signs.

A summary of effort expended per method for each site is presented in table 4.

- **Bucket Pitfall Trapping**

At each site one trap line was set up consisting of 11 buckets sunk flush to the ground and arranged 5m apart. A drift fence was constructed from plastic sheeting set up along the length of

the line in order to direct individuals into the buckets. These buckets were checked in the morning and afternoon of each day and contents of each trap were recorded. Animals caught were identified, sexed and weighed; the snout-vent length (SVL) and tail length (if appropriate) were measured. Effort was recorded in pitfall trap-nights (table 5).

- **Sherman Trapping**

Sherman traps were set up in the area of the trap lines at various angles and height. Peanut butter was used as bait to attract small mammals. Individuals caught were identified, sexed, weighed and the head-body, tail, ear, and hind foot were measured. The trap number was recorded for each capture. The bait was removed and traps closed after the morning check and were reset in the afternoon. Effort was recorded in Sherman trap-nights (table 5).

- **Bat netting**

Bat nets were erected at potential bat 'flyways'; near or over streams or pools, and along paths within the forest. The unit of sampling is net-metre-hours (net length (m) x trap duration (hrs)) (table 3). Survey included the erection of three 9m long mist nets, which were erected solely in the area of SS1, near the settlement of La Garita, with a total of 59 trapping hours.

- **Opportunistic/indirect observation**

All observations, both direct and indirect (tracks and signs) were recorded and entered into data sheets to increase the species inventory lists for the reserves.

3.1.2 Results

A total of 10 species (within 9 families) were either captured or directly observed within Isla Juan Venado nature reserve (table 5). The inventory list will consist of 30 mammal species in total after the addition of new species within the order of Chiroptera and Carnivora.

- **Large mammals**

Six species of large mammal were recorded in six families. Although large mammals have been observed in the areas, such as the Eastern cottontail (*Sylvilagus floridanus*) and hooded skunk (*Mephitis macroura*), both Sherman traps and the bucket pitfall traps at TS1 failed to catch any large or small mammal species. Larger traps need to be used to catch these larger mammalian species. Other mammalian species observed in the area and confirmed by park rangers are: Common hognosed skunk (*Conepatus mesoleucas*), Kinkajou (*Potos flavus*), Northern raccoon (*Procyon lotor*) and the Northern tamandua (*Tamandua mexicana*).

- **Small mammals and bats**

Bat netting was carried out for a total of 54.7 hours yielding two species in two families (*Molossus molossus* and *Rhogeessa tumida*) out of five individuals caught. Mistnetting, proved successful as previously only six bats had been included in the Management plan of the reserve and there exists a lack of information on bat species inhabiting the area.

Table 5. List of mammal species recorded within Isla Juan Venado

Order	Family	Species	MP	FN FRP	Unconfirmed reports (locals)
Cetacea	Platanistidae	<i>Sotalia spp.</i>			X
Marsupialia	Didelphidae	<i>Didelphis spp.</i>	X		
		<i>Phylander opossum</i>	X	X	
Chiroptera	Phyllostomidae	<i>Hylonicteris underwoodi</i>	X		
		<i>Carollia subrufa</i>	X		
		<i>Artibeus cf. phacotis</i>	X		
	Vespertilionidae	<i>Myotis nigricans</i>	X		
	Meolossidae	<i>Molossus molossus</i>		X	
	Vespertilionidae	<i>Rhogeessa tumida</i>		X	
Xenarthra	Myrmecophagidae	<i>Tamandua mexicana</i>		X	X
		<i>Cyclpes didacctylus</i>			X
	Dasyopodidae	<i>Dasyopus novemcinctus</i>			X
Carnivora	Procyonidae	<i>Procyon lotor</i>	X	X	
	Mustelidae	<i>Conepatus mesoleucas</i>		X	
		<i>Mephitis macroura</i>		X	
		<i>Eira Barbara</i>			X
		<i>Spilogale agustifrons</i>			X
	Procyonidae	<i>Potos flavus</i>		X	X
	Canidae	<i>Canis latrans</i>			X
		<i>Urocyon cineereoargenteus</i>			X
	Felidae	<i>Felis wiedii</i>			X
		<i>Felis yagouaroundi</i>			X
Perissodactyla	Cervidae	<i>Odocoileus virginianus</i>	X		
Rodentia	Sciuridae	<i>Sciurus variegatoides</i>	X		
	Muridae	<i>Sigmodon hispidus</i>		X	
		<i>Rattus rattus</i>			X
		<i>Mus musculus</i>			X
	Erethizontidae	<i>Coendu mexicanus</i>			X
Lagomorpha	Leporidae	<i>Sylvilagus brasiliensis</i>	X		
		<i>Sylviagus floridanus</i>		X	
TOTAL	18	30	10	10	14

3.1.3 Discussion

Although FN FRP was able to add an additional 6 species to the current Management Plan inventory, it is still felt that mammals have been understudied in this area. Therefore, further in-depth studies need to be initiated in order to produce a comprehensive mammal list for the area. This will enable specific management techniques to be employed to enhance and protect mammal habitat.

3.2 Birds

Birds are one of the most studied taxonomic groups in Nicaragua. To date 688 species of bird have been observed in Nicaragua, 21 of which are endemic to Central America. Ten species of

bird found in Nicaragua are listed on the IUCN Red list, four categorised as vulnerable, and five as lower risk and one as endangered.

The aim of the FN FRP bird survey is to produce (by observation) as extensive as possible an inventory list of birds for Isla Juan Venado. Bird diversity is often regarded as a good measure of overall biodiversity in an area (Borlow et al, 2006) . While this may not always be the case, it is true that identification and ecological data are almost always more complete for birds than most other groups of organisms. Birds are also relatively easy to identify in the field, unlike many plant and insect groups where there are a large number of very similar species and field identification guides for the region are few.

3.2.1 Methods

- **Timed Observation Walks**

Timed bird counts were conducted daily around the trap site with all individuals observed, identified and the habitat, sex and behaviour recorded. Survey effort was recorded in man-hour units.

- **Casual observations**

Sightings of bird species made outside of timed observations were also recorded in order to increase the species inventory list for the reserve.

3.2.2 Results

In total 156 species of birds (within 16 orders and 46 families) have been recorded at Isla Juan Venado nature reserve. 16 species (within 14 families and 1 order) and three families were new records for the reserve (table 6).

In total, FN FRP recorded 53 species of birds (within 27 families) (TS1; 16 species, SS1; 37 species - 19 species and three families being new records), this list including migratory birds as well as resident birds. Some bird families, such as Parilinae and Vironidae seem to reside mainly in the mangrove area, whilst others, such as white-throated magpie jay (*Calocitta formosa*), mangrove cuckoo (*Coccyzus minar*), white-lored gnatcatcher (*Polioptila albiloris*) and (*Euphonia altinis*) travelled between both mangroves and dry forest. Most other families were restricted to dry forest habitat such as Icteridae, Caprimulgidae, Falconidae, Trogonidae and Tryannidae. Black headed trogon (*Trogon melanocephalus*) was abundant near TS1. Migratory birds, such as *Egretta caerulea* and *Numerius phaeopus* were observed at both trap site and study site.

Table 6. List of bird species recorded within Isla Juan Venado

ORDER	FAMILY	SPECIES	Ap. CITES	MP	Unconfirmed reports (locals)	FN FRP
PELECANIFORME	Fregatidae	<i>Fregata magnificens</i>	-	X		X
	Pelecanidae	<i>Pelecanus occidentalis</i>	-	X		X
	Anhingidae	<i>Anhinga anhinga</i> <i>leucogaster</i>	-			X
	Phalacrocoracidae	<i>Phalacrocorax</i> <i>olivaceus</i>		X		
CICONIIFORME	Ardeidae	<i>Egretta thula</i>	-	X		X
		<i>Egretta caerulea*</i>	-	X		X
		<i>Egretta tricolor</i>	-	X		X

ORDER	FAMILY	SPECIES	Ap. CITES	MP	Unconfirmed reports (locals)	FN FRP
		<i>Ardea herodias</i>	-	X		X
		<i>Butorides striatus</i>	-			X
		<i>Botaurus pinatus</i>	-		X	
		<i>Nictinasa violacea</i>	-		X	
		<i>Nycticorax nycticorax</i>	-		X	
		<i>Hydranasa tricolor</i>	-		X	X
		<i>Bubulcus ibis</i>	-	X		
		<i>Casmerodius albus</i>	-	X		
		<i>Butorides virescens</i>	-	X		X
		<i>Alba egretta</i>				X
		<i>Tigrisoma m. mexicanum</i>	-	X		X
		<i>Cochlearius cochlearius</i>		X		
	Ciconiidae	<i>Mycteria americana</i>		X		
	Threskiornithidae	<i>Mesembrinibis cayanensis</i>		X		
		<i>Eudocimus albus</i>	-	X		X
		<i>Plegadis chichi</i>				X
		<i>Ajaia ajaja</i>			X	X
GALIFORMES	Cracidae	<i>Ortalis cinereiceps</i>		X		
		<i>Ortalis vetula</i>			X	
		<i>Penelope purpurascene</i>			X	
	Phasianidae	<i>Colinus leucopogon</i>			X	
	Jacaniidae	<i>Jacana espinosa</i>			X	
ANSERIFORMES	Anatidae	<i>Cairina moschata</i>	-	X		
		<i>Dendroayna a. autaminalis</i>		X		
CHARADRIFORMES	Scolopacidae	<i>Catoptrophorus semipalmatus*</i>	-	X		X
		<i>Limosa fedoa*</i>	-	X		
		<i>Actitis macularia*</i>	-	X		X
		<i>Calidris minutilla*</i>	-			X
		<i>Numenius phaeopus*</i>	-	X		X
		<i>Catoptrophorus semipalmatus</i>	-	X		X
		<i>Totanus falvipes</i>			X	
		<i>Totanus melancholencus</i>			X	
		<i>Arenaria interpres</i>			X	
		<i>Ereunetes pusillus</i>			X	
		<i>Erolia minutilla</i>			X	
		<i>Erolia bairdii</i>			X	
		<i>Calidris canutus</i>			X	
		<i>Crocetia alba</i>			X	
		<i>Tringa solitaria</i>		X		

ORDER	FAMILY	SPECIES	Ap. CITES	MP	Unconfirmed reports (locals)	FN FRP
FALCONIFORMES	Charatriidae	<i>Charadius collaris</i>				X
		<i>Charadius semipalmatus</i>			X	
		<i>Charadius vociferans</i>			X	
	Laridae	<i>Larus atricilla</i>			X	
		<i>Sterna hirundo</i>			X	
		<i>Thalasseus elegans</i>			X	
		<i>Sterna albifrons</i>			X	
		<i>Larus pipiscans</i>			X	
	Recurvirostridae	<i>Himantopus mexicanus</i>		X		X
	Rhynchophidae	<i>Ryncops nigrans</i>			X	
	Cathartidae	<i>Cathartes aura</i>	-	X		
		<i>Coragyps atratus</i>	-	X		X
	Accipitridae	<i>Buteo magnirostris</i>			X	
		<i>Buteo brachiurus</i>			X	
COLUMBIFORMES		<i>Buteogallus anthracinus</i>	-			X
		<i>Leptodon cayanensis</i>	-			X
		<i>Elanus l. caeruleus</i>		X		
	Pandionidae	<i>Pandion haliaetus</i>	II			X
	Falconidae	<i>Micrastur semitorquatus naso</i>				X
	Falconidae	<i>Polyborus plancus</i>	II	X		
	Columbidae	<i>Zenaida asiatica</i>	-	X		X
		<i>Columbina inca</i>	-	X		X
		<i>Columbina passerina</i>	-	X		
		<i>Chadrius falvirostris</i>		X		X
		<i>Columbina talpacoti</i>		X		
		<i>Claravis pritioca</i>				X
		<i>Leptotila plumbeiceps</i>			X	
		<i>Columbina minuta</i>			X	
PSITTACIFORMES		<i>Leptotila verreauxi</i>		X		
		<i>Leptotila rufaxilla</i>		X		
	Psittacidae	<i>Amazona auropalliata</i>	II	X		X
		<i>Amazona farinosa</i>	II	X		
		<i>Amazona albifrons</i>	II	X		
		<i>Aratinga canicularis</i>	II	X		
CUCULIFORMES		<i>Brotogeris jugularis</i>	II	X		
	Cuculidae	<i>Crotophaga sulcirostris</i>	-	X		X
		<i>Morococcyx erythropygius</i>	-	X		
		<i>Piaya cayana</i>		X		
		<i>Coccyzus minar</i>			X	X
		<i>Tapera naevia</i>			X	
CAPRIMULGIFORMES	Caprimulgidae	<i>Nyctidromus albicollis</i>	-	X		X
APODIFORMES	Apodidae	<i>Chaetura pellagica</i>			X	
	Trochilidae	<i>Amazilia rutila</i>	-	X		
		<i>Anthracothorax prevostii</i>			X	

ORDER	FAMILY	SPECIES	Ap. CITES	MP	Unconfirmed reports (locals)	FN FRP	
		<i>Chlorostibon canivetti</i>			X		
TROGONIFORMES	Trogonidae	<i>Hylocharis eliciae</i>		X			
		<i>Trogon melanocephalus</i>	-	X		X	
		<i>Trogon violaceus</i>				X	
CORACIIFORMES	Momotidae	<i>Eumomota superciliosa</i>	-		X	X	
		<i>Momotus momota</i>		X			
		<i>Chlorocerile amazona</i>				X	
PICIFORMES	Alcedinidae	<i>Ceryle torquata</i>		X			
		<i>Ceryle alcyon</i>		X			
		<i>Centurus aurifrons</i>				X	
		<i>Centurus hoffmannii</i>			X		
STRIGIFORMES	Tytonidae	<i>Celeus castaneus</i>				X	
		<i>Tyto alba</i>		X			
PASSERIFORMES	Cotinguidae	<i>Pachyramphus polycopterus</i>				X	
	Hirundinidae	<i>Iridoprocne albilinea</i>				X	
		<i>Progne chalybea</i>				X	
		<i>Riparia riparia</i>		X			
	Formicariidae	<i>Thamnophilus doliatus</i>	-	X			
		<i>Myrmecisa exsul</i>				X	
	Fringillidae	<i>Passerina cyanea</i>				X	
		<i>Sphorphila torqueola</i>				X	
		<i>Sphorphila aurita</i>				X	
		<i>Sphorphila minuta</i>				X	
		<i>Volantinia jacarina</i>				X	
	Parulidae	<i>Basileuterus d. Delatrii</i>				X	
		<i>Dendroica petechia</i>		X		X	
		<i>Miniotilta varia</i>		X			
		<i>Vermivora peregrina</i>		X			
		<i>Dendroica p. erithachorides</i>		X			
		<i>Seiurus noveboracensis</i>		X			
		<i>Icteria virens</i>		X			
		<i>Setophaga ruticilla</i>		X			
		<i>Pitangus sulphuratus</i>	-	X		X	
		<i>Tyrannus melancholicus</i>	-	X		X	
		<i>Myiodynastes luteiventris</i>	-	X			
		<i>Megarhynchus pitangua</i>				X	
		<i>Myiarchus crinidus</i>				X	
		<i>Myiarchus muttingu</i>				X	
	<i>Myiarchus tuberculifer</i>		X				
	<i>Myiozetetes similis</i>		X		X		
	<i>Tyrannus forficatus</i>		X				
	<i>Empidonax alnorum</i>		X				

ORDER	FAMILY	SPECIES	Ap. CITES	MP	Unconfirmed reports (locals)	FN FRP
	Troglodytidae	<i>Campylorhynchus rufinucha</i>	-		X	
		<i>Thryothorus pleurostictus</i>	-	X		
		<i>Thryothorus modestus</i>		X		
	Turdidae	<i>Turdus grayi</i>	-	X		
	Corvidae	<i>Calocitta formosa</i>	-	X		X
	Sylviidae	<i>Polioptila plumbea</i>	-	X		
		<i>Polioptila albiloris</i>			X	X
	Icteridae	<i>Quiscalus mexicanus</i>	-			X
		<i>Psarocolius montezuma</i>	-	X		
		<i>Icterus galbula</i>				X
		<i>Icterus gularis</i>				X
		<i>Icterus pectoralis</i>		X		
		<i>Tangarius aoneus</i>			X	
		<i>Dives dives</i>			X	
		<i>Icterus Schlateri</i>			X	
	Emberizidae	<i>Sporophila minuta</i>	-			X
		<i>Sporophila torqueola</i>				X
	Thraupinae	<i>Thraupis episcopus</i>			X	
		<i>Euphonia lauta</i>			X	
		<i>Piranga rubra</i>		X		
	Mimidae	<i>Mimus cf. gilvus</i>		X		
	Vireonidae	<i>Vireo huttani</i>				X
		<i>Vireo gilvus</i>			X	
		<i>Vireo pallens</i>			X	
TOTAL 16- 156	46			78	57	53

Key: * Migratory Speices

3.2.3 Discussion

The inventory list for bird species within the Current Management plan is the most extensive compared to the other taxa. Within the limited survey period FN FRP showed that many species of birds had not yet been added to the inventory list, with 16 species added to the existing list. That said, FN FRP believe that there are still other unrecorded species of birds in the Reserve, and further research is necessary.

3.3 Reptiles and Amphibians

Over half of the reptile species found in Nicaragua are North American species, with 15 species that are only found in Central America. There are five species endemic to Nicaragua, including the recently discovered *Norops wermuthi* and *Rhadinea spp.* Five species of marine turtle exist in Nicaragua, all of which are in danger of becoming extinct. Both the hawksbill turtle (*Eretmochelys imbricata*) and the Leatherback turtle (*Dermochelys coriacea*) in the Atlantic and Pacific are critically endangered species and work towards providing protected nesting beaches have been at the forefront of recent conservation efforts.

The IUCN Species Red List for Nicaragua lists a total of 8 reptile species that are threatened; two of which are critically endangered, two listed as vulnerable, three listed as endangered with the

rest in the lower risk category. Nicaragua's humid forests and water associated habitats are inhabited by 64 known species of amphibians, four of which are endemic, The most recent IUCN Red List (2006) now states that there are 10 (previously 0) amphibian species under threat. However IUCN state that agreement could not be reach about many South and Central American amphibian species so there may be further changes to this number.

The aims of the FN FRP herptofauna survey were to produce a comprehensive list of amphibians and reptiles for EPR, and assess their conservation value with particular reference to species which IUCN Red-listed (threatened) at a national or international level (IUCN, 2001).

3.3.1 Methods

- **Bucket Pitfall Trapping**

At each site one trap line was set up consisting of 11 buckets sunk flush to the ground and arranged 5m apart. A drift fence was constructed from plastic sheeting set up along the length of the line in order to direct individuals into the buckets. These buckets were checked in the morning and afternoon of each day and contents of each trap were recorded. Animals caught were identified, sexed and weighed; the snout-vent length (SVL) and tail length (if appropriate) were measured. Effort was recorded in pitfall trap-nights.

- **Timed Searches**

Timed herptile searches were conducted daily around the trap site targeting suitable habitats such as dead logs, ponds and leaf litter. Individuals observed were identified and recorded, Survey effort was recorded in man-hour units.

- **Casual Collections and observations**

All species observed within the reserve were recorded in order to increase the species inventory list for the reserve.

3.3.2 Results

In total, 14 species of reptiles and eight species of amphibians, within 14 and four families, respectively, have been recorded for Isla Juan Venado. Bucket pitfall traps caught some individuals of the very abundant orange-cheeked lizard (*Sceloporus variabilis*) and Blue wiptail (*Cnemidophorus deppii*). Opportunistic included the spiny-tailed or black iguana (*Ctenosaura similis*), green iguana (*Iguana iguana*), *Ameiva quadrilineata*, *Gonatodes albogularis*, *Cnemidophorus deppii*, *Oxybelis aeneus* and *Drymobius margaritiferus*. The capture of *Hemidactylus frenatus* and *Phyllodactylus tuberculatus* near Base Camp increased the reptilian inventory list with two more species. Five reptilian species (within 3 families) can added to the existing reptilian inventory in the Management plan of Isla Juan Venado (Table 7). Seven species of reptiles are included into the CITES appendices with six on Appendix 1. This information could affect management strategies for the reserve in future.

Table 7. List of reptilian species recorded within Isla Juan Venado

Order	Family	Species	CITES	MP	Unconfirmed reports (locals)	FN FRP	
Testudines	Chelonidae	<i>Lepidochelys olivacea</i>	I	X		X	
		<i>Eretmochelys imbricata</i>	I		X		
		<i>Caretta caretta</i>	I		X		
		<i>Chelonia mydas agassizi</i>	I		X		
	Dermochelidae	<i>Dermochelys coriacea</i>	I	X		X	
	Kinosternidae	<i>Kinosternin agustipons</i>			X		
Crocodylia	Emydidae	<i>Rhinoclemmys pulcherrima</i>		X			
	Crocodylidae	<i>Crocodylus acutus</i>	I	X		X	
	Alligatoridae	<i>Caiman crocodilus</i>			X		
Sauria	Geckonidae	<i>Gonatodes albogularis</i>			X	X	
		<i>Hemidactylus Frenatus</i>				X	
		<i>Phyllodactylus Tuberculosis</i>					X
	Iguanidae	<i>Ctenosaura similis</i>			X		X
		<i>Iguana iguana</i>	II		X		X
		<i>Sceloporus variabilis</i>			X		X
		<i>Ameiva Quadrilineata</i>					X
		<i>Cnemidophorus deppii</i>					X
		<i>Anolis sp.</i>			X		
		Teiidae	<i>Cnemidophorus deppei</i>			X	
	Serpentes	Leptotyphlopidae	<i>Leptotyphlops spp.</i>		X		
		Colubridae	<i>Drymobius margaritaferus</i>				X
			<i>Oxybelis aeneus</i>				X
<i>Oxybelis fulgidus</i>						X	
<i>Coniophanes fissidens</i>						X	
<i>Dipsas spp.</i>						X	
<i>Drymarchon corais</i>						X	
<i>Drymobius rhombifer</i>						X	
<i>Leptophis spp.</i>						X	
<i>Rhandinea spp.</i>						X	
<i>Tantilla spp.</i>						X	
<i>Erythrolampus spp.</i>						X	
Boidae			<i>Boa constrictor</i>			X	
Elapidae			<i>Pelamis platurus</i>			X	
Viperidae			<i>Crotallus durisus</i>			X	
			<i>Agkistrodon bilineatus</i>			X	
TOTAL			14	35		10	20

Key: CITES= Trade limitations apply

Within the current management plan no inventory has been included for Amphibians within the Isla Juan Venado Nature Reserve. Within the limited time, FN FRP was able to add 1 specie (within 1 family) to the management plan (table 8) . None of the species recorded is listed on the CITES appendices. Crabs inside bucket pitfall traps might have contributed to the low catching success of the traps.

Table 8. List of amphibians recorded within Isla Juan Venado

Order	Family	Species	MP	Unconfirmed reports (locals)	FN FRP
Anura	Bufonidae	<i>Bufo leutkenii</i>		X	X
		<i>Bufo marinus</i>			X
		<i>Bufo valiceps</i>	X		
		<i>Bufo spp.</i>	X		
	Hylidae	<i>Smilisca spp.</i>		X	
	Leptodactylidae	<i>Eleutherodactylus spp.</i>			X
		<i>Lepydactylus spp.</i>			X
	Ranidae	<i>Rana maculata</i>		X	
TOTAL	4	8	2	5	2

3.3.3 Discussion

A basic inventory list of herptile species had been included in the current management plan. There is a lack of knowledge on herptile species within the Isla Juan Venado Nature Reserve and more research is needed in order to expand inventory lists. Amphibian species can be used as indicator species for the health of the reserve. Reports from locals have added a number of amphibian species to the inventory which indicates that local knowledge should be used in order to compile inventory lists.

3.4 Lepidoptera

Each of Nicaragua's ecosystems has distinct insect populations. However, very little published work exists on the Lepidoptera of this country reflecting the lack of information available on the IUCN red list database.

As with work on other insects, the seasonal nature of many of Nicaragua's forests means that it is usually impossible to sample the entire butterfly or moth fauna of an area over a short period. Flight periods of many species are short and can vary between different locations. However, Hebert (1980) found that moth communities of montane rainforest in New Guinea appeared to be a-seasonal, with adults of all species flying all year. In certain restricted circumstances, therefore, it may be possible to collect a representative sample of the entire fauna in a relatively short period of fieldwork. No prior research had been conducted on Lepidoptera within the area of Estero Padre Ramos. FN FRP has been working in collaboration with Jean Michel Maes, director of the Entomology Museum in Leon, in the identification of lepidoptera species.

The aim of the FN FRP Lepidoptera survey is to produce (by observation and specimen collection) an extensive inventory of butterflies and moths for the forest area under investigation.

3.4.1 Methods

- **Canopy Traps**

A total of six canopy traps were set in the area of the trap lines at various heights between 0.5 and 1.8m. Fermented bananas were used as bait. The traps were set in the mornings and checked in the afternoons, the bait was removed and traps closed overnight. Survey effort is measured in canopy trap days.

- **Hand-held sweep nets**

Timed sweep netting were conducted daily around the trap site sampling a variety of habitats. Survey effort is measured in canopy trap days.

All individuals were identified (as much as possible, usually to Family) and photographed for further identification by taxonomist Jean Michel Maes.

3.4.2 Results

Fermented banana bait proved successful for butterfly families such as Nymphalidae, but Pieridae families ignored the bait and needed to be caught by sweep net. The area also supports Pappilionidae, but none were caught in the net. No previous data has been collected on butterfly species in the area, therefore all butterfly species can be added to the inventory list of the reserve.

100% of butterflies caught in canopy traps were identified as belonging to the Nymphalidae family. This may be a reflection of a particularly high abundance of Nymphalidae in the area or a result of the capture methods including bait type. 75% of butterflies caught by sweep netting were representatives of Pieridae.

All individuals were photographed and are awaiting identification by Jean Michel Maes, director of the Entomology Museum, Leon.

3.4.3 Discussion

Identification of Lepidoptera is a laborious time-consuming task. Caught and observed individuals will be added to the inventory list of the Management plan, once identified. As no inventory list exists on Lepidoptera within the area, this list can be used a base for further research.

Table 9. Summary of species inventory between FN FRP(FN) and the Management Plan(MP)

Taxa	FN No. of families	FN No. of species^a	MP No. of families	MP No. of species	Total Number of families	Total number of species	No. species on CITIES appendices
Mammals	10	10	14	24	18	30	0
Birds	26	53	43	135	46	156	7
Reptiles	7	14	14	29	35	14	7
Amphibians	1	2	4	7	4	8	0
Butterflies	DD*	DD	0	0	DD	DD	DD
Total	44	79	75	195	103	208	14

* DD: Data Deficient

4. DISCUSSION

Survey work was limited due to time limitations as FN FRP was also conducting survey work during this period in other Nature Reserves in the Northwest Pacific Area of Nicaragua. Trap sites were kept at the minimum survey time of five days. Length of duration of both trap sites was standardised, therefore data between trap sites could be compared with more confidence. The number and fitness of research assistants had an effect on the size of a trap site as well as duration.

However, despite time limitations, this study represents an important contribution to the knowledge of the Isla Juan Venado Area, as a number of new species were observed during the research undertaken. The results of this survey provide a resource to update the Management Plan for the Isla Juan Venado Reserve, with the addition of new species to the existing inventories (in particular the inventory of butterflies, which at present is not listed in the Management Plan).

5. CONCLUSIONS AND RECOMMENDATIONS

The findings of this biodiversity survey of the Isla Juan Venado Nature Reserve reveal that the area is of great importance for a variety of both habitats and species. Species of local and global conservation importance inhabit all forest types and disturbance zones of the reserve, such as the critically endangered hawksbill sea turtle and leatherback sea turtle as well as the nationally important white tailed deer. The additions to existing species inventories and new inventories as a result of this study are important in contributing to the sustainable management of the area. It is highly recommended that the inventory of bird species listed here is compared with that upon which the Management Plan is based, in order to identify any further species additions.

Conservation efforts should not be restricted to the protected area, but should also stretch to a national and international level. By protecting threatened and endangered species within their native habitats, this would affect populations at a global level. Global populations of migratory birds and sea turtle species which nest seasonally within the borders of the Isla Juan Venado Nature Reserve, are vulnerable to any decision made relating to the degradation of their habitats.

A variety of human activities do currently threaten both habitats and species and the long-term future of the reserve. These include the grazing of domestic animals, the production of timber, the hunting of wild animals and the unsustainable collection of natural resources for commercial and personal use.

Increased protection through carefully designed management plans should aim to reduce the impact of all such forms of human resource-use within the reserve. The area holds great potential for carefully managed tourism and is as yet unrealised as a tourist destination for wildlife watching and trekking. This could bring much-needed revenue to the local communities and the nature reserve.

It is vital to involve local communities at all stages of decision-making as their future should be considered alongside that of the reserve. Government implementation of CITES is needed in order to clamp down on the illegal sale and trade of endangered species at tourist markets throughout Nicaragua.

6. REFERENCES

- AECI (2002). *Programa de la cooperacion espanola para la conservacion de la biodiversidad y el desarrollo sostenible en iberoamerica*. AECI, Madrid, Spain.
- Berman, J. & Wood, R. (2003). *Moon handbook Nicaragua*. Avalon Travel Publishing, Emeryville, USA.
- Bolow, J, Peres, C.A., Henriques, L.M.P., Stouffer, P.C., Wunderle, J.M., 2006. BIOLOGICAL CONSERVATION. **128** (2). 182-192
- Frontier Nicaragua Forest Research Programme. (2004) *Methodology Manual*, Society for Environmental Exploration, London, United Kingdom
- Hebert, P.D.N., 1980. *Moth communities in Montane Papua New Guinea* JOURNAL OF ANIMAL ECOLOGY. **49** (2). 593-602
- Howell, S.N.G. & Webb, S. (1995). *A guide to the birds of Mexico and Northern Central America*. Oxford University Press, New York, USA.
- Kohler, G. (2001). *Anfibios y reptiles de Nicaragua*. Herpeton, Offenbach, Germany.
- Kricher, J. (1999). *A Neotropical Companion* (2nd edn.. Princeton University Press, New Jersey, USA.
- Maes, J.M. & Brabant, R. (2003). *Mariposas de Nicaragua*. Museo Entomologico, Leon, Nicaragua.
- MARENA/INAFOR (2002). *Guia de especies forestales. Orgut Consulting Ab*, Managua, Nicaragua.
- MARENA. (2000). *Biodiversity in Nicaragua: A country study*. Managua, Nicaragua.
- MARENA. (2002). *Areas Protegidas Informe Nacional.*, MARENA, Nicaragua
- Miller, K., et al. (2001). *En Busca de un Enfoque Comun Para El Corredor Biologico Mesoamericano*
- Miller, L. D. & Miller, J. Y. (2004). *The butterfly handbook*. Quarto Publishing, London, UK.
- Perez, A.M. (2001). *Informaciones cientificas sobre biodiversidad, medio ambiente y sociedad (Num 1)*. GAIA, Managua, Nicaragua.
- Perez, A.M. (2001). *Informaciones cientificas sobre biodiversidad, medio ambiente y sociedad (Num 2)*. GAIA, Managua, Nicaragua.
- PROARCA. (2001). *Corredor Biologico Golfo de Fonseca Nicaragua*, Nicaragua

PROARCA. (2001). *Golfo de Fonseca Conociendo las Areas Nucleo del Corredor Biologico*, Nicaragua.

Raxworthy, C.J., Nussbaum, R.A., 1994. *A rainforest survey of amphibians, reptiles and small mammals at Montagne d'Ambre Madagascar*. BIODIVERSITY CONSERVATION. **69** (1). 65-73

Reid, F.A. (1997). *A field guide to the mammals of Central America and Southeast Mexico*. Oxford University Press, New York, USA.

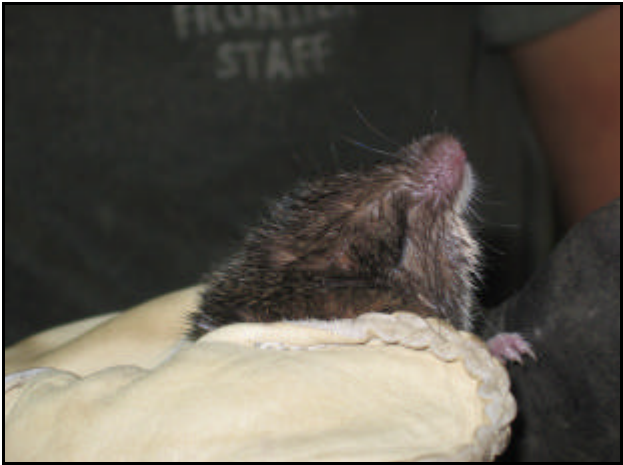
Ridgely, R., Gwynne, J. (1989). *A guide to the birds of Panama*. Princeton University Press, Chichester, UK.

Robinson, D (2004), *Emergence success of leatherback hatchlings, Estacion las Tortugas, Costa Rica*, University of Leeds, United Kingdom.

Schulze, M.D., Seavy, N.E., 2000. *A comparison of the phyllostomid bat assemblages in undisturbed neotropical forest and in forest fragments of a slash-and-burn farming mosaic in Peten, Guatemala*. BIOTROPICA. **32** (1). 174-184

Stevens, W.D (2001) *Flora de Nicaragua*, Missouri Botanical Garden Press, St. Louis, United States of America

Appendix 1. Images of Isla Juan Venado Nature Reserve



Lyomis salvini



Hatchling Black Iguana (*Ctenosaurus similis*)



Smilisca baudinii



Hatchlings Olive Ridley (*Lepidochelys olivacea*)