

**The National Birds and an
Endangered Bird of Trinidad
and Tobago:**

The Cocrico

[*Ortalis ruficauda*],

The Scarlet Ibis

[*Eudocimus ruber*],

The Green Hermit/

Guy's Hermit/

White Tailed Hermit/

[*Phaethornis guy guy*]

and

The Pawi

[*Aburria pipile/ Pipile pipile*]

By

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The SCARLET IBIS (*Eudocimus ruber*)



**The GREEN HERMIT/GUY'S HERMIT/
WHITE TAILED HERMIT (*Phaethornis guy guy*)**



The PAWI (*Aburria pipile*/Pipile pipile)



**Wildlife Farmers' and Producers' Booklet #3:
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Hermit/White Tailed Hermit [*Phaethornis guy guy*] and
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Wildlife Farmers' and Producers' Booklet #3

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Note on the XICIMFAUNA Conference Electronic Draft Edition

I would like to inform All COMFAUNA members, XICIMFAUNA participants and persons visiting the XICIMFAUNA website that this is the Electronic Draft Edition of the book on “**The National Birds and an Endangered Bird of Trinidad and Tobago**”. It was prepared for the XICIMFAUNA to be held in Trinidad and Tobago 17th – 22nd August 2014. The book is a work in progress and I take responsibility for any imperfections. Your comments would be appreciated.

Gary Wayne Garcia
First Author and
President XICIMFAUNA
August 2014

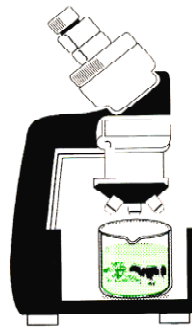
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**Wildlife Farmers' and Producers' Booklet #3:
The Open Tropical Forage-Animal Production Laboratory
[OTF-APL]**



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Dedication



This book is dedicated to Felix Thompson [1919 – 2005], one of the unsung heroes of the Poultry Industry in Trinidad and Tobago.

“Uncle Felix”, as he was affectionately called was one of the pioneers of the Deep Litter System of Chicken Production in Trinidad and Tobago. His operation was at the top of Auzonville Road, Tunapuna from the early 1950s to the early 1960s. He was self-taught on domestic animals and neo-tropical songbirds. He was also always willing to share what he knew with others. During the 1950s staff and students from the Imperial College of Tropical Agriculture [ICTA]¹ and extension officers from the Department of Agriculture would make the trip to Auzonville Road. There they would visit with “Uncle Felix” and his friend Garrick Warner [who was a self-taught pioneer with pigs] to see Uncle Felix’s innovations in Chicken Layer and Broiler production “under humid tropical conditions”. We chose to dedicate this book to Felix Thompson as he was never a scientist or a writer in the formal sense, but he was **“an innovator from the soil”**, and like many innovators from the soil, their contributions were never acknowledged after their intellectual output became available in the public domain. We (and in particular the first author, Gary Wayne Garcia) would like to thank Uncle Felix for his early innovation that is now benefiting all those persons involved in the Poultry Industry in Trinidad and Tobago. This has now allowed so many persons to make a living from the Poultry Industry and has resulted in chicken being made available to us all, not only on Sundays (as was the case in the 1950s and 1960s prior to our independence), but now every day of the week.

¹ The Imperial College of Tropical Agriculture [ICTA] was established in 1921. In 1960 it became the Faculty of Agriculture, The University of the West Indies and the ICTA facilities at St Augustine became the St Augustine Campus of the UWI. In 1996 the Faculty of Agriculture was changed to the Faculty of Agriculture and Natural Sciences and a few years later it was changed to the Faculty of Science and Agriculture, from August 1st 2012 it was renamed the Faculty of Food and Agriculture.

Foreword by the First President of the Republic of Trinidad and Tobago

Sir Ellis Clarke, TC, GCB, GCMG

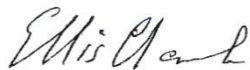
I find it difficult to express my amazement, amounting to incredulity, when I received a “Request for a FOREWORD to a book on the National Birds of Trinidad and Tobago”.

Was it the perverted sense of humour of someone who was highlighting my abysmal ignorance of birds? I discovered that someone was seeking to remedy it.

Appropriately the book begins with the three birds that adorn our Coat of Arms designed for our Independence in 1962 and, of course, continuing through our Republican status in 1976. I am informed that my intimate connection with both of the events led to the request for this Foreword. There is a wealth of information not only about the birds but about all other aspects of the Coat of Arms. For instance, in addition to an explanation of the Heraldic Description of the Coat of Arms there is a biographical account of the members of the Committee that designed it, the significance of the colours – red, white and black, the three ships and the cross on them and much else.

This book is not only informative generally but is geared to stimulate the interest of children and to enlighten them in an easy, practical question and answer format. This is not to suggest that there is any lack of adult, scientific information. What is true is that it should appeal to a comprehensive readership – the young in age, the not so young and the irrepressibly young at heart.

I congratulate Dr. Garcia and his co-workers on producing a book that is readable, informative, stimulating and, for many, enchanting.



Ellis Clarke
December, 2007

**Welcome by the Prime Minister of the Republic of Trinidad
and Tobago:
The Honourable Kamla Persad-Bissessar**

**Welcome by the Secretary of the Tobago House of Assembly,
Republic of Trinidad and Tobago:
The Honourable Mr. Orville London**

Foreword by former President of eTeck: Mr. Khalid Hassanali

As our nation moves towards Developed country status and as we strive to become a technologically savvy society in order to enrich the quality of life for every citizen, it is imperative that we take time to understand and appreciate the delicate synergistic relationship that we share with our environment, its flora and fauna.

Trinidad and Tobago has one of the most diverse and unique indigenous species of both plants and animals in the World and together with the rest of the Neo-tropical region we account for approximately thirty three percent of the Worlds' ecology.

As a proud citizen of Trinidad and Tobago and of the Earth, I am quite pleased to contribute to this invaluable publication that finally documents the three significant species of birds (Scarlet Ibis, Cocrico and the Humming Bird) that make up our Coat of Arms. I commend Dr. Garcia and his colleagues for their fortitude and commitment to write and publish this book in order to educate the general public about our National Birds and their physiology.

Each of us has an inherent responsibility to be the guardians of our environment including the flora and fauna that make up our diverse and unique ecosystem. I believe in sustainable development that would be in harmony with communities and with nature. We must make a conscious effort to conserve or replace the natural resources that we remove from our fragile ecosystem so that they could be enjoyed by future generations.

Khalid Hassanali
July 3rd, 2007

Scientific Foreword: Prof. Holman E. Williams, Emeritus Professor of Livestock Science, UWI

The *Financial Times Magazine* of June 2-3, 2007, reports that there are of the order of 10,000 species of birds worldwide, of which 1,221 are regarded as threatened with extinction, meaning that some intervention is needed to avoid their disappearance from this planet.

What a poorer world we shall be left to inhabit were these threatened species and a further 812 near-threatened species allowed to perish. What an indictment against the superior species on earth.

Birds are among the most colourful, sweet sounding and sweet tasting animals. Some are capable of great feats of flight, from hovering in the air to long distance migration over continents and oceans in pursuit of favourable weather, feeding and breeding conditions. Some flatter us by speaking while others astound us by their navigational skills.

In several parts of the globe they play a positive role in Tourism and Insect Control. However, it is paradoxical that:

while birds efficiently spread the flora it is the loss of their habitat that is their greatest threat;

while bird flu virus is lethal for birds and humans it is the hen's embryonating egg that grows the bird flu virus for vaccine production; and

while birds enjoy the largest living space around us it is the captive breeding programme which has saved some birds from extinction.

Both the Cocrico and the Pawi are edible birds and a proposal is made in this document for their "commercial" rearing. This is a long-term exercise. In the near-term and for some time to come output would be modest and cost of production high. However, the Tourist Industry and Wild Meat Restaurants will be able to pay a premium for these delicacies.

Holman E. Williams

St Anns, Port of Spain, Trinidad, Trinidad and Tobago
June 2007

Scientific Review: Dr. Samuel B. Howard, Retired Deputy Director of Livestock Research and Chief Technical Officer, Ministry of Agriculture, Lands and Marine Resources, formerly Senior Projects Officer University of Trinidad and Tobago

The value of animal wildlife has been largely ignored as well as widely underrated. Whether viewed from the standpoint of its direct values for consumptive purposes such as game etc. or for productive use in commerce or indirectly for non-consumptive purposes as in scientific research, bird watching/recreational or for ethical or optional future value, Neo-tropical Animal Wildlife Studies cannot be overstated. This current publication by *Gary Wayne Garcia et al.* compiles and documents information on the national birds of Trinidad & Tobago as represented on the Coat of Arms of the Republic of Trinidad and Tobago. It also treats with another bird commonly called the Pawi (*Aburria pipile* or *Pipile pipile*) and it is one of the largest birds to be found in Trinidad & Tobago. Despite its prevalence throughout continental South America, the Pawi has been identified as one of the endangered species locally.

While literature can be found in several publications on the National Birds of Trinidad and Tobago there has not been any previous attempt within my knowledge to document the compiled information in a single volume. To this extent the publication is extremely valuable. The study is particularly welcomed because it elaborates the on-going conflicts:

- private/public sector needs and perspectives
- ***in situ*** vs ***ex situ*** conservation and
- knowledge and education gaps in scientific information on Neo-tropical animal species.

The publication is organized into four (4) booklets on the three birds that appear on the Coat of Arms of Trinidad & Tobago followed by the last booklet on the endangered Pawi. The information provided on this bird which is the largest local bird can definitely fall within the category of optional future value activities. This publication despite its specific orientation to children, I have no doubt that it will receive the support from animal wildlife researchers and other members of the scientific community alike. This is because the book:

1. provides scientific information in a condensed format
2. presents compiled information that can form a framework for future intensive production and
3. provides the base knowledge for captive rearing.

Samuel B. Howard, April 2007

INTRODUCTION

How to use this book?

The Cocrico, the Scarlet Ibis and the Green Hermit/Guy's Hermit/White Tailed Hermit (a hummingbird) are the birds represented on the Coat of Arms of the Republic of Trinidad and Tobago [Figure 2]. The Cocrico and the Scarlet Ibis are both specific species that are familiar to most persons in Trinidad and Tobago. However, we know little about our hummingbirds and in particular the Green Hermit/Guy's Hermit/White Tailed Hermit [*Phaethornis guy guy*], and this is the hummingbird that is on the Coat of Arms. This bird was included by the designers of the Coat of Arms "for sentimental reasons" (Anon, 1962). The Pawi [*Aburria pipile*/ *Pipile pipile*] is one of the largest birds in Trinidad and Tobago and is endangered here although it is widely distributed in South America. This book, **The National Birds and an Endangered Bird of Trinidad and Tobago:**

The Cocrico [*Ortalis ruficauda*], The Scarlet Ibis [*Eudocimus ruber*], The Green Hermit/ Guy's Hermit/ White Tailed Hermit [*Phaethornis guy guy*] and The Pawi [*Aburria pipile*/ *Pipile pipile*], is all about these birds. The Cocrico (Chachalacas) and the Pawi (Guans) both belong to the Order of birds called Galliformes which are broken down into the following Families:

1. MEGAPODIIDAE (Megapodes)
2. CRACIDAE (Chachalacas, Guans and Curassows)
3. MELEAGRIDIDAE (Turkeys)
4. TETRAONIDAE (Grouse)
5. ODONTOPHORIDAE (New World Quails)
6. PHASIANIDAE (Pheasants, Partridges and Chickens)
7. NUMIDIDAE (Guineafowls) (del Hoyo, Elliott and Sargatal, 1994).

The close relationship of the Cocrico and the Pawi with the families above, whose species of birds have been well studied and commercialized (e.g. chickens and turkeys) provides us with a good starting point to get a good understanding of our birds.

The Purpose of this book.....

This book, like the previous two in this series, arose out of the classroom of the course entitled **“Tropical Zoo and Wildlife Production and Management”**Error! Bookmark not defined. [AGLS6502/AL65B] offered out of the Department of Food Production, UWI, St Augustine. This course has been taught by the first author [Professor Gary Wayne Garcia] with initial support from Professor Stanley Temple [of the University of Wisconsin-Madison] and Dr. Howard Nelson [his Ph.D. student and former Wildlife Biologist of the former Ministry of the Environment and Research Director of the Asa Wright Nature Centre]. This course has been a Graduate Elective in the **M.Sc. in Tropical Animal Science and Production Programme** that has been offered since 1995. Within the Neo-tropical Animal Wildlife classroom students showed interested in the Scarlet Ibis, the Cocrico and the Pawi [one of the largest and the most endangered bird of Trinidad and Tobago], but we all took the Hummingbirds for granted. However, not much scientific and general production information was available on these species. This book has been written to address the need for this information and the following are the primary objectives:

1. to outline the reasons for our concerns regarding the Cocrico [in Tobago], the Scarlet Ibis and Pawi [in Trinidad] and the Green Hermit/Guy’s Hermit/White Tailed Hermit [in Trinidad] and the Hummingbirds of Trinidad and Tobago,
2. to be able to quickly answer for you some of the simple questions asked about these birds; questions which we call **“Aryann’s, Anais’ and other Children’s’ Questions”** these were the “questions that a fourteen year old girl [Aryann Garcia], her 10 year old sister [Anais Garcia] and other children asked about these animals,
3. to provide you with the justification for the captive rearing of the these birds in Trinidad and Tobago,
4. to be able to provide you with the scientific information on these animals in a condensed format and
5. to be able to provide you with a framework for the intensive production and rearing of these animals.

This book is therefore organized in a manner to help you to enjoy the reading and the photographs. To this end the book is organized as follows:

Introduction on how to use this book

The Coat of Arms of the Republic of Trinidad and Tobago

Biographies on the Members of the Committee who designed the Coat of Arms of Trinidad and Tobago

Booklet 1: The Cocrico [*Ortalis ruficauda*]

Children's Questions on the Cocrico

A Literature Review of the Cocrico

Production Modelling of the Cocrico

Booklet 2: The Scarlet Ibis [*Eudocimus ruber*]

Children's Questions on the Scarlet Ibis

A Literature Review of the Scarlet Ibis

Production Modelling of the Scarlet Ibis

Booklet 3: The Green Hermit/Guy's Hermit/ White Tailed Hermit [*Phaethornis guy guy*] and Hummingbirds in General

Children's Questions on the Hummingbirds

A Literature Review of the Hummingbirds of Trinidad and Tobago

Production Modelling of Hummingbirds

Booklet 4: The Pawi [*Aburria pipile/Pipile pipile*]

Children's Questions on the Pawi

A Literature Review of the Pawi

A Conservation Strategy for the Pawi

Index

MAJOR CONCERNS FACING THE COCRICO, THE SCARLET IBIS, THE GUY'S WHITE TAILED/GREEN HERMIT [HUMMINGBIRDS IN GENERAL] and THE PAWI

The Cocrico [one of the three national birds of Trinidad and Tobago] is now becoming a pest of food crops in Tobago [Booklet 1]. On the other hand the Scarlet Ibis and the Green/Guy's Hermit/White Tailed Hermit [the other birds on the Coat of Arms of the Republic of Trinidad and Tobago] and the Pawi are being threatened for the following reasons, Human/ Biotic Factors, Pollution and Climate Change. Additionally we know very little about the third "national" bird, the Hummingbird that is called Guy's Hermit.

1. Human/Biotic Factors

As human populations increase so does the need for additional housing settlements. The forested areas and swamps where these animals inhabit are not only threatened from the clearing of land for the construction of housing, but also from the building of motorways and access roads that fragment their natural habitat. In Trinidad, the gas and oil lines when passing through the forests significantly fragment the habitats of our animal wildlife. These gas and oil lines are both buried and above ground.

In our country's aim to become self-sufficient in food, agricultural enterprises have increased in the last ten years. New areas are being rapidly developed in an attempt to supply the country with food and thereby decreasing the importation of food. However, this land clearance has had a detrimental effect on the wildlife of our country because it has reduced their habitat, impaired their ability to breed and reproduce which has lowered the odds of their survival. Additionally, the removal of timber from the forests and forest fires caused by the careless disposal of lit cigarettes, have created less obstacles for hunters and have destroyed variable flora and fauna.

Major causes for the decline in the number of our wild birds are the acts of over-hunting and indiscriminate killing. Some hunters disregard the illegality of hunting in the closed season and kill animals that may be reproducing or tending to their young. This is compounded by the willingness of members of the society to support the trade, by being consumers of the meat and skins. Additionally, the unregulated killing of animals for sport, is in direct conflict with the preservation of wildlife.

2. Pollution

When the air, water and soil become polluted all species of life are in danger. When the human population disposes of refuse using unsanitary or environmentally hazardous methods, there are negative effects on the preservation of all of our wildlife. The dumping of waste into inland water sources causes the contamination of the water with toxins that kill several of the fish species. (Toxins and by-products, and the use of new materials and technologies from manufacturing industries and households cause similar adverse results. Specifically, “the toxin polychlorinated biphenyl (PCB) impairs the ability to reproduce in carnivorous animals such as the Ocelot.”²)

3. Climate Change

Micro-climatic changes due to natural or manmade involvement have impacted negatively on the survival of all of our wildlife. Global warming will lessen the available land space by rising sea levels and creating longer rainy seasons and increasing the daily temperatures. This causes flooding in forested areas and the destruction of flora and fauna. The importance of climate change has been given international recognition through the award of the Nobel Peace Prize for 2007 to Al Gore and the Intergovernmental Panel on Climate Change **Error! Bookmark not defined.** (IPCC).

THE PROBLEMS WITH REGARDS TO OUR NEO-TROPICAL ANIMAL WILDLIFE

The Neo-tropical Animal Wildlife/Fauna/Terrestrial non-aquatic wildlife of the Caribbean is the group of animals most at risk of extinction because of ignorance and confusion. Little attention has been given to our Neo-tropical animals. So there has been and continue to be uncontrolled and unsustainable harvesting. Furthermore, there has always been confusion about who is responsible for the terrestrial Neo-tropical animal wildlife. Sometimes this has been the responsibility of the Forestry Ministry, sometimes the Environmental Ministry, sometimes it was the Ministry responsible for Fisheries and sometimes the Ministries of Agriculture of the different Caribbean countries. This lack of a permanent location for this responsibility has arisen from the fact that there has been an ongoing dialogue within the domains of the “Wildlife” and the “Forest” and who should have the responsibility for each of them. It is now clear that this responsibility needs to be permanently anchored within a Ministry. In addition, the custom has been that the wildlife [in this case, the animal wildlife] is usually seen under the domain of the forest. However, those persons with the responsibility for the forests have

² D.E. Brown, “The Ocelot”, Auduborn Wildlife Report 1989-1990. (Auduborn: Academic Press Inc, 1990) 64.

usually been trained in Botany, Ecology, Environmental Science or Timber production but they generally have no training in the Animal Science/Livestock Science disciplines. The animals, therefore, have been always left at the bottom of the priority list. This situation cannot be resolved overnight, but it would be helpful if the future foresters have in their training packages adequate components of the Animal Science disciplines. In addition those who are presently in the job should be exposed to training in “Neo-tropical Animal Science and Production”. Courses such as **“Tropical Zoo and Wildlife Production and Management”** [AGLS6502/AL65B] that precipitated the writing of this book and the others in this series should therefore be offered to them.

THE PROBLEMATIQUE OF NEO-TROPICAL ANIMAL WILDLIFE

The “Problematique’ with respect to Neo-tropical Animal Wildlife revolves essentially around three areas:

- (1) the contradiction between the Private Sector and Public Sector needs and perspectives,
- (2) the conflict between the *in situ* and the *ex situ* conservation activists and
- (3) the lack of knowledge of our Neo-tropical Animal Wildlife species (Garcia et al, 2005).

These will be elaborated on further below.

1. The contradiction/competition between the Private *vs* Public Sector or Governments

Figure #1 presents a view of the world that reflects two polar extremes, from the perspective of the “Private Sector” and the “Governments or the Public Sector”.

2. The Conflict between *In situ* and *Ex situ* Conservation

The world is also shown in Figure 1 to be divided into two vertical hemispheres, **“*In situ* Conservation activities”** and **“*Ex situ* Conservation activities”**. *In situ* refers to conservation within the animals’ natural or undisturbed habitat, while *ex situ* refers to animals being conserved or managed artificially outside of their natural habitats, e.g. Zoos and Wildlife Parks and Reserves. **However, all the scientific and social actors are called upon to service both the *in situ* and *ex situ* activities.**

3. Lack of Knowledge and Education regarding our Neo-tropical Animal Wildlife *vs* Extensive Knowledge of the Domestic Species that have been imported into the Neo-tropics over the last five hundred (500) years

There is little knowledge of the Anatomy, Physiology, Behaviour, Nutritional Needs and Husbandry regarding our thirty important neo-tropical animal wildlife species. In addition only few scientific studies have been conducted on these species as opposed to the vast body of scientific literature to be found on the imported [non-neo-tropical] domestic species of livestock that have been generated by North American, Latin American, Caribbean, European, African, Asian and Australian Universities and scientists. There has also been a lot of research done on the domestic species outside of universities. In the case of Australia, where there is a vast repository of unique animal wildlife, research has been conducted through their Departments of Animal Science and Schools of Veterinary Medicine [Anon (1978), Anon (1989), Anon (1990), Anon (1992), Anon (1994a & b)].

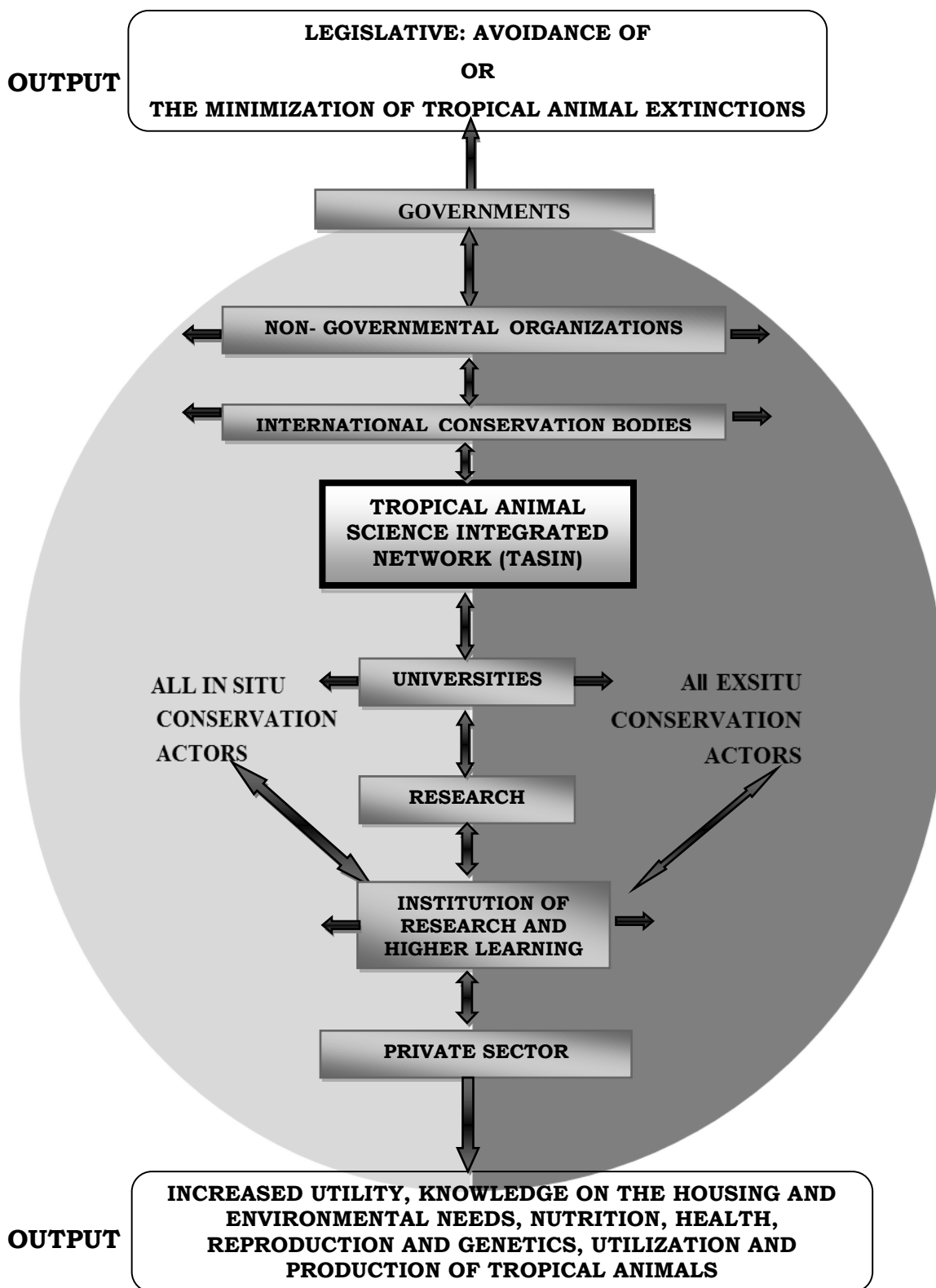


Figure 1: A conceptual framework for the formation of a Tropical Animal Science Integrated Network (TASIN)

The limited understanding of our Neo-tropical animal wildlife by the public is further reflected by their general ignorance and lack of “awareness” of the existence and role that these species play within our ecosystem. Additionally the topics of “Zoos and Wildlife” and “Neo-tropical animals” have only now been included in the School Curricula of Caribbean countries through the initiatives of Professor Francis Davis and his team who teach the BA Agricultural Education within the University of Trinidad and Tobago. This topic is only now marginally included in the curricula of Caribbean and Latin American Universities. It is indeed unfortunate that today [2014] students can graduate from any campus of the UWI with degrees in Agriculture, Biology, Zoology, Environmental Science and Education without having been exposed to a single course on the Biology and Production of our terrestrial Neo-tropical animal species. Yes, they can graduate without any knowledge of any of the animals in their backyard. This is so, simply because our “Eurocentric” and “North American” view of the world has not afforded our educators the opportunity to appreciate the need for us to know more about what we have and how we can use these resources in a sustainable manner to enrich our lives. Therefore, funding is urgently needed to conduct the basic and applied research to be done on the thirty (30) important Neo-tropical animal wildlife species as identified by Ojasti (1996). In 2013 Juani Ojasti did a Foreword to a book on the Capybara (Moreira, Ferraz, Herrera and Macdonald, 2013) in which he said: “.....It is therefore surprising that ecological studies of the Capybara such a peculiar and widely distributed rodent, so important....should only have started about 40 years ago....”.

The situation is similar with our birds but little or no work is being done on them. The preparation and delivery of the educational material arising from this research that pin points those species of commercial value would be very useful.

The neglect that our “Western World” animal scientist and animal health infrastructure have displayed by not paying attention to our Neo-tropical animals has resulted in an absence of information of these animals in the literature. This is well demonstrated in Dunlop and Williams (1996) ***Veterinary Medicine: An Illustrated History***. This reference text was and still is excellent and was written by one of the most respected and accomplished professors of Veterinary Medicine (Emeritus Professor Robert H. Dunlop) who was also a former Vice-President of the World Association for the History of Veterinary Medicine. The text contained 692 pages but only 28 pages (4%) were devoted to the New-world and Neo-tropical animals. What was ironic about this was that the first draft of this book was written by Professor Dunlop while he had a sabbatical at the new School of Veterinary Medicine of the University of the West Indies, Trinidad and Tobago, which can be considered to be at the centre

of the Neo-tropics. In this book it was reported the following about Neo-tropical animals:

1. The Muscovy duck (*Cairina moschata*) was domesticated in Mesoamerica and South America.
2. Of American domesticates, the most important numerically is undoubtedly the turkey (*Meleagris gallopavo*), which was wide spread throughout North and Central America and was domesticated long before the arrival of Columbus.
3. The Incas of Peru made wide use of the Guinea Pig (*Cavia porcellus*) both as highly nutritious food and for ceremonial purposes.

What is most interesting now is that in order to satisfy our culinary palate in Trinidad and Tobago (to make our curry duck) we now have to resort to importing duck eggs and chicks for meat production from the USA and France.

SUMMARY OF ALTERNATIVE SOLUTIONS TO THE THREATS TO NEO-TROPICAL ANIMAL WILDLIFE CONSERVATION IN SMALL ISLAND STATES

Kissoonsingh and Garcia (unpublished) have suggested a Strategy for Trinidad and Tobago [a two small island state] consisting of the following elements:

1. Enforcement of the existing Land Use Zoning Laws
2. Enforcement of the Wildlife Conservation Laws with increased penalties
3. Enactment of new Anti-Pollution laws
4. Establishment of Wildlife Emergency Relief Centres
5. Education of the population
6. Establishment of Captive Breeding Centres or the Empowering of Farmers to produce wildlife
7. Establishment of the Centre for Neo-tropical Animal Wildlife [CNAW].

The following is a more in depth explanation of these elements.

1. Enforcement of the existing Land Use Zoning Laws

These are enacted laws dictating land use in order to preserve the natural habitat of many species of wildlife. These laws have not always been enforced. Unless the situation improves land use zoning will continue to be problematic and not be of any real benefit to conservation.

2. Enforcement of Wildlife Conservation Laws

In some small island states the concept of conservation is incorporated into the wildlife laws for protecting all wildlife against hunting. In Trinidad and Tobago for example the **Scarlet Ibis and the Pawi** need special attention because of their threatened status. Those law enforcement initiatives are weak yet the monetary gains for the lawbreakers are high. Higher monetary penalties are necessary, accompanied by long terms of penal punishment, for both the lawbreakers and guilty law enforcement officers. In this way they may be deterred from continuing their trade outside of the legal hunting season. The Wildlife Laws of Trinidad and Tobago can be obtained from the website of the Ministry of the Environment and Water Resources.

3. Enactment of New Anti-PollutionError! Bookmark not defined.

Laws

The enactment of new pollution laws with an emphasis on the proper disposal of industrial waste is critically needed in many countries. Meaningful penalties, including permanent closure of the offending industry, could be introduced to deter the indiscriminate dumping of effluent into water sources. Additionally, the burning of waste that causes air pollution would be included in these laws. However, in the legislative process, there is the human element, which too often is easily compromised.

4. Establishment of Wildlife Emergency Relief Centres

Wildlife emergency relief centres, once developed, can assist in the protection and rehabilitation of wildlife. These centres could be established in those populated areas near to forests to allow the retrievers easy access. Their services would include a mobile unit to recover wild animals from homes, disaster areas and to recover young animals orphaned by hunters. The rehabilitation centre will act as the repository for breeding animals. This solution can be costly.

5. Education of the Population

Public education with special emphasis on hunters is an existing program. Unfortunately this has had minimum impact on the general trends. Ignorance by the status quo of most of our wildlife species, as well as the potential monetary gains associated with the wildlife trade has rendered the education of commercial hunters invalid. This book, containing these four booklets, is an effort towards strengthening this important educational effort.

6. Establishment of Captive Breeding Centres/Empowering Farmers to Produce Neo-tropical Animal Wildlife species in captivity

The establishment of captive breeding centres where young adults will be housed is the recommendation of choice for several reasons. ***This was recommended by Hislop (1987), a long time ago!!!***

Firstly, this would lend itself to intensive production. Secondly the centres would provide protection and a healthy environment for reproduction. “Predictable reproduction models will allow correct charting and knowledge of the animal’s cycle.”³ This approach has been successfully used for the development of production models for the Agouti and the Collared Peccary/Quenk. These models were outlined in ***Part 4 of Booklets #1 and #2 of the series*** [Brown-Uddenberg *et al*, 2004 and Garcia *et al*, 2005 respectively]. Booklet #1 could be downloaded from the following website: **The Open School of Tropical Animal Science and Production.**

The centres could be housed at stations that are already established and associated with the conservation, protection and reproduction of wildlife, such as the Emperor Valley Zoo and the OTF-APL [in Trinidad and Tobago]. The trained staff present there will be available to address medical and behavioural concerns. This is the role in conservation that zoos could fulfil. These centres could also act as relief centres for orphaned and traumatized animals, so rehabilitation and restoration of the animals can be handled in a proper manner and under secure conditions. This type of facility will reduce the threat of human compromise as there will be existing security measures at the Zoo.

Additionally all private persons and farmers could be encouraged to produce and manage these animals commercially [in the first instance] thereby decreasing the dependence on the wild animal populations. The establishment of the first captive breeding centre could be constructed under the umbrella of The OTF-APL and a Zoo. This could become the blueprint for the other centres throughout the country where State institutions exist. These will provide the animals with trained professional health care and security [from attack by hunters through the security mechanisms, already established at the Zoo] comparable to that found at the Zoo. This approach would also assist in integrating wildlife conservation, management, production, utilization and cuisine.

³ C.G.C. Rawlins, “Zoos and Conservation: The Last 20 Years.” Advances in Animal Conservation. (London: Zoological Society of London, 1984) 83.

7. The Establishment of the Centre for Neo-tropical Animal Wildlife [CNAW]

In Trinidad and Tobago there is an urgent need for us to establish a Centre for Neo-tropical Animal Wildlife with the following objectives:

- i. to produce and multiply the animals for animal science and production research
- ii. to develop and improve on the production systems for these animals
- iii. to act as a demonstration centre for the production of Neo-tropical animal wildlife species
- iv. to produce and maintain a breed register and stud book for these selected Neo-tropical animal wildlife species
- v. to produce animals for sale to farmers as breeding stock
- vi. to produce animals for reintroduction into and repopulation of the wild
- vii. to operate and develop the centre as an Agro-tourism enterprise and
- viii. to develop a Neo-tropical Animal Industry in Trinidad and Tobago.

An initiative of the Ministry of Food Production (under the Honorable Devant Maharaj) at the Sugarcane Feeds Centre, Longdenville (with Professor Gary Wayne Garcia as Consultant) was the beginning of this. It started in December 2013 and on August 8th 2014 it was launched with the Agouti (*Dasyprocta leporina*) and the Red Brocket Deer (*Mazama americana*). Therefore the journey of one thousand miles has begun with the first step.

THE COAT OF ARMS OF THE REPUBLIC OF TRINIDAD AND TOBAGO AND THE NATIONAL BIRDS



Figure 2: The Coat of Arms of the Independent State of Trinidad and Tobago [1962] and the Republic of Trinidad and Tobago [1976]

Description and significance of the devices on the Coat of Arms

The following is the exact description as contained within Anon (1962) *Our Flags and other National Emblems*, published by the Trinidad and Tobago Ministry of Home Affairs. This is now out of print and only available in reference libraries.

The Heraldic [Formal] Description of the Coat of Arms

Arms: Per chevron enhanced sable and gules the chevronel enhanced argent between the chief two Humming-birds respectant gold and in base three ships of the period of Christopher Columbus also gold the sails set proper.

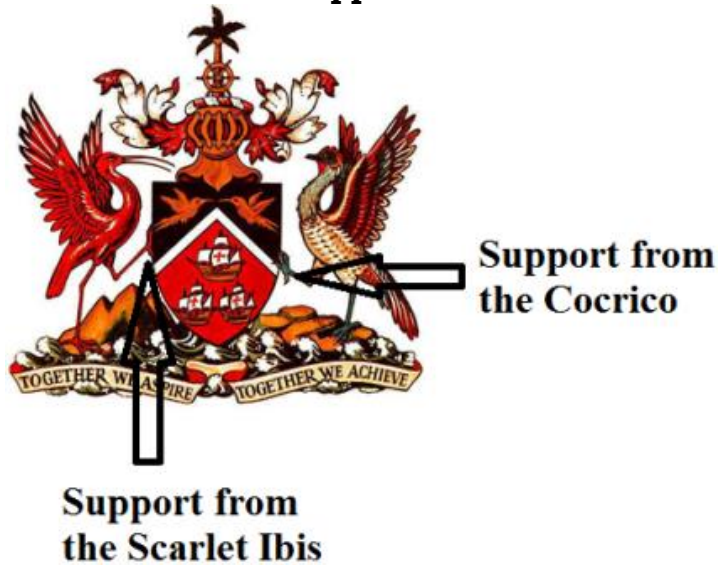


Crest: Upon a Wreath argent and gules in front of a Palm Tree proper a Ship's wheel gold.



Supporters: Upon a Compartment representing two Islands arising from the sea, on the dexter side a Scarlet Ibis and on the sinister side a Cocrico, both proper and with wings elevated and addorsed.

Supporters



MOTTO: “Together we aspire; together we achieve.”

Source: Anon (1962): *Our Flags and other National Emblems*, Trinidad and Tobago Ministry of Home Affairs, Port of Spain, Express Service, 32 pages.

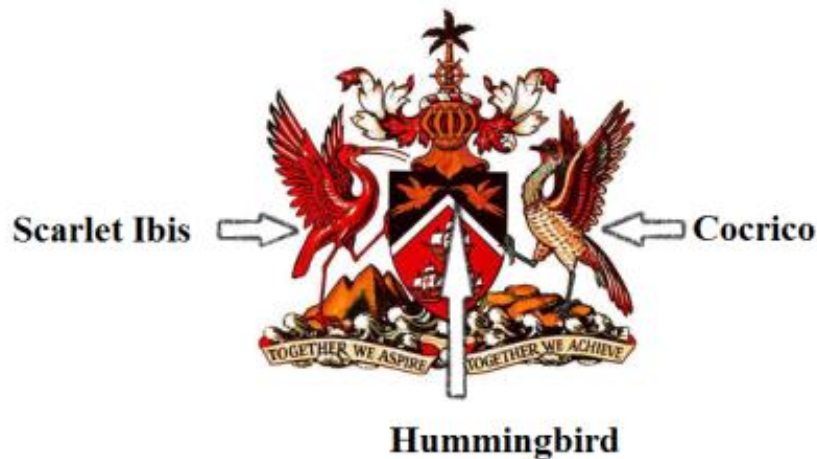


The Birds on the Coat of Arms

The Scarlet Ibis [*Eudocimus ruber*]

The Cocrico [*Ortalis ruficauda*]

Green Hermit/Guy's Hermit/White Tailed Hermit: [*Phaethornis guy guy*]



The Committee that Designed the Coat of Arms of Trinidad and Tobago

The committee that designed the Flag and the Coat of Arms was made up of the following seventeen (17) persons, of whom three (3) were ladies:

Thomas Charles Cambridge (Chairman), Carlisle Chang, John Albert Bullbrook, John Newel Lewis, Peter Bynoe, Andrew Thomas Carr, Alston Huggings, Harry Dow (Col.), Daniel Joseph Samaroo, Conrad Errol O'Brian, George Bailey, Felix Frederick, and Enos Sewlal; Misses Sybil Atteck, Margaret Emily Ottley, Badroul Armstrong and **Mr. Mohammed Pharouk Alladin (Secretary)**.

The following is a brief biography of each one. The oldest was possibly **Dr. John Albert Bullbrook** who was born in 1881 and the youngest was possibly **George Bailey** who was born in 1935 and who unfortunately died at the very tender age of 35 years. They are all now dead. We must in earnest apologize for not having complete information on all of these distinguished citizens of our noble republic. We hope, however, that the effort contained herein would help to anchor them into our memories and to record their collective contribution to our independent state and modern Republic for this and future generations. It is also hoped that this could act as a catalyst for the development of proper biographies of those members of the committee for whom we have limited information.

Thomas Charles Cambridge (Chairman):

Date of Birth: June 9th 1906
Positions Held: Justice of the Peace, Senior Warden Trinidad and Tobago (1956), Permanent Secretary Ministry of Works and Transport (1959), Permanent Secretary Ministry of Public Utilities (1961), Chairman National Trust Fund, Chairman Archives Committee.
Education: Queen's Royal College.
Awards: George VI Silver Jubilee Medal, War Medal (1939-1945), Queen Elizabeth Coronation Medal (1954).

Carlisle Fenwick Chang

Date of Birth: April 21st 1921
Profession: Artist, Business Executive.
Positions Held: Managing Director Gayapa Industries Ltd.
Education: San Juan Government School, Tranquility Boys Government Intermediate School, Pamphylian High School, New York Institute of Photography.
Awards: British Council Art Scholarship to study Mural Painting and Pottery (1950); Italian Government Scholarship to study Ceramics at the Istituto Statale D'Arte, Faenza (1953).
Other Professional
Achievements: Designed several Carnival Bands with Stephen Lee Heung, the first one being "The Land of the Kaboukis" in 1964 that won the Carnival Band of the Year Title. Mr. Chang was also responsible for producing the final drawing of the Coat of Arms.

Dr. John Albert Bullbrook

Date of Birth: 1881
Profession: English Archaeologist, Geologist and Historian
Positions Held: Petroleum Geologist (1913), Assistant Curator of Royal Victoria Institute (now the National Museum) (1953)
Education: King's School Rochester (England), University of London, (June 1900).
Professional
Achievements: Pioneered the search on the indigenous population of Trinidad in 1919. He conducted [in the 1940's] extensive excavations in the Amerindian middens in Cedros, Erin and Palo Seco. He authored the following; (1) The Aboriginal Remains of Trinidad and the West Indies, (2) Notes Concerning Excavation of Shell Mounds or Kitchen Middens, (3) On the Excavation of a Shell Mound at Palo Seco, Trinidad, BWI.

John Newel Lewis, Dip. Arch., F.R.I.B.A.,

Date of Birth: February 12th 1920.
Profession: Architect and Painter.
Positions Held: Principal of the Architect Firm: Newel Lewis, Broadbridge and Associates.
Education: Regent's Street Polytechnic School of Architecture.
Awards: Owen Jones Studentship by the Royal Institute of British Architects (1950).
Other Professional
Achievements: Recorded old buildings in Trinidad in Water colours.

Peter Cecil Alexander Bynoe, A.R.I.B.A.

Date of Birth: June 17th 1918
Profession: Architect
Positions Held: Chief Architect Ministry of Works (1962).
Education: St Mary's College, Architectural Branch, Brixton School of Building, London.

Andrew Thomas Carr

Date of Birth: March 7th 1902.
Profession: Folklorist, PNM Founding Member and Naturalist.
Positions Held: 1921- 1967 Trinidad Building and Loan Association from Office boy to Accountant to Secretary/Treasurer.
Education: Belmont Boys R.C. School.
Awards: (1953) Fulbright Scholarship to North Western University Illinois – Rada Community in Belmont; (1969) The Hummingbird Medal (Gold) for Folklore; (1970) The Chase Manhattan Folk Culture Award Honorary Fellow – Research Institute for the Study of Man, New York; (1977) National Carnival Commission Award: “In recognition for his Outstanding Contribution to Carnival (Posthumously presented). 1982 Trinidad & Tobago Tourist Board Award: “Contribution to the Tourism Industry” (Posthumously presented); (2002). Prime Minister's Best Village Award: Certificate of Recognition for Outstanding Contribution to Best Village (Posthumously presented). 2009 Queen's Hall Award: 50th Anniversary “For Documentation of Culture” (Posthumously presented).
Other Professional
Achievements: Honorary Secretary/Treasurer of Field Naturalist Club (1926-1946), Member of the Tourist Board, Museum Committee of the Royal Institute, Film Censors and (1968) Queen's Hall Board, Founding member of the

Carnival Development Committee, PNM (People's National Movement) and of the Zoological Society of Trinidad & Tobago, Foundation member and member of the Board of Directors for the Little Carib Theatre, President of Trinidad Art Society (1950) and The Ethnographic Society, Chairman of the Historical Sites Committee, (1968); the Indigenous Culture Committee and the Advisory Committee of Trinidad and Tobago Steelband Association (1958).

Publications: They include (1) 'The Cultural Personality of Trinidad and Tobago', (2) 'The United Nations in miniature' (1963), (3) 'Pierrot Grenade', (4) 'A Rada Community in Belmont' (1957), (5) 'Calypso in Trinidad', (6) 'A Brief History of the Trinidad Field Naturalists Club' and (7) 'The Cultural Personality of Trinidad.'

Alston Henry Huggings

Date of Birth: March 16th 1920.
 Profession: Civil Servant.
 Positions Held: Acting Assistant Secretary Ministry of Education and Culture (1958), Senior Assistant Secretary Ministry of Home Affairs (1962).
 Education: Western Boys R.C. School, St Mary's College, Oxford University.

Harry Dow Lt.-Col. V.D., E.D., J.P., O.B.E.

Date of Birth: 1888 (Aberdeen, Scotland).
 Profession: Lieutenant-Colonel of 2nd Battalion Trinidad Volunteers Regiment.
 Positions Held: Head of Printery and Stationery Departments, Davidson and Todd Ltd. (1913), Director, Davidson and Todd Ltd. Director, Yuilles Printerie (1930), Royal Engineers (1908-1913), 2nd Lieutenant, 2nd Battalion Trinidad Volunteers(1915). Lieutenant (1917), Captain (1918), 4th Battalion London Regiment Royal Fusiliers, Captain and Adjutant, Major (1938), Lt.-Colonel (1943), 2nd Battalion Trinidad Volunteers. Colonel, Member of Advisory Committee on Enemy Aliens (1943).
 Awards: Order of the British Empire (O.B.E.) (1939), Volunteer Officer Decoration (1928), Efficiency Decoration (1947), Silver Decoration (1933), Silver Wolf (1948).
 Other Professional Achievements: Boy Scouts 23rd Aberdeen Troop, Assistant Scoutmaster (1909); Trinidad and Tobago Local Associates, Badge Secretary (1920); Trinidad and

Tobago Overseas Branch, Branch Secretary (1921); Colony Commissioner 1927, Member Trinidad Legion British Empire Service League, Auditor Trinidad Branch; British and Foreign Bible Society, St. Andrew Society Session Clerk, Greyfriars Church; Overseas Ground Rank, United Grand Lodge of England; Hon. Grand Director of Ceremonies, Supreme Grand Royal Arch Chapter of Scotland .

Daniel Joseph Samaroo

Date of Birth:

Profession: Justice of the Peace.

Positions Held: President Trinidad and Tobago Red Cross Society, Governor Young Mens Club, Vice President Boy Scouts Association.

Education:

Awards: 1976 Humming Bird Medal [Silver]

Other Professional

Achievements: Writer of Short Stories.

Conrad Errol O'Brian

Date of Birth: October 6th 1925

Profession: Salesman and Businessman.

Positions Held: Accounts Clerk B.W.I.A, Salesman (1948), Manager (1950), Managing Director (1953), Sales Manager Assistant (1953), Sales Manager (1959); Director (1960), Managing Director (1969) Charles Mc Enearney & Co. Ltd. Chairman and Managing Director, Deputy Chairman of the group McEnearney-Alstons (1983); Chairman and Chief Executive Officer (1992), Chairman of the ANSA McAL (US) Inc. and DCI Miami INC.; Chairman of Amalgamated Industries Ltd., Trinidad Distributors Ltd.; Director of Trinidad Publishing Company Ltd., Caribbean Development Company Ltd., The Advocate Company Ltd., (Barbados), Director of McEnearney-Alstons Foundation, Director of Fincor (Finance House), H.J Gransauil & Co.; Hardware and Oilfield Equipment Co. Ltd.; J.D. Allum & Co. Ltd; Amalgamated Finance Ltd.

Education: St Mary's College.

Awards: Humming Bird Medal [Gold] for Public Service (1974).

Other Professional

Achievements: Founding member and President Junior Chamber of Commerce of Trinidad and Tobago (1957), West Indies President (1960) and World President Junior Chamber International (1964). Chief Advisor on committee

hosting World Congress of the JC International in Trinidad and Tobago (1969). Organized many Carnival bands including Toy Soldiers; Flag Wavers of Sienna; Siamese Dancers; Beefeaters; Fantasy of Chess; Greek Guards etc., which won many prizes at the various competitions. Appointed to the Upper House (Senate), as the business representative 1966; served on the Police Commission.

George Bailey

Date of Birth: 1935
 Date of Death: 1970 [35 years of Age]
 Profession: Civil Servant Clerk, Port of Spain General Hospital.
 Other Professional
 Achievements: Won the Band of the Year Title Six (6) times before he was 35 year of age.
 Note: The genius of Carnival was George Bailey. Bailey, knighted early by his friends as "Sir George", first came to attention at Carnival 1957, when he was only 22. That Carnival he led the sensational band *Back to Africa*, and straightaway gave the impression that what the crowd was looking upon was the greatest bandleader the Trinidad Carnival had ever seen.
 [http://www.nalis.gov.tt/Biography/bio_GeorgeBailey2.htm]

Felix Frederick

Positions Held: Community Development, Tobago House of Assembly.
 Other Professional
 Achievements: Chairman of the Tobago Cultural Committee of the National Cultural Council.

Enos Sewlal

Profession: Licensed Chemist and Pharmacist, (1952) Civil Servant.
 Positions Held: Government Archivist (1960).
 Education: Fyzabad Mission School, Tranquility Boys Intermediate Government School, Naparima College, London University.
 Publications: Bibliography of Trinidad and Tobago (1958), Archives of Trinidad and Tobago (1961).

Miss Sybil Atteck

Date of Birth: February 3rd 1911
Profession: Artist and Art Teacher.
Positions Held:
Education: Bishop Anstey High School; Regent Street Polytechnic, London; BFA Washington University, USA; Escuela Belles Artes, Lima, Peru; University for Foreigners, Italy.
Other Professional
Achievements: She was a truly professional artist.

Miss Margaret Emily 'Pearl' Ottley

Date of Birth: November 2nd 1903.
Profession: Nurse.
Positions Held: Matron of Colonial Hospital in Tobago (Scarborough General Hospital).
Education: Port of Spain General Hospital (Nursing Graduate).
Awards: The 1932 Princess Mary Nursing Gold Medal for Proficiency in Nursing.
Other Professional
Achievements: Trinidad & Tobago Registered Nurses Association.

Miss Badroul Armstrong

Date of Birth: October 07th 1916.
Profession: Teacher.
Positions Held: Primary and Elementary School teacher at Bishops' High School Tobago, Principal of St. Nicholas Primary School (The first teacher to incorporate Montessori with traditional teaching methods in Tobago).
Education: Scarborough Lower and Upper School, Bishops High School Tobago, Bishops Otter College now known as the University of Chichester, West Sussex, England.
Other Professional
Achievements: Secretary of the Trinidad and Tobago Association for Mental Health, Bishops' High School Alumni.

Mr. Mohammed Pharouk Alladin, B.Sc., M.A. (Secretary)

Date of Birth: January 11th 1919
Profession: Civil Servant and Renowned Artist.
Education: Tagarigua Canadian Mission School, Government Training College for Teachers, Birmingham College of Arts and Crafts, Chelsea Polytechnic School of Art, Columbia University New York.

PREP 4 LUCIA'S PRIVATE SCHOOL (2006-2007) QUESTIONS ON THE COAT OF ARMS OF TRINIDAD AND TOBAGO



Jabari Emanuel, Shenera Bridgeraj, Marquez Mc Lean, Miss Tricha Daljitsingh (Science Teacher), Alexander Blake, Kaita Smith, Shelly Yang, Anoop Rajbir, Kandice Ferve, Triston Mc David, Darrell Burgis, Jonathan Alexander, Shannon Mohammed, Gehorky Cardet, Anais Garcia, Jadon Maurice, Tineka Durity, Justyne Dubery, Chase Honore, Kaidisha Johnson, Bridgette Castello, Kern Buccan, Sherley Finly, Amalyse Mohammed, Moesha Walker, Jonathan Butcher, Jed Aqui, Edwin Young, Miss Afiya Clyne [Computer Teacher], Nicholas De Freitas-Smith, Leon Lambert Thompson, Chell Thompson, Jean-Paul Hopkinson, Darien Sayer and Jousher Ruben [absent Naomi Samlal and Miss Joan Cooper (Head Teacher and Class Teacher)].

Figure 3: Prep 4 Lucia's Private School (2006-2007) at the Emperor Valley Zoo

Questions and Answers

The following questions were collectively developed by the students of the Lucia's Private Primary School of St Augustine, Prep 4 Class of 2006-2007 at a visit to the Emperor Valley Zoo, Port of Spain. This memorable and enjoyable Field Trip was conducted by Dr. Gary Wayne Garcia and the children were supervised by Miss Tricha Daljitsingh (Science Teacher) and Miss Afiya Clyne (Computer Teacher).

GENERAL QUESTIONS

1. **Who came up with the idea for a Coat of Arms?**

"Coat of Arms" has been around for thousands of years by the Europeans and Japanese. A "Coat of Arms" or "Armorial Bearings" [or just "Arms" for short], in the European tradition, is a design belonging to a particular person [or group of people] that was used by him or her or them in many ways. Unlike seals and emblems, Coats of Arms have a formal description that is expressed or stated as a "blazon". Japanese and Chinese nobility also had similar symbolic representations or Coat of Arms.

The Heraldic [Formal] Description of the Coat of Arms for Trinidad and Tobago is as follows:

Arms: Per chevron enhanced sable and glues a chevronel enhanced argent between a chief two Humming-birds respectant gold and in base three ships of the period of Christopher Columbus also gold the sails set proper.

Crest: Upon a Wreath argent and glues in front of a Palm Tree proper a Ship's wheel gold.

Supporters: Upon a Compartment representing two Islands arising from the sea, on the dexter side a Scarlet Ibis and on the sinister side a Cocrico, both proper and with wings elevated and addorsed.

Motto: ***"Together we Aspire; Together we Achieve"***

2. **Who designed the Coat of Arms?**

The Coat of Arms and the National Flag was designed by a committee which was made up of the following seventeen (17) persons, of which three (3) were ladies:

Messrs. T.C. Cambridge (Chairman), Carlisle Chang, J. A. Bullbrook, J. Newel Lewis, Peter Bynoe. Andrew Carr, Alston Huggings, Harry Dow (Col.), D. Samaroo, C. O'Brian, G. Bailey, F.

Frederick, and Enos Sewlal; Misses Sybil Atteck, M. E. Ottley, B. Armstrong and Mr. **M.P. Alladin (Secretary). Mr. Carlisle Chang was responsible for the final drawings.**

3. **How old is the Coat of Arms of Trinidad and Tobago?**

The Coat of Arms was designed in 1962. This is the year that we obtained our political independence from the United Kingdom [31st July 1962].

4. **Why is the flag different from the Coat of Arms?**

The flag represents the colours of the country or of a battalion or an army.

5. **Why is it called the Coat of Arms?**

This is a representation of the armorial insignia [design] which was on the coat or cloak that Knights wore over their armour that they used to protect themselves in battle. It is also called an “escutcheon or shield of arms”. This was a European tradition or practice for many hundreds of years from about 1000 AD to 1500s AD. Then as countries became more formal and legal structures, a Coat of Arms was developed for each country to be seen and respected by all other countries or “states” to mean the “Official Symbol” of that “state” and the “Symbol” used by the “Head of State” for that country.

6. **Where do we find the Coat of Arms?**

We can find the Coat of Arms on all official government buildings and official documents. The Coat of Arms is the official Seal of the President of the Republic of Trinidad and Tobago.

7. **Why do we have the Coat of Arms on our dollar bills?**

As the “Coat of Arms” is the official symbol of any state and the dollar is the legal monetary instrument for the “State of Trinidad and Tobago”, The Coat of Arms on our dollar bills makes them “official” and “legal” for the State or Country of Trinidad and Tobago.

8. **Why is the colour on the shield of the Coat of Arms red, white and black?**

The **red** represents the people, the **white** is symbolic of the bountiful sea, and the **black** represents the hard work and strength of the people.

9. **What are the things on the top of the Shield?**

They are the crest, wreath, ship’s wheel and a palm tree.

BIRDS

10. **How many birds are on the Coat of Arms?**

There are four (4) images of birds on the Coat of Arms of Trinidad and Tobago. But there are three (3) types of birds, the Scarlet Ibis, the Cocrico and a Hummingbird.

11. **What do the birds represent on our Coat of Arms?**

The Scarlet Ibis and the Cocrico are the “Support” for the Shield on the Coat of Arms, the Hummingbirds form part of the Shield. The Scarlet Ibis is on the “dexter” side and the Cocrico is on “sinister” side of the shield. These three birds are our National Animals or National Birds. Some countries have other types of animals on their Coat of Arms. The United Kingdom is a rather interesting example. On their Coat of Arms they have 3 Lions, but Lions are not native to the United Kingdom [Scotland, Ireland, England and Whales].

12. **Why is the Hummingbird on the Coat of Arms?**

Trinidad is or was called the land of the Hummingbirds by the Europeans. But what is most interesting is that there are 328 species of Hummingbirds [and they are only found in the Americas] and in Trinidad and Tobago we only have 17 species. Only one of the hummingbird species is on the Coat of Arms. This species is called the Green/Guy’s/White Tailed Hermit [***Phaethornis guy guy***]. In the “Description and significance of the devices on the Arms” the committee chosen to design it stated that the Hummingbird was included for “sentimental reasons”. In Booklet #3 of this book you would learn more about this and other hummingbirds.

13. **Who chose the National Birds?**

The national birds were chosen by the committee who designed the Coat of Arms in consultation with other persons from Trinidad and Tobago in 1962.

SHIPS

14. **What do the crosses on the ships mean?**

The crosses on the ships represent the symbol of the Cross of Christopher Columbus [the flag that he had on his ships originally had a green cross]. Christopher Columbus’ real Spanish name was Cristobal Colon and he had set out from Spain for the “New World” in 1492.

15. **What do the three boats or ships represent**Error! Bookmark not defined.?

The three gold ships represent the Trinity. This was originally stated in the “Description and significance of the devices on the Arms”. However the three ships could also represent the three ships that Christopher Columbus Sailed on from Spain to the “New World” in 1492. They were named the *Nina*, *Pinta* and the *Santa Maria*.

16. **Why are there three ships on the Coat of Arms and not three steel pans?**

The Coat of Arms was designed in 1962. Up until then, fifty two [52] years ago we [the people and islands of Trinidad and Tobago] were still under British rule. In those days people who played the steel band were not considered respectable citizens of our community and the steel band was not considered a “proper” musical instrument. So we would assume that the designers of the Coat of Arms thought that it was best to use the Ships of Columbus.

MOTTO

17. **Who came up with the words “Together we aspire together we achieve”?**

It is believed that this was developed by the committee that designed the Coat of Arms by consulting with members of the Government at the time. At that time the Prime Minister was Dr. Eric Eustace Williams and the Government was formed by the elected representatives from the People’s National Movement [PNM]. This was the political party that was in office when we obtained our independence from the United Kingdom on August 31st 1962. The PNM was also the Political Party that was in office when we became a Republic on the 24th September 1976.

18. **What does “Together we aspire together we achieve” mean?**

It probably means that we [the people of Trinidad and Tobago] must have common goals and we must all also work together to achieve these goals, dreams, aims and aspirations.

MOUNTAINS

19. **What do the Mountains signify?**

The mountains signify the Trinity Hills or the Southern Range of Trinidad. This was reported to be the first thing that Christopher Columbus saw when he sighted Trinidad and this is how the island

was named. It was named after the “Holy Trinity”.

20. **Why is the mountain on one side of the shield and the flat land is on the other side of the shield?**

This represents the fact that Trinidad and Tobago is made up of mountain ridges and plains. It could also symbolize the two islands that make up this country. The Scarlet Ibis is found in Trinidad and stands on the Trinity Hills, the Cocrico is from Tobago and stands on Tobago and the Sea under the Shield divides the two islands. In addition the Hummingbirds are found on both islands and are therefore on both sides of the shield.

WATER

21. **What does the water signify on the Coat of Arms?**

The water signifies the seas around Trinidad and Tobago, The Caribbean Sea, The Atlantic Ocean, The Gulf of Paria and the Columbus Channel.

REFERENCES

- Anon (1902): The British Medical Journal 1902, Memorandum Medical, Surgical, Obstetrical, Therapeutical, Pathological, Etc. Universities and Colleges, University Of London. 492 pages (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2512071/pdf/brmedj08210-0016.pdf>)
- Anon (1922): Contributions to the Geology and Paleontology of the West Indies (1922), Carnegie Institution of Washington, Washington (<http://scans.library.utoronto.ca/pdf/2/13/fossilechiniofwe00jackuoft/fossilechiniofwe00jackuoft.pdf>)
- Anon (1962): *Our Flags and other National Emblems*, Trinidad and Tobago Ministry of Home Affairs, Port of Spain, Express Service, 32 pages
- Anon (1962): *Sunday Guardian* (1962) “Who’s Who, Penn Sketches of Writers in the Independence Supplement” p. 5
- Anon (1973): Main Source of the Biographical Information: Who’s Who in Trinidad and Tobago (1973). <http://www.whoswhotnt.com>
- Anon (1978): *Fauna*. Proceeding #36, February, 1978, Post Graduate Foundation in Veterinary Medicine, Sydney, South, NSW., Australia, 784 pages
- Anon (1989): *Inveterbrates in Aquaculture*, Proceeding #117, May, 1989. Post Graduate Foundation in Veterinary Medicine, Sydney, South, NSW., Australia, 266 pages
- Anon (1990): *Rodents and Rabbits*, Proceeding #142, September 1990. Post Graduate Foundation in Veterinary Medicine, Sydney, South, NSW., Australia, 559 pages

- Anon (1992): *Urban Wildlife*, Proceeding #204, October 1992, Post Graduate Foundation in Veterinary Medicine, Sydney, South, NSW., Australia, 138 pages
- Anon (1994a): *Australian Wildlife (Abridged)*, Proceeding #104, September, 1994, Post Graduate Foundation in Veterinary Medicine. Sydney, South, NSW., Australia, 493 pages
- Anon (1994b): *Wildlife*, Proceeding #233, September, 1994. Post Graduate Foundation in Veterinary Medicine, Sydney, South, NSW., Australia, 675 pages
- Anon (2000): People of the Century, Michael Anthony *Express*, Section 2 March 29, 2000 Pages 18 & 19
- Anon (2011): Hall of Fame 2011, Trinidad and Tobago Chamber of Industry and Commerce (<http://chamber.org.tt/articles/hall-of-fame-2011-conrad-errol-obrien/>)
- Anthony, M. (1997): *Historical Dictionary of Trinidad and Tobago*. Scarecrow Press, Lanham, Maryland p.108
- Brown-Uddenberg, R. C.; Garcia, G.W; Baptiste, Q. S.; Adogwa, A. O.; Counand, T. and Sampson, T. (2004): *The Agouti Booklet and Producers' Manual, Wildlife Farmers' and Producers' Booklet #1*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago ISBN#: 976-95123-0-3
- del Hoyo, J; Elliott, A. and Sargatal, J (Editors) (1994): *Handbook of the birds of the World, Volume 2 New World Vultures to Guinea fowl*, Lynx Edicions, Barcelona, 638 pages
- Dunlop, R. H. and Williams, D. J. (1996): *Veterinary Medicine: An Illustrated History*, Mosby-Year Book, Inc., Missouri, USA, 692 pages
- Garcia, G.W (1998): Intensification of Animal Production Systems for Improved Wildlife Conservation, In *Proceedings of UWI, Ag.50 Conference*, August 1998, Faculty of Agriculture and Natural Sciences, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., Volume 3: 91-101
- Garcia, G. W., Young, G.G., Amour, K. M., James, D., Lallo, C. H. O., Mollineau, M., Roopchand, A., Spencer, M., Prosper, M. A., Ganessingh, N., Rooplal, R., Gayan, N., Steil, A., Xande, A., Bemelmans, A., Norgueira Filho, S. G., Guimaraes, D., Gálvez, H., and Mayor Aparicio, P. (2005): *The Collared Peccary/ Pakira/ Javelina/ Catto/ Catete/ Porco de Monte/ Taitetu/ Sajino/ Quenk [Pecari tajacu, Tayassu tajacu] Booklet & Producers' Manual, Wildlife Farmers' and Producers' Booklet #2*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs,

- Trinidad and Tobago ISBN 976-95123-1-1
- Hislop, G. (1987): *Wildlife Farming: Problems and Prospects* (A Commentary). Ministry of Food Production, Marine Exploitation, Forestry and the Environment 5 pages
- Ojasti, J. (1996): *Wildlife Utilization in Latin America and the Caribbean: Current Situation and Prospects for Sustainable Management*, FAO Conservation Guide 25, FAO, Rome
- Mitchell, D. (2000): *Mitchell's West Indian Bibliography, 2000. 10th Edition. An online bibliography.* Lists English language non-fiction from 1492 to the present. (<http://www.books.ai/10th/Bru-Buq.htm>)
- Moreira, J.R.; Ferraz, Katia-Maria, P.M.B.; Herrera, E. and Macdonald (2013): *Capybara, Biology, Use and Conservation of an Exceptional Neotropical Species*. Springer, New York, 417 pages
- Sealey, J. (2010): *He served his Fellowman: the Life and Work of Andrew Thomas Carr*. Lexicon Trinidad Ltd. pp.127, 110
- Smith, L. S. (1950): *'Commandants Trinidad Local Forces' Trinidad Who, What, Why (1950)* 1st Edition, 149 pages
- Lucille Ottley (2012) *personal communication*.
- Dr. Audrie Armstrong (2012) *personal communication*

BOOKLET 1

THE COCRICO [*Ortalis ruficauda*]

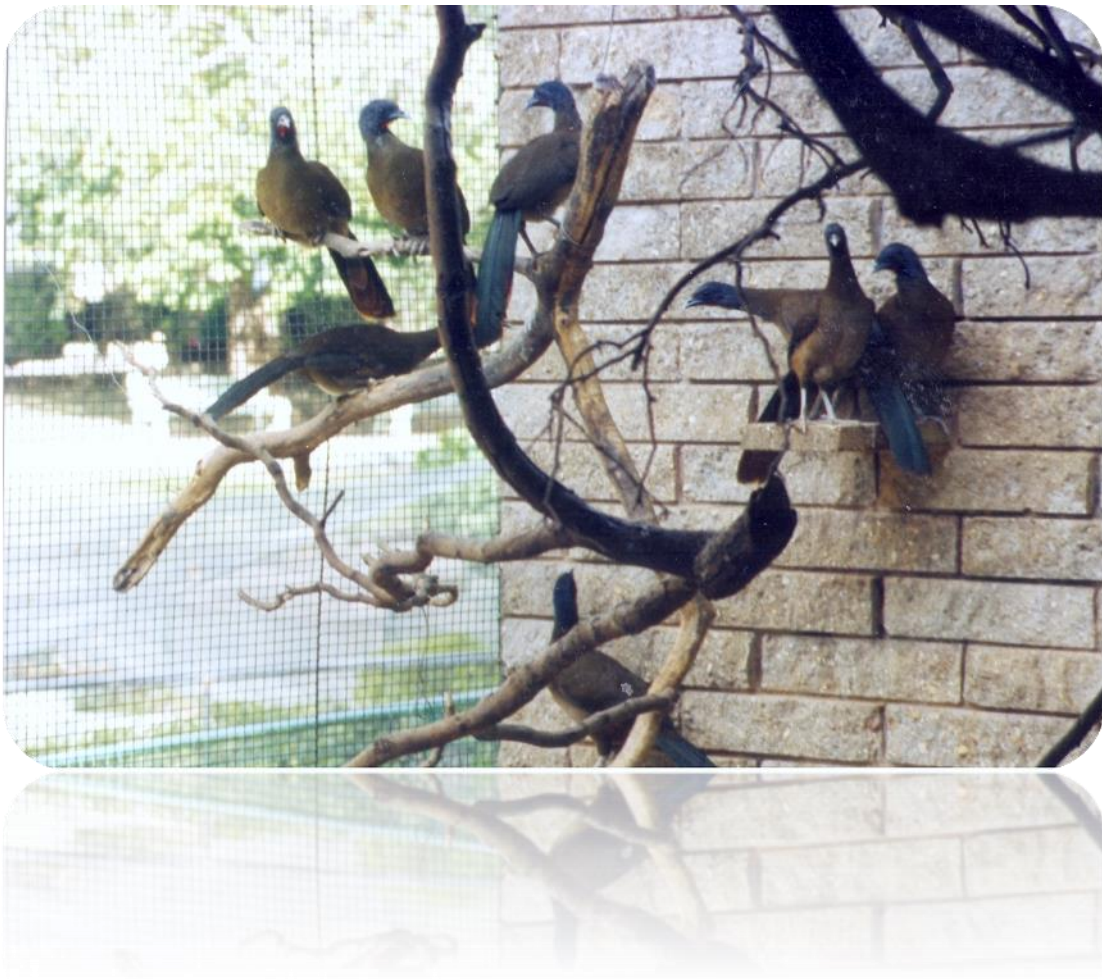


Figure 1.1: The Cocrico at the Emperor Valley Zoo, Port of Spain, Trinidad, Trinidad and Tobago, W.I.

PART 1.1 Questions on the Cocrico





Figure 1.2: The Cocrico Exhibit at Rovenilles Guest House, Tobago, Trinidad and Tobago, W.I.

ARYANN'S, ANAIS' AND OTHER CHILDREN'S QUESTIONS ON THE COCRICO



Figure 1.3: Anais Garcia and Rachel Kendall in their birdlike stance

Naming the Cocrico

1. What is the Cocrico?

It is a medium-sized bird that can fly. However, the Cocrico can only fly for short distances.

2. What is the name of a Baby Cocrico?

It is called a **Cocrichick**.

3. What is the name of a Mommy Cocrico?

It is called a **Cocrihen**.

4. What is the name of a Daddy Cocrico?

It is called a **Cocricock**.

5. How did it get its name “Cocrico”?

This bird was first called by the Caribs in Tobago **Cockerrico** [**Cock-er-ri-co**]. Later in the 19th century it was called **Cockricko** [**Cock-ri-cko**] and **Cockrico** [**Cock-ri-co**] by the planters in Tobago. Today it is called **Cocrico** [**Coc-ri-co**] by the modern-day Tobagonians. The 19th Century Tobago planters also called it the “Tobago Pheasant”, probably as it is in the same bird Order as Pheasants. This Order is called Galliformes. In Central America the Cocrico is also called the Rufus-vented Chachalaca.

6. Why does it have the other complicated name?

This other complicated name is called the “**Scientific Name**”. The Cocrico’s **scientific name** is *Ortalis ruficauda*. The scientific name is made up of two main parts. The first part is called the “genus” and the second part is called the “species”. Sometimes those scientists responsible for giving the scientific names to animals [animal taxonomists] cannot always all agree and they would give an animal a genus and a species and/ a subspecies. Animals having the same species name mean that they would be able to reproduce if the male and female are allowed to mate. The offspring produced from this union would be fertile and would be able to produce more offspring if allowed to mate with each other.

The breakdown of the scientific name for the **Cocrico** is as follows:

Genus: *Ortalis*

Species: *ruficauda*

The scientific name is written in two formats:

(i) Italics- *Ortalis ruficauda* or

(ii) With each word separately underlined- Ortalis ruficauda.

You should also note that the Genus begins with a capital letter while the species begins with a common letter.

7. Why is this complicated name necessary?

This is necessary so that people from anywhere in the world and speaking any language would have a universal way of naming animals and plants. This is to avoid confusion.

8. Who came up with this system for scientific names?

This system of naming is called the **binomial nomenclature**. It refers to the formal method of naming of species. This system was developed by a man called Linnaeus and he lived in the eighteenth century (1700s). He described the entire natural world and gave every species (plant or animal) a two-part name. However, binomial nomenclature in various forms existed before Linnaeus, and was used by the Bauhins, who lived nearly two hundred years before Linnaeus. Before Linnaeus hardly anybody used binomial nomenclature. After Linnaeus, all scientists now use this system of naming species.

9. Who was Linnaeus?

He was Carl Linnaeus and he was born in 1708 and died in 1778. He was also known [after he became a noble] as **Carl von Linné**. He is sometimes called **Carolus Linnaeus**. He was a Swedish Botanist who laid the foundations for the modern scheme of taxonomy (the naming of biological things- plants and animals). He is also considered as one of the fathers of modern Ecology.

10. Who were the Bauhins?

The Bauhins were a family of physicians and scientists. Jean Bauhin (1511-1582) was a French Physician, Gaspard Bauhin (1560-1624) was a Swiss-French Botanist and Johann Bauhin (1541-1613) was a Swiss-French Botanist. The genus of plants *Bauhinia* was named after them.

Geographical Location

11. Where is the Cocrico found?

The Cocrico is found in Tobago, the island of Bequia in the Grenadines [within the state of St Vincent and the Grenadines] in the Caribbean, and in Central and South America. It is not found in Trinidad or on most of the other islands of the Caribbean.

12. Where does it live?

It lives in trees both in the forests and forest edges.

13. Does the Cocrico live in groups?

Yes this animal can be found in groups as shown in the following figures, where they are responding to feeding at 8am and 4pm at the Grafton Estate Wildlife Sanctuary in Tobago that was founded by Ms. Eleanor Alefounder (Figure 1.7).

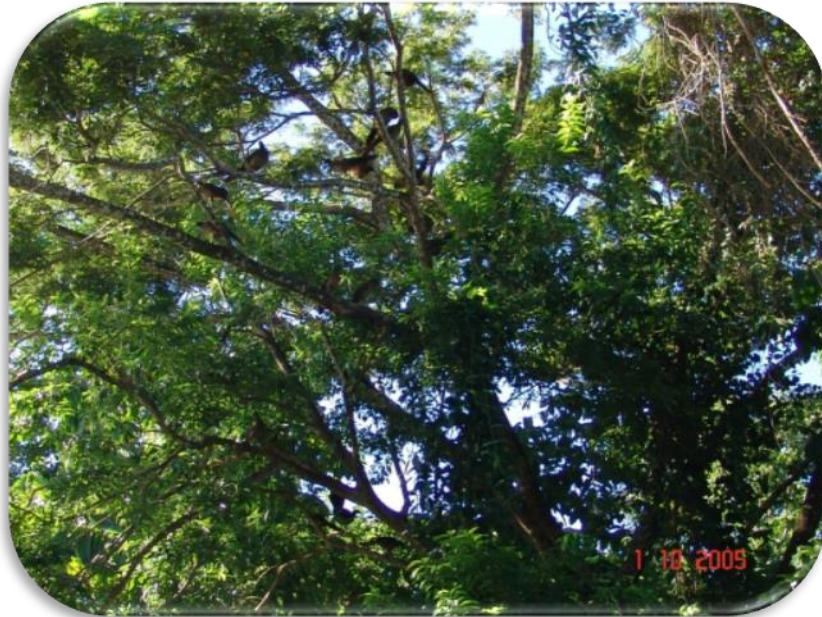


Figure 1.4: The Cocrico habitat

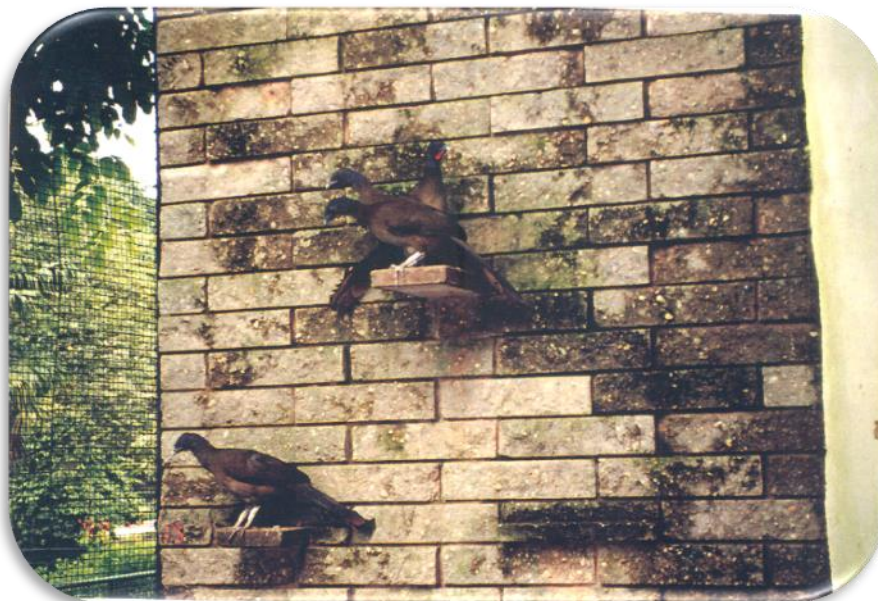


Figure 1.5: The Cocrico Exhibit at the Emperor Valley Zoo, Port of Spain, Trinidad, Trinidad and Tobago



Figure 1.6: A Perched Cocrico in Tobago

Physical Descriptions

14. Can you tell a male/ Daddy Cocrico from a female/Mommy Cocrico?

You can't tell a male/Daddy Cocrico from a female/Mommy from the outside. This can only from the inside. There are many animals in nature whose sexual difference are not visible externally.

15. Does the Cocrico have many coloured feathers?

Its tail feathers are dark brown and red.

16. Why is the Cocrico not a colourful bird?

We really do not know, but there are other *Ortalis* species that are a bit more colourful than the Cocrico. Some of them could be seen in the next section of this book.

17. Why is the Cocrico's head so small and the body so large?

This may be an anatomical adaptation, so that the bird can fly and glide easily.

18. How big can a Cocrico get?

A Cocrico could grow to a weight of about 800g to 1.3kg. This is equal to about 2.8 lb.

19. Is the Cocrico an aggressive bird?

Yes it can be an aggressive bird. It becomes aggressive if it is protecting its nest or if it is not familiar with you.

20. How old can a Cocrico live up to?

This is a question that we are unable to answer at this point in time. It is also one of the reasons why we have to establish production flocks of the Cocrico, so that we could conduct the necessary research.

Diet

21. What does it eat?

It eats fruits, vegetables and seeds. That is why in Tobago although it is a national bird it is considered a pest of agricultural crops.



Figure 1.7: The Cocrico Feeding on Corn in Tobago



Figure 1.8: A Picture of Ms. Eleanor Alefounder feeding the Cocricos at the Grafton Estate, Tobago



Figure 1.9: The Cocrico habitat and watering site at the Grafton Estate Wildlife Sanctuary

General Questions

22. Could we prevent it from becoming a pest?

Yes. If we develop a system of managing them in captivity and rearing them like we rear chickens we would change them from being a pest of our food crops to a source of food.



Figure 1.10: A young boy from Tobago with his pet Cocrico

23. Who is the ugly man in the photograph?

That is your Uncle Romano Mac farlane when he was about nineteen years old; he is holding his favourite Cocrico pet in front of his house in Plymouth, Tobago.

24. Can the Cocrico be eaten?

Yes. In Tobago it is a favourite, and it is stewed when the men get together to make a cook.

25. Is the Cocrico protected?

The Cocrico became protected as a result of the Conservation of Wildlife Act, Chapter 67:01 of the Laws of Trinidad and Tobago, Act 16 of 1958. Section 2 of this Act states... *“a protected animal is an animal which is not listed under the Second or Third Schedules.”* The Cocrico is not listed under any of these schedules.



Figure 1.11: A Plaque dedicated to Sylvanus Joseph at the Grafton Estate Wildlife Sanctuary

PART 1.2

Literature Review on the Cocrico Cockerrico/Cockricko/Cockrico/Tobago Pheasant

1.2.1 Recorded History of the Cocrico in Tobago

The scientific name for the **Cocrico** is *Ortalis ruficauda*. The **Cocrico** was first referred to in the literature as the “**Cockerrico**” by Poyntz (1683) as cited by Anon (1962). This was the original name given to it by the native Indians of Tobago when the Europeans came to the West Indies. This animal was later referred to as “**Cockricko**” by Jardine (1847) and then the “**Cockrico**” or the “**Tobago Pheasant**” by Woodcock (1867). Today in Tobago it is called the “**Cocrico**” or “**Rufous-vented Chachalaca**” (*Ortalis ruficauda*) and it is one of the three (3) birds that are represented on the Coat of Arms of the Republic of Trinidad and Tobago (West Indies). The other two birds on the Coat of Arms are the Scarlet Ibis (*Eudocimus ruber*) and the Green Hermit/Guy’s Hermit/White Tailed Hermit (*Phaethornis guy guy*) [a hummingbird]. The Coat of Arms was created in 1962 (52 years ago) when the twin island state achieved its independence from the United Kingdom. Ten years later the Cocrico and the green parrot (*Amazona sp.*) were accused of being the two most destructive agricultural pests on the island of Tobago. The area of this island is 300 square kilometres with a human population of 46,435 (1990 national census) and the major industries are Fishing and Tourism. It is believed that the birds were normally deep-forest dwellers, but due to a hurricane in 1963, which destroyed most of their food and habitat, the birds came to the forest edge in search of food. It has been suggested that they found an almost limitless supply of agricultural produce at the forest edge and adapted well to a new environment and multiplied (Hislop, 1986). While the ‘theory’ of their arrival at the forest edge does not appear to be robust, the bird in fact gradually attained the unofficial status of being an agricultural pest sometime after 1963.

The authorities attempted to deal with the situation in two ways, both of which failed. The first method was to employ “Pest Control Officers”, and the second was “to promote captive breeding and rearing”. The “Pest Control Officers” were game wardens employed to shoot the pest on private property. They were issued three shotguns and 25 rounds of ammunition per day and expected to shoot 75 birds a day. There were also proposals to dispose of the birds shot (Hislop, 1986). The proposal

for the captive breeding of the Rufous-vented Chachalaca according to (Hislop, 1986) had the following elements:

1. collect the eggs from the wild and incubate them by use of domestic chickens;
2. captive bred birds were not to be added to the wild population;
3. captive stock were to be built up for sale for meat or for release in the case of a drastic wild population decline and
4. payment for egg collection would be from a petty cash system.

Captive breeding of the Cocrico has not taken root in Tobago. However, the project was considered by some to be a priority (Hislop, 1986). In spite of the failed attempts of the authorities, the bird is still hunted without control and therefore very soon this bird in Tobago could become threatened and this would be unfortunate as it is one of the country's national birds. In light of this, it was decided to begin a systematic study of this species with the aim of developing suggestions for improvements in rearing and to get a better understanding of its growth and reproduction. This part of the book attempts a review of the literature on *Ortalis ruficauda* and to make available to the public what pioneering scientific work we have done and published on this animal.

1.2.2 Taxonomy and Ecology

CLASS: AVES
ORDER: GALLIFORMES
SUB-ORDER: GALLI
FAMILY: CRACIDAE [Guans, Chachalacas and Curassows]
SUB-FAMILY: CHACHALACAS [12 species]
GENUS: *Ortalis*
SPECIES: *ruficauda* (del Hoyo, Elliott and Sargatal, 1994).

1.2.2.1 Background

The Cocrico (Chachalacas) belongs to the Order Galliformes and these are medium sized mainly ground feeding birds that includes the so-called game birds. Galliformes are broken down into the following Families:

1. MEGAPODIIDAE (Megapodes)
2. CRACIDAE (Chachalacas, Guans and Curassows)
3. MELEAGRIDIDAE (Turkeys)
4. TETRAONIDAE (Grouse)
5. ODONTOPHORIDAE (New World Quails)
6. PHASIANIDAE (Pheasants, Partridges, Chickens)
7. NUMIDIDAE (Guineafowls) (del Hoyo, Elliott and Sargatal, 1994).

The Cocrico belongs to the family Cracidae that is composed of the Chachalacas, Guans and Curassows. The Cracidae (called Cracids) have been considered the most primitive family in Galliformes. The Chachalacas and Guans are sometimes listed as a separate sub-family: Penelopinae that contains 36 species; and the Curassows (14 species) are listed as another separate sub family the Cracinae. Therefore the Cracidae is also considered as having two sub families the Penelopinae (Chachalacas and Guans) and the Craeinae (the Curassows) (del Hoyo *et al* 1994). Most of the species live in deep forests and generally inaccessible areas, except the Chachalacas, which live on forest edges, secondary forest and thickets (Campbell and Lack, 1985). They tend to be fairly gregarious birds. Although it is not rear to find a lone bird, Cracids are more often found in pairs and family groups. Sometimes more numerous groups form, especially in Chachalacas, which tend to be the most sociable group in the family. In several Chachalaca species, groups of 20-30 birds may feed together, even up to 50 Rufous-vented Chachalacas were seen feeding together in the llanos of Venezuela (del Hoyo *et al* 1994).

1.2.2.2 Genus: *Ortalis*

The Cocrico further belongs to the Sub-family Penelopinae and within the Genus: *Ortalis*. This genus has been accepted as having twelve (12) species (del Hoyo *et al* 1994). Further information could be obtained from the web site of the **Cracid Specialist Group** <http://www.cracids.org/>. The following is an attempt at an analysis of this Genus because of the limited information available in the literature on the *Ortalis* species (Table 1.1). Photographs were used from the internet with the correct

citations to demonstrate the similarity phenotypes of the animals within this genus.

1.2.2.3 Identification of the *Ortalis* Species within an “Historical Timeline”

Ortalis vetula was the first to be identified by Wagler (1830). Table 1.1 presents the listing of the 12 reported *Ortalis* species. But it should be noted that it (the Genus) was first referred to as *Ortalia*, *Phasianus* and *Penelope*. The information presented in Table 1.1 indicates that this genus can be found from California in the North down through Central America and into South America as far down as Argentina. It is not found in Chile and in the Caribbean it is found only on the islands of Margarita, Tobago, Bequai and Union Islands off St Vincent. This genus is truly Neo-tropical.

Table 1.1: Taxonomy of the reported *Ortalis* species including their Sub-species and Distribution.

SPECIES	REFERENCES ON TAXONOMY
[1] Rufous-vented Chachalaca, Rufous-tailed/Red-tailed Chachalaca, Rufous-tipped Chachalaca <i>Ortalis ruficauda</i> [ruficauda, ruficrissa]	<i>[Ortalia ruficauda]</i> Jardine, 1847- Tobago Subspecies and Distribution: <i>O. r. ruficrissa</i> P.L. Sclater & Salvin, 1870- North Colombia and NW Venezuela. <i>O. r. ruficauda</i> Jardine, 1847- NE Colombia, N & NE Venezuela (including Margarita I) and Tobago; also Bequia I and Union I, Lesser Antilles, where probably introduced from Tobago.
[2] Chestnut-winged Chachalaca <i>Ortalis garrula</i> [garrula]	<i>[Phasianus garrulus]</i> Humboldt, 1805- Magdalena River, Colombia. Distribution: NW Colombia.
[3] Plain Chachalaca, Common/ Mexican/ Eastern Chachalaca, Northern Chachalaca, Utila Chachalaca <i>Ortalis vetula</i> [vetula, deschauenseei, mcalli, pallidiventris, intermedia Peters 1913]	<i>[Penelope vetula]</i> Wagler, 1830- Mexico. Subspecies and Distribution: <i>O. v. mcalli</i> Baird, 1858 - extreme S Texas (USA) and NE Mexico S to N Veracruz. <i>O. v. vetula</i> (Wagler, 1830) - E & S Mexico, Belize, E Guatemala, Honduras, W Nicaragua and NW Costa Rica. <i>O. v. pallidiventris</i> Ridgway, 1887 - N Yucatán. <i>O. v. deschauenseei</i> Bond, 1936 - Utila I, off N Honduras.

SPECIES	REFERENCES ON TAXONOMY
[4] Grey-headed Chachalaca <i>Ortalis cinereiceps</i>	[<i>Ortalis cinereiceps</i>] G. R. Gray, 1867, 'north-west coast of America', error = Pearl Islands (?). <u>Distribution:</u> E Honduras, E & C Nicaragua, Costa Rica (except drier NW), Panama (including Isla del Rey in Pearl Is, where perhaps introduced by Indians) and adjacent NW Colombia.
[5] Rufous-headed Chachalaca, Ecuadorian Chachalaca <i>Ortalis erythroptera</i>	[<i>Ortalis erythroptera</i>] P. L. Sclater and Salvin, 1870, Babahoyo and Guayaquil, western Ecuador. Monotypic. <u>Distribution:</u> W Ecuador and extreme NW Peru; may occur in SW Colombia (Nariño).
[6] Rufous-bellied Chachalaca, Wagler's Chachalaca <i>Ortalis wagleri</i>	[<i>Ortalis Wagleri</i>] G. R. Gray, 1867, California and Mexico. <u>Distribution:</u> W Mexico, from S Sonora S to NW Jalisco.
[7] West Mexican Chachalaca <i>Ortalis poliocephala</i> [<i>poliocephala, lajuelae</i>] Moore and Medina 1957	[<i>Penelope poliocephala</i>] Wagler, 1830 - Mexico. <u>Distribution:</u> W Mexico, from S & NE Jalisco and Colima S to CS Chiapas.
[8] Chaco Chachalaca, Grey-headed Chachalaca (!) <i>Ortalis canicollis</i> [<i>canicollis, pantanalensis</i>]	[<i>Penelope canicollis</i>] Wagler, 1830 - Paraguay. <u>Subspecies and Distribution:</u> <i>O. c. canicollis</i> (Wagler, 1830)- Chaco in E Bolivia, W Paraguay and N Argentina. <i>O. c. pantanalensis</i> Cherrie & Reichenberger, 1921- SW Mato Grosso, Brazil.
[9] White-bellied Chachalaca <i>Ortalis leucogastra</i>	[<i>Penelope leucogastra</i>] Gould, 1843, no locality. <u>Distribution:</u> Extreme SW Mexico (SE Chiapas), S Guatemala, El Salvador, S Honduras, NW Nicaragua and NW Costa Rica.

SPECIES	REFERENCES ON TAXONOMY
[10] Speckled Chachalaca, Spotted Chachalaca, <i>Ortalis guttata</i>; Colombian Chachalaca (<i>columbiana</i>) ; Brazilian/White-bellied Chachalaca Bookmark not defined. (<i>araucuan</i>) ; Scaled Chachalaca (<i>squamata</i>)	<i>[Penelope guttata]</i> de Spix, 1825, Rio Solimes, Brazil. <u>Subspecies and Distribution:</u> <i>O. g. columbiana</i> Hellmayr, 1906 - N & C Colombia. <i>O. g. guttata</i> (de Spix, 1825) - E Colombia, E Equador, E Peru, N Bolivia and W Brazil. <i>O. g. subaffinis</i> Todd, 1932 - E & NE Bolivia and adjacent Brazil. <i>O. g. araucuan</i> (de Spix, 1825) - E Brazil. <i>O. g. squamata</i> Lesson, 1829 - SE Brazil.
[11] Little Chachalaca, Guiana Chachalaca <i>Ortalis motmot</i>; Rufous-headed Chachalaca (<i>ruficeps</i>)	<i>[Phasianus motmot]</i> Linnaeus, 1766, Brazil and Guiana = Cayenne. <u>Subspecies and Distribution:</u> <i>O. m. motmot</i> (Linnaeus, 1766) - S Venezuela, the Guiana and N Brazil, N of R Amazon. <i>O. m. ruficeps</i> (Wagler, 1830) - NC Brazil, S of R Amazon.
[12] Buff-browed Chachalaca, Superciliated Chachalaca <i>Ortalis superciliaris</i>	<i>[Ortallida superciliaris]</i> G. R. Gray, 1867, South America. <u>Distribution:</u> NE Brazil, S of R Amazon.

Source of Taxonomic Information: Citations by del Hoyo *et al* (1994)

1.2.2.4 Listing of the Species by Description of Names

The meaning of the word *Ortalis* is the following:

Greek- Fowl or Bird; Greek- ORNIS- Bird.

An examination of the significance of the species' names will now be explained. The suggested name of the species reflects the following meanings as found in the Webster's Third New International Dictionary (Gove 1961), and The Oxford English Dictionary (Simpson and Weiner 1989).

1. *ruficauda*:
 cauda – Latin- Tail;
 rufi- rufous- Latin- red, several colours from yellowish pink to moderate orange;
 rufus/ rufous- English- having reddish hair or a freckled skin; of brownish red colour, reddish;

2. *garrula*:
garrire –French- to babble or chatter; -Latin- garrulous,
-English- garrulous- chattering of birds;
3. *vetula*: ?
4. *cinereiceps*:
cineraceus-Latin- ashes; cinercinis-Franch- ashes; cineraria-
English- ash coloured
5. *erythroptera*:
erythrite/erythritol- rose red mineral
ptera- animal with wings or wing like parts
pteros-Greek- Winged
6. *wagleri*:
7. *poliocephla*:
polio- shortening or attributed to shortening;
cephalic- of or relating to the head;
shortened head;
8. *canicollis*: ?
9. *leucogastra*:
Leuco- light or weakly coloured compound;
Gastr- Greek- gastra- belly;
10. *guttata*:
guta/ guttae- drop or draps- guttural
11. *motmot*: ?
12. *superciliaris*:
super- large
cilia- Latin- eyelid
Large Eyelid

Therefore the foregoing would suggest that the species naming within the genus *Ortalis* was just based on phenotype and location. It was not based on the inability of the offspring from different species to reproduce. **The genus *Ortalis* is therefore in need of review.** This species naming and uncertainty was also pointed out for the genus *Dasyprocta* (Brown-Uddenberg et al, 2004). Based on the photographs presented in Table 1.2 all the species seem similar with the exception of *Ortalis pilirocephala* (the

West Mexican Chachalaca).

1.2.2.5. Key to the species within the Genus *Ortalis*

Table 1.2 presents some notes on the reported *Ortalis* species with Internet sourced images.

**Table 1.2: Descriptive notes on the reported *Ortalis* species
Commonnames, measurements and images]**

SPECIES	DESCRIPTION	IMAGES
[1] Rufous-vented Chachalaca Error! Bookmark not defined., Rufous-tailed/Red-tailed Chachalaca, Rufous-tipped Chachalaca. <i>Ortalis ruficauda</i>	Length: 53-61cm Weight: 430-800g Colour: Greyish buff belly becomes rufous on undertail-coverts. Immature resembles adult. Races differ in size, tone of general colouration and colour of tail tip.	 Trinidad & Tobago: Birding & Liming. February 21, 2011. Accessed May 01 2014. http://robertmaciver.blogspot.com/p/trinidad-tobago.html.
[2] Chestnut-winged Chachalaca. <i>Ortalis garrula</i>	Length: c. 53cm Weight: 630-755g Colour: Bright chestnut primaries conspicuous in flight.	 Chestnut-winged Chachalaca, <i>Ortalis garrula</i>. March 20, 2014. <i>Oiseaux.net</i>.1996-2014. Accessed May 01, 2014. http://www.oiseaux.net/photos/gerard.herpeignies/chestnut-winged.chachalaca.1.html

SPECIES	DESCRIPTION	IMAGES
[3] Plain Chachalaca, Common/Mexican/Eastern Chachalaca, Northern Chachalaca, Utila Chachalaca. <i>Ortalis vetula</i>	Length: 48-58cm Weight: Male: 468-794g; Female: 439-709g. Colour: Plain colouration. Juvenile more olivaceous above. Races vary in size and colouration; nominate darker and more richly coloured than all other races; very dark variants of nominate race occasionally occur in S Mexico and Central America. Feet:	 www.ontamos.net/.../chachalaca-780866.jpg
[4] Grey-headed Chachalaca. <i>Ortalis cinereiceps</i>	Length: 46-58cm Weight: 490-540g, but one bird 682g. Colour: Bright chestnut primaries conspicuous in flight. Juvenile browner, especially on the head.	 Grey-headed Chachalaca, November 2007. NaturePhoto-CZ.com. 2014. Accessed May 2, 2014. http://www.naturephoto-cz.com/grey-headed-chachalaca-photo-8051.html.
[5] Rufous-headed Chachalaca, Ecuadorian Chachalaca. <i>Ortalis erythroptera</i>	Length: 56-66cm Weight: 620-645g. Colour: Similar to <i>O. garrula</i> , but tail tips rufous and lower breast and abdomen creamier.	 Rufous-headed Chachalaca (<i>Ortalis erythroptera</i>). October 20, 2010. The Internet Bird Collection, IBC. 2014. http://ibc.lynxeds.com/photo/rufous-headed-chachalaca-ortalis-erythroptera/bird-tree

SPECIES	DESCRIPTION	IMAGES
(6) Rufous-bellied Chachalaca, Wagler's Chachalaca. <i>Ortalis wagleri</i>	Length: 62-67cm Weight: Colour: Most richly coloured <i>Ortalis</i> . Bare skin around eye pink and blue. Juvenile duller, lacks well defined chestnut tail tips	
[7] West Mexican Chachalaca. <i>Ortalis poliocephala</i>	Length: 62-67cm Weight: c. 760g. One of the largest <i>Ortalis</i> . Colour: Tail tips pale buff.	 http://conabioweb.conabio.gob.mx/bancoimagenes/imagenes/thumbs/thumbs10629.jpg
[8] Chaco Chachalaca, Grey-headed Chachalaca. <i>Ortalis canicollis</i>	Length: 50-56cm Weight: 479-599g. Colour: Head and neck contrast little with colour of back and breast. Immature resembles adult. Race <i>pantanalensis</i> browner, less greyish, and larger.	 www.mangoverde.com/wbg/images/00000005424.jpg

SPECIES	DESCRIPTION	IMAGES
[9] White-bellied Chachalaca. <i>Ortalis leucogastra</i>	Length: 43-50cm Weight: 439-560g. Colour: Brown breast rather abruptly separated from dull white belly. Juvenile like adult, but plumage looser and fluffier	 filin.vn.ua/birds/image/kury/o.leucogastra.jpg http://ibc.lynxeds.com/photo/white-bellied-chachalaca-ortalis-leucogastra/bird-walking-perch
[10] Speckled Chachalaca, Spotted Chachalaca, Ortalis guttata Colombian Chachalaca (columbiana); Brazilian/ White-bellied Chachalaca (araucuan) ; Scaled Chachalaca (squamata)	Length: 45-60cm Weight: 500-600g (<i>colombiana</i>). Colour: Feathers of lower throat and breast conspicuously edged or tipped white or buffy white. Races vary in size, colouration and shape of breast markings.	 www.design2d.co.uk/.../peru/one/Dscn0845.jpg http://ibc.lynxeds.com/photo/speckled-chachalaca-ortalis-guttata/ortalis-guttata

SPECIES	DESCRIPTION	IMAGES
[11] Little Chachalaca, Guiana Chachalaca, Ortalis motmot; Rufous-headed Chachalaca (ruficeps)	Length: 43-54cm Weight: 385-620g. Colour: Chestnut head like <i>O. garrula</i> and <i>O. erythroptera</i> , but brown, not chestnut, primaries. Race <i>ruficeps</i> smaller and darker.	 www.arthurgrosset.com/.../photos/ortmot2564.jpg http://www.oiseaux.net/photos/maxime.dechelle/little.chachalaca.6.html http://ibc.lynxeds.com/photo/little-chachalaca-ortalis-motmot/adult-perch-lateral-view
[12] Buff-browed Chachalaca, Superciliated Chachalaca. Ortalis superciliaris	Length: 42-46cm; Smallest <i>Ortalis</i> . Colour: Only species with superciliary streak, which varies individually from buffy white to pale cinnamon.	 filin.vn.ua/birds/image/kury/p.superciliaris.jpg http://www.cracids.org/buff_browed_chachalaca.php

Source Information: del Hoyo *et al* (1994) and the photographs with the citations.

1.2.2.5.1 *Ortalis ruficauda*

This race was considered a separate race as *Ortalis ruficrissa*, but intergradations occurred (with *Ortalis ruficauda*) in Colombia and Maracaibo, Venezuela, where birds of the latter have been awarded a different race: *Ortalis baliolus*. Two subspecies have been recognized: *Ortalis ruficauda ruficrissa* and *Ortalis ruficauda ruficauda*. The latter exists in NE Colombia, NE Venezuela also Bequia and Union Islands and Tobago (del Hoyo *et al* 1994). Figures 1.1, 1.6 and 1.12 are images of the Cocrico Exhibit at the Emperor Valley Zoo in Trinidad, and Figure 1.8 is the Cocrico feeding in Tobago.

1.2.2.6 Ecology

Table 1.3 summarises the habitats, food and feeding for the different *Ortalis* species.

Table 1.3: Habitats, Food and Feeding for the different *Ortalis* sp

SPECIES	HABITAT	FOOD AND FEEDING
[1] Rufous-vented Chachalaca, Rufous-tailed/Red-tailed Chachalaca, Rufous-tipped Chachalaca. <i>Ortalis ruficauda</i>	Thorny deciduous brushland and forest in fairly open areas, e.g. <i>llanos</i> of Venezuela and Colombia; often near water, in gallery forest, along rivers or near lagoons. Marked preference for abandoned farmland, with mixed second growth and palms. Also clearings, in areas of humid forest. Mainly in lowlands; locally up to 1600m in Venezuela.	Fruits, tender shoots and leaves. Main food types are fruits, and occasionally leaves, of tree <i>Genipa caruto</i> , and nut-like fruits of palm <i>Copernicia tectorum</i> . Also leaves and flowers of guarumo (<i>Cecropia</i>). Forages in flocks of 4-20 birds, occasionally over 50; usually in trees, sometimes on ground.
[2] Chestnut-winged Chachalaca, <i>Ortalis garrula</i>	Dense tropical thickets, scrubby deciduous forest, tall second growth, arid scrub, riparian woodland and mangroves of N coastal region. Lowlands of up to c. 800m. Avoids densely forested areas, but occurs in humid forest borders at N base of the Andes.	Forages in groups of up to 12 birds.

SPECIES	HABITAT	FOOD AND FEEDING
[3] Plain Chachalaca, <i>Ortalis vetula</i> Common/ Mexican/ Eastern Chachalaca, Northern Chachalaca, Utila Chachalaca.	Areas of tall brush vegetation, thickets, scrub and second growth in lowlands. In S Veracruz ventures along streamside tangles into rain forest, but in areas where meets or approaches range of <i>O. poliocephala</i> and <i>O. cinereiceps</i>, present species found in drier habitats. In Guatemala and Honduras, also occurs in lowland and pre-montane forest, from sea-level locally up to c. 1850m. Race <i>deschauenseei</i> found in mangroves covering three quarters of Utila I; also, formerly, in adjacent scrub patches.	Fruits of many kinds, including hackberries (<i>Celtis laevigata</i>, <i>C. pallida</i>), mesquite (<i>Prosopis glandulosa</i>), mangoes, palmettos, persimmons, wild grapes, figs, <i>Bumelia</i>, <i>Achros</i>, <i>Juniperus flacida</i>; fleshy fruit apparently makes up roughly half of the diet. Also fresh green leaves, shoots, buds and twigs of several trees. Occasionally takes some insects from the ground. Forages in groups of up to 15 birds.
[4] Grey-headed Chachalaca. <i>Ortalis cinereiceps</i>	Tangled thickets, light second growth woods, plantations, bushy abandoned fields, clearings and thinned out forests, in humid areas; lowlands or hills, locally up to 1700m. Especially favours thickets where scattered, rapidly growing trees rise well above shrubs and vines. Shuns dense forest, although can occur in open borders of streams or sometimes in forest canopy, taking fruits from tree tops.	Fruits, e.g. spikes of guarumo trees (<i>Cecropia</i>), berries (<i>Hamelia patens</i>, <i>Miconia hyperpralina</i>, <i>Mantingia calabura</i>, <i>Phytolacca</i>), drupes of aceituno (<i>Simaruba glauca</i>) and guavas (<i>psidium guajava</i>); guara fruits taken from branches of trees, not from ground. Also leaves, whole or pieces pecked off plant, e.g. of composite shrubs (<i>Veronia patens</i>, <i>Oyedaea verbesinoides</i>); occasionally insects. Has been recorded picking up food in rivers, and from branches over water or exposed rocks; during dry season, also visits rivers to drink, in morning and evening. Forages in groups of 6-12 or even more birds, at all vegetation strata; mainly arboreal, but does come to ground, where sometimes scratches to uncover food.

SPECIES	HABITAT	FOOD AND FEEDING
[5] Rufous-headed Chachalaca, Ecuadorian Chachalaca. <i>Ortalis erythroptera</i>	Dry, deciduous forest, humid cloud forest, thickets, savannah and brushy areas, occasionally on agricultural land, in tropical coastal zone, inland to Andean foothills. In Sozoranga Mts. Loja (S Ecuador), occurs in dry Ceiba dominated deciduous forest, but is commoner in semi-evergreen and evergreen forest patches. Previously observed up to 1390m, but recently seen at 1850m, and heard apparently not much below 2500m. Not found in arid regions.	Birds have been observed pecking leaves of cloud forest trees, and one bird had leaves in its stomach. A flock frequented a banana plantation; one bird seen on ground in a maize field. Forages mainly in small groups of 2-7 birds.
[6] Rufous-bellied Chachalaca, Wagler's Chachalaca <i>Ortalis wagleri</i>	Tropical deciduous forest and thorn forest in lowlands. Also sometimes in palm plantations and dense mangroves along coast. Present in areas with drier vegetation than <i>O. poliocephala</i> , and at lower altitudes, seldom above 1300m.	Fruits of trees.
[7] West Mexican Chachalaca <i>Ortalis poliocephala</i>	Mainly tropical deciduous forest with rather narrow humidity limits as avoids rain and cloud forests and does not occur in dry oak-pine forests, except in most humid gullies with luxuriant vegetation. Also sometimes in palm plantations and dense mangroves. In the 2 narrow areas of contact with <i>O. wagleri</i> and <i>O. vetula</i> present species found in wetter woodland, reaching higher altitudes, up to 3000m.	Diet based on plant matter represented by leaves, seeds, flowers and fruits. Seems to be an important disperser of seeds.
[8] Chaco Chachalaca, Grey-headed Chachalaca (!) <i>Ortalis canicollis</i>	Swampy lowland forest and surrounding <i>monte</i> scrub; frequents borders of trails and edges of groves with dense, close cover.	Leaves, fruits, seeds and flowers; also caterpillars, which can be important in periods of abundance.

SPECIES	HABITAT	FOOD AND FEEDING
[9] White-bellied Chachalaca <i>Ortalis leucogastra</i>	Swampy forest, swamps with coyal palm undergrowth and thick, second growth scrub; also dry forests, pasture or plantation edges and mangrove forests, in lower tropical zone of Pacific slope. Commonest on coastal plain, but also occurs in hills up to c. 1500m.	Mainly berries and fruits, either green or ripe, especially coyal palm dates; also leaves, buds, flowers and some invertebrates. Forages in groups of 6 or more birds. Usually at 6-10m above ground, seems to come to ground less often than other species of <i>Ortalis</i> .
[10] Speckled Chachalaca, Spotted Chachalaca, <i>Ortalis guttata</i> Colombian Chachalaca (<i>columbiana</i>) ; Brazilian/White-bellied Chachalaca (<i>araucuan</i>) ; Scaled Chachalaca (<i>squamata</i>)	Thickets, grassy slopes, palm groves, interfaces of forest and second growth and low forests, less often in canopy or at edges of tall forest. In lowlands and foothills of tropical and subtropical zones, locally up to near transition area with temperate zone, at minimum 2275m in Bolivia, but up to 2500m in Colombia and 2700m in Peru. Race <i>squamata</i> mainly occurs from sea-level to 800m.	Virtually no information; often takes catkins of guarumo (<i>Cecropia</i>) trees. Usually forages in small flocks.
[11] Little Chachalaca, Guiana Chachalaca, <i>Ortalis motmot</i> ; Rufous-headed Chachalaca (<i>ruficeps</i>)		Mainly berries and fruits. Usually forages in pairs or small flocks, in trees or on the ground.
[12] Buff-browed Chachalaca, Superciliated Chachalaca <i>Ortalis superciliaris</i>	Thickets of scrub and forest, in lowlands.	No information available.

Source: Compiled from del Hoyo *et al* (1994).

Breeding

In Colombia the females lay in July. In Tobago laying has been observed to be year-round with the peak period being from March to June. They make their nests of twigs and leaves on trees but sometimes eggs are laid on the ground. They lay a clutch of 2-3 eggs [sometimes 4] and the duration of incubation is 28 days.

1.2.2.7 Status and Conservation

The species is not globally threatened. They are still common in Colombia and Tobago. They are not very common in live animal collections (del Hoyo *et al* 1994).

1.2.2.8. The Human Impact on Cracids in South and Central America

The family Cracidae is composed of 49 species of large Neo-tropical birds and it has been confirmed that Cracids are widely distributed in Venezuela and are considered an important source of 'bush meat' among both the campesinos and indigenous peoples (Silva and Strahl 1991 citing several authors). The Cracids are also well distributed across the rest of Latin America (Silva and Strahl, 1991). However, little was known twenty or more years ago about the ecology of the fourteen (14) species of Cracids in Venezuela, all of which have appeared on the official list of game birds in that country. Only eight (8) were included in the hunting schedule for the 1987 hunting schedule. Virtually all studies carried out listed the Cracidae as the family contributing the most avian biomass extracted by hunters in the Neo-tropics. One study done by the Ministry of Environment found that Cracids were not highly preferred by game sport hunters in Venezuela. However, indigenous people use Cracidae in the production of arms and ornaments. Curasow feathers were the only ones used by the Yonomami and Ye' kwana peoples in southern Venezuela. Along the Rio Caura, the Yanomami use Curasow's femurs to make arrowheads. Indians also use cracids feathers in bracelets, belts, headbands and other ornaments for adornment, religious functions, and for sale to tourists. This appears to be the most important commercial use for the Cracidae in remote locations, although campesinos have also commercialized the meat in a few areas on the local scale. The harvest of Cracids, both by number and by weight, exceeds that of all other avian families in Latin America. *Penelope* is the most hunted genus among the avian genera. Mammals are harvested more commonly than Cracids, however Cracids as a group are harvested more frequently than any mammalian order except for primates and rodents, (Silva and Strahl, 1991, Peres, 2000). In Latin American the Cracidae is undoubtedly an important source of food for the campesino and indigenous populations in the Neo-tropics. However, both campesinos and indigenous people affect the Cracid densities in different ways. The Latin American campesinos are characterized as being sedentary, hunting with shot guns along clear paths, so they exert a lower level of pressure on avian communities than do indigenous people. In Tobago, the people are no different and relish the Cocrico meat as wild game (Personal

communications). Indigenous peoples on the other hand who are less sedentary, hunt with bow, blowguns and shotguns, and often on a rotational basis. This rotational system of individuals allows for the recovery of bird populations. This system is lacking in campesino hunting methods, which usually deplete Cracid populations rapidly. A clear example of this is the extinction of the Cracidae population in the non-protected areas of Venezuela (Silva and Strahl 1991). Human impact on the Cracidae may have irreversible long-term effects on the biology of Neo-tropical forest ecosystems. This results not only in the reduction of population densities and local extinction of these species, but also in a reduction of seed dispersal of various plant species and perhaps the elimination of a vital link in the tropic system of the large frugivores and their predators. The Cocrico in Tobago also faces a similar situation.

1.2.2.9. Feeding, Breeding and Food Value

The nutritional content of the Rufous-vented Chachalaca has the potential to be a meat desired by individuals who are health conscious (Table 1.4).

Table 1.4: The Nutritional Content of the flesh of the Rufous-Vented Chachalaca.

Sample Size	Moisture %	Fat	Ash	Protein
8	73.1	0.4	1.1	24.1

Source: Hislop (1986)

As can be seen from Table 1.5, the meat of the Rufous-vented Chachalaca is higher in protein content than most of the common and conventional table meats. Amour (1998) reported that the breast was 35.9 % of the carcass weight. This has been reported to be 31% for broilers, 40% for turkeys and 32% for ducks (Moran, 1995). Prior to the publication by Garcia *et al* (2001) there were no reports in the literature of the conditions under which the Cocrico was artificially or intensively reared in Tobago.

Table 1.5: The Protein and Fat Content of Conventional Animal Meat Diets

Meat	Fat%	Protein%
Beef	14.0	
Mutton and Lamb	10.0	
Pork	47.0	11.2
Poultry/Chicken	10.0	18.2
Duck	14.5	13.3
Goose	13.3	13.9
Guinea Fowl	6.4	23.1
Codfish	0.3	17.6
Turkey	11.8	13.1
Cocrico	0.4	24.1

Source: Anon (1974)



**Figure 1.12: The Cocrico on exhibit at the Emperor Valley Zoo
Trinidad, Republic of Trinidad and Tobago**

1.2.2.10. Anatomy and Reproduction of the Cocrico

1.2.2.10.1. Reproduction and the Reproductive System

General

It has been suggested that the Chachalacas are monogamous, forming strong pair bonds (Delacour and Amadon, 1973; del Hoyo *et al.*, 1994). The birds are territorial, aggressive and also very protective of their young (del Hoyo *et al.*, 1994). Mating of the Chachalacas has been observed to occur when the pair is alone, rather than when in small flocks (del Hoyo *et al.*, 1994). From observations of groups in captivity with a male to female ratio of 3:1, successful mating was hampered by the other males present (Waldron, 1997). In Tobago, ffrench (1991) reported year-round breeding of the Rufus-Vented Chachalaca. In equatorial areas where there may be no fixed nesting season, Delacour and Amadon (1973) also reported year-round breeding of the Chachalacas. In contrast, observations with captive flocks at the Emperor Valley Zoo in Trinidad indicated that these birds mated even while in groups (Personal communication from Zookeepers at the Emperor Valley Zoo). Research considerations therefore, should be placed on the sex ratio in captive breeding colonies and their stocking densities.

Clutches and Clutch Size

In general, Cracids are single brooders (Delacour and Amadon, 1973). Clutches may contain as many as 2 to 3 eggs, rarely 4 (Delacour and Amadon, 1973). del Hoyo *et al.* (1994) reported 3 to 4 eggs twice per year while ffrench, 1991 reported 3 to 4 eggs. del Hoyo *et al.* (1994) also presented the clutch sizes of some Chachalaca species as seen in Table 1.6. In comparison, Table 1.6 shows the clutch sizes of wild versus domestic Gallinaceous species. The members of the genus *Gallus* have shown great potential for domestication. Table 1.6 attempts to show that through selective breeding, considerable advances have been made with respect to clutch sizes. In addition, it also shows that under captive rearing, the wild relations were able to show increases in clutch sizes. The Chachalacas can possibly be exploited in this respect. This is therefore an important area for research with the Cocrico.

As a family, replacement clutches may be laid in the wild and in captivity. Delacour and Amadon (1973) and del Hoyo *et al.* (1994) made reference to Cracids laying as many as four (4) clutches in a season, if the eggs were regularly removed. Marion and Fleetwood (1978) reported that a pair of Plain Chachalacas laid a total of 19 eggs in one season.

Another captive flock of four (4) females laid nearly 100 eggs (Marion and Fleetwood, 1978), which were about twenty-five (25) eggs per female. These authors felt that the number of eggs laid was dependent on the existing moisture conditions. When damp conditions prevailed during the nesting season, many more eggs were laid, which is in contrast to the drier times when egg production was severely curtailed (Marion and Fleetwood, 1978). Atmospheric conditions may have their effect on the availability of foods, or directly on the bird. The absence of information on body temperature in the literature has been noted. This is an important area in determining the zone of thermal comfort of the bird and ultimately the environmental conditions to which it is best suited. There is also a need to research the temperature changes at which the birds are most productive. Rufous Headed Chachalacas were recorded to have laid a second clutch about three (3) weeks after the first and a third clutch six (6) weeks later. The recycling time between clutches was 20 to 25 days in the Plain Chachalacas (Marion and Fleetwood, 1978).

Table 1. 6: Clutch Size of some Galliformes

Species	Clutch Size		Source
	Wild	Captive/ Commercial	
Green Jungle Fowl <i>Gallus</i> sp.	3-4	6-12	Johnsgrad (1986)
Red Jungle Fowl <i>Gallus</i> sp.	5-6	-	"
Gray Jungle Fowl <i>Gallus</i> sp.	4-5	-	"
Ceylon Jungle Fowl <i>Gallus</i> sp.	2	-	"
Turkey	8-15 9.6 (average)		Austin (1961) Vangilder <i>et al.</i> (1987)
Quail		200-300/yr.	Shanaway (1994)
Domestic Fowl <i>Gallus</i> sp.	-	280/yr.	NRC (1991)
Guinea Fowl	15-20	190/yr.	NRC (1991)

Incubation and Hatching

The incubation period for Chachalacas is estimated to be about 25 days (Marion and Fleetwood, 1978). Table 1.7 shows the variation of the incubation period of several Chachalaca species. This is shown to be comparable with other known species of Galliformes as shown in Table

1.8. The incubation period for the Rufous Headed Chachalaca was recorded at 28 days at a temperature of 36 ° C (Artmann, undated). **Reports were made in Marion and Fleetwood (1978) on chicks of the Plain Chachalaca as leaving their nests 24 hours after hatching. Chachalaca chicks are referred to as precocial, are active and agile in climbing through trees and shrubs (Marion, 1977).** Within six (6) days of hatching, chicks are able to jump and fly at least 1.3 m (Marion and Fleetwood, 1978).

Table 1.7: Chachalacas: Clutch Size and Incubation Period

Chachalaca Species	Clutch Size	Incubation Period (Days)
Plain Chachalaca	2-4	22-27
Gray-Headed Chachalaca	3	22
Chestnut Winged Chachalaca	3	26
Rufous Vented Chachalaca	3-4	28
Rufous Headed Chachalaca	3	26-28
Rufous Bellied Chachalaca	3	-
West Mexican Chachalaca	-	-
Chaco Chachalaca	3-4	-
White Bellied Chachalaca	2-3	-
Speckled Chachalaca	-	21
Little Chachalaca	3	-
Buff Browed Chachalaca	2-3	-

Source: Compiled from del Hoyo, Elliott and Sargatal (1994)

Table 1.8: Incubation Period for some Galliformes

Species	Incubation Period (days)	Source
Green Jungle Fowl	21	Johnsgard (1986)
Red Jungle Fowl	20	“
Gray Jungle Fowl	20-21	“
Ceylon Jungle Fowl	20-21	“
Domestic Fowl	21	NRC (1991)
Guinea Fowls	27	NRC (1991)
Quails	17	Shanaway (1994)
Turkeys	28	NRC (1991)

Table 1.9 also describes the breeding habits for the different Chachalaca species. The contents of this table suggest that there is still considerable ignorance on many of the “so called” Chachalacas species.

Table 1.9: Breeding information on the different Chachalaca species.

SPECIES	BREEDING PERIOD	NEST TYPE & HATCHLINGS
[1] <i>Ortalis ruficauda</i>	All year round in Tobago, with peak from March to June.	NEST: Made of twigs and leaves, have been found built in trees, usually 1-3m above ground, occasionally as high as 20m. HATCHLINGS: One juvenile weighing only 300g seen to fly as well as an adult.
[2] <i>Ortalis garrula</i>	April	HATCHLINGS: Chicks are brown and reddish brown above, buff and whitish below.
[3] <i>Ortalis vetula</i>	March to May in Yucatán and S Chiapas, April to May in Texas, July in Tamaulipas and Nuevo Leon.	NEST: It is a small, flimsy structure of plucked sticks, grasses and leaves, lined with a few green leaves, placed in dense vegetation (trees or bushes), usually at 1.5-7 (0.9-10)m above ground. HATCHLINGS: Chicks are cinnamon buff, russet and black above, white below, with cinnamon buff band across breast.

SPECIES	BREEDING PERIOD	NEST TYPE & HATCHLINGS
[4] <i>Ortalis cinereiceps</i>	Season variable, with laying recorded from January to May, comprising at least part of the rainy season.	NEST: It is a broad, shallow platform of sticks, leaves, grass stems, pieces of vine and inflorescences, placed in vine-draped bushes, tangles of creepers or small trees, at 0.9-2.4m above ground. HATCHLINGS: Chicks dull chocolate brown and sooty brown above, with some cinnamon marks, cinnamon and white below.
[5] <i>Ortalis erythroptera</i>		HATCHLINGS: Chicks unevenly rust brown, chestnut brown to dark brown and black above, paler below.
[6] <i>Ortalis wagleri</i>		NEST: One nest was 1m above ground in a small spiny tree c. 3.5m tall. HATCHLINGS: Chicks are variegated rich brown and buffy white, paler below.
[7] <i>Ortalis poliocephala</i>	??	??
[8] <i>Ortalis canicollis</i>		NEST: It is a small, simple, shallow platform, loosely built with sticks, stems, tendrils and leaves, without lining; usually situated 2.5-4m up in dense bush or tree.
[9] <i>Ortalis leucogastra</i>		NEST: A small, loosely built platform, lined with flattened leaves; placed in trees usually 5-10m above ground.
[10] <i>Ortalis guttata</i>	???	????

SPECIES	BREEDING PERIOD	NEST TYPE & HATCHLINGS
[11] <i>Ortalis motmot</i>		NEST: A fairly small cup, made of small roots, flattened leaves and sticks, and lined with leaves; one nest was built on fork of small shrub at c. 2m above ground, another was found in a low tree.
[12] <i>Ortalis superciliaris</i>	December to February	NEST: One nest was a fairly large, flat structure made of dry twigs.

Source: Compiled from the information in del Hoyo *et al* (1994)

1.2.2.10.2. Investigating the Reproductive and Digestive Systems of the Cocrico from Tobago

Sources of Birds

The quantitative work on the gross anatomy was done using eight (8) specimens of the Cocrico, seven (7) were females and one (1) was a male (Amour, 1998). Two (2) of the birds came directly from Tobago and these birds were wild caught. One (1) was donated by a pet owner in Trinidad. The other five (5) birds were sourced in Trinidad from the Zoological Society of Trinidad and Tobago (Emperor Valley Zoo), and were held in captive facilities for some period of time. The source of the birds by specimen numbers is presented in Table 1.10. The stages of maturity of the birds were unknown. This was the first and only study of its kind done with the Cocrico.

Table 1.10: Source and sex of specimens of Cocricos (Rufous Vented Chachalacas)

Specimen	Sex	Source
1	F	Donated by pet owner
2	M	Forestry Division, Tobago
3	F	"
4	F	Zoological Society of Trinidad & Tobago
5	F	"
6	F	"
7	F	"
8	F	"

Dissection of the birds

A dissection of the birds was conducted. The procedure was adapted from Webster and Sorater (1980). The reproductive and digestive systems were removed for quantitative measurements.

The quantitative measurements taken were the following:

1. The weight of the live bird
2. The weight of the carcass
3. The lengths and diameters or widths (in cm) of each section of the digestive tract and reproductive tract
4. The weight of the entire digestive tract
5. The weight of the entire reproductive system
6. The length of each segment of the digestive tract as a percentage of total length
7. The weight of each segment of the digestive tract
8. The weight of each segment of the reproductive system
9. The weight of each segment of the digestive tract as a percentage of total weight of the digestive tract
10. The weight of each segment of the digestive tract as a percentage of total live weight
11. The weight of each segment of the reproductive system as a percentage of live weight
12. The weight of the different components of the carcass.

Total Body and Carcass Weights

The Rufous vented Chachalaca body weights and carcass measurements are presented in Table 1.11. Samples varied in total body weights from 375 g to 682 g. An average total body weight was recorded at 565.85 g $\pm$ 128.17. The carcass weight as a key production parameter was recorded as ranging between 184 g to 376.1 g. The carcass shown in Figure 1.10, constituted 49.07% to 55.15% of the total body weight of the bird. On an average, the carcass comprised some 50.42% of the bird's total body weight. Chest measurements were also recorded. These weights ranged from 74.0 g to 126.3 g. The chest constituted 30.93% to 42.25% of the carcass weight of the bird. The average chest weight was found to be 109.24 $\pm$ 30.59 g. Figure 1.13 presents the carcass demonstrating the pronounced chest.

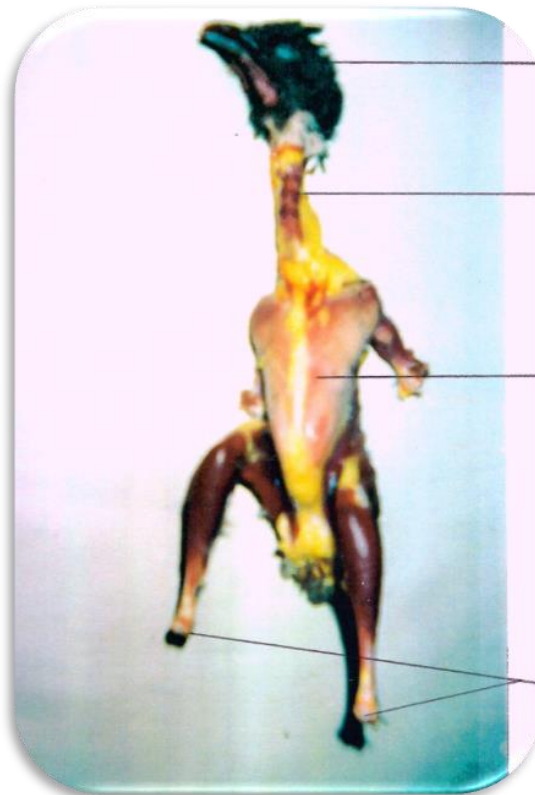


Figure 1. 13: The Carcass of the Cocrico in ventro-dorsal position with the skin removed.

Table 1.11: Total body Weight and Carcass Weight of the Cocrico

Parameter	Sample Number and Weights (g)								
	1♀	2♂	3♀	4♀	5♀	6♀	7♀	8♀	Mean ± S.D.
Total Live Body Weight (g)	682	425	375	660	440	651.2	638	655.6	565.85 ±128.17
Carcass Weight (g)	376.1	223	184	334.5	220.5	291.0	295.7	359.5	285.54 ±70.36
Dressing %	55.15	52.47	49.07	50.68	50.11	44.69	46.35	54.84	50.42
Chest Weight (g)	-	-	-	126.3	74.0	90.3	103.7	151.9	109.24 ±30.59
Chest, as % of Carcass Weight	-	-	-	37.76	33.56	30.93	35.07	42.25	35.91
Chest, % of Total Body Weight	-	-	-	19.14	16.82	13.87	16.25	23.17	17.85

S.D. - Standard Deviation

1.2.2.10.2.1 The Male and Female Reproductive System of the Cocrico

I The Male Reproductive System

The male reproductive system included a pair of testes and ductus deferens. Figure 1.14 presents the general schematics of a typical avian male reproductive system. The pair of testes together weighed 0.1 g. A length of 0.9 cm was recorded for each testis. There was no difference in length or weight of the two testes sampled. The male reproductive system had a total length of 10.0 cm and a total weight of 0.5 g. In relation to the total body weight, the male sex organs contributed 0.12% (Table 1.12).

II The Female Reproductive System

Only the left ovary and oviduct were identified for the Rufous vented Chachalaca. Figures 1.15, 1.16, 1.17 and 1.18 present the general schematics of a typical avian female reproductive system. Quantitative measurements were taken of the samples provided. Length measurements from the ovaries to the cloaca ranged from 9.53 cm to 10.5 cm. Weight measurements ranged from 0.7 g to 4.1 g. Average lengths and weights were recorded at 10.02 cm ± 0.37 cm, and 1.71 g ± 1.25 g respectively. Ovaries were found to vary in lengths ranging from 1.0 cm to 2.055 cm. Widths (at the widest point), were found to range from 0.7 cm to 1.25 cm. Average widths were recorded at 0.92 cm ± 0.27 cm. Weight measurements ranging from 0.1 g to 1.1 g were recorded for

the birds examined. The ovaries were found to range in percentage of total body weight, from 0.10% to 0.64%. As a percentage of the total reproductive system, ranges were recorded from 12.5% to 41.66%. Average lengths and weights of the ovaries were recorded at 1.52 cm $\pm$ 0.39 cm, and 0.46 g $\pm$ 0.32 g, respectively (Tables 1.13 and 1.14).

Follicles were noted to vary in size -Tables 1.15 and 1.16. Samples measured were taken from birds dissected in July 1998. Follicles above 0.1cm in diameter were recorded. Sample no. 4 recorded 24 follicles at, and above 0.1 cm, with the largest follicle having a diameter of 0.4 cm. The largest follicles were recorded from sample no. 7, where 33% of the follicles recorded were above 0.4 cm.

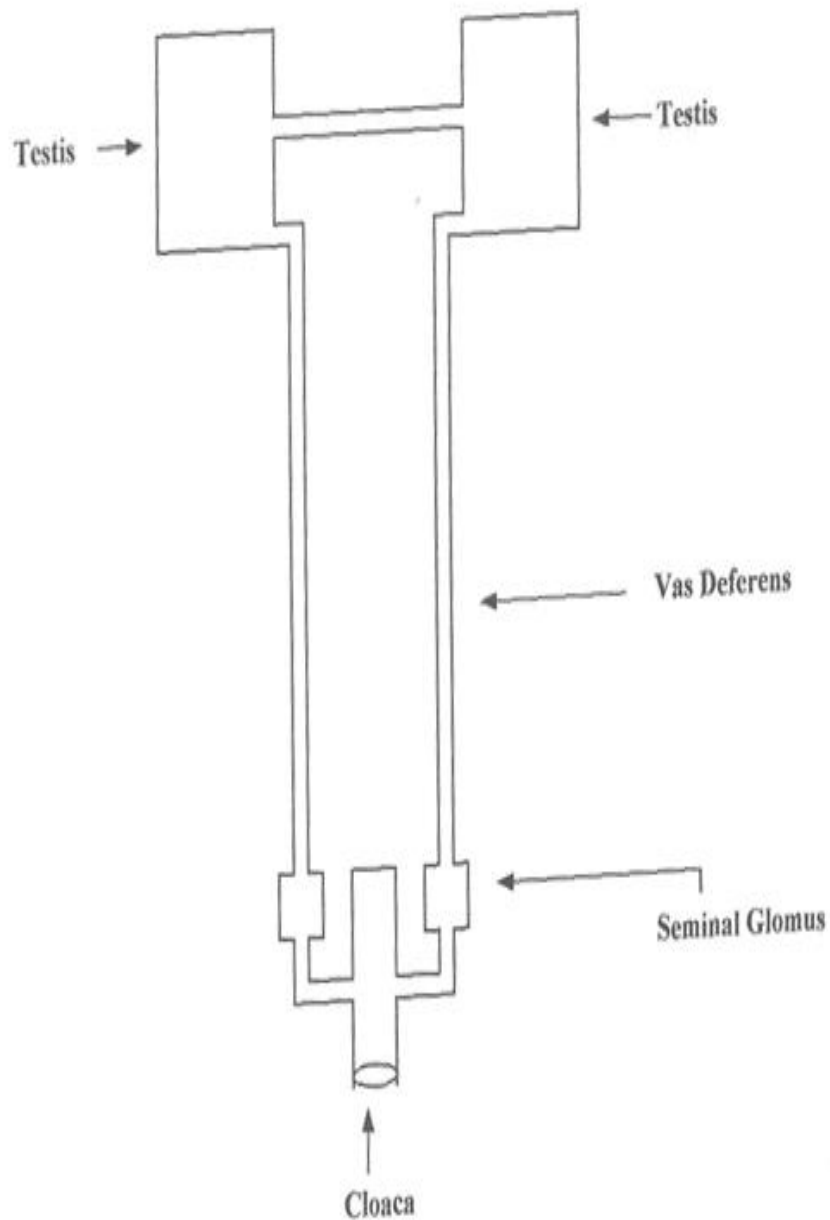
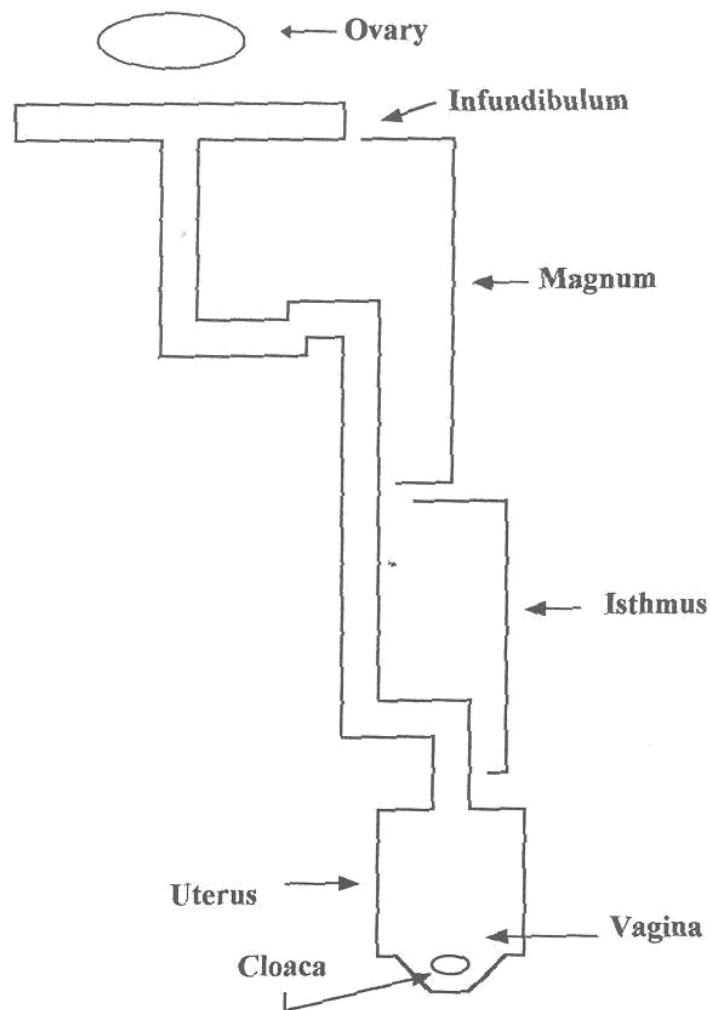


Figure 1.14: Schematic diagram of the Reproductive System of a male bird.

Source: Adapted from Anon (1987) and Moreng and Avena (1985)

Table 1.12: Length and Weight Measurements of the Male Reproductive System (Animal Sample # 2) of the Cocrico

	Length (cm)	Weight(g)
Reproductive System	10.0	0.5
Testis	0.9	0.1
Reproductive system as a percentage of total body weight (%)	0.12	
Testes weight as a percentage of the reproductive system (%)	20	
Testes length as a percentage of the reproduction system (%)	9	



Source: Adapted from Moreng and Avens (1985)

Figure 1.15: Schematic diagram of the Reproductive System of a female bird.

Table 1.13: The Length and Width Measurements of the Female Reproductive System of the Cocrico

	Sample Numbers and Measurements									
	1	2	3	4	5	6	7	8	Av.	(S) *
Reproductive System	-	-	10.5	10.16	9.62	10.16	9.53	10.16	10.02	0.37
Ovary (length/cm)	1.35	-	1.0	2.055	1.75	1.10	1.60	1.80	1.52	0.39
Ovary (width/cm)	-	-	0.725	1.27	0.825	0.7	1.25	0.75	0.92	0.27

* - Standard Deviation

Table 1.14: The Weight Measurements of the Female Reproductive System of the Cocrico

	Sample Numbers and Weights (g)								
	1	2	3	4	5	6	7	8	Mean $\pm$ S.D
Reproduction System	0.7	-	0.8	2.5	0.8	1.2	4.1	1.9	1.71 $\pm$ 1.25
Ovaries	0.2	-	0.4	0.5	0.1	0.5	1.1	0.4	0.46 $\pm$ 0.32
%Total weight of the reproduction system	28.57	-	50	20	12.5	41.66	26.83	21.05	
% of total body weight	0.10	-	0.21	0.38	0.18	0.18	0.64	0.29	

S.D. -Standard Deviation

Table 1.15: The Quantification of Follicles ≥ 0.1 cm in the Ovaries of the Cocrico

Sample #	Total number of follicles ≥ 0.1 cm	Quantity of Follicles at Follicle Length (cm) Ranges and % of Total Follicles ≥ 0.1 cm							
		0.1-0.19	%	0.2-0.29	%	0.3-0.39	%	≥ 0.4	%
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-
4	24	13	54	06	25	04	17	01	4
5	11	05	45	03	27	03	27	00	
6	12	08	67	04	33	00	-	00	
7	15	01	07	05	33	04	27	05	33
8	15	05	42	04	33	03	25	00	

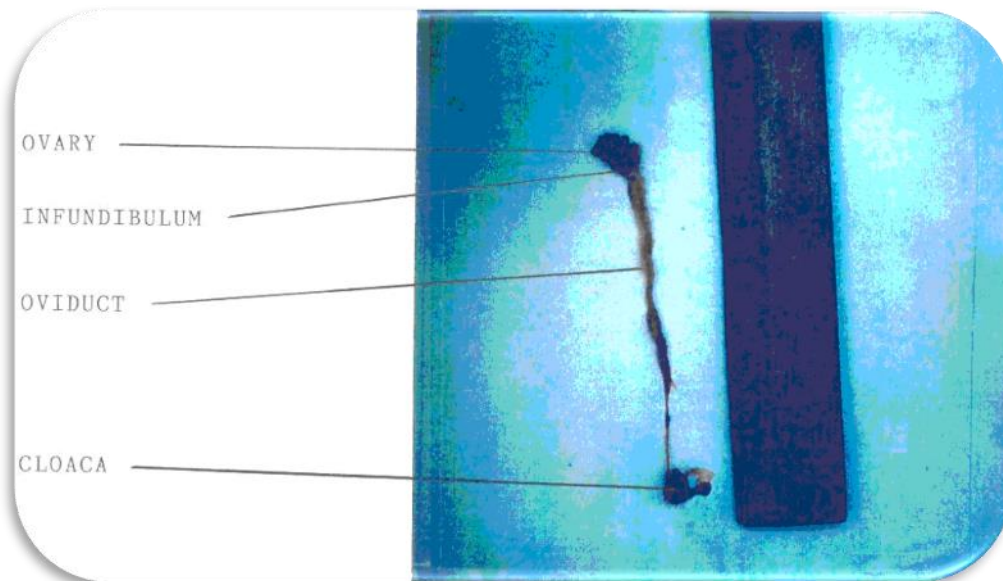


Figure 1.16: The Female Reproductive System of the Cocrico

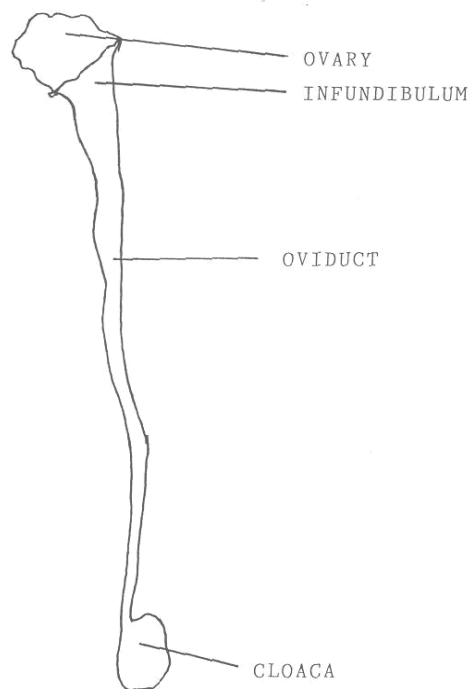


Figure 1.17: The Female Reproductive system of a Cocrico

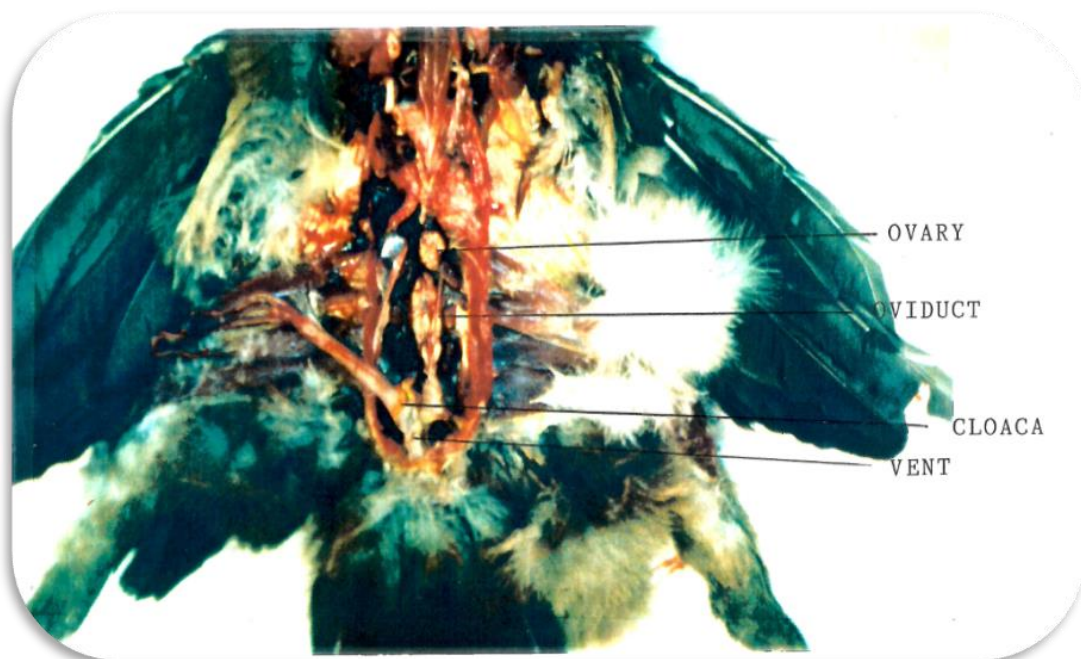


Figure 1.18: The Position of the Female Reproductive System in the Cocrico

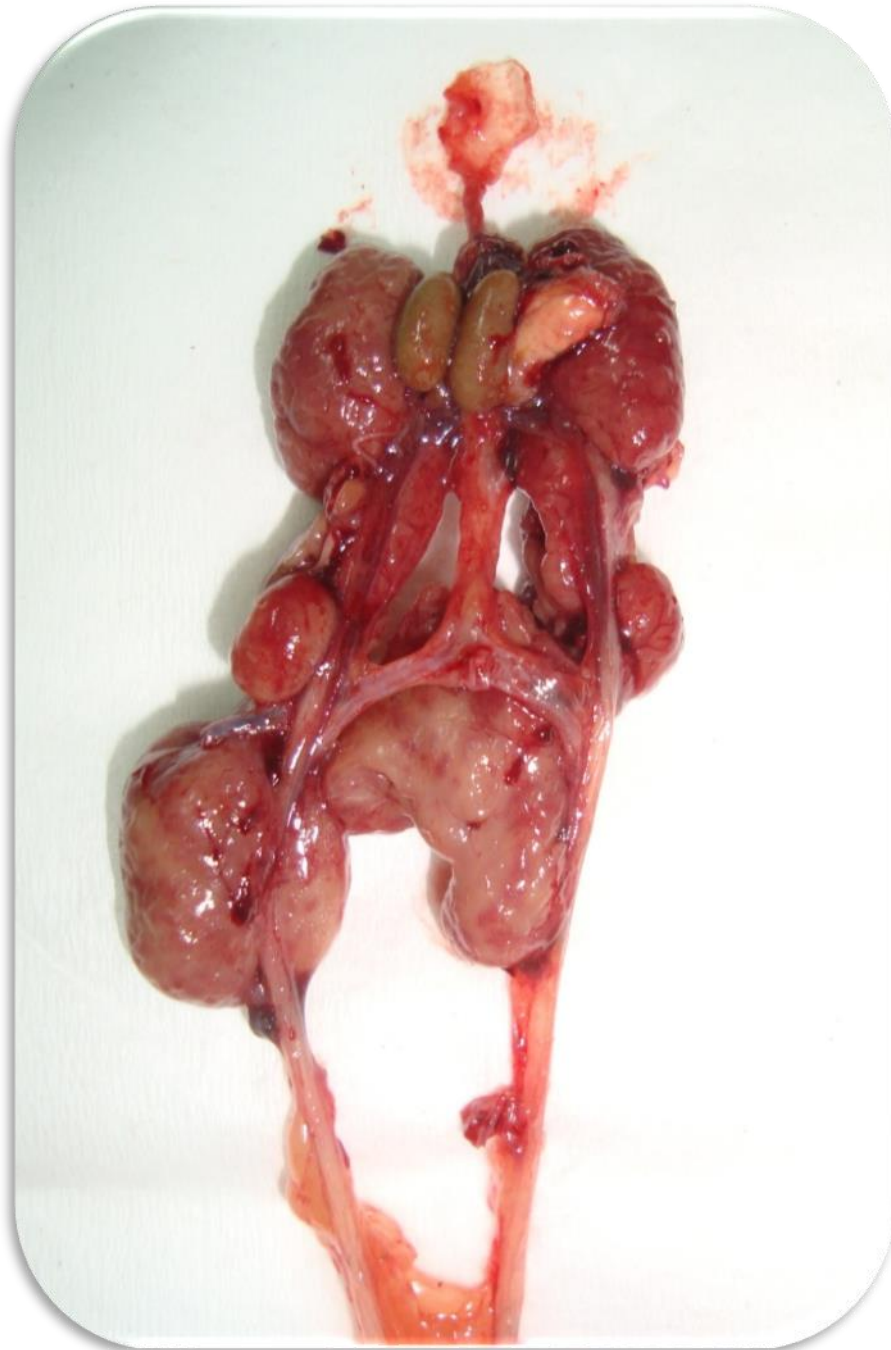


Figure 1.19: The Female Reproductive System in the Cocrico

Table 1.16: The Follicle Measurements of the Rufous Vented Chachalaca

Sample Number	Follicle Size (cm)	Date Sample	Remarks
1			None Taken
2			Male
3			None Taken
4	0.3 ,0.3, 0.3, 0.2, 0.4, 0.3, 0.2, 0.2, 0.15 ,0.1, 0.2, 0.175, 0.2, 0.2, 0.15, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1	July 1998	24 follicles recorded at and above 0.1 cm
5	0.35, 0.3, 0.225, 0.3, 0.1, 0.2, 0.2, 0.175, 0.175, 0.175, 0.1	July 1998	11 follicles recorded at an above 0.1 cm
6	0.2, 0.2, 0.2, 0.175, 0.1, 0.2, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1	July 1998	12 follicles recorded at an above 0.1 cm
7	0.7, 0.6, 0.35, 0.32, 0.35, 0.45, 0.2, 0.15, 0.39, 0.25, 0.4, 0.2, 0.45, 0.225, 0.25	July 1998	15 samples recorded at and above 0.1 cm
8	0.35, 0.3, 0.35, 0.275, 0.225, 0.1, 0.2, 0.1, 0.2, 0.15, 0.175, 0.15	July 1998	12 follicles recorded at and above 0.1 cm

1.2.2.10.2.2 Discussion on Reproduction and the Reproductive System of the Cocrico

Understanding the mating habits of the Rufous Vented Chachalaca will be the key to developing systems for a sustainable breeding programme. del Hoyo *et al.* (1994) and Delacour and Amadon (1973) reported on the monogamous nature of the chachalaca. Waldron (1997) also alluded to the difficulties faced in having breeding success in a backyard holding

with a ratio of three (3) males to one (1) female. Determining an efficient sex ratio is paramount in establishing a production system. The literature was found to be deficient in this area. del Hoyo *et al.* (1994) also made reference to the birds breeding when in pairs, rather than in small flocks. In contrast, breeding occurred at the Zoological Society of Trinidad and Tobago in a small flock held in a cage, semi-natural enclosure.

The monogamous nature of the Cocrico, stocking densities, sex ratios and parental care are topic areas in the literature that were not dealt with sufficiently. These areas should hold the key to facilitating a better understanding of the reproductive behavior of the Cocrico. It was reported to have the potential of year-round breeding, with a seasonal peak in May (Herklots, 1969). There is a need to investigate the ability of the birds to be in a reproductive state throughout a calendar year. These are however dependent on the control of broodiness and the number of replacement clutches that the birds can produce and the ability of the female bird to produce mature follicles continually. For the male bird, year-round breeding is dependent on its ability to sustain sperm production throughout a calendar year.

Tables 1.6 and 1.7 show the clutch sizes of Chachalaca species and other Galliformes respectively. By comparison, the wild relations of the domestic fowl have been shown to produce clutches ranging from 2 to 4 eggs. The green jungle fowl in captivity has been documented as producing clutches of 6 to 12 eggs. The genetically improved and commercially grown Galliformes - the quail, domestic fowl and guinea fowl - have been reported to produce 200 to 300, 280 and 190 eggs respectively. Based on the comparison shown between wild birds and genetically improved and managed birds, the Chachalaca may also possess the ability to increase the clutch size. In its favor, several authors have referred to the ability of the bird to produce replacement clutches, both in the wild and in captivity.

Factors known to affect increased egg production are:

- (i) the husbandry practices and environmental conditions as inferred in reports by del Hoyo *et al.* (1994); Delacour and Amadon (1973) and Marion and Fleetwood (1978); and
- (ii) the recycling time between clutches, noted by Marion and Fleetwood (1978) as 20 - 25 days for the Plain Chachalaca.

Male and Female Reproductive Systems

The identified areas of the male reproductive system are shown in Figures 1.13 and 1.14. These areas are the testes and the vas deferens. The total weight of the male reproductive system was calculated at 0.12% of total body weight (Table 1.12). King and McLelland (1984) in reference to the domestic fowl, and Marion and Fleetwood (1978) on the Plain Chachalaca, made note of the differences in sizes between the left and right testes. This was not observed in the sample measured in this study. More research may be needed. King and McLelland (1984) and Koch (1973) were cited in reference to increase in testes dimensions during periods of increased sexual activity. The literature made no reference to age or seasonal changes in the testes of the Rufous Vented Chachalaca.

Studies in this respect may

- (i) allude to the ability of the male bird to produce adequate sperm for year-round breeding; and
- (ii) aid in determining the age of sexual maturity of the male bird.

The Rufous vented Chachalaca shows development of the left ovary and oviduct alone (Figures 1.17 and 1.18). In the domestic fowl, the hen has been noted in King and McLelland (1984), when actively laying, to possess 4 or 5 large follicles, reaching 40 mm (0.4 cm) in diameter. Table 1.15 on the Rufous vented Chachalaca shows ovaries producing five (5) at or above 0.4 cm in diameter. Four (4) of the ovaries sampled had 3 to 4 follicles between 0.3 to 3.9 cm in diameter. The quantity of follicles above 0.3 cm in diameter may be an indicator to the bird coming into a breeding phase.

The lengths of the reproductive systems existed within a narrow range of $9.53 \text{ cm} \pm 10.5 \text{ cm}$, averaging $10.02 \text{ cm} \pm 0.37 \text{ cm}$. The length of the reproductive system could not be conclusively used as an indicator of the breeding status of the bird. The ovary dimensions varied with each sample, the largest dimensions were found in samples number 4 and 7, both of which had large numbers of follicles $\geq 0.1 \text{ cm}$ in length. In assessing the weight measurements, the ovary showed no pattern with follicle size. The readiness for breeding was better determined through the weight of the entire reproductive system. The heaviest reproductive systems were recorded for samples number 4 and 7. Examining the records of the reproductive systems of mature birds over a calendar year may allow more concrete assessments to be made.

Histological evaluation of the reports on the reproductive systems would have made a vital contribution to this study. Attempts were made to have such studies included, but this was not possible as the histological

preparation samples were not completed in time for inclusion in this document.

1.2.2.10.2.3 The Cocrico's Digestive System by weight

In determining the characteristics of the digestive system of the Rufous Vented Chachalacas, length and weight measurements were taken of the component parts. These measurements were accompanied by a photographs and a line drawings (Figures 1.19 and 1.20) of the related segments. Total length and weight measurements of the digestive tract were taken from the oesophagus to the large intestine where it enters the cloaca. Empty weight measurements for the cocrico ranged from 22.8 to 29.7 g. An average weight was obtained and recorded at $25.55 \text{ g} \pm 2.68 \text{ g}$. Ranges in weight and averages of the component parts of the digestive tract are recorded in Table 1.17. The averages of these parts were as follows: the oesophagus $3.0 \text{ g} \pm 0.5 \text{ g}$; the stomach $7.48 \text{ g} \pm 1.12 \text{ g}$; the intestines $13.5 \text{ g} \pm 0.58 \text{ g}$. By percentage, these parts comprised 11.74 %, 29.28% and 52.84% of the total weight of the digestive tract respectively (Table 1.18). Further quantitative data were recorded of the segments of the digestive system. These segments included the oesophagus with crop, of an average weight $1.24 \text{ g} \pm 0.19 \text{ g}$. The components of the stomach - the proventriculus and the gizzard - ranged in weights from 1.2 g - 1.9 g and 4.2 g - 8.8 g respectively. The parts to follow the stomach, the intestines, were divided into the following segments, the small intestine 9.8 g - 11.2 g, averaging $10.38 \pm 0.52 \text{ g}$. This is further divided into the duodenum, ranging in measurements of 3.5 - 4.9 g and the jejunum and ileum, 5.5 g - 6.9 g. The large intestine followed with weight ranges from 2.5 g - 3.5 g.

1.2.2.10.2.4 The Digestive System by length

I Oesophagus

The oesophagus measured an average length of $14.3 \text{ cm} \pm 1.54 \text{ cm}$ (Table 1.19). The oesophagus comprised 20.53% of the length of the digestive tract (Table 1.20). Weight ranges obtained are shown in Table 1.18. The oesophageal lumen had an average diameter of $0.616 \text{ cm} \pm 0.025 \text{ cm}$. The oesophageal tube was of uniform diameter throughout its length, except where expansions distinguished as the *crop* occurred. The *crop* by length, ranged from 2.0 cm - 3.81 cm; an average length was recorded at $2.82 \text{ cm} \pm 0.69 \text{ cm}$. (Table 1.19). The crop was determined to constitute 19.72% of the average length of the oesophagus and 40.92% of its weight empty.

II Stomach

The two chambers of the stomach were easily distinguished. The total stomach weight was recorded (Table 1.18), and an average weight of $7.48 \text{ g} \pm 1.12 \text{ g}$ was obtained. An average length was also determined from the length ranges obtained. This was recorded as $5.54 \text{ cm} \pm 0.82 \text{ cm}$. The stomach in relation to the entire digestive tract was calculated as comprising 29.28% and 7.95% of its weight and length respectively.

The first chamber of the stomach, the proventriculus, recorded an average weight of $1.6 \text{ g} \pm 0.23 \text{ g}$, and an average length of $2.68 \text{ cm} \pm 0.43 \text{ cm}$. In relation to the stomach, this chamber accounted for 21.39% and 48.38% of the average weight and length respectively.

The gizzard of the Rufous vented Chachalaca showed an average length of $2.98 \text{ cm} \pm 0.48 \text{ cm}$, from length ranges of 2.0 cm - 3.18 cm. This chamber was determined to constitute 53.79% of the length of the stomach. Weight measurements were also recorded (Table 1.17). An average of $6.13 \text{ g} \pm 1.35 \text{ g}$ was determined. By weight, the gizzard was calculated as comprising 81.95% of the stomach.

Average diameters were also obtained from the samples examined. The diameter readings were recorded from the widest joint of the chambers (Table 1.21). Averages were calculated and recorded as $1.11 \text{ cm} \pm 0.275 \text{ cm}$ and $1.65 \text{ cm} \pm 0.384 \text{ cm}$ for the proventriculus and gizzard respectively.

III Intestines

The intestines of the Rufous vented Chachalaca ranged in weight from 12.8 g to 14.2 g, and in length, from 42.55 cm to 59 cm. Averages were calculated at $13.5 \pm 1.35 \text{ g}$ and $49.15 \text{ cm} \pm 6.65 \text{ cm}$ for the weight and length respectively. The intestines, from its averages, were calculated to be 70.56% by length, and 52.84% of the weight of the digestive tract of the Cocrico.

The segments of the intestines identified were:

- (a) The small intestine consisting of
 - (i) The duodenum, measured immediately after the gizzard, and forming a loop, and
 - (ii) The jejunum and ileum, the coil of the intestine, which follows the duodenal flexure; and

(b) The large intestine, which was measured from the point where the paired caeca enter the large intestine.

The diameter measurements of the duodenum, jejunum and ileum, and large intestines are recorded in Table 1.21. Average diameters were calculated at $1.27 \text{ cm} \pm 0.449 \text{ cm}$, $0.574 \text{ cm} \pm 0.083 \text{ cm}$, and $0.845 \text{ cm} \pm 0.194 \text{ cm}$ for the respective segments. Average diameters for the paired caeca were recorded at $0.286 \text{ cm} \pm 0.174 \text{ cm}$.

Small Intestine

The small intestine was recorded to have an average length of $42.62 \text{ cm} \pm 7.03 \text{ cm}$, and an average weight of $10.38 \text{ g} \pm 0.52 \text{ g}$. These measurements represented 76.89% by weight and 86.71% by length of the intestines. The component parts, the duodenum and the jejunum and ileum, were recorded as having average lengths of $9.48 \text{ cm} \pm 1.2 \text{ cm}$ and $32.64 \text{ cm} \pm 8.11 \text{ cm}$, respectively. These segments represented 22.24% and 76.58% of the respective lengths of the small intestine.

Weights for the component parts ranged from 3.5 g to 4.9 g for the duodenum, and 5.5 and 6.9 g for the jejunum and ileum (Table 1.17). Averages were calculated at $4.2 \text{ g} \pm 0.66 \text{ g}$ for the duodenum, 40.15% of the weight of the small intestine. The jejunum and ileum averaged $6.18 \text{ g} \pm 0.52 \text{ g}$, representing 59.08% of the weight.

Large Intestine

The large intestine was identified from the opening of the paired caeca into the rectum. The rectum was short, with length measurements ranging from 5.8 cm to 7.62 cm. An average of $6.4 \text{ cm} \pm 0.58 \text{ cm}$ was calculated, contributing 13.02% of the intestines and 9.19% of the total digestive tract. Weight measurements recorded ranged from 2.5 g - 3.5 g, averaging $3.07 \text{ g} \pm 0.52 \text{ g}$. The large intestine constituted 22.4% of the weight of the intestines and 12.02% of the average total weight of the digestive tract.

The paired caeca were observed as long narrow organs opening into the rectum. The appendages were brownish-red in colour. An average length of $5.91 \text{ cm} \pm 0.62 \text{ cm}$ was calculated per caecum, from a range of 5.08 cm to 6.99 cm. As an appendage of the large intestine, the average weight of $0.5 \text{ g} \pm 0.34 \text{ g}$ was recorded (Table 1.18), constituting 16.29% by weight of the large intestine.

IV Pancreas

The presence of the pancreas was noted, but no quantitative measurements were recorded.

V Liver

The liver was found lying ventral to the lungs, stomach, spleen and intestines, filling most of the cranial and middle regions of the body cavity. This organ was reddish-brown in colour, and weights recorded ranged from 8.5 g to 17.5 g, and averaged 13.45 g $\pm$ 4.1 g (Table 1.17). The liver was calculated to constitute 2.1% of the total body weight of the bird.

Table 1.17: The Weight Measurements of the Digestive Tract of the Cocrico

Parts & Segments	Sample Number and Weight (g)									
	1	2	3	4	5	6	7	8	Average	$\pm$ S*
Digestive Tract	22.8	-	-	25.6	22.5	26.9	29.7	25.8	25.55	2.68
Oesophagus	-	2.4	2.7	-	3.3	3.5	3.5	2.6	3.0	0.5
Crop	-	-	1.3	1.1	1.0	1.5	1.3	-	1.24	0.19
Stomach	7.3	7.6	6.8	7.0	5.4	8.7	8.7	8.3	7.48	1.12
Proventriculus	1.5	1.6	1.5	1.5	1.2	1.9	1.9	1.7	1.6	0.23
Gizzard	5.8	6.0	5.3	5.5	4.2	6.8	8.8	6.6	6.13	1.35
Intestines	-	-	-	14.2	12.8	13.2	14.0	13.3	13.5	0.58
Small Intestine	-	-	-	10.4	10.1	10.4	11.2	9.8	10.38	0.52
Duodenum	-	-	-	3.5	4.6	4.5	4.9	3.5	4.2	0.66
Jejunum & Ileum	-	-	-	6.9	5.5	5.9	6.3	6.3	6.18	0.52
Large Intestine	-	2.6	2.9	3.8	2.5	2.7	3.5	3.5	3.07	0.52
Caeca	-	0.3	0.3	0.5	0.4	0.1	0.8	1.1	0.5	0.34
Liver	10.5	8.5	8.5	16.4	17.0	-	15.8	17.5	13.45	4.10

* - Standard Deviation

Table 1.18: The Average Weights and Percentages of the Parts & Segments of the Digestive Tract of the Cocrico

Parts & Segments	Average Weight (g)	Percentage Weight of Digestive Tract	Percentage of Segment
Digestive Tract	25.55	22.15 *	-
Oesophagus	3.0	11.74	-
Crop	1.24	-	40.92 ^a
Stomach	7.48	29.28	
Proventriculus	1.6	-	21.39 ^b
Gizzard	6.13	-	81.95 ^b
Intestines	13.5	52.84	
Small Intestine	10.38	40.62	76.89 ^c
Duodenum	4.2	-	40.15 ^d
Jejunum & Ileum	6.18	-	59.08 ^d
Large Intestine	3.07	12.02	22.74 ^e
Caeca	0.5	-	16.29 ^e
Liver	13.45	2.38 *	-

^a - % of oesophagus

^b - % of stomach

^c - % of intestines

^d - % of small intestine

^e - % of large intestine

* - Percentage of average body weight

Table 1.19: The Length Measurements of the Digestive Tract of the Cocrico

Parts & Segments	Sample Number and Lengths (cm)									
	1	2	3	4	5	6	7	8	Average	± S*
Digestive Tract	84	-	-	68.56	65.41	63.84	63.1	73.04	69.66	7.92
Oesophagus	15.0	15.5	15.	13	16.51	12.70	14.61	12.07	14.30	1.54
Crop	2.0	-	3.5	-	3.81	2.54	2.54	2.54	2.82	0.69
Stomach	4.0	-	-	5.4	5.72	5.72	6.04	6.36	5.54	0.82
Proventriculus	2.00	3.18	2.90	2.22	2.54	2.54	2.86	3.18	2.68	0.43
Gizzard	2.00	-	-	3.18	3.18	3.18	3.18	3.18	2.98	0.48
Intestines	59	-	-	50.16	43.18	45.42	42.55	54.61	49.15	6.65
Small Intestine	53.0	-	-	43.82	35.56	39.07	36.02	48.26	42.62	7.03
Duodenum	8	-	-	8.89	9.53	11.43	8.89	10.16	9.48	1.2
Jejunum & Ileum	45	-	-	34.93	26.03	27.64	24.13	38.10	32.64	8.11
Large Intestine	6.0	-	5.8	6.35	7.62	6.35	6.35	6.35	6.40	0.58
Caeca	5.5	-	6.0	5.72	5.72	5.08	6.35	6.99	5.91	0.62

*-Standard Deviation

Table 1.20: The Average Lengths and Percentages of Parts & Segments of the Digestive Tract of the Cocrico

Parts & Segments	Average Weight (cm)	Percentage Length of Digestive Tract	Percentage of Segment
Digestive Tract	69.66	-	-
Oesophagus	14.30	20.53	-
Crop	2.82	4.05	19.72 ^a
Stomach	5.54	7.95	-
Proventriculus	2.68	3.85	48.38 ^b
Gizzard	2.98	4.28	53.79 ^b
Intestines	49.15	70.56	-
Small Intestine	42.62	61.18	86.71 ^c
Duodenum	9.48	-	22.24 ^d
Jejunum & Ileum	32.64	-	76.58 ^d
Large Intestine	6.40	9.19	13.02 ^e
Caeca	5.91	-	-

^a - % of oesophagus

^b - % of stomach

^c - % of intestines

^d - % of small intestine

^e - % of large intestine

Table 1.21: The Diameter Measurements of the Digestive Tract of the Cocrico

Parts & Segments	Sample Number and Diameters (cm)									
	1	2	3	4	5	6	7	8	Average	± S*
Oesophagus	-	-	-	0.64	0.64	0.6	-	0.589	0.616	0.025
Proventriculus	-	-	-	1.27	0.64	1.27	1.11	1.27	1.111	0.275
Gizzard	-	-	-	1.905	1.27	1.905	1.905	1.27	1.651	0.348
Duodenum	-	-	-	0.635	1.27	1.905	1.27	1.27	1.27	0.449
Jejunum & Ileum	-	-	-	0.476	0.635	0.635	0.49	0.635	0.574	0.083
Large Intestine	-	-	-	0.785	0.595	0.95	1.11	0.785	0.845	0.194
Caeca	-	-	-	0.159	0.159	0.159	0.476	0.476	0.286	0.174

*-Standard Deviation

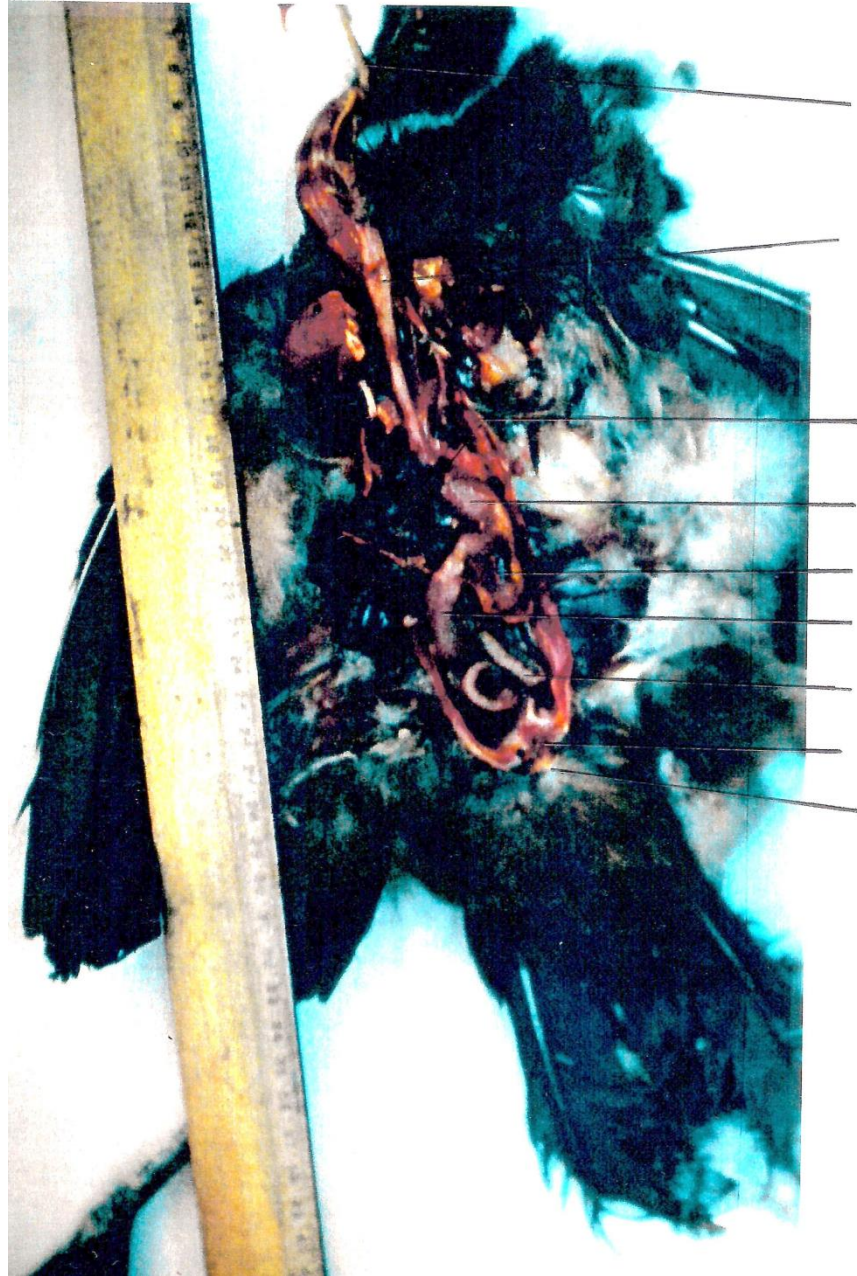


Figure 1.20: The Digestive System of the Cocrico

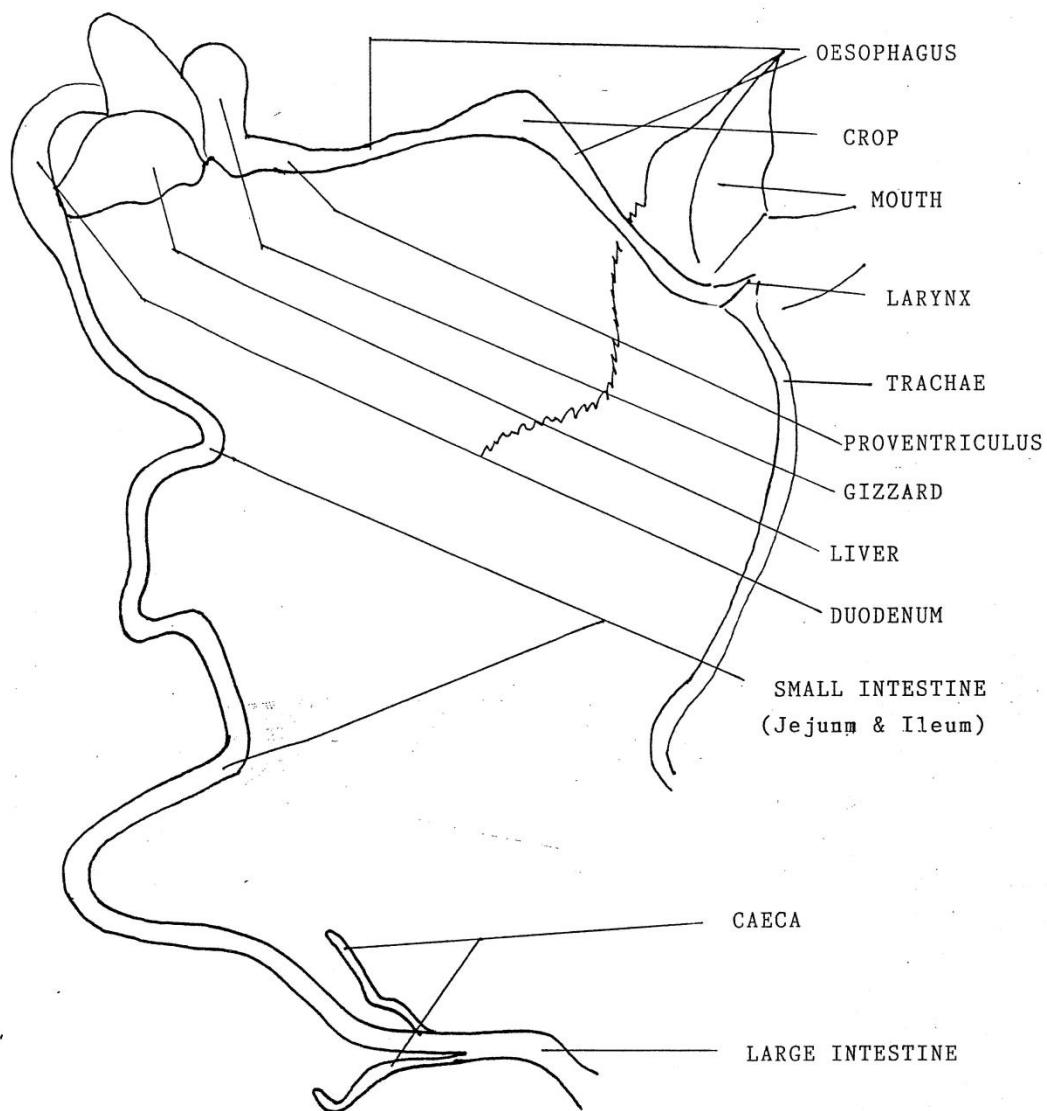


Figure 1.21: The Digestive System of the Cocrico (Line Drawing)

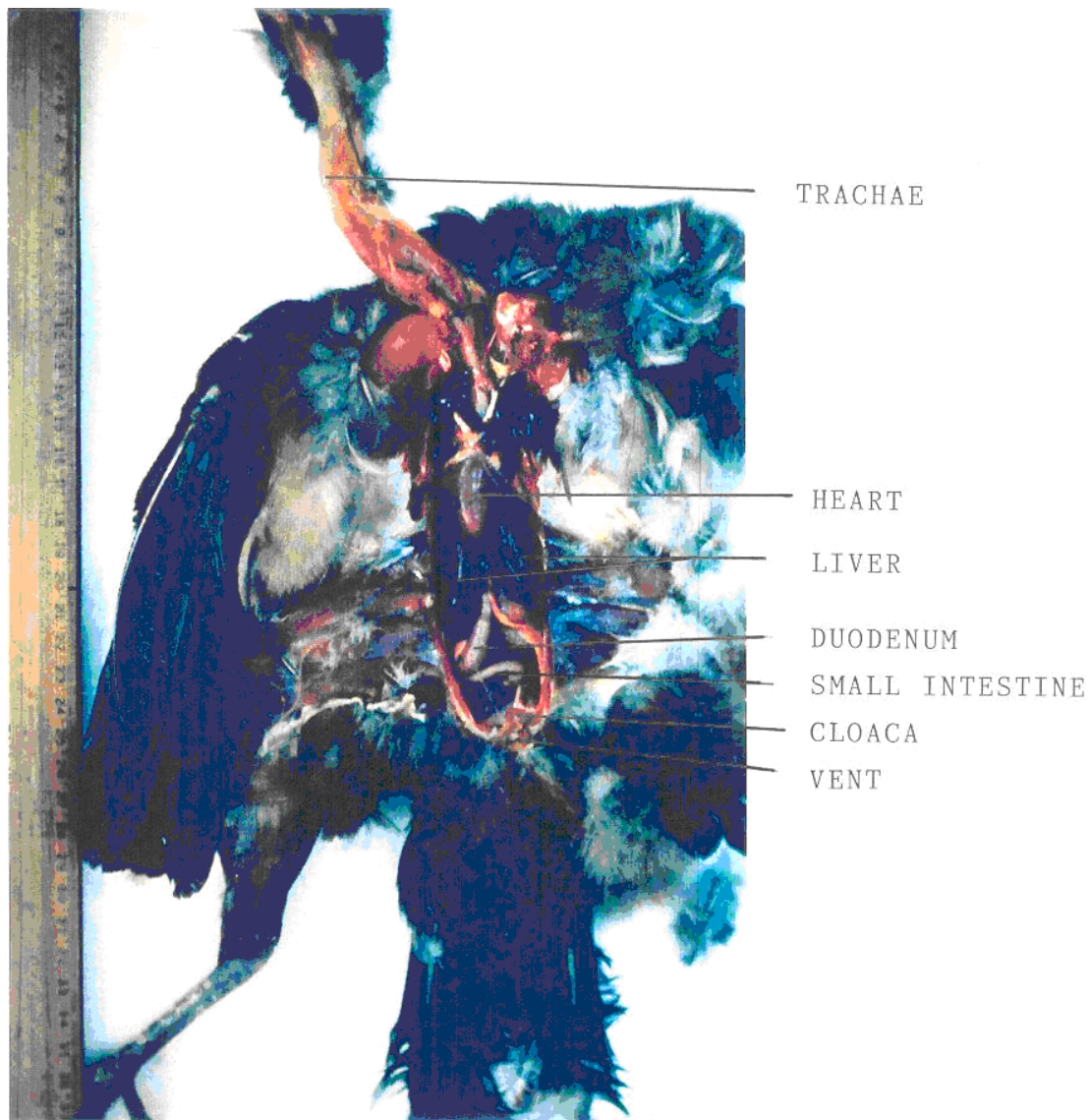


Figure 1.22: A Dissected bird showing positions of the liver and heart

1.2.2.10.2.5 Discussion on the Digestive System of the Cocrico

The Rufous Vented Chachalaca has the potential to be developed as a species for an intensive production system. The results have indicated that the bird can attain weights ranging from 375 g to 682 g. Based on the literature studied, maximum body weights can be obtained from 4 - 6 months in some chachalaca species. By comparison, the domestic fowl has been bred to produce a commercial meat animal of weights above 2.0 kg (Price, 1969) in six to eight weeks. The domestic fowl is a product of wild jungle fowls, with male body weights ranging from 790 g to 1140 g, and females, with body weights ranging from 485 g to 790 g. The domestic fowl was developed into a commercial meat animal, three times the body weight of its wild ancestors. The Cocrico, from the examinations conducted, can be considered a “chesty” bird. The average chest weight was found to be $109.24 \text{ g} \pm 30.59 \text{ g}$, constituting 35.91% of the total carcass weight. In comparison with other birds the Cocrico is shown to have a breast percentage above that of the broiler and quail, but less than that of the turkey recorded between 39.9% and 40.7% the carcass weight (Leeson and Summers, 1980b). In the development of a commercial breed, emphasis can be placed on the selection for chest size. The many positive advances in the science of animal production and husbandry can be transferred into the development of the Rufous vented Chachalaca as a new source of commercial poultry meat. Cocrico meat is quite red as shown in Figures 1.23 and 1.24.

Feeding and the Digestive System

The literature has suggested that the Chachalacas were primarily frugivores, occasionally consuming tender leaves, twigs and buds (NRC, 1991; Campbell and Lack, 1985; Delacour and Amadon, 1973). NRC (1991) also reported the bird's diet to include insects and worms obtained from scratching the ground. The digestive tract of the domestic fowl on which much of the analogy is made, is based on the eating habits of the bird. Many of the characteristics of the digestive system of the fowl can be typical of Galliformes. The short beak of the chachalaca is described as typical to all Galliformes (Delacour and Amadon, 1973). With classification based on dietary adaptation, King and McLelland (1984) described the tongue of the Galliformes as being adapted for swallowing. These tongues are non-protrusible, with caudally directed papillae. These adaptations allowed the caudal movement of food, and prevented regurgitation.



Figure 1.23: The Breast of the Cocrico



Figure 1.24: A Cocrico's Fabricated Carcass

There is an absence of data on the salivary glands of Chachalacas, for progress in the development of the bird, there is a need to study the level of development and variation of the Cocrico, and compare this with the extensively studied salivary glands of the domestic fowl. The salivary

glands of the domestic fowl have been found to mainly serve to produce mucus, which acts as a lubricant. Jerrett and Goodge (1973) in McLelland (1979) reiterated the lubrication importance of the saliva, by indicating that the secretions were low in amylase and had little digestive capabilities. Earlier reference to the diet of the bird inferred that the materials consumed may not necessarily be dry, therefore less lubrication may be needed. Studies on the salivary glands of the chachalaca may serve to confirm their level of importance in digestion. Additionally, the studies will assist in determining the food material that may best constitute the bird's diet.

Chicks represent the future generation, therefore, their survivability in captivity is important to production and research programmes. Reference was made to Delacour and Amadon (1973), who highlighted the cracids as the only Galliformes that fed their young. The literature does not single out these birds as performing begging displays, yet such knowledge is important in determining the level of dependence of the chicks on the parents. If paternal care is conducted for any prolonged period, how will this affect production, and can it be curtailed?

Questions that have arisen in the study with respect to the feeding of young, and not addressed in the literature, relate to:

- (i) The time breeding birds spend non-producing; and
- (ii) If parental feeding was removed, what would be the survival percentage of the chicks?

These would become important considerations for designing intensive production systems.

Oesophagus

As defined by King and McLelland (1984), the oesophagus is a thin-walled canal, which lies from the cranial part of the neck, closely attached to the larynx and trachea. Campbell and Lack (1985) and Delacour and Amadon (1973) both indicated that the extended feature of the chachalaca's oesophagus was a dilation of the gullet rather than a true crop. This dilation was found to comprise 40.92% by weight and 19.72% by length of the oesophagus. Throughout the literature, the area will be continued to be identified as the *crop*. Delacour and Amadon (1973) indicated that both forms serve the same storage purpose in the digestive system.

Stomach

The stomach of birds consists of two chambers:

- (i) A cranial proventriculus, which is glandular; and
- (ii) A caudal chamber, the gizzard, which is muscular.

Both chambers have been identified in the Cocrico. McLelland (1979) suggested that the stomachs of birds are of two basic types, depending on: (a) the diet and (b) the level of adaptation of the gizzard. The stomach of the bird functions more as an organ of mechanical disintegration than for storage, with the majority occurring in the gizzard as against the proventriculus. In the Rufous vented Chachalaca, the importance of the gizzard may be indicated in its percentage component of the stomach. By length, both chambers - the proventriculus and the gizzard - contribute 48.38% and 53.79% respectively. By weight, the gizzard was shown to contribute more to the total stomach weight. The proventriculus contributed 21.39%, in contrast to the gizzard's 81.95%. Thus, the stomach of the chachalaca is designed to be more a filtration machine (i.e. grinding food), than as a storage and digestion chamber. Should a relationship be drawn between the proventriculus of the chachalaca and that of the domestic fowl with respect to size and importance, it should follow, according to Anon (1981) and Moreng and Avens (1985), that little importance can be placed on the proventriculus as a storage organ, or as a site for digestion.

Studies on the histology of the stomach may well provide a better understanding of the development and function of the gizzard and confirm the relative importance of each chamber in food digestion.

Intestines

McLelland (1979) described the intestines of Galliformes as being relatively primitive. The intestines were described as being randomly distributed in loose coils throughout the abdomen of the bird. In contrast to the uniform diameter of the intestinal segments of the domestic fowl described by Anon (1987), the intestines of the Chachalacas were found to vary in diameter at each segment (Table 1.21). The intestines were found to contribute 52.84% by weight (Table 1.18) and 70.56% by length of the total digestive tract.

As identified in the samples taken, the following segments were recorded: the small intestine and its component parts, and the large intestine with its appendages. The small intestine constituted 61.18% of the total length of the digestive tract, and 86.75% of the intestines. The component parts referred to are: the duodenum and the jejunum and

ileum. The duodenum has a greater diameter, averaging $1.27 \text{ cm} \pm 0.449 \text{ cm}$, compared to the $0.574 \text{ cm} \pm 0.083 \text{ cm}$ of the coiled jejunum and ileum. The greater length of the small intestine has been attributed to the jejunum and ileum, comprising 76.58% of the small intestine. The duodenum was calculated to contribute 22.24% of the total length of the small intestine. In the *Gallus* sp., McLelland (1979) cited Pilz (1937), who indicated, that the jejunum and ileum together form four times the length of the duodenum. This has been found to be consistent with measurements taken for the Rufous Vented Chachalaca.

Large Intestine

The large intestine of the cocrico consisted of paired caeca and a short straight rectum. The caeca were long, narrow appendages, averaging $5.91 \text{ cm} \pm 0.62 \text{ cm}$ (Table 1.19) and $0.286 \text{ cm} \pm 0.174 \text{ cm}$ in diameter. The length of the large intestine of the bird was measured from the point where the paired caeca open into the rectum. The rectum is relatively short and straight, with an average length of $6.4 \text{ cm} \pm 0.58 \text{ cm}$, which accounted for 9.19% of the total length of the digestive tract, and 13.02% of the intestines.

The paired caeca of the Rufous Vented Chachalaca showed some dissimilarity with those described for the domestic fowl. King and McLelland (1984) and McLelland (1979), found the caeca of the fowl to be dark green in colour. McLelland (1979) further indicated that in Galliformes where they are well developed, a large part may be bent over so that it faces caudally. In contrast, the caeca of the Rufous Vented Chachalaca were not only narrow and long, but were also reddish-brown in colour, and did not appear to be bent caudally.

Liver

The liver of the Rufous vented Chachalaca was seen to fill most of the ventral parts of the cranial and middle regions of the body cavity ventral to the linings, stomach, spleen, intestines and gonads, as described in King and McLelland (1984). In the Rufous vented chachalaca, the liver weights ranged from 8.5 g to 17.5 g. On average it was 2.38% of the total body weight of the bird. This percentage total body weight by comparison, was within the range cited by McLelland (1979) on work presented by Schumacher (1973). Several areas of research on the liver of the Rufous vented Chachalaca should be conducted. These include:

- (i) The relationships between age and liver size;
- (ii) The correlation between colour and breeding activity and sexual maturity; and
- (iii) The histological studies.

Pancreas

The pancreas was observed and identified within the duodenal loop of the birds. No quantitative measurements were recorded.

Anatomically, there appeared to be few differences of significance between the digestive systems of the cocrico and the domestic fowl. This was based on the comparative studies made from the oral cavity to the proventriculus. The presence of a true crop in the domestic fowl versus a dilated gullet of the cocrico, proved to be the one area of difference. These areas have been inferred to be similar functionally.

Gizzard

The gizzard, a chamber of the stomach of avian species has been described as well developed in the domestic fowl, does not appear as well developed in the cocrico. Confirmation of the differences can come from histological studies of the chamber. In relation to the proventriculus and the stomach as a whole, the gizzard appears to play the greater role in the digestive tract.

Intestines

The segments of the intestines, unlike that of the domestic fowl, were not of uniform diameter. The greater diameter found in the duodenum may be in relation to a greater storage capacity. An increased capacity may allow more time for enzymatic action in the small intestine. The jejunum and ileum combined were found to be by length comparable to that found in the domestic fowl. The significance of the jejunum and ileum as sites of absorption and digestion may be interpreted for the domestic fowl and the cocrico as being comparable. The large intestine showed some difference anatomically in the caeca. This appendage in the Rufous vented Chachalaca was very much dissimilar to that described for the domestic fowl. An attempt in future should be made to determine the significance of the caeca and their contribution to digestion.

1.2.2.11. Experiences with the Cocrico in Captivity in Trinidad and Tobago

Garcia, Mac Farlane, Lallo, Jonkman, Biptah and Makita (2001) reported the following experiences with the Cocrico in Trinidad and Tobago. Information was obtained from a Cocrico colony on exhibit at the Emperor Valley Zoo in Port of Spain, Trinidad and a survey of farmers who had Cocrico in captivity in Tobago was undertaken.

1.2.2.11.1. Observations of the Cocrico at the Emperor Valley Zoo, Trinidad

In November 1998, several visits were made to the Emperor Valley Zoo, Queens Park North, Port of Spain, Trinidad, Republic of Trinidad and Tobago, West Indies. The dimensions of the cage and nest box of the Cocrico exhibit were taken. The records of in-house hatches were also taken, and discussions were held with the keepers to document their experience with the rearing of the Cocrico therein.

The Rufous-vented Chachalaca at the Emperor Valley Zoo

The Cocrico was first put on exhibit at the Emperor Valley Zoo in Trinidad in 1988. In June of that year the first female laid a clutch of three (3) eggs and in July two (2) hatchlings issued. The birds at the Emperor Valley Zoo were housed in a cage approximately 4 x 4 x 4 meters. In the cage there was a nest box approximately 45 x 45 x 60 cms with a circular hole in the top half. The nest box was perched on a pedestal about 1 meter from the ground. Other structures in the cage were bars for the birds to perch on, and a stand for feeding (Figure 1.25). When this study was conducted there were nine (9) birds on exhibit. There were records of chicks produced at the zoo from 1988 to 1997 details of which are presented in Table 1.22.



Figure 1.25: An External View of the Cocrico Exhibit at the Emperor Valley Zoo

Table 1.22: The Records of Cocrico births at the Emperor Valley Zoo

Date	Notes
June 9 th 1988	3 eggs laid
July 6 th 1988	2 hatchlings
July 1 st 1995	1 hatchling
November 13 th 1995	1 hatchling
January 15 th 1996	2 hatchlings
March 30 th 1996	3 hatchlings
May 30 th 1996	3 hatchlings
July 20 th 1997	1 hatchling

The information recorded did not suggest any seasonal pattern of egg laying. The keepers indicated that the birds were easy to feed and rear in captivity, with no health problems.

Feeding

The birds were fed fruits and vegetables and fruits in season (cucumber, papaya, bananas, oranges, watermelon, and lettuce), cracked maize and commercial pellets for growing broilers. The vegetables and fruits were cut into halves and offered to the animals either on the ground or in feed boxes.

Health and disease

There were no major health care problems. Health care issues were on an individual bird basis. The most common problem arose when cage mates showed aggressive behaviour to a single animal. This could be age related or when a dominant male shows aggressive behaviour to a younger male.

What was most interesting was that although the Cocrico is endemic to Tobago, 25 kilometres away to the north east of Trinidad, there are no Cocricos found in the wild in Trinidad which is the closer island to the South American mainland where the *Ortalis* species flourishes in the wild.

1.2.2.11.2. The Cocrico farmers of Tobago and their Methods of Rearing

Survey of the some farmers in Tobago

A Survey of the wildlife farmers in Tobago who kept the birds was done to determine the success of their efforts. Brown *et al* (2000) had reported on

Wildlife Farming in Trinidad. The situation in Tobago (the other component of the twin island state of Trinidad and Tobago) may also be similar but no reports were seen on the Tobago situation. Five (5) farmers were visited on Saturday April 03rd, 1999. Later questionnaires were posted to another 10 farmers.

Response to Posted Questionnaire to some wildlife farmers in Tobago

On August 15th, 1999, a questionnaire was posted to ten (10) other Cocrico farmers in Tobago; only two of them responded. The questionnaire asked the farmer's age, number of years involved in farming, type of animals kept, why they rear non-domestic species, animal inventory, number of Cocricos kept and the largest number ever kept at one time, and questions on the laying and the hatching of the Cocrico in their care. Tobago was believed to have fifteen (15) wildlife farmers who have had the experience of rearing the Cocrico. This case study therefore contained 47% of the population of these wildlife farmers.

Five (5) farmers agreed to a visit and two (2) others to the questionnaire. The details of their Cocrico experience were summarized in Table 1.23. Figures 1.24 and 1.25 give the geographic location of Tobago and of the Farmers in Tobago. What is most interesting is that the Main Ridge of Tobago is the oldest Forest Reserve in the western hemisphere (1765). All seven (7) persons from whom information was obtained also reared other forms of wildlife, and they were all males over 40 years of age. In addition rearing of the Cocrico was a hobby for them. This is similar to the findings of a Trinidad study of Brown *et al* (2000) who concluded, from a Case Study of Wildlife farmers in Trinidad, that there were Cocrico fanciers. In 1992 there were only **20** registered wildlife farmers in Trinidad [Brown *et al* (2000)] but by 1998 there were **115** and in 2004 there were **250** [Mollineau, Garcia, Samayah, Kissoonsingh and Procope-Garcia, 2000, Rooplal, 2004]. Today in 2014 there is in excess of **500** persons registered as wildlife farmers with the Wild Life Section of the Forestry Division of the Ministry of The Environment and Water Resources (Romano Mac farlane and Chad Rackal, personal communication). This suggests that the rearing of wildlife in Trinidad was increasing in popularity. A more detailed study of wildlife rearing in Tobago is now needed. But this study showed that some of these farmers have had up to thirty (30) Cocricos in captivity with successful reproduction taking place. What is also now needed is the development of production models for this wildlife species.

The *Ortalis sp.* literature reviewed was very limited. Only seventeen (17) references were found on the Cocrico or Chachalacas (Hislop 1986, Scott 1974, del Hoyo *et al* 1994, Campbell 1985, Caziani 1994, Christensen

1978, Marion 1976, Marion 1997, Silva 1991, Amour 1998, Austin 1961, Beazley 1974, Collar 1993, French 1991, Banks 1990, Delacour 1973, Brooks 2000). Ten (10) of these were general (Hislop 1986, Scott 1974, del Hoyo 1994, Campbell 1985, Silva 1991, Austin 1961, Beazley 1974, Collar 1993, French 1991, Banks 1990). Only three (3) made reference to their feeding habits specifically (Caziani 1994, Christensen 1978, Marion 1976), one addressed the anatomy of the digestive and reproductive systems (Amour 1998), one addressed growth and development (Marion 1997), one (1) addressed reproduction specifically, Delacour 1973, and one (1) addressed conservation strategies Brooks (2000). There is clearly a need to research this species and to convert it from being a pest to a useful animal for food and Agro-tourism in Tobago. An approach at developing intensive production models for species that are at present considered wild has been suggested by Garcia (1998).

Table 1.23: Summary of the findings on the Cocrico Farmers in Tobago

Farmer # [Location]	Maximum number of birds ever kept	Reproductive Experience	Housing Features	Other Notes
1 [Mason Hall]	10 4 females 6 males	- twice birds laid - 6 eggs laid but only 2 hatched - one bird laid on ground	- Nest boxes were small - Pen size 1.8 m x 1.8 m x 1.8m - earth floor and gravel	- also reared agouti [<i>Dasyprocta leporina</i>] - people stole his animals - birds fed cracked corn, papaya and sweet potato [<i>Ipomea batata</i>] leaves
2 [Mason Hall]	30	- birds laid in a hole in the ground - two chicks hatched	- Pen Size 3m x 3m x 2.5m - gravel and earth floor	- also reared agouti [<i>Dasyprocta leporina</i>] and collard peccaries [<i>Tayassu tajacu</i>] - problems with domestic cats attacking birds
3 [Mason Hall]	Only one pair	- pair laid once	- bamboo pens 3m x 3m x 2.5m	Also kept nine banded armadillos (<i>Dasypus novemcinctus</i>); agouti and opossums (<i>Didelphis marsupialis insularis</i>);

Farmer # [Location]	Maximum number of birds ever kept	Reproductive Experience	Housing Features	Other Notes
4 [Bethel]	15 birds	- two (2) instances of laying (3) eggs each - none of the eggs hatched - birds laid on the ground - birds ate their eggs	- Pen size 4m x 2.5 m x 1.7m	Also kept monkeys, a Curvier dwarf caiman (<i>Paleosuchus palpebrosus</i>); , iguanas (<i>Iguana iguana</i>), parrots (<i>Amazona sp</i>), an ocelot (<i>Felis pardalis</i> / <i>F. leopardus pardalis</i> / <i>Leopardus pardalis</i>); and salipinter or common tegu or matt (<i>Tupinambis negropunctatus</i>);
5 [Bethel]	30 birds	- birds laid on the ground - birds tended to lay in March and April	- Pen size 2m x 0.7m x 0.7m	- also kept parrots and monkeys - animals fed cracked corn and fruit
6 [Speyside]	12 birds	- never observed any laying activity	- Pen size 2m x 1.3m x 1.3m - Dirt and gravel floor with wood shavings	- also kept parrots, iguanas, agouti, snakes, quails and Japanese Game Birds - fed cracked corn and commercial chicken feed
7 [Roxborough]	7 birds	- observed laying activity once - two (2) eggs laid and both hatched but one (1) chick died after one (1) week	- Pen Size 7m x 3.3m x 3.3m	- also kept parrots, parakeets, iguanas, salipinters/ matt/ common tegu, caimans, agouti, armadillo and collared peccaries - fed commercial poultry feed, cracked corn, dried coconut kernels, bananas and mangoes



Figure 1.26: The Location of Trinidad and Tobago [Tobago: 600 40' West Longitude & 110 15' North Latitude]



Figure 1.27: The Distribution of the Cocrico Farmers in Tobago and in Table 1.23 [Mason Hall, Bethel, Speyside, and Roxborough]

1.2.2.11.3 Conclusions and Recommendations from the observations made in Tobago.

The limited information generated from this Case Study suggested the following conclusions.

1. All the farmers were male and were all over 40 years of age.
2. Some people were interested and have been rearing the Cocrico in captivity.

3. In captivity this bird will lay and incubate its eggs successfully.
4. In captivity this bird did not demonstrate any seasonality in reproduction.
5. There is an absence of structured production information on this bird.

It is therefore recommended that investigative work be done on this bird in the following areas:

1. A detailed habitat analysis should be conducted, particularly of the Main Ridge of Tobago to determine what measures could be taken to reduce the incidence of this bird becoming a pest.
2. A more detailed set of anatomy and physiological studies of this bird.
3. Studies on the nutrition and growth requirements of this bird must be done.
4. Studies on nutrition and reproduction aimed at increasing the number of eggs produced by a female should be conducted.
5. Studies on phenotypic variability within the populations of birds in Tobago aimed at improvement of carcass structure and meat yield should be undertaken.

The above recommendations are not in disagreement with those of Brooks & Strahl (2000) for future work with Chachalacas and other Cracids. However, in order for this work to be done there is the need for the establishment of an intensive Cocrico production unit, as part of a Centre for Neo-tropical Animal Wildlife as was suggested in the Introduction of this book.

1.2.2.11.4 Conclusions and Recommendations on the Cocrico and the Genus *Ortalis*

1. The Genus *Ortalis* is in need of a Taxonomic review.
2. The *Ortalis* sp. literature reviewed was very limited. Only seventeen (17) references were found on the Cocrico or Chachalacas, with ten (10) of these being general and only three (3) made reference to their feeding habits specifically, one addressed the anatomy of the digestive and reproductive systems, one addressed growth and development, one (1) addressed reproduction specifically and one (1) addressed conservation strategies. There is clearly a need to research this species and to convert it from being a pest to a useful animal for food and Agro-tourism in Tobago. An approach at developing intensive production models for species that are at present considered wild has been suggested by Garcia (1998).

3. There is the need to have a working living collection of all the *Ortalis* species in one location for closer observation and research.
4. The Cocrico deserves to be studied with a view to its domestication and commercialization as a meat producer. The development of a Cocrico production system can be accomplished through studies in the subject areas of nutrition, reproduction, housing and the environment, and animal behaviour.
5. The observations on the characteristics of the digestive and reproductive systems have served to satisfy some of the fundamental curiosities, but in themselves are only a foundation for further research. To complete the studies on the characteristics of the reproductive and digestive systems of the bird, histological investigations are imperative. Histological studies of the organs will allow a microscopic understanding of the characteristics of the tissues, and a more accurate comparison with known avian species. It should be noted that as larger numbers of birds are reared in a limited space (pens), another study area will arise, namely diseases.
6. With respect to the digestive system, further studies are recommended on the salivary glands, the gizzards and the liver. The salivary glands of birds vary to the extent in which they secrete and serve as lubricants and a source of enzymes. That is their role in the digestive process. Comparative studies can be conducted with the salivary glands of the domestic fowl.
7. Additional reproductive studies will require further observation on measurements and development of the reproductive systems at various ages over a calendar year for sexually mature birds. For the Chachalacas, the literature reviewed was deficient in information on the ages of sexual maturity, which is key in the establishment of a breeding programme. The Cocrico has been cited to have the potential to breed all year round. Further understanding of this potential is needed. Can females breed at any period of the year, but only once in a calendar year? How can the birds be made to increase the number of eggs produced? Can the number of eggs produced be increased by the removal of individual eggs, or through the removal of the entire clutch, inducing the bird to produce replacement clutches? How many replacement clutches can a bird produce? How is broodiness controlled? And does photoperiodism affect production of eggs? Studies are therefore essential in the areas of sustaining the ovary to produce mature follicles, larger clutch sizes and replacement

- clutches and minimizing broodiness. Similarly, studies on ensuring the male can produce sperm throughout a calendar year are needed. An understanding of the monogamous nature of the bird is important in a breeding programme. Knowledge on the ability of one male to serve more than one female is critical to developing sex ratios in breeding flocks.
8. Further quantitative studies are needed in the areas of body weights and growth rates. These areas are important as they relate to the development of growth curves that display incremental growth (weight) versus age, highlighting growth rates and the age at maximum body weight.
 9. The Cocrico was determined to be a chesty bird. A selection programme for birds based on the relative sizes of their breast to body weight can be conducted to develop a more meaty bird.
 10. A comprehensive study on the meat cuts of the Cocrico is recommended. The component parts will include the total body weight, carcass weight, breast, leg, wing and the neck plus back weights. Non-meat cuts should also be studied. These include the liver, heart, feathers, head, digestive reproduction systems and feet. Comparative studies with known domestic breeds like the domestic fowl, turkey and duck should be made.
 11. Studies on the body temperature of the Cocrico to determine its thermal comfort zone are recommended. Such information is critical in providing an adequate environment for captive rearing of the bird. Accompanying studies on the habitat of the bird and its habits in the wild are also recommended.

Comparable quantitative information on the Cocrico and other Galliformes was absent from the literature reviewed. This indicates that though some Galliformes have been exploited worldwide (e.g. Turkeys, Pheasants, Chickens and Guineafowls) there is still limited information on the Neo-tropical families within this order of birds.

1.2.2.12 REFERENCES COCRICO [*Ortalis ruficauda*]

- Amour, K. (1998): *Characteristics of the Reproductive and Digestive Systems of the Cocrico (Ortalis ruficauda)*. Unpublished M.Sc. Project Report, Department of Food Production, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I.
- Anon (1962): *Our Flags and other National Emblems*, Trinidad and Tobago Ministry of Home Affairs, Port of Spain, Express Service, 32 pages
- Anon (1974): *Food composition Tables for Use in the English Speaking Caribbean*. The Caribbean Food and Nutrition Institute, Kingston 7, Jamaica
- Anon (1980): Conservation of Wildlife Act, Chap. 67:01, Laws of Trinidad and Tobago, Government Printers
- Anon (1987): *Manual of Poultry Production in the Tropics*. Technical Centre for Agricultural and Rural Cooperation (CTA). CAB International. 119 pp
- Anon (1990): *Endangered and Threatened Species Recovery Program: Report to Congress*, US Department of the Interior, US Fish and Wildlife Service, Washington DC, 20240, December 1990
- Anon (1998): *Endangered and Threatened Species Recovery Program*. Washington, D.C: U.S. Department of the Interior and U.S. Fish and Wildlife Service, 1998
- Artmann, A. (undated): Successful breeding of the Rufus-Headed Chachalaca *Ortalis erythroptera* (Sclater and Salvin, 1870) pp. 174-177
- Asibey, E.A.O. (1986): *Evaluation and Development of Wildlife Resources, Trinidad and Tobago, Wildlife farming in Trinidad and Tobago: Problems and Prospects*. FAO/UNDP. Port-of-Spain. 75 pp
- Austin: O. L. (1961): *Birds of the World*. Golden Press. New York. 316 pp
- Banks; R.C. (1990): Taxonomic Status of the Rufus-Billed Chachalaca (*Ortalis wagleri*). *The Condor*. **92**:749-753
- Beazley; M. [Editor] (1974): *The World Atlas of Birds*. Random House, New York
- Beresford, W.A. (1977): *Lecture notes on histology*. Blackwell Scientific Publication. Great Britain. 243 pp
- Blake, E.R. (1977): *Manual of Neotropical Birds Vol. II*. University of Chicago Press, USA. 674 pp
- Brooks, D. M. and Strahl, S. D. (compilers) (2000): *Curassows, Guans and Chachalacas. Statuu Survey and Conservation Action Plan for Cracids 2000-2004*, IUCN/SSC Cracid Specialist Group, IUCN, Gland, Switzerland and Cambridge, UK. vii + 182pp
- Brown, R.C., Garcia, G.W., Manick, M., Poujade, S., Arishima, K and Makita, T (2000): The Survey of Wildlife Farms in Trinidad, *Japanese Journal of Zoo and Wildlife Medicine* **5**: 123-126

- Brown, D. E. (1990): *"The Ocelot," Auduborn Wildlife Report 1989-1990.* Auduborn: Academic Press Inc., 1990
- Campbell; B., Lack; E. (1985): General Editors. *A Dictionary of Birds.* The British Ornithologists' Union. T & A.D. Poyser, England. 670 pp
- Caziani, S. M. and Protomomastro, J .J. (1994): Diet of the Chaco Chacahlaca. *Wilson Bulletin* **106** (4): 640-648
- Charleau, D. Personal interview. Emperor Valley Zoo, Queens Park West, Port of Spain, Trinidad, Trinidad and Tobago
- Christensen, Z. D. (1978): Notes on Food Habits of the Plain Chachalaca from the Lower Rio Grande Valley. *Wilson Bulletin* **90**:(4) 647-648
- Coe, J.C. (1996): *"What's the Message." Wild Mammals in Captivity, Principles and Techniques.* Chicago: The University of Chicago Press Ltd., 1996.
- Cook, R.E. and Bletner, J.K. (1955): Normal appearance of the internal organs of chicks from hatching through six weeks of age. *Poultry Science*, **34**: 1188 – 1189
- Delacour, J. and Amadon, D. (1973): Reproduction - Chachalacas. In *Curassows and Related Birds.* Chapter VII, The American Museum of Natural History, New York, pp 46-55.
- del Hoyo; J., Elliott, A., and Sargatal, J., Editors (1994). *Handbook of Birds of the World, Vol: 2. New World Vultures to Guinea-fowl;* Birdlife International. Lynx Edicions, Barcelona.
- de Spix, J. B. (1825): *Avium Species Novae, quas in Itinere per Brasiliam Annis MDCCCXVII- MDCCCXX,* Tomus II, 53-56
- French, R. (1991). *Birds of Trinidad and Tobago.* Second Edition. Comstock Publishing Associates. A division of Cornell University Press, Ithaca, New York. 470pp.
- Garcia, G.W. (1998): Intensification of Animal Production Systems for Improved Wildlife Conservation, *Proceedings of UWI, Ag.50 Conference,* August 1998, Faculty of Agriculture and Natural Sciences, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., Volume III: 91-101
- Garcia, G.W., Baptiste, Q.S, Adogwa, A. O., Kakuni, M., Arishima, K and Makita, T (2000) The Digestive System of the Agouti (*Dasyprocta leporina*)-Gross Anatomy and Histology *Japanese Journal of Zoo and Wildlife Medicine* **5**:55-66
- Garcia, G.W., Mac Farlane, R. A., Lallo, C. H. O., Jonkman, T., Biptah, N., and Makita, T. (2001): The Rufus-vented Chachalaca or Cocrico (*Ortalis ruficauda*) in Tobago, West Indies: A Case Study. *Jpn. J. Zoo. Wild. Med.* **Vol. 6** No. 2: 61-66
- Gilbert, A.B. (1979): Female genital organs. In: *Form and Function of birds Vol. 1.* A.S. King and J. Mc Lelland (eds.). Academic Press. Great Britain. pp. 237-360
- Gould (1843);

- Gray, G. R. (1867): *List of the Specimens of Birds in the collection of the British Museum, Part V, Gallinae*. pp 10-13, London
- Grove, P.B. (1961): Editor in Chief *Webster's Third New International Dictionary of the English Language Unabridged*. G. Bell and Sons LTD, London A-K, L-2
- Herklots, G.A.C. (1969): *The Birds of Trinidad and Tobago*. Collins, London. 287 pp
- Hislop, G. (1986): Working Plan Proposal for an Integrated Approach to Pest Control (Cocrico and Parrot). Forestry Division Ministry of Agriculture Lands and Marine Affairs of Trinidad and Tobago
- Holmes, R. (1998): *"Our Duties to Endangered Species."* *Conservation and Values*. Colorado: Colorado State University Press, 1998
- Humboldt (1805):
- Jackson, P. (1997): The status of cats in the wild. *International Zoo Yearbook* **35**:17-27
- Jardine, W. (1847): Birds of Tobago. In *The Annals and Magazine of Natural History, including Zoology, Botany and Geology*. **Vol. XX**: 370-378. Printed and Published by R. and J.E. Taylor, London. Conducted by: P.J. Selby, G. Johnston, C.C. Babington, J. H. Balfour and R. Taylor
- Johnsgard, P.A. (1986): *The Pheasants of the World*. Oxford University Press. Great Britain. 300 pp
- Kelly, J. D. (1997): Effective conservation in the twenty-first century: the need to be more than a zoo. One organization's approach. Guest essay *International Zoo Yearbook* 35: 1-14
- King, A.S. and Mc Lelland, J. (1984): *Birds. Their structure and function*. Bailliere Tindall. Great Britain. 334 pp
- Koch, T. (1973): *Anatomy of the chicken and domestic birds*. The Iowa State University Press. Ames, Iowa. 170 pp
- Lake, P.E. (1981): Male genital organs. In: *Form and Function of Birds Vol. 2*. A.S. King and J. Mc Lelland (ed.). Academic Press, Great Britain. pp. 1-61
- Law, G., Mac Donald, A. and Reid, A. (1997): Dispelling some common misconceptions about the keeping of felids in captivity. *International Zoo Yearbook* 35, The Zoological Society of London, UK. pp. 197-207
- Leeson, S. and Summers, J.D. (1980a): Production and carcass characteristics of the broiler chicken, *Poultry Science*, **59**:786 - 798
- Leeson, S. and Summers, J.D. (1980b): Production and carcass characteristics of the large white turkey. *Poultry Science*, **59**:1237 - 1245
- Linnaeus (1766):

- Lucas, A.M. and Denington, E.M. (1956): Morphology of the chicken liver. *Poultry Science*, **35**: 793 - 806
- Marion, W.R. (1976): Plain Chachalaca Food Habits in South Texas. *Auk*, **93**: 376-379
- Marion, W.R. (1977): Growth and Development of the Plain Chachalacas in South Texas. *Wilson Bulletin*. **89**: 47-56
- Marion, W.R. and Fleetwood, R.J. (1978): Nesting ecology of the Plain Chachalaca in South Texas. *Wilson Bulletin*, **90** (3): 386-395
- Mc Callion, D.J. and Aitken, H.E. (1953): A cytological study of the anterior submaxillary glands of the fowl, *Gallus domesticus*. *Canadian Journal of Zoology*, **31**:173 - 178
- Mc Lelland, J. (1979): Digestive System. In: *Form and Function of Birds*, Vol. 1. A.S. King and J. Mc Lelland (eds.). Academic Press. Great Britain. pp. 69-181
- Mellen, J. D. and Shepherdson, D. J. (1997): Environmental enrichment for felids: an integrated approach. *International Zoo Yearbook* **35**:191-197
- Mollineau, W., Garcia, G.W., Samayah, D., Kissoonsingh, W., and Procope-Garcia, A. (2000): The Wildlife Industry in Trinidad: A Case Study Towards Developing a Sustainable Industry Model for a Small Developing State (Trinidad and Tobago). Paper presented at "Managing Space for Sustainable Living in SIDS (Small Island Developing States), UWI/SEDU, UNDP, ECLAC/CDCC, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., October 16-17, 2000
- Moran, E. T. (1995): Body Composition, In *Poultry Production*, *World Animal Science Series*. Chapter 7, P. Hunton Editor; Elsevier Scientific Publishing Co., Amsterdam, pp 139-156
- Moreng, R.E. and Avens, J.S. (1985): *Poultry Science and Production*. Reston Publishing Co., Virginia. 438 pp
- NRC (1983): *Managing Tropical Animal Resources. Little-known Asian animals with promising economic future*. National Academy Press, Washington, D.C. 131 pp
- NRC (1991): *Microlivestock. Little-known small animals with promising economic future*. National Research Council. National Academy Press. Washington, D.C. 449 pp
- Nowak, R. M. (1991): *Walkers Mammals of the World Volume II*, Fifth Edition, The John Hopkins University Press, Baltimore, USA.
- "Ocelot" "Microsoft Encarta Online Encyclopedia 2000." <<http://encarta.msn.com>>.1997
- Parker, W. (ed.): "A Portfolio of Endangered Species and a Plea on their Behalf." *Arizoo*. Arizona: Phoenix Zoo Press, 1993
- Peres (2000): Effects of Subsistence Hunting on Vertebrate Community Structure in Amazonian Forests. *Conservation Biology* **14**: 240-253

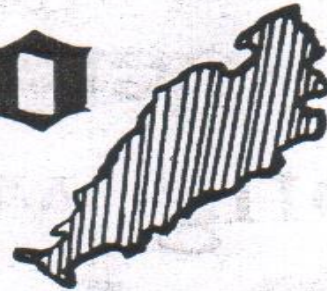
- Powell, K. E. (1997): Environmental enrichment programme for Ocelots *Leopardus pardalis*. *International Zoo Yearbook* **35**:159-164
- Price, C.J. (1969): *Poultry Husbandry I: General characteristics of birds, anatomy, physiology and breeds of poultry*. UNDP/FAO. Rome. 53 pp.
- Rawlins, C. G. C. (1984): "Zoos and Conservation: The Last 20 Years." *Advances in Animal Conservation*. London: Zoological Society of London, 1984.
- Rogers, A.W. (1983): *Cells and Tissues. An introduction to histology and cell biology*. Academic Press Inc. (London) Ltd. Hong Kong 242 pp
- Rooplal, R. (2004): *A Case Study of Wildlife Farming in Trinidad*. AL312 Final Year Project, Department of Food Production, The University of the West Indies, St Augustine, Trinidad and Tobago
- Sampson, J.A, and Weiner E. S. C. (1989): *The Oxford English Dictionary*. Second Edition Clarendon Press, Oxford. Vol xiv (Vol I to XX)
- Scott, P. M., Editor (1974): *The World Atlas of Birds*. First Edition, Mitchell Beazley Publications Ltd., London
- Sclater and Salvin (1870): Slater and Salvin on the Cracidae. In *Proceedings of the Scientific Meetings of the Zoological Society of London for the year 1870*. Pages 538 to 540. Longmans, Green, Reader and Dter, Paternoster Row, London.
- Shanaway, M.M. (1994): *Quail Production Systems: A review*. FAO Rome 145 pp
- Shoemaker, A. H. (1997): Developing a regional collection plan for felids in North America. *International Zoo Yearbook* **35**:147-152
- Silva, J. L., and Strahl, S.D. (1991): Human Impact on Populations of Chachalacas, Guans, and Curassows (Galiformes: Cracidae) in Venezuela. Paper in: *Neotropical Wildlife Use and Conservation*. Editors, John G. Robinson and Kent H. Redford. University of Chicago Press. USA. pp. 37-52
- Simon, F.; Cassaro, K. and Quillen, P. (1997): Small felid breeding project at Sao Paulo Zoo. *International Zoo Yearbook* **35**:159-164
- Steven's, L. (1991): *Genetics and evolution of the domestic fowl*. Cambridge University Press. Great Britain. 306 pp
- Strahl, S.D. and Grajal, A. (1991): Conservation of large avian frugivores and the management of neotropical protected areas. *Oryx*, **25** (1):50-55
- Swanson, W. F. and Wildt, D. E. (1997): Strategies and Progress in reproductive research involving small cat species. *International Zoo Yearbook* 35, The Zoological Society of London, UK. pp. 152-159
- Tserverni-Gousi, A.s. and Yannakopoulos, A.L. (1986): Carcass characteristic of Japanese quail at 42 days of age. *British Poultry Science*, **27**: 123 - 127

- Vangilder, L.D.; Kurzejeski, E.W.; Kimmel-Truitt, V.L. and Lewis, J.B. (1987): Reproductive parameters of wild turkey hens in North Missouri. *Journal Wildlife Management* **51**(3): 535-540
- Wagler, I. (1830): Revisio generis Penelope. Inpp 1110 to 1112 [London Zoological Society Library]
- Waldron, M. (1997): Personal Communication. Cocrico Farmer. Sangre Grande, Trinidad
- Webster, G.A. and Sorater T.L. (1980): Postmortem examination. In: *Wildlife Management Techniques Manual*. Sanford D. Schemnitz (ed.). The Wildlife Society. Washington D.C. pp. 89-98
- Woodcock, H. I. (1866): *A History of Tobago*. Reprinted by Syncreators (1976) Ltd., Colombus Publishers Ltd. Trinidad, Trinidad and Tobago, pp. 192

Part 1.3: Towards the Development of an Intensive Production Model and Manual for the Cocrico [the “Tobago Pheasant” or the “Tobago Ornis”]

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COCRICO KILLING AGRICULTURE

THE Cocrico, a national bird of Trinidad and Tobago continues to destroy the agriculture sector in the island.

As a result, if a solution was not found to the problem, the bird will survive and Tobagonians would either starve or be faced with spending valuable foreign exchange to acquire food to eat.

This was the harsh reality related by Agriculture, Marine Affairs and the Environment Secretary Hilton Sandy as he addressed a one-day workshop on reducing the impact of wildlife on agriculture in Tobago at the Works Lecture Room last week Wednesday. The workshop was organised by the Departments of Agriculture, Natural Resources and the Environment and the National Reforestation and Watershed Rehabilitation Programme to discuss solutions to the continuing pest problems. It was attended by a large number of farmers.

He reminded the participants that the Cocrico, which only existed in Venezuela, Columbia and Tobago, has been a protected

bird since 1963 under the Conservation of Wildlife Act, that Tobago had over 200 species of birds, which appealed to tourists, and bird watching, generated significant income to stakeholders in the tourist industry.

He also said eco tourism and the conservation of wildlife were vital to the quality of life of Tobagonians and there was urgent need to become pro-active and creative in finding methods to deal with the problem in the long and short term.

As a result, he told the farmers that they may wish to consider initiatives such as grow box, green houses and hydroponics, while attempting to find a humane, legal and scientific approach to minimising the damage to crops caused by birds and other pests.

Sandy noted that there had been a steady decline in agricultural produce by Tobago farmers over the years due largely to losses sustained by agricultural pests. He said the problem was a long-standing one, which goes back to 1963 after Hurricane Flora destroyed the rain forest, the natural habitat of the island's

wildlife, sending them in search of food.

He said efforts were made to assist in controlling the problem by specific incentives but this was short lived and the problem was further aggravated by sector policies in the 1970s and 1980s, which resulted in mass departure from the land, and abandonment of many plantations. He said this in effect was a virtual surrender to the massive invasion of pests in search of food, which was no longer available in the forest.

Sandy said the problem grew worst through the years, with significant increase in the pest population, and very little attempt to control them. He said the pests were now invading the back yards and home gardens of farmers and householders, adding: "we who are charged with the responsibility to produce food in Tobago must rise to the challenge".

More recently, he said, after the devastating effect of Hurricane Ivan in September and the severe rain storms in the last quarter of last year, wildlife, especially the avian population, with particular reference to the Cocrico and parrot have been inflicting untold damage to just about every thing that was cultivated.

"As a consequence," Sandy said, "we now know that if we do not find a solution to the problem, the pests will survive, and we, as a people will either starve or be prepared to spend the foreign exchange necessary to acquire the food we eat."

1.3.1: Background to the Conceptualization of the Intensive Production Model for the Cocrico

The **Tobago News** article of Friday July 29th, 2005 was captioned “Cocrico Killing Agriculture”. The sentiment today in August 2014 seems to be the same. We are always trying to blame something for a failure that is in or may be within our (human) domain. Well it is about time that we look for the OPPORTUNITY arising out of any disaster or misfortune. This is where the Cocrico can now be put centre stage, it needs to be revisited, studied and rebranded as the “**Tobago Pheasant**” or the “**Tobago Ornis**”. The latter comes from the Greek word for bird. We would then need to create a specialty cuisine around it.

The approach taken to conceptualize an intensive production model for the Cocrico was as described in Garcia (1998), Brown-Uddenberg *et al* (2004) and Garcia *et al* (2005). Brown-Uddenberg *et al* (2004) can be downloaded from the website of “**The Open School of Tropical Animal Science and Production**”. The model being suggested herein was done in the absence of detailed production information. We are attempting to provide you with as much useful information as possible on this bird, so that interested persons can now go ahead and innovate. We have included information and reference to scientific publications on the related species upon which the suggestions or assumptions were based. We hope that this information could be used by anyone in the near future through whose efforts the Cocrico could be on its way to domestication. In this way this animal could be converted from being an agricultural pest in Tobago to a sustainable economic agricultural resource of the Republic of Trinidad and Tobago. The conclusion from the literature reviewed in Part 1.2 suggested:

the Cocrico can be kept in captivity and could produce offspring under captive reared conditions.

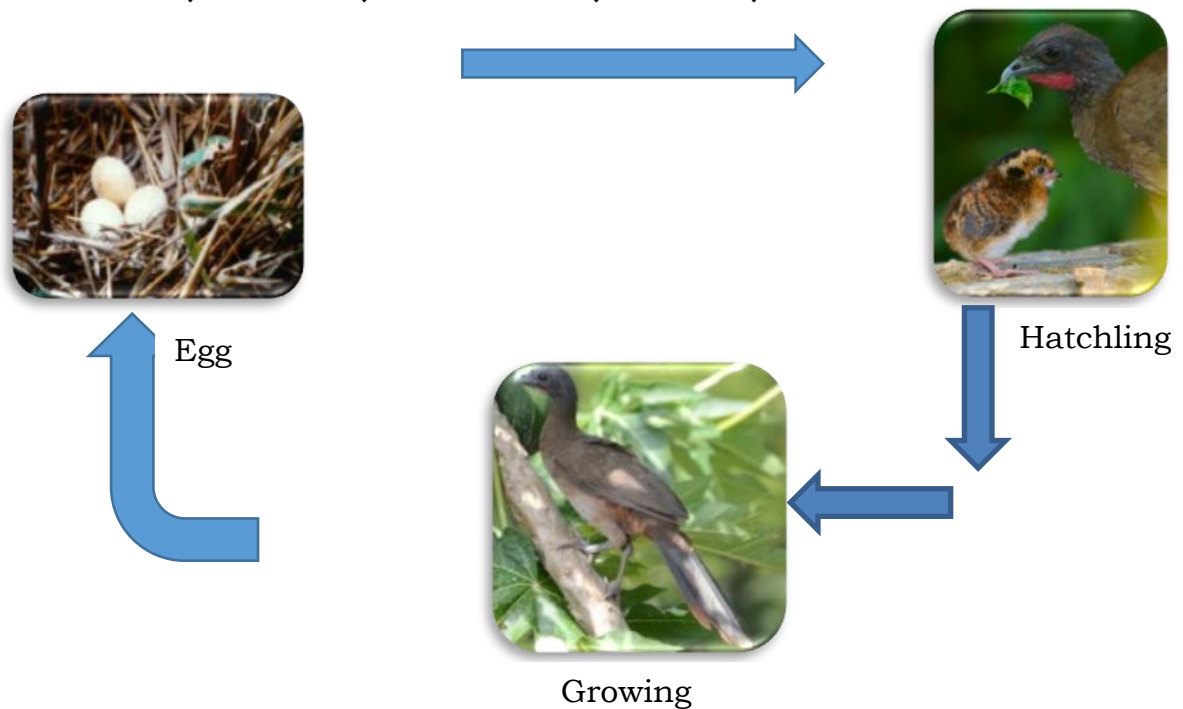
1.3.2: The Objectives of the Intensive Cocrico Production Model

The objectives of this conceptualized Cocrico Production Model will be to provide you with the available information and simulated guidelines for you to attempt the following:

1. to rear Cocricos in captivity and produce fertile eggs,
2. to incubate these fertile eggs and successfully hatch them,
3. to rear some of the Cocrico as broilers,
4. to select and rear some Cocrico to sexual maturity and
5. to get the Captive reared sexually mature Cocricos to produce fertile eggs.

1.3.3: The Life Cycle of the Cocrico

Adult Male (Cocricock) Female bird (Cocrihen) Fertile



1.3.4: The Physiological States of the Cocrico

The Physiological States of the Cocrico would therefore be as follows:

- Cocrihen [Mature Laying Hen]
- Cocricock [Mature Serving Cock]
- Cocriyoungcock [Growing Replacement Cock]
- Cocripullet [Growing Replacement Hen]
- Cocrihatchling [Day old Cocrichicks]
- Cocrichick [One to Two week Old Hatchlings]
- Cocribroilers [young animals being reared for meat to be slaughtered at an economic market weight].

1.3.5: The Production Units of the Intensive Cocrico Production Model

1. Laying Unit
2. Incubation Unit
3. Breeding Replacement Unit [Cocripullet and Cocriyoungcock]
4. Cocribroilers Growth Unit

1.3.6: The Assumptions of the Intensive Cocrico Production Model

The production model proposed was based on the following assumptions:

1. The onset of laying would be about ten months of age.
2. The average number of eggs per clutch is three (3).
3. After the removal of a clutch of eggs laid, the birds would lay another clutch of eggs within a month.
4. Continuous laying can be sustained for twelve (12) months.
5. The third clutch laid would be used as replacement breeders.
6. There will be a minimum of thirty-three and one-third percent (33.3%) mortality from egg to adult bird.

1.3.7: The Target Performance Coefficients for the Intensive Cocrico Production Model

The target performance coefficients for the Cocrico as generated from the literature are presented in Table 1.24.

Table 1.24: Target Performance Coefficients for the Rufous-vented Chachalaca

Parameter	Coefficient
Egg Incubation Period	26 Days
Weight at Hatching	18 gm
Broiler Weight at 1 week	53 gm
Broiler Weight at market	420gm – only 14oz live weight
Age at market Weight	120 days [4.3 months]
Age at Maturity of Breeder	300 days [43 weeks / 10.7 months]
Weight at maturity of Breeder	550gm – only 18oz/ 11b.2oz
Age at onset of Laying	170 days [24.3 weeks/ 6.1 months]
Weight at onset of Laying	560 gm
Eggs per Clutch (batch of laid eggs)	3
Frequency of Clutch laying	30 days?
Persistence of Laying	12 Months?

1.3.8: The Housing Design for the Production Units of the Intensive Cocrico Production Model

The evidence found on the farms visited in Tobago and that were reported on in the previous section suggested that it was clear that no real effort was placed on the production management of the bird because of the other exotic animals kept by these farmers (Garcia *et al* 2001). In all the cases seen the bird laid eggs, even though the floor space per bird ranged from 2.5 to 50sq ft. (0.2 to 4.7m²). However, in most of the instances all the eggs laid did not hatch. This was most likely the result of an inadequate availability of nest boxes, thus causing the birds to lay and sit on their eggs on the ground. As a consequence, the eggs were at risk of contamination or physical damage. The pens themselves had very little ventilation and, with half or more of the roof covered with zinc sheeting, overheating (heat stress) would have been an additional negative factor. Considering the fact that these birds are heavily feathered and in their natural environment and are usually active mostly in the cooler parts of the day, the heat build up likely adversely affected the birds' activities. Also there was no evidence to suggest that there were proper structures for feeding the birds. Therefore it is likely that the birds were fed on the floor. The designed breeding unit will incorporate structures to facilitate the birds' comfort in all the physiological states experienced with the required adequate equipment for feeding.

The suggested units of housing in this model will be as follows:

1. Laying Unit: Proposed Breeding House
2. Incubation Unit
3. Breeding Replacement Unit [Cocripullet and Cocriyoungcock]
-Broiler unit/Growing Unit
4. Cocripullet and Cocricock Unit.

1.3.8.1: Laying Unit for the Intensive Production of the Cocrico: Proposed Breeding House

This facility will be composed of four (4) sections/pens each designed to house forty-five (45) breeding pairs under one roof. Each section is designed 40 ft (12.2m) with a passageway space of 10ft (3.1m) separating the sections which are at the sides of each other. There is one door 8 x 4 ft to enter the Unit at the end of one passageway. The height of the ridged roof in the centre is 22 ft (6.1m) and each side slopes off 16ft (4.9m). The eve of the roof extends 2ft (0.6m). The perimeter of the structure is covered with 0.5 in (5.1cm) mesh wire.

Each pen has a thin metal feeding platform 2ft x 30ft (0.6m x 9.1m) supported 1ft (0.3m) above the ground on one passageway side. The

other passageway side beyond the floor space has the 45 open egg boxes 8 inches x 8 inches x 3 inches (20.3cm x 20.3cm x 7.6 cm) for which the birds will be encouraged to lay their eggs. This will be supported above the ground in two rows at 12 ft and 14 ft (3.66m and 4.27m). The outer sides of the pens have growth of a chosen woody species 10ft high.

Within the passageway at the side of the nest boxes is a wooden platform 2 ft x 50 ft (0.6m x 15.2m) and 12 ft (3.7m) above the ground. This platform will facilitate the researcher to get to the nest boxes without going inside the pen. There is a small door directly at the back of each individual nest box in the two rows at the height of 12 ft (3.7m) and 14 ft (4.3m). The floor plan is shown in Figure 1.28.

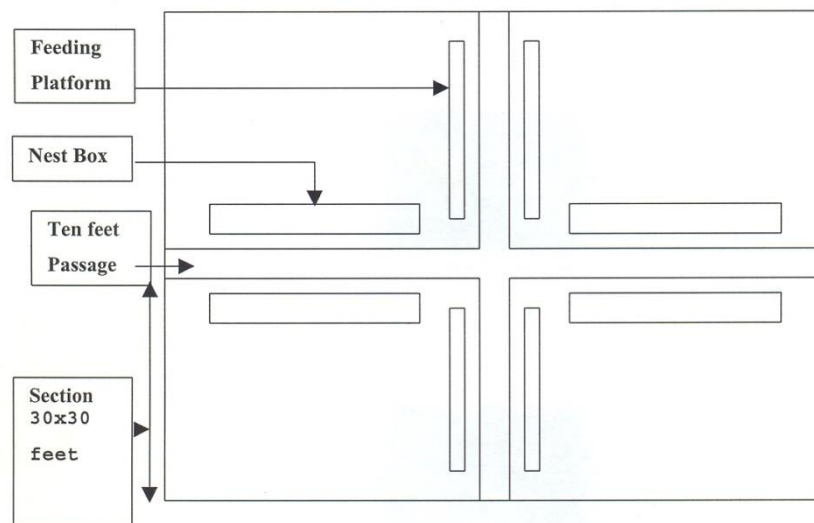


Figure 1.28: Cocrico Breeder Pen Floor Plan

1.3.8.1.1: Proposed Water Delivery Sub-system

There should be three (3) bell-shaped poultry drinkers two (2) inches (5 cm) off the ground attached to an incoming water line via a hose. One end of the PVC water line should have a screw on cap to allow for flushing and cleaning the water line. The incoming line would bring water from a tank situated outside of the pens and painted white and covered. The tank should be about 10ft (3.1m) above the ground to afford gravity flow of water. The feeding will be done by hand while the water will be supplied using an automatic waterer.

1.3.8.1.2: Estimated Required Feed Delivery Sub-system

This could be done by hand. There should be 8 cone-shaped feeding pans and 4 flat tray-shaped feeding pans in each pen in addition to the feeding platform.

1.3.8.1.3: Estimated Required Electrical and Lighting Subsystem

There should be 4 light bulbs in the centre of each pen. There should be also an electrical outlet in each pen to power a fan when needed.

1.3.8.2: The Incubation Unit

This may be a small enclosed area containing a small commercial incubator. Another option would be to modify the Breeding Unit to contain nest boxes so that the Cocrico females could be afforded the opportunity to incubate the eggs naturally.

1.3.8.3: The Proposed Broiler House

The broiler house should be so divided in order to receive broilers on a weekly basis. This number can be as much as 100. The floor plan for domestic poultry broiler production could be used. The broiler house could consist of six pens on either side of a 6ft (1.8m) wide passageway and each could be divided into 8 subsections or pens.

1.3.8.4: Pullet and Cockerel Units

This unit will have to bring 180 males and 180 females to maturity separately in accommodation measuring 50ft x 50ft divided into two separate sub-units 20ft x 50ft (15.2m x 15.2m) with a 10ft (3.1m) passageway across the structure. It will be 12ft (3.7m) high will be enclosed by 0.5in (1.3cm) mesh wire around it. The entry to the building will be through a door at one end of the passageway. There will also be doors to enter the sub-units from the passageway.

Each section will have 10 feeding pans and 10 bell-shaped water drinkers. There will also be 10 baby chick waterers. Pullets can however be reared in the breeding unit if this is available.

1.3.9 Sources of the Initial Start-up Flock of Birds

These will have to be trapped from the wild in Tobago as no large Cocrico producers exist. It might be best to begin the unit with birds weighing between 100 to 200g.

1.3.9.1 Methods of Sexing and Identifying the Birds

The assistance of the Emperor Valley Zoo could be sought in sexing birds to identify the different sex of the birds. Also, Dr. Gabriel Brown at the School of Veterinary Medicine, Faculty of Medical Sciences, UWI, Mount Hope can be approached for assistance in this area.

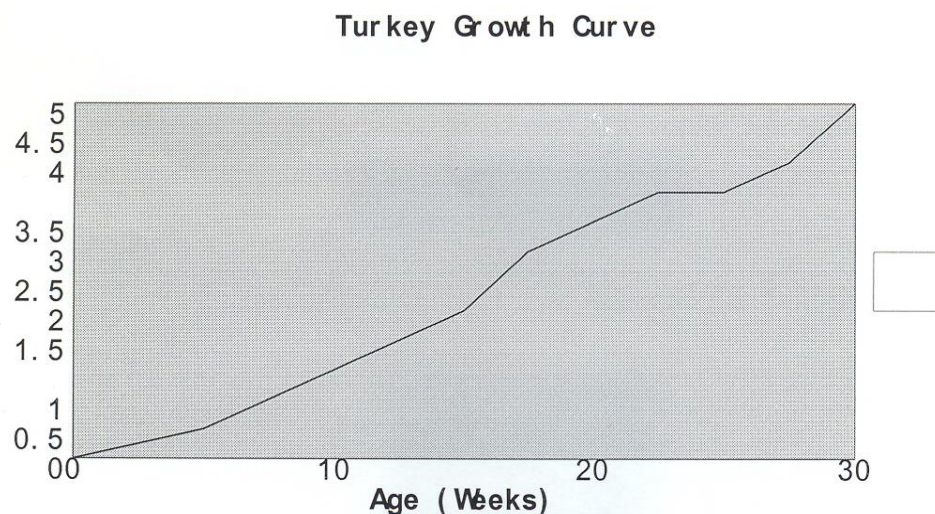
1.3.10: Feeding and Nutrition [Proposed Feeding of the Cocrico under an Intensive System of Production]

1.3.10.1: Theoretical Nutritional Framework

No growth studies on the Cocrico have been conducted to date. In the circumstances, information on related avian species has been gathered, simulated and presented here for guidance.

1.3.10.2: A Theoretical Growth curve of the Cocrico

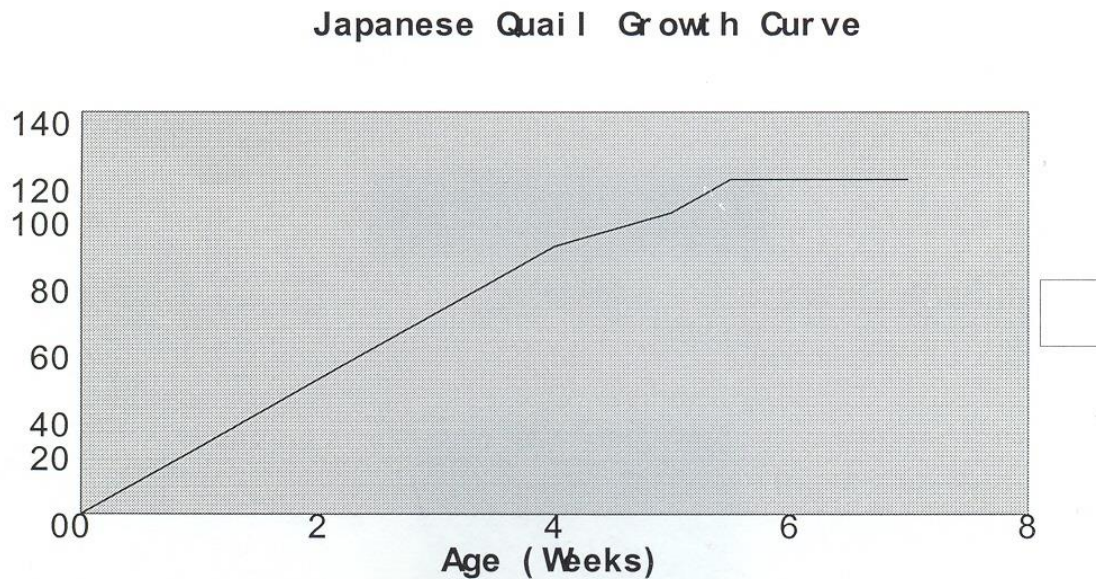
The Turkey is used as the avian domestic species that closely resembles the Cocrico. Figure 1.29 a curve taken from Emmans (1989) for [Burbon Red Turkeys] shows that the point of inflection (POI) starts after one third of the time it takes for the bird to mature. Prior to this point the growth rate is slow and the bird has grown to only 20% of its mature body weight. Further examination of this curve would suggest that at approximately two-thirds of the maturity time the growth rate begins to fall.



Source: Emmans (1989)

Figure 1.29: Growth Curve for Burbon Red Turkeys

In the case of the Japanese quail in Figure 1.30 (taken from Shannaway, 1994) it is seen that the POI was much earlier. This happened at the first one-seventh (14%) of the time it took to attain maturity and this was at the time that it had gained 16% of its maturity weight, and at 26% of the maturity time the bird measured 37% of the maturity weight.



Source: Shannaway (1984)

Figure 1.30: Growth Curve of Japanese Quail

What appears to have been common with the growth curves of both the quail and the turkey was that the rate of growth declined after approximately 65% (two-thirds) of the mature body weight had been attained. However, this happened at different times; for the quail it was when 43% of the time it took to reach maturity had elapsed, while in the case of the turkey it was 70%. One can expect then that in Chachalacas, the point of decreased growth rate will be reached even earlier than the quail as it may possibly achieve an earlier POI. The "growth path" of the Rufous-vented Chachalaca was estimated (Figure 1.31 and Table 1.25) and both the broiler and breeder desired growth path were determined so that a feed requirement could be determined. However, the authors recognised the need for research to be done in this area and fitted to smooth curves (Tjørve and Tjørve, 2010).

Marion (1977) reported that ten (10) one-week-old Plain Chachalacas (*Ortalis vetula*) averaged 53gms ranging from 40 to 65gms, and for nine (9) birds at one month 149gms ranging from 96 to 196gms. Since this closely related species is similar in size and weight to the Rufous-vented

Chachalaca, then these weights could be considered as the best guides for the estimation of the early growth for the latter. This information suggests on closer examination of the curve for the Plain Chachalaca, that 10% of the time it takes to get to maturity the bird is approximately 28% (one-quarter) of its mature weight.

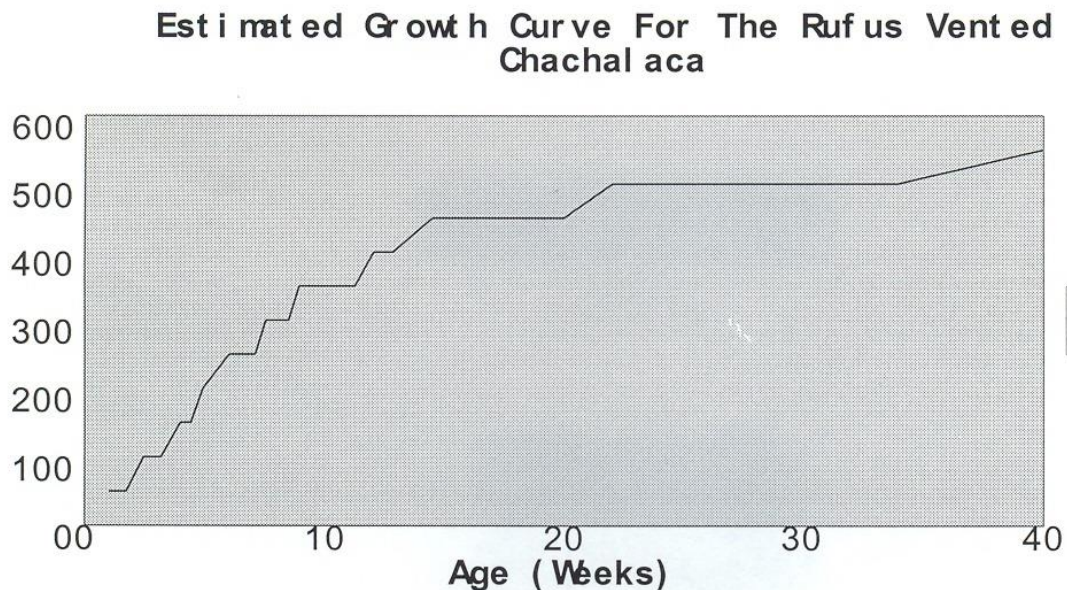


Figure 1.31: The Estimated Growth Path of the Cocrico

Table 1.25: Estimated Growth of the Rufous-vented Chachalaca Broiler

Age (weeks)	Weight (g)	Age (weeks)	Weight (g)	Age (weeks)	Weight (g)	Age (weeks)	Weight (g)
1	50	8	300	15	483	22	530
2	83	9	338	16	500	23	535
3	116	10	367	17	505	24	540
4	150	11	401	18	510	25	545
5	187	12	435	19	515	26	548
6	225	13	451	20	520	27	555
7	262	14	468	21	525	50	555

1.3.10.3: The Theoretically Estimated Feed Requirement for the Cocrico

As already stated, no feeding trials with the Cocrico were even conducted but based on our review of the literature the following was our estimation of the nutrient needs of the Cocrico based on its different physiological status on stages of life. We have come up with the theoretical feeding formulation under the following headings:

1. Metabolizable Energy Needs (M.E)
2. Crude Protein (CP) and Amino Acid (AA) Needs
3. Major Mineral Needs
4. Composite Diets for Broilers
5. Composite Diets for Breeders.

These are only being suggested to serve as guidelines that could be used when selecting any formulated poultry feeds to be used for the Cocrico. In addition we have identified the selected references that we have used as the rationale.

1.3.10.3.1: Theoretical Metabolizable Energy [ME] Needs

1) Early Growth

ME requirement for turkeys appears to start low and increase with age. The initial low value of energy is probably due to their requirement for high dietary protein with low fat deposition in the young birds. Moran *et al* (1968) and Salmon (1983) found no effect on the growth rate up to 6 and 8 weeks of age, but a positive relationship thereafter. However, this weight increase may have been associated with fat deposition or real tissue growth may have occurred under certain conditions. For example, Salmon (1983) showed that with levels at 12.96-14.21 of ME for turkeys 3-6 weeks of age, for both sexes, using pellets was positive only after 6 weeks. Horwitz *et al* (1980) showed that the energy requirement for turkey and chickens decreased at constant temperature from 12-24°C, reaching a low from 24-28°C.

Anthony *et al* (1990) showed that the only fundamental difference in the growth curve of turkeys and chickens was from hatch to the point of inflection (POI). Classen and Stevens (1995) noted that the response was similar in ducks and geese as that described for broiler chickens. They also commented that the optimal level of energy in a diet was based on the cost of feed ingredients and the expected biological response to potential dietary energy ranges available.

2) Pullet Layer Ration

The goal of a pullet layer ration is to develop hens that are capable of producing large numbers of quality eggs during their laying cycle. This objective is mostly likely to be met if the pullet meets target goals for body weight and skeletal development at the time of the adult housing. Skeletal development in chickens can be divided into two parts: size, and degree of mineralization (Classen and Stevens, 1995). Noting that long bones attain their maximum development at 12-14 weeks, the only option for manipulation of these structures is before that age. Since the actual growth during the rearing stage is just as important as achieving the target weight at the age of housing. A successful feeding program will then be a gradual development of the pullet during the brooding and rearing stages. Therefore a moderate level of ME is recommended for starter and developer diets.

The virtual low values of ME in young turkey diets were also a reflection of the high requirement for dietary protein and also the desire not to use high levels of dietary fat. Sell *et al* (1986) confirmed that young turkeys have a poor ability to use high levels of dietary fat which have potential detrimental effects as 'fat malabsorption' on skeletal development. Moran *et al* (1969) and Salmon (1983) found no effect of ME on the growth rate of turkeys up to eight weeks and six weeks of age respectively. Leclercq (1986) speculated that any weight increase with ME at that age has to be an increase in body fat, which is not desirable.

Domestic ducks (*Anas platyrhynchos*) respond in a similar fashion to ME (Classen and Stevens, 1995). Reporting in one study that growth rate was unaffected by diets between 9.2-13.0 MJ/Kg ME provided that the diets are balanced by other nutrients and are pelleted. However, ducks will (eat) increase feed intake to meet their needs hence they will consume diets with wider energy levels and grow normally (Scott and Dean, 1991; Cherry and Morais, 2008). This is because of the high levels of dietary fat and irregular feed intake energy increase tends to increase with ME and ducks which feed on higher levels of ME are also fatter. Classen and Stevens (1995) reported that Muscovy ducks and crosses between Muscovy and other domestic ducks responded in a similar manner to ME. Laclercq (1986) and Scott and Dean (1991) showed that ME levels lower than 10.5 may reduce growth rate.

The Rufous-vented Chachalaca energy needs at the early pullet stage should be around the same as that for turkeys since their body conformation is similar compared to that of the laying and growing chicken and the duck.

Since no studies has been previously done to establish the requirement for ME by the Rufous-vented Chachalaca, one can by all rational means assume the requirement is within the range needed by a similar species kept for poultry production. Based on the weight of the bird, it was estimated to be 2900, 3000 and 3100 kcal for starting pullets, growing pullets and active breeders, respectively. While the requirement for the broilers was estimated to be 3000, 3200 and 3300 kcal for starting growing and finishing birds, respectively.

1.3.10.3.2: Theoretically Estimated Needs for Crude Protein [CP] and Amino Acids [AA]

1) Pullets and Breeders

Protein requirement for layer pullets reflects the objective of producing a layer pullet (and cockrels) with adequate skeletal growth and body weight at sexual maturity. The level of protein required by the pullets is affected by amino acid balance and lower levels of protein can be successfully fed if available amino acids can be maintained above the requirement of the birds (Keshavarz and Jackson, 1992). Insufficient protein/amino acid intake can retard the acquisition of body weight, increase carcass fat, delay sexual maturity and reduce egg size.

Pullets gain weight as they approach sexual maturity. The increase in body weight is associated with the development of the ovary, oviduct and increase in body size. This suggests that amino acid requirement for chicken pullets will increase before oviposition. This requirement can be met with a higher protein pre-layer ration at that time.

Most nutritionists agree on the amino acid levels for pullet starter for chicken (Boorman and Burgess (1986) and NRC (1994)). This is because of the amino acid in the lean tissue at that early age. Turkeys on the other hand need higher requirements for arginine, lysine, methionine, sulphur amino acids, threonine and tryptophan (Nixey 1990). Classen and Stevens (1995) noted that the requirements for older turkeys are particularly high for sulphur amino acids based on the premise that they are important for the birds' maintenance needs. For ducks and geese the maintenance of adequate protein in relation to the energy is also very important because of the propensity for these birds to deposit fat. Considering the fact that the Rufous-vented Chachalaca has an early point of inflection, at 4 weeks attaining one-quarter (25%) of its final body weight at the onset of lay, and very little fatty tissue, 0.4% fat in adult birds, they will require a high level of dietary protein. This could be as much as 30% for pullets and 31% CP for broilers. The Rufous-vented Chachalaca is a heavily feathered bird. Due to the constant feather loss, the protein requirement for maintenance will most likely be greater than

for the turkey. This would also suggest that requirement for methione may be higher in starter phase than for the turkey.

Nixey (1989) found that most commercial diets for turkeys have amino acid imbalances as their most common shortcoming. The usual deficient amino acids are lysine, TSAA and threonine. He stated that in the presence of these circumstances, there could be amino acid antagonism. The same author made reference to the work of Jones, Walters and Burnett (1966), the guinea pig: O'Dell and Regan (1963), the chick: Jones (1964), Smith and Lewis (1966), D'Mello and Lewis (1990) and The turkey: Emmans (1975). The literature suggested that an excess in Lysine caused a decrease in feed intake and growth rate, an elevation of plasma lysine concentration and a decrease in plasma arginine concentration. But it did not seem that the reverse was true as the work of D'Mello and Emmans (1975) have suggested.

A combination of a factorial and empirical models for nutrition determination was done by Nixey (1989) for male turkeys. It is shown in Table 1.26.

The estimated requirement of crude protein for the Rufous-vented Chachalaca should be 20%, 15% and 12% for starting, growing and actively breeding birds, respectively.

Table 1.26: Suggested Nutrient Ratios for Big 6 male Turkeys Where the Conditions and Pellet Quality are Good (g/MJ ME)

Ingredients	As Fed (weeks)					
	0-4	4-8	8-12	12-16	16-20	20-24
Lysine	1.57	1.34	1.10	0.89	0.75	0.65
Methionine	0.57	0.53	0.47	0.44	0.43	0.42
TSAA	1.02	0.94	0.82	0.76	0.75	0.71
Tryptophan	0.27	0.23	0.19	0.15	0.13	0.11
Threonine	1.00	0.86	0.75	0.58	0.48	0.42
Arginine	1.69	1.46	1.21	1.02	0.88	0.80
Calcium	1.10	1.05	0.95	0.85	0.80	0.70
Avail. phos.	0.62	0.60	0.55	0.50	0.45	0.40
Sodium	0.13	0.13	0.13	0.13	0.13	0.13
NaCl	0.30	0.30	0.30	0.30	0.30	0.30
EFA	1.27	1.09	No minimum stated			
ME (MJ/kg)	12.0	12.1	12.2	12.4	12.6	12.8

Source: Nixey (1989)

2) Broiler

A formulated broiler feed regimen for the Rufous-vented Chachalaca should cater to three developmental stages of the bird. **A starter diet for birds 0-3 weeks, a grower from 4-24 weeks and a finisher for from 25-32 weeks approximately.** Each diet should contain the elements listed in **Table 1.27** and in amounts based on the expected needs of the bird by comparison to the chicken, duck and turkey.

1.3.10.3.3: Theoretically Estimated Major Minerals Needs-Theoretically Estimated Sodium, Potassium and Chloride Needs

Simmons (1986) stated that when the energy was lower, the requirements for elements (expressed as a proportion of the diet) can be lower. It is therefore necessary to relate these recommendations to dietary metabolizable energy. He noted that raw plant materials contain much more potassium than birds need and some practical diets may even have excess of this element. Simmons (1986) reviewed the ARC (1975) recommendation and found little variation from those of the NRC (1977). Recommendations for these three minerals are being suggested for layer, pullet and broiler for the Rufous-vented Chachalaca, Table 1.26.

1.3.10.3.4: Estimated complete diets for the Rufous -vented Chachalaca

Based on the foregoing a suggested theoretically estimated complete diets for Rufous-vented Chachalaca broilers and Breeders are presented in Tables 1.27 and 1.28.

Table 1.27: Theoretically Suggested Diet for the Rufous-vented Chachalaca Broilers

Nutrient	Starter 0 to 3 weeks	Grower 4 to 12 weeks	Finisher 13 to 32 weeks
ME Kcal	3000	3200	3300
% Crude Protein	20	22	18
% Fat	5	5	5
% Fibre	2.8	2.6	2.4
% Calcium	1.4	1.4	0.9
% Phosphorous	0.75	0.75	0.45
% Sodium	0.18	0.19	0.17
% Lysine	1.76	1.76	0.85
% Methionine	0.65	0.65	0.45
% Methionine and Cystine	1.25	1.05	0.75
% Tryptophan	0.39	0.35	0.25

A suggested diet for Rufous-vented Chachalaca breeders should be of a starter 0- 3 weeks, a grower 4-24 weeks, and a laying ration from 24 weeks onwards. The diet should contain the following constituents in quantities as shown in Table 1.27.

Table 1.28: Suggested Diet for the Rufous-vented Chachalaca Breeders (kcal/kg diet; % or mg/kg of the diet)

Feed Nutrient	Pullet Starter	Pullet Grower	Active Breeder
Energy [Kcals/kg]	2900	3000	3100
Crude Protein	20	15	12
Arginine	1.18	0.89	0.71
Histidine	0.36	0.27	0.22
Isoleucine	0.77	0.58	0.46
Leucine	1.32	1.00	0.79
Lysine	1.14	0.86	0.68
Meth & Cys	0.82	0.62	0.49
Methionine	0.46	0.35	0.28
Phyal & Tyro	1.31	0.98	0.79
Phenylalanine	0.71	0.53	0.43
Threonine	0.72	0.54	0.43
Tryptophan	0.21	0.16	0.13
Valine	0.75	0.60	0.20
Linoleic Acid	0.80	0.80	0.80
Calcium	0.75	0.60	2.00
Phos (avail)	0.30	0.30	0.30
Potassium	0.40	0.30	0.50
Sodium	0.14	0.14	0.14
Chloride	0.14	0.14	0.14
Magnesium	0.05	0.05	0.06
Manganese (mg)	60	60	60
Zinc (mg)	80	70	70
Iron (mg)	90	80	90
Copper (mg)	10	8	8
Iodine (mg)	0.40	0.40	0.40
Selenium (mg)	0.20	0.40	0.40
Vitamin A (IU)	8000	8000	8000
Vitamin D (ICU)	800	600	700
Vitamin E (IU)	30	25	20
Vitamin K (mg)	1.50	1.50	1.50
Riboflavin (mg)	5.00	4.50	4.00
Pantothenic Acid (mg)	12.00	12.00	12.00
Niacin (mg)	60.00	60.00	60.00
Vitamin B12 (mg)	0.012	0.012	0.012
Choline (mg)	2000	1800	1600
Biotin (mg)	0.20	0.20	0.20
Folacin (mg)	1.00	1.00	1.00
Thiamin (mg)	2.50	2.50	2.00
Pyridoxine (mg)	4.50	4.50	4.00

1.3.11: Reproductive Management of the Cocrico under an Intensive System of Production

1.3.11.1: Management of the Male and the Female Lines

The second or third set of eggs from the breeders will be used to create new breeders and birds will be culled after 12 more clutches of eggs are laid. From these the lines will have to be developed separately and it will have to be done only after the first grow-out to determine the kind of producers housed. Similar producers will be used for a particular line. According to North (1974), crossing two or more inbred lines each possessing a great homogeneously for a desired genetic trait produces a high nickability.

Many genes are responsible for the expression of quantitative characteristics. When the offspring of two different inbred lines have nicked, the offspring will be better than either parent with respect to certain characters even though other characteristics in the same lines may show no nickability. The objective is to produce breeders with the following positive genetic characteristics as listed in the subsequent subheadings.

1.3.11.2: Hatchability

Constant selection-breeding from only the better female birds will be the focus. However, due to the relatively (compared to present day commercial chicken layer production) small numbers of birds that will have to be housed it will take many generations before any improvements would be obtained. Moreover, hatchability depends on a lot of other factors besides genetics.

1.3.11.3: Egg Production

The present day domestic poultry layers will take more than 24 hours and less than 30 hours between laying successive eggs. Laying birds generally produce long sequences of eggs on succeeding days. Then there is a no egg day on that one day referred to as a 'pause' day. Individual laying birds will have different 'pause' days. This will have to be observed for the Cocrico under preliminary intensive production. Some other egg production traits that would have to be considered will now have to be touched upon.

High Intensity of Lay

This character is manifested by the ability of the bird to lay at an above normal egg rate. Since such a bird may be laying in clutches as chickens do, the clutch size (length) is an important genetic factor.

Persistence of Lay

The longer the laying cycle before the hen enters her molting period the better the producer she is. Persistence is a definite genetic factor associated with egg production.

Early Sexual Maturity

The earlier the sexual maturity the less costly the bird will be to maintain. If there are large numbers of birds the savings can be significant, especially in the case of broilers.

1.3.11.4: Body Characteristics

Selection pressure/increased selection within a given flock of birds will be an important activity so that the smaller segment of the flock population will be used as breeders. This will be a selection pressure on both the male and female lines. Management will seek to exert selection pressure at a rate no faster than a satisfactory level of egg production can be maintained. This will entail placing a minimum amount of selection on the line for body weight, while increasing the pressure for other factors. A very small number of birds at any one time will satisfy the requirements.

1.3.12: Health and Disease Prevention Program

1.3.12.1: Current Health Status

No study has established the health status of the Rufous-vented Chachalaca in Tobago. In the circumstances, therefore, a pre-requisite will be to examine the health status of other existing species of poultry, determine the relevance to the production system design adopted in question and copy those aspects that may be applicable. We could use the present experiences of the Commercial Broiler and Egg/Layers of Tobago.

1.3.12.2: Intended Stocking System

The stocking density of the production system for the Rufous-vented Chachalaca will be far less than the average commercial broiler chicken systems anywhere in the world. Therefore, most of the preventative measures that are normally taken under normal commercial production systems may not be necessary in this case. One should expect however that under any intensive production system some form of stress will be placed on the animal involved. Therefore some form of health preventative procedures must be in place.

1.3.12.3: Likely Disease Problems

In Trinidad & Tobago where there is a major chicken industry, birds are routinely immunized against the following diseases:

1. Bacterial Respiratory Diseases
2. Infectious Coryza
3. Virial Respiratory Diseases
4. Aspergilosis
5. Digestive System Diseases (Bacterial and Viral) Necrotic, Ulcerated Enteritis and Haemorrhagic Enteritis.

Unless the Cocrico will be raised in complete isolation, it would seem wise to immunize this species in like manner to chickens and turkeys. Similarly, measures against other infectious diseases and helminths should mimic those used in chickens and turkeys. All illnesses and fatalities should also be thoroughly investigated.

1.3.12.4: Husbandry Practices to Minimise Health Problems

High levels of bacteria accumulation must not be allowed to occur. Therefore birds will have to be checked regularly and treated with the relevant antibiotics for the prevention of bacterial respiratory diseases. Since Aspergilosis affects quails as much as chickens, the ground litter should be treated with copper sulphate prior to brooding young chicks. This is a standard practice used in the present commercial chicken broiler production systems.

1.3.12.4.1: Required Overall Management System and Activities

Feeding

This must be done to ensure that the feeding program achieves its main objective, which will be to keep the growth rate of the birds on par with the desired rate as depicted by the preliminary growth curve (Figure 1.31).

Water

There must always be an adequate supply of portable water for all physiological states. Also, management must ensure that a water reservoir is available for each pen to enable vaccines, chlorine or medication to be added when required.

Egg Collection & Storage

Eggs must only be handled with clean hands and stored in a cool room with a Relative Humidity (RH) of 75- 80%.

Hand Rearing

Newly hatched chicks must be divided into manageable groups of similar ages for observation.

Biosecurity

Strict Biosecurity measures as outlined by the Poultry Industry of Trinidad and Tobago must be instituted. Personnel in contact with other poultry farm must always be sanitized before entering and leaving the premises.

Culling

Birds should be scheduled for culling after they have had a laying period of one year. However, if the performance of a particular batch of birds appears to be outstanding, consideration should be given to extend their laying life.

Records

Birds should be tagged for identification to enable proper records to be kept on each batch of birds at each physiological state. Records must be kept in a manner that will facilitate the linking of certain genetic traits between parent and off-spring.

1.3.13: Closing and Recommendations

In attempting to prepare any instructional document it is always best to outline the intentions, present the contents, summarize what was done and then offer any apologies for the limitations of the work. This we shall now attempt to do for you.

We have put together these guidelines for you with the following objectives:

1. to rear Cocricos in captivity and produce fertile eggs,
2. to incubate these fertile eggs and successfully hatch them,
3. to rear some of the Cocrico as broilers,
4. to select and rear some Cocrico to sexual maturity and
5. to get the Captive reared sexually mature Cocricos to produce fertile eggs.

We have provided you with a good justification for this initiative and the guidelines within the 27 pages manual were divided into fourteen (14) sections:

- 1.3.1: Background
- 1.3.1: Objectives
- 1.3.3: Life Cycle
- 1.3.4: Physiological States
- 1.3.5: Production Units
- 1.3.6: Assumptions
- 1.3.7: Target Performance Coefficients
- 1.3.8: Housing Design
- 1.3.9: Sources of Initial Start-up Flock
- 1.3.10: Feeding and Nutrition
- 1.3.11: Reproductive Management
- 1.3.12: Health and Disease Prevention
- 1.3.13: Closing and Recommendation
- 1.3.14: References.

The last section was the comprehensive set of references which has informed us in writing this document so you can immediately use if you would now like to go and establish a Cocrico Production unit.

This manual has been in the making for more than a decade and during that time we have not as yet been informed of anyone attempting to establish an Intensive Cocrico Production Unit. This manual is **Part 3** of the Booklet on the Cocrico. In **Part 2** we reported on the literature on the **Genus *Ortalis*** with the emphasis on the species *ruficauda* or the Cocrico. Recommendations for future work were suggested. However, in closing we would like to **STRONGLY** recommend that the Tobago House of Assembly [THA] in association with the Open Tropical Forage-Animal Production Laboratory [OTF-APL] of the Department of Food Production, UWI, establish in Tobago the “First Intensive ***Ortalis*** Production Unit” with emphasis on the Cocrico (*Ortalis ruficauda*). This initiative could be two fold as follows:

1. An Avian Zoo with the focus on Tobago Birds and a collection of the genus *Ortalis*, the ideal location for this would be Grafton Estate were there is already a viable Cocrico population and
2. An Intensive Cocrico Production Unit that could serve the following purposes:
 - (i) Developing, Demonstrating and Validating the Intensive Cocrico Production Model;
 - (ii) Developing the “**Tobago Pheasant**” or the “**Tobago Ornis**” and
 - (iv) Developing a Neo-tropical Avian Centre for research.

1.3.14: REFERENCES

- Amour. K (1998): Characteristics of the Reproductive and Digestive System of the Rufus-vented Chachalaca (*Ortalis ruficauda*). A Project Submitted in Partial Fulfilment for the Requirements of the Degree of Masters of Science, Tropical Animal Science and Production, the University of the West Indies. Unpublished. 94 - pps
- Anon (1974): *Food composition Tables for Use in the English Speaking Caribbean*. The Caribbean Food and Nutrition Institute Kingston 7 Jamaica.
- Anon (1978): Notes on Food Habits of the Plain Chachalaca from the Lower Rio Grande Valley. *Wilson Bull.*, **90** (4): 647-648
- Anthony, N.B., D.A. Emmerson, K.E. Nester and W.L. Bacon (1990): Comparison of Growth Curves of weight Selected Populations of Turkey, Quail and Chicken. *Poultry Science* 70: 13-19.
- Austin, O. L. (1961): *Birds of the World*. Golden Press. New York.
- Beazley, M. (1974): *The World Atlas of Birds*. Random House, New York.
- Boorman, K. N. and A. D. Burgess (1995): Response to Amino Acids. In: *World Animal Science C Production System Approach. Poultry Production* 9. P. Hutton (ed). A. Neimal- Sorenson and D.E. Tribe (eds) Elsevier. pp.99-123.
- Brown-Uddenberg, R. C.; Garcia, G.W; Baptiste, Q. S.; Adogwa, A. O.; Counand, T. and Sampson, T. (2004): *The Agouti Booklet and Producers' Manual, Wildlife Farmers' and Producers' Booklet #1*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago ISBN#: 976-95123-0-3
- Cambell; B. and E. Lack (1985): General Editors. *A Dictionary of Birds*. The British Ornithologists' Union. T & A.D. Poyser, England
- Cherry, P. and Morais, T. (2008): Domestic Duck Production: Science and Practice. Publi. pp. 239
- Classen, H. L. and J. P. Stevens (1995): Nutrition and Growth. In: *World Animal Science C.. Production System Approach. Poultry Production* 9. P. Hutton (ed). A. Neimal- Sorenson and D.E. Tribe (eds). Elsevier. pp.79-96
- Collar, N.J., L.P. Gonzaga, N. Krabbe, A. Madrono Neito, L. G. Naranjo, T.A Parker III and D. C. Wege; D.C. (1993): *Threatened Birds of the Americas. The*
- ICBPIIUCN Red Data Book. Third Edition, part 2. Smithsonian Institution Press, Washington.

- del Hoyo, J., A. Elliot and J. Sargatal (Editors) (1994): *Handbook of Birds of the World, Vol: 2. New World Vultures to Guinea-fowl*; Lynx Edicions, Barcelona
- Delacour, J. and D. Amadon (1973): *Reproduction -Chachalacas*. The American Museum of Natural History, New York.
- D'Mello, J.P.F. (1987): Amino Acid Requirements in the Young Turkeys: Leucine Isoleucine and Valine. *British Poultry Science* **16**: 607-615
- D'Mello, J.P.F. and G. C. Emmans (1975): Amino Acid Requirements in the Young Turkeys: Lysine and Arginine. *British Poultry Science* **16**: 297-306
- D'Mello, J.P.F. and D. Lewis (1970a): Amino acid Interactions in Chick Nutrition 2. Inter-relationships between Leucine, Isoleucine and Valine. *British Poultry Science* **11**: 313-323
- Emmans, G. C (1989): The Growth of Turkeys. In: Recent Advances in Turkey Science. Poultry Science Symposium 21. C. Nixey and T.C. Grey (eds). Butterworths. pp. 135-165
- French, R. (1991): *Birds of Trinidad and Tobago*. Second Edition. Comstock Publishing Associates. A division of Cornell University Press, Ithaca, New York
- Garcia, G. W. (1999): Some Species Production Modeling. Model IV, Unit 14 Species Production Modeling. *Course AL 65 B: Tropical Zoo And Wildlife Production and Management. Intensive Wildlife Production*.
- Garcia, G.W (1998): Intensification of Animal Production Systems for Improved Wildlife Conservation, Proceedings of UWI, Ag.50 Conference, August 1998, Faculty of Agriculture and Natural Sciences, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., Volume **3**: 91-101
- Garcia, G. W., Young, G.G., Amour, K. M., James, D., Lallo, C. H. O., Mollineau, M., Roopchand, A., Spencer, M., Prosper, M. A., Ganessingh, N., Rooplal, R., Gayan, N., Steil, A., Xande, A., Bemelmans, A., Norgueira Filho, S. G., Guimaraes, D., Gálvez, H., and Mayor Aparicio, P. [2005]: *The Collared Peccary/ Pakira/ Javelina/ Catto/ Catete/ Porco de Monte/ Taitetu/ Sajino/ Quenk [Pecari tajacu, Tayassu tajacu] Booklet & Producers' Manual, Wildlife Farmers' and Producers' Booklet #2*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago. ISBN 976-95123-1-1
- Hislop, G. (1986): *Working Plan Proposal for an Integrated Approach to Pest Control (Cocorico and Parrot)*. Forestry Division Ministry of Agriculture Lands and Marine Resources, Republic of Trinidad and Tobago. 6-pp
- Horwitz, S., M. Weiselburg, U. Eisner, I. Bartov, G. Reisenfeld, M. Sharvit, A. Niv and S. Borsten (1980): The Energy Requirement

- and Performance of Growing Chickens and Turkeys as Affected by Environmental Temperatures. *Poultry Science* **59**:2290-2299
- Keshavarz, T. and M.E. Jackson (1992): Performance of Growing Pullets and Laying Hens Fed Low-Protein Amino Acid Supplemented Diets. *Poultry Science* **63**: 2229-2240
- Leclercq, B. (1986): Energy Requirements of Avian Species.. In: *Nutrient Requirement for Poultry and Nutritional Research. Poultry Science Symposium 9*. C. Fisher and K.N. Boorman (eds), Butterworth. pp.125-139
- Leeson, S. and J.D. Summers (1991): *Commercial Poultry Nutrition*. University Books Guelph, Canada
- Marion, W.R. (1976): Plain Chachalaca Food Habbits in South Texas. *TheAuk*, **93**: 376-379
- Marion, W.R. (1977): Status of the Plain Chachalaca in South Texas. *Wilson Bull.*, **89**: 47-56
- Moran, E. T. JR., Summers, J. D., and Orr, H. I. (1968): The Effect of Absolute Alterations in Energy Concentration of Developing and Finishing Diets for Large White Turkeys on Performance and carcass Quality with a Note on the Correlation of Back Skin Fat and Grade Finish. *Poultry Science*, **10**: 127-138
- National Research Council (1994): *Nutrient Requirement of Poultry*. Ninth Revised Edition, National Academy Press, Washington DC
- Nixey, C. (1989): The Nutritional Responses of Growing Turkeys. In *Recent Advances in Turkey Science. Poultry Science Symposium 21*. Nixey.C. and Grey, T.G.(eds). Butterworths, Great Britan. pp. 183-199
- Pearce, D. W. (1992): *McMillian Dictionary of Modern Economics Fourth Edition*. D Pearce (gen. ed.) Mc Million Press Ltd., London
- Perry, T. W. (1984): *Animal Life-Cycle Feeding and Nutrition*. Academic Press, Inc. I Orlando, Florida
- Salmon, R.E. (1983): The Effect of the Energy Protein Ratio of the Diet, Strain, and Age of Slaughter and Performance of Carcass Quality on Turkey Broilers. *Poultry Science* **62**:824-831
- Scott, M.L., M.C. Nesheim and R.J. Young (1982): *Nutrition of the Chicken*. M.L Scott and Associates, Ithaca, NY, USA. 562 pp
- Scott. M.L. and W.F. Dean, W.F. (1991): *Nutrition of the Chicken*. M.L Scott and Associates, Ithaca, NY, USA. 177 pp
- Scott, M.L. and Dean, W.F. (1991): Nutrition and management of ducks. Connell University. CAB intervation UK. Publ. M.L. Scott of Ithaca, pp. 177
- Sell, L.J., Krogdahl, A. and Hanyu, N. (1986): Influence of Age and Utalization of I Supplemented Fats by Young Turkeys. *Poultry Science* **65**: 546-554.
- Shannaway, W.W. (1994): *Quail Production Systems. A Review*. FAO, Rome. 145 pp

- Silva; J.L., and S.D Strahl (1991): Human Impact on Populations of Chachalacas, Guans, and Curassows (Galiformes: Cracidae) in Venezuela. Paper in: *Neotropical Wildlife Use and Conservation*. John G. Robinson and K. H. Redford (eds). University of Chicargo Press. USA. pp. 37-52
- Simmons, P. C. M. (1986): Major Minerals in the Nutrition of Poultry. In: *Nutrient Requirement for Poultry and Nutritional Research*. C. Fisher and K.N. Boorman (eds), *Poultry Science Symposiun* 9 Butterworth. pp.141-154
- Strahl: S., and Grajal, A. (1991): Conservation of Large Avian Frugivores and their Management in Neotropical Areas. *Oryx* **25**:1, 50-55.
- Summers, J. D. (1995): Nutrition and Poultry Production. In: *World Animal Science. C. Production System Approach* 9. *Poultry Production*. P. Hutton (gen ed). A.Neiman-Sovensen and D.E. Tribe (eds in ch) Elsevier
- Tjørve, K.M.C. and Tjørve, E. (2010): Shape and function of bird-growth models: how to characterize chick postnatal growth. *Zoology*, **113**:326-333

BOOKLET 2
**The Scarlet Ibis/Ibis Rouge/
Corocoro Rojo/Guara/
Scharlachsichler
(*Eudocimus ruber*)**



**Figure 2.1: A Mature Scarlet Ibis along with Wild Ducks at the
Pointe-a-Pierre Wildfowl Trust, Trinidad, Trinidad and Tobago**

Part 2.1

Questions on the Scarlet Ibis

?

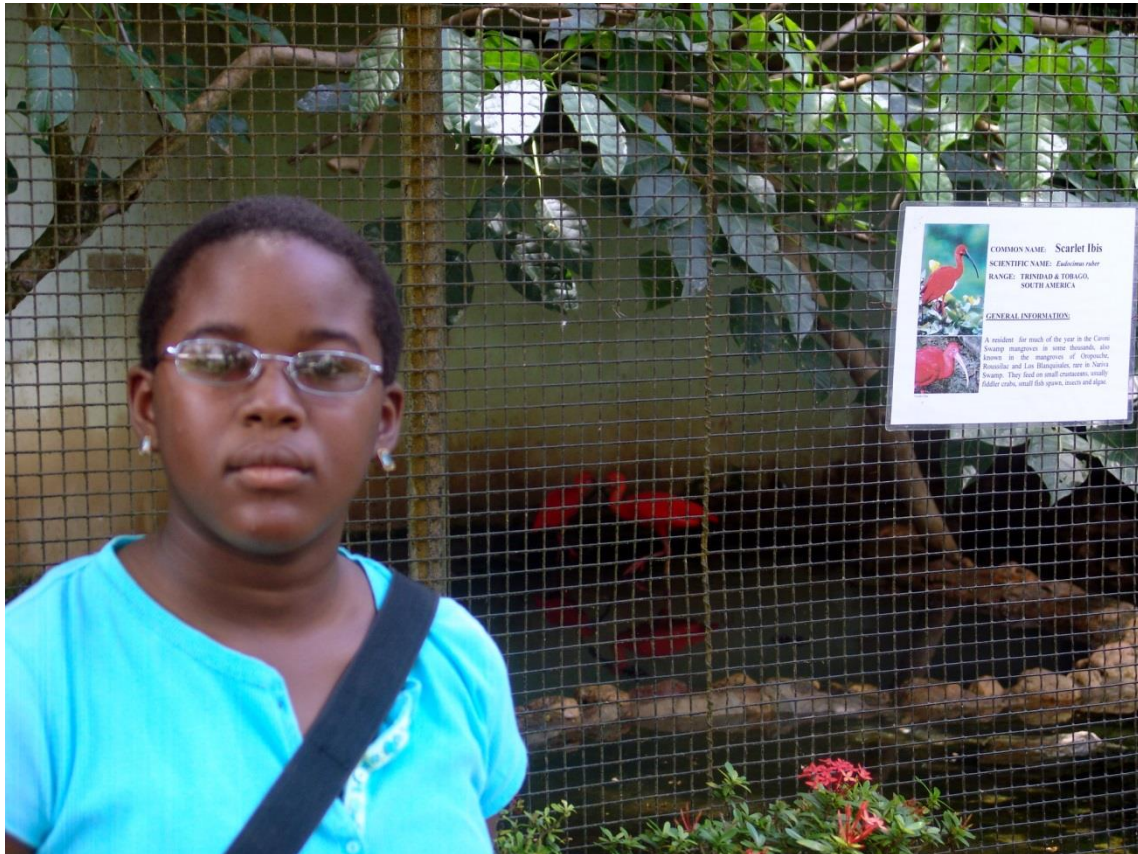


Figure 2.2: Anais Garcia in front of one of the Scarlet Ibis Exhibits at the Emperor Valley Zoo, Trinidad, Trinidad and Tobago

Part 2.1.1
Aryann's, Anais' and Children's Questions on
the Scarlet Ibis



Figure 2.3: The Children who asked the Questions: Aryann Garcia, Auntie Michelle Mac farlane, Jarred “Zico” Stewart, Anais Garcia, Xavier Mac farlane, Jed “Ronaldo” Stewart and Zachary de Lima

History

1. **Who discovered the Scarlet Ibis?**

The Scarlet Ibis was first documented by Linnaeus in 1758, but we are sure that it was the Arawaks and the Caribs who first discovered this bird as they were here first.

2. **Is the Scarlet Ibis a protected animal by the Government?**

The Scarlet Ibis is a National Bird and it is protected by the Laws of the Republic of Trinidad and Tobago. After 1963 the Scarlet Ibis was protected by the Conservation of Wild Life Act that prohibited the hunting and trapping of the bird. However, before 1963, it was protected under the Wild Animals and Birds Protection Ordinance of 1933.

3. **Was the Scarlet Ibis here when the native Arawaks and Caribs lived in Trinidad and Tobago?**

The Scarlet Ibis has a fossil record that dates back to 60 million years. However, the literature about the bird in Trinidad has placed the migration of the bird into the country from the 1940's. It is important to note this, as it was the Europeans who wrote down the information or created the "Modern Day Historical Records". However, the Caribs and Arawaks did not write down things or we were not taught about their writings as they were killed off by the Europeans. In addition, the parts of Trinidad where the Scarlet Ibis lived were inaccessible to most humans before the Highways were built, so this bird was here for sure with the Arawaks and the Caribs.

Naming of the Scarlet Ibis

4. **What species is the Scarlet Ibis?**

The Scarlet Ibis belongs to the **Class:** Aves (birds), **Order:** Ciconiiformes (storks and relatives), **Family:** Threskiornithidae (Ibises and Spoonbills), **Genus and Species:** *Eudocimus ruber* (Scarlet Ibis). This scientific way of naming animals has been earlier described in Booklet #1 [The Cocrico] of this book.

5. **Are there other names for the Scarlet Ibis?**

In Venezuela it is called the **Corocoro**. In French Guyana it is called the **Ibis Rouge**. In Brazil it is called the **Guara**.

6. **What is a Mommy Scarlet Ibis called?**

A mommy Scarlet Ibis we could call a **Scarlet**.

7. What is a Daddy Scarlet Ibis called?

A daddy Scarlet Ibis we could call a **Scarlo**.

8. What is a Baby Scarlet Ibis called?

A baby Scarlet Ibis we could also call a **Scarlin**.

9. What is a Newborn Scarlet Ibis called?

A Newborn Scarlet Ibis we could also call a **Hatchlin Scarlin**

Geographical Location

10. Where in Trinidad and Tobago are Scarlet Ibises found?

a. Trinidad

In Trinidad they are found in the swamps on the western and southern side of the island [Caroni, Carli Bay, Roussillac, South Oropouche, Icacos and Los Blanquizaes] and to a lesser extent on the swamps on the Eastern side of the island of Trinidad [North Oropouche and Nariva] [Figure 2.4]. There is also a small breeding colony held at the Pointe-a Pierre Wild Fowl Trust and at the Emperor Valley Zoo.

b. Tobago

It was reported to be present in Tobago by a man called Woodcock in the 19th century, over 100 years ago, but it is no longer found in Tobago.

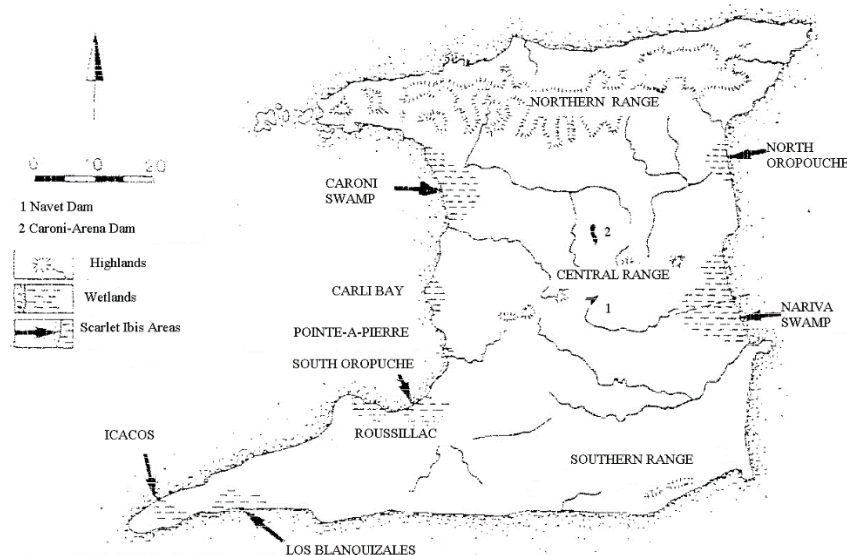


Figure 2.4: The Locations in Trinidad where the Scarlet Ibis have been found [Source: Mayer de Schaunensee, 1970]

11. Where else in the world is the Scarlet Ibis found?

The Scarlet Ibis is also found in Colombia, Brazil, Venezuela, Guyana, Suriname and French Guyana. The little map in Figure 2.5 shows the locations where they are found and the stamps from the countries with the Scarlet Ibis [Figure 2.6].

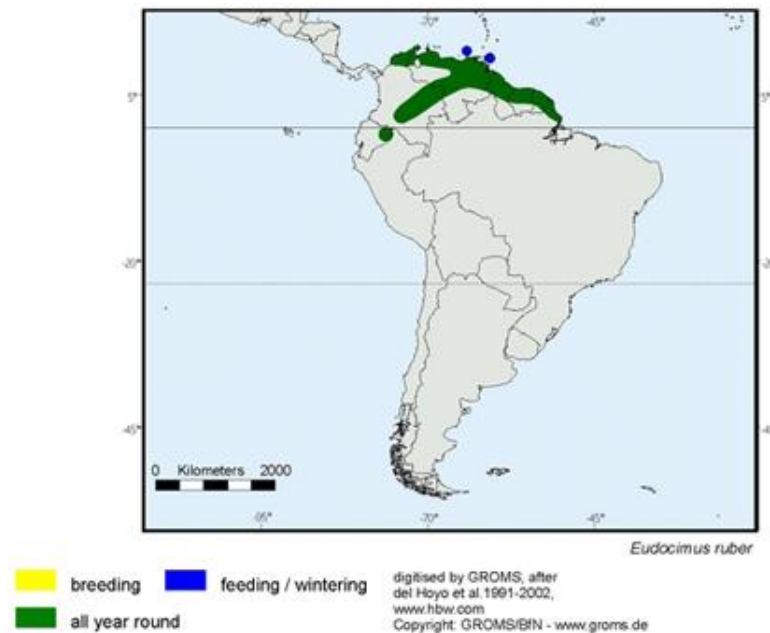


Figure 2.5: The Locations where the Scarlet Ibis is found



Figure 2.6: A stamp of the Scarlet Ibis [Guara]

Physical Description

12. Why is the Scarlet Ibis red?

The red colour of the Scarlet Ibis comes from the pigments in the bodies of the crustaceans that they eat. Crustaceans are the invertebrate animals [without internal skeletons] that live in the water where the Ibis feeds. The Scarlet Ibis synthesizes the carotene [in this case it is the red coloured pigment] present in the body of the crustaceans, especially crabs. This is called carotenoid-based colouration in Birds. The red colour intensifies as the bird ages. In addition, when these birds do not get sufficient amount of this red pigment in their body their colour fades to pink as is shown in Figure 2.7.



Figure 2.7: A Scarlet Ibis at the Emperor Valley Zoo showing signs of fading colours in captivity

13. Why does it have such long legs?

The long legs are useful for wading in the shallow water such as mangrove flats and swamp lands where the Scarlet Ibis feeds [Figure 2.8].



Figure 2.8: A Scarlet Ibis feeding at the Caracas Zoo

14. Can it walk very long distances?

The Scarlet Ibis walks to forage for food in mangrove swamps, rivers and other bodies of shallow water. However, because they are birds they can also cover long distances through flight. They sleep at night where they also nest and in the early morning they fly to their feeding grounds. They also migrate between Trinidad and Venezuela.

15. Why does it have such a long beak?

The Scarlet Ibis uses its beak for preening to clean and smooth its feathers. But the primary importance of the length of the beak is to allow the Ibis to reach their food in the ground. This allows the Ibis to forage (search) for food in the shallow or muddy waters where the birds feed.

16. How can you distinguish between a Mommy and Daddy Scarlet Ibis?

As this bird does not easily show external signs of sexual differences, we can only just estimate their gender visually. The daddy is usually larger, has longer legs and a longer beak.

17. What colour is a Baby Scarlet Ibis?

The young scarlet ibis is generally dull greyish brown in colour with white rumps and under parts [Figure 2.9 and 2.10]. As it gets older the plumage [feather] changes until it turns red. This usually occurs when the Scarlet Ibis is around 2 years old.



**Figure 2.9: Very Young Scarlet Ibis [a Fledgling Scarlin]
[Kallicharran and Leed 2001]**



**Figure 2.10: Juvenile Scarlin [with the plumage/feathers changing
from dark brown to Scarlet]
[Kallicharran and Leed 2001]**

18. Why does it have black feathers at the tip of the tail?

The black feathers are thought to give extra strength to the wing tip. These feathers are called the primaries.

19. How much does the Scarlet Ibis weigh?

The average weight of an adult Scarlet Ibis is 1.35kg (3lbs).

20. What is the wing span of a Scarlet Ibis?

The average wingspan of the Scarlet Ibis is about 38 inches (97 cm).

21. What is the height of a Scarlet Ibis?

The average height of this bird is roughly 60 cm (23 in.) from head to tail.

22. Does the Scarlet Ibis have ears?

The Scarlet Ibis does have ears however they are not visible as they are small and hidden under the feathers of the bird. The sense of sound allows the bird to differentiate between the number of sounds they hear such as their mating calls and distress calls.

Diet

23. Does the Scarlet Ibis drink nectar?

The Scarlet Ibis eats fish, crustaceans [crabs and crab like animals] and insects; however nectar is not a component of their dietary requirements, as the beaks and mouth parts of this animal are not designed by nature for this. However, the hummingbirds one of the other birds in this book are known to drink the nectar of many flowering plants as their mouth parts are adapted or have evolved for this type of feeding.

24. Can it be eaten?

The Scarlet Ibis is a bird and to the best of my knowledge, all birds are edible. However, it is against the laws of Trinidad and Tobago to hunt this animal, it is not a CITES **Red Listed** animal. This is a national bird of Trinidad and Tobago that makes it a **Protected Species**. In French Guyana and other South American Countries it is also against the law to hunt this bird.

25. What kind of fish does the Scarlet Ibis eat?

The Scarlet Ibis usually feeds on freshwater or brackish water fish species as well as small crabs that live and breed in the swamp and fresh water areas where this bird lives.

26. Does the Scarlet Ibis eat itself?

The Scarlet Ibis is a carnivore, that eats fish, crabs and other small crustaceans, but it is not known to be cannibalistic (that is it does not eat members of its own species).

General Question

27. What is CITES?

This is an international agreement aimed at protecting endangered plants and animals from extinction, and as you know, **EXTINCTION IS FOREVER!!!!** CITES means **Convention on International Trade in Endangered Species**.

28. Why is the Scarlet Ibis kept in captivity?

The Scarlet Ibis is kept in captivity principally in zoos as displays for visitors to view this magnificent bird. It is listed in the Bird Life International (2000) as being low risk/low concern for extinction so they are mostly not kept for species recovery programs at present. However, in Trinidad because of the encroachment of humans into their habitat, the animals are considered at risk here.

29. To what other animals is the Scarlet Ibis related?

The Scarlet Ibis' closest relative is the *Eudcoimus albus* (the White Ibis) which is the same anatomically as the Scarlet Ibis but is white in colour. In fact they may be the same species with just different colours. This will also be discussed in the next section of this booklet.

30. For how long does a Scarlet Ibis live?

The record for the longest living Scarlet Ibis is of a female member of the species that arrived at Amsterdam Zoo on the 18th November 1953. This animal survived until the 25th February 1987, reaching an age of **33 years, 3 months and 7 days**. A White Ibis male also lived at the San Diego Zoo for 27 years and 7 months. Some birds however live for roughly 20 years or less in captivity.

31. Can the Scarlet Ibis swim?

The Scarlet Ibis forages for its' food in shallow waters of mangrove swamp, lakes and rivers and may sometimes prune itself in these wetland areas but it does not swim.

32. Does any other animal prey on the Scarlet Ibis?

Small cats such as the ocelot, snakes that climb trees [like the Cook's Tree Boa/the Cascabel] and man are the main predators of the Scarlet Ibis.

33. Can the Scarlet Ibis be shot?

The Scarlet Ibis is a national bird of Trinidad and Tobago and therefore it cannot be hunted. There are some hunters in South America however who hunt the birds for their plumage for decorative purposes.

Part 2.2

Literature Review on the Scarlet Ibis



Figure 2.11: The Scarlet Ibis on exhibit at the Emperor Valley Zoo

2.2.1 INTRODUCTION

2.2.1.1 Classification

The Scarlet Ibis is a colonial water bird which breeds and nests in large colonies. It inhabits swamps, marshes, muddy tidal flats, dense cave bracken (large coarse ferns) shore areas and mangrove coasts. The taxonomy of the Scarlet Ibis can be illustrated as follows:

Name:	Scarlet Ibis
Scientific Name:	<i>Eudocimus ruber</i>
Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves (Birds)
Order:	Ciconiiformes
Family:	Threskiornithidae [Ibises and Spoonbills]
Genus:	<i>Eudocimus</i>
Species:	<i>ruber</i>
CITES Status:	Cites II, not globally threatened
Status in Trinidad & Tobago:	Threatened in Trinidad, now extinct in Tobago (del Hoyo, Elliott and Sargatal, 1992).

An early report on the Scarlet Ibis in Trinidad and Tobago was by Belcher and Smooker (1934) and the scientific name used by them for this bird was *Guara rubra*. This bird was originally named *Scolopax rubra*, Linnaeus, 1758 and the White Ibis was *Scolopax alba* (del Hoyo *et al* 1992). They reported that it was not found in Tobago and that in Trinidad it was hunted along with Herons, Ducks, Charadriidae and Small Waterfowls. Woodcock (1866) reported that Scarlet Ibis or Flamingos had been shot in Tobago.

The main body of literature on the Scarlet Ibis was presented at the **“First International Scarlet Ibis Conservation Workshop”** [Frederick, Morales, Spanna and Luthin, 1990]. Therein there were two papers of relevance to Trinidad and Tobago, Hislop and James (1990) and Brouwer and Van Wieringen (1990). The latter contained a Bibliography on the genus *Eudocimus*, in which work reported on this bird from Trinidad up to that time was listed. Work on the Scarlet Ibis out of Trinidad and Tobago since Bildstein (1990) has been by Samayah (2009), nineteen years later.

Samayah (2009) reported on nesting dynamics and the effect of human disturbance on the colonial water birds in the Caroni Swamp. What was most important from this work was that it confirmed successful nesting of the Scarlet Ibis in the Caroni Swamp in 2008. The nesting took place in a

mixed colony comprising Cattle Egrets (*Bubulcus ibis*), Snowy Egrets (*Egretta thula*), and to a lesser extent Little Blue Herons (*Egretta caerulea*), Black Night Herons (*Nycticorax nycticorax*), and Yellow-crowned Night Herons (*Nyctanassa violacea*). Data was collected on eighty two (82) nests.

The **“Naturalist”** magazine Volume 6, Number 5, December 1985 was a special issue devoted to the Caroni Swamp. In this issue the Scarlet Ibis was the focus of several articles. These were by Gerald (1985), Luthin (1985a & b), French (1985) and Rooks (1985). Therein it was reported that in 1985 the Caroni River that flowed through the Caroni Swamp was an “open sewer”. Gerald (1985) described the changes (between 1922 and 1985) that took place within the Caroni Swamp. This has been the main habitat of the Scarlet Ibis in Trinidad. The main message was that between 1922 and 1985 8.8% of the original swamp was lost and he alluded to a continued further loss. Luthin (1985a & b) suggested that the Scarlet Ibis was being loved to death in Trinidad. French (1985) also noted the following:

“It is not easy to establish with reasonable precision the status of the ibis at mid-century, partly because of a lack of records and partly because of the tendency of inexperienced or impressionable observers to exaggerate in their descriptions.”

This statement still appears relevant today and continues to resonate. Rooks (1988) spoke on the last days of the Scarlet Ibis. A very informative book was written on the White Ibis by Bildstein [1993] and therein was a chapter on the Scarlet Ibis. The information contained in del Hoyo *et al* (1992) on this bird was also quite concise. The review of the Scarlet Ibis herein attempts to bring together the available information on this bird with the focus on Conservation, Nutrition, Breeding and Reproduction.

2.2.1.2 Legal Status in Trinidad and Tobago

In 1962, upon the attainment of Independence from the United Kingdom by Trinidad & Tobago, the Scarlet Ibis was declared a National Bird [see Figure 2.12]. In 1965, the species was listed as totally protected, but in 1981 the bird was listed as a game species [in error] during the reprinting of the Laws of Trinidad & Tobago. In 1986 the bird was removed from the list of game birds and it is now protected by both the **Forests Act [Chapter 66:01]** and the **Conservation of Wild Life Act [Chapter 67:01]**.



Figure 2.12: The Stamp with the Scarlet Ibis celebrating the Independence of Trinidad and Tobago from the United Kingdom in 1962

In 1979, the main habitat of the Scarlet Ibis, the Caroni Swamp, became a National Park. However, the Scarlet Ibis has been subjected to a number of threats. These were poaching, noise disturbance, and organic and inorganic pollution [Bacon, 1970a & b]. In Trinidad the Scarlet Ibis can be found in some thousands in the mangroves of the Caroni Swamp, Oropouche, Roussillac and Los Blanquizales. It was rarely found in the Nariva Swamp, (Meyer de Schauensee, 1970). The bird was reported to be narrowly distributed between North East Colombia, Eastern Ecuador, Northern Venezuela, the Guyanas, Central Brazil, Trinidad and Margarita (del Hoyo *et al*, 1992; Hansen, and Richard-Hansen, 2000).

2.2.1.1 Are the Scarlet Ibis [*Eudocimus ruber*] and the White Ibis [*Eudocimus albus*] different species?

The Scarlet Ibis was first named by Linneaus in his *Systema Naturae* in 1758, and in that document he named both this animal and the White Ibis on the same page. He named them *Scolopax rubra* and *Scolopax alba* respectively [Ramo and Busto, 1987]. Later the Scarlet Ibis was referred to as *Guara rubra* [Belcher and Smooker, 1934]. But today their scientific names are *Eudocimus ruber* and *Eudocimus albus*, respectively. Both species are colonial water birds. The Greek meaning of *Eudocimus* is famous, in good standing, of high repute (Gaskin and Shephard, 1992).

The White Ibis is predominately found in Southern USA and some areas of South America [Bildstein, 1993]. Ramo and Busto (1982) have suggested the distribution as shown in Figure 2.13. In Venezuela and Northern South America the two species [Scarlet Ibis and White Ibis] have been reported to coexist in breeding colonies [Ramo and Busto, 1982]. However, some very careful observations were made by Ramo and Busto (1982, 1985) and this led them to conclude that both birds were one

species consisting of two subspecies. Their work was based on observations made during July and August 1980 [120 breeding pairs], June 1981 [200 breeding pairs] and July to September 1984 [6750 breeding pairs]. Bildstein (1993) has also reported on the reproductive behaviour of the White Ibis which was similar to the observations made by Ramo and Busto (1982 and 1985). They further suggested that the two sub species be renamed as follows: *Eudocimus ruber ruber* and *Eudocimus ruber albus* [Ramo and Busto, 1982, 1987].

They reported that these animals species [based on phenotype alone] did in fact cross breed. They were therefore the same species and in 1987 they reaffirmed their proposal for the change in the Taxonomic status of these birds [Ramo and Busto, 1987]. This was supported by the observations that they made between 1981 and 1984. They recorded cross breeding and found no differences in the diets or reproductive behaviour of these animals [Ramo and Busto, 1987]. Their drawings of the reproductive behaviour that they observed with these animals are presented under the section “Breeding and Reproduction” [Section 2.2.3]. In addition it was very instructive that the newborn of both species had the same colours. They were born dark brown, then they changed as juveniles into brown and red/or brown and white, then as adults they again changed into complete scarlet (in the case of the Scarlet Ibis) and white (in the case of the White Ibis). In both cases the adults had black tail feathers.

It is important to note that the eggs from the mixed pairs from the conception between a Scarlet Ibis male and a White Ibis female or vice versa have the same period of incubation [21-23 days] and the adults of both species raise their young in the same manner as mates of the same colour according to Cristina Ramo and Benjamin Busto in 1985. Their paper was titled “*Comprtamiento Reproductivo del Corocoro (Eudocimus ruber) en los Llanos De Venezuela*”. This paper has presented us with very comprehensive information on the reproduction and reproductive behaviour of both of these birds. We in Trinidad and Tobago should all be grateful to Ramo and Busto for this piece of work and the invaluable graphics that are contained in this book.

The publications of Ramo and Busto (1982, 1985 and 1987) have strongly concluded that the Scarlet Ibis and the White Ibis were one species but just different colour morphs. Observations made in 2003 by Saira Kalicharan and Ronald Leed [Zookeepers 1] at the Emperor Valley Zoo, Trinidad, Republic of Trinidad and Tobago have also confirmed that the Scarlet Ibis and the White Ibis were able to cross and produce off spring that were white or mildly pinkish white. This further confirms the earlier observations of Ramo and Busto [1982, 1985 and 1987] that these two species were the same. Figures 2.14, 2.15 and 2.16 show these birds at

the Emperor Valley Zoo [EVZ]. Subsequently further observations made by Zookeepers [Delbert Charleau] at the EVZ in early 2010 indicated that the crosses of White Ibises and Scarlet Ibises born earlier at the EVZ produced fertile eggs that hatched, but the hatchlings died due to poor management. This therefore confirms that the White Ibis and the Scarlet Ibis were/are the same species of bird.

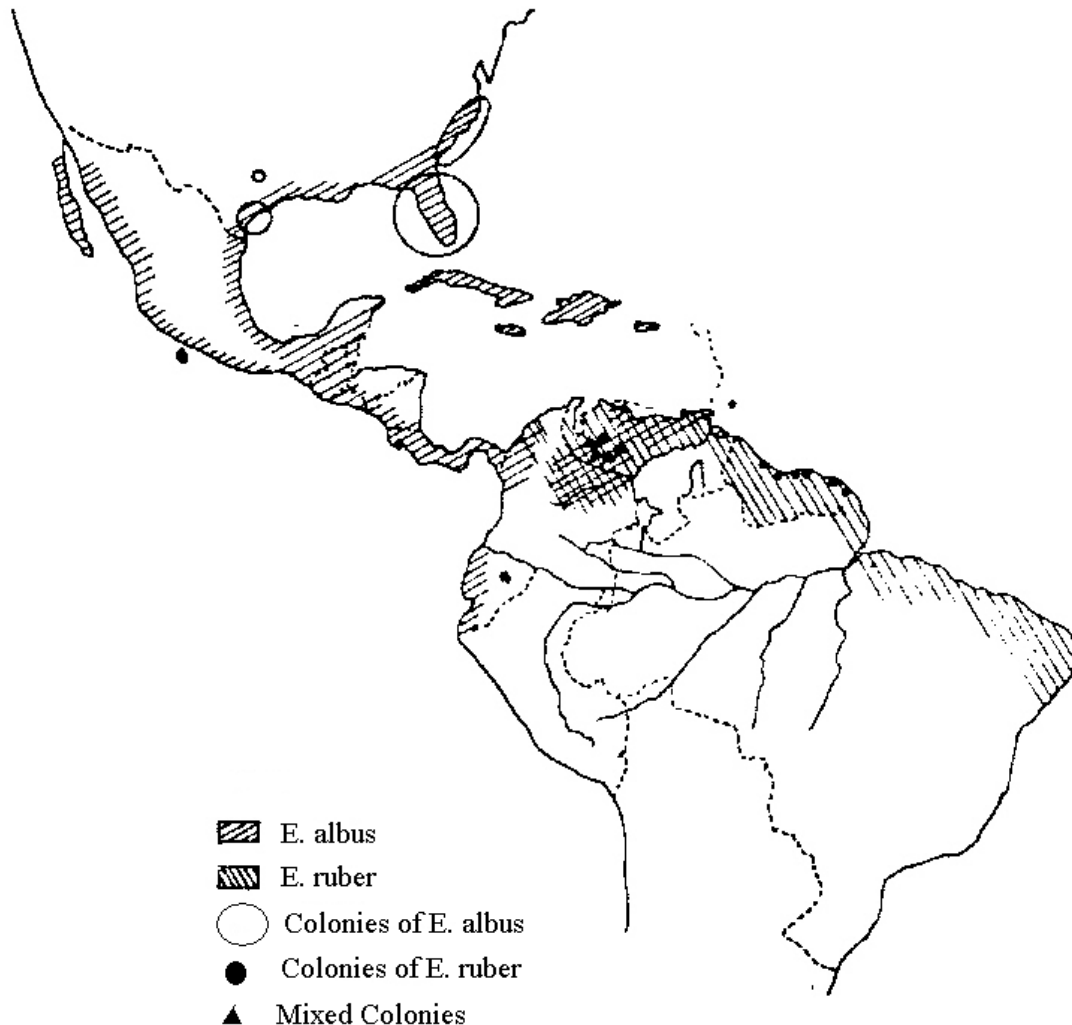


Figure 2.13: Map showing the distribution of *E. albus*, *E. ruber* and Mixed Scarlet and White Ibis colonies
[Source: Ramo and Busto, 1982]

Ramo and Busto (1987) indicated that within the mixed ibis populations in the Llanos the White Ibis made up a small percentage of the ibis population, rarely exceeding 10%. They further reported that they recorded 40 mixed pairs of White [WI] and Scarlet Ibises [SI] and observed 40 mixed copulations in 1981 and 1984. The mixed pairs they observed were broken down as follows: 14 [SI Male with WI Female], 17 [WI Male

with SI Female] and 9 [Unknown]. In the colonies that they observed the colour of the Scarlet Ibis varied from light orange to scarlet and some of the White birds had scattered orange feathers. This they indicated was further evidence of hybridization. The fact that the crosses tend to be less red would suggest that the Scarlet Ibis is probably the expression of the homozygous recessive gene. In addition (as earlier stated) these two ibises were on the same diet and living in the same environment, with the Scarlet Ibis showing the red pigmentation and the White Ibises showing white. This is probably because the uptake of the carotenoid pigments from the diet is genetically linked [Tella *et al* (2003) and Olson and Owens (2005)].



Figure 2.14: The White and Scarlet Ibis Cross at the Emperor Valley Zoo, Trinidad, Trinidad and Tobago [Source: Kalicharan and Leed 2003]



Figure 2.15: The White Ibis X Scarlet Ibis Cross at the Emperor Valley Zoo, Trinidad, Trinidad and Tobago
[Source: Kalicharan and Leed 2003]



Figure 2.16: The White and Scarlet Ibis Cross at the Emperor Valley Zoo, Trinidad, Trinidad and Tobago
[Source: Kalicharan and Leed 2003]

*2.2.1.2 The Description of the Scarlet Ibis (*E. ruber*)*

Size and Feather Colour

The Scarlet Ibis (*Eudocimus ruber*) are on average 21-27" [53 - 69 cm] long with a 38" [97cm] wingspan. The full-grown male is slightly larger than the female, and the male has longer legs and a longer beak. Both sexes are completely scarlet with black wing tips. They have a long pinkish-black down curved bill, with dark brown eyes and pink legs. The immature ibises are born with their upper parts coloured dark brown. The under parts of the young are white and they show a brownish bill, [Tables 2.2.1 and 2.2.2].



Figure 2.17: An Adult Scarlet ibis [possibly a Scarlo] showing its black primary feathers

The colour of the feathers is due to the reflection of some components of the incident white light. According to the way in which the white light is reflected feather colours are either *pigmentary* or *structural*. Some colours are a combination of both these forms [King & McLelland, 1984]. The colour of the Scarlet Ibis's feathers (Scarlet) is due to the presence of pigments in the feathers mainly, carotenoids. The carotenoids occur in the feathers in diffused form from being dissolved in fat globules. They obtain most of the carotenoid pigments either directly or indirectly from plants and crustaceans and mollusks. Some examples of these are fiddler and aratus crabs (*Uca*, *Aratus* and *Ucides*), shrimp, algae and aquatic insects [news.carib-link.net (Internet), 1996]. In captivity the Scarlet Ibis fade to a dull pink and thus have to be fed special diets containing pigments to maintain the feather colour. The colour of the feathers is used to display, for concealment, for protection from injurious light and temperature [King & Mac Lelland, 1984]. The four longest primaries are tipped blue-black; this is thought to give extra strength to the wing tip [news.carib-link.net (Internet), 1996].

Beak / Bill

The horny bill/beak is a hard keratinized epidermal structure covering the rostral parts of the upper and lower jaws and functionally replacing the lips and teeth of mammals [King & Mac Lellard, 1984]. The bill of the Scarlet Ibis is long and curved black in adult and pinkish brown in juvenile and used to probe for food in mud and shallow water, guided mostly by touch. In the adults it is also used as a defence against enemies and to protect their offspring [Whozoo.org (Internet) 1998] (see Table 2.2.2 for the full description of the beak/bill in the adult and juvenile and also in Table 2.2.3 the full function of the beak/bill). At the base of the bill

there is a “wattle” or a “growth” that becomes very prominent red and enlarged in size in the males during the nesting season [Walter Bonyun personal communication, Emperor Valley Zoo, 2007].



Figure 2.18: A Mature Scarlet Ibis Male [Scarlo] during the Breeding Season [picture taken at the Emperor Valley Zoo, 30th June 2007, during the “Rainy Season” in Trinidad] showing the enlarged wattle or growth below the neck

Table 2.1: Photos of the Scarlet Ibis at different stages of development

Stage of Development	Picture of Scarlet ibis
Young [Fledglin Scarlin]	
Juvenile [Juvenile Scarlin]	
Adult [Scarlo/Scarlin]	

Table 2.2: The description of each external feature of the Scarlet Ibis (*Eudocimus ruber*)

Feature	Developmental Stage and Description	
	Juvenile	Adult
Colour	▪ Greyish-brown above and white rump underparts ▪ Between 6 – 12 months plumage gradually changes from pink to scarlet	▪ Scarlet all over
Beak/bill	▪ Pinkish brown	▪ Colour change from pinkish brown to black in the breeding season
Primaries	▪ Greyish-white	▪ 4 longest primaries are tipped blue black
Legs	▪ Greyish-white	▪ Pinkish-red
Feet	▪ Slightly webbed	▪ Slightly webbed

Primaries (flight feathers)

There are 2 groups of flight feathers namely the primary flight feathers and the secondary flight feathers. The primaries are attached to the manus (the hand) and are themselves divided into metacarpal primaries (*primaries 1-6 in Figure 2.19*) that are attached to the metacarpal bones and digital primaries that attach to the phalanges of the major digit (*primaries 8-10 in Figure 2.19*) and to the single phalanx of the minor digit (*primary 7 in Figure 2.19*); the secondaries attach to the ulnar (*Figure 2.19*), [King & Mac Lellard, 1984].

In Figure 2.19, the primaries 1-6 are metacarpal primaries, primaries 8-10 are digital primaries attaching to the major digit, and primary 7 is a digital primary attaching to the minor unit. The rudimentary primary attached to the terminal phalanx of the major digit is known as a remicle: this is present in many species but absent in others. The alular digit is shown with only one flight feather, but 2-7 are present depending on the species. There is no carpal remix in this wing [King & Mc Lelland, 1984]. In the Scarlet Ibis the 4 longest primaries are tipped blue-black. During flight the Scarlet Ibis flies strongly with its neck extended, almost as if it were gliding [Whozoo.org (Internet), 1998].

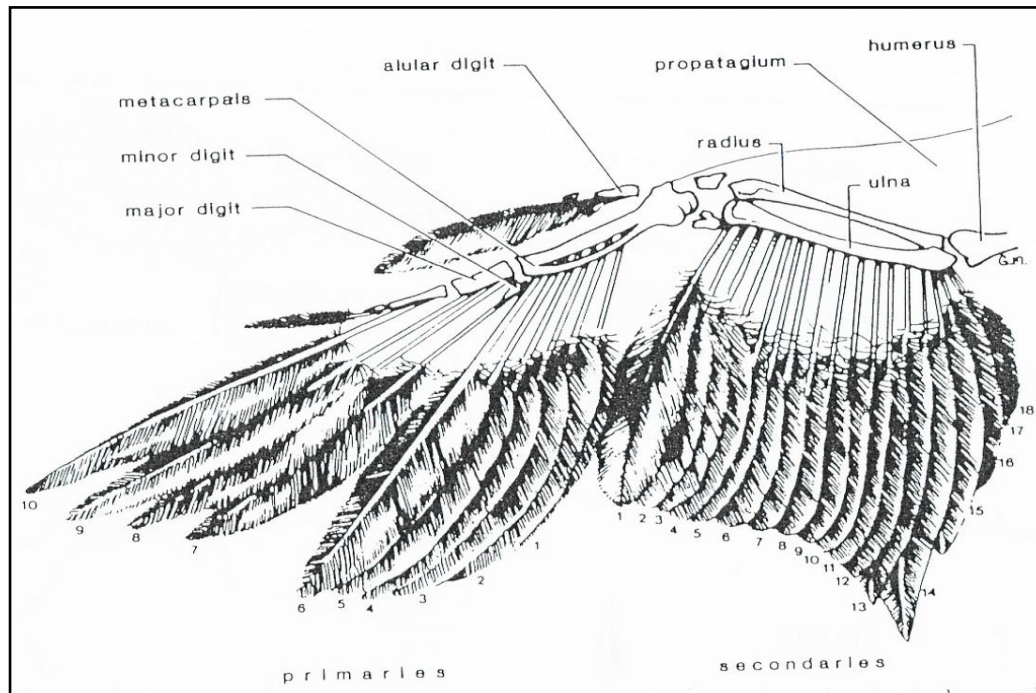


Figure 2.19: Ventral view diagram of the bony attachments of the primary and secondary flight feathers of the right wing
[Source: King and Mc Lelland, 1984]

Feet

The Scarlet Ibis has slightly webbed feet and 4 toes [King & Mac Lelland, 1984] [6]. It functions to grip tree branches and help them stay balanced.

Voice

The Scarlet Ibis has a light, high – pitched, squeaky *tior-tior*, plaintive but more musical than heron's calls. The vocalization is only heard at the nest, roost or when disturbed. Young birds call a faint, shrilling *ssiu* [Whozoo.org (Internet), 1998].

Table 2.3: The external features and their functions in the Scarlet Ibis (*Eudocimus ruber*)

Feature	Function
Beak/bill	Used to clean and smooth its feathers in a process known as preening
Primaries	Used in flight at about 4-6 weeks of age Flies strongly with it's neck extended, almost as if it were gliding Used as a defence mechanism to protect themselves and their offspring
Legs	Used to protect themselves and offspring For walking To maintain balance
Feet	Used to grip tree branches & help them stay balanced
Voice	For communication

Defence Mechanism

The Scarlet Ibis fights with its beak, legs and wings against enemies in order to protect themselves and their offspring [Whozoo.org (Internet), 1998] [2].

2.2.2 Feeds and Feeding

2.2.2.1 Feeding in the Wild

In the wild, Ibises feed on small crabs (*Uca*), principally the fiddler crabs and molluscs. They also prey on aquatic insects, snails, and green algae. The Scarlet Ibis typically breed soon after the outset of heavy rains. In Trinidad this is, late May [French and Haverschmidt, 1970]. In the dry season they are found mostly in Venezuela because the reproductive activity for most fishes, crustaceans and insects is restricted to this period [Lowe-Mc Cornell, 1975]. **The digestive, endocrine and reproductive systems of the Scarlet Ibis are in need of study.**

The chemical composition of the type of foods eaten by the Scarlet Ibis is outlined in Table 2.2.4. These food sources are of medium to low Gross Energy [GE] content, but they are high in Crude Protein (CP) content that ranges from 28.14 % (crabs) to 58.14 % (cray fish). Commercial fish meal is 61.38 % CP. This can be rounded off to 60%. These feed sources are also high in ash content with the % Calcium ranging from 1.89 % (mudskipper which would be like cascadura) to 0.74 5 % (shrimps), and the % Phosphorus ranging from 0.31 % (shrimps) to 0.98% (mudskipper).

Table 2.4: The Chemical Composition [% Dry Matter Basis] or Nutritive Value of some of the types of aquatic animal species eaten by the Scarlet Ibis

Component of Diet	Dry Matter (%)	Gross Energy (MCals/kg)	Crude Protein (%)	Crude Fibre (%)	Ether Extract (%)	Ash (%)	Ca (%)	P (%)
Crabs	90.2	1.64	28.14	1.73	6.02	39.11	0.93	0.63
Snails								
Shrimps	91.27	1.31	53.5	1.18	3.42	16.8	0.74	0.31
Commercial Fish Meal	91.14	1.83	61.38	1.23	5.52	5.96	2.56	1.92
Cray Fish	89.92	2.87	58.14	1.28	6.32	13.86	0.86	0.94
Mudskipper	89.94	2.84	54.82	1.16	4.89	17.65	1.89	0.98

Source: Ojewola and Udom (2005)

2.2.2.2 Feeding the Scarlet Ibis and other Ibises in Captivity

In order to succeed in the rearing and breeding of endangered Ibises in captivity Archibald *et al* (1980) reported that there were two most important items. These were:

1. getting a better understanding of the Biology of the Ibis in terms of habitat, reproductive behaviour, breeding season, nesting and physical development and
2. captive breeding beginning with Ibis species that have been bred successfully in captivity, namely the American White Ibis, the Scarlet Ibis, the Glossy Ibis and the Indian White Ibis.

The success of captive breeding lies in two initiatives and they are as follows:

1. incubation and post hatch management and
2. feeding, firstly in early life and then as adults.

The first hurdle will be the formulation of diets for the hatchlings. The chemical composition and nutritive value of this must obviously be a reflection of the diet of the adults. In section 2.2.2.1 this was addressed.

2.2.2.2.1 Artificial Diets for the Ibises

Artificial diets consisting of a heterogeneous selection of calf liver, heart strips, mutton strips, turkey breeder pellets, minced chicks, carrot pieces, boiled eggs, fruit, meal worms, crickets, snails, mice, vitamin supplements and artificially propagated fish have been reported, (Mallet (1977) and Yamashina (1978) as cited by Archibald *et al* (1980). This was done as observation that Mexican White Ibises in the wild consumed 53% crustaceans and 20% fish.

Feeding Adult Ibises at Vogelpark, Walsrode, Germany

The adults were fed a semi-liquid soup of homogenized day old domestic chicks. Once every six months over a four week period a multivitamin mix was added and Scarlet Ibises received a rhodophyll compound to maintain plumage colour.

Feeding Young Ibises at Vogelpark, Walsrode, Germany

They were given a watery mixture of ground beef heart sprinkled with calcium carbonate and a Vitamin Mineral compound. The animals were fed this during hand rearing for the first four (4) weeks.

Tokyo Zoo diet for Adult Ibises

The adult diet at the Tokyo Zoo was made up of as follows:
56.5% raw horse meat/mutton, 30.0% of the Powder in the table below, 10.0% carrots and 3.5% boiled eggs.

Table 2.5: Prepared Ibis Supplement from the Tokyo Zoo

Ingredient	% of Mix
Powdered Corn	15.0
Wheat Flour	21.6
Wheat Hulls	4.7
Peanut Grinding	6.7
Bean Grinding	8.3
Lucerne Meal	5.8
Dry Yeast	14.8
Skim Milk	13.1
Stabilized fat	4.7
Powdered Bone	2.5
Salt	0.75
Lime Powder	0.45
Iodine salt	0.23
Mineral/ Vitamin Mix	1.37

Feeding and care of Young Ibises at Parque Mangal das Garças in Belém-PA-Brazil

The Scarlet Ibis flock at the Parque Mangal das Garças in Belem was obtained from wild parents rescued by the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis [IBAMA] of Ministério do Meio Ambiente [MMA] between 2004 and 2005. The eggs were laid as will be shown in the manual on the Scarlet Ibis in Part 3 to follow. In 2008 the Scarlets began nesting and laying eggs, the eggs were artificially incubated in a PREMIUM ECOLOGICA Incubator [temperature 37.5° C and Relative Humidity 50% for 21 - 23 days]. After the hatchlings

emerged they were kept at the same temperature as the hatchlings. They then received a mix (beginning with 0.5 ml and increasing each day by 0.5 ml) of Megazoo FL-32, with chopped fish (sardines), shrimp with peel and a vitamin mineral complex [Aminomix and Vitagold) made by the TRATADORES DE ANIMAIS DO BERÇÁRIO E ESTAGIÁRIOS, until they were 20 days old.

The Megazoo FL32 was a commercially formulated feed for ornamental birds, flamangoes and Guans. The nutritive value of the feed was 3000 Kcals/kg ME, 88% DM, 32% CP, 6.5% EE, 3% CF, 2.5% Ca and 1.0% P.

The mix feed was made in a liquidizer *7, stored in plastic containers [Tupperware® *8] and refrigerated (for same day use). All feed and feeding equipment for preparation of feed for the birds and young were sterilized with hot water and the baby food was re-heated. Then the animal keeper with cleaned hands tapped lightly on the base of the bird's bill to imitate the mother's feeding signal. When each one of the babies opened its mouth, the food was dropped inside using a Pasteur disposable plastic pipette *6] [Linhares personal communication]. That process will be repeated each hour for 12 hours per day, giving food to all group in sequence. After 20 days of age they were moved to bigger spaces in the nursery area of the zoo. It was important to use hay to cover the floor and continue giving the same mix of food for 12 hours, but in that time the offer will be completed with cuts of fish and shrimp mixed inside of plastic plates (20cm x 30cm x 6,0cm; 25cm x 40cm x 7,0cm). Each day clean water was offered. After the offering of mix food was diminished gradually and was substituted with the FL32 on the cuts of fish and shrimp. As the animals became adapted to this the fish and shrimp were removed and the animals fed only FL32 supplemented with naturally occurring carotenoids (CAROPHYLL® RED) *9.

Summary on the Nutrition and Feeding of Ibises

Slifka et al (1999) indicated that the field of exotic animal nutrition is still in its infancy. They further stated that compared with humans and domestic animals, we know very little about the nutrient requirements of captive reared wild animals.

2.2.3 Breeding and Reproduction

2.2.3.1 Breeding Overview

Role of the Male

The male chose the site where the nest would be built [see Figures 2.20 and 2.21]. He also performed the following functions: preening, head rolling, twig pulling and plumage shaking.

Role of Female

The female responds, surrounding the male and performing the following activities: preening, head rolling and plumage shaking (Ramo and Busto, 1985). The female perform courtship displays (attention getting movements or songs) to attract a mate (French and Harverscunmidt, 1970).

Both Sexes

Both sexes were involved in building the nests and caring for the young. They built their nest about 15 feet [180 inches/ 450 cm/ 4.5 meters] or even up to 35 feet [420 inches/ 1050 cm/ 10.5 meters] above the high water level mark. The nests were constructed in the forks of branches or where 2 branches cross. They interweaved mangrove twigs, mostly dry and a few green leaves in and around the supporting branches. The nests measured about 12 inches [30 cm] across; the twigs made up the framework that measured 9 inches [23 cm]. Most of the nests lasted only 1 (one) season (French and Harverscunmidt, 1970).

Numbers of Eggs Laid

The Ibis laid 2 or 3 dull green eggs smeared with brown. The eggs were incubated and chicks brooded by both parents, relieving each other at the nest 2 times a day during the incubation period of approximately 23 days, and 4 times a day once the chicks were hatched (Brouwer and Van Wieringer, 1986). The juvenile Scarlet Ibises can climb through trees at 14-21 days. At 23 days of age the feathers were complete, both gray and white. They fluttered from branch to branch. At 25 days of age they could almost fly. The juvenile fledglings did not leave the nest until they are 35-42 days [5 to 6 weeks] old. The longevity record for this species is held by a female that arrived at Amsterdam Zoo on the 18th November 1953 and survived until 25th February 1987, reaching an age of 33 years, 3 months and 7 days [Int. Zoo Yb. (1994), Vol. 33:94-102)].

Colonial Behaviour

It is very important to pay attention to the colonial behaviour exhibited by the Scarlet Ibis especially with regard to creating an environment to stimulate the conditions required for reproduction in captivity. The following is an excerpt from the paper "Managing colonial waterbirds: the Scarlet Ibis (*Edocimus ruber*) as a model species" [Elbin and Lyles, 1994]: The article stated....

"...In captivity, flock (colony) size seems to be an important determinant of breeding successcolonies of less than 32 individuals have fewer chicks on average or do not produce at all. Large colonies always produce some chicks and in some cases produce a greater number of chicks than the small colonies. Although there appears to be no precise minimum threshold for viable colony size, bigger ones are markedly more reproductively active than small colonies."

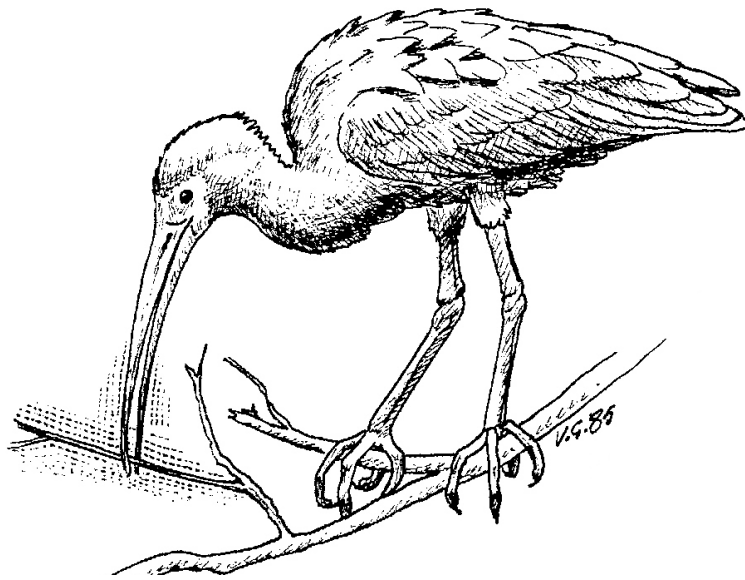


Figure 2.20: The Scarlet Ibis Twig Pulling
[Source: Ramo and Buxo 1985]



Figure 2.21: The Scarlet Ibis Male Building Nest
[Source: Ramo and Buxo 1985]

The paper by Ramo and Busto (1985) gave the Spanish and English terminologies for the colonial behaviour of the Scarlet Ibis. Table 2.2.5 presents the terminology:

Table 2.6: English and Spanish terminologies used to describe the colonial behaviour of the Scarlet Ibis

Ramo and Busto (1985)	Rudegeair (1975) as cited by Ramo and Buxo (1985)
Picotazo	Forward threat and fighting
Pico-pico	Stab-and-Counterstab
Lucha	Aerial aggression
Picotear ramita	Snap and Head Bobbing
Restregar nuca	Head Rolling
Display de limpieza	Display preen and Preening and Feather Ruffling
Sacudir plumaje	
Saludo	Up-Down Greeting
Picotear ramita	Twig pulling
Cruce de cuellos	[Neck crossing]
Copula con sacudida de pico	Copulating Bill Shake
Acicalamiento	Allopreening
Dar sombra	Shading behaviour

Male aggression is presented in Figure 2.22: forward threat, Figure 2.23 presents Stab and Counterstab and Figure 2.24 presents Aerial aggression.

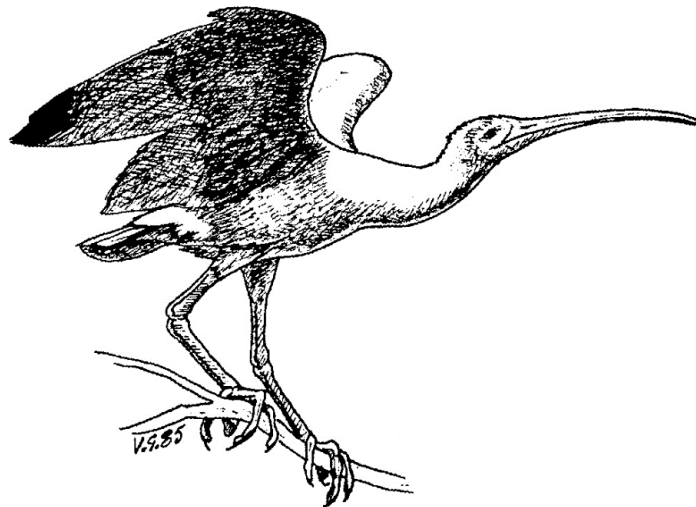


Figure 2.22: The Scarlet Ibis Male Forward Threat
[Source: Ramo and Buxo 1985]

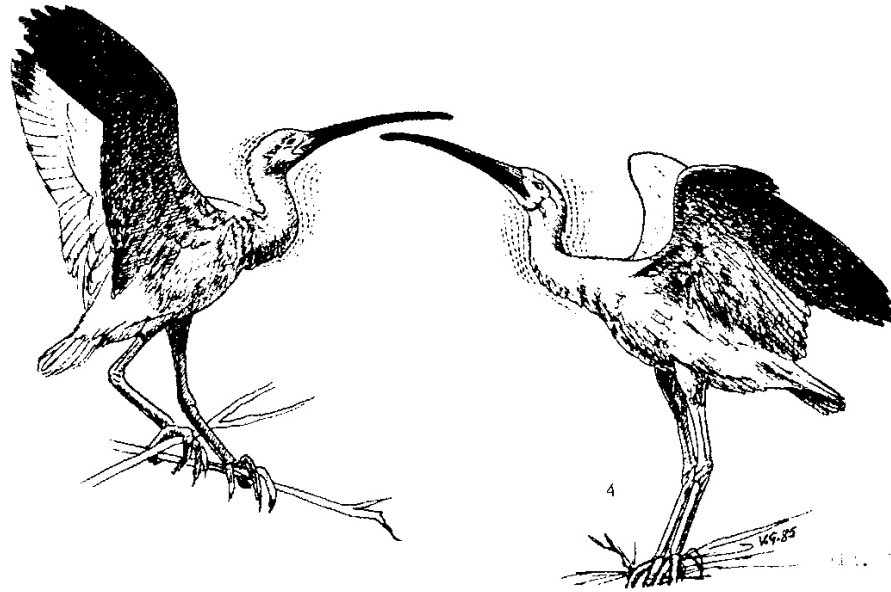


Figure 2.23: The Scarlet Ibis Males Stab-and-Counterstab
[Source: Ramo and Buxo 1985]

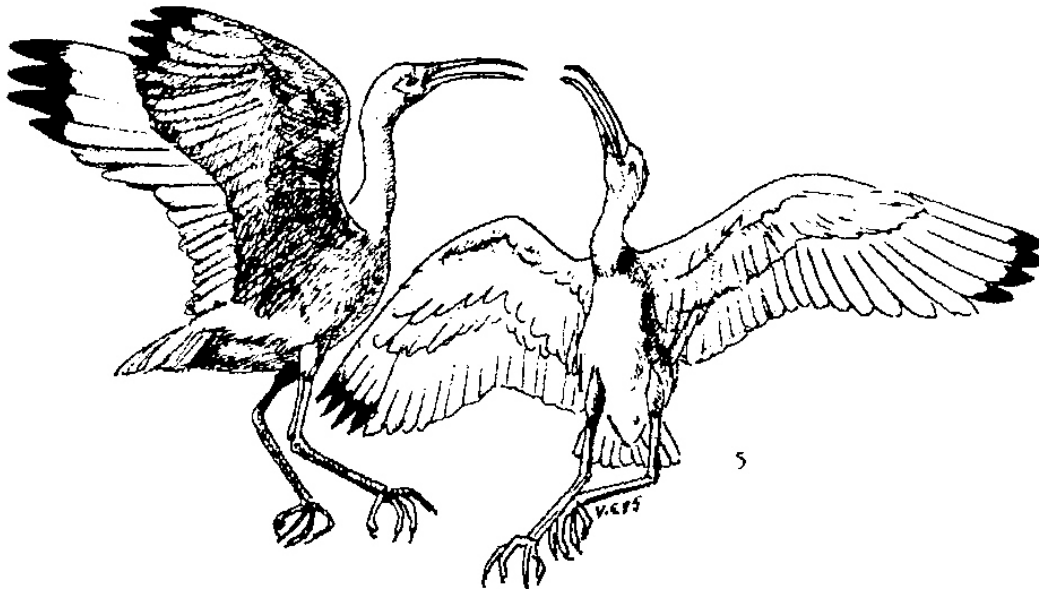


Figure 2.24: The Scarlet Ibis Males Aerial Aggression
[Source: Ramo and Buxo 1985]

Courtship display and Reproduction

The males performed courtship displays (attention-getting movements or songs) to attract a mate. According to Cristina Ramo and Benjamin Busto (1985) in their paper “Comprtamiento Reproductivo del Corocoro (*Edocimus ruber*) en los Llanos De Venezuela” published in Mem. Soc. Cienc. Nat. La Salle Tomo XLV No. 123:177-113:

“The male chooses the site where the nest will be built. Perched among the branches, he performs the following activities: preening, head rolling, twig rolling and plumage shaking.”

The study included a total of 96 hours and included all observations of all stages of reproduction. The research was done during July and August 1980, July 1981 and July, August and September 1984 in an ibis colony in Portuguesa state, Venezuela.

The paper stated...

“The females respond, surrounding the male and performing the following activities: preening, head rolling and plumage shaking. The male accepts by greeting the female with mutual neck crossing and twig pulling, after which copulation occurs.”

Figures 2.25 to 2.32 present the mating sequence of the Scarlet and White Ibises.

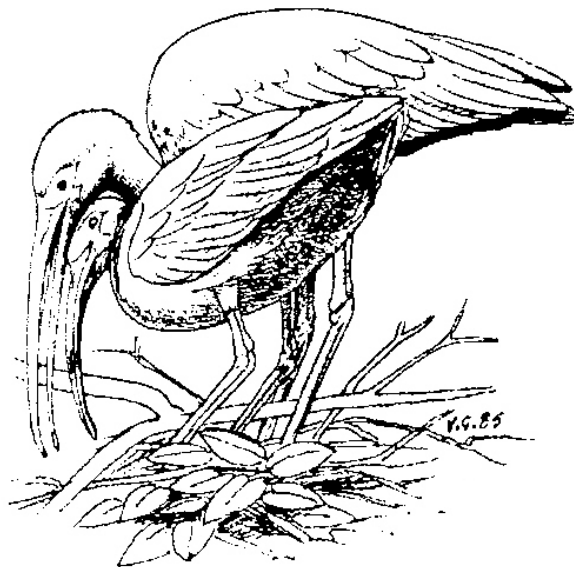
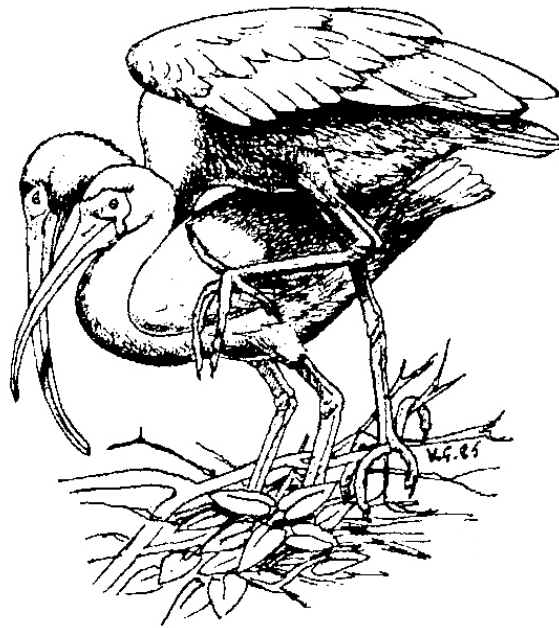
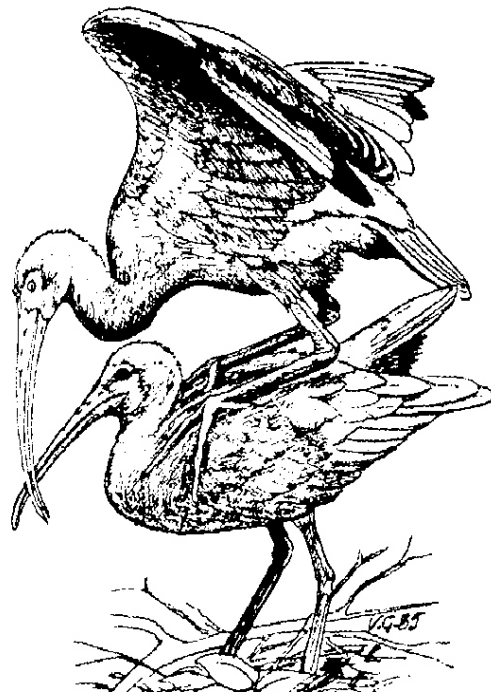


Figure 2.25: The Scarlet Ibis Male and Female Neck Crossing as a preamble to copulation
[Source: Ramo and Buxo 1985]



**Figure 2.26: The Scarlet Ibis Male mounting the Female before
copulation**
[Source: Ramo and Buxo 1985]



**Figure 2.27: The Scarlet Ibis Male fully mounted onto the Female
just prior to copulation**
[Source: Ramo and Buxo 1985]

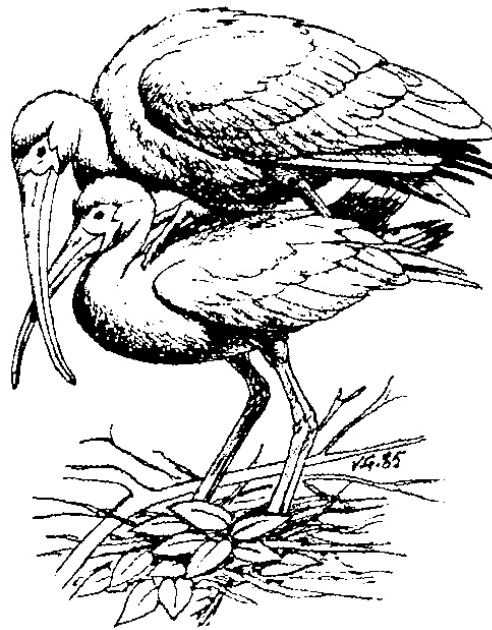


Figure 2.28: The Scarlet Ibis Male on top of the female positioning himself to copulate
[Source: Ramo and Buxo 1985]

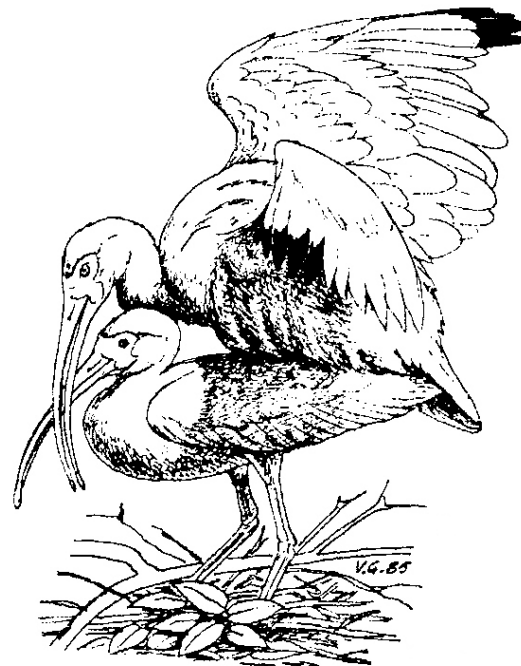


Figure 2.29: The Scarlet Ibis Male on top of the Female beginning to copulate
[Source: Ramo and Buxo 1985]



Figure 2.30: The Scarlet Ibis Male and female in full copulation
[Source: Ramo and Buxo 1985]

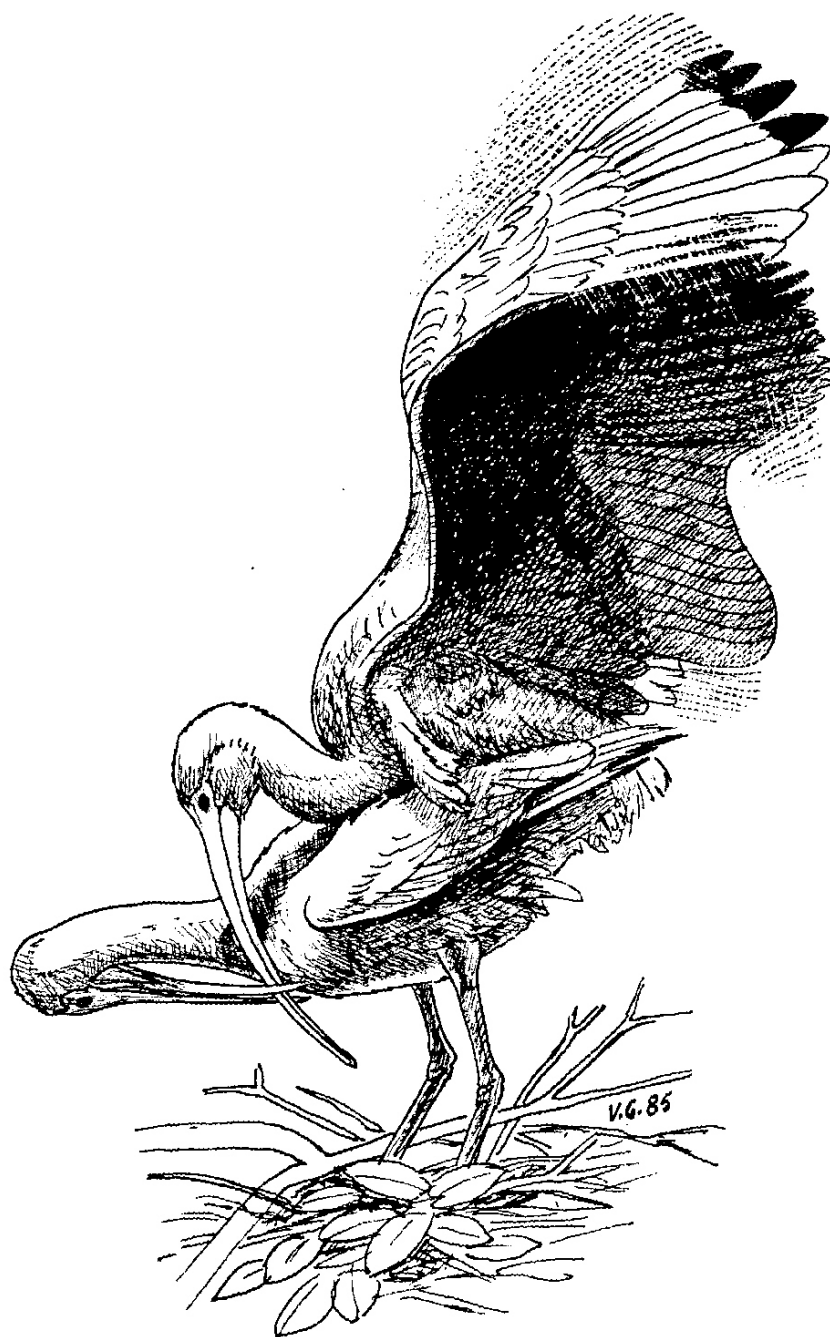


Figure 2.31: The Scarlet Ibis Male and Female at the height of copulation
[Source: Ramo and Buxo 1985]

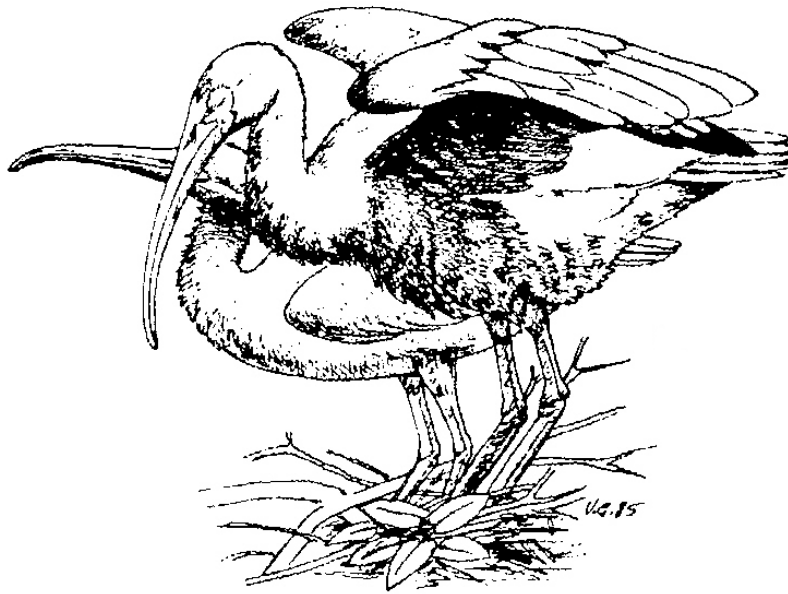


Figure 2.32: The Scarlet Ibis Male and Female at the height of copulation
[Source: Ramo and Buxo 1985]

Another contribution to the mating ritual of the Scarlet Ibis came from King & Mc Lelland (1984) who indicated that the dermis of the female ibis' breast becomes modified during the brooding period to form the incubation (brood) patches or patches. In these regions the dermis becomes thickened and very vascular, and the feathers are lost. These modifications promote the transfer of heat from parent to eggs.

The details of reproduction in the wild are difficult to decipher because of the large number of birds present in the field. Some information regarding the reproduction of the Scarlet Ibis at the Wildlife Conservation Park was presented by Elbin and Lyles (1994) as follows:

"... the colony for potentially breeding adult birds (fertilizable ♀♀: sexually active ♂♂ or the operational sex ratio (Emlen & Oring, 1977) has changed from 1:3.5 (actual sex ratio of 1:2.5) in 1992 to an operational sex ratio of 1:1.6 (actual sex ratio of 1:2.3) in 1993."

The same research revealed that

"... in the 1992 breeding season there were four active nests and two chicks fledged from the same clutch. In 1993 there were six active nests. Seven chicks were produced from six pairs but one disappeared from the nest a few days after hatching. One pair reared a chick from each of the two clutches."

Table 2.7 is a summary of these findings.

Table 2.7: Summary of reproductive activity in the Scarlet Ibis [*Eudocimus ruber*] colony at the Wildlife Conservation Park during two breeding seasons

	1992	1993
No. adults in colony	4.14	7.11
Operational sex ratio	1:3.5	1:1.6
No. active nests	4	6
Clutch size	2.6 (S.E. ± 0.5)	2
No. clutches per pair	2.75 (S.E. ± 0.95)	1.6 (S.E. ± 0.9)
Total no. chicks produced	2	7

* The table was copied from “Managing colonial waterbirds: the Scarlet Ibis (*Edocimus ruber*) as a model species” (Elbin and Lyles, 1994).

Samayah (2009) reported that in the 2008 nesting season the mean clutch size was 1.98 ± 1.8 in the Caroni Swamp in Trinidad, Republic of Trinidad and Tobago. Sixty four percent (64%) of the nests contained 2 eggs, 22 % contained 3 eggs and 13% had only 1 egg. Out of 171 eggs laid [from a sample of 82 nests] 127 or 74% of them hatched. Fifty seven (57%) of the nests produced 2 hatchlings. Fifty two percent (52%) of the nests had at least 1 hatchling surviving to 14 days, while 37% produced two hatchlings that survived to 14 days.

Breeding and Nesting

The ibises bred reportedly in large colonies. They usually breed soon after the onset of heavy rains. In Trinidad, breeding occurred in late May [French & Haverschmidt, 1970]. This was later confirmed by Samayah (2009) based on observations made in the Caroni Swamp when he reported observing 500 breeding pairs during April to September 2008. The adult birds present during this breeding season were estimated to be 3000. This author collected detailed data on 82 nests.

It was believed that one of the reasons why the Scarlet Ibis bred soon after the onset of heavy rains is that the water level rises and there is an abundance of food present; and that these two (2) factors are needed when the parents have to feed their chicks and for the juveniles to grow [Frederick, Morales, Spaans & Luthin, 1990]. In the dry season they are found mostly in Venezuela because the reproductive activities for most fishes, crustaceans and insects are restricted to this period of the year [Lowe-Mc Connell, 1975]. However it could also be that the Scarlet Ibis may initiate nesting and breeding in response to a photoperiod change,

i.e. the onset of longer day lengths. In the case of Trinidad this is the period from May to August which also co-insides with the onset of the rainy season.

When the Scarlet Ibis is not breeding it leaves the roost in the morning and return late in the day. The presence of large numbers of birds in a certain area throughout the day indicates that the birds have selected that area for nesting, and breeding will begin soon. After a few days at the site, they start building their nests. What stimulates the nesting ritual has not been seen in the literature and this should be investigated.

Ramo and Busto (1985) reported.....

“During the nest building the male bring sticks while both sexes participate in building the nest. Both sexes incubate the eggs, taking turns at attentiveness several times a day. Once the nestlings are born, both parents take turns with their feeding and care. While the semi-altricial young are recently hatched, they are always lying down in the nest with one of the adults protecting them.”

“During the day there are four peaks in the number of feedings: 8, 12, 15 and 18 hours. A week later they have well-developed pin-feathers and are capable of standing and walking within the nest, one of the parents always being present.”

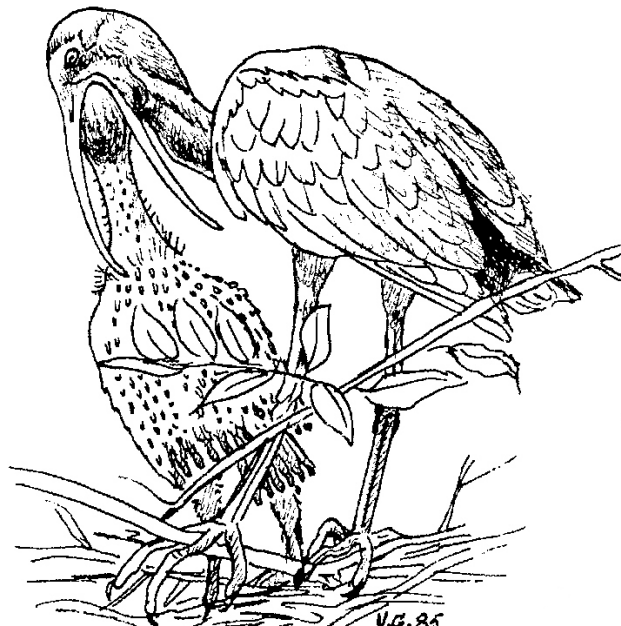


Figure 2.33: Adult Scarlet Ibis Males feeding the hatchling
[Source: Ramo and Buxo 1985]

Another important feature is that the parents provide food for the young and the paper continues...

“The distribution of the feedings at this time has two important peaks at 7 or 16 hours. A week later the young can leave the nest and may be without their parents since they form juvenile groups accompanied by some of the adults. The parents encourage the fledgling to follow while flying from bush to bush.”

Figures 2.33 and 2.34 demonstrates the methods of feeding the young by the adults, and Figure 2.35 demonstrates how the hatchling is shaded.

In captivity the birds were observed with regard to their interaction with their physical environment. Elbin and Lyles (1994) indicated the following:

“Birds tended to use their habitat in a very simple way: they perched on the highest branches available and did not nestle in the vegetation or they walked in the open ground. The perches were stable and at least 2cm in diameter; generally perching areas were bare sections of branches or nest platforms.....trees were pruned substantially to give an increased flight space, and additional horizontal perching was supplied in areas of heavy use. The birds’ use the total area increased and competition for perching space decreased. Following the modifications, we observed less aggressive activity, especially displacements, among breeding birds.....Previously a mated bird would perch on a nearby nest, whether unoccupied by a subordinate individuals were frequently disrupted. After the modification the non-incubating partner was able to perch on nearby branches without displacing other birds.”

Samayah (2009) reported that nesting success of the Scarlet Ibis in the Caroni Swamp, Trinidad, Trinidad and Tobago was dependent on the following:

1. distance to the fourth nearest neighbour nest,
2. distance of the nest to the water edge and
3. number of nests per tree.

The Eggs and Hatchlings

The female Ibis lays 2 or 3 dull green eggs streaked with brown. The eggs are incubated for 23 days and after 23 days of within the nest the young hatchling is able to leave the nest. The young are first featherless, and then the feathers became a dark brownish colour, which slowly changes to the red of their parents as they age. Tables 2.2.7 & 2.2.8 show the Growth & Development of the Scarlet Ibis, the changes in plumage & soft parts during development.

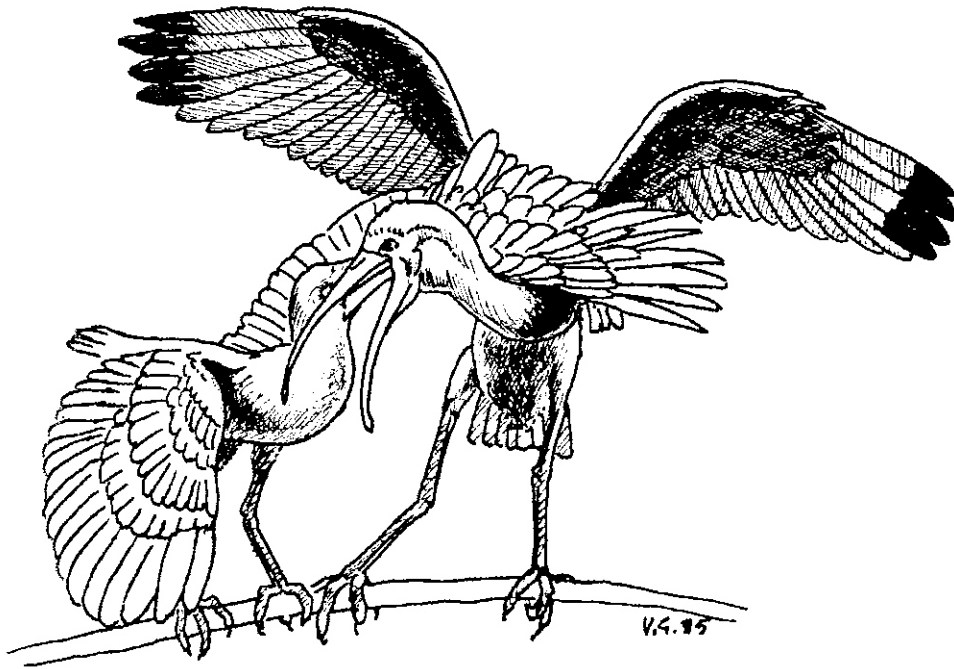


Figure 2.34: An Adult Scarlet Ibis feeding the fledgeling
[Source: Ramo and Buxo 1985]

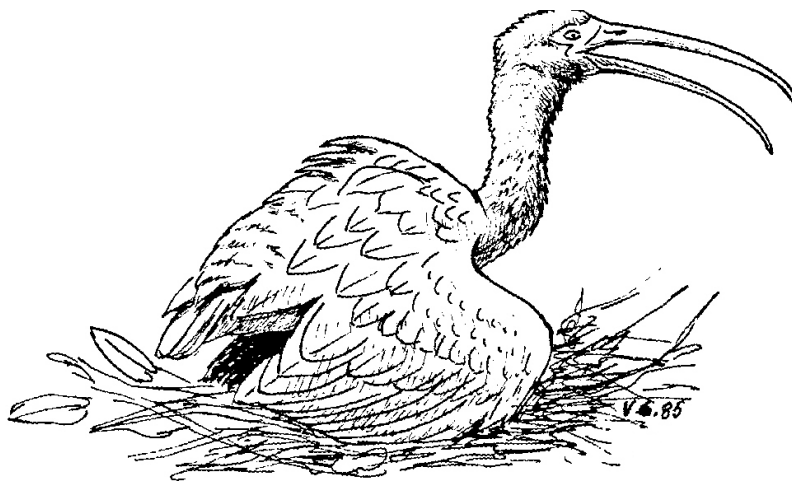


Figure 2.35: An Adult Scarlet Ibis shading the hatchling
[Source: Ramo and Buxo 1985]

Table 2.8: Growth and Development of the Scarlet Ibis in Trinidad

Age (days)	Weight (gms)	Wing (mm)†	Longest Primary (mm) ‡	Bill (mm)	Tarsus (mm)
Hatching	27	20	-	18	16
1	47	24	-	22	17
2	57	28	-	22	22
3	80	32	6	24	26
8	178	45	13	30	28
11	195	72	25	36	40
16	>300	120	55	49	56

NB † Wing measurement from carpal joint to wing tip.

‡ Primary measured from tip to point of insertion of quill in socket.

Weights and measurements represent means of seven birds.

Source: ffrench & Haverschmidt (1970)

Table 2.9: Changes in plumage and soft parts during development

Age (days)	Condition
Hatching	Eyes shut, bill orange with black tip, egg tooth present orbital area orange, legs flesh-pink, horny digital claws noticeable.
2	Eyes just opening, orbital area flesh-pink, tinged gray.
4	Eyes open, orbital area dull gray, legs dull pinkish gray, bill orange with black tip and other dark marks faintly showing.
8	Feather tracts visible.
11	Feathers sprouting on wings and body, head and neck downy, bill almost all dark with penultimate pink band.
16	Feathers all over, except head – still downy. Primaries and tail sprouting, rump whitish. Bill darker but still with faint pink patches. Horny digital claws present.
23	Feathers complete, both gray and white. Can flutter from branch to branch.
25 [approximately 4 weeks]	Could almost fly.

At the age of 2 years the Scarlet Ibis is considered an adult and by this time it has gained its brightened colour (ffrench & Haverschmidt, 1970).

2.2.3.2 Environmental and Ecological parameters of the Scarlet Ibis in the Llanos of Venezuela

Table 2.9 presents the sequence of activities for laying as affected by environmental factors.

Table 2.10: The ecological parameters of the Scarlet Ibis during breeding, breeding season, and non-breeding

ACTIVITY	ECOLOGICAL OR ENVIRONMENTAL CONSIDERATIONS
Breeding	
Proximate factor	Quickly rising water level, caused by rains
Foraging habitat	Both terrestrial and aquatic
Foraging behaviour	Pecking and probing
Breeding season	First 3 months of wet season
Breeding habitat	Primarily thorny shrubs standing in water
Non-breeding	
Seasonal movement	To lower areas of Llanos
Diet	Aquatic insects and possibly some fish species

Source: [Kushlan, 1986]

2.2.3.3 Development chronology of chicks (Scarlet Ibis- *Eudocimus ruber*)

1. The newly hatched semi-altricial chicks are brooded or watched over from a short distance (<1m) constantly by one parent for the first 8-12 days (eldest chick) or 5-9 days (youngest chicks, if present). During periods of heavy rain or fierce sunshine the attending adult protects the chick by standing over it with its own body [Figure 2.35].
2. The first few days when left alone by the parents the chicks keep very quiet and sit low in the nest. By the time the chicks are 12-13 days old they leave the nest to explore the surroundings. A few days later they spent most of their time in “chick-creches” in the top of the nesting shrubs. The chicks are also fed there.
3. At about 4 (four) weeks of age every spot in their own breeding shrubs is accessible to the chicks. By walking or flying short distances (1-3m) they reach their parents returning from foraging journeys in order to be fed. The adult stimulates this particular behaviour by moving away from the chicks once or twice during each feeding bout; this results in extensive locomotion by chicks.

4. A week later the chicks easily fly distances up to 10 m, occasionally leaving their nesting shrub. The first “pursuit-flight” (chick follows parent; terminology from Rudegeair, 1975) is seen 40 days after the first chick has hatched in the colony site from this period on. The chicks leave the colony at 9-10 weeks of age. What we could conclude from this is that “bird weaning” [a term adapted from mammalian weaning, or the period after which the hatchlings are no longer fed by the parents] takes place at about 2.5 months. This would be important information for attempting to develop the artificial feeding system for nestlings.

Sexual dimorphism in body size is apparent for both species with the adult males being larger than that of the female in every aspect [Rudegeair, 1975, Kushlan, 1977, Brouwer & van Wieringen, 1986].

2.2.3.4 Breeding in Captivity

The Scarlet Ibis was reported to be first bred in captivity at the Berlin Zoo in 1881 (Brouwer *et al* 1994). It has continued to be successfully bred in captivity in zoos and there is a “North American Stud Book” that is now kept. It has been breeding in captivity at the Bronx Zoo for over twenty years [Shepherd, personal communication]. In 1992 the population numbered 792 in North American zoos and the numbers was growing at a rate of 10% per annum (Elbin and Lyles, 1994). Good success with captive breeding have been reported at the Parque Mangal das Gracias, Belem, Estado do Para, Brazil (Seligmann *et al*, 2009). Practical features of their success will be included in the next part of this book.

Archibald *et al* (1980) reviewed the literature on Ibises and their reproduction in captivity. They indicated that within the sub-family Threskiornithidae (the Ibises and Spoonbills) there were **16 genera** and **26 species, but they suggested that this sub-family was also in need of revision**. This has been alluded to earlier in section 2.2.1.1 wherein it was suggested that the *E. ruber* and *E. albus* were the same species. Also quite interesting was the absence of information on five (5) of the (11) Neo-tropical Ibises. These five (5) were the **Puna Ibis** (*Plegadis ridgwayi*), **Green Ibis** (*Mesembrinibis cayennensis*), **Plumbous Ibis** (*Harpiprion caerulescens*), **Whispering Ibis** (*Phimosus infuscatus*) and **Sharp-tailed Ibis** (*Cercibis oxycerca*). All five species are found in Central and South America and none of the Neo-tropical Ibises are endangered. The six endangered Ibises are found in South East Asia and Africa.

The captive breeding of the six rear species began with the Waldrapp Ibis (*Geronticus eremite*) of North Africa and West Asia. It produced a clutch of 3-4 eggs, had an incubation period of 26-28 days, and has a fledge age of

35 to 42 days (5 to 6 weeks). This was successfully done at the Basle Zoo in 1957. Successful Ibis captive breeding has also been done in Tokyo (Ueno and Tama zoos), Germany (Vogelpark) and the USA (Bronx Zoo, Jersey Zoo and the National Zoo). In Tokyo extensive research was done on the captive reproduction of the White, Scarlet and Indian White Ibises. The experience gained was applied to the conservation of the Japanese Crested Ibis.

The main element of the captive breeding successes were:

1. the use of successful artificially formulated diets for both adults and hatchlings and
2. the use of incubators.

The descriptions of the diets used were described earlier.

Incubation of eggs

[I] At Vogelpark, Walsrode, Germany

Incubation Process

Type of Incubator:	Forced Air Incubator
Temperature:	37.5° C
Relative Humidity [RH]:	60%
Turning of eggs:	Egg Trays automatically rotated through 90° arc every 90 minutes

Hatching

Equipment:	Still Air machine
Temperature:	36.0° C
Relative Humidity [RH]:	90%
Hatching rate:	90%

The eggs are transferred to the Hatcher as soon as the chicks begin peeping and knocking.

Brooding

The newly hatched chick was placed in a small bowl lined with soft absorbent paper towels, which then remains in a modified hatching machine [brooder] at 34° C and 60% RH for a week.

Two to three chicks are placed together in a paper lined basket nest within a cardboard box with a heat lamp over the basket maintaining an ambient temperature at about 22.0° C. Each week the temperature over the basket is lowered by 2° C by raising the lamp.

The chicks within each group should be of a similar size to prevent trampling. At about 4 to 6 weeks they would begin to jump out of the box. They can now be moved to the company of larger brooding groups with animals of similar sizes.

[II] At the Tokyo Zoos, Japan

Incubation Process

Type of Incubator:	Still Air Incubator
Temperature:	38.5 to 39.0° C
Relative Humidity [RH]:	65%
Turning of eggs:	Egg were hand turned 180° three or four times per day

Hatching

Equipment:	Eggs hatched within the incubator
Temperature:	38.5 to 39.0° C
Relative Humidity [RH]:	65%
Hatching rate:	90%

Brooding

Animals were placed in a small towel lined shallow bowls for 2 weeks in a brooder. This is artificially illuminated and kept at 35°C and 90% RH.

2.2.3.5 Success with artificial rearing of the Scarlet Ibis

At Vogelpark

Their experience has been that the best time for the collection of the eggs was when most pairs were already incubating. The eggs can then be collected thereafter for about two (2) to three (3) intervals. This enables the pairs to nest 2 to 5 times per season. Two pairs of Scarlet Ibis fledged 20 young in three years [i.e. 6.6 fledglings per year]. In five (5) years six pairs of Scarlet Ibis fledged 106 young [3.5 fledglings per year].

At Tokyo Zoos

Similar successes were obtained as above.

2.2.3.6 Other Ibises Captive Reared

Archibald et al (1980) indicated that Ibises of different species living together stimulated breeding and nesting behaviour and there is the possibility of species interbreeding. At Walsrode, American White Ibis and Scarlet Ibis interbred. This is consistent with the reports for the Emperor Valley Zoo in Trinidad and Tobago and the reports of Ramo and Busto (1982, 1985 and 1987) in the Llanos in Venezuela. Devakar, Khanpara, Bhimani and Katara (2006) also reported breeding success of the Oriental White Ibis (*Threskiornis melanocephalus* Lathan) in captivity.

2.2.4 Conservation of the Scarlet Ibis in Trinidad

The Scarlet Ibis is a protected animal under the Wild Life Laws of Trinidad and Tobago [The Forests Act and the Conservation of Wild Life Act]. French (undated) summarized the history of the conservation initiatives for the Scarlet Ibis as follows:

*“After the Second World War....Trinidad and Tobago gained Independence in 1962. However, sometime before this the Forestry Division under the British Administration had secured two major victories for wildlife conservation. **First**, a sanctuary was set up in the Caroni Swamp during **1953** to protect the Scarlet Ibis and their breeding site, and wardens were appointed to patrol the area. Soon after this a comprehensive law dealing with conservation was prepared,.....in **1958**, the Wildlife Conservation Ordinance [Laws of Trinidad and Tobago- CONSERVATION OF WILD LIFE ACT CHAPTER 67:01, Act 16 of 1958] was passed,providing for Open and Closed Seasons for Hunting, various groups of animals and birds selected for hunting or protection at certain times of the year, the prescribing of certain methods of hunting, the establishment of Game Sanctuaries, bag-limits and the appointment of Honorary Game Wardens.....*

Dr Eric Williams’ administration did make some efforts towards promoting conservation....Thus National Birds were chosen- the Scarlet Ibis for Trinidad and the Cocrico for Tobago.....The Prime Minister also proclaimed that as “national symbols” they should be protected. Accordingly the Scarlet Ibis, which hitherto could be legally hunted from October to March, was from 1965 [commencement 15th March 1963 CONSERVATION OF WILD LIFE ACT CHAPTER 67:01, Act 49 of 1963] totally protected- but only in theory. No extra resources were available to help enforce this regulation, so poaching continued.

*...people began to ask for the establishment of National Parks....and the Report was submitted in about **1978**....*

After much agitation from local conservationists, the Trinidad and Tobago Government finally ...signed [the CITES agreement] in February 1984.....

It is perhaps not surprising that private efforts towards practical conservation have often borne more fruit than official ones. Local societies such as the Trinidad and Tobago Field Naturalist Club the Zoological Society.....The Asa Wright Nature Centre....Pointe-a Pierre Wildfowl Trust.....Eleanor Alefounder at Grafton Estate, Tobago.....give us all some hope for improvements in the future.....

The present law relating to wildlife conservation for the nation is the Conservation of Wild Life Act, Chapter 67:01 of 1980 [Act 31 of 1980] which replaced the 1958 Ordinance. The later Act mainly updated the earlier one in terminology and brought financial penalties into line with the considerable inflation during the 22 year interval. But there was practically no other positive improvement, so the conservationists were left wondering why the 1980 Act was ever brought in. Indeed, through an incredible but apparent oversight the latter law seemed to cancel the 1965 Amendment which guaranteed total protection for the Scarlet Ibis, and this anomaly took several years to put right. “

Anon (undated) [circa 1997] has suggested a proposal for a Freshwater Marsh Ecosystem in the Caroni Swamp with the objective being

“to ensure sustainability of the resident population of Scarlet Ibis in the Caroni Swamp and to maximize resource values”.

The above, it appears, arose out of the reports of Bacon, Bissessar and Cuffy (1997), Phelps (1997) and Ramnarine (1997) that formed part of an Inter American Development Bank study for the Caroni Swamp Rehabilitation.

2.2.5 The Wetland Policies of Trinidad and Tobago

More recently Anon (2002) outlined the National Policy and Programme on Wetland Conservation for Trinidad and Tobago. This was presented to the Cabinet of the Government of the Republic of Trinidad and Tobago in 1999 and was approved by Cabinet in July 2001 [Cabinet Minute No. 917, July 11, 2001]. This National Wetlands Policy provides a rational framework through which the wise use of our wetlands can be achieved. Chapter I of the document outlines the Rationale for the policy. Chapter II identifies and defines the Resource. Then Chapter III outlines the POLICIES and STRATEGIES.

The **WETLAND POLICIES for Trinidad and Tobago** will now be outlined.

1. The Government of Trinidad and Tobago will promote awareness and understanding of the wetland resources in Trinidad and Tobago and actively encourage participation of landowners, non-governmental organizations and institutions in wetland conservation.
2. The Government of Trinidad and Tobago, in keeping with the wise use principle as defined under the Convention on wetlands, will develop exemplary practices in support of wetland conservation and suitable wetland use when it designs and implements government programmes on publicly owned land and waters.
3. The Government of Trinidad and Tobago will preserve outstanding examples of all wetland types in Trinidad and Tobago by including them in a system of national parks and protected natural areas.
4. The Government of Trinidad and Tobago will be an active partner in cooperative activities which promote wetland conservation in Trinidad and Tobago and the Caribbean region.
5. The Government of Trinidad and Tobago will support and promote the development within Trinidad and Tobago of the scientific and technological expertise needed for wetland conservation and ensure that this expertise is accessible to planners, managers, regulators and other decision-makers.

The government of Trinidad and Tobago will identify weaknesses in the present institutional and organizational structures relevant to wetland conservation and will develop activities for their improvement.

2.2.6 Threats to the Scarlet Ibis in Trinidad and Tobago

The following are the threats to the Scarlet Ibis in Trinidad and Tobago:

- 1) habitat destruction
- 2) hunting
- 3) poaching
- 4) human disturbance of the nesting colonies
- 5) agriculture
- 6) industrial development and
- 7) pollution (Luthin 1985a).

Currently, the Scarlet Ibis has been under a conservation plan. This is being done through habitat management by maintaining and patrolling the swamp nesting sites. In this manner the authorities hope to keep the ibis population at a healthy level. However, there are constraints due to lack of funds and trained manpower. The water channels are maintained

by a labour gang to ensure free access to the swamp by patrol officials and tourist boats.

There are also educational programmes. These programmes have been primarily directed towards children, for instance, the “Bus Programme” travels to schools and shopping centres to inform the public of the value of swamps, mangroves, and the Scarlet Ibis. Often colouring books, cartoons and pamphlets are employed to appeal to children. Secondary school youngsters are brought to Swamps where they are guided on board walk tours where there are informative signs, bird guides and booklets.

2.2.7 Conservation initiatives Specific to the Scarlet Ibis in Trinidad & Tobago

There are three [3] main conservation initiatives with respect to the Scarlet Ibis in Trinidad & Tobago. These are (1) the Caroni Bird Sanctuary, (2) the Pointe a Pierre Wildfowl Trust and (3) the Emperor Valley Zoo.

(1) The Caroni Bird Sanctuary:

The first initiative has been maintained by the Wildlife Unit of the Forestry Division, formerly of the Ministry of Agriculture, Lands & Marine Resources, now under the Ministry of the Environment and Water Resources. The location of the Caroni Birds Sanctuary is presented in Figures 2.36 and 2.37.

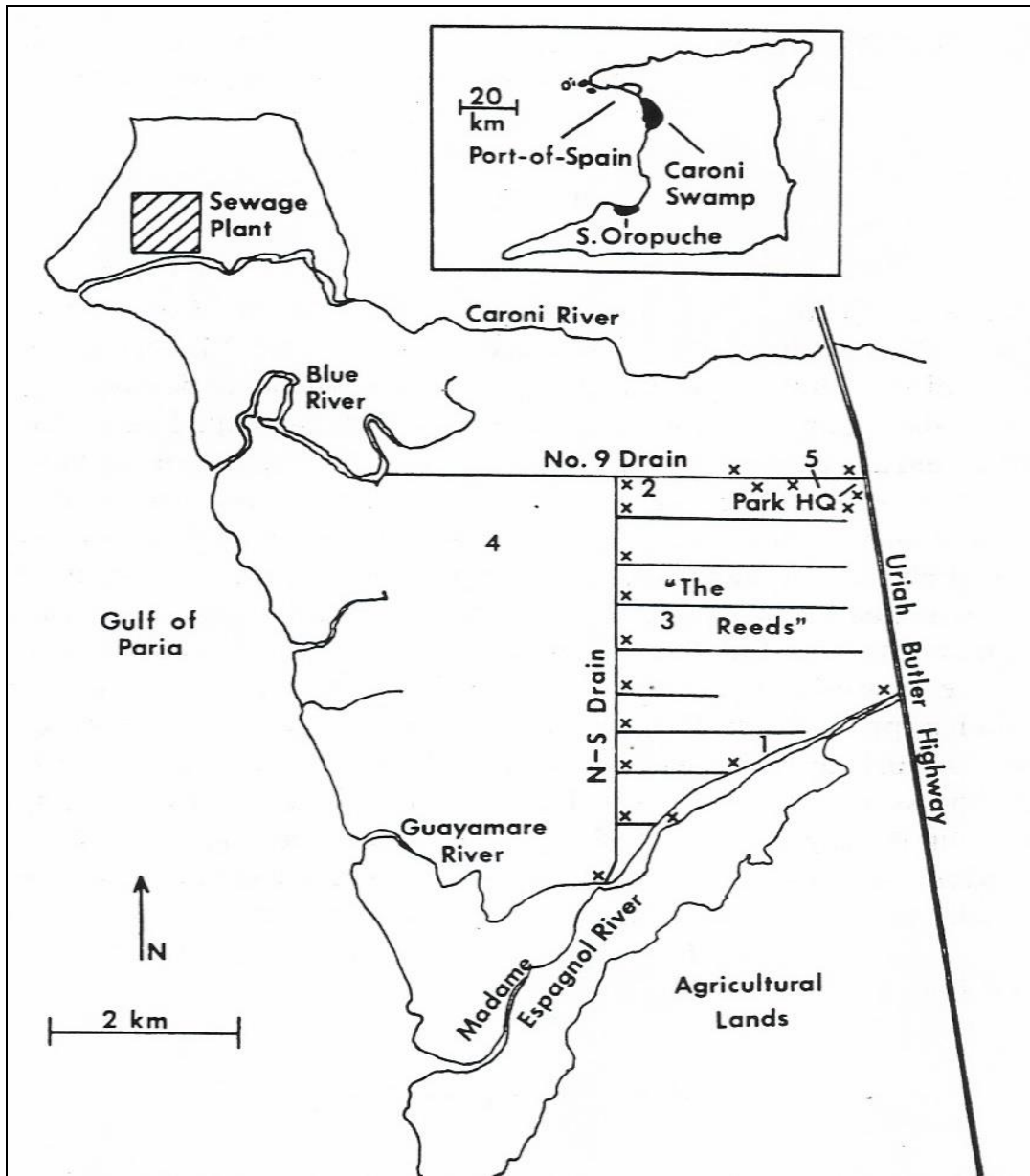


Figure 2.36: The Location of the Caroni Swamp.
[Source: Bildstein, 1990]

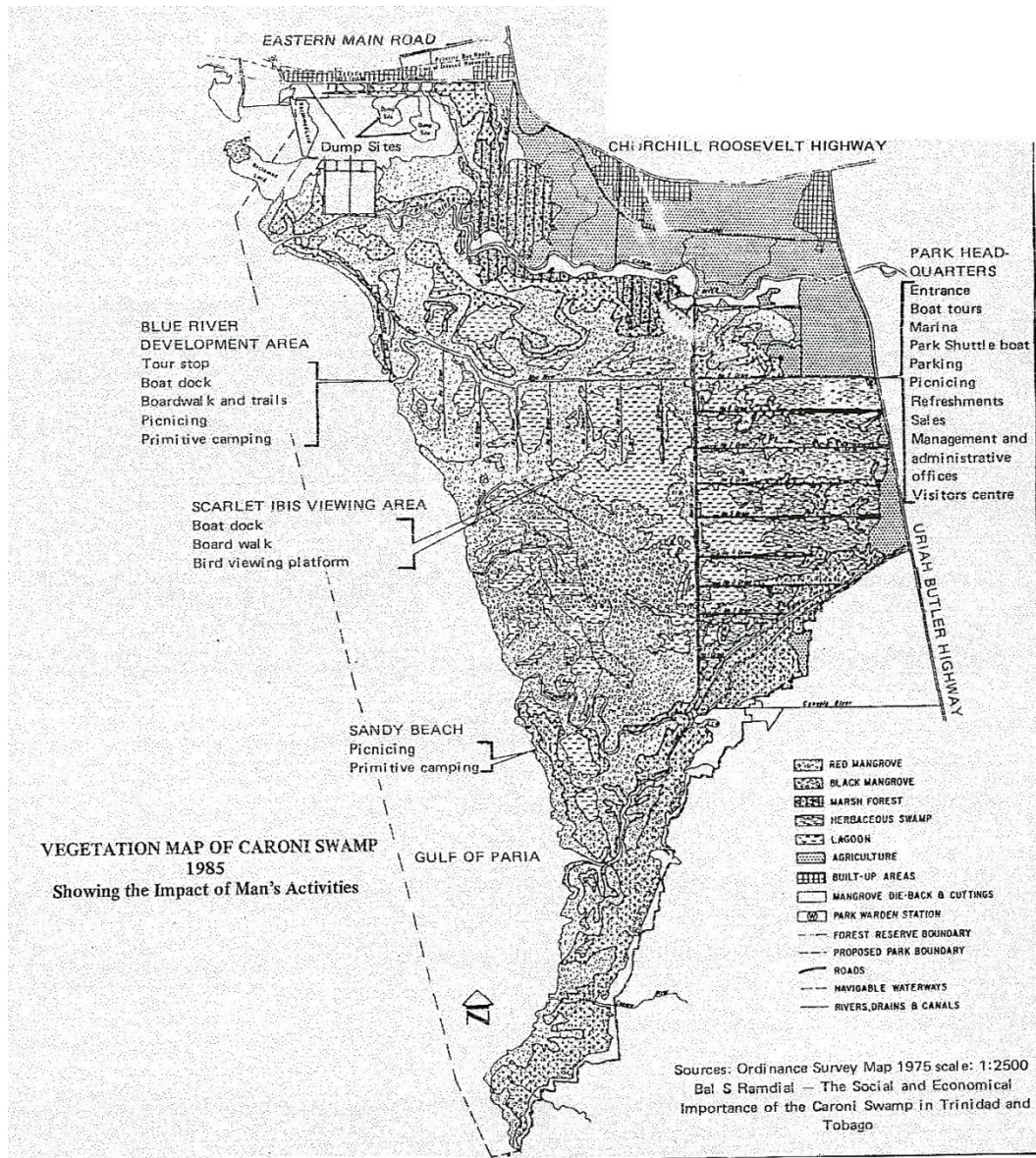


Figure 2.37: A detailed description of the Caroni Swamp.
[Source: Gerald (1985)]

Figures 2.38 to 2.43 present the entrance to the Caroni Bird Sanctuary and aspects of the Caroni Bird Sanctuary Visitors' Centre.



Figure 2.38: The Entrance to the Caroni Bird Sanctuary from the Highway

The Caroni Swamp has been historically a natural attraction, hunting and fishing location. Mr. Simon Nanan started guiding hunting and fishing expeditions into the Caroni Swamp in the early 1930s. In 1948 Mr. Nanan and about 200 of his hunting friends got the Government of the Crown Colony of Trinidad and Tobago to declare the Caroni Swamp a Bird Sanctuary with 136 hectares of Ibis nesting grounds designated as a “protected area” [Mangurian, 2002].

The Laws of Trinidad and Tobago CHAPTER 67:01 CONSERVATION OF WILD LIFE ACT [Act 16 of 1958 and Act 14 of 1963, 15th March 1963] declared the Caroni Swamp a Game Sanctuary.

Bildstein (1990) reported on the Status, Conservation, and Management of the Scarlet Ibis in the Caroni Swamp, Trinidad. He reported that these animals had not been breeding in the Caroni Swamp between 1970 and 1990 (i.e. for 20 years). This was around the same year that the interest in the Scarlet Ibis was stimulated at the Emperor Valley Zoo. However, six years later these animals were able to reproduce successfully in captivity at the Emperor Valley Zoo and since the middle of the 1990s the Scarlet Ibis began to return to the swamps to nest. Today there are about 2,500 birds nesting again.



Figure 2.39: The Boardwalk to the Caroni Bird Sanctuary

The Caroni Swamp's 5611 hectares is a mangrove dominated wetland and was declared a National Park in 1979. Figure 2.36 shows the location and layout of the Caroni Swamp. French (1978) indicated that at least 157 species of birds have been seen there and about one half of them have been seen nesting. Ramnarine (1997) reported that there were twenty four (24) species of fish, five (5) species of molluscs and several species of crustaceans [of which four (4) were of commercial importance].

Today the Wildlife Unit has established the Caroni Bird Sanctuary as one of the nine (9) National Parks of Trinidad & Tobago. It is managed as the Caroni Swamp Visitor Centre and Bird Sanctuary.



Figure 2.40: The Entrance to the Caroni Bird Sanctuary from the Highway



Figure 2.41: The Entrance to the Caroni Bird Sanctuary from the Highway

The logs of the visitors to the Bird Sanctuary over the two year period (2005 to 2006) are presented in the following tables.

Table 2.11: Monthly breakdown by type of visitors recorded at The Caroni Swamp (March 2005 – December 2005)

Year	Month	Swamp	Centre	Other	Total Visitors	Known Local Visitors	Known Foreign Visitors	Known Adults Visitors	Known Children Visitors
2005	Mar	2,169	1,388	204	3,761	502	1,667	3,112	445
	May	1,459	1,017	164	2,640	474	985	1,952	524
	June	1,322	919	144	2,385	525	797	1,606	635
	July	1,288	824	220	2,332	289	999	1,689	423
	Aug	1,882	1,087	270	3,239	988	894	2,168	801
	Sept	1,216	636	103	1,955	271	945	1,710	142
	Oct	611	559	122	1,292	136	475	1,006	164
	Nov	719	535	115	1,369	156	563	1,080	174
	Dec	432	373	46	851	20	412	775	30

Missing – April 2005

Table 2.12: Total Visitors Recorded at The Caroni Swamp by type of visitor (March 2005 – December 2005)

Year	Swamp	Centre	Others	Total Visitors	Known Local Visitors	Known Foreign Visitors	Known Adults Visitors	Known Children Visitors
2005	11,098	7,338	1,388	19,824	3,361	7,737	15,098	3,338

Table 2.13: Monthly breakdown by type of visitors recorded at The Caroni Swamp (January 2006 – December 2006)

Year	Month	Swamp	Centre	Others	Total Visitors	Known Local Visitors	Known Foreign Visitors	Known Adults Visitors	Known Children Visitors
2006	Jan	1,099	528	104	1,731	255	844	1,455	172
	Feb	1,132	493	78	1,703	107	1,025	1,505	120
	Mar	706	252	55	1,013	318	388	795	163
	Apr	2,105	982	269	3,356	590	1,515	2,648	439
	May	1,625	880	176	2,681	741	884	2,073	432
	Jun	670	477	106	1,253	199	471	1,026	121
	Jul	626	651	80	1,357	217	409	1,130	147
	Aug	1,134	610	206	1,950	305	829	1,330	414
	Sept	713	443	93	1,249	212	501	1,019	137
	Oct	424	462	76	962	53	371	705	181
	Nov	1,460	961	136	2,557	318	1,142	2,293	128
	Dec	1,355	504	150	2,009	15	1,340	1,777	82

Table 2.14: Total Visitors by category recorded at The Caroni Swamp for 2006

Year	Swamp	Centre	Others	Total Visitors	Known Local Visitors	Known Foreign Visitors	Known Adults Visitors	Known Children Visitors
2006	13,049	7,243	1,529	21,821	3,330	9,719	17,756	2,536



Figure 2.42: A Sign at the Visitor Centre Caroni Bird Sanctuary



Figure 2.43: The Entrance to the Visitor Centre Caroni Bird Sanctuary

The workers at the Visitors' Centre and the Sanctuary have indicated the following concerns:

1. that enough was not known about **the biology of the Scarlet Ibis and the other Birds and animals at the Sanctuary,**
2. that often **visitors to the sanctuary were disappointed when they did not see the Scarlet Ibis** and other residents of the Sanctuary and
3. that they did **not have sufficient literature and information** for the visitors.

Some of their suggestions:

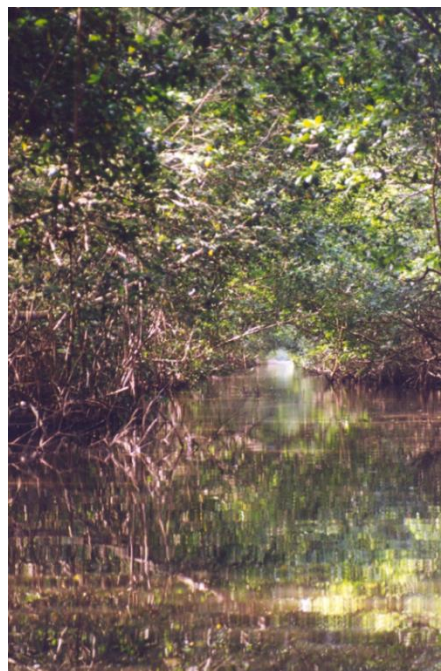
1. Establish **a large breeding Aviary** to develop a large colony of Scarlet Ibis and other swamp avifauna.
2. Use 1] above **for exhibit display and public information.**
3. Prepare for **release into the natural habitat** captive reared animals.

Their suggestions are in keeping with the Government's Wetland Policy of 2002.

Figures 2.44 to 2.55 will take you on a tour of the Caroni Bird Sanctuary. We do hope that you enjoy it.



**Figure 2.44: Along the waterway of the Caroni Bird Sanctuary
[Taken by Dave Samayah]**



**Figure 2.45: Along the waterway of the Caroni Bird Sanctuary
[Taken by Dave Samayah]**



**Figure 2.46: Along the waterway of the Caroni Bird Sanctuary
[Taken by Dave Samayah]**



**Figure 2.47: Along the waterway of the Caroni Bird Sanctuary
[Taken by Dave Samayah]**



Figure 2.48: The Nesting Sites of the Scarlet Ibis within the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.49: The Scarlet Ibis Nesting on the Mangrove in the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.50: A Scarlet Ibis Nest four feet off the ground within the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2. 51: The Scarlet Ibis eggs within a nest at the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.52: The Scarlet Ibis Hatchlings within the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.53: The Scarlet Ibis hatchlings within the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.54: Hundreds of Perched Scarlet Ibis within the Caroni Bird Sanctuary
[Taken by Dave Samayah]



Figure 2.55: The Scarlet Ibis in full flight within the Caroni Bird Sanctuary
[Taken by Dave Samayah]

(2) The Pointe-a-Pierre Wildfowl Trust:

The **Pointe-a-Pierre Wildfowl Trust** was founded in 1966 by Richard Deane with support from Sir Peter Scott of the **Wildfowl and Wetlands Trust UK**. It is made up of two lakes and occupies an area of 26 ha. On July 11th 1991 the Scarlet Ibis nested and bred for the first time in captivity at this location (Gaskin and Shephard, 1992).

(3) The Emperor Valley Zoo:

In 1990, the Scarlet Ibis was introduced into the Emperor Valley Zoo system primarily for viewing. At that time three (3) adult birds were introduced. Later, in 1995, the Pointe-a-Pierre Wild Fowl Trust donated two (2) adult Scarlet Ibis and two (2) White Ibis (*E. albus*). All of these animals (2 ♂ and 1 ♀ Scarlet Ibis and 1 ♂/1 ♀ White Ibis) were kept on display; and in June 2001 (after six years in captivity) the Scarlet Ibis began showing signs of mating. Successful hatchlings were obtained in September 2001, January 2002, and again later in 2002. This success with the breeding of the Scarlet Ibis in captivity at the Emperor Valley Zoo has continued up to the time of the beginning of the writing of this book in 2007. Success with the breeding of the Scarlet Ibis in captivity was also obtained at the Pointe-a-Pierre Wildfowl Trust.

2.2.8 The Future of the Scarlet Ibis in Trinidad and Tobago

“If the conditions of 1953 (i.e. restricted access to the sanctuary, careful guarding and a ban on hunting) were re-established, there is no doubt in my mind that the Ibis would resume breeding in the Caroni...” (ffrench 1966).

Herein lies the ***“problematique avec les animaux sauvage neo-tropicaux”***. Someday, in this Neo-tropical Small Island State, the swamps will have to be drained for roads, for housing and for human population expansion. There will be ***“inevitable habitat destruction”***.

The first author of this book, Gary Garcia, remembers in 1964 that as a ten-year-old-boy being awestruck while journeying on the newly-opened Beetham Highway on a Friday at five o'clock in the afternoon -- awestruck at the wonder of seeing the birds nesting on the trees at the side of the road. The red birds perched on and completely covering the green branches were a spectacular and most memorable sight. This was a regular Friday afternoon trip for that ten-year-old boy travelling to San Juan in a Volkswagen with “Uncle Donald”, and how pleasant and exciting was the anticipation of that spectacle.

The Caroni Swamp today does not come close to that spectacle. That former nesting site on the Beetham Highway gradually gave way to industrial use and is the same area that smells today like an open cesspool - an area that has been transformed in forty eight [48] years from an **ecstatic visual delight** (of the early sixties) to an **offensive attack on the human sense of smell with no longer visual enjoyment** (in the 1990s and 2000s). With all due respect to the noble and honourable contributions of Mr French towards Trinidad and Tobago Avian Wildlife Conservation and Appreciation, one must say that one has to be **“realistic”** and not **“pessimistic”**.



Figure 2.56: View of some of the Scarlet Ibis Nesting Sites that are being destroyed at the edge of the Caroni Swamp

2.2.9 Conclusions

The following are the Conclusions from the literature reviewed on the Scarlet Ibis.

1. The White Ibis and the Scarlet Ibis are one and the same species.
2. The Scarlet Ibis has been successfully reared and bred in captivity for over 120 years.
3. There is still a dearth of knowledge on the anatomy and physiology of these animals.
4. An understanding of the nutrition of the Scarlet Ibis in captivity is still in its infancy.
5. The Scarlet Ibis was successfully breeding in the Caroni Swamp in 2008 with a breeding population of about 3000 animals containing about 500 breeding pairs.
6. Conservation of the Scarlet Ibis in Trinidad must involve *In situ* and *Ex situ* initiatives.

2.2.10 Recommendations for Future Research

The following is the list of recommendations for future research.

- (1) Survey the diseases of the wild migratory avian populations.
- (2) Research the Digestive and Reproductive system of the Scarlet Ibis.
- (3) Investigate the physiology of laying by this bird.
- (4) Conduct Ecological research concerning the birds' needs in order to protect the bird in the future.
- (5) Conduct investigations to understand the impact of the water flow alteration at Caroni Swamp.
- (6) Investigate the effect of the salt-water invasion into the fresh water herbaceous swamp.
- (7) Monitor the movement of bird population between Trinidad, Venezuela and the Guyanas.
- (8) Investigate the effect of Government's enforcement of the wildlife legislation on the conservation of the Scarlet Ibis and other environmentally sensitive species.
- (9) Use identification marks to monitor the movement, health, size, sex, age and behaviour of composition of a population and to examine recruitment and movement of breeding individuals.

2.2.10 References and Literature Consulted

- Archibald, G.W., Lantis, S. D. H., Lantis, L. R., and Munetchika, I. (1980): Endangered ibises Threskiornithinae :their future in the wild and in captivity. *International Zoo Yearbook*, **20**:6-17
- Anon (undated): Proposal for a Freshwater Marsh Ecosystem in the Caroni Swamp
- Anon (2002):National Policy and Programmes on Wetland Conservation for Trinidad and Tobago. National Wetlands Committee, Forestry Division, Long Circular Road, St James
- Bacon, P.R. (1970a): *The Ecology of the Caroni Swamp, Trinidad: with special reference to the plankton and cirripedes*. Ph.D. Thesis, UWI
- Bacon, P.R. (1970b): *The Ecology of the Caroni Swamp, Trinidad*, Central Statistical Office Printing Unit, Port of Spain, Trinidad
- Bacon, P.R. (1990): Field guide to the caroni Swamp-Trinidad. Prepared for the fifth Meeting of Carriibbean Foresters, POS, Trinidad and Tobago, 21-25 March 1990, UWI, Mona
- Bacon, P.R., Bissessar, V. and Cuffy, G. (1997): Study of the feasibility of Marsh Restoration in Caroni Swamp, Trinidad. Final Report on Wetland Ecology, UWI-Zoology/IDB Project July 1997
- Belcher, C. and Smooker, G. D. (1934): Birds of the Colony of Trinidad and Tobago. *Ibis*, 1934: 572-595
- Bildstein. K.L. (1990): Status, Conservation and management of the Scarlet Ibis *Eudocimus ruber* in the Caroni Swamp, Trinidad, West Indies. *Biological Conservation*, **54**: 61-78
- Bildstein. K.L. (1993): *White Ibis, Wetland Wanderer*. Smithsonian Institution Press, Washington and London
- Brouwer, K., Schifter, H. and Jones, M. L. (1994): Longevity and Breeding records of Ibises and Spoonbills (Threskiornithidae) in captivity. *International Zoo Yearbook*, **33**: 94-102
- Brouwer, K and Van Wieringen, M (1990): Bibliography of the Genus *Eudocimus* In *The Scarlet Ibis (Eudocimus ruber): Status, Conservation and Recent Research*. Proceedings of the First International Scarlet Ibis Workshop, 4-6 March 1988, Caracas, Venezuela, IWRB Special Publication No 11 Slimbridge, United Kingdom : International Waterfowl and Wetlands Research Bureau (IWRB). P.C. Frederick, L.G. Morales, A. L. Spaans, and C. S. Luthin (Editors) pp 157-189
- Brouwer, K and Van Wieringen, M (1990): De Rode Ibis. Een onderzoek naar de ethlogie en ecologie Van de Rode Ibis *Eudocimus ruber* in net wild. Postgraduate Essay, University of Amsterdam
- Brown-Uddenberg, R. C.; Garcia, G.W; Baptiste, Q. S.; Adogwa, A. O.; Counand, T. and Sampson, T. (2004): *The Agouti Booklet and Producers' Manual, Wildlife Farmers' and Producers' Booklet #1*, The Open Tropical Forage-Animal Production Laboratory [OTF-

- APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago ISBN#: 976-95123-0-3
- Bonyun, W. (2007): Personal Communication, Zookeeper 1, Emperor Valley Zoo, Port of Spain, Trinidad, Trinidad and Tobago.
- Burger, J. (1996): Advantages and disadvantages of nesting in colonies. *AAZPA Reg. Conf. Prog.*, 1992 :818-819
- Burger, J. and Gochfeld, M. (1990): The Black Skimmer : Social Dynamics of colonial species. *International Zoo Yearbook* (1994) **33**:85-94
- Coe, J. C. (1980): The waterfowl exhibit at Woodland Park Zoo, Seattle. *International Zoo Yearbook*, **20**:282-286
- del Hoyo, J., Elliott, A. and Sargatal, J (1992): *Handbook of the Birds of the World Vol 1 Ostrich and Ducks*, Lynx edicions, Barcelona, Spain, 696 pages
- Devakar, R. V., Khanpara, P. S., Bhimani, S. H. and Katara, R. D. (2006): Breeding success of Oriental White Ibis (*Threskiornis melanocephalus* Lathan) in captivity. *Current Science*, **90** (1):28-31
- Elbin, S. B. and Lyles, A. M. (1994): Managing colonial waterbirds: the Scarlet Ibis (*Eudocimus ruber*) as a model species. *Internatinal Zoo Yearbook*, **33**:85-94
- ffrench, R. P. (1966): The Scarlet Ibis. *J. Bio. Soc.UWI* **1**:30-36
- ffrench, R. P. and Haverschmidt, F. (1970): The Scarlet Ibis in Suriname and Trinidad. *The Living Bird* **9**:147-165
- ffrench, R. (1978): Birds of the Caroni Swamp and Marshes. *Living World* [J. of the Field Naturalist Club of Trinidad and Tobago] 1977:42-44
- ffrench, R. P.(1984): The Scarlet Ibis in Trinidad. Unpublished Report, Wildlife Section, Forestry Division, Ministry of Agriculture, Trinidad and Tobago, UN-FAO, Port of Spain
- ffrench, R. (1985): A new look a our Scarlet Ibis. *Trinidad Naturalist* **6**(5):30-34,55,59
- ffrench, R. P.(undated): Threatened birds of Trinidad and Tobago. Unpublished Report, Wildlife Section, Forestry Division, Ministry of Agriculture, Trinidad and Tobago
- Frederick, P. C., Morales, L. G., Spaans, A. L. and Luthin, C. S. (Editors) (1990): *The Scarlet Ibis (Eudocimus ruber) : Status, Conservation and Recent Research*.Proceedings of the First International Scarlet Ibis Workshop, 4-6 March 1988, Caracas, Venezuela, IWRB Special Publication No 11 Slimbridge, United Kingdom : International Waterfowl and Wetlands Research Bureau (IWRB)
- Garcia, G.W (1998): Intensification of Animal Production Systems for Improved Wildlife Conservation, Proceedings of UWI, Ag.50 Conference, August 1998, Faculty of Agriculture and Natural Sciences, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., Volume 3: 91-101

- Garcia, G.W. and Archibald, K.A.E. (2001): The Philosophy of the Open School of Tropical Animal Science and Production. *Proceedings of the Caribbean Food Crops Society 37th Annual Meeting Volume XXXVII*: 20-27
- Garcia, G. W., Young, G.G., Amour, K. M., James, D., Lallo, C. H. O., Mollineau, M., Roopchand, A., Spencer, M., Prosper, M. A., Ganessingh, N., Rooplal, R., Gayan, N., Steil, A., Xande, A., Bemelmans, A., Norgueira Filho, S. G., Guimaraes, D., Gálvez, H., and Mayor Aparicio, P. (2005): *The Collared Peccary/ Pakira/ Javelina/ Catto/ Catete/ Porco de Monte/ Taitetu/ Sajino/ Quenk [Pecari tajacu, Tayassu tajacu] Booklet & Producers' Manual, Wildlife Farmers' and Producers' Booklet #2*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago ISBN 976-95123-1-1
- Gaskin, M.R. and Shephard, ? [1992]: *A Collection of Occasional Papers-Pointe-a-Pierre Wildfowl Trust*, Pointe-a-Pierre Wildfowl Trust, Trinidad, Trinidad and Tobago.
- Gerald, L. (1985): The Changing Caroni Swamp 1922-1985. *Trinidad Naturalist* 6(5):14-17
- Hansen, E. and Richard-Hansen, C (2000): *Faune de Guyane, Guide des principales especes soumises a reglementation*. Office Nationale de la Chasser, Paris, France. 152 pages
- [Http://www.news.carib-link.net/%7Ewildfowl/ibis.htm](http://www.news.carib-link.net/%7Ewildfowl/ibis.htm)
- <http://www.interlog.com/%7Ebarrow/ibis.html>
- http://www1.nhl.nl/-ribot/english/euro_ng.htm
- <http://www.whozoo.org/Intro98/tonytown/tontow2.htm>
- Hilty, S. L. (2003): *Birds of Venezuela*. Second Edition, Princeton University Press. N.J., USA
- Hislop, G. and James, C. (1990): Status and Conservation of the Scarlet Ibis (*Eudocimus ruber*) in Trinidad and Tobago. In *The Scarlet Ibis (Eudocimus ruber): Status, Conservation and Recent Research*. Proceedings of the First International Scarlet Ibis Workshop, 4-6 March 1988, Caracas, Venezuela, IWRB Special Publication No 11 Slimbridge, United Kingdom : International Waterfowl and Wetlands Research Bureau [IWRB]. P.C. Frederick, L.G. Morales, A. L. Spaans, and C. S. Luthin (Editors) Pp 115- 123

- James, C. (1990): Caroni Swamp Trinidad: A guide to the World Famous home of the Scarlet Ibis. Forestry division, Ministry of the Environment and National Service
- Johann, A (1991): Grossvolieren und Tropenhallen :Einige Bemerkungen uber begehbare Volieren. Z. Koln. Zoo **34**:105-115. Manuscript 1993. *International Zoo Yearbook* (1994) Vol **33**:119-124
- Kalicharan, S. and Leed, R. (2003): The Scarlet Ibis in Captivity. Unpublished, Research Project, AGLS6502 Tropical Zoo and Wildlife Production and Management, UWI, April 4th 2003.
- Kenny, J. S. and Bacon, P. R. (1981): Aquatic Resources. In *The Natural Resources of Trinidad and Tobago*, Editors: St George Cooper and P.R. Bacon. Edward Arnold, London, pp 112-144
- King, A. S. and Mc Lelland (1994): *Birds- Their Structure and Function* Bailliere Tindall, UK
- Kushlan, J. A. (1977): Sexual dimorphism in the White Ibis. *Wilson Bulletin* **89**:92-98
- Kushlan, J. A. (1986): Responses of wading birds to seasonally fluctuating water levels. Strategies and their limits. *Colonial Waterbirds* **9**:155-162
- Lowe-Mc Connell, R. (1975): *Fish communities in tropical fresh waters*. Longman, New York
- Luthin, C. (1985a): The bird that is being loved to death. *Trinidad Naturalist* **6** (5):18-21
- Luthin, C. (1985b): Suffering Scarlet. *Trinidad Naturalist* **6** (5):23-27
- Lyles, A. M. (1991): North American Regional studbook of The Scarlet Ibis (*Eudocimus ruber*) No 1. *International Zoo Yearbook* [1994] **33**:94-102.
- Mangurian, D. (2002): The Flaming Tres of Trinidad. *IDB America*. January 2002.
www.iadb.org/IDBAMERICA/English/JAN02E/jan02e3.html
- Marion, W.R. and Shamis, J.D. (1977): An annotated bibliography of bird marking techniques. Bird-Banding. *International Zoo Yearbook* **33**:148-156
- Mayer de Schaunensee, R. (1970): *A Guide to the birds of South America*, Oliver and Boyd, Edinburgh, Scotland, UK.
- Negro, J.J., Tella, J.L., Blanco, G., Forero, M. G. and Garrido-Fernandez, ?? (2000): Diet Explains Interpopulation Variation of Plasma Carotenoids and Skin Pigmentation in Nesting White Stork. *Physiological and Biochemical Zoology* **73**:97-101 (Abstract)
- Ojewola, G. G. and Udom, S. F. (2005): Chemical Evaluation of the Nutrient Composition of some Unconventional Animal Protein Sources. *International Journal of Poultry Science* **4** (10):745-747

- Olson, V. A and Owens, I. P. F. (2005): Interspecific variation in the use of carotenoid-based colouration in birds: diet, life history and phylogeny. *Journal of Evolutionary Biology* **18** (6):1534-1546
- Phelps, H. O. (1997): Caroni Swamp Rehabilitation Study : Hydrology and Engineering. Inter American Development Bank Report, July 1997.
- Ramdial, B. S. (1980): The Social and Economic Importance of the Caroni Mangrove Swamp Forests. Forestry Division, Port of Spain, Trinidad.
- Ramnarine, I. W. (1997): Report on Fisheries Ecology of the Caroni Swamp. Inter American Development Bank Study
- Ramo, C. and Busto, B. (1982): ¿ Son *Eudocimus ruber* y *E. albus* DISTINTAS ESPECIES? *Donana, Acta Vertebrata* **9**, 404-408
- Ramo, C. and Busto, B. (1985): Comportamiento Reproductivo del Corocoro (*Eudocimus ruber*) en los Llanos De Venezuela, *Mem. Soc. Cienc. Nat. La Salle* Tomo **XLV** No. 123:77-113
- Ramo, C. and Busto, B. (1987): Hybridization between the Scarlet Ibis [*Eudocimus ruber*] and the White Ibis [*Eudocimus albus*] in Venezuela. *Colonial Waterbirds* **10**(1):111-114
- Roberts, H. R. (1934): List of Trinidad Birds with field notes. *Tropical Agriculture* **11**(4): 87-99
- Rooks, D. (1985): The Last days of the Scarlet Ibis. *Trinidad Naturalist* **6** (5):64-68
- Rudegair, T. (1975):The gular pouch of the female White Ibis. *Auk* **92**:168-169
- Samayah, D. (2009): *Nesting dynamics of the Scarlet Ibis (Eudocimus ruber) in Trinidad, West Indies and the effects of human disturbance on colonial waterbirds*. Thesis Master of Science in Forestry, Faculty of Forestry and the Environment, Lakehead University, 79 pages
- Salzert, W. and Johann, A. (1994): The Wetland Aviary at Rheine Zoo. *International Zoo Yearbook* **33**:119-124
- Schlawe, L. (1969): ----- *International Zoo Yearbook* **33**:94-102.
- Seligmann, I. C., Martins-Gabriel, Á., Mika Ester, A, Andreza da Costa, F.,Rafael dos Santos, A. (2009): Methodo para reprodução de Guarãs (*Eudocimus ruber*) em cativeiro desenvolvido no Parque Mangal das Graças, Belém-Pa. In: XXXIII Congresso da Sociedade de Zoológicos do Brasil, 2009, Bauru. Anais do XXXIII Congresso da Sociedade de Zoológicos do Brasil, 2009
- Slifka, K.A., Bowen, P.E., Stacewicz-Sapuntzakis, M. and Crissey, S. D. (1999): A survey of Serum and Dietary Carotenoids in Captive Wild Animals. *The Journal of Nutrition* 1999: 380-390
- Spaans, A. L. (1975): On the present breeding status of the Scarlet Ibis (*Eudocimus ruber*) along the north-eastern coast of South America. *Biological Conservation* **7**:245-253

Tella, J.L. ; Figuerola, J., Negro, J., Blanco, G., Rodriguez-Estrella, R., Forero, M.G., Blazquez, M. C., Green, A.J. and Hiraldo, F. (2004) : Ecological, morphological and phylogenetic correlates of interspecific variation in plasma carotenoid concentration in birds. *Journal of Evolutionary Biology*. **17** (1) 156-164

Anon [1989] : Top.....

Van Wieringen, M. and Brouwer, K. (1990): Morphology and ecology of Scarlet Ibis (*Eudocimus ruber*) and White Ibis (*E. albus*): A comparative review. In *The Scarlet Ibis (Eudocimus ruber): Status, Conservation and Recent Research*. Proceedings of the First International Scarlet Ibis Workshop, 4-6 March 1988, Caracas, Venezuela, IWRB Special Publication No 11 Slimbridge, United Kingdom : International Waterfowl and Wetlands Research Bureau (IWRB). P.C. Frederick, L.G. Morales, A. L. Spaans, and C. S. Luthin (Editors) pp 7-15

Wittenberger, J. F. and Hunt, G. L. Jr. (1985): The adaptive significance of coloniality in birds. In *Avian Biology*, D.S. Farmer and K.C. Parkes (Editors), New York, Academic Press.

.....International Zoo Yearbook (1994] **33**:85-94

Woodcock, H. I. (1866): *A History of Tobago*. Reprinted by Syncreators (1976) Ltd., Colombus Publishers Ltd. Trinidad, Trinidad and Tobago, 192 pages

Wray, R.S. (1887): Some points on the morphology of the wings of birds. *Proceedings of the London Zoological Society*, 343-357

Part 2.3

Production Model and Manual for Scarlet Ibis Production



Figure 2.57: The Scarlet Ibis within the large aviary at the Emperor Valley Zoo

2.3 A CONCEPTUALIZED PRODUCTION MODEL FOR SUSTAINABLE SCARLET IBIS (*E. ruber*) PRODUCTION AND CONSERVATION

2.3.1 Background

The information gathered to develop this production model came from different sources: articles were from scientific journals, magazines, and the internet. Discussions were also held with the Wildlife Personnel at the Wildlife Unit-Forestry Division and the Caroni Bird Sanctuary in Trinidad, with Zoo Keepers at the Emperor Valley Zoo, Port of Spain, Trinidad, and personnel at the Bronx Zoo as far back as 1996 [Dr Christene Shepherd]. A visit was also paid to the Parque Mangal das Garças Passagem Carneiro da Rocha - Cidade Velha CEP 66020-160 Belém, Para, Brazil.

It was discovered that Scarlet Ibises have been breeding in captivity at the Bronx Zoo, New York for the past three decades, [Christine Shepperd Personal communication] and at European Zoos since the 19th Century. With this information a simulated production model is being suggested herein using the production modelling framework as suggested by Garcia and Archibald (2001) and contained in Brown-Uddenberg et al (2004) and Garcia et al (2005). Brown-Uddenberg et al (2004) could be downloaded from the website of **“The Open School of Tropical Animal Science and Production”**.

2.3.2 Objectives of the Scarlet and White Ibis Production Model

In order for any species of animal to be successfully produced in captivity or as a pre-condition for domestication we must be able to do the following with the animal:

- get the animal to eat and grow in captivity
- get the animal to be able to successfully reproduce and increase their population in captivity and
- house them in captivity in such a manner that they would not injure themselves, other animals and humans, and in addition we must be able to manipulate the animal in any way that we want to ensure the well being of the animals.

The objectives therefore of this production model are as follows:

1. to rear and breed Scarlet Ibis and White Ibis successfully and in a predictable manner in captivity,
2. to use this model in experimental research to increase the clutch size or the number of eggs laid by this bird within a nesting season and
3. to develop and implement a release programme for repopulating the wild.

2.3.3 Rationale for the development of an Intensive Production Model for the Scarlet Ibis

The Scarlet Ibis is listed in the 2006 IUCN Red List of Threatened Species as a species of low concern for extinction. The IUCN is **The International Union for the Conservation of Nature and Natural Resources**. Use of the name **“World Conservation Union”** began in 1990, but the full name and the acronym are often used together as many people still know the Union as IUCN. The World Conservation Union was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France. The organization changed its name to the International Union for Conservation of Nature and Natural Resources in 1956.

Although the Scarlet Ibis is not globally threatened it is vulnerable in Trinidad. The pressures they face are as a result of human development and infringement of their natural habitats. Two examples are drainage systems constructed for agriculture in the Caroni swamp and the fragmentation of their habitats by the Uria Butler Highway.

The problems stemming from human impact may not be solved solely by increasing the numbers of the birds in the wild. Captive bred animals however, can assist in *in situ* conservation work to a limited extent. This can be done by developing practical techniques that could be used in relocating the birds to other areas within the country that may not be as significantly influenced by humans. The programme can also assist in the management of endangered species with the same ecological requirements. The captive breeding project would also allow for research to be conducted on the Scarlet Ibis which would be difficult to do in the field.

The Main Challenge

The anatomy and functional physiology of the digestive and reproductive systems of the Scarlet and White Ibis and many other Neo-tropical birds are not yet fully understood. The main challenges in getting this production model to be fully productive are:

1. the need to first explore the possibilities of these animals being able to lay more than two to three eggs per clutch during the breeding season so that the productivity of these birds could be increased and
2. the need to develop artificial feeding techniques for the nestlings: the approach could be similar to what has been done with the artificial feeding of newborn lambs, kids, calves, and pups [i.e. the common domestic mammalian species of animals].

Systems of newborn nutrition management for domestic animals have been developed over the last 200 years at the formal Agricultural Educational Institutions and Universities in Scotland, England, France, Germany, Russia and the USA. Therefore there should be no reason why we cannot develop similar approaches for the handling of neo-tropical birds.

We hope that the production framework proposed in this booklet can stimulate the public's interest and generate the support needed for us to Conserve, Manage, Produce and Utilize our Neo-tropical Animals. This will create the foundation for the synergy referred to as Neo-tropical Animal Conservation, Production, Management and Utilization. This is particularly appealing since the Scarlet Ibis is one of [if not the most splendid of] the national birds of Trinidad and Tobago. We are also blessed to be well supplied with a wide variety of birds.

2.3.4 Life Cycle of the Scarlet Ibis

The life Cycle of the Scarlet Ibis and the White Ibis is outlined in Figure 2.58.

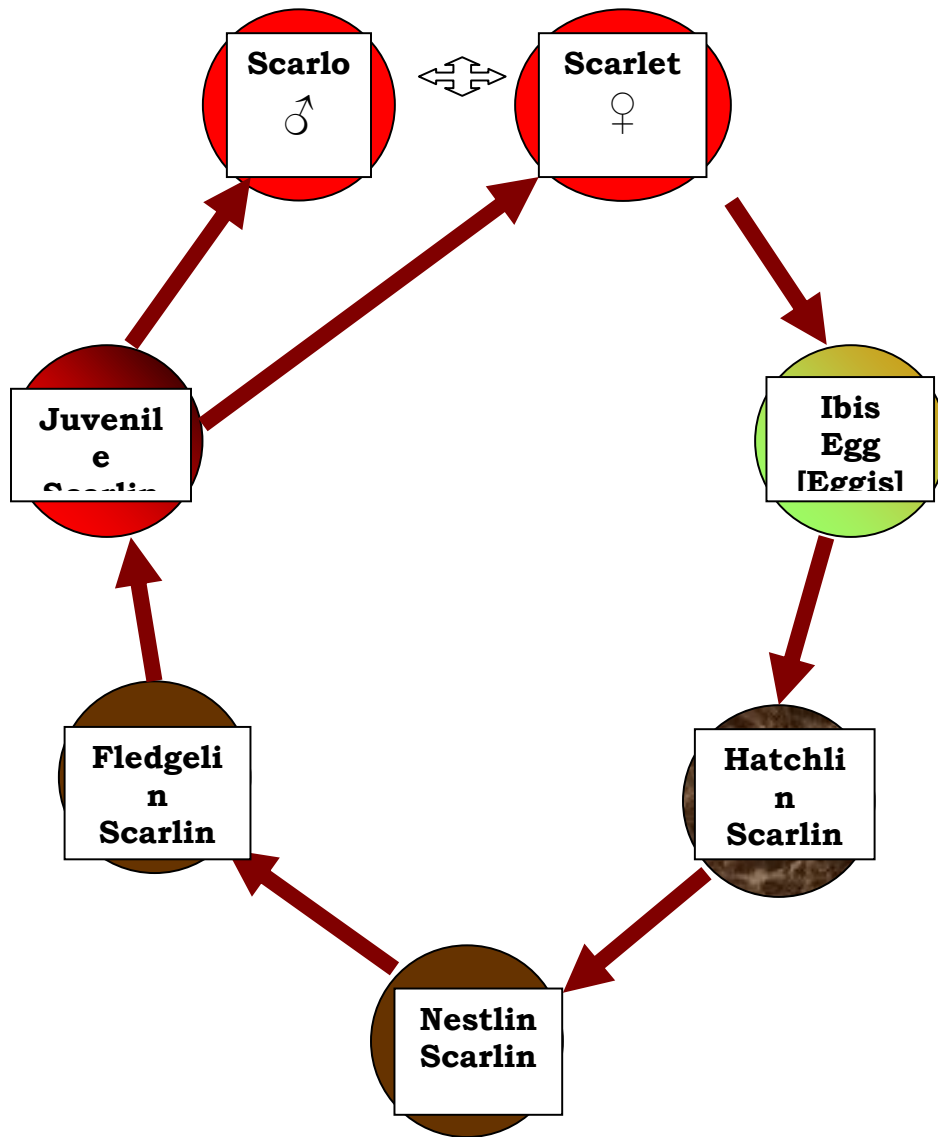


Figure 2.58: The Life Cycle of the Scarlet Ibis and White Ibis

2.3.5 Physiological States

Based on the life cycle of the Scarlet Ibis and White Ibis the following are the physiological states:

Scarlo [Adult Male ♂]

Scarlin [Adult Female ♀]

Egg [Eggis]

Hatchlin Scarlin [♂ or ♀] - Birth to about 4 weeks

Nestlin Scarlin [♂ or ♀] - 4 weeks to 8/10 weeks

Fledgelin Scarlin [♂ or ♀] - 8/10 weeks to time of feather colour change

Juvenile Scarlin [♂ or ♀] - from feather colour change to about 2 years.

2.3.6 Production Units for the Scarlet Ibis

The specific needs of the physiological states would lead to the production units as outlined in Figure 2.59.

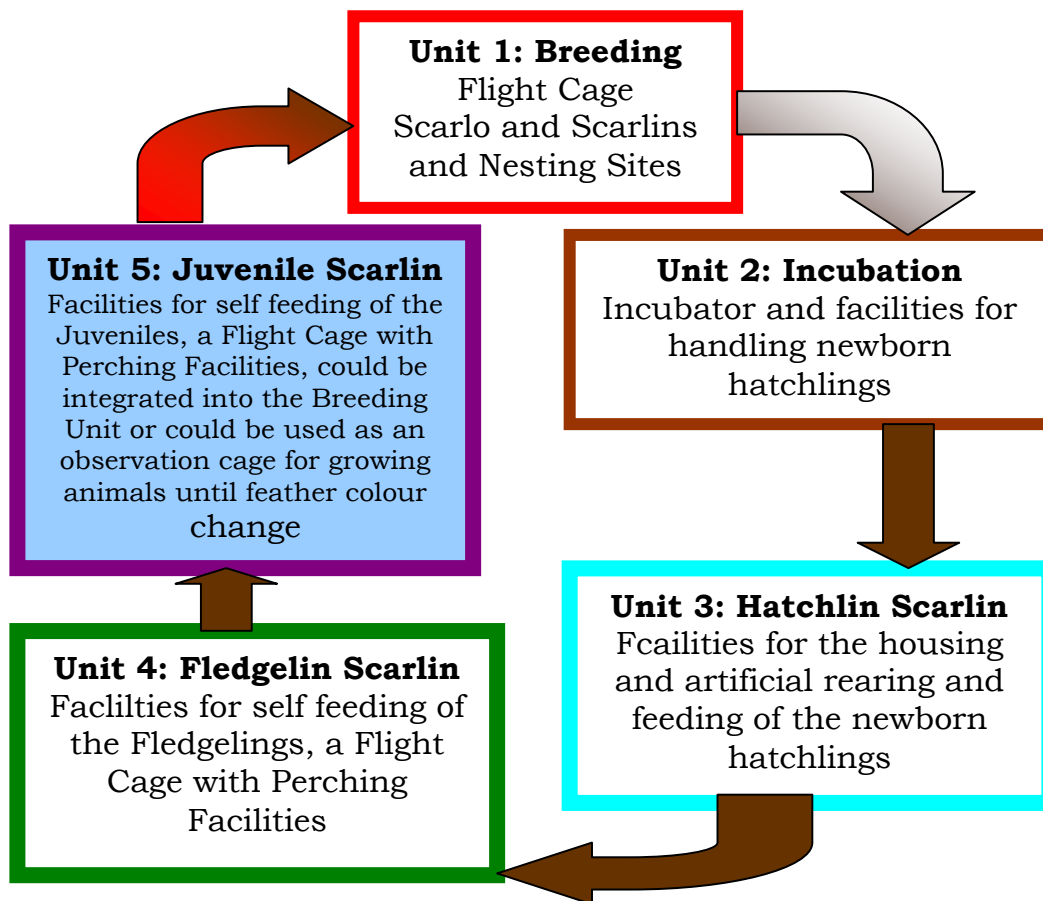


Figure 2.59: The Production Units for the Intensive Production of The Scarlet Ibis and White Ibis

2.3.7 Scarlet Ibis Performance Coefficients

Not all of the performance coefficients for the Scarlet and White Ibis are known. But what we do know we have summarized in table 2.3.1 and this was based on the contents of the literature reviewed in Part 2.2.

Table 2.15: Performance Coefficients of the Scarlet Ibis and White Ibis

Performance Coefficients	Value
Incubation period	23 days
Number of eggs per clutch	2 to 3 eggs
Birth Weight	27 gm
Do these animals lay more than one clutch?	?
Length of time fed by parents	9 to 10 weeks [54 to 70 days]
Age at first flight	9 to 10 weeks [54 to 70 days]
Weight at first flight	?
Age at first self feeding	?
Age at sexual maturity [Male]	About 2 years
Weight at sexual maturity [Male]	?
Age at sexual maturity [Female]	About 2 years
Weight at sexual maturity [Female]	?
Age at first lay	2 to 2.5 years
Expected Life Span	At least 20 years

2.3.8 Animal specific needs as influenced by the factors affecting animal production (Housing, Feeds and Feeding, Breeding & Reproduction, Health & Disease and Economic)

2.3.8.1 Housing and Environment

It is important that the design of the housing environment meets all the necessary requirements for the Scarlet Ibis to be comfortable. The importance is to ensure that the housing is suitable so that the animal will not be stressed. The animals must be able to remain healthy by eating a balance diet with which it is provided with the captivity for maintenance, maintaining the overall health of the bird and for it to be able to reproduce.

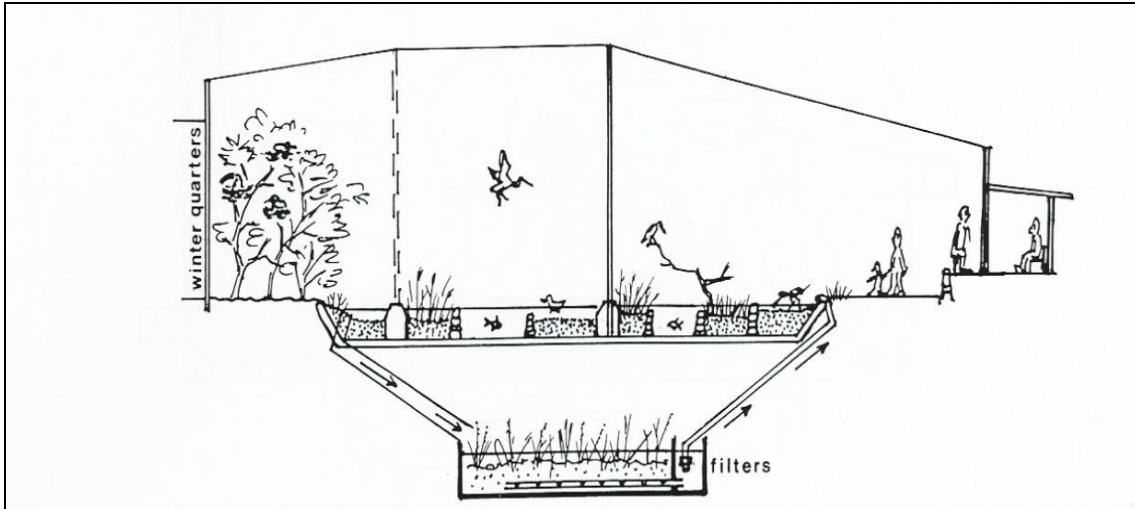
The recommendations for the design of a “Wetland Aviary” for the Scarlet Ibis were based on the following:

1. The Wet Land Aviary at the Rheine Zoo (Salzert and Johann, 1994);
2. The design of the Scarlet Ibis exhibit at the Bronx Zoo (Elbin and Lyles, 1994);
3. A visit to the Bronx Zoo by Dr Gary Garcia in 2006 and 2008;
4. The design of the Scarlet Ibis exhibit at the Emperor Valley Zoo, and the experience of the Zookeepers therein; and
5. The experience of the Parque Mangal in Belem, Brazil.

The Rheine Zoo in Germany was described as a “a naturalistic wetland” [this was a multispecies exhibit] and it was designed to house the Scarlet Ibis (*Edocimus ruber*), along with Cattle egrets (*Ardeola ibis*), Little egrets (*Egretta garzetta*) and Roseate spoonbills (*Ajaia ajaia*). This aviary was opened as a way of exhibiting these conspicuous and gregarious birds in what closely mimicked their wetland habitat both for the visitors as well as the birds. The walk-through aviary was opened in 1984. Figure 2.60 is a diagram of the cross section of the Wetland and Figure 2.61 is the ground plan of the Wetland Aviary. We are suggesting this as the recommended design concept for an Intensive Production Aviary or the Intensive Scarlet Ibis Production Unit. Reference will also be made to relevant features of the aviaries at the Bronx Zoo and the Emperor Valley Zoo.

Features of the design of the Wetland Aviary at the Rheine Zoo

Before an elaborate description of this aviary is put forward it is important to note that this was designed for a *zoo exhibit* in a *temperate* region. Consequently, there are several areas of the plan that may not be required by a similar system if it is established in the tropics such as Trinidad and Tobago. The most notable omission for Trinidad would be the winter aviary since the temperature is roughly the same year round and from night to day with variation of none of these parameters exceeding several degrees Celsius.



NB filtration plant not to scale.

Figure 2.60: The cross-section of the Wetland Aviary at the Rheine Zoo from rear to front enclosure
[Source: Salzert and Johann, 1994]

General Dimension: The aviary itself has a rectangular base measuring 40m x 25m [1000 sq m/ 0.1 ha/ about 0.25 acres], the height at the back of the exhibit is 7m and the front (which faces the visitors) is 4m high.

Roof: The roof should be made of soft nylon netting (this prevents broken beaks and wings of the birds when in flight). This would be supported by 3 poles, the sides could be made of plastic-coated, wire-mesh to a height of 3m with the nylon netting covering the remainder. The mesh width of both types of material should be 20 mm to exclude small birds from the aviary.

Pond: Partly deep water with muddy or sandy ground. The pond could also have open areas where dense aquatic and emergent plants could exist with self-sustaining fauna of invertebrates. The ponds could be made of concrete and could cover about half of the aviary area. The ponds could then be subdivided by walls, which reach almost to the surface of the water. The compartments could be filled with sand or soil to different levels. The compartmentalization is critical in the design because it would allow for experimenting with different types of plants separately. It would also prevent more vigorous plants from spreading from one area to the next.

Filtration system: A 40 m² gravel bed planted with reeds is situated outside the aviary. The water is circulated every 2 days. Replacement water must be added to the system to make up for loss of water through evaporation and leakage.

Aquatic invertebrates: A pond with a depth of 50-80 cm could be constructed to contain fish and other water invertebrates to gain refuge and for the development of a sustainable breeding area. An additional benefit of these organisms would be in the breakdown of the waste from the birds which would also help reduce the organic pollution of the water.

Vegetation: The vegetation (trees and bushes) would or could be used to mask all the technical equipment from the spectator allowing an impression of a natural landscape to be maintained.

Trees: Trees would be included to provide nesting sites so that nesting could take place in the trees and bushes at the rear of the aviary.

Nesting sites: Nesting sites or nesting platforms could also be provided as has been done at the Bronx Zoo. However, it would be essential to provide as well human access to all nesting sites either via a series of ladders or elevated walkways. This will be to facilitate the monitoring of all nesting sites.

Sliding doors: The scarlet Ibis is a migratory bird. In the wetland aviary, sliding doors can be built on the sides of the aviary. These doors can be opened early in the morning while it is still dark and closed late in the evening while it is dark.

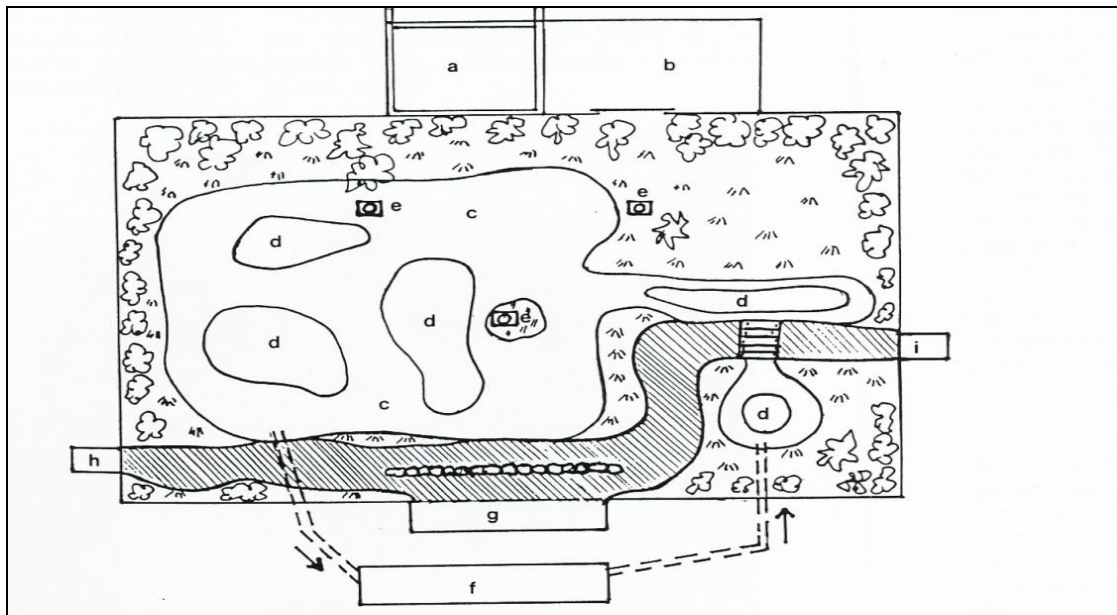


Figure 2.61: The ground plan of the Wetland Aviary

a. heated winter accommodation b. winter aviary; c. shallow water; d. deep water; e. roof support; f. filtration plant; g. public shelter with seats and graphics; h. entrance; i. exit.

A slight modification to the diagram would be to use the winter quarters as either an area to observe the birds or an emergency unit, Medical unit or a Food preparation area or Hatchery Unit.

It can also be used as a Bird sanctuary (Eco-tourist site) with a small fee to visitors. The reservations about housing such a large number of birds in an effective area 500m² proved not to be a significant problem in the Rheine Zoo and further research showed that populations of fewer than 32 Scarlet Ibises generally do not result in reproduction [Elbin and Lyles, 1994].

Incubation Unit: This could be a very simple room that must have an entrance from the aviary, through which the eggs would be brought in, and an exit into the Hatchling Unit. All the principles applied to poultry eggs could be applied to this unit and as time goes along and experiences gained improvements could be made. The unit should consist of small incubators that could possible handle batches of 10 to 20 eggs at a time. The facility initially should have a capacity for about 10m such small units to facilitate experimentation and replication of temperature and humidity treatments. This unit should be temperature controlled.

Hatchling Unit: This unit would be the equivalent to a lamb or calf rearing unit but with features of a premature baby unit. The hatchlings would have to be fed by humans with either bottles or tubes with the formulated hatchling feed. The formulation of these feeds would be the first most important area of research and development work that would have to be done.

Fledgling Unit: This unit would have to be high enough so that the young birds could begin to develop their flight skills. It must be adjacent to the Juvenile unit. The Fledgling Unit should have all the features of the main Production Unit or Aviary with the exception of nesting sites.

Juvenile Unit: This could be a Unit on its own or it could be a part of the main flight cage and Production Unit. The Juvenile Unit should have all the features of the main Production Unit or Aviary with the exception of nesting sites.

Features of the Aviary at the Bronx Zoo

Table 2.16 presents some of the features of the aviary at the Bronx Zoo. Figure 2.62 displays an adult at rest on the artificial nesting site on an elevated platform. Figures 2.63 and 2.64 also display the artificial nesting sites at the Emperor Valley Zoo in Trinidad.

Table 2.16: Some other variations based on the Environment of the Scarlet Ibis Exhibit at the Bronx Zoo: An Indoor Aviary

Parameter	Description
Cubic Capacity	20 x 10 x 6.5 meters high
Type of Lighting	skylight, over the entire area to provide ambient light and natural day lengths
Water Supply	hose fed, stream flowing throughout the exhibit
Ground cover	oyster shells and soil
Foliage	Rubber trees (<i>Ficus elastica</i>), local hardwood species for most of the perches
Nesting	Artificial Nests on platforms on long steel pipes
Feeding	Feed offered twice daily in metal pans suspended over the streams of water.
Animal activities observed	on the ground- 36% of the time; foraging or eating food from the pans – 81% of the time; Perched High- 49%; Preening- 39%; Resting-23%; Remaining alert- 18%; Typically birds are perched 2 meters or higher above the ground; Aggressive action- 1.6% (non-breeding), 5.8% (during breeding season);
Spacing	The birds (outside of breeding) maintained an average individual distance of about 1 meter apart
Perching	Perches are needed adjacent to the nesting sites.



Figure 2.62: A Scarlet Ibis at rest on an artificial nesting site at the Bronx Zoo in summer of 1996

Features of the Aviary at the Emperor Valley Zoo

Figures 2.63 to 2.72 present the main features of the two aviaries at the Emperor Valley Zoo.

General Husbandry

The aviary design must attempt to simulate the natural habitat of the animal, but the design must also take into consideration the general husbandry requirements. These considerations would be necessary as the animals must be kept as comfortable as possible while the daily or periodic human intervention is taking place. These would include recording the activities at nests and nesting sites, cleaning of the feeding sites and waterers, attending to plumbing (proper water management) and general physical maintenance of the facilities. The operation and maintenance of the filtration system is necessary to ensure a clean flow of water throughout the ponds. This would be assisted by decomposing bacteria and fish present in the water which would allow for the breakdown of the excrement from some of the birds.

During the months from May to August **[the breeding season of the birds]** most of the work would revolve around:

- feeding the birds
- providing nesting materials
- mowing occasionally the grassed areas and
- removing and pruning some of the water plants.



Figure 2.63: A Pair of Scarlet Ibises on an artificial nesting site at the Emperor Valley Zoo in June 2007.



Figure 2.64: Details of Scarlet Ibis artificial nesting site at the Emperor Valley Zoo in June 2007.



Figure 2.65: The Larger Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.66: Inside the Larger Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.67: The feeding area inside the Larger Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.68: A Fledgling Scarlin within the Large Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.69: A Fledgling Scarlin being fed by an adult Scarlet Ibis within the Large Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.70: The Smaller Scarlet and White Ibis Aviary at the Emperor Valley Zoo



Figure 2.71: Within the Smaller Scarlet Ibis Aviary at the Emperor Valley Zoo



Figure 2.72: The floor within the Smaller Scarlet Ibis Aviary at the Emperor Valley Zoo

In the simulated wetland at the Rheine Aviary about 60 – 100 birds can be housed comfortably. In a paper titled “Managing colonial waterbirds: the Scarlet ibis (*Edocimus ruber*) as a model species” [Elbin and Lyles, 1994]] it was stated that the Scarlet ibis “tends to keep close inter-individual distances. Close space is maintained independent on exhibit size.” It also stated that “Regardless of exhibit size birds maintained an average inter-individual distance of 1m during the non breeding season. While the rule remained constant for non-breeding birds during the breeding season, inter-individual distances between pair members ranged from contact to a maximum of 1m except when one of the pair was feeding.”

Rainfall Simulation:

It would be useful to include into the Aviary design a system for rainfall simulation. This would be necessary for general cleaning of the area, cooling down the aviary on hot days and for the simulation of rainfall to see if this could induce the birds in captivity to lay eggs throughout the year. The aviary could also be made up of several flight/reproduction cages so that experimentation could take place with different environmental elements being varied.

Day Length Simulation:

It would be useful to include into the Aviary design a system for varying the day length as is done with commercial domestic laying birds. The simulation of different day lengths could be tested to see if the birds could be induced to lay eggs throughout the year.

Features of the Open Aviary at the Parque Mangal das Garças in Belém-PA-Brazil

The **Parque Mangal das Garcas** in Belem, Estado Para in Brazil, is a Wet Lands Zoo that has the following features:

- (i) it is located in a wetland area on the river bank at one end of the old city of Belem;
- (ii) it is an Open Aviary, a Caged Aviary and it is also an observation station that has a tower that overlooks the whole of the Old City of Belem (Figure 2.73);
- (iii) it also has an enclosed Butterfly Zoo, a Gift Shop, a Park and a Boardwalk that overlooks a Micro Wetland (Figure 2.74) and the river that borders Belem and the Boardwalk leads to a Gourmet Restuarant (Figures 2.75 and 2.76).

Most important is that it is located in close proximity to the Fort of Belem that may have been the first Fortress constructed by the Portuguese in Brazil and the New World. Figures 2.77, 2.78 and 2.79 show the Scarlet Ibis on display, making nests and laying eggs on the upland dry areas of the exhibit.

The Figures contains archival photographs (2008-2009) of animals at Parque Mangal das Garças taken by the two persons who were responsible for the Zoo: the veterinarian Dr. Áurea Linhares Martins and the biologist Dr. Igor Seligmann. They both received notable mention in the annual congress of The Brazilian Society of Zoos for the work reported: MÉTODO PARA REPRODUÇÃO DE GUARÁS (*Eudocimus ruber*) EM CATIVEIRO DESENVOLVIDO NO PARQUE MANGAL DAS GARÇAS, BELÉM - PA.. In: XXXIII Congresso da Sociedade de Zoológicos do Brasil, 2009, Bauru. Anais do XXXIII Congresso da Sociedade de Zoológicos do Brasil, 2009.



Figure 2.73: The Open Aviary, Closed Aviary and Observation Tower at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.74: Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.75: A Boardwalk leading to the Restaurant and a Lookout at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.76: A Wetland component at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.77: Scarlet Ibis and White Ibis at the Parque Mangal das Garças in Belém-PA-Brazil

Figures 2.80 to 2.82 display the incubation of the eggs, an emerging hatchling and brooding of recently hatched chicks. The latter figure was quite innovative. Figure 2.83 displays growing Scarlet Ibis hatchlings being group reared.



Figure 2.78: The Scarlet Ibis nesting on the dry upland areas at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.79: The Scarlet Ibis nesting on the dry upland areas at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.80: The Scarlet Ibis eggs being incubated at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.81: Recently hatched Scarlet Ibis at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2.82: The Scarlet Ibis hatchlings being brooded at the Parque Mangal das Garças in Belém-PA-Brazil



Figure 2. 83: Scarlet Ibis hatchlings over 30 days old being group reared at the Parque Mangal das Garças in Belém-PA-Brazil

2.3.8.2 Feeds and Feeding

In the captive rearing of the birds the feeding of the animals will depend on the needs of the different physiological states as earlier described in 2.3.5. The feeding of the Juveniles and adults would not pose a problem. However, the artificial feeding of the hatchlings and the fledglings would have to be worked out. The young Scarlet Ibises can be fed minced meat, vitamins, minerals, frozen shrimp, sprouted wheat and pelleted chicken starter in a bowl. The juveniles could then be placed on a diet that is the same as the adults such as crustaceans, fish, amphibians, reptiles and some vegetable matter **[Salzert and Johann, 1994] [13]**. In the wetland aviary the aquatic invertebrates that breed in the water are secondary sources of food for the birds. In fact a small aquatic production unit could be integrated into the “Production Aviary”. The conditions for the breeding and feeding of these aquatic invertebrates are present in the exhibit and is not intensively cultivated externally and then introduced in the aviary.

Feeding as practiced at the Emperor Valley Zoo in Trinidad:

Daily-

The birds are given daily measurements of fish (Jousha and Herring), cut into 1-2 cm pieces, horse feed (broodmare- oats based), broiler finisher, bread, and Canthaxanthin powder. When the pigment is not available sometime fruit are added to provide the pigments. This mixture of fruits can be made up of pureed beetroot, spinach, carrots, and pumpkin.

Feed and environmental enhancements-

Liberty mollies, Tilapia fingerlings, fresh and salt water shrimp, fiddler crabs and snails are also introduced into the exhibit to provide feed and environmental enrichment.

2.3.8.3 Breeding and Reproduction

The first challenge of this production model would be

- (a) to obtain an understanding of the factors that stimulate these birds to a lay;
- (b) to manage these birds so that they would increase the number of eggs laid and
- (c) to support (b) to be able to artificially feed the nestlings and increase their livability.

Colonial Behaviour, Courtship display and Reproduction, Breeding and Nesting

This would have to be observed in Figures 2.16 to 2.28, and the flight and breeding cages would have to be adequately supplied with nesting platforms and nesting sites.

2.3.8.4 Health and Disease

In Rheine Zoo, Germany, it was recorded that there were a few cases of infectious disease of adult birds and when it occurred, it was almost invariably when the birds were housed in the winter quarters. A few accidental fatalities have also occurred in the winter. Of course this is not a concern in the tropics as there is no need for a separate winter facility for these birds.

2.3.9 Management Routines Required

Daily Management

Feeding

The most important daily management routine would be the feeding of the animals. The experience over the years has suggested that feeding be done in a silver or metallic [possibly stainless steel pan]. A pan is used to prevent the mixing of sand with the food.

Ensuring the delivery and functioning of the water supply

The water supply system must be monitored daily. This is important as the daily water needs of all terrestrial animals must always be met, as an animal would first die from a lack of water than from a lack of food.

The mechanism of the water supply system will be important if the aviary contains a self-sustaining aquatic production unit that is aimed at providing food, contributes to the exhibit or the production unit enrichment and for mosquito control.

Ensuring the proper functioning of the drainage system

The areas within the exhibit that simulate swamp conditions would have to be drained from time to time, while the concreted and grassed areas may have to be properly sloped to promote adequate daily drainage.

Daily observations of the animal health status

This is a routine observation in any intensive animal health facility.

Daily management routines within the Hatchling Unit

This is going to be the most challenging area for the full development of the Scarlet Ibis Intensive Production system. The first hurdle to be overcome would be the formulation of the “Starter/Hatchling Diet”. The young hatchlings would have to have their independent compartments or nests and a specialist attendant would have to be specially trained for this area.

Daily management routines for Fledgling Unit

This is going to be the second most challenging area for the full development of the Scarlet Ibis Intensive Production system. The first hurdle to be overcome would be the formulation of the “Fledgling Diet”. The young fledglings would have to have their independent compartments or nests and a specialist attendant would have to be developed for this area or this area could be managed by the same person from the “Hatchling Unit”.

Weekly Management

During the rainy season the meadow areas would need to be mowed and some water plants would have to be pruned or removed.

The tree and bushes also have to be pruned and cut to prevent them from becoming overgrown and to keep them in shape, appropriate for both nesting and perching.

The physical facilities must also be inspected to ensure that there are no portals of entry of wild birds or undesirable rats and snakes.

Alternate years Management

This would have to be developed through experience and trial and error as the production system evolves.

2.3.10 Output expectations of the Scarlet Ibis production model

The output expectations of this model would be as follows:

1. 2-3 clutches per breeding season, provided that we can get the birds to lay again as soon as we remove the eggs for incubation,
2. that we would be able to raise the Scarlet Ibis successfully from birth to adult (within 2 years); this is achievable as the animals have been successfully bred and reared in captivity for over 100 years,
3. several adult and/juvenile males and females can be released back into the wild,

4. the unit would also stimulate an appreciation of the bird via education and with the use of the wetland aviary as an Eco-tourist site, it should attract casual visitors, casual eco-tourist, dedicated eco-tourist, researchers, do-it yourselves, group tours, study group, nationals and foreigners,
6. it would generate revenue by charging a fee to visitors,
7. it would provide employment,
8. it would provide an opportunity for an increased knowledge and understanding of this bird via research and observation.

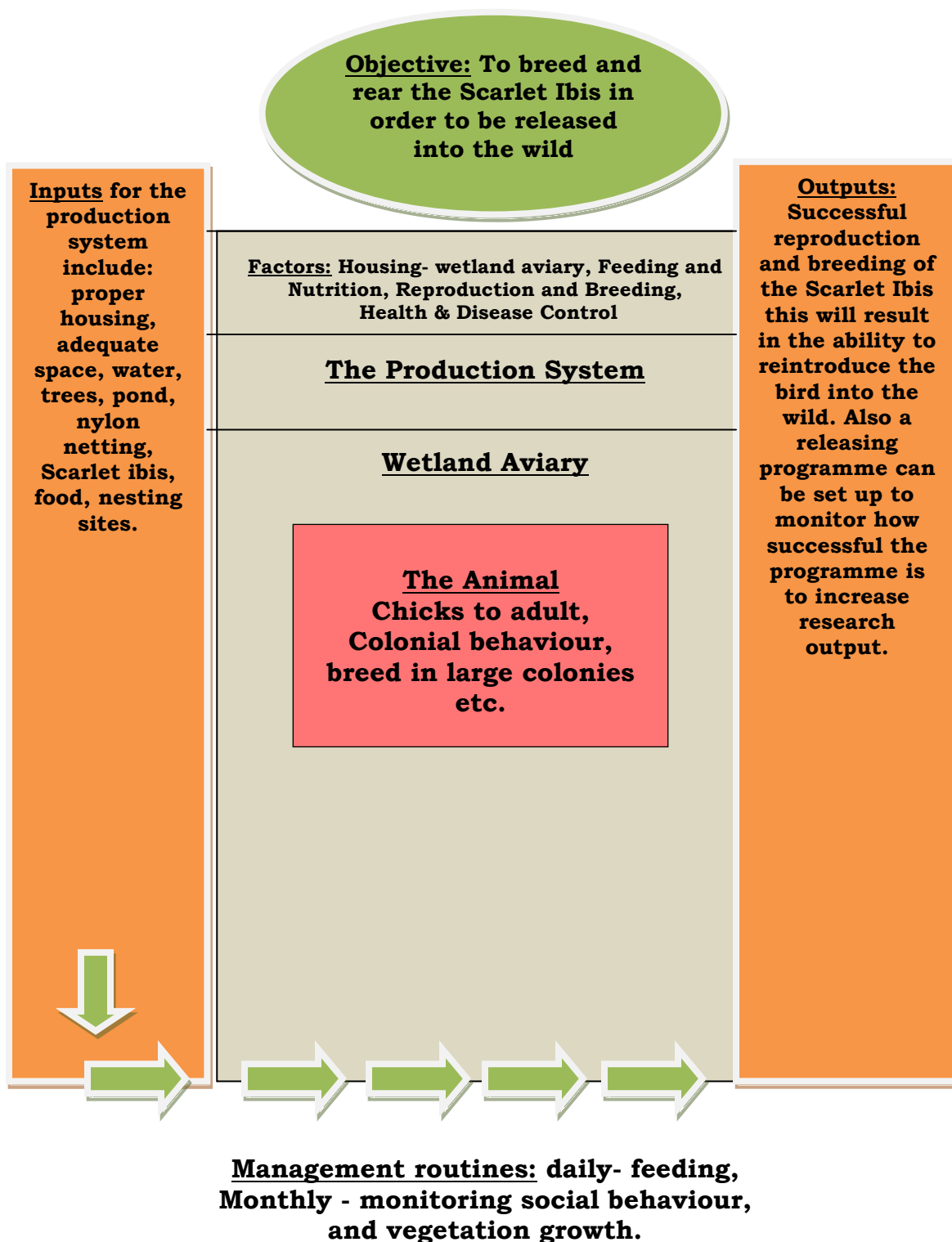


Figure 2.84: Production System for the Scarlet Ibis (*Eudocimus ruber*) [Conceptual Animal Production Model Framework as suggested by Garcia and Archibald, 2001] [12]

2.3.12 Releasing Programme

Before releasing the bird into the wild, the breeder must ensure that the environment is able to sustain the bird. It must contain all the necessary components required by the bird to breed, live and be comfortable. Another consideration that must be taken into account is the ability to monitor the bird in the wild. This would require a system of animal identification. The type of identification mark whether it is an auxiliary mark or alteration on the animal itself, should easily and humanely be applied. It can be permanent, unambiguous, unobtrusive yet visible at a distance and should not affect the animal's behaviour [Marion & Shamis, 1977]; in some cases it is desirable to have a marking scheme that is changeable, or will fade or fall off naturally. The need for identification of individual animals is as important as the success of the releasing programme. The identification mark can assist in tracking the movement, health, age, sex and behaviour of individual birds, and the age composition of a population can be determined in addition to examining the recruitment and movement of breeding individual birds.

2.3.13 Limitations to the design of the production model

There is a lack of information on the reproductive and the digestive systems of this animal (thus we have relied on what they have been fed at zoos and what they have been observed to eat in the wild and how they behave in the wild during the breeding season).

2.3.14 Closing Discussion on the Suggested Intensive Production Model for the Scarlet and White Ibis

The production model for the Scarlet Ibis (*E. ruber*) can only be successful if the management strategies put forward are sensibly coordinated and implemented. Also the naturalistic environment of the wetland proposed should add greatly to the wellbeing and health of these birds. It is important to include all members of society in this attempt to successfully manage one of the National Bird of Trinidad and Tobago. This intensive production model simulated for the Scarlet and White Ibis could be located at any of the following areas:

1. The Caroni Birds Sanctuary Visitor Information Centre,
2. The Pointe-a-Pierre Wildfowl Trust,
3. The Emperor Valley Zoo,
4. The future Centre for Neo-tropical Animal Wildlife,
5. Proposed Visitor Facilities at any of the swamps in Trinidad,
6. Private Wildlife facilities that are registered with the Wildlife Unit,

- [formerly the Ministry of Public Utilities and the Environment] now the Ministry of Housing and the Environment,
7. The Campuses of the UWI and the UTT.

It is instructive to note that in Barbados they have established a commercial tourist wetland facility that has included in it the Scarlet Ibis. Discussions with the wildlife forestry staff on the ground at the Caroni Bird Sanctuary Information and Education Centre have suggested that it will be a good initiative to establish a captive breeding centre at that location for the following reasons:

1. visitors to the centre will always be able to see live animals, which does not now happen,
2. animals could be captive bred for release and
3. the staff would become more expert at managing these birds.

The model of the **Open Aviary at the Parque Mangal das Garças in Belém-PA-Brazil** could be used.

BOOKLET #3
**Green Hermit/Guy's Hermit/
White Tailed Hermit/
Brin Blanc/Ermite Vert/
Ermitaño Verde/
Gruner Schattenkolibri
[*Phaethornis guy guy*] and
the Hummingbirds of
Trinidad and Tobago**

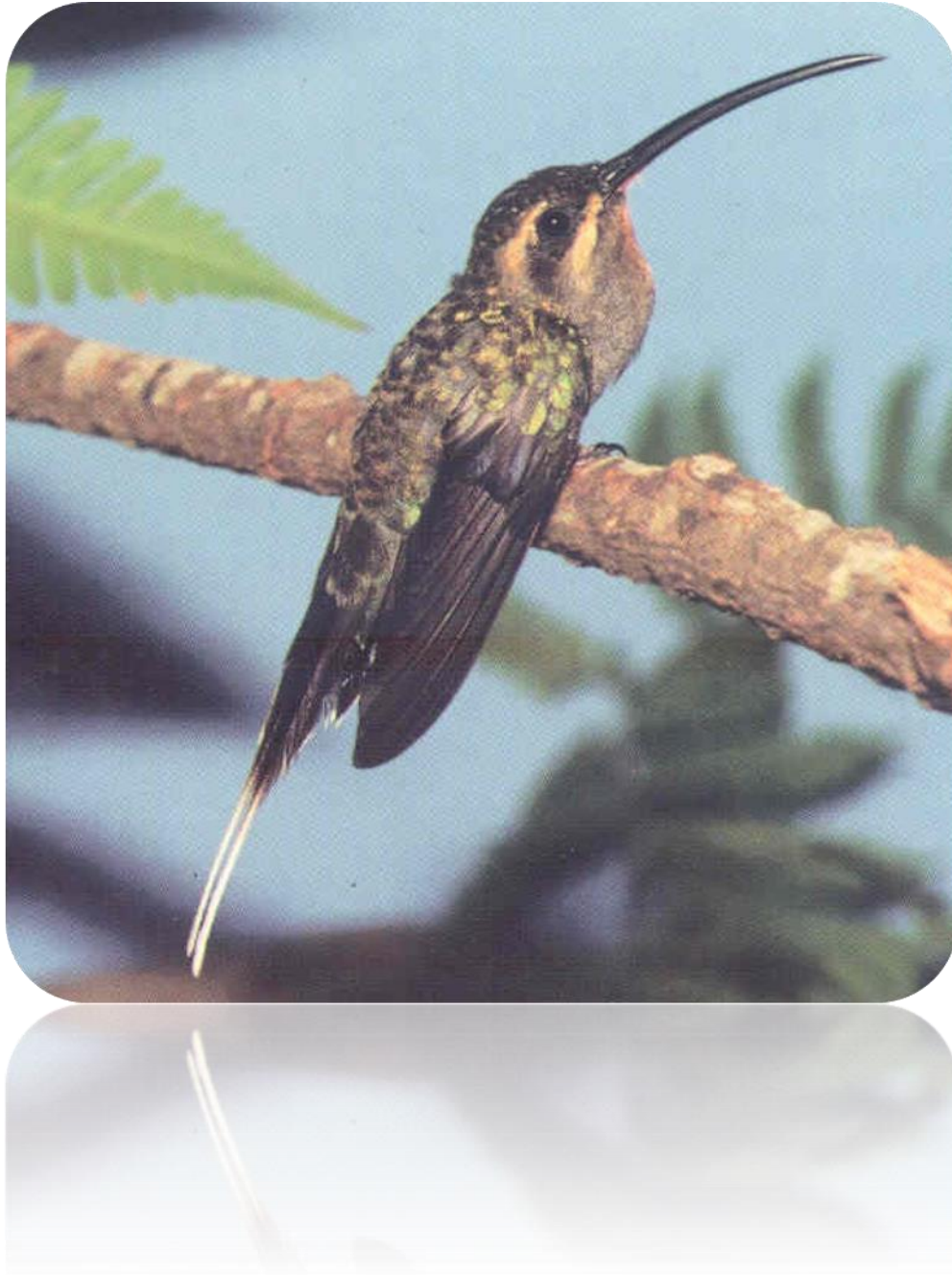


Figure 3.1: The Green Hermit/Guy's Hermit/White Tailed Hermit

PART 3.1 Anais' Questions on the Hummingbirds



History

1. **Why is Trinidad called the Land of the Hummingbirds?**

Dr. Theodore Ferguson in an article in the **Trinidad Guardian on Friday January 7th 2011** answered this question. The following is the exact quotation from this article:

*“.... According to some historians, Trinidad was inferred as the Land of the Hummingbird by its original inhabitants, the Amerindians, who named Trinidad **Iere** after the **Ierette** or **Yerette**, Amerindian names for the hummingbird. Later, the name **Colibri** was widely used in Trinidad and other American territories by both the indigenous Amerindians and colonising Europeans to refer to the hummingbird. The name survives in T&T to the present as **“Kwilibi”** and is commonly used by our older and more rural residents. In Europe, Trinidad also became known as the Land of the Hummingbird for a completely different reason. During the 19th and early 20th centuries, hummingbirds were captured in large numbers (millions) in the Americas and exported to Europe for use as “jewelry” in the hat-making and fashion industries. They were made into pins, brooches and other accessories. Many of the skins were shipped from T&T and hence T&T became known to Europeans as the Land of the Hummingbird.....”*

Naming the Hummingbird

2. **What is the correct spelling for this group of bird Hummingbird or Humming Bird?**

It is “Hummingbird”.

3. **What is the scientific name for Hummingbirds?**

Hummingbirds are scientifically known as Trochilidae.

4. **How did the Green Hermit get its name?**

We are not quite sure why it is called the Green Hermit. However, we propose that it may be because of the colour of the bird.

5. ***What is the mummy hummingbird called?***
She is called a “**hummy**”.
6. ***What is a daddy hummingbird called?***
He is called a “**hummer**”.
7. ***What is a baby hummingbird called?***
They are called “**hummlings**”.
8. ***Why does it have such a complicated name in brackets?***
This is the scientific name of the animal and it allows people all over the world to relate to the species in question. You can go back to the Questions in Booklets #1 and #2 where this is very well explained.
9. ***Which of the Hummingbirds found in Trinidad and Tobago do you think is the most beautiful?***
The male Tufted Coquette (*Lophornis ornatus*) but what is most unusual about this animal is that the word “coquette” means a woman who flirts girlishly with men to gain their admiration, but in this case it is the male of this species that is so beautiful.

Geographical Location

10. ***What other countries of the Caribbean have the Hummingbird as their national bird?***
Jamaica has a Hummingbird as its national bird. This is the **Streamer-tailed Hummingbird** or the **Western Streamertail** or **Red-billed Streamertail (*Trochilus polytmus*)**, it is also called the “**Doctor Bird**”. Its body is 4-5 inches (10-12.5 cm) long and its tail extends another 8-10 inches (20-25 cm). It is a Hummingbird that has become very well adapted to human habitation
11. ***In what parts of the world are hummingbirds found?***
Hummingbirds are found only in the New World, that is, the Americas and the Neo-tropics or New-world Tropics (Central and South America and the Caribbean).

Physical description of hummingbirds

12. ***How do we tell a male from a female?***

The female hummingbird generally has duller plumage when compared to that of the male. This is the major way of differentiating between males and females.

13. ***How much do hummingbirds weigh?***

The weight of hummingbirds varies among the different species. For example, the Bee hummingbird [*Mellisuga helenae*, native to Cuba] is the smallest bird in the world and it is known to weigh approximately 2 grams whereas other hummingbirds are known to be fairly larger.

14. ***How small are hummingbirds?***

The size of Hummingbirds varies from species to species, e.g., the **Bee Hummingbird** is known to be the smallest bird in the world. Hummingbirds measure from 5-22 cm (with tail streamers, up to 35 cm long). Trinidad contains the second smallest bird in the world which is the Tufted Coquette or the Splendid Coquette [*Lophornis ornatus*] mentioned in answer 9. This is an exceptionally pretty hummingbird.

15. ***What are the colours of Hummingbirds?***

The colour varies with the different kinds of hummingbirds. All hummingbirds however, have brilliant metallic colours which look iridescent in the sun, especially on the crown and gorget.

16. ***Why do they have different colours?***

The different colours are related to the behaviour of the birds, for example, its feeding patterns. There are two main groups with respect to colour, that is, birds that encourage concealment and those that enhance conspicuousness.

17. ***What is iridescent***

Iridescent refers to the displaying of colours similar to that of a rainbow. Did you know that the colours of the rainbow are red, orange, yellow, green, blue, indigo and violet?

18. ***What is concealment?***

Concealment is a state of being hidden. Hummingbirds that promote concealment have relatively dull, dark-coloured feathers since they prefer to remain hidden in their environment. This

prevents them from being a target for predators and therefore their colours have a major role to play in camouflaging/hiding the bird.

19. ***What is conspicuousness?***

Conspicuousness is a state of displaying oneself or attracting attention. Hummingbirds that promote conspicuousness have brightly coloured feathers and this may be for attracting mates. A very good example of conspicuousness is the peacock when it displays all its feathers

20. ***What is the gorget?***

The Gorget refers to a patch on the throat. In the case of the Hummingbird, it is distinguished by its colour. Please see Figure 3.4.

21. ***Why do they have long beaks?***

The long beaks help them to extract nectar from the flowers that they feed upon and they also have a long tongue that sticks out through its beak and into the flowers to withdraw the nectar.

22. ***What is the wingspan of the hummingbird?***

The wingspan varies between each species, for example, with the Rufous-shafted Woodstar, the average wingspan for males is 3.55cm while the females is 3.5cm. The White-tailed Sabrewing has an average wingspan of 7.64cm for males while the females have it as 7.4cm. Wingspan would therefore vary depending on the size of the Hummingbird.

23. ***For how long can they fly?***

Some Hummingbirds are known to fly very long distances, especially those that migrate in search of food supplies and new nesting grounds.

24. ***How fast is a hummingbird?***

These birds are extremely fast and are able to fly at speeds reaching up to 60 miles per hour (80km/hr).

25. ***Up to what size does the Rufous-shafted Woodstar grow?***

This bird grows up to 6-8 cm (about 3 inches) or 7.5 long, which includes its moderately long tail.

26. *How does it make the humming sound?*

The beating of its wings produces the humming sound. This is referred to as a “Wing Whistle”. Hummingbirds are able to beat their wings at a rate of 60-200 times per second.

27. *How do we hear the humming sound?*

The humming sound is heard from the fast beating of the wings.

28. *How many babies can it have?*

Birds make their babies by laying eggs. Generally hummingbirds are known to lay two eggs in their relatively small nests.

29. *For how long can hummingbirds live?*

They can live for up to 5 to 6 years in the wild. In captivity, however, they are able to live for at least 6 to 8 years. In some instances, they can live up to 12 years, once they are properly cared for.

Diet

30. *How much do they eat?*

They are known to consume up to 50% (a half) of their body weight in nectar every day.

31. *What do hummingbirds eat?*

Hummingbirds feed mainly on nectar, small insects and arthropods.

32. *What is nectar and what are arthropods?*

Nectar is a sweet, sugar-rich liquid that is produced by flowering plants and attracts pollinating insects and animals. Nectar is made up mainly of sugar and on average nectar contains about 25% sugars.

Arthropods are invertebrate animals that are made up of a very hard exoskeleton (external shell or covering), jointed legs, segmented bodies and they also lack backbones. These animals include crustaceans [crabs and shrimps], insects (animals with three pairs of legs like mosquitoes and bees) and spiders.

Invertebrates are animals that lack an internal spinal column, like worms.

General Questions

33. *Can we keep them as pets?*

No, we cannot keep them as pets as they are fully protected under the laws of Trinidad and Tobago. However, if you wish you could create conditions within your garden to ensure that the hummingbirds visit you every day so that you can enjoy their presence and contribute to their sustainable conservation.

34. *Does any animal prey on the hummingbirds?*

Yes, there are some animals that prey on the Hummingbirds. These include camouflaged snakes on *Heliconia* flowers, forest-falcons (*Micrastur* sp.), pygmy-owls (*Glaucidium* sp.), jays (*Corvidae* sp.), toucans (*Ramphastidae* sp.) and possibly some bats.

35. *Is the hummingbird a endangered species?*

Some hummingbird species are considered endangered. There are twenty five (25) threatened hummingbird species in the world, one of which is found in Tobago. This is the **White-tailed Sabrewing (*Campylopterus ensipennis*)**. **It was reported to be found only in Tobago** by a man called Mr. Richard French in 1973, but it is rarely seen.

36. *Are hummingbirds aggressive?*

Hummingbirds have an aggressive temperament and are known to fiercely protect their nests and feeding areas from other birds. The *Amazilia tobaci* (Copper-rumped Hummingbird, Common Emerald) is one of the most aggressive of the hummingbirds.

37. *Where can we find excellent pictures of the Hummingbirds of Trinidad and Tobago?*

You would not find it in this book. It is focused on giving you information not pretty pictures. You can obtain them from Theo Ferguson at Yurette, Roger Neckles, Nigel Cross, Terry Sampson and other professional photographers.

PART 3.2
Literature Review of the Green
Hermit/Guy's Hermit/
White tailed Hermit/
Brin Blanc
[*Phaethornis guy guy*] and
the Hummingbirds of Trinidad and
Tobago

3.2.1 Introduction

The hummingbird species that is on the Coat of Arms of the Republic of Trinidad and Tobago is *Phaethornis guy guy* (Green Hermit/Guy's Hermit/ White-tailed Hermit). There is not very much information on this Hummingbird. We have therefore attempted to include as well in this review information on the other Hummingbird species present in Trinidad and Tobago and to give you a working knowledge of Hummingbirds in general. Many of us often take these birds for granted, without realising their importance and the significant contribution that these precious birds make to our beautiful twin island republic. Some of you may have come into contact with them every day, and you may have been unaware of this. Just take a look at any Trinidad and Tobago twenty dollar bill (Figure 3.2).



Figure 3.2: A twenty dollar (\$20) bill of the Republic of Trinidad and Tobago

Upon taking a closer look at the twenty dollar bill, an image of a Hummingbird (that is supposed to be the *Phaethornis guy guy*) is present on the Coat of Arms or the National Emblem of Trinidad and Tobago along with the Scarlet Ibis and the Cocrico. Even more distinguishable on this twenty dollar bill is a larger image of the *P. guy guy* represented on the left side of the bill. Here we can see this remarkable Hummingbird feeding on a hibiscus flower (Figure 3.3).



Figure 3.3: A magnification of the Hummingbird on the twenty dollar bill of Trinidad and Tobago

3.2.2 Hummingbirds

The following is the zoological classification of the Hummingbirds:

CLASS: AVES
ORDER: APODIFORMES
SUB-ORDER: TROCHILI
FAMILY: TROCHILIDAE [Hummingbirds]
SUB-FAMILY: PHAETHORNITHINAE [Hermits: 6 genera, 34 species]
TROCHILINAE [Typical Hummingbirds: 96 genera, 294 species] (del Hoyo *et al* 1999).

Hummingbirds are found only in the New World (the Americas and the Neo-tropics or New-world tropics). They also occupy a wide variety of habitats and can be found from sea level up to 5,000 meters above sea level. Within this family, there are reported to be two sub-families, 102 genera, 328 species and 684 taxa. Twenty five (25) species of hummingbirds are threatened and one species has become extinct since 1600 (del Hoyo *et al* 1999). Figure 3.4 gives us an idea of how the species are clustered or grouped within the Americas. Although this reference is not very up to date it still gives us an idea of the species distribution. One of the threatened species is found in Tobago and this is the **White-tailed Sabrewing (*Campylopterus ensipennis*)** (ffrench 1973, 1991) [Tables 3.2 and 3.3].



Figure 3.4: Distribution of Hummingbird Species in the Americas
[Source: Grant and Grant, 1968]

Hummingbirds are small to tiny fast flying birds with extensively iridescent plumage and with strikingly coloured gorget or crests. They have thin bills/beaks that are extremely variable, from short to extremely long, from straight to sharply curved (Figs 3.14 and 3.15). They also have very tiny feet. These birds range in length from 3 to 22cm, with tail streamers up to about 35cm long. The Jamaican Doctor Bird or Doctor Hummingbird [Western Streamertail, Red-billed Streamertail (*Trochilus polytmus*)] which is the national bird of Jamaica, has a tail streamer that extends about 20.3cm to 25.4cm long (del Hoyo *et al*, 1999). Within Trinidad and Tobago are found seventeen (17) species of hummingbirds. Six (6) of these seventeen (17) species are found in Tobago [***Glaucius hirsuta*, *Florisuga mellivora*, *Anthracothonax nigricollis*, *Amazilia tobaci*, *Chrysolampis mosquitus* and *Campylopterus ensipennis* (White-tailed Sabrewing)**]. The other eleven (11) species that exist in Trinidad are *Phaethornis guy*, *P. longuemareus*, *Polytmus guainumbi*, *Amazilia chionopectus*, *Lophornis ornatus*, *Chorestes notatus*, *Colibri delphinae*, *Cholorostilbon mellisugus*, *Anthrocothonax viridigula* and *Chaetocercus jourdonii* (ffrench,1973, 2003].

3.2.3. Systematics

WHAT IS SYSTEMATICS?

The term systematics deals with the scientific study of life's diversity with regard to natural relationships. It involves the biological nomenclature and classification of all species, as well as the historical evolutionary and phylogenetic relationships among organisms. In such a case, strong emphasis is placed on the phenotypic similarities and differences of the particular organism. Systematics also includes the building and maintenance of biodiversity collection. With respect to the Hummingbird, it provides information on the entire background of the bird, which includes its classification and taxonomy. From this, we are able to differentiate between different species and also compare this remarkable bird to that of other birds, globally (del Hoyo *et al*, 1999).

WHY IS SYSTEMATICS IMPORTANT?

Systematics plays a major role in terms of a biological perspective, as it provides

- i. A basis for biodiversity conservation methods
- ii. Independent evidence for patterns of geological change
- iii. Identification services and documentation of identity and
- iv. Identification of specialists (del Hoyo *et al* 1999).

About Hummingbird Systematics

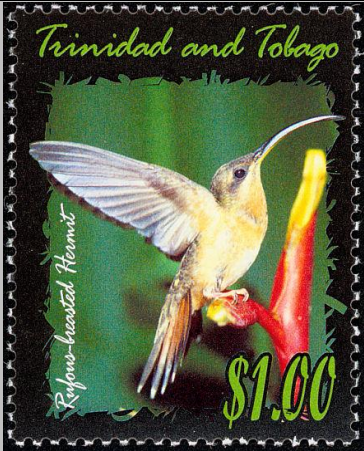
Hummingbirds (Trochilidae) are the second largest avian family in the New World or Americas. The largest New-world avian family is the tyrant-flycatchers (Tyrannidae) with over 370 species. The present classification which is based mainly on anatomical and morphological characters, such as modified cervical musculature, the skeleton of the flight apparatus, wing muscle innervations or feather tracts. The question still remains whether these similarities are due to convergence or to common ancestry. Modern anatomical methods, careful morphological character analyses and molecular biology techniques may in the future shed some light on these unsolved problems of higher level relationships (del Hoyo *et al* 1999).

3.2.4 The Hummingbirds of Trinidad and Tobago

French (2003) reported that 17 or 18 species of Hummingbirds were found in Trinidad and Tobago. He has suggested that the *Amazilia fimbriata* (Glittering Throated Emerald or Lesson's Emerald) was cited in the literature in error, and this is the 18th species to which he referred. Trinidad is known as the **“Land of the Hummingbirds”** although there is present herein only 16 out of the 328 species of Hummingbirds listed. The Hummingbirds of Trinidad and Tobago after French (1973, 1991, 2012, 2003) will now be described. There are three (3) species within the Hermit sub-family (Table 3.1) and fourteen (14) species within the sub-family of Typical Hummingbirds (Table 3.2). The references on the Taxonomy are all as cited by del Hoyo *et al* (1999) and French (1973, 1991, 2012, 2003).

Table 3.1: The Hummingbirds of the Hermit sub-family found in Trinidad and Tobago

SPECIES	REFERENCES ON TAXONOMY
1. Guy's Hermit, White-tailed Hermit, Green Hermit <i>Phaethornis guy</i> [Trinidad] Length: 16.51 cm, fairly large. Wingspan: Average • Males: 6.31cm; • Females: 6.2cm. Weight (g): Average • Males: 6.4g; • Females: 6.33g. Colour: Green above and gray below. • Males: Dark head with a rufous (light red or rust) superciliary stripe. • Females: Pale buff stripes above and below the eyes. Bill: • Long (3.81cm) and decurved, mandible bright red below. Tail: • Males: Slightly elongated, white-tipped central tail feathers. • Females: Longer white tail-tips	[<i>Trochilus guy</i>] Lesson, 1832 - Trinidad <u>Subspecies and distribution:</u> <i>P. g. coruscus</i> Bangs, 1902 - Costa Rica to NW Colombia. <i>P. g. emiliae</i> (Bourcier&Mulsant, 1846) - Colombia (major river valleys). <i>P. g. apicalis</i> (Tschudi, 1844) - E Andean slopes from N Colombia and NW Venezuela to SE Peru. <i>P. g. guy</i> (Lesson, 1832) - Trinidad and NE Venezuela.
2. Rufous-breasted Hermit, Hairy Hermit. <i>Glaucis hirsuta</i> [Trinidad and Tobago] This is the only hermit found in Tobago. Length: 12.7cm Wingspan: Average • Males: 6.4cm • Females: 5.83cm. Weight (g): Average • Males: 7.3g • Females: 6.7g	[<i>Trochilus hirsutus</i>] J. F. Gmelin, 1788 - North-eastern Brazil. <u>Subspecies and distribution:</u> <i>G. h. insularum</i> Hellmayr& von Seilern-Aspang, 1913 - Grenada, Trinidad and Tobago. <i>G. h. hirsuta</i> (J. F. Gmelin, 1788) - Panama, Colombia W of the Andes, and E of the Andes S to C Bolivia, and through Venezuela to the Guianas and almost all of Brazil.

SPECIES	REFERENCES ON TAXONOMY
2. Rufous-breasted Hermit, Hairy Hermit. <i>Glaucis hirsuta</i> [Trinidad and Tobago] Colour: • Head generally brown with buff superciliary and moustachial streaks; upperparts bronze-green, underparts pale rufous (light red or rust). Bill: • Long, about 3.81cm strongly decurved; lower mandible yellow, upper blackish. Tail: • Tail rounded, tipped white, outer 4 tail-feathers bright chestnut with black subterminal band.	
3. Little Hermit, Longuemare's/ Rusty-breasted Hermit. <i>Phaethornis longuemareus</i> [Trinidad] Length: 10.16cm Wingspan: Average • Males: 4.2cm; • Females: 4.24cm Weight (g): Average • Males: 3.2g • Females: 3g Colour: • Upperparts bronze-green, rump rufous (light red or rust), head dark with buff streak behind eye, underparts rufous (light red or rust). Bill: • Decurved (2.54cm), upper mandible black, lower yellowish with black tip. Tail: • Tail wedge-shaped, central feathers elongated and white-tipped.	[<i>Trochilus Longuemareus</i>] Lesson, 1832, Cayenne

Source of Taxonomic Information: Citations by del Hoyo *et al* (1999), French (2003).

Table 3.2: The Hummingbirds of the sub-family TROCHILINAE found in Trinidad and Tobago

SPECIES	REFERENCES ON TAXONOMY
4. White-tailed Sabrewing, <i>Campylopterus ensipennis</i> (Threatened Species) [Tobago] Length: 12.7cm Wingspan: Average • Males: 7.64cm; • Females: 7.4cm Weight(g):Average • Males:10g • Females: ??? Colour: • Generally bright green with dark blue throat and white moustachial streak. Bill: • Black, (2.54cm), slightly decurved. Tail: • Outer 3 pairs of tail feathers mainly white.	[<i>Trochilus ensipennis</i>] Swainson, 1822.
5. White-necked Jacobin, (Great) Jacobin/ White-bellied/ Collared Hummingbird, <i>Florisuga mellivora</i> [Trinidad and Tobago] Length: 11.43cm, fairly large. Wingspan: Average • Males: 7cm; • Females: 6.55cm Weight (g): Average • Males: 6.66 • Females: 9g	[<i>Trochilus mellivorus</i>] Linnaeus, 1758 - India; error = Surinam. <u>Subspecies and Distribution:</u> <i>F. m. mellivora</i> (Linnaeus, 1758) - S Mexico to Panama and Columbia, S to W Ecuador, SE Peru and N Bolivia and E to Venezuela, Trinidad, the Guianas and Amazonian Brazil. <i>F. m. flabellifera</i> (Gould, 1846) - Tobago.
5. White-necked Jacobin, (Great) Jacobin/ White-bellied/ Collared Hummingbird, <i>Florisuga mellivora</i> [Trinidad and Tobago] Colour: • Males: head and breast dark blue, broad white band on nape, rest of upperparts bright green, underparts white • Females: Bronze-green above, throat and breast green, feathers edged white	

SPECIES	REFERENCES ON TAXONOMY
6. Brown Violet-ear, <i>Colibri delphinae</i> [Trinidad] Length: 12.1cm Wingspan: Average • Males: 7.43cm; • Females: ??? Weight(g): Average • Males: 6.8g; • Females: ??? Colour: • Generally dull brown above, gray below, broad violet patch across cheeks and ear-coverts, white moustachial streak, iridescent green throat with the presence of some blue. Bill: • Bill black and straight (1.9cm). Tail: • Presence of a blackish subterminal band.	[<i>Ornismya delphinae</i>] Lesson, 1839, no locality = Santa Fé de Bogotá, Colombia.
7. Green-throated Mango, Black-breasted Hummingbird, <i>Anthracothorax viridigula</i> [Trinidad] Length: 12.7cm Wingspan: Average • Males: 7.11cm; • Females: 6.78cm Weight (g): Average • Males: 8.5g; • Females: ??? Colour: • <i>Male:</i> underparts bronze green, throat and sides of underparts iridescent green, abdomen black. • <i>Female:</i> As male but under-parts white with black stripe from chin to abdomen. Bill: • Bill fairly long (over 2.54cm), black, slightly decurved. Tail: • <i>Males:</i> Outer tail purple-tipped black; <i>Females:</i> Outer tail tipped white	

SPECIES	REFERENCES ON TAXONOMY
8. Ruby Topaz Hummingbird, <i>Chrysolampis mosquitos</i> [Trinidad and Tobago] Length: 8.89cm (quite small) Wingspan: Average • Males: 5.63cm; • Females: 5.46cm Weight (g): Average • Males: 4.3g • Females: 4.4g Colour: • Male: upperparts dark brown, glossed greenish, throat and breast brilliant golden, crown and nape iridescent ruby red, underparts brown. • Females: upperparts bronze-green, underparts pale gray with dark stripe from chin to breast.	
8. Ruby Topaz Hummingbird, <i>Chrysolampis mosquitos</i> [Trinidad and Tobago] Bill: • Straight, black and fairly short (1.27cm). Tail: • Males: Chestnut tail, tipped black • Females: Chestnut tail, tipped white.	

SPECIES	REFERENCES ON TAXONOMY
9. Tufted Coquette, Splendid Coquette, <i>Lophornis ornatus</i> [Trinidad] Length: 7cm (quite small) Wingspan: Average • Males: 3.96cm; • Females: 3.85cm Weight (g): Average • Males: 2.25g; • Females: 2.75g Colour: • <i>Male:</i> Underparts bronze-green with pale buff bar across rump, chestnut crest, rest of head green with long rufous (light red or rust) tufts, iridescent, golden green throat. • <i>Females:</i> Lacks crest and tufts, greenish above with pale buff rump-bar, rufous (light red or rust) below. Bill: • Short, straight bill (less than 1.27cm), reddish with black tip. Tail: • Males: Dark chestnut, edged brown	[<i>Trochilus ornatus</i>] Boddaert, 1783, Cayenne
10. Blue-chinned Sapphire, Audebert's Hummingbird, <i>Chlorestes notatus</i>/<i>Chlorostilbon notatus</i> [Trinidad] Length: 8.89cm Wingspan: Average • Males: 5.08cm; • Females: 4.77cm Weight (g): Average • Males: 4.2g; • Females: 4.1g Colour: • <i>Male:</i> Upperparts dark green, upper throat blue, rest of underparts bright green, white thighs. • <i>Female:</i> As male, but under-parts mainly white tipped green, appearing as green spots. Bill: • Straight (1.9cm), upper mandible black, lower reddish. Tail: • Steel blue tail.	[<i>Trochilus notatus</i>] Reich, 1793, Cayenne. <u>Subspecies and Distribution:</u> <i>C. n. notatus</i> (Reich, 1793) - NE Colombia through N & E Venezuela, Trinidad and Tobago, and the Guianas to E Brazil (Pará to Bahia). <i>C. n. puruensis</i> Riley, 1913 - NW Brazil (N of Amazon, E to mouths of R Trombetas and R Negro) to SE Colombia and NE Peru (upper R Ucayali). <i>C. n. obsoletus</i> (Zimmer, 1950) - NE Peru on lower R Ucayali near mouth of R Napo, and W probably to mouth of R Huallaga.

SPECIES	REFERENCES ON TAXONOMY
11. White-chested Emerald, White-breasted Emerald, <i>Amazilia chionopectus</i>/ <i>Agyrtria brevirostris</i> [Trinidad] Length: 10cm Wingspan: Average • Males:5.21cm; • Females:5cm Weight (g):Average • Males: 4.6g; • Females: 4.4g	[<i>Ornismya brevirostris</i>] Lesson, 1829, Guyana. <u>Subspecies and Distribution:</u> <i>A. b. chionopectus</i> (Gould, 1859) - Trinidad. <i>A. b. brevirostris</i> (Lesson, 1829) - E Venezuela, Guyana, Surinam and extreme NC Brazil. <i>A. b. orienticola</i> (Todd, 1942) - coastal French Guiana.
11. White-chested Emerald, White-breasted Emerald, <i>Amazilia chionopectus</i>/ <i>Agyrtria brevirostris</i> [Trinidad] Colour: • Underparts brilliant golden green, glossed with bronze, especially on rump and tail, sometimes with a narrow white edging, underparts white with sides green or white spotted with green, sexes similar. Bill: • Bill straight, fairly long (1.9cm), black. Tail: • Tail glossed with bronze, tipped purplish-	

SPECIES	REFERENCES ON TAXONOMY
12. Blue-tailed Emerald, <i>Chlorostilbon mellisugus</i> Golden-crowned Emerald (<i>auriceps</i>); Cozumel Emerald (<i>forficatus</i>) ; Fork-tailed/Canivet's Emerald (<i>canivetii</i>); Salvin's Emerald (<i>salvini</i>); Garden/allied Emerald (<i>assimilis</i>) ; West Andean Emerald (<i>melanorhynchus</i>) ; Red-billed Emerald (<i>gibsoni</i>) , [Trinidad] Bill: • Straight, short, black bill (1.27cm). Tail: • Males: Steel blue forked tail. • Females: Outer tail tipped white.	<i>C. m. pumilus</i> Gould, 1872 - arid and semi-arid tropical and sub tropical zones of W Columbia and W Equador. <i>C. m. melanorhynchus</i> Gould, 1860 – upper sub-tropical W Columbia into temperate zone in W & C Andes of Equador. <i>C. m. gibsoni</i>(Fraser, 1840) - upper Magdalena Valley (C Colombia). <i>C. m. chrysogaster</i>(Bourcier, 1843) – N Colombia from Cartagena to Santa Marta. <i>C. m. nitens</i> Lawrence, 1861 - NE Colombia and NW Venezuela (W & N Andes of Mérida). <i>C. m. caribaeus</i> Lawrence, 1871 - islands of Curacao, Aruba, Bonaire, Trinidad and Margarita, and NE Venezuela. <i>C. m. duidae</i> Zimmer & Phelps, 1952 - Mt Duida (S Venezuela). <i>C. m. subfurcatus</i> Berlepsch, 1887 - E & S Venezuela, Guyana and the Rio Branco region of NW Brazil. <i>C. m. mellisugus</i>(Linnaeus, 1758) - Surinam, French Guiana, lower Amazon Valley of Brazil. <i>C. m. phaeopygus</i> (Tschudi, 1844) - upper Amazon and its Eastern tributaries in Colombia, Equador, Peru and Bolivia. <i>C. m. peruanus</i> (Gould, 1861) - Peru and E Bolivia.

SPECIES	REFERENCES ON TAXONOMY
13. White-tailed Goldenthrroat, White-tailed Hummingbird , <i>Polytmus guainumbi</i> [Trinidad] Length: 10.16cm Wingspan: Average • Males:5.55cm; • Females: 5.5cm Weight (g): Average • Males:??? • Females:??? Colour: • <i>Male:</i> upperparts pale bronze-green, brownish head with white streaks above and below eye, underparts leaf green with whitish abdomen, glittering green throat. • <i>Female:</i> As male, but facial streaks and underparts tinged rufous (light red or rust). Bill: • Slightly decurved, fairly long bill (2.54cm), black above, reddish below. Tail: • Outer tail tipped and edged white.	Guianas and N Brazil. <i>P. g. thaumantias</i> (Linnaeus, 1766)- E Bolivia, E Paraguay and C & E Brazil (S Maranhão and Bahia to Mato Grosso do Sul, São Paulo and N Paraná) to NE Argentina.
14. Copper-rumped Hummingbird, Common Emerald, <i>Amazilia tobaci/ Saucerottia tobaci</i> [Trinidad and Tobago] Length: 9.5cm Wingspan: Average • Males:??? • Females:??? Weight (g):Average • Males:??? • Females:???	

SPECIES	REFERENCES ON TAXONOMY
14. Copper-rumped Hummingbird, Common Emerald, <i>Amazilia tobaci/Saucerottia tobaci</i> [Trinidad and Tobago] Colour: • Upperparts generally bronze-green with a pronounced coppery bronze on rump, head and underparts brilliant green, thighs white. Bill: • Straight, fairly long bill (1.9cm) and mainly black; base of lower mandible pinkish in colour. Tail: • Tail black.	[<i>Trochilus tobaci</i>] J. F. Gmelin, 1788, Tobago. <u>Subspecies and Distribution:</u> <i>S. t. tobaci</i> (J. F. Gmelin, 1788) - Tobago. <i>S. t. erythronotos</i> (Lesson, 1829) - Trinidad. <i>S. t. aliciae</i> (Richmond, 1895) - I Margarita, Venezuela. <i>S. t. monticola</i> (Todd, 1913) - NW Venezuela. <i>S. t. feliciae</i> (Lesson, 1840) - NC Venezuela. <i>S. t. caudata</i> (Zimmer&Phelps, 1949) - NE Venezuela. <i>S. t. caurensis</i> (Berlepsch&Hartert, 1902) - E & SE Venezuela. 
15. Long-billed Starthroat, <i>Heliomaster longirostris</i> [Trinidad] Length: 11.43cm Wingspan: Average • Males: 5.88cm; • Females:??? Weight (g): Average • Males: 6.5g • Females:??? Colour: • <i>Male:</i> Upperparts bronze-green, crown blue, white moustachial streak, throat reddish-purple, rest of underparts gray	[<i>Trochilus longirostris</i>] Audebert and Vieillot, 1801, Trinidad. <u>Subspecies and Distribution:</u> <i>H. l. pallidiceps</i> (Gould, 1861) - S Mexico to Nicaragua. <i>H. l. longirostris</i> (Audebert & Vieillot, 1801) - E & SW Costa Rica, Panama and Colombia S to E Bolivia and C & NE Brazil; Trinidad. <i>H. l. albicrissa</i> (Gould, 1871) - W Ecuador and NW Peru.

SPECIES	REFERENCES ON TAXONOMY
15. Long-billed Starthroat, <i>Helimaster longirostris</i> [Trinidad] Colour: with mid-;abdomen and flanks white. • Female: As male, but crown greenish, throat black and edged purple, moustachial streak broader. Bill: • Long, black and almost straight bill (3.81 cm). Tail: • Outer tail black, tipped white; under-tail-coverts black, tipped white.	
16. Black-throated Mango, <i>Anthracothorax nigricollis</i> [Trinidad and Tobago] Length: 11.43cm Wingspan: Average • Males: 6.66cm; • Females:6.49cm Weight (g): Average • Males: 7.3g; • Females: 7.4g Colour: • Males: Throat black bordered with iridescent blue. • Females: Similar to males, occasionally have plumage like that of the males. Bill: • Fairly long (just less than 2.54cm), black and slightly decurved. Tail: • Males: Outer tail chestnut, glossed purple. • Female: Similar to males	<i>Trochilus nigricollis</i>] Vieillot, 1817, Brazil.

SPECIES	REFERENCES ON TAXONOMY
17. Rufous-shafted Woodstar, Jourdan's Woodstar, <i>Chaetocercus jourdanii</i> [Trinidad] Length: • 7cm (a very small, fork-tailed species). Wingspan: Average • Males: 3.55cm; • Females: 3.5cm Weight (g): Average • Males: ??? • Females: ??? Colour: • Male: upperparts bronze-green, throat violet, breast white, abdomen green. • Females: upperparts bronze-green, underparts rufous (light red or rust). Bill: • Straight, black bill (1.27cm). Tail: • Males: Black tail, deeply forked. • Females: Tail light cinnamon with dark bar	[<i>Ornismya jourdanii</i>] Bourcier, 1839, Trinidad. <u>Subspecies and Distribution:</u> <i>C. j. jourdanii</i> (Bourcier, 1839) – Trinidad and NE Venezuela (mountains of Cumaná). <i>C. j. rosae</i> (Bourcier & Mulsant, 1846) – highlands of N Venezuela (Zulia to Distrito Federal). <i>C. j. andinus</i> (Phelps & Phelps, Jr., 1949) – Andes of Venezuela (Lara to Táchira) and E Andes of N Colombia

Source of Taxonomic Information: Citations by del Hoyo *et al* (1999), French (2003)

3.2.5 The External Anatomy of Hummingbirds

Many of the features of Hummingbirds are similar to that of other birds. These features include a head with a crown, beak and eyes, the chin, throat and chest region, the body which possesses the wings, the tail, and lastly, the small feet, (See Figure 3.4).

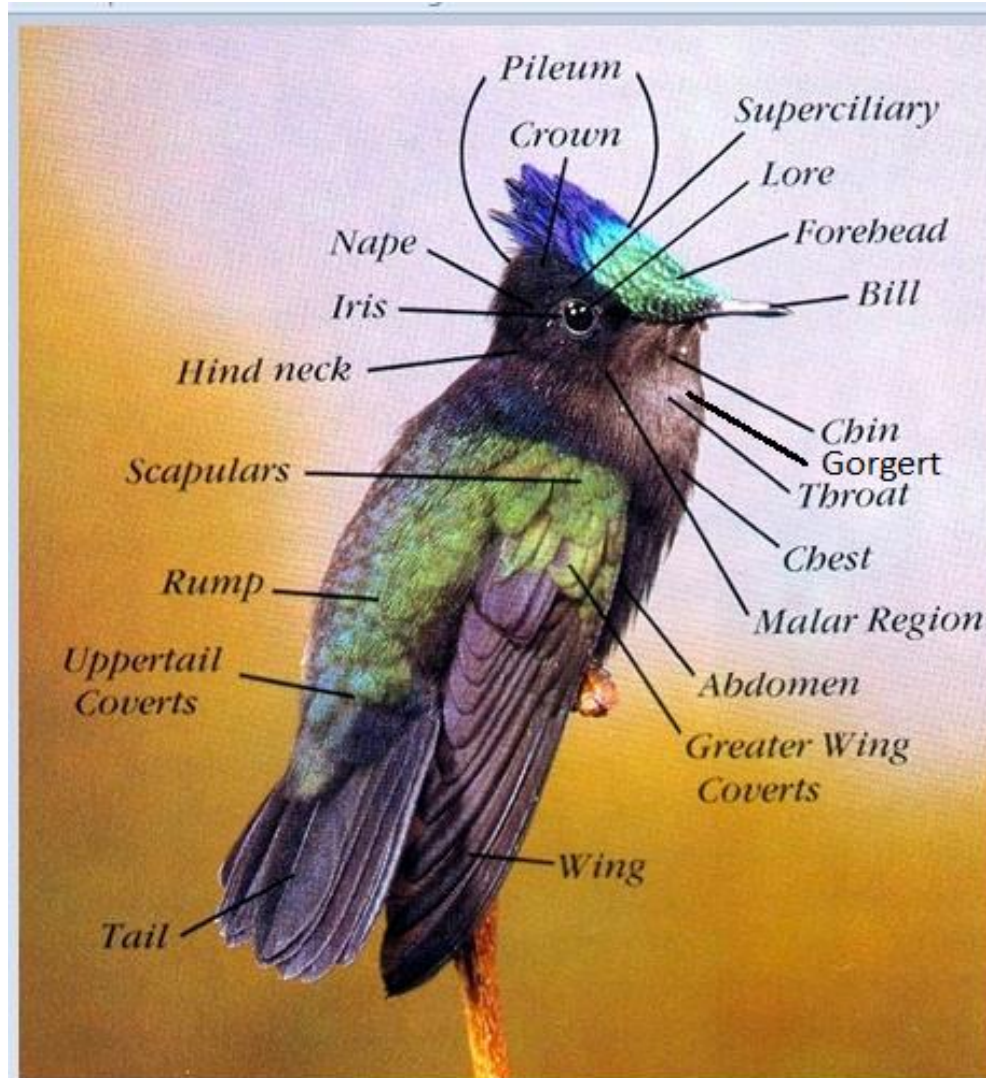


Figure 3.5: The External Anatomy of a Hummingbird
[Source: Tyrrell and Tyrrell, 1990]

3.2.6 The Internal Anatomy of Hummingbirds

3.2.6.1 Skeletal System

The skeletal system is of major importance since it provides a framework for the Hummingbird's entire body. The skeleton also allows for the protection of internal organs and for the attachment of muscles to allow for flying. With respect to the skeletal system, the bones are very light and most of them are hollow. This is due to the overall size of the bird and also, the lightness allows for efficient flying since there is not excessive weight placed on the bird. Although these bones are light and some porous, they are not fragile. As a matter of fact, these bones are stronger than solid bones since some of them are strengthened internally by a series of struts (Tyrrell and Tyrrell, 1985).

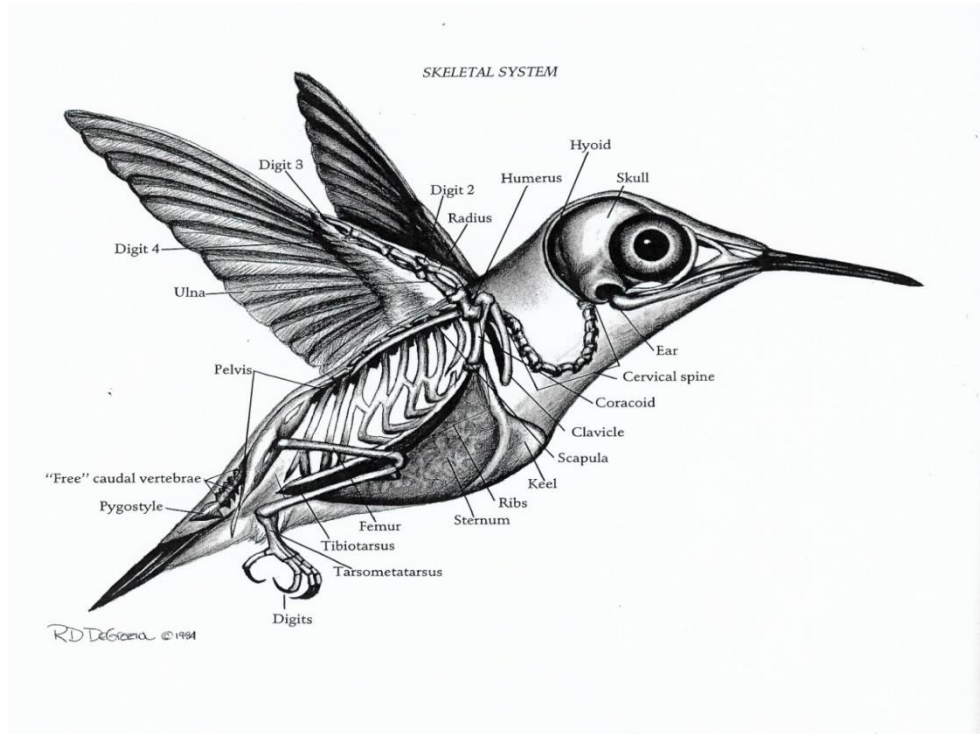


Figure 3.6: The Skeletal System of Hummingbirds
Source: Tyrrell and Tyrrell, (1985)

The skeletal system of Hummingbirds is relatively similar to that of other birds, however, there are certain structures that are unique and are of particular importance. These structures are:

1. The Hyoid apparatus
2. The Sternum
3. Eight pairs of ribs
4. Arm bones
5. The foot
6. The Cervical Vertebra.

1. **The hyoid apparatus** is a special feature found in Hummingbirds and this supports the extendable tongue. It appears as two arms ("horns") which are located under the jaw and extend around the back of the bird's skull. These horns assist with the intake of nectar since they must slide forward to accommodate for the extension of the Hummingbird's very long tongue.

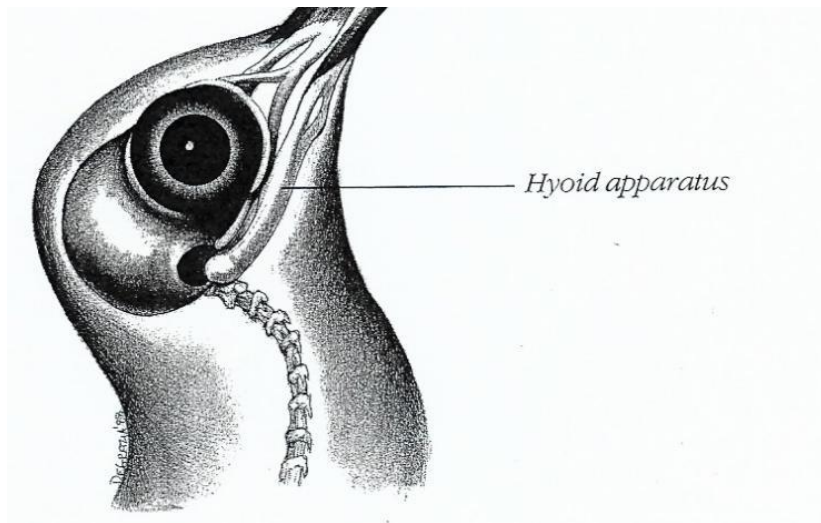


Figure 3.7: The Hyoid Apparatus of Hummingbirds.

Source: Tyrrell and Tyrrell, (1985)

2. **The sternum or breastbone** is also very interesting since it is elongated and relatively larger than that of other birds. It is quite deep, has a rounded edge and extends nearly the entire length of the bird's body. This does serve an advantage since it allows for a greater area of attachment of flight muscles and also because the ridges for muscle attachment are fairly large and quite prominent.
3. Hummingbirds have **eight pairs of ribs**, two pairs more than other birds. These extra ribs help in stabilizing the bird during flight and also serve to protect the delicate lungs.
4. The bones of the pectoral girdle must be very strong to allow for flight and this is associated with strong coracoids. These bones are connected to the sternum and form a shallow cup-and-ball joint. The **arm bones** include the radius, ulna and humerus. These are shortened to a great degree since the hand bones comprise of most of the wing skeleton. The hand bones support 10 (ten) large primary flight feathers. These feathers increase in size from the short, inner portion of the wing straight towards the tip. These feathers along with the arm bones are responsible for the fast beating of the Hummingbird's wings.

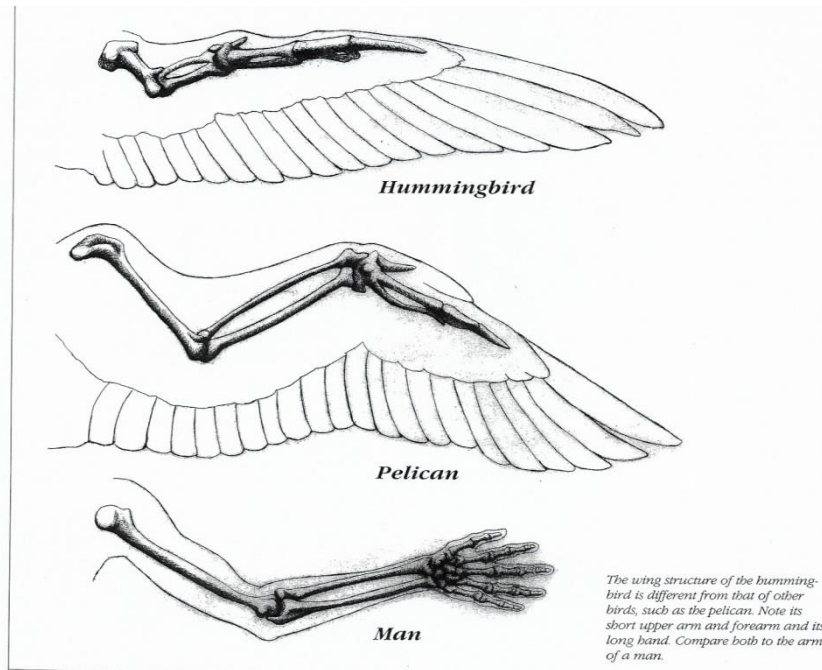


Figure 3.8: Comparisons between the arm bones of a Hummingbird and that of a Pelican and Human.

Source: Tyrrell and Tyrrell, (1985)

5. **The foot** of the Hummingbird comprises four digits, in which case, three point forward while one points backwards. The first digit has two phalanges (joints) and it is the shortest among the four. The second has three joints, the third has four and the fourth has five joints. The third digit is generally the longest among the four digits (toes).
6. **The cervical vertebra** or the neck vertebra is different from other birds. Hummingbirds have between fourteen (14) and fifteen (15) of these. The number of movable cervical vertebra for some other avian species are 13 for chickens, 17-18 for geese, 14-15 for ducks, 12 for pigeons, 11 for parrots and up to 25 for swarms (Koch, 1973).

3.2.6.2 Muscular System

The muscular system along with the skeletal system enables locomotion to take place. Each feather is connected to a muscle of which there are two major kinds, that is, light muscle and dark muscle. There are two main muscles that are involved with flight, the *Musculus pectoralis* major and the *Musculus supracoracoideus*. Both of these muscles are rich in mitochondria and provide energy for flying. The *Musculus pectoralis* major is attached to the sternum, clavicle and humerus. The *Musculus supracoracoideus* is located beneath the pectoralis major and it is also

connected to the sternum. Both of these muscles are relatively large since they must allow for powered flight. The role of the *pectoralis* is to pull the wing downwards, whereas the *supracoracoideus* has an antagonistic role, in which case, it raises the wing. Together, they make up over 30% of the body mass of a Hummingbird, Tyrrell and Tyrrell, (1985).

The heart is also a specialized muscle and beats at extraordinary speeds, that is, 500 to 600 times per minute while the bird is at rest, and over 1,000 times per minute during aggressive behaviours. The heart must be able to beat at fast enough speeds and it must also be able to transport blood throughout the entire body, thereby providing oxygen for the bird's survival. The heart amounts to about 2.5% of a hummingbird's body mass, as compared to other birds, in which case this percentage is lower, Tyrrell and Tyrrell, (1985).

3.2.6.3 Digestive System

The digestive system comprises the buccal apparatus which includes the bill, the mouth with rudimentary salivary glands and a few taste buds and the tongue. It also includes the oesophagus, crop, stomach, small and large intestines and ends with the cloaca.

During feeding, nectar is extracted from the flowers and enters the mouth with the aid of an extendable tongue. Insects and spiders are also consumed since this is a vital feature of the bird's diet. The food material is then swallowed and passes through the walls of the oesophagus and into the crop. The **crop** allows for the moistening and softening of food materials, namely insects and arthropods. The food then enters the stomach and this is divided into the proventriculus and the ventriculus (gizzard). In the proventriculus, gastric juices are produced to break down the food. In the ventriculus, further breaking down occurs with the aid of particles such as sand and gravel. After the ventriculus, food enters the duodenum and small intestines, where bile is secreted from the liver to further break down the food matter. The bile emulsifies fats and neutralizes any traces of acid. Enzymes from the pancreas such as amylase, trypsin and lipase also help with the process, where they break down carbohydrates, proteins and fats respectively. It may take about 4 (four) minutes for the Hummingbird to empty its crop into the small intestines. It is in the small intestines that nutrients are absorbed through the walls and enter the bloodstream. From the small intestines, the food enters the large intestines which are relatively short. **Hummingbirds have no caeca**, which are merely short projections of the large intestines and which provide further bacteriological digestion of nutrients. Therefore, Hummingbirds do not have the capacity to digest fibre. This is not necessary since nearly all the food is already digested by

the time it enters the large intestines. The wastes move along the large intestines and pass through the cloaca, in which case, the waste matter exits the Hummingbird's body (Tyrrell and Tyrrell, 1985).

3.2.6.4 Respiratory System

Hummingbirds have the highest oxygen requirements of all other vertebrates and this is due to the high amounts of energy that they need on a daily basis. The respiratory system must therefore be very effective in carrying out the role of supplying oxygen throughout the entire bird's body. It comprises a trachea, bronchus, two compact, symmetrical lungs and nine thin-walled air sacs which are adapted for utilizing high gas volumes. The trachea forms a passageway for the air to travel, the lungs allow for gaseous exchange and the air sacs, which are connected to the lungs by tubes, allow for increased efficiency of respiration and also help in controlling the overall temperature of the bird's body. When the bird inhales, the air enters the body through two nostril slits and moves to the pharynx. It then enters the glottis at the base of the tongue into the upper end of the windpipe, or trachea. The glottis has a long slit without a protective cartilage flap and it is compressed by rapid reflex movements, which in turn prevents any solid particles from entering the trachea. The trachea, however, comprises cartilaginous rings, with fibrous tissue in between which assists in providing the necessary support and flexibility during locomotion. The air then passes through the bronchi and enters the lungs. With the process of inhalation, the blood becomes oxygenated and this oxygenated blood moves throughout the bird's body, providing all the cells with the required amounts of oxygen. Exhalation on the other hand allows for the removal of waste materials. In this case, carbon dioxide is allowed to exit the bird's body through the nostril slits, Tyrrell and Tyrrell, (1985).

3.2.6.5 Reproductive System

Hummingbirds are oviparous creatures that is, they lay eggs (like other birds). The sexual organs (gonads) of these birds are very small and they remain dormant for most parts of the year. During the breeding season, however, they are known to become enlarged. The male gonads comprise a pair of pale, oval testes, which is located near the kidneys. In most instances, the left testis is larger than the right. Each testis has a coiled sperm duct (vas deferens), that leads to the cloaca. The seminal vesicle, located at the lower portion, acts as a storage receptacle for the sperm. This structure may bulge at times during the breeding season. Initially, the female gonads comprise paired ovaries. However, early in the developmental stages, the right ovary degenerates, thus leaving only a functional left ovary. It is believed that the degeneration of one ovary may be helpful since it prevents the bird from carrying unnecessary weight. In

the ovary, there are a number of egg cells (ova), and some of these become ripe during the breeding season. When the egg becomes fully ripen, it travels down the oviduct with the aid of both muscular contractions and ciliary action, (Tyrrell and Tyrrell, 1985, Figure 3.8).

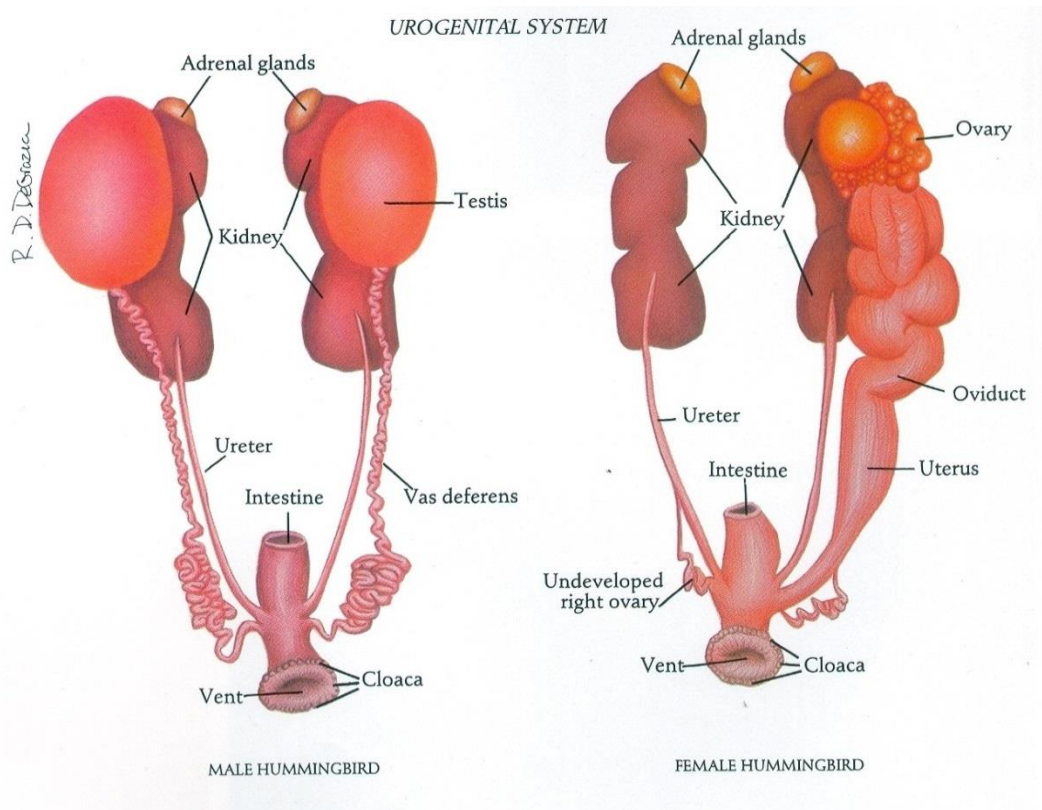


Figure 3.9: The Reproductive System of the Male and Female Hummingbird.

Source: Tyrrell and Tyrrell (1985)

Male gonads produce androgens, while the female gonads produce estrogens. Estrogen originates in the ovary and this stimulates the development and regulation of the female bird's sexual organs and breeding behaviour. The Hummingbird's gonads also secrete other hormones such as progesterone and testosterone (Tyrrell and Tyrrell (1985).

At this point, mating occurs where the male mounts the female's back and presses his cloaca against hers. Here, thousands of sperm is expelled into the cloaca of the female and this then travels up towards the oviduct where they would come in contact with the egg/ovum. Only one of these sperm will be able to penetrate and fertilize the ovum.

Reproduction and Breeding information on the different Hummingbird species of Trinidad and Tobago is limited. This suggested that breeding of the Green Hermit is seasonal and takes place in the dry season

(commonly between January to April). Most of the Hummingbird species in Trinidad and Tobago also have been reported to nest in the dry season. The following are the exceptions:

- ♦ Blue-chinned Sapphire- wet season;
 - ♦ White-tailed Golden throat- dry to wet season;
 - ♦ Long-billed Star throat- wet to dry season;
 - ♦ Copper-rumped Hummingbird/ Common Emerald- most months of the year
- (ffrench 2003).

3.2.7 Mating and Courtship Rituals

In order for mating to occur, the males must be able to advertise themselves to the females. This is done by song, aerial flights and by their iridescent plumage either at traditional display grounds, or at their feeding territories where they are visited by females when receptive to copulation. This behaviour of attracting females is similar to that of a defensive strategy that is used towards food competitors, predators and any other intruder that may enter their territory and feeding grounds. When the female becomes receptive, copulation occurs, and when this is completed, both the male and the female separate. Males are known to be polygamous (which means that they mate with a number of females during the reproductive cycle) (del Hoyo *et al*, 1999).

3.2.8 A Day in the Life of a Hummingbird

Hummingbirds have certain habits that we can use to distinguish them from other birds. They spend over 70% of their time self-preening, singing and sunbathing. This is done on a daily basis. Hummingbirds enjoy bathing and they do this several times a day. Hermits and many Trochilines are known to hover over gently flowing forest streams, and in an instant, dive into the water sometimes submerging their entire bodies. These peculiar dives may be performed several times. Hummingbirds also enjoy gathering moisture and spray from waterfalls, as well as from rainfall, and also, they may bathe in banana and *Heliconia* leaves that have accumulated water or dew. As these birds indulge in their bathing activities, they tend to spread and vibrate their wings, while at the same time, ruffle their body feathers. This is a sign that they are enjoying their daily bathing activities (del Hoyo *et al*, 1999).

Hummingbirds are also known to spend long periods of time self-preening. This process is done with the bill and the claws. The bill is used for oiling as well as for cleaning and arranging the feathers. It is able to preen areas such as the underparts, primaries and secondaries,

wing-coverts, the lower upperparts and the rectrices. The claws are used to clean the head and throat regions and this is done by lifting the foot up and over the wing (del Hoyo *et al*, 1999).

3.2.9 Social Traits in Hummingbirds

Hummingbirds are known to be solitary animals and may only associate with each other around superabundant nectar sources or during mating. They do not show flocking behaviour. These birds tend to establish territories within their habitat which they defend very aggressively. These territories are mainly located around nectar supplies and also around nesting and roosting areas. With the presence of an intruder, vocal warning signs and antagonistic flights are first made by the hummingbird. If the intruder decides to ignore these warning signs and venture into the hummingbird's territory, a physical combat may result. This struggle shows the intruder that the hummingbird is supposed to be dominant in that particular area, (del Hoyo *et al*, 1999).

3.2.10 Torpor

Hummingbirds suffer from low thermal inertia and high heat loss, and as a result, they must therefore conserve energy since flapping is energetically expensive. Most of the energy that they have comes directly from the nectar that they consume, since it is able to supply the daily requirements for a high-metabolism animal such as the hummingbird. To ensure that this energy is conserved, hummingbirds go into a state of torpor which is an energy-regulating mechanism that is triggered below a threshold value, equivalent to a physiological regulation pattern coming into force in extreme conditions. With Neo-tropical trochilids, torpor occurs nocturnally and it follows a regular trend. This energy-controlling system in Neo-tropical birds results in the regulation of certain bodily functions. These include a reduction in metabolism and body temperature. Accompanying this also is the lowering of the heart rate to 50 beats per minute and a reduction in the breathing rate by about 50% compared to activity levels. Nearctic migratory hummingbirds, on the other hand, do not have a specific time of day in which they experience torpor. Also, it is an irregular trend. While in torpor, hummingbirds become lethargic and incapable of reacting in a coordinated way to external stimuli. This is due mainly to the drastic changes in bodily functions that occur in the bird. The duration and depth can vary depending on the size of the energy reserve accumulated during the previous day. Therefore, if the energy reserve is considerably high, then the bird would be able to go into torpor for longer periods as compared to a bird with lower energy reserves. These birds must therefore meet the daily food and energy requirements so that they would be able to survive

during the night without food. There are two main ways that hummingbirds are able to obtain this high energy requirement: firstly, by feeding on flowers which are known to have high quantities of nectar and secondly, setting up their territories in areas where nectar is easily accessible. Because of these two ways, the birds would not need to fly great distances to feed, and therefore, energy would be conserved. It is known that energy savings can account for up to 60% of the total energy accumulated for the nocturnal resting phase, (del Hoyo *et al*, 1999).

3.2.11 The Importance of Hummingbirds

3.2.11.1 Pollination

Hummingbirds play a vital role in nature which involves the cross-pollination of flowers. There is a close mutualistic evolutionary relationship that exists between these birds and the flowering plants. The hummingbirds depend on these plants for food and in turn, these plants depend on the hummingbirds to transport the pollen, thus ensuring for their survival. As a result of this, these flowering plants produce nectar which is used to attract the birds. When the bird feeds on the nectar which is located deep within the flower, pollen sticks to the crown, throat and bill of the bird, and this is transferred from flower to flower. Hummingbirds tend to choose flowers depending on the colour. They prefer flowers whose colours are in the warmer shades of the spectrum, such as red, orange and yellow. In some cases, the colour of the flower is associated with the quantity of nectar, for example, red flowers with tubular corollas generally produce great quantities of nectar. The hummingbirds have a stronger association. It is known that some insects with the exception of butterflies do not readily see the colour red. Also, hummingbirds are not attracted to flowers by scent, which is common in most insects. Therefore, there is less competition with other animals since these flowers are odourless, (Tyrrell and Tyrrell, 1990).

Some hummingbirds are known as “nectar robbers”. This is due to the fact that they consume, or rather steal the nectar of flowers without actually helping in the pollination process. These birds tend to have small bills and because of this, they are unable to withdraw the nectar which is situated deep into the flower. To combat this problem, these birds tend to drill a hole at the base of the flower and here, the nectar is extracted. Obviously, using this technique, pollen would not be transferred onto the bird, and therefore, these birds would have no role to play in pollination, (Tyrrell and Tyrrell, 1990).

3.2.12 Reproduction

3.2.12.1 Nesting Behaviour of Hummingbirds

Nest selection must now occur after mating and this is performed by the female. Many female *Trochilinae* select their nests close to a nectar-rich source. This ensures that food is always available, for both the adult and the hatchlings. In this process, suitable branches are inspected by means of hovering above the surface and repeatedly touching a particular spot to ensure that it is strong enough to provide support. With Hermits however, nest sites are not associated with nearby food sources. With this sub-family, the females select their nesting sites by frequently clinging onto leaves with their feet. This serves to test the strength of the stratum before nest construction can take place (del Hoyo *et al*, 1999).

When choosing a nest site, certain conditions must first be suitable, for example, there must be a balanced microclimate which includes temperature and humidity. Both of these factors are very important for the successful development of the embryos. As a result, nests are often located near waterfalls and streams. The nests must also be placed in areas that provide protection, whether from other trees or branches, so that the nest would not be exposed to direct sunlight or rainfall. Hummingbird's nests are normally tiny and vary with respect to its size, shape and location. For example, members of the genus *Phaethornis* construct small, compact, pendent nests on the leaves of plants. These nests comprise of plant fibres and spider webs. All other Hermits tend to build loose nests with open walls of course material such as dry pieces of leaves and liverworts and rootlets. Their nests are mainly attached to the inner side of a palm plant or *Heliconia* leaf tip. This type of nest structure is an adaptation to the forested areas of Trinidad and Tobago. Most nests are cup-like in shape. However, the locations of nests may vary for example, with *Anthracothorax* and *Florisuga* species. The nests are saddled on branches and on large leaves. With *Phaethornithinae* however, they are fastened beneath a pendular leaf which serves in supplying shelter from the heavy rains. *Phaethornis* nests may be found a few centimeters above the ground as compared to *Anthracothorax* and *Helimaster*, in which case the nests may be found at 10-30m above the ground. Many hummingbirds tend to decorate the outer walls of their nests with various materials. This serves to camouflage the nest and includes materials such as pieces of lichen, dead leaves, rootlets, moss, bark and spider webs, (del Hoyo *et al*, 1999).

The construction of the nests for most species may last for about 5-10 days. In some species, the building process starts early in the morning and ends around mid-afternoon. With other species however, the

building process may occur all day, once the weather conditions are favourable, (del Hoyo *et al*, 1999).

3.2.12.2 Eggs and Incubation Period

Two eggs are white and non-glossy. They have an elliptical oval shape. These eggs are usually laid in the morning periods. In normal circumstances, the first egg is laid and this is followed by an interval of two (2) days, rarely one (1) or three (3), before the second egg is laid. There are some instances where the eggs are laid before the nest is completed. In such a case, the female continues nest construction between the incubation spells. After the eggs are laid, there is the start of incubation. This may begin when the first egg is laid, however, it is more commonly known to occur with the production of the second egg. The incubation period may last from 16-19 days for the majority of Trochilids. Depending on the timing of the start of incubation, the eggs may hatch at intervals of 48 hours or almost synchronously (del Hoyo *et al*, 1999).



Figure 3.10: A Hummy sitting on eggs in Santa Cruz

3.2.12.3 Hatchlings/Hummlings

The new born hummlings are **altricial**, that is, they are nearly unfeathered, blind and helpless. There are three (3) well-differentiated morphological stages in the development process of hatchlings.

- [1] **The first stage is from day one (1) to day five (5).** Here, the hummlings are nearly naked and their eyes are still closed. In this stage, the hummlings are generally inactive and are fed by the mother. The mother, on landing at the edge of the nest, regurgitates food from her crop and this is fed to the babies. The food matter consists of nectar and insects. This process is carried out for a while, that is, until the hatchlings are able to feed themselves. There are no begging calls made at this stage of growth.



Figure 3.11: Newly hatched hummlings in Santa Cruz

- [2] **The second stage is from day six (6) to day nine (9).** There are still no begging calls at this stage. This may be an advantage however, since begging calls made by the hummlings would attract predators to the nest. This would pose a serious threat both to the babies and the nest, as well as the mother. In this stage of growth, the eyes begin to open and there is a great deal of feather development on the wings, tail and back.
- [3] **The third stage covers day ten (10) straight up to day nineteen (19).** At this stage, the young are almost completely feathered and are able to move about readily. These hummlings grow very quickly, reaching almost **80% of their adult mass within 10-12 days** (del Hoyo *et al*, 1999).



Figure 3.12: Third stage hummlings in their nest in Santa Cruz

Weather conditions play a vital role in the upbringing of these birds. If the conditions are unfavourable, development of the hummlings would be retarded and also, the required nesting period would have to be extended for several days. Unfavourable conditions may also lead to hummling mortality, since these babies are not fully equipped with internal control mechanisms, and hence, they are not able to regulate all of their bodily functions effectively.

3.2.13 Hummingbirds' Habitats

Hummingbirds have been able to thrive under an extreme range of conditions which suggests that they may not be as fragile and delicate as they were assumed to be. These remarkable birds have been found 15,000 feet (about 5000 meters) up on the Andean peaks of Cotopaxi and Chimborazo. Here, nocturnal frosts, snowstorms and daily temperatures of a few degrees above zero are the environmental conditions in the Andean regions. Hummingbirds also occur in areas such as arid scrub, desert oasis, Nearctic pine forests, remote islands in the Caribbean and rainforests of the Amazon. However, some of these habitats may be occupied seasonally, that is, during the breeding season or only for short periods of time. These birds may be found in some areas only when there is an abundant supply of nectar, or if conditions are suitable. They would

then leave these areas from time to time when conditions become unfavourable. Migration therefore is common in some Hummingbird species. The habitat requirements of Hummingbirds are still not fully understood. Table 3.3 also suggests that Hummingbirds are found in a wide variety of habitats in Trinidad and Tobago (del Hoyo *et al*, 1999).



**Figure 3.13: Hairy Hermit, Rufous-breasted Hermit (*Glaucis hirsuta*)
the only Hermit found in Tobago**

Table 3.3: Habitat, Feeds and Feeding of the Hummingbirds found in Trinidad and Tobago

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
1. Green Hermit (<i>Phaethornis guy</i>) [Trinidad]	Hill forests, especially near water. Keeps to the undergrowth, sometimes found feeding near clearings. Feeds on the same understory plants as that of the Rufous-breasted Hermit. Also feeds at the bromeliad <i>Tillandsia fasciculate</i> .	Plant nectar and small insects.	 www.avesphoto.com/website/SA/gallery/Gall-4.htm
2. Hairy Hermit, Rufous-breasted Hermit (<i>Glaucis hirsuta</i>) [Trinidad and Tobago]	Resident of forests and secondary growth. Found in the open near forest edges, undergrowth, near streams. Rarely seen more than a few feet above ground. Feeds at understory flowers of <i>Heliconiabihai</i> , <i>Pachystachys occinea</i> and <i>Centropogon surinamensis</i>	Nectar, insects, spiders. Feeds on small invertebrates obtained from leaves and twigs. <i>Erythrinapadilla</i> mainly pollinated by this species. It is one of the main visitors to <i>Heliconiapsittacorum</i>	 http://www.avianweb.com/RufousbreastedHermits.html

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
3. Little Hermit (<i>Phaethornis</i> <i>longuemareus</i>) [Trinidad]	Sometimes seen in the open at the forest edge, mostly found in shaded areas and undergrowth. Common resident of forested areas.	Nectar and small invertebrates. Nectar taken from a large variety of plants, mainly 5 feet above ground. Feeds at <i>Pachystachys</i> and <i>Costusspiralis</i> , also the shrub <i>Palicourea crocea</i> . Occasionally forages at leaves and twigs for small invertebrates. This is one of the main visitors to <i>Heliconia psittacorum</i> .	 http://www.avianweb.com/littlehermithubmingbirds.html
4. White-tailed Sabrewing (<i>Campylopterus</i> <i>ensipennis</i>) [Threatened Species] [Tobago]	Common resident in hill-forested areas of Tobago. Feeds at understory plants.	Small insects, nectar of flowering bromeliads, <i>Heliconia</i> , <i>Palicourea</i> and banana (<i>Musa sp.</i>).	 http://www.birdforum.net/opus/Image:White-tailed_Sabrewing-by_revs45.jpg

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
5. White-necked Jacobin <i>(Florisuga mellivora)</i> [Trinidad and Tobago]	Found in forests at high elevations, seen at a high perch or just above the canopy. Recorded in Tobago feeding at the <i>Inga</i> and <i>Vismia</i> trees and pigeon peas (<i>Cajanus</i>).	Small arthropods, mainly small <i>Diptera</i> and <i>Hymenoptera</i> . Feeds on nectar from the immortal (Erythrina), canopy vines (<i>Noranteaguianensis</i>), <i>Bauhinia</i> , shrubs. Also found hawking 30-40 feet above ground.	 http://www.avianweb.com/white-necked-jacobins.html
6. Brown Violet ear <i>(Colibri delphinae)</i> [Trinidad]	Found at the Northern Range forests. Seen at elevations over 2500 feet. However, between November and February it is found at elevations of 500 feet and up. Found feeding at the Aripo Valley.	Nectar and insects. Feeds at Immortelle trees and other flowers with short corollas, epiphytes, vines and shrubs. Hawks for small flies at treetop levels.	 http://www.avianweb.com/brown-violet-ear-hummingbirds.html

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
7. Green-throated Mango <i>(Anthracothoraxviridigula)</i> [Trinidad]	Uncommon resident of mangrove swamps and marshy savannahs. Recorded in the Northern Range.	Nectar and small insects. Feeds at swamp Immortelle (<i>Erythrina glauca</i>).	 http://www.antpitta.com/images/photos/hummers/gallery_hummers2.htm
8. Black-throated Mango <i>(Anthracothoraxnigricollis)</i> [Trinidad and Tobago]	Found in open garden-like vegetation with bushes and scattered trees, cultivated slopes of mountain ranges. Confined to Tropical areas up to 1,000m.	Feeds on small insects. Obtains nectar from shrubs, vines and tall flowering trees such as the Immortelle, yellow poui (<i>Tabebuiaserratifolia</i>), piercing the corolla tube at its base. Also feeds at Ixora, Hibiscus and <i>Russellia</i> trees.	 Male  Female http://www.antpitta.com/images/photos/hummers/gallery_hummers2.htm

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
9. Ruby Topaz (<i>Chrysolampis</i> <i>mosquitus</i>) [Trinidad and Tobago]	Found in open country, gardens and cultivated areas at lower elevations.	Feeds at large trees such as the samaan (<i>Samanea</i>) and <i>Cordia bicolor</i> . Also feeds at small trees such as the wild ixora (<i>Isertia parviflora</i>) and <i>Citharexylum fruticosum</i> , cultivated crops, e.g. pigeon peas (<i>Cajanus</i>), garden shrubs – <i>Russelia</i> .	 Female  Male http://www.avianweb.com/rubytopazhummingbird.html
10. Tufted Coquette (<i>Lophornis</i> <i>ornatus</i>) [Trinidad]	Found in open cultivated areas, forest edges in the Northern Range up to 2,000 feet, bush savannahs, pigeon pea cultivations.	Small arthropod and nectar of flowering plants such as the orange milkweed (<i>Asclepias curassavica</i>), <i>Stachytarpheta</i> , <i>Lantana camara</i> and cultivated <i>Verbena</i> , pigeon pea flowers. Feeds by trap lining.	 Female  Male www.avesphoto.com/website/SA/species/COQTUF-1.htm

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
11. Blue-chinned Sapphire <i>(Chlorestes notatus; Chlorostilbon notatus)</i> [Trinidad]	Edges of deciduous woodlands, savannas, plantations, fields, town gardens.	Small spiders, insects and insect honeydew. Insects are caught in the air by hawking. Feeds on nectar from flowering plants such as the Hibiscus, <i>Heliconia</i> and coffee bushes.	 Immature Male  Adult Male  Juvenile Female  Female http://www.avianweb.com/bluechinnedsapphire.html

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
12. Blue-tailed Emerald <i>(Chlorostilb-on mellisugus)</i> [Trinidad]	Found in semi-open savannas (xerophytic habitats), scrub, plantations, edge of deciduous woodlands, cultivated areas and canopy areas of orange trees. Found on the Bocas Island.	Small insects and nectar from Hibiscus trees. Some pierce the petals of <i>Laminaceae</i> flowers. Takes honeydew from <i>Diaspididae</i> found in bracaatinga trees. Insects are caught in the air by hawking. Trap lining is also used.	 pancho.cahlander.com/websit e/EC/species/Blue-...
13. White-tailed Hummingbird <i>(Polytmus guainumbi)</i> [Trinidad]	Found in waterlogged savannas and grasslands, open areas, shrubby areas.	Small insects and spiders. Insects are caught in the air by hawking. Spiders are gleaned from the surfaces of vegetation. Nectar is obtained from low growing shrubs, e.g. <i>Russellia</i> , clumps of <i>Heliconia</i> , <i>Leguminosae</i> , <i>Bougainvillea</i> and <i>Lagerstroemia</i> .	 Female  Male http://www.avianweb.com/stripetailedhummingbird.html

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
14. White-chested Emerald <i>(Amazilia chionopectus;</i> <i>Agyrtria brevirostris)</i> [Trinidad]	Open valleys with plantations, forest edges, second growth, clearings. Ranges from sea level to 500m.	Small insects- caught by hawking or by hunting in vegetated areas. Nectar from large trees such as the Immortelle and <i>Samanea</i> . Small trees include <i>Calliandra</i> , herbaceous plants- <i>Pachystachys</i> and <i>Heliconia wagneriana</i> .	 www.mangoverde.com/wbg/spec/ec/spec86-157.html  http://www.birdsinfocus.com/show.php?absID=3216
15. Copper-rumped Hummingbird, Common Emerald. <i>(Amazilia tobaci;</i> <i>Saucerottia tobaci)</i> [Trinidad and Tobago]	Found at levels of up to 2,000 feet. Found near houses, open country, second growth, cultivations and forests. This is one of the most aggressive Hummingbirds in Trinidad and Tobago.	Small insects (flies) - caught in the air by hawking. Nectar from small flowering plants such as the <i>Calliandra</i> , <i>Isertiaparviflora</i> , large trees such as the Immortelle, shrubs, e.g. <i>Palicourea</i> , <i>Ixora</i> , <i>Hamelia</i> , <i>Lantana</i> , <i>Russellia</i> , <i>Costus scaber</i> , <i>Centropogon surinamensis</i> , <i>Renealmia exaltata</i>	 Copper-rumped Hummingbird by Judd Patterson http://www.flickr.com/photos/96046307@N00/galleries/72157624598183624/#photo_4836486978

COMMON NAME	HABITAT	FOOD AND FEEDING	IMAGES & SOURCE
16. Longbilled Starthroat <i>(Heliomaster longirostris)</i> [Trinidad]	Found at forested country at all levels, clearings, gardens-in more open sub urban areas.	Small insects (flies and gnats), small arthropods, flies (<i>Diptera</i> and <i>Hymenoptera</i>). Trap lines small flowering trees. Obtains nectar from large trees (where the flowers have long, narrow corollas), flowers of climbing vines, e.g. <i>Mandevillahirsuta</i> , shrubs, <i>Heliconia</i> , cultivated bananas. Also feeds at <i>Ixora</i> , <i>Erythrina</i> and <i>Tabebuia</i> trees. The main pollinator of <i>E. padilla</i> .	
17. Rufous-shafted Woodstar <i>(Chaetocercus jourdanii)</i> [Trinidad]	Found in coffee plantations, Nature centres, forested areas.	Small insects which are caught in the air by hawking. Seen feeding at flowers of the <i>Inga</i> trees and at shrubs such as the <i>Leonotisnaptaeifoliae</i> and vervain (<i>Verbena</i>).	

Sources of Information: ffrench (2003), del Hoyo, Elliott, Sargatal (1999), Feinsinger (1983), Feinsinger, Wolfe and Swarm (1982), Linhart and Feinsinger (1980), Feinsinger, Linhart, Swarm and Wolfe (1979), Feinsinger, Swarm and Wolfe (1985), Feinsinger and Swarm (1982).

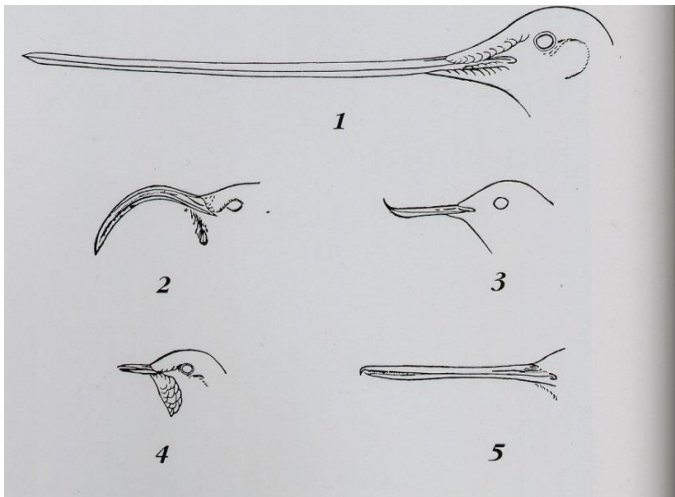
3.2.14 Feeding and Nutrition in Hummingbirds

Hummingbirds are both nectarivores and insectivores. They cannot survive on a diet of only sugars, that is, they also need some kind of protein in their diets. This is very important to note as they do not contain a caecum, and as a result, their system does not produce microbial protein. Trochilids depend a great deal on the carbohydrate-rich sugar secretions (nectar) of ornithophilous flowering plants. Their diets comprise 90% nectar and 10% arthropods and pollen. The daily energy requirement of a 4-5gram Hummingbird is approximately 30-35kJ, and this amounts to five times the estimated basal metabolic rate. In order for these birds to meet their energetic needs, they must consume nectar from about 1,000-2,000 flowers every day. **Water is also of major importance and it is estimated that the daily water intake**

with nectar meals amounts to about 160% of the bird's body mass, (del Hoyo *et al*, 1999).

3.2.14.1 Bill/Beak

The bill of the Hummingbird is elongated and needle-like. It can be of various shapes, for example, straight, decurved or even curved upwards. The length and shape of the bill is directly related to the type of feeding habits that the bird possesses. This would involve the types of flowers that the Hummingbird feeds on and also how deep within the flower the nectar is located.



Hummingbird bills come in a variety of shapes and sizes.

(1) Sword-billed

Hummingbird,

(2) White-tipped Sicklebill,

(3) Fiery-tailed Aowlbill,

(4) Purple-backed Thornbill,

(5) Tooth-billed Hummingbird

Figure 3.14: Different shapes and sizes of Hummingbirds' beaks.

Source: Tyrrell and Tyrrell, (1985)

Figure 3.13 displays the different shapes and sizes of the beaks of Hummingbirds. One main function of the bill is to protect the specialized, very sensitive, translucent tongue. The tongue which is controlled by the hyoid apparatus is extendable and biforked and this allows for the uptake of nectar. The tongue is muscular and the proximate half is cartilaginous. The distal half, however, is divided lengthwise, thus forming two separate membranous curled troughs, see Figure 3.14. The frontal region is essential in nectar drinking processes, since the liquid nectar is carried into the external troughs by capillary action. It is known that the Hummingbird has 40-60 taste buds which are located in the posterior region of the mouth, (Tyrrell and Tyrrell 1985). Figure 3.15 shows the different beaks of the different types of Hummingbirds in Trinidad and Tobago (Feinsinger Swarm and Wolfe, 1985).

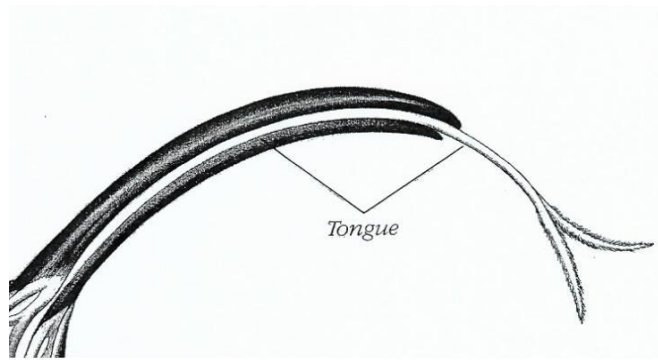


Figure 3.15: Extendable and Biforked tongue of a Hummingbird.
Source: Tyrrell and Tyrrell, (1985)

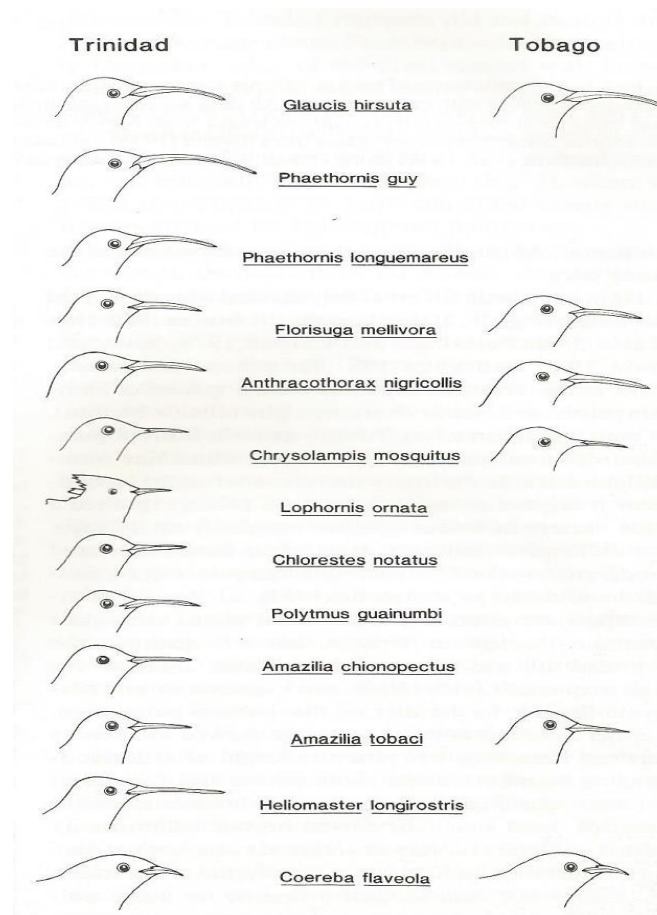


Figure 3.16: The different beaks of the majority of hummingbirds in Trinidad and Tobago [Feinsinger, Swarm and Wolfe, 1985]

The following are some important points to note on the feed intake of Hummingbirds:

1. It was estimated that Hummingbirds consume a daily ratio of nectar to arthropods of approximately 9:1 by mass. Nectar is therefore one of the main food sources for Hummingbirds. Nectar is an excellent source of quick energy and is easily digested. This is of major importance since these birds have a very high metabolic rate. It also supplies the necessary energy that the animal needs for the highly evolved muscular system of Trochilids. It also allows for the growth and renewal of body tissue, maintenance of body temperatures at 40-42°C (endothermy) and other important biological functions including reproduction.
2. Hummingbirds may consume up to 50% of its weight in nectar everyday. This is collected by a licking motion of the tongue at a rate of about 13 licks per second, (3-13 licks per second) (del Hoyo *et al*, 1999).

In aviaries, there may also be the use of artificial nectar. The formula for this was derived after a very long process of trial and error. The liquid used comprises of a mixture of **glucose, fructose and saccharose** which is all diluted in water to a **concentration of about 10%**. Glucose is a monosaccharide sugar that is found in most plant and animal tissues. It is present in the bloodstream as a circulating sugar and is capable of providing high amounts of energy for the body. Fructose is also a monosaccharide and it is known to be the sweetest naturally occurring sugar. It may be produced by the breakdown of sucrose. Sucrose or saccharose is a crystalline disaccharide sugar that comprises both glucose and fructose. It is found in many plants and is known to be sweeter than glucose. However, the protein element in the diet would vary since some species are more sensitive to this than others. Lowland species are said to be “less sensitive” than the upland species, and therefore, the protein supplemental intake would vary from species to species. If the protein intake is unfavourable, that is, too high, the bird would become very ill, (del Hoyo *et al*, 1999).

The sugar concentration of the nectar of the flowers from *Erythrina pallida* was equivalent to 29% [29g sucrose/100g of solution], that of *E. fusca* and *E. poeppigiana* was 16.5% (Feinsinger, *et al* 1979), that for *Justica secunda* and *Mandivilla hirsuta* ranged 20.6 to 23.4% and 31 to 40% respectively (Linhart and Feinsinger 1980). These are all flowers visited by hummingbirds in Trinidad and Tobago. The sugar concentration of the nectar was measured using hand refractometers that measure the Brix in the liquid. This is similar to the technique used in the Sugaracane Industry to measure the sugar content of the standing cane.

3.2.14.2 Feeding Patterns

There are three main feeding patterns that are used by Hummingbirds. These are Trap lining, Hawking and Hover-gleaning.

Trap-lining

Hummingbirds, especially Hermits, feed by means of trap lining. In such a case they circulate along a regular route visiting the same plants in a particular sequence. Trap liners do not establish territories. Instead they choose to feed from flowers found in the extensive areas over which they roam.

Hawking

Hawking is common in short and straight-billed species. With this process, the insects are caught in the air by the birds.

Hover gleaning

Long-billed species such as Hermits are specialized insect gleaners. In this case, they collect the prey (arthropods) from plant substrate or from spider webs (del Hoyo *et al* 1999).

Table 3.3 presents the habitats, feeds and feeding of the Hummingbirds of Trinidad and Tobago. This can serve as a guide for us so that we would know where to look for them if we wanted to enjoy seeing these birds.

3.2.14.3 Seasonality and Feed Supply for Hummingbirds with particular reference to Trinidad and Tobago

In most Neo-tropical habitats the abundance of hummingbird food varies greatly over the year, as different plant species flower (Feinsinger and Swarm, 1982 summarising the work of Feinsinger 1976, 1980, Wolf *et al* 1976 and Stiles 1978, 1980). Feinsinger and Swarm (1982) reported that there were three (3) “Seasonal Feeding Phases” for *Amazilia tobaci* in Trinidad and Tobago as follows:

1. ***Erythrina-Acanthaceae* Phase**- mid December to March when four species of plants flower profusely, *E. poeppigiana*, *E. fusca*, *Justica secunda* and *Pachystachys coccinea*,
2. ***Heliconia- Hemelia* Phase**- April to August when *Heliconi awagneriana* and *Hamelia patens* flowers, and
3. **Food Shortage Phase**- September to early December when there is a shortage of nectar due to limited flowering of plants during the heavy rains.

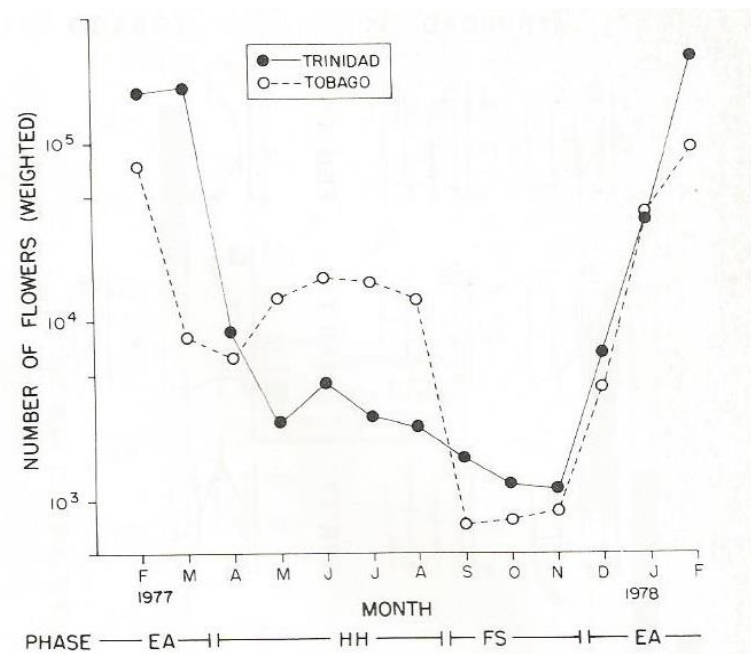


Figure 3.17: Annual Necta Density in Trinidad and Tobago
[Source: Feinsinger and Swarm (1982)]

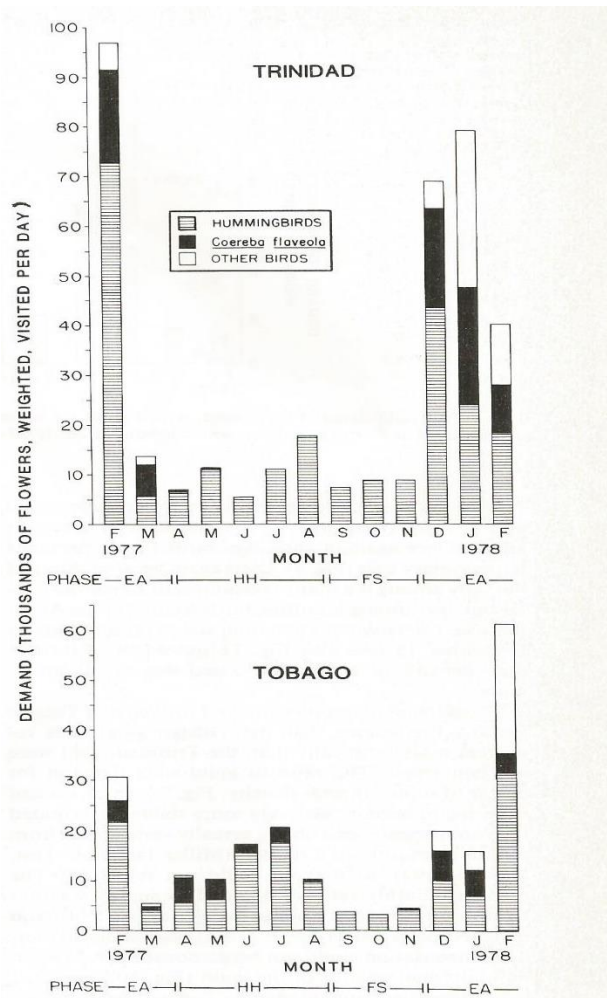


Figure 3.18: Guild Demand for Nectar

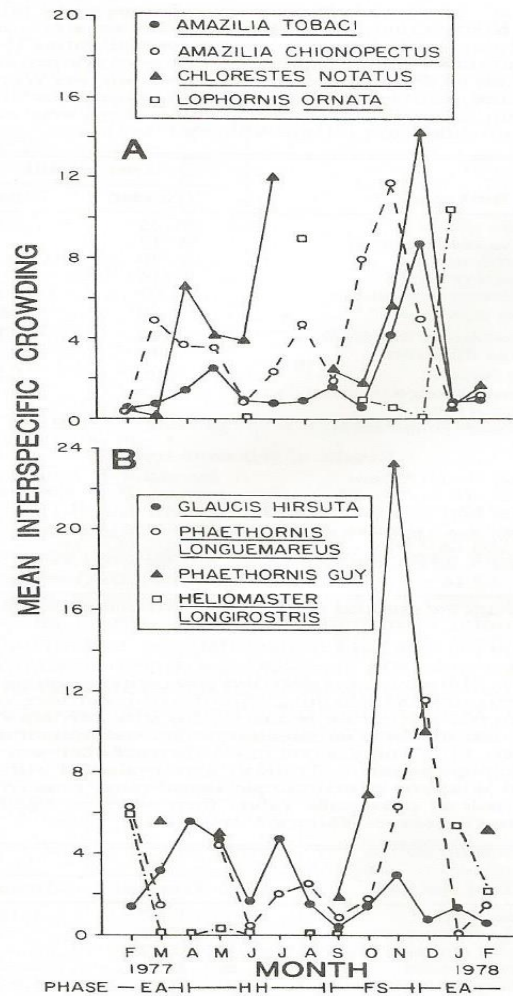


Figure 3.19: Intensity of exploitative competition

[Source: Feinsinger *et al* (1985)]

3.4.14.4 Flowering Plants visited by Hummingbirds in Trinidad and Tobago

In the areas studied in Trinidad and Tobago the minimum number of resource sites that were available to Hummingbirds during a month was 13 (Feinsinger and Swarm 1982). The following [supported by information in Table 3.4] was the list of flowering plants available to Hummingbirds in Trinidad and Tobago as suggested by Feinsinger and Swarm (1982):

TREE species

1. *Erythrina fusca* [T&T]
2. *E. poeppigina* [T&T]
3. *Vismia.falcata* [T&T]
4. *Inga edulis* [Tobago]

SHRUBS

5. *Hamelia patens* [T&T]
6. *Gonzala guniaspicata* [T&T]
7. *Lantena camera* [T&T]
8. *Isertiaparviflora* [Trinidad]
9. *Pachystachy soccinea* [Trinidad]
10. *Stachytarpheta jamaicensis* [Vervine] (Theodore Ferguson, 2013, Personal communication)

HERBACEOUS PLANTS COMMON TO BOTH T&T

11. *Mandivilla hirsuta* [year round flowering, yellow and red flowers]
12. *Justicia secunda* [year round flowering, rose red zygomorphic flowers] 11] and 12] visited by 9 species of hummingbirds (Linhart and Feinsinger, 1980)
13. *Heliconia wagneriana*
14. *H. psittacorum*
15. *Costus scaber*
16. *Asclepias curassavica*
17. *Miconia sp.*
18. *Piper sp.*
19. *Costus scaber* [visited by *A. tobaci* in T&T during the food shortage period - September to December]
20. *Centropogon surinamensis* [visited by *A. tobaci* in T&T during the food shortage period- September to December]
21. *Renealmia exaltata* [visited by *A. tobaci* in T&T during the food shortage period- September to December.

Table 3.4: Various flowering Plants visited by Hummingbirds in Trinidad and Tobago

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
Tree Species		
ahuijote (Spanish) bucago (Spanish) bucare (Spanish) bucayo coral-bean (English) gallito de pantano (Spanish) palosanto (Spanish) purple coraltree (English) swamp immortal (English)	<i>Erythrina fusca</i>	 
amasisa [(Spanish (Peru))] anauca (English) bucaro [(Spanish (Colombia))] ceibo [(Spanish (Bolivia))] coraltree (English) eritrina-do-alto [Portuguese (Brazil)] immortal-tree (English) mountain immortal (English) poróextranjero (Spanish) porógigante (Spanish) saibo (Spanish) sinã [Portuguese (Brazil)] http://luirig.altervista.org/biology/main.php?taxon=Erythrina+poepigiana	<i>Erythrina poeppigiana</i>	 
	<i>Vismia falcata</i> <i>Vismia falcata</i> Rusby	

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
chalaite (Spanish) cuajiniquil (Spanish) guaba (Spanish) ice-cream-bean (English) icecreambean inga-cipó (Portuguese) pacay (Spanish) pois doux (French)	<i>Inga edulis</i>	   <i>Inga spectabilis</i> (Fabaceae)
Shurbs		
Firebush, Scarlet bush	<i>Hamelia patens</i>	  http://www.plantcreations.com/hamelia_patens.htm  http://edis.ifas.ufl.edu/fp237

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
Mata De Mariposa	<i>Gonza laguniaspicata</i>	
Lantana	<i>Lantana camara</i>	 http://www.iewf.org/weedid/Lantana_camara.htm
	<i>Isertia parviflora</i>	

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
Cardinal's guard, Red Shrimp Plant http://www.rareflora.com/pachystachyscoc.htm	<i>Pachystachys coccinea</i>	 http://toptropicals.com/catalog/uid/pachystachys_coccinea.htm
Vervine	<i>Stachytarpheta jamaicensis</i>	

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
HERBACEOUS PLANTS		
savannah flower http://luirig.altervista.org/biology/main.php?taxon=Mandevilla+hirsuta	<i>Mandevilla hirsuta</i>	  http://www.brazilplants.com/apocynaceae/mandevilla-hirsuta-Prado.html http://herbario.up.ac.pa/Herbario/herb/vasculares/view/species/310
blood root, St. John, St. John's bush http://ecflora.cavehill.uwi.edu/plantsearch.php?search_method=scientific_name&searchtxt=Justicia+secunda&source=index&offset=0&rows=10	<i>Justicia secunda</i>	  http://ecflora.cavehill.uwi.edu/images.php?pid=11&sn=Justicia+secunda&cn=blood+root%2C+St.+John%2C+St.+John%27s+bush&gh=herb

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
Heliconia http://ntbg.org/plants/plant_details.php?plantid=6019	<i>Heliconia wagneriana</i>	  http://ntbg.org/plants/plant_details.php?rid=630&plantid=6019
Parakeetflower Heliconia Parakeet flower Parrot's Beak Parrot's Flower Parrot's Plant Parrot's Tonque Popokaytongo	<i>H. psittacorum</i>	  http://ntbg.org/plants/plant_details.php?plantid=5957

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
Spiral or Indian Head Ginger http://www.onlineplantguide.com/Plant-Details/3425/	<i>Costus scaber</i>	 http://www.onlineplantguide.com/Plant-Details/3425/
Scarlet Milkweed, Mexican Milkweed, Blood flower, and Silkweed http://www.nababutterfly.com/milkweed_tropical.html	<i>Asclepias curassavica</i>	 http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=c376#AllImages

COMMON NAMES	SCIENTIFIC NAMES	IMAGES
<i>miconia</i>	<i>Miconia sp.</i>	
	<i>Piper sp.</i>	

3.2.15: Conclusions

The following is the list of the conclusions compiled from the literature reviewed:

1. The most informative document on Hummingbirds was edited by del Hoyo *et al* (1999), it was contained within a book containing 759 pages of which 213 pages (28.1%) were devoted to Hummingbirds [the Family of birds called Trochilidae], however, this book is generally out of the reach of the average reader as it is a very large and expensive reference text.
2. There was an absence of information on the anatomy, physiology, nutrition and ecology of the Hummingbird that is on the Coat of Arms of Trinidad and Tobago (*Phaethornis guy guy*).
3. There was also an absence of information on the Hummingbird species present in Trinidad and Tobago in particular **the White-tailed Sabrewing (*Campylopterus ensipennis*)** that was and is a threatened Neo-tropical species and found only in Tobago in the twin island state.
4. The body of work on the Hummingbirds of Trinidad and Tobago reported on by Pete Feinsinger and his collaborators between 1977 and 1985 [almost 30 years ago], working out of the Asa Wright Nature Centre, seemed to have been all the local research work conducted with these birds in this country. This work now needs to be built upon.
5. The Hummingbirds in Trinidad and Tobago experience periods on “Feed Shortages” or “Nutritional Stress” during the periods of heavy rainfall when there is limited flowering and this is also accompanied by limited nesting.
6. Trinidad is called the land of the Hummingbirds but it only has 16 [as the White-tailed Sabrewing is found only in Tobago] of the 328 species contained within the Neo-tropics or 4.9% of all Hummingbirds.
7. The Hummingbirds are truly remarkable animals and there is need to better understand these animals to ensure that they are sustainably conserved for this and future generations of Trinidad and Tobago.

3.2.16: Recommendations for Future Work

1. There is the need to establish a “Core Group” of workers to focus on the Hummingbirds of Trinidad and Tobago which should ideally include participants from the following:
 - i. Private Gardens, such as Yerette’s Humming Bird Garden
 - ii. Public Parks and Gardens
 - iii. The Horticulture Society of Trinidad and Tobago
 - iv. The Asa Wright Nature Reserve
 - v. Grafton Estate, Tobago
 - vi. The Zoological Society of Trinidad and Tobago
 - vii. The Agricultural Society of Trinidad and Tobago
 - viii. The University of Trinidad and Tobago
 - ix. The University of the Southern Caribbean and
 - x. The University of the West Indies.
2. The work should begin in already established gardens that are frequently visited by Hummingbirds with the following priorities:
 - i. to establish which species are the most popular visitors to these gardens,
 - ii. to get an understand of what could be done to attract the infrequent visitors,
 - iii. to observe what the infrequent visitors feed upon at these and other locations and
 - iv. to develop a manual for Home-owners and Gardeners on **“How to attract Hummingbirds into your Gardens in Trinidad and Tobago”**.
3. In Tobago the priority should be the **the White-tailed Sabrewing (*Campylopterus ensipennis*)** and the following should be the first set of objectives:
 - i. to identify the locations where it is found,
 - ii. to observe what it feeds upon and to evaluate the composition of the nectars from these plant species,
 - iii. to establish more of the species that it feeds upon,
 - iv. to do what is necessary to enhance its year round feed supply,
 - v. to observe its reproductive patterns and
 - vi. to introduce measures to enhance its reproduction.
4. Begin work on the anatomy, physiology, nutrition and ecology of the Hummingbirds of Trinidad and Tobago beginning with the one that is on the Coat of Arms of Trinidad and Tobago (*Phaethornis guy*) and with one of the more popular and larger of the

- Hummingbirds e.g. the White-neck/White-bellied Jacobin (*Florisuga mellivora*).
5. Establish a network with other Hummingbirds Focus Groups in the Neo-tropics and participate in the COMFAUNA [website: comfauna.org or fundamazonia.org].

3.2.16 REFERENCES

- del Hoyo, J., Elliott, A. & Sargatal, J. eds. (1999): *Handbook of the Birds of the World. Vol. 5 Barn-owls to Hummingbirds*, Lynx Edicions, Barcelona
- Feinsinger, P. (1980a): Asynchronous Migration Patterns and the Coexistence of Tropical Hummingbirds. [In *Migration of Tropical Hummingbirds*] *Migrant birds in the Neotropics; Ecology, Behaviour, Distribution and Conservation*, A. Keast and E.S. Morton (Editors) Smithsonian Institution Press, Washington, DC, USA. pp. 411-419
- Feinsinger, P. (1983): Variable Nectar Secretion in a *Heliconia* Species Pollinated by Hermit Hummingbirds. *Biotropica* **15**(1): 48-52
- Feinsinger, P., Linhart, Y.B.; Swarm, L.A. and Wolfe J.A. (1979): Aspects of the pollination biology of three *Erythrina* species of Trinidad and Tobago *Annals of the Missouri Botanical Garden* **66**:451-471
- Feinsinger, P. and Swarm, L.A. (1982): "Ecological Release", Seasonal Variation in Food Supply, and the-Hummingbird *Amaziliatobaci* on Trinidad and Tobago. *Ecology* **63**(5): 1574-1587
- Feinsinger, P., Swarm, L.A. and Wolfe, J.A. (1985): Nectar feeding Birds of Trinidad and Tobago: Comparison of diverse and depauperate guilds. *Ecological Monographs* **55**(1): 1-28
- Feinsinger, P., Wolfe, J.A. and Swarm, L.A. (1982): Island Ecology: Reduced Hummingbird Diversity and the Pollination Biology of Plants, Trinidad and Tobago, West Indies. *Ecology* **63**(2): 494-506
- French, R. (1973): *A Guide to the Birds of Trinidad and Tobago*. First Edition; Christopher Helm (Publishers) Ltd, London; Revised Editions Published in 1976, 1980 by Harrowood Books
- French, R. (1991): *A Guide to the Birds of Trinidad and Tobago*. Second Edition; Cornell University Press
- French, R. (2003): *A Guide to the Birds of Trinidad and Tobago*. Second Edition; Christopher Helm (Publishers) Ltd, London
- French, R. (2012): *A Guide to the Birds of Trinidad and Tobago*. Second Edition; Cornell University Press
- Garcia, G.W. and Archibald, K.A.E. (2001): The Philosophy of the Open School of Tropical Animal Science and Production. *Proceedings of the Caribbean Food Crops Society 37th Annual Meeting* **Volume XXXVII**: 20-27
- Grant, K. A. and Grant, V. (1968): *Hummingbirds AND THEIR FLOWERS*. Columbia University Press, New York and London

- Koch, T. (1973): *Anatomy of the Chicken and Domestic Birds*, Iowa State University Press, Ames, Iowa
- Krebbs, K; Rimlinger, D and Mace, M; (2004): *Hummingbird Husbandry Manual*. American Zoo and Aquarium Association PACT TAG
- Linhart, Y.B. and Feinsinger, P. (1980): Plant-Hummingbird interactions: Effects of island size and degree of specialization on Pollinations. *Journal of Ecology* **68**:745-760
- Scheithaur, W. (1967): *Hummingbirds Flying Jewels*. Arthur Barker Limited, 5 Winsley Street, London W1, UK
- Thompson, B. and Toops, C. (1984): *Hummingbirds and Butterflies*. Backyard Bird Guides, Bird Watcher's Digest, Houghton Mifflin Harcourt Publishing Company, Boston and New York, 288 pages
- Tyrrell, E.Q and Tyrrell, R.A. (1985): *Hummingbirds their life and behaviour: a photographic study of the North American Species*. First Edition, Crown Publishers, Inc., One Park Avenue, N.Y. 10016 USA. 212 pages
- Tyrrell, E.Q. and Tyrrell, R.A (1990): *Hummingbirds of the Caribbean, their life and behavior: a portfolio of the Caribbean species*, First Edition, Crown Publishers Inc., N.Y. USA. 238 pages

3.2.17 Additional Hummingbird References

- Baker, H.G. and Baker, I. (1975): Studies of Nectar-constitution and pollinator-plant co-evolution in L.E. Gilbert and P.H/ Raven (editors) *Coevolution of Animals and Plants*. University of Texas Press, Austin, Texas
- Feinsinger, P. and Chaplin, S.B. (1975): On the relationship between wing disc loading and foraging strategy in hummingbirds. *American Naturalist* **109**:217-224
- Feinsinger, P. (1976):- Organisation of a tropical guild of nectarivorous birds. *Ecological Monographs* **46**:257-291
- Feinsinger, P., (1978): Ecological interactions between plants and hummingbirds in a successional tropical community. *Ecological Monographs* **48**:269-287
- Feinsinger, P. (1983): Variable nectar secretion in a Heliconia species pollinated by hermit hummingbirds. *Biotropica* **15**:48-52
- Feinsinger, P. and Colwell (1978): Community organization among Neotropical nectar-feeding birds. *American Zoologist* **18**:779-795
- Feinsinger, P. (1979): Between-patch migration and the coexistence of tropical hummingbirds. In *Migrant Birds in the New World Tropics: Ecology, Behaviour and Conservation* (Ed. By A. Keast and E.S. Morton) Smithsonian Institution Press, Washington D.C. USA
- Feinsinger, P., Colwell, R.K.; Terbangh, J.; Chaplin, S.B, (1979a): Elevation and the Morphology, Flight energetics and foraging ecology of tropical hummingbirds. *American Naturalist* **113**:481-497

- Feinsinger, P. (1980b): Sugar Analysis of Floral nectar and their significance. In T.S. Elias and B.L. Bentley (editors) *The Biology of Nectaries*, Columbia University, N.Y.
- Feinsinger, P.; Spears, E.E., and Poole, (1981): A simple measure of niche breadth. *Ecology* **62**:27-32
- Hainsworth, F.R., Wolf, L.L. (1972): Energetics of nectar extraction in a small high altitude, tropical hummingbird, *Selasphorus flammula*. *Journal of Comparative Physiology* **80**:377-387
- Hayes, F. E. and Samad, I. (1998): Diversity, abundance and seasonality of birds in a Caribbean pine plantation and native broad-leaved forest of Trinidad, West Indies, *Bird Conserv. Int.* **8** (1):67-87
- Pyke, G. H. (1978): Optimal foraging in Hummingbirds: Testing the marginal value theorem. *American Zoologist* **18**:739-752
- Snow, B.K. and Snow, D.W. (1972): Feeding Niches of hummingbirds in a Trinidad Valley. *Journal of Animal Ecology* **41**:471-485
- Stiles, F. G. and Wolf, L.L. (1973): Techniques for color marking hummingbirds. *Condor* **75** (2):244-245
- Stiles, F.G. (1975): Ecology, Flowering phenology and Hummingbird pollination of some Costa Rican Heliconia species. *Ecology* **56**:285-301
- Stiles, F.G. (1978): Temporal organization of flowering among the hummingbird Foodplants of a tropical wet forest. *Biotropica* **10**:194-210
- Stiles, F.G. (1980): The annual cycle in a tropical wet forest hummingbird community. *Ibis* **122**:322-343
- Stiles, F.G. (1977): Coadapted Competitors: The flowering seasons of Hummingbird Pollinated Plants in a Tropical Forest. *Science* **198**:1177-1178
- Wolf, L.L., Stiles, F.G. and Hainsworth, F. R. (1976): Ecological Organization of a tropical, highland, hummingbird community. *Journal of Animal Ecology* **45**:349-379

PART 3.3

Production Modelling for Hummingbirds



Figure 3.20: An adult male [Hummer] White-necked/White-bellied Jacobin [Florisuga mellivora]

3.3.1 Introduction

The contents of this section have been organized to be used as a guide to enhance your appreciation of Hummingbirds and for attracting these animals into your home garden. It attempts to be as informative as possible. We must admit that although the focus of Booklet #3 was to be on the *Phaethornis guy*, we soon discovered that there was very little scientific information published on this species. We therefore made every effort within the space and time limitations to compile what was known on those species present in Trinidad and Tobago. At the same time, we tried to present to you in the literature reviewed the important generalized information on Hummingbirds' anatomy, feeding and reproduction. In outlining for you the Production Modelling for Hummingbirds, we were guided by the following document, Krebs, K; Rimlinger, D and Mace, M; (2004): ***Hummingbird Husbandry Manual***. American Zoo and Aquarium Association, Silver Spring, Md. PACT TAG.

The **Association of Zoos and Aquariums** (previously **American Zoo and Aquarium Association**) was originally the **American Association of Zoological Parks and Aquariums**. It was founded in 1924 and is a nonprofit organization dedicated to the advancement of zoos and public aquariums for conservation, education, science, and recreation. The AZA headquarters is located in Silver Spring, Maryland. Additionally we would like to suggest to you that you could also read other reader friendly books on Hummingbirds. We do hope that you enjoy using this part of the book either for conserving or for attracting our Hummingbirds into your gardens. We shall begin this section by highlighting for you a beautiful Hummingbird garden in Trinidad.

3.3.2 Yerette- the Theodore and Gloria Ferguson's Hummingbird Garden

There is a hidden gem with respect to Hummingbirds in Trinidad. This is the home garden of Dr Theo and Mrs. Gloria Ferguson and it is called **Yerette - Home of the Hummingbird**. It is located at 88 Valley View Maracas, Trinidad, Trinidad and Tobago. This place is worth a visit if you are really interested in hummingbirds and Dr. Theo Ferguson who is better known as "Fergie" is an excellent host and educator. The following are the Websites:

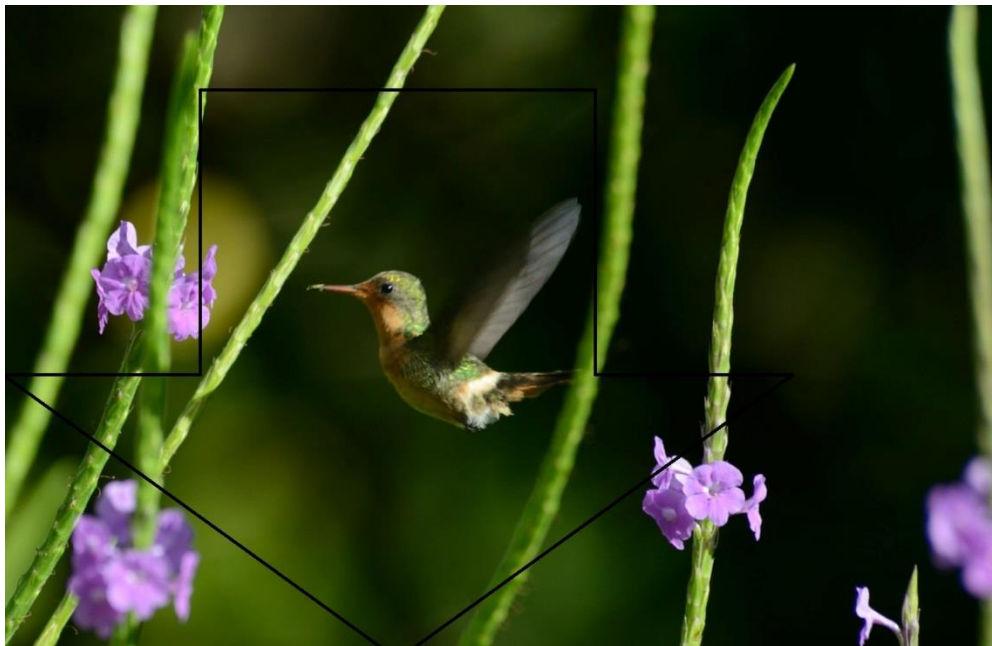
<http://yerette.com/about.swf>

[http://introvertlybubbly.com/can-find-home-hummingbird-leisurely-peaceful-therapeutic-twin-island-republic/.](http://introvertlybubbly.com/can-find-home-hummingbird-leisurely-peaceful-therapeutic-twin-island-republic/)

The following figures will give you a good idea of the beauty of Yerette.



Figure 3.21: An overview of the Yerette garden



**Figure 3.22: A female Tufted Coquette feeding on Vervine
[*Stachytarpheta jamaicensis* [Vervine]]**



Figure 3.23: Floral diversity at Yerette



Figure 3.24: Hummingbirds feeding at Yerette

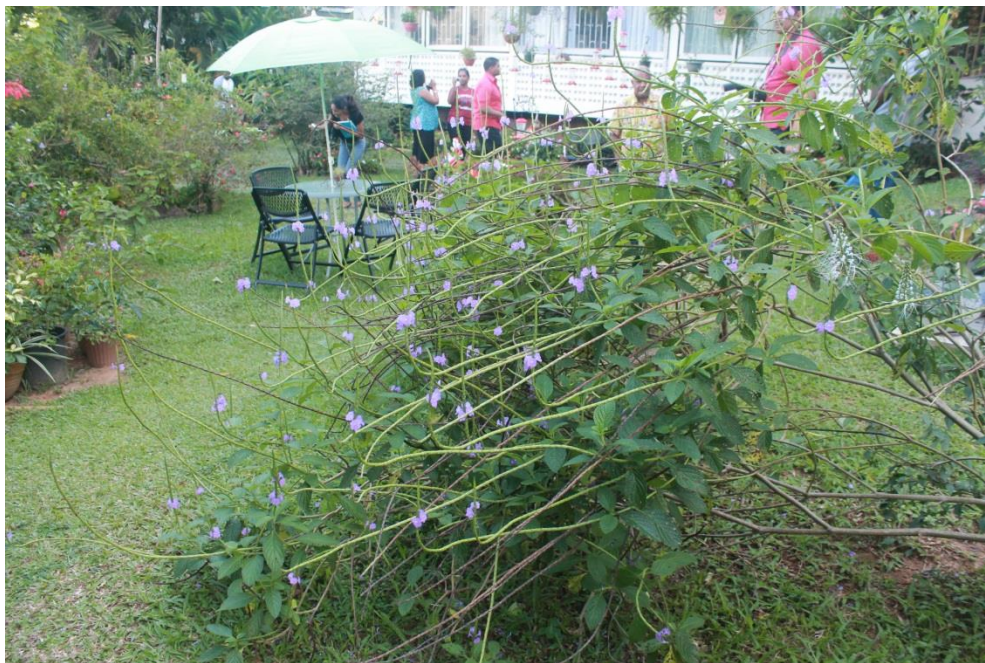


Figure 3.25: Floral diversity at Yerette



Figure 3.26: Flowers for Hummingbirds



Figure 3.27: Hummingbirds feeding at Yerette

3.3.3 A production model for sustainable hummingbird production and conservation

The approach towards developing this production model contains the elements as suggested by Garcia and Archibald (2001). It is schematically presented in Figure 3.28.

3.3.3.1 Objectives of the Hummingbirds' Production Model

First we must begin with the listing of the objectives of the Production model and they could be any of the following:

1. to rear and breed Hummingbirds successfully in captivity
2. to perform experimental research on this model to help us get a better understanding of the Hummingbirds of Trinidad and Tobago for this and future generations
3. to develop gardens and environments that would attract hummingbirds and
4. to develop and implement a release programme for re-populating the wild.

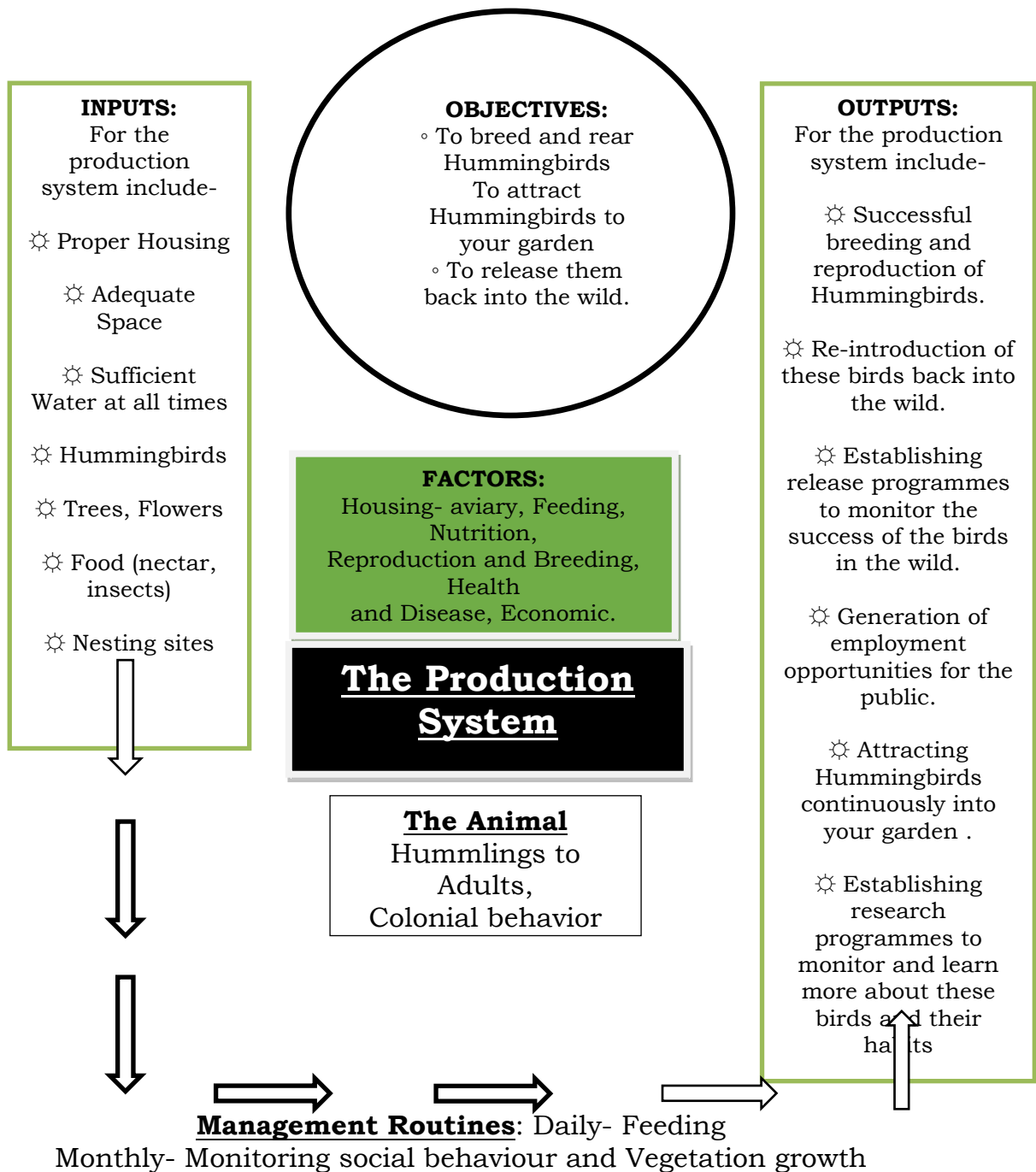


Figure 3.28: Schematics of a conceptual production system for Hummingbirds after the concept of Garcia and Archibald (2001)

3.3.3.2 The life cycle of the humming bird

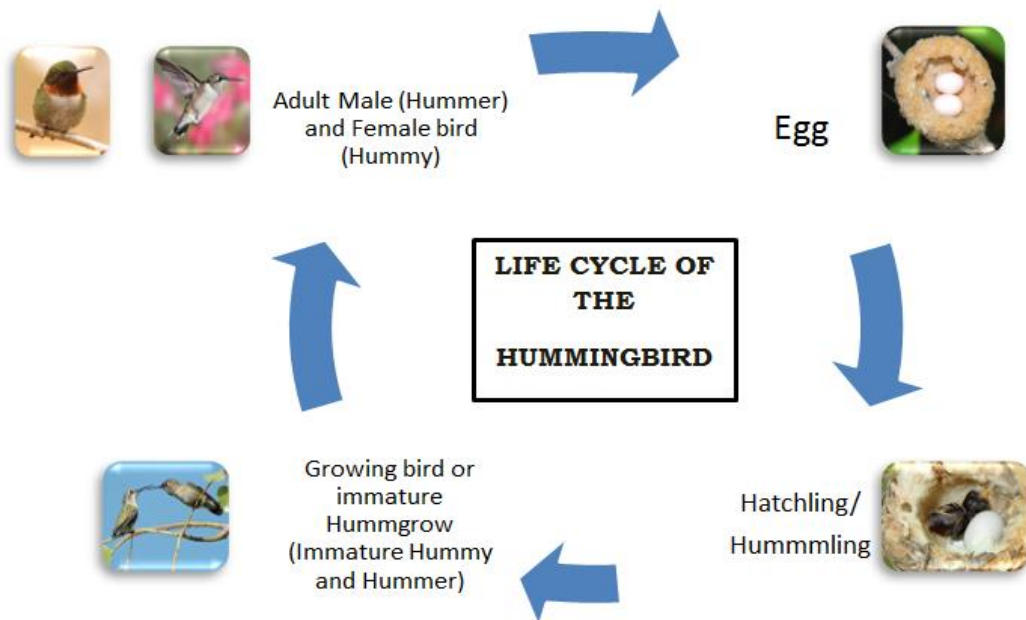


Figure 3.29: Life Cycles of the Hummingbird

3.3.3.3 Physiological States of Hummingbirds

Based in the life cycle of the hummingbird the Physiological States of the Hummingbird are as follows:

1. Mature Laying Female (Hummy)
2. Mature Serving Male (Hummer)
3. Growing Replacement Male (Immature Hummer)
4. Growing Replacement Female (Immature Hummy)
5. Egg
6. 1-5 day old hatchling (Newborn Hummmling)
7. 6-9 day old Hummmling
8. 10-19 day old Hummmling

We have identified the physiological states of the animal and the **hummingbirds' specific needs as influenced by the "Factors Affecting Animal Production" is now listed as follows:**

1. *Housing and Environment,*
2. *Feeding and Nutrition,*
3. *Breeding and Reproduction,*
4. *Health and Disease Prevention and Control and*
5. *Economic and Social Factors.*

3.3.3.4 Housing Requirements of the Hummingbird

The environmental conditions are of major importance since they must fulfill all the necessary requirements for hummingbirds to feed and reproduce. Trochilid's [Hummingbirds] habitat requirements are still poorly understood, but these birds are found in a wide range of habitats. Temperature and Humidity are two factors that must first be taken into consideration, although the hummingbirds are able to tolerate temperature and humidity extremes.

The birds should have access to water at all times as water is one of the key dietary ingredients for all animals. Animals would die first from a lack of water than from a lack of food. The birds should also obtain ideal amounts of sunlight (as would be elaborated on later). They should also have adequate vegetation for nesting. Finally, the housing design must be well constructed to allow for the total protection of the bird.

3.3.3.4.1 Housing Design for Intensive Hummingbird Production

It should be noted that the housing must provide total comfort for the bird. It must also simulate the wild environmental conditions that provide the hummingbirds with food, conditions for reproduction, protection and avoidance of predators, comfort, favourable temperature and humidity environments, water and desired light.

The experience of the Arizona-Sonora Desert Museum has suggested that outdoor aviaries are more suitable for housing Hummingbirds when compared to indoor aviaries. The main reason for this involves the role of natural factors in the immediate surroundings, such as flora and sunlight. The description of the major features for the housing design will now be described under the following headings:

1. Cage Design
2. Roofing design
3. Quarantine areas
4. Breeding cage setup.

1. Cage Design

The main considerations for cage design are:

- (i) Cage Size,
- (ii) Shape,
- (iii) Construction materials to be used,
- (iv) Space,

- (v) Feeders and Waterers per bird,
- (vi) Vegetation,
- (vii) Barriers
- (viii) Double gates and
- (ix) Perches

(i) **Cage Size**

Firstly, the **cage size** is of major importance since there must not be overcrowding or undercrowding, since this severely affects the birds with respect to mating, breeding and even feeding. A small exhibit of 4 feet wide x 8 feet long x 8 feet high (1.22m x 2.44m x 2.44m) is suitable for birds that are exhibited alone. Aviaries with larger dimensions such as 12 feet wide x 18 feet long x 8 feet high (3.66m x 5.49m x 2.44m) would be suitable for housing 8-10 Hummingbirds.

(ii) **Shape**

The **shape** of the exhibit is also important and should vary so that one bird cannot dominate the entire aviary. In this case, the birds are allowed to establish only a small territory within the system. ***It is recommended to construct circular or oval shaped aviaries since this would prevent one bird from dominating the entire area.*** The presence of corners in the aviary is considered unsuitable since birds are known to defend these areas very aggressively.

(iii) **Construction materials**

Wire mesh is the ideal material to be used when constructing this housing design. In some cases, glass enclosures are used. However, some precautions must be taken when using glass as birds tend to fly into the glass, thus damaging themselves. With glass enclosures, the outside should be painted with a water-soluble paint, preferably white or green. This would still allow for light penetration into the enclosure. This procedure should be performed before releasing the birds into the enclosure. When the birds are released, they should be given sufficient time to adjust to the new climate and also familiarize themselves with the glass surroundings. After a week, a layer of the coating may be removed, and if all the birds are adjusted to the surroundings, then the remaining layer of paint can be removed.

(iv) **Feeders and Waterers**

A good rule to note is to allow approximately 80-100 square feet (24.4 x 30.5 sq m) surface area per bird. Therefore, a larger number of birds would involve an aviary with more space so that there would not be any overcrowding. **Space** is also required to allow the birds to establish territories and also nesting sites.

- (v) **Each bird should have at least two feeders.** Larger numbers of birds would therefore involve more feeders and waterers present in the aviary.
- (vi) **Vegetation** [These vegetation guidelines would also hold for Open Gardens]

Vegetation within the aviary is of major importance and plants should be chosen carefully. There should be three main types of vegetation.

Firstly, there should be a wide supply of flowering plants that are rich in nectar. The flowering plants chosen should be as close as possible to those on which the Hummingbird species feed on in the wild. This would be a constant source of food for the birds.

Secondly, there should be non-flowering, non-nectar plants. The role of this is to provide roosting areas for the birds at night and these plants should therefore be bushy.

The third should consist of tall trees and shrubs. This would serve to establish boundaries within the aviary so that one bird would not dominate the entire aviary.

(vii) **Barriers**

Within very large aviaries, there should be the **presence of barriers** within the housing design. These barriers would include structures such as railings, signs, walls and rope barriers. The main reason for this is to keep the public in a particular path and trail so that the birds are not disturbed. The large aviaries at the San Diego Zoo and other Major Zoos have this feature. The Emperor Valley Zoo in Port of Spain, Trinidad and Tobago has a small Hummingbird exhibit but the animals are only visible externally.

(viii) **Double gates**

There should also be **Double Gates** at the entrance and exits to the aviaries. This is to prevent the birds from escaping.

(ix) **Perches**

There should also be the **presence of perches** within the aviary. These should be of a variety of small sizes from 0.078 inches to 0.234 inches in diameter and should be placed horizontally throughout the cage. **Higher perches seem to be better since the hummingbirds tend to be more comfortable at these heights.**

2. *Roofing Design*

With respect to outdoor aviaries, consideration must be placed on the shelter requirements for the system. This is due to the fact that the exhibit may be exposed to harsh rains from time to time. Tarpaulin and plastic covers are considered good materials for temporary coverings for the top of the aviary.

3. *Quarantine Areas*

When designing the aviary, a quarantine area should also be included since this is of major importance. This would allow for the bird to be separated from the others due to certain circumstances such as diseases or illnesses. As a result of this, there would be no further spread of the particular disease. The quarantine area would also allow the bird to acclimatize to captivity in an enclosed area, and this would include the introduction of new birds into the aviary. Ill birds when placed in quarantine areas should be treated and cared for properly and this would assist in its recovery and rehabilitation.

The normal quarantine time should be from 30-60 days (4-8 weeks) depending on the bird and its circumstances. Ideal materials for use in the construction of a quarantine area should include a standard wire mesh such as ½ inch x ½ inch (1.27cm x 1.27cm), ½ inch x ¼ inch (1.27cm x 0.635 cm), ½ inch x 3 inch (1.27cm x 7.62cm), or ¼ inch x ¼ inch (0.635cm x 0.635cm). Quarantine areas should also be downwind of the aviary or on the downwind side of the aviary.

4. *Breeding cage set-up*

If breeding is to occur, the Hummingbirds must first feel comfortable in the aviary and should not be stressed. If the bird is not able to adjust to the new habitat, then breeding would be very difficult and unsuccessful. The best path to take when trying to breed Hummingbirds is to have the aviary resemble the natural habitat of the bird as much as possible. Also, it is best not to separate the breeding pair into another enclosure since this might only encourage them to fight. If breeding is to occur, it is recommended that the breeding pair stay in the same aviary as the other birds. This would mimic a natural situation, since there would be competition among males to mate with the female. ***It is also recommended to have at least one male for every female in the enclosure.*** Therefore, a separate cage is not required for breeding Hummingbirds since it is best to keep all birds, that is, both breeding and non-breeding within the same aviary.

5. *Estimated Required Electrical and Lighting Sub-System*

The most suitable lighting source would be from the sun, that is, natural light as compared to artificial lightning for the upbringing of the birds. Our climate in Trinidad and Tobago and the Neo-tropics is quite ideal for this as we have more or less equal hours of sunlight and darkness. Outdoor aviaries are therefore considered more successful than indoor aviaries. In outdoor aviaries, the natural light is important for the Hummingbirds' health, well-being and also for nesting success. If indoor aviaries are to be constructed, there should be maximum utilization of the natural light by using windows or skylights. ***It is also recommended that the birds be exposed to 12-13 hours of light to ensure successful breeding practices. When using artificial light also, there should be the presence of a dimmer.*** This must be used so as to warn the birds about one hour before the lights are completely turned off.

6. *Estimated Required Water Delivery Sub-System (Water Quality)*

Water is a major necessity for the bird's upbringing. It is important for both food preparation as well as bathing. As a result, the water should not be contaminated and should be void of any chemicals. To ensure this, the water supply should be tested on a regular basis so as to detect any signs of contamination. There should be the presence of tanks and pipes that would assist in distributing the water throughout the aviary.

7. *Required Air Filtration System*

Outdoor aviaries should not be exposed to heavy air pollution nor to the exhaust from vehicles. Indoor aviaries and holding areas should also have good air quality and should be void of any pollutants. When establishing such an area, it should be constructed away from industrial estates etc., since some of these companies are known to emit pollutants into the atmosphere. It is recommended that the air is tested on a regular basis to detect the presence of any pollutants or contaminants in the immediate atmosphere, since the presence of these would affect the birds severely.

8. *Waste Disposal*

In the aviaries, waste matter must be disposed of in an effective and efficient manner. Indoor aviaries should be washed daily to remove the nectar that is collected on the floors. This is necessary so that there would not be the presence of insects and ants that would be attracted to the nectar. Both outdoor and indoor aviaries should have good drainage so that the water would be allowed to escape the premises rather than

being collected in small puddles throughout the aviary. This is necessary since, the stagnant water may be a breeding ground for bacterial growth and other harmful organisms.

3.3.3.5 Feeding Requirements of the Hummingbird

1. Estimated Required Feed Delivery Sub-System

Each Hummingbird must have access to feeders at all points in time. It is recommended that there must be two feeders for each bird in case there may be problems with one of the feeders. In establishing an aviary, there should be the use of artificially made nectar since pure nectar may be difficult to come by. Hummingbirds should have a balanced diet which would contain proteins, fats, carbohydrates, vitamins and minerals.

The ideal size for a feeder should be small, about 2 oz. (0.06 litres). This should be hung in a position where the birds would be able to feed readily on the solution at the bottom of the nectar column. **The small size is recommended since less food would be put into the feeders so that there would not be a great degree of wastage.** Also, it serves to be more economical since more feeders can be used with smaller amounts of nectar. **Feeders obtained in plant shops tend to be much larger as they were designed to be used in open-air gardens to attract many Hummingbirds (Figure 3.29).**

These feeders would attract insects and therefore, it should be cleaned and disinfected properly. This would entail using a disinfectant such as chlorine bleach, which would ensure that no residues are left behind in the feeders. **One part chlorine bleach to twenty parts water** may be used to clean the feeders and this should then be washed off thoroughly and left to dry. Since the nectar would attract insects, preventive measures must be put in place so that these insects do not harm the Hummingbirds. This is done by using ant guards and also by rubbing Vaseline on the legs of the cages and also on the feeders. Small cages could also have their legs in water containers or the aviary could have a small channel of water surrounding it. Care should be taken however when using Vaseline, since Hummingbirds should not come in contact with it. It is best to use Vaseline therefore on vertical surfaces to ensure the bird's safety.



**Figure 3.30: Large Hummingbird feeders used in open-air gardens
(Note the bright red colours which are used to attract the birds)**

2. Flowering plants required for feeding Hummingbirds in Trinidad and Tobago

The following are the flowering plants that are recommended for the inclusion in a Hummingbird garden or aviary in Trinidad and Tobago:

TREE species

1. *Erythrina fusca*
2. *E. poeppigina*
3. *Vismia falcata*
4. *Inga edulis*

SHRUBS

5. *Hamelia patens*
6. *Gonzala guniaspicata*
7. *Lantena camera*
8. *Isertia parviflora*
9. *Pachystachy soccinea*
10. *Stachytarpheta jamaicensis* [Vervine]

HERBACEOUS PLANTS COMMON TO BOTH T&T

11. *Mandivilla hirsuta* [year round flowering, yellow and red flowers]
12. *Justicia secunda* [year round flowering, rose red zygomorphic flowers] 11] and 12] visited by 9 species of hummingbirds
13. *Heliconia wagneriana*
14. *H. psittacorum*
15. *Costus scaber*
16. *Asclepias curassavica*
17. *Miconia sp.*
18. *Piper sp.*

19. *Costus scaber* [visited by *A. tobaci* in T&T during the food shortage period- September to December]
20. *Centropogon surinamensis* [visited by *A. tobaci* in T&T during the food shortage period- September to December]
21. *Renealmia exaltata* [visited by *A. tobaci* in T&T during the food shortage period- September to December.

3.3.3.5 Health

1. Health Issues

A major health issue that should be considered is the effect of stress on the birds. Stress may be brought on by a number of causes. Poor environmental and management practices may bring on stress. This may include factors such as overcrowding and undercrowding. Therefore, to minimize stress placed on these birds, it is suggested that there should be proper management practices that would prevent any signs of overcrowding and undercrowding. This would allow the birds to set up their desired territories and also this would reduce fighting between birds. It is also suggested that there be sufficient feeders and waterers so that the birds will always have access to food, so that they would not be irritable.

2. Health problems *Error! Bookmark not defined.*

Hummingbirds may encounter a few health problems when bred in captivity, these include:

- (i) Tapeworms
- (ii) Avian pox and
- (iii) Candidiasis.

1. Disease: Tapeworms

Causative Agent: May be found in the small intestines of hummingbirds that consume arthropods. These worms are segmented and contain a small head which attaches to the wall of the intestines. Segments of the worm containing eggs may be consumed by arthropods either in the larval or mature stages. As a result, the mature eggs will find their way back into the digestive tract of the Hummingbird when the arthropods containing these eggs are ingested.

Symptoms: This infestation may be mild or severe and would lead to intestinal discomfort.

Methods of Treatment and Control: Not sure how to control this.

2. **Disease: Avian Pox**
Causative Agent: This can be caused by the Avipox Virus and can be transmitted by mosquitoes or by contact with infected birds.
Symptoms: This disease is mild to severe. In this case, the bird may contract avian pox lesions, which resemble warts. This may occur on the unfeathered parts of the bird's body, and also on the mouth, trachea and larynx.
Methods of Control: In captive situations, there are a variety of treatments that have been used along with supportive care to treat the pox lesions and to prevent secondary infections in various avian species. These treatments consist of removing skin lesions and utilizing sodium bicarbonate or Lugol's solution of iodine washes, removing the diphtheritic membrane from the mouth and throat and swabbing the area with Lugol's solution of iodine, bathing the eyes with a 1-2% saline solution, and raising the environmental temperature. In all cases, providing assistance for recovery may spread the infection to other parts of the skin or to other birds [Michigan DNR Wildlife Disease Laboratory].
3. **Disease: Candidiasis**
Causative Agent: A fungus called *Candida albicans*. This may be brought on by stress within the environment.
Symptoms: Red infectious skin lesions that could appear around the mouth or on the skin.
Methods of Control: Topical administration of antifungal drugs. In such a case, a drug known as Nystat may be used which would help in treating these fungal problems. If treatment methods are used as soon as the problem is detected, the bird may be cured within one or two days after receiving the treatment.

Other Common Problems and Injuries

Wing injuries and head injuries are common problems in Hummingbirds. The main cause of this is due to the fact that these birds tend to fly into the enclosures. Therefore, care must be administered to these birds according to the extent of these injuries.

3.3.3.6 Required Overall Management System and Activities

The following measures involve several features which are all important in properly treating and the breeding of Hummingbirds.

Firstly, feeding must be monitored on a daily basis to ensure that all the objectives are met. This would include a proper, well-balanced diet for these birds which are rich in nutrients and are also capable of providing

sufficient energy. The cages must be properly constructed and this should be maintained to ensure the bird's safety.

Secondly, the bird's health must also be monitored daily and this is best done through daily observations of the animal. With all of this, thorough records should be kept with proper tables which would include a list of important information such as; birth rates and mortality rates, number of hummlings born each year, types of diseases and how many birds are infected, population numbers within each aviary, etc. All of this information would help in making the breeding processes within the aviary more effective.

In Figure 3.27 we have attempted to provide you with a summary of the elements required for a Hummingbird Production Model. This was only a preliminary attempt, as there is still a long way to go towards our having a good understanding of these animals. However, we hope that the information contained in this book would help us all to learn more about the Hummingbirds of Trinidad and Tobago. Your comments to the authors will also be appreciated and we hope that as we go along our journey continuing to enjoy the Hummingbirds we would also help to make Trinidad and Tobago truly the Land of the Hummingbirds.

3.3.4 REFERENCES

- del Hoyo, J., Elliott, A. & Sargatal, J. eds. (1999): *Handbook of the Birds of the World. Vol.5. Barn-owls to Hummingbirds*, Lynx Edicions, Barcelona
- Feinsinger, P. (1980a): Asynchronous Migration Patterns and the Coexistence of Tropical Hummingbirds [In *Migration of Tropical Hummingbirds*] *Migrant birds in the Neotropics; Ecology, Behaviour, Distribution and Conservation*, A. Keast and E.S. Morton (Editors) Smithsonian Institution Press, Washington, DC, USA. pp. 411-419
- Feinsinger, P. (1983): Variable Nectar Secretion in a *Heliconia* Species Pollinated by Hermit Hummingbirds, *Biotropica* **15**(1): 48-52
- Feinsinger, P., Linhart, Y.B.; Swarm, L.A. and Wolfe J.A. (1979): Aspects of the pollination biology of three *Erythrina* species of Trinidad and Tobago, *Annals of the Missouri Botanical Garden* **66**:451-471
- Feinsinger, P. and Swarm, L.A. (1982): "Ecological Release", Seasonal Variation in Food Supply, and the-Hummingbird *Amaziliatobaci* on Trinidad and Tobago, *Ecology* **63**(5): 1574-1587
- Feinsinger, P., Swarm, L.A. and Wolfe, J.A. (1985): Nectar feeding Birds of Trinidad and Tobago: Comparison of diverse and depauperate guilds, *Ecological Monographs* **55**(1): 1-28

- Feinsinger, P., Wolfe, J.A. and Swarm, L.A. (1982): Island Ecology: Reduced Hummingbird Diversity and the Pollination Biology of Plants, Trinidad and Tobago, West Indies, *Ecology* **63**(2): 494-506
- French, R. (2003): *A Guide to the Birds of Trinidad and Tobago*. Second Edition; Christopher Helm (Publishers) Ltd, London
- Garcia, G.W. and Archibald, K.A.E. (2001): The Philosophy of the Open School of Tropical Animal Science and Production. *Proceedings of the Caribbean Food Crops Society 37th Annual Meeting* **Volume XXXVII**: 20-27
- Grant, K. A. and Grant, V. (1968): *Hummingbirds AND THEIR FLOWERS*. Columbia University Press, New York and London
- Krebbs, K; Rimlinger, D and Mace, M; (2004): *Hummingbird Husbandry Manual*. American Zoo and Aquarium Association, Silver Spring, Md. PACT TAG
- Linhart, Y.B. and Feinsinger, P. (1980): Plant-Hummingbird interactions: Effects of island size and degree of specialization on Pollinations. *Journal of Ecology* **68**:745-760
- Scheithaur, W. (1967): *Hummingbirds Flying Jewels*. Arthur Barker Limited, 5 Winsley Street, London W1, UK
- Thompson, B. and Toops, C. (1984): *Hummingbirds and Butterflies*. Backyard Bird Guides, Bird Watcher's Digest, Houghton Mifflin Harcourt Publishing Company, Boston and New York, 288 pages
- Tyrrell, E.Q and Tyrrell, R.A. (1985): *Hummingbirds their life and behaviour: a photographic study of the North American Species*. First Edition, Crown Publishers, Inc., One Park Avenue, N.Y. 10016 USA. 212 pages
- Tyrrell, E.Q. and Tyrrell, R.A (1990): *Hummingbirds of the Caribbean, their life and behavior: a portfolio of the Caribbean species*, First Edition, Crown Publishers Inc., N.Y. USA. 238 pages

BOOKLET 4

The Pawi [*Aburria pipile*, *Pipile pipile*]



Figure 4.1: The only Pawi that was on exhibit at the Emperor Valley Zoo

Part 4.1 Questions on the Pawi



4.2 Aryann's, Anais' and Other Children's Questions on the Pawi

History

1. Is the Pawi a national bird?

No it is not a national bird. It is however one of the largest birds of Trinidad and Tobago and is critically endangered in this country. There are however, large populations of members of the *Pipile* species elsewhere in Latin America.

2. In what year was the Pawi discovered?

The Trinidad Piping Guan or Pawi was first documented by Jacquín, 1784, but it has been known to the Amerindians who lived in Trinidad [Iere] for thousands of years.

3. Why is the Pawi protected and respected by our wildlife laws?

According to the Environmental Management Agency (EMA), the Pawi is an indigenous bird to the island and is an endemic sub-species to Trinidad. The Pawi was declared an Environmentally Sensitive Species (ESS), in 2004. An ESS is any species that is in danger of extinction throughout all of its range.

4. For how long in Trinidad and Tobago has the Pawi been endangered?

There has been declining numbers of the Pawi since the 1980s. The Trinidad Piping Guan was referred to as critically endangered by The International Union for Conservation of Nature and Natural Resources (IUCN) Red List in 2006. However, this bird is found in South America and is not threatened there.

Naming the Pawi

5. What is a Mommy Pawi called?

It is called a "Pawien".

6. What is the Daddy Pawi called?

It is called a "Pawio".

7. What is a young Pawi called?

It is called a "Pawieno".

8. Why is the Pawi also called the Piping Guan?

The Pawi is called a Piping Guan like all the other birds in the genus because the sound it makes (piping) and the word guan means belonging to the family of Cracidae and it is native to the

jungles of tropical America.

9. Is its scientific name *Pipile pipile* or *Aburria pipile*?

According to a recent research paper¹ the Pawi should be merged with the *Aburria* genus because of similar genetic make-up of the species in both genii. Consequently, the new scientific name of the Pawi is *Aburria pipile*. You can also refer to the Booklet #1 questions on the Cocrico for an explanation of the concept of “Scientific Names”.

Location

10. Where is Latin America?

Latin America refers to Central America and South America. The Caribbean is sometimes included in the classification of Latin America.

11. Why is it called Latin America?

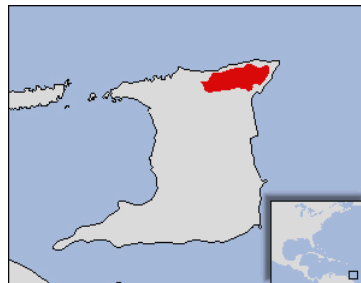
It is called Latin America because the major languages spoken are the Latin based languages which are Spanish, Portuguese and French (also known as the Romantic Languages).

12. Where does a Pawi live?

The Pawi is presently located in the eastern portion of the Northern Range, in the forests of Salybia, Madamas and Grande Riviere.

13. Where can you find the Pawi in Trinidad and Tobago?

The distribution of the Pawi in Trinidad is restricted to the eastern region of the Northern Range in areas like Madamas, Aripo, Cumaca/Platanal, Hollis Dam, Salybia/Matura and Grand Riviere. It is not found on the island of Tobago. Below is a map showing its distribution in Trinidad.



The map was reproduced from BirdLife International, <http://www.birdlife.org>

Figure 4.2: The range of the Pawi [*Aburria pipile*/*Pipile pipile*] in Trinidad

14. In Trinidad does the Pawi only live in the high woods of the Northern Range?

The Pawi lived in the Trinity Hills and in the lowland areas such as the Nariva Swamp and the Aripo Savannas. Due to hunting and habitat loss no members of the species have been seen in these areas for over a decade

Physical Description

15. Why is it called the “Pawi”?

The word “Pawi” means “Paw or “Pawen”, the foot of a beast of prey. We suspect that it was originally given this common name because of its large chicken-like feet and claws that made it look like a hawk or a bird of prey.

16. What is a bird of prey?

A bird of prey is a predator. It typically hunts live animals (the prey) typically by attacking them from the air. It kills and consumes these animals as a source of nutrition.

17. Does the triangular mark on the Pawi mean anything?

The significance of the triangular mark on Pawi is not known.

18. Why does it have chicken feet?

The Pawi belongs to the same Order as the chicken, Galliformes, which means chicken-like birds.

19. Is it related to the Chicken because of its blue throat?

No. Both the common chicken and the Trinidad Piping Guan belong to the same order or group of animals i.e. Galliformes, which is the order of chicken-like birds. They differ in terms of the Families to which they belong. The Pawi is a member of the Cracidae family which is large arboreal birds that lives in the forest. The common chicken belongs to the Phasianidae family and these are typically ground birds, short-billed and short-winged.

20. What is the blue thing underneath its throat called?

This is called a wattle.

21. Why are the feathers of the Pawi dark blue and white with spots of brown?

We do not know. There are other Pawi-like birds that share the same colours of feathers.

22. How much does the Pawi weigh?

The average weight of an adult Pawi is between 2.5kg and 7 kg or between 5 to 15 lb.

23. What is the Wing span of the Pawi?

The wingspan of the Pawi can be up to 60 cm long that is about 2 feet wide

24. Is the Pawi bald or does it have feathers on its head?

The Pawi has blackish brown feathers on its head that goes white at the corners.

25. How do you tell a Mommy Pawi from a Daddy Pawi?

Usually a female Pawi is described as being slightly smaller than the male. But there are no distinctive physical differences between the two sexes.

26. How do you tell a Baby Pawi from its Parents?

An easy indication of a baby Pawi would be its size in relation the adults.

27. What are the colours of a baby or newly hatched Pawi?

No literature could be found with the description of the baby Pawis. In addition in Trinidad juvenile Pawis are not usually seen in the wild.

Diet

28. What does the Pawi eat?

The Pawi eats fruit and seeds from the trees in the forest. They particularly like fruits of the palm tree. They are also known to eat cultivated seeds such as nutmeg and coffee beans.

29. Does the Pawi eat fish?

The Pawi generally eats fruits and berries found in the forests. As they live in the least disturbed areas in the forests they do not have access to fish to supplement their diets.

30. Does the Pawi eat other Pawis?

The Pawi is not known to be cannibals or even carnivorous.

General Questions

31. What species of birds is the Pawi related to?

The Pawi belongs to the genus *Aburria*. It has three other close

relatives that live in South America. These are the Blue-throated Piping-Guan (*A. cumanensis*), the Red-throated Piping Guan (*A. cujubi*) and the Black-fronted Piping-Guan (*A. jacutinga*).

32. How many young ones can the Pawi make during birth?

The Pawi can generally lay two eggs per clutch (per delivery).

33. What sound does the Pawi make?

The Pawi makes a piping sound, mainly during the breeding season. This is made up of a half a dozen clear whistles with a gradually rising pitch. This sound is the reason that all the four birds in the genus are referred to as “Piping Guans.”

34. How could you tell a Pawi in flight?

You can tell a Pawi in flight by its red legs and blue wattle.

35. About how many years can the Pawi live up to?

The closest estimate of the maximum age a Pawi can live up to comes from a fellow member in its family Cracidae that includes the guans, chachalacas and curassow. One member of the cracaid a great curassow (*Crax rubra*) lived for a reported 24 years (Delacour and Amadon, 1973). A pawi was kept in captivity at the Emperor Valley Zoo in Trinidad for 15 years.

36. Does any animal prey on the Pawi?

Human beings are the main predator of the Pawi. There is presently no known predator of the Pawi in the wild. In addition there are no large carnivorous animals that reside in the forests of Trinidad.

37. Can the Pawi be eaten?

Some hunters eat the Pawi when they camp in the forests. The hunters describe the meat as not very tasty.

38. Does it taste like chicken?

Though the Pawi is in the order Galliformes that is often described as a chicken-like bird, however, the taste and texture are not the same as the common chicken.

39. Can a Pawi swim?

No the Pawi is a land bird and as such is not known to have the ability to swim.

Part 4.2

Literature Review on the Pawi



Figure 4.3: The perched Pawi on exhibit at the Emperor Valley Zoo

4.2.1. Introduction

The Trinidad Piping Guan or Pawi (old species name: *Pipile pipile*; new species name: *Aburria pipile*) is believed to be endemic only to Trinidad and has never been reported in Tobago (Alexander 2002, Bacon and French 1972, Brooks, Olmos and Begazo 1998 and James and Hislop 1988). This bird was originally found throughout the island of Trinidad but increasing pressures on the animal and its habitat over the years have limited its presence to a small corner of north-eastern Trinidad as shown in Figure 4.2.

4.2.1.1 Conservation Status

The wild population of Pawi is currently estimated to be between 70 –200 birds in Trinidad. They are currently classified as critically endangered by the IUCN (Birdlife International 2006). Its future is threatened by continued habitat loss, predation and hunting as explained at the

beginning of this book. Also there is a dearth of information on the Pawi. The major Conservation Education drive was executed during the period June 1997 to June 1998 (Fournillier, 2005). The Rare Centre for Tropical Conservation funded this effort, with the local project executor being Mr. Kenneth Fournillier a Forest Ranger II of the Wildlife Section of the Forestry Department of Trinidad and Tobago, Ministry of Agriculture Land and Marine Resources (MALMR). He later became the Education Officer of the Asa Wright Nature Centre, Arima, Trinidad, Trinidad and Tobago. A memorandum of understanding was signed by the government of Trinidad and Tobago and the Rare Centre for Tropical Conservation on July 1st, 1997 in order to initiate the project. Mr. Fournillier executed approximately 98% of the recommended tasks of the education protocol. The targeted institutions were schools, non-governmental organizations and community based organizations on the north-eastern quadrant of Trinidad ranging from Blanchicheusse to Arima and Matelot (Fournillier, 2005). However, there has been limited assessment of this program's effectiveness. Conservation initiatives like this one has suffered from a lack of funding and focus.

Five years ago Hayes, Sanasie and Samad (2009) reported that despite several recent and ongoing public education campaigns and research projects, a national action plan has yet to be adopted for the conservation of the Piping-Guam. They also reported that from historical records [pre-1950s to 2004] the Piping Guam formerly occurred throughout much of Trinidad at all elevations, except perhaps along the west coast. But today it is only found in the eastern half of the Northern Range. Their data also indicated that this animal could thrive when hunting pressure is reduced and canopy trees are left intact in small-scale agricultural plantations.

This section of the book attempts to present the following:

1. A review of the literature on the Genii *Pipile* and *Aburria* and the species therein and
2. To establish the local knowledge as a vehicle for assessing both the community conservation awareness and the status of the Pawi in Trinidad.

4.2.2 Taxonomy and Ecology

Hansen and Richard-Hansen (2000) also referred to the pawi by the common name in French Guyana, “**Pénélope siffleuse**” and scientifically they have referred to it as ***Aburria pipile/ Pipile cumanensis/ Pipile pipile***. Grau, Periera, Silveira, Höfling and Wajntal (2005) using DNA sequences have concluded that it is related to the members of the *Aburria* genus and as such it should be renamed

Aburria pipile. They also concluded that all the members in the Genus *Pipile* should be renamed and included in the Genus *Aburria* since it was the older of the two Genii. This would suggest five species within the genus *Aburria* as follows: *A. pipile* [Trinidad Piping-Guan], *A. cumanensis* [Blue-throated Piping-Guan], *A. aburri* [Wattled Guan], *A. cujubi* [Red-throated Piping-Guan] and *A. jacutinga* [Black-fronted Piping-Guan] with the distribution as shown in Figure 4.4. It is also likely that these may just be colour morphs of the same species.

4.2.2.1 Status

The Trinidad Piping-Guan (*Aburria pipile*, *Pipile pipile*) has been suggested to be endemic to Trinidad, a rare resident of the dense tropical forest. This bird has been seen to date in two regions of the country located in the Northern Range (Grande Riviere and Aripo). Current estimates range from 150 – 260 km sq (Alexander, 2002, Birdlife International 2006) with historical populations cited in central and south-eastern Trinidad (Bacon and French, 1972). According to the IUCN's (IUCN 2003) assessment in 2000 the Trinidad Piping-Guan is on the Red List of Threatened Species and is classified as Critically Endangered. The Pawi thus is afforded full protection under the Conservation and Wildlife Act of Trinidad and Tobago Chapter 67:01 and cannot be hunted or captured without special permission from the conservator of forests, issued under Section 10:1 for scientific study or for zoo or museum collections only (James and Hislop, 1988).

4.2.2.2 Classification

A. pipile belongs to the kingdom Animalia. Further classification puts it in the phylum Chordata, class Aves and order Galliformes. It also belongs to the family Cracidae and formerly to the genus *Pipile* (IUCN 2003), now under the genus *Aburria* (Grau et al, 2005). Some common names for the bird are: Pawi, Trinidad Piping Guan, Trinidad White-Headed Currassow, Trinidad White-Headed Piping Guan, Penelope Sifféléuse de la Trinite, Pava de Trinidad, Pava Rajadora and Yacutinga Cariazul (IUCN 2003). About a decade and a half ago a taxonomic review of the entire genus *Pipile* was recommended (Brooks, Olmos and Begazo, 1998).

Table 4.1 indicates that there are three types of piping guans other than the Pawi (*A. pipile*). The first is the Black-fronted Piping-Guan (*A. jacutinga*) found in Brazil, Paraguay and Argentina (IUCN 2003) and this bird is classified as endangered in all three locations. The Blue-throated Piping-Guan is the second class of piping guan cited in the literature that

has two distinct species. The first (*A. cumanensis*) can be found in French Guiana, Suriname, Brazil, Venezuela, Guyana, Colombia, Ecuador, Peru and Bolivia. The second species of the Blue-throated Piping-Guan is (*A. grayi*) which is located in Bolivia, Paraguay and Brazil. Previously in the literature the Blue-throated Piping Guan was referred to as (*A. pipile*). In some cases it was also treated as a sub species of (*A. pipile*) since the 1960's the taxon has been treated as a full species based on plumage analysis and geographical range, (<http://www.ib.usp.br/cbro/res31-70htm> 7am 08/09/04 Resolution no 39).

The Red-throated Piping-Guan is also cited as having two distinct species (*A. cujubi*) found in Brazil and (*A. nattereri*) endemic to Brazil and Bolivia. Before the 1960's (*A. cujubi*) was referred to as a race of (*A. pipile*) or (*A. jacuntiga*). However, to date it is referred to as a full species of either the genus *Pipile* or *Aburria*. Identification of the bird in this case was also based on plumage characteristics and geographical range (<http://www.ib.usp.br/cbro/res31-70htm> 7am 08/09/04, Resolution no. 38). In earlier times both species of Red-throated Piping-Guan were considered to be sub-species of (*A. cumanensis*) (<http://www.ib.usp.br/cbro/res31-70htm> 7am 08/09/04, Resolution no 38 & 39).

Table 4.1: Piping Guan Species, Scientific Names, Location, Distribution and Status.

Common Name	Scientific Name	Location	Status
1] Black-fronted Piping Guan	<i>Aburria jacutinga</i>	Br, Py, Ar	Endangered [E]
2a] Blue-throated Piping-Guan	<i>A. cumanensis</i>	FG, Su, Br, Ve, Gy, Co, Ec, Pe, Bo	Unknown [UN]
2b] Blue-throated Piping-Guan	<i>A. grayi</i>	Bo, Py, Br	Unknown [UN]
3a] Red- throated Piping Guan	<i>A. cujubi</i>	Br	Unknown [UN]
3b] Red- throated Piping Guan	<i>A. nattereri</i>	Br, Bo	Unknown [UN]
4] Trinidad piping guan (also has a blue wattle)	<i>A. pipile</i>	Td	Critically Endangered [CE]

Country Key:

Ar = Argentina Gy = Guyana
Bo = Bolivia Pe = Peru
Br = Brazil Py = Paraguay
Co = Colombia Su = Suriname
Ec = Ecuador Td = Trinidad
FG = French Guiana Ve = Venezuela

Sources: IUCN 2003; Clements, J. 1991& Taxonomic Reference List The Family Cracidae: Order Galliformes, Suborder: Craci
<http://www.cracids.org/distribution.html> 20/08/04.

What has been suggested in the literature therefore is that over time two distinct species for both the Blue-throated and Red-throated Piping Guan have been derived based on plumage characteristics and geographical locations. This method of classification also holds true as regards the Trinidad piping guan and the Black fronted piping guan (IUCN 2003; Clements, J. 1991& Taxonomic Reference List The Family Cracidae: Order Galliformes, Suborder: Craci
<http://www.cracids.org/distribution.html> 20/08/04.
<http://www.ib.usp.br/cbro/res31-70htm> 7am 08/09/04, Resolution no 38 & 39). This is therefore a purely descriptive approach and is not very scientific and some further analysis will now be attempted.

Table 4.2: The common name, previous species name and the current species name assigned to all the piping guans.

Common Name	Previous Species Name	Current Species Name	Pictures of the species
Trinidad Piping-Guan	<i>Pipile pipile</i>	<i>Aburria pipile</i>	
Blue-throated Piping-Guan	<i>Pipile cumanensis</i>	<i>Aburria cumanensis</i>	
Red-throated Piping-Guan	<i>Pipile cunjubi</i>	<i>Aburria cunjubi</i>	
Black-fronted Piping-Guan	<i>Pipile jacutinga</i>	<i>Aburria jacutinga</i>	

SOURCE: Grau *et al* (2005).

4.2.2.3 Distribution and Range of the Blue Throated Guan [*Aburria pipile*/ *Pipile cumanensis*/ *Pipile pipile*]

BirdLife International indicated the following:

- [1] *Pipile cumanensis* has a wide range in northern South America. It is still locally abundant in **Suriname** and in **Guyana**, but in **French Guiana** it is rare and very local.
- [2] Its abundance is described as local in **Colombia** and Amazonas, **Venezuela**. In **Ecuador** the taxon was estimated to occur at densities of over 20 birds/km² in its preferred habitat, but is now considered uncommon.
- [3] In **Peru**, it remains common in the south, but is rare and in some danger of local extinction in the north-east.
- [4] The range reaches northern **Bolivia**, while in **Brazil** the taxon is common in north Roraima, but it is scarce around cities (Tefé, Manaus) and there have been no recent records from the state of Amapá.
<http://www.birdlife.org/datazone/species/factsheet/22727323>, 8/8/2014.



Figure 4.4: The range of the *Aburria pipile*/*Pipile cumanensis* species

4.2.2.4: The Meanings of the names of the species and the historical context of the naming

Table 4.3 presents the historical naming of the *Pipile* and *Aburria* species.

Table 4.3: Comments on Reported Piping Species

Species	Reviewed by	Comment
<i>Pipile pipile</i>	Jacquín, 1784	The Genus <i>Pipile</i> , Bonaparte 1856. Morphologically all these animals are similar only colour variations are observed. Grau et al 2005 suggested that <i>Pipile</i> is <i>Aburria</i> .
<i>P. jacutinga</i>	Spix, 1825	
<i>P. cujubi</i>	Pelzen, 1858	
<i>P. natterei</i>	Reinchenbach, 1862	
<i>P. cumanensis</i>	Jacquín, 1784	
<i>P. grayi</i>	Pelzen, 1858	
<i>A. Aburri</i>	Lesson 1828, Reinchenbach 1852	

References:

1. Blake, E.R., 1977: Manual of Neo-tropical Birds: Volume 1, Spheniscidae (Penguins) to Laridae (Gulls and Allies), University of Chicago Press Ltd. London pp. 414-419
2. Grau, E. T., Pereira, S. L., Silveira, L., Hofling, E., Wajntal, A., (2005): Molecular phylogenetics and biogeography of Neotropical piping guans (Aves: Galliformes**Error! Bookmark not defined.**): *Pipile* Bonaparte, 1856 is synonym of *Aburria* Reichenbach, 1853 *Molecular Phylogenetics and Evolution* **35**:637-645

An examination of what is the significance of the species names (based on the root meanings of the words) will now follow. This is similar to the approach taken by Garcia and Johnson (2003) as cited by Brown-Uddenberg *et al* (2004).

Root Meaning of words:

Aburri:	Spanish- Aburrir ... to bore Aburridobored (Carvajal and Horwood, 2003)
Cubuji:	nothing found
Cumanensis:	Spanish- Cuma... common
Grayi:	English- Gray, dismal not bright or hopeful (Simpson and Weiner, 1989)
Jacutiga:	nothing found
Nattereï:	English- to chatter in an aimless manner (Simpson and Weiner, 1989)
Pipile:	English- Pipio, Pipilo...complaining or crying Pip...to chirp or cry like a bird (Johnson, 1979)
Piping:	English- Piping...weak feeble sounds (Johnson, 1979)

Table 4.4: Key and Descriptions of the A. pipile species reported

Species [Common Name]	Distribution	HB [mm]	T [mm]	HF [mm]	W [mm]	Wt [kg]
*Trinidad Piping-Guan *Pawi *Pava de Trinidad *Pava Rajadora *Jacutinga Cariazul *Penélope Siffleuse de la Trinité	*Typically found in the tropical, moist, montane forest, in mature trees that typically exceed 50m high. *Highest population concentration in the Northern Range in areas such as Madamas, Aripo, Cumaca/Platanal, Hollis Dam, Salybia/ Matura and Grand Riviere.	609.6 (average adult)	280- 290♂, 281♀		360- 363♂, 350♀	2.5 – 3.3 (average adult)

Table 4.5: Reported colours of the different species within the genus Pipile

Species	Colours
<i>Pipile pipile</i>	Main colour (Bl), legs (R), wattle (B) patches on crest & wings (W)
<i>P. jacutinga</i>	Main colour (Bl), legs & wattle (R), patches on crest & wings (W), bill (pB), tip of bill (Bl)
<i>P. cujubi</i>	Main colour (Bl),
<i>P. natterei</i>	Main colour (Bl),
<i>P. cumanensis</i>	Main colour (Bl), legs (R), wattle (B), patches on breast & wings (W), bill (pB), around eyes (W)
<i>P. grayi</i>	Main colour (Bl),
<i>A. Aburri</i>	Main colour (Bl),

Key to Colours: Black [Bl]; Brown [Br]; Dark Brown [DBr]; Orange [Or]; Golden Brown [GBr]; Yellow [Y]; White [W]; Olive Green/ Olivaceous [OGr]; Red [R]; Pale Yellow [PY]; Pale Orange [POr]; Cream [Cr], Blue [B]; Pale Blue [pB]; Purple [Pu]

Key to body parts: Rump [R]; Back [Bk]; Body [Bd]; Chest [Ch]; Legs and Feet [Ft]; Eyes [E]; Head [H]; Underparts [UP]; Throat [T]; wings [Wi]

The *Pipile cujubi* and the *Pipile nattereri* are classified a subspecies: *Pipile cujubi cujubi* south of the Amazon between the Madeira river and northern Pará; and *Pipile cujubi nattereri* in southern and Western Amazonia.

4.2.3 Description, Biological Information, Behavior, Feeding and Nutrition and Pests and Diseases of The Pawi

Table 4.6 presents the Description, Biological Information, Behavior, Feeding & Nutrition and Pests and Diseases of the Pawi.

Table 4.6: Description, Biological Information, Behavior, Feeding & Nutrition and Pests and Diseases of the Pawi.

Category	Information	Sources
Description:		
Length	69 Centimeters	IUCN (2000)
Weight	1200-1350 Grams	
Body	Males 15% larger than females (sexual dimorphism). Blackish-brown, slight purple-green, glossy hue.	Ibid
	Large blackish –brown edged with white.	French, (1980) & IUCN (2000).
Crest	Bearing a conspicuous white patch.	Ibid
Wing Coverts	Black	
Bill	Blue	
	Blue	Ibid
Orbital Ring	Bare and Dark Blue	Ibid
Wattle	Dark blue	Ibid
Throat	Red	Ibid
Legs		Ibid

Category	Information	Sources
Biological Information:	Monogamous	?????
Breeding	Wing drumming and singing	Ibid
Courtship	(piping Sound).	Ibid
Copulation	In the trees	Alexander (2002)
Breeding	Unclear: ffrench reported nestings in	ffrench, (1980)
Season	July and August. Carnovan and Alexander mentioned a protracted breeding season.	Carnovan, (1999), Alexander, (2002), ffrench, (1980)
Nest	Platform made of twigs and leaves	Alexander, (2002)
Nest Location	Undetermined: Carnovan reports nests in trees and shrubs up to 20m in canopy. However Alexander and ffrench mentioned nests in tangles of vegetation close to the ground.	ffrench, (1980). Alexander (2002), ffrench, (1980)
Clutches		
Replacement Clutches		??
	2-3 white eggs	???
Incubation Period	Two clutches (4 or more eggs) can be produced, once eggs are removed as soon as they are laid (Fact in the great currasow and assumed to be possible with the pawi).	James and Hislop, 1988
Chicks		James and Hislop, (1988)
Juvenile		
.....	28 days.	del Hoyo, Elliot and Sargatal, (1994).
.....	Robust & precocial, fed by both parents on regurgitated food.	
.....	Bare - necked, black and downy.	
Sexual Maturity & Lifespan	 Lighter blue face, throat and wattles. Weights 1-1.3 Kg. Mottled white wing coverts. No distinct colour changes with development. Unknown. Other species such as the Great Currasow, or other members of the Cracid family, used as parameters. At the Emperor Valley Zoo in Trinidad, A Pawi lived for at least 15 years in captivity. The animal came to the Zoo as an injured adult with a gunshot wound this would suggest that this animal has a life span of at least 17-20 years. The animal lived at the EVZ from about 1992 to 30 th June 2007.	Keepers at the Emperor Valley Zoo.

Category	Information	Sources
Behaviour: Arboreal..... Gregarious.... Feeding Preening, Dust & Sun Bathing..... Flight	Elongated hind toe on the same level as the three front toes (the perfect adaptation for perching in trees and branch hopping). Family groups 10 – 20 birds in the past. Pairs commonly seen, single birds not uncommon. Carnovan stated that feeding was done in the late evening until nightfall. Whereas Alexander observed feeding in the early morning (longer period) & late evening. Parasite removal, pair bonding, plumage maintenance and oiling Best fliers of the cracid family.	??? ???..... Carnovan, (1999) Alexander, (2002)..... del Hoyo, Elliot and Sargatal, (1994)..... ???
Feeding & Nutrition The wild In captivity	Fruits, flowers, seeds, leaves, berries of species: <i>Ocetea</i> , <i>Ponteria</i> , <i>Busera</i> , <i>Didymoranax</i> , <i>Erythroxylum</i> and <i>lantana</i> . Occasional invertebrates. Pebbles swallowed to aid digestion. Clean water consumed from various sources. Cracked corn, brood mare, bananas, paw-paw, watermelon, mangoes, lettuce, water-cress, guava and other available fruits.	?????..... ???
Pests & Diseases Eyes Eggs	Affected by insect borne parasitic nematodes. Predation by snakes, opossum and monkeys.	????? James and Hislop (1988)

To date the bulk of information on the Pawi in Trinidad has been obtained from *in situ* observations. Efforts are being made to improve this by the Pawi Group of Trinidad (Cooper, 2005 personal communication). There is no concrete information on the breeding season, clutch potential, nesting and feeding habits of the Pawi. In addition, no documentation has been found on the gross anatomy, reproductive physiology and internal parasites related to the Pawi.

4.2.4 Biology and Conservation of the Pawi and Piping Guans: The Work of the Cracid Specialist Group

The work of the Cracid Specialist group is at present the most important and consistent scientific initiative aimed at expanding our knowledge on the Cracids and the Pawi. More information can be obtained from their very informative website <http://www.cracids.org/>.

The Cracids are a family grouping of Neo-tropical birds or avian species. These large-bodied birds inhabit the Neo-tropical rain forests, where

- (1) they play a critical role in contributing to the overall avian biomass,
- (2) they are important in forest regeneration through seed dispersal-predation dynamics,
- (3) they also play a historical ethnobiologic role and they are good bioindicators for the overall health of an ecosystem [De Matteo, Karagiannis, Asa, Macek, Snyder, Tieber and Parker, 2004],
- (4) they are an important source of animal protein for rural and indigenous peoples (Brooks, 1998) and
- (5) they have the potential for domestication as a producer of alternative avian animal protein for the Americas (Gary Wayne Garcia, personal opinion, as the Pawi was once referred to as the “Trinidad turkey”).

The Taxonomic Reference List of the Cracids contain 12 Genii and 50 species and the listing is as follows:

Class:	Aves
Order:	Galliformes
Suborder:	Craci
Genus:	<i>Ortalis</i> [12 species] <i>Penelope</i> [15 species] <i>Pipile</i> [4 species] <i>Aburria</i> [1 species] [Grau <i>et al</i> (2005) suggested that <i>Pipile</i> be merged into <i>Aburria</i> so that <i>Aburria</i> will now have 5 species as earlier indicated] <i>Chamaepetes</i> [2 species] <i>Penelopina</i> [1 species] <i>Oreophasis</i> [1 species] <i>Nothocrax</i> [1 species] <i>Mitu</i> [4 species] <i>Pauxi</i> [2 species] <i>Crax</i> [7 species]

[www.cracids.org/taxon2.html 4/10/2007].

Three primary documents on the Cracids were reviewed and they were del Hoyo, Elliot and Sargatal (1994), Strahl, Beaujon, Brooks, Begazo, Sedaghatkish and Olmos (1997) and Brooks, Olmos and Begazo (1998). In addition there is the “Bulletin of the Cracid Specialist Group” [<http://www.cracids.org>].

del Hoyo *et al* (1994) was an excellent source of first line information. Strahl *et al* (1997) was the more comprehensive document that reported on research activities on the Cracids. Therein were contained 89 articles including a preface in Spanish, Portuguese and English. The articles were also presented in the spoken language of the reporting scientific group. The articles were grouped as follows:

- Natural History
 - General
 - Multiple Species
 - Ortalis
 - Penelope
 - Crax
 - Mitu
 - Pauxi
- Methods and Models
- Captive Breeding
 - General
 - Species Reports
 - Regional Reports
- Cracids and Man
 - Utilization of Cracids
 - Educational Programmes for Cracids
- Species Status Reports
 - Ortalis
 - Oreophasis
 - Penelope
 - Pipile
 - Crax
 - Mitu
- Regional Status Reports
 - Argentina
 - Brazil
 - Colombia
 - Costa Rica
 - Ecuador
 - El Salvador
 - French Guyana
 - Guatemala
 - Honduras
 - Nicaraagua
 - Panama
 - Paraguay
 - Peru
 - Suriname

- Venezuela
- The Proceedings of the III International Cracid Symposium-Houston, Texas, USA

Brooks *et al* (1998) contained eleven important articles under the following headings:

- Field Conservation and Ecology
- Captive Breeding
- Harvest Patterns
- Conclusions.

As stated at the end of the last section, no published information in the literature was observed on the Anatomy, Physiology and Health of the Pawi or Guans. In the first booklet of this book we presented what was done in Trinidad and Tobago on the Anatomy of the Cocrico/Rufus Vented Chachalaca (*Ortalis ruficauda*). However, it was evident from the suggestions of Conolly and Seutin (1998) and De Matteo *et al* (2004) that captive breeding programmes will be essential for the successful conservation of the Pawi in Trinidad. De Matteo *et al* (2004) demonstrated the possibility of using Assisted Reproductive Techniques (ART), mainly semen ejaculation from the males and artificial insemination into the females, for the production of fertile eggs of the Common Piping Guan (*Pipile cumanensis cumanensis*). This for all practical biological purposes is the same animal as the Pawi.

Conolly and Seutin (1998) suggested that a captive breeding programme be developed for the Pawi in conjunction with field investigations *in situ*. They further indicated that many factors so far have prevented the implementation of captive breeding programmes and these would include:

- (1) the paucity of information on the biology and ecology of the species,
- (2) a lack of funds,
- (3) the absence of the necessary captive stock (but this is how our present day domestic species lines were first started), and
- (4) an uneasiness of decision makers and policy makers with the idea of deliberately capturing wild birds to form the founder stock.

They recommended the husbandry protocol based on the experience of North American Zoos, and they suggested that private participation and

ownership should be encouraged. This is the reason why the Grande Riviere Community and the Caribbean Poultry Association should be encouraged in this initiative. This was therefore the rationale for study that would follow in the next section of this booklet.



Figure 4.5: The expedition to the Grande Riviere location

4.2.5 A Study of the Grande Riviere and Montevideo Communities to Determine the Communities' Knowledge of the Pawi

4.2.5.1 Methodology

Preliminary field visits during 2003 and 2004 to north-eastern Trinidad verified the presence of the Pawi in its present habitat. Following this a survey was conducted in the Montevideo and Grande Riviere villages to assess the villagers' knowledge of the Pawi. The survey was done according to the "Sondeo" methodology of information gathering that is commonly used in Agricultural Extension. The survey was conducted by a class of wildlife students taking the course AL65B/AGLS6502 (Tropical Zoo and Wildlife Production and Management) in the Department of Food Production, Faculty of Science and Agriculture (now Faculty of Food and Agriculture) of the University of the West Indies, St Augustine, Trinidad and Tobago. The survey was executed on the 13th of February 2004. In Montevideo, surveys were administered to a random sample of villagers. In Grande Riviere participants were selected based on their known involvement in conservation initiatives.



Figure 4.6: The students exploring the Pawi Habitat in Grande Reviere before the community survey.

4.2.5.2 The Findings

Age:

All of the subjects interviewed were men, partially because they were the most visible in the communities. In addition, they had encounters with the Pawi in its natural environment and were willing to be surveyed. Of the men surveyed 64% were between the ages of 30 – 45, 27% were between the ages of 55 – 80 and 9% under 20 years (Table 4.7). The varied ages of the survey group were beneficial because the information gathered mapped the changes that have occurred in the population of the Pawi in the area over time.



Figure 4.7: The view of the Pawi habitat from the main Road at Grande Riviere

Location & Distribution:

Persons were surveyed between the north-easterly costal villages of Monte Video and Grande Riviere. Both villages were located directly in the habitat of the birds. The only difference being that Grande Riviere was more densely populated and had a lot more commercial activity than Monte Video.

Employment Activities:

Most of the people interviewed earned their income by engaging in more than one economic activity. Seventy two percent (72%) of the persons surveyed spent a substantial amount time in the habitat of the Pawi. Consequently, this made them good reservoirs of information. Their occupations were as follows: 18% farmer / hunter / skilled laborer, 18% farmer / hunter, 9% farmer, 9% hunter / hotelier, 9% tour-guide and 9% retired hunter.

The other 28% of the sample earned their incomes by engaging in activities outside of the habitat of the Pawi. These persons however were also able to provide information when interviewed.

Communication Tools:

Only 27% of the survey sample had telephones (LAN lines). The other 73% of the sample could only be contacted via the post if necessary or by personal visits. None of the persons interviewed had electronic communication devices (cell phones, etc.). It was difficult to maintain quick communication and to facilitate information exchange with these persons.

Communication Linkages:

The majority (64%) of the surveyed population had no contact with any government agency from which to obtain information. A smaller percentage of the sample (36%) knew of the wildlife section of the Forestry Division of Trinidad and Tobago and mentioned it as a source of information, thereby ensuring that some members of the community were aware of a government agency that serves as a source of information for the Pawi.

All of the persons interviewed in the survey confirmed that Pawis were present in the surveyed areas and that they were regularly seen on a daily basis by 36% of the sample. Most of the economic activities of the interviewees occurred in the habitat of the Pawi. Twenty-seven percent (27%) of the sample stated that they saw the bird at least once annually because they did not spend much time in its habitat. Ten percent of the participants saw the Pawi every time they went on hunting expeditions. Nine percent (9%) of the sample saw the Pawi weekly, fortnightly or quarterly depending on the interim between hunting trips. The frequency of sightings of the Pawi (derived from the data obtained in the survey conducted) strongly suggested that there was an existing population of the Pawi in the surveyed area that has exhibited some level of sustainability to date.

In 46% of the occasions the Pawi were sighted in pairs. This may be due to the monogamous nature of the bird as mentioned in Table 3.3. Thirty-six percent of the persons surveyed saw groups of 2-7 birds on occasion, however it was not clear if they were family groups or pairs of birds socializing. Nine percent (9%) of the people interviewed mentioned sightings of 10-15 birds in the not too distant past (back in 2004), and some have seen as much as 36 birds a long time ago during the 'mating' season. The question of a distinct mating season for the Pawi has not been answered to date or at least has not been indicated in the literature. The information yielded from the questionnaire showed clearly however that there has been a definite decline in the Pawi population over the years.

Table 4.7: A summary of the biological and ecological information on the Pawi obtained from the survey

Information Type	Opinion	Response (%)
Presence of the bird	Yes	100
Frequency of sightings	Daily Weekly Fortnightly Quarterly Annually When hunting	36 9 9 9 27 10
Number of birds per sighting	Pairs 2 –7 10 – 15 (Less birds seen recently) 36 Birds when mating long ago	46 36 9 9
Places commonly seen	Canopy Low down on trees / on the ground or in vines feeding. Flying around	73 18 9
Times of bird sighting	Mornings & evenings Midday & moonlight nights	90 10
Visual differentiation	Yes No	55 45
Sexual differentiation	None Males larger Long wattles in male Dark blue wattles in male Dark blue comb in male Straight long feathers in male	34 25 17 8 8 8
Signs of reproduction	None Young birds Nest on ground with eggs	64 18 18
Signs of death	No Yes	73 27
Population status	Decline Increase Stable	82 9 9
Reasons for population decline	Hunting Habitat destruction Birds more elusive	55 38 7
Reasons for population increase	Game warden intervention	100
Predators	Hunters Hawks Ocelot Tyra Snakes	46 20 20 7 7

The Pawi is an arboreal bird that spends the majority of its time in the treetops. It is no surprise therefore that 73% of the persons often saw the birds high in the canopy of trees. Some persons 18% saw birds feeding in dense tangles of vegetation and vines close to the ground. It is also averred that the Pawi can and will feed on various fruits, insects and collect pebbles close to and on the ground to aid in digestion. A small proportion (9%) of the sample observed birds in flight. This is quite plausible because the Pawi is thought to be the best glider of the Cracidae family.

An overwhelming majority (90%) of the persons surveyed observed the birds in the canopy of trees at dawn and dusk, which corresponded to what was mentioned in the literature in Table 4.7. The rest of the sample population (10%) reported midday and moonlight sightings. It may be quite possible to see birds at midday, however no moonlight activity of the Pawi has been reported in the literature where they are dealt with as a diurnal species.

More than half (55%) of the survey sample stated that they could discern one Pawi from another in a group because all of the birds were not uniform in appearance. This may be tied into sexual or developmental differences indicating that the Pawi population may still be breeding. The remainder of the sample (45%) stated that they observed no differences in bird appearance. This may mean that the bird population is static or on the decline or that the persons never got close enough to the birds to make thorough observations.

No distinctions between male and female of the Pawi species could be made by 34% of the survey sample. Males are stated to be 15% larger than females as seen in Table 4.7. Twenty-five percent of the persons surveyed mentioned that males were larger than females but were not specific on how they arrived at this conclusion. Males were stated to have long wattles by 17% of survey group, 8% mentioned dark blue wattles and a further 8% referred to a dark blue comb. This information is not mentioned in the literature and is most likely apocryphal.

No signs of reproduction were noted by 64% of the participants. Eighteen percent (18%) observed the presence of young birds. The same percentage of the sample observed nests on the ground with light brown eggs in them. This can be indicative of a shrinking bird population.

Only 27% of the survey sample observed bones and feathers that they felt belonged to dead birds in the forest environment. The other 73% never observed any signs of bird mortality resulting from the amalgamated effect of poaching of the birds for meat, the rapid decomposition of carcasses in the humid tropics and a retracting bird

population.



Figure 4.8: Assembly before the community interview

A decline in the bird population was noticed by 82% of the persons surveyed. Nine percent (9%) of the sample stated that the population had remained stable but appeared to decline because the Pawi had become more evasive as a result of increased survival pressure. An additional 9% of the survey group stated that the population of the Pawi had increased.

Fifty-five percent (55%) believed that hunting and thirty-eight percent (38%) identified habitat destruction, were the main reasons for the decline of the Pawi population in the surveyed areas. Hunting was defined as the legal harvest of wildlife and so human harvesting of the Pawi should be correctly referred to as poaching. With the continued development of these forested areas the adverse effects incurred by habitat destruction will continue if left unchecked. The remaining 7% stated that the birds had become more evasive and as a result the population only appears to be reduced. This is unlikely as so many in the sample observed a population decline. All persons interviewed indicated that the game warden intervention was responsible for the increase in the Pawi population. **This information is also to be treated with reservation in light of opposing evidence.**

Animals that were thought to prey on the bird in the wild were Hawks (20%), Ocelot (20%), Tyra (7%) and Snakes (7%). Poaching by man (46%) was mentioned to be the most devastating form of predation on the Pawi population.

The types of feed consumed by the Pawi as suggested by the persons surveyed are presented in table 4.8.

Table 4.8: Types of feed consumed and there corresponding popularity amongst the surveyed sample

*COMMON NAMES	**SCIENTIFIC NAMES	%
Nutmeg	<i>Myristica fragrans</i>	27
Cajuca (wild nutmeg)	<i>Virola surinamensis</i>	13
Wild Kaimit	<i>Chrysophyllum sp.</i>	10
Wild Seeds	-	10
Coffee Beans	<i>Coffee sp. (arabica, coneophora)</i>	8
Wild Tobacco Berries	<i>Acnistus arborescens</i>	8
Poultry Ration	-	3
Figuier Seed	<i>Ficus goponensis</i>	3
Gereton	<i>Schefflera morototoni</i>	3
Manjack	<i>Cordia collococca</i>	3
Serette	<i>Byrsonima spicata</i>	3
Wild Cashew	<i>Anacardium occidentale</i>	3
Wild Gri Gri	<i>Aiphanes aculeate</i>	3
Wild Pewa	<i>Bactris gasipaes</i>	3

Sources: * This survey; **Comeau, Comeau & Johnson, (2003) and National Herbarium Trinidad and Tobago, Tree Species List. 23/02/01

The nutmeg (*Myristica fragrans*) was identified by 27% of the sample group. Roughly half (13%) specified Cajuca or “wild nutmeg” (*Virola surinamensis*) as being eaten by the Pawi. Ten percent of the sample group identified the Wild kaimit (*Chrysophyllum sp.*) and a further ten percent of the sample stated the Pawi consumed unnamed wild seeds. Eight percent of the interviewees named Coffee beans [*Coffee sp. (arabica, coneophora)*] and an additional named wild tobacco berries (*Acnistus arborescens*) as a food source for the Pawi. Three percent mentioned poultry ration as a type of food eaten by the Pawi the fed alongside ranging poultry at a small farmer holding in the habitat.

Figuier Seed (*Ficus goponensis*) (3%), Gereton (*Schefflera morototoni*) (3%), Manjack (*Cordia collococca*) (3%), Serette (*Byrsonima spicata*) (3%), Wild Cashew (*Anacardium occidentale*) (3%), Wild Gri Gri (*Aiphanes aculeate*) (3%) and Wild Pewa (*Bactris gasipaes*) (3%) were some of the other mentioned sources of feed utilized by the birds in their natural habitat.



Figure 4.9: Another Aspect of the Pawi habitat at Grande Riviere

The Pawi has an eclectic diet, the composition of which is determined by food sources that are available in its habitat. This is evident as all of the food eaten by the Pawi, with the exception of the poultry ration, are distributed throughout its habitat.

Education Programs:

The conservation education program (that was funded by the Rare Centre for Tropical Conservation in 1987 – 1988 and facilitated by the Wildlife Department of the forestry division of Trinidad and Tobago) was mostly responsible for generating the awareness of the Pawi in the areas surveyed. A memento of this initiative is an old signboard at the beginning of the Grande Riviere district that was left to the elements (Figure 4.10, 2005).



**Figure 4.10: A weathered “Save the Pawi Sign” at the entrance of the Grande Riviere Village
[Taken Friday 18th March 2005 by Gary Garcia]**



**Figure 4.11: A “Save the Pawi Sign” at the Brasso Seco Junction, Northern Range, Trinidad
[Taken by Gary Garcia 2012]**

4.2.5.3 Conclusions from the Survey

1. There is still an existing Pawi population in the Grande Riviere, Montevideo and Brasso Seco district in Trinidad.
2. The size and viability of this population remains unknown with an apparent observed decline in the numbers of these animals over the years.
3. The Pawi appears to be able to utilize nutrition from a variety of sources in its habitat. These range from fruits and seeds to invertebrates.
4. Some critical pieces of information are still unknown with regard to this bird and they are: breeding patterns, reproductive parameters, nesting habits, anatomy and physiology.
5. The locals know of the bird and some of the types of feed that it survives on.
6. Phenotypic sexual and developmental differences are unknown.
7. There has been no confirmed reproductive activity in the population over the years, the result of which is an enigmatic critically endangered bird population with an uncertain future.

4.2.6 Conclusions from the Literature Reviewed

1. There is species uncertainty amongst the Avian Sub-order called Cracids which includes the Guans containing the Genii *Pipile* and *Aburria*.
2. The evidence presented in the literature suggested that all species within the Genus *Pipile* to which the Pawi belongs should be included under the genus *Aburria*, as both Genii are the same.
3. The *Pipile pipile*/*Pipile cumanensis* /*Aburria pipile* is threatened in Trinidad but is common over its range in South America.
4. The work of the Cracid Specialist Group [<http://www.cracids.org/>] has contributed significantly to expanding the knowledge on these species of the Order of birds called Galliformes.
5. Cracids are important Galliformes from the standpoint of human utilization in Latin America.
6. Focused work needs to be done on the Cracids from the standpoint of animal anatomy, nutrition, reproduction, physiology and environmental requirements.
7. Captive Breeding Programmes are recommended for the at risk Cracids and in particular *Pipile*/*Aburria* species and this must involve both *In situ* and *Ex situ* initiatives.

4.2.7 Recommendations

1. It is necessary that a molecular review be done on the existing piping guan species in order to determine the genetic relationship that exists within the species. This information may prove vital in the event that other piping guan gene-stock need be introduced to save the Trinidad Piping Guan.
2. Continued peer pressure to curb poaching. must be exerted in the communities near the forested areas where the Pawi lives.
3. Continued *in situ* monitoring and protection of existing Pawi population is necessary to ensure the continued existence of the species in the wild in Trinidad.
4. Conservation education programs are quite useful to create public awareness of the issues. This has been somewhat successful in the

case of the Pawi. It is necessary to have follow-up initiatives after the awareness stage has been set in order to carry out concrete rehabilitative work on the target species. This was never done with the Pawi however. There is now a sensitized human population who are not equipped with a clear mandate on how to proceed with the restorative work on the Pawi. Therefore *ex situ* conservation and captive breeding centres (living gene banks) must be initiated in areas where the Pawi once frequented and where there are currently populations residing. To be effective, these initiatives must be sanctioned by the relevant governmental agencies and supported by research and development institutions (local and foreign) in conjunction with non-governmental, community-based organizations and other organizations.

4.2.7 References and Literature Consulted

- Alexander, G.D. (2002): *Observations of the Trinidad Piping Guan, or Pawi (Pipile pipile), in northern Trinidad*. Department of Life Sciences, University of the West Indies, St Augustine, Occasional Paper 11:119-130.
- Anon, (2007): Bulletin of the Cracid Specialist Group. Vol 23 Spring 2007, ISSN#:1096-7168, CSG Website: <http://www.cracids.org>
- Bacon, P.R., and French, R.P. (1972): The wildlife sanctuaries of Trinidad and Tobago. Wildlife Conservation Committee, Ministry of Agriculture, Lands and Fisheries.
- Birdlife International (2000): *Pipile pipile*. In: IUCN 2003. 2003 IUCN Red List of Threatened Species [www.redlist](http://www.redlist.org) Downloaded 09 July 04.
- Blake, E.R. (1977): *Manual of Neotropical Birds, Volume 1 Spheniscidae (Penguins) to Laridae (Gulls and Allies)*. University of Chicago Press, Ltd., London 414 - 418.
- Brooks, M. D. (1998): Pipile as a protein source to rural hunters and Amerindians. In Brooks, M.D., Olmos, F. and Begazo, J.A. (1998). [Editors] *Biology and Conservation of the Piping Guans (Aves: Cracidae)*. Special Publication of the Cracid Specialist Group Number 1. Cracid Specialist Group 1537 Marshall, Suite #1 Huston, Texas 77006, USA. ISBN 0-9668278-0-5.
- Brooks, M.D., Olmos, F. and Begazo, J.A. (1998): [Editors] *Biology and Conservation of the Piping Guans (Aves: Cracidae)*. Special Publication of the Cracid Specialist Group Number 1. Cracid Specialist Group 1537 Marshall, Suite #1 Huston, Texas 77006, USA. ISBN 0-9668278-0-5.
- Carvajal, C.S. and Horwood, J. (2003) (Editors): *The Oxford Spanish Dictionary*, Oxford University Press, Oxford, UK.
- Carnarvon, H.D. (1999): *The Trinidad Piping Guan (pipile pipile) Considerations For Developing an Intensive Production Model*. Al 65

- B Course Project, Department of Food Production University of The West Indies, St Augustine, Unpublished.
- Clements, J. (1991): *Birds of the World: A Check List*. 4th ed. Ibis Publ. Co., Vista, CA
- Comeau, L. P.; Comeau, S. Y. & Johnson, W. (2003): *The Palm Book of Trinidad and Tobago Including the Lesser Antilles*. International Palm Society. Script – J Printers Ltd, Trinidad and Tobago.
- Connolly, V. and Seutin, G. (1998): The how and why of a captive breeding program for the critically endangered Trinidad Piping Guan, In Brooks, M.D., Olmos, F. and Begazo, J.A. (1998). [Editors] *Biology and Conservation of the Piping Guans (Aves: Cracidae)*. Special Publication of the Cracid Specialist Group Number 1. Cracid Specialist Group 1537 Marshall, Suite #1 Huston, Texas 77006, USA. ISBN 0-9668278-0-5.
- Cooper, J. (2005): Head of the Pawi Group, UWI School of Veterinary Medicine, Trinidad, Personal Communication.
- De Matteo, K.E., Karagiannis, K.L., Asa, C.S., Macek, M.S., Synder, T.L., Tieber, A.M. and Parker, P.G. (2004): Semen collection and artificial insemination in the common piping guan (*Pipile cumanensis cumanensis*): potential application for Cracidae (Aves: Galliformes). *Journal of Zoo and Wildlife Medicine*. **35**: 447-458
- del Hoyo, J; Elliot, A. and Sargatal, J.eds. (1994): *Handbook of birds of the world vol. 2. New World Vultures to Guinea-fowl*. Barcelona. Lynx edicion.
- French, R. (1980): *A Guide to the Birds of Trinidad and Tobago*. 2nd ed. Illustrated by John, P.O'Neil and Don .R. Eckleberry. New York: Comstock Publishing Associates, ITHCA.
- Fournillier, K. (2005): (Personal Communication) Interview with the author, 10 a.m. – 12 noon, 27/01/05.
- Grau, E. T., Pereira, S. L., Silveira, L., Hofling, E., Wajntal, A., (2004): Molecular pylogenetics and biogeography of Neotropical piping guans (Aves: Galliformes): *Pipile Bonaparte*, 1856 is synonym of *Aburria* Reichenbach, 1853. *Molecular Phylogenetics and Evolution* **35**:637-645
- Hayes, F.E., Sanasie, B. and Samad, I. (2009): Status and conservation of the critically endangered Trinidad piping guam *Aburria pipile*. *Endangered Species Research* **7**:77-84
- Hansen, E. and Richard-Hansen, C. (2000): *Faune de Guyane: Guide des principales especes soumises a reglementation*. Office Nationale de la Chasse, Paris.
- <http://www.ib.usp.br/cbro/res31-70htm> 7am 08/09/04. Resolution no 38 & 39.
- James, C. and Hislop, G. (1988): *Status and conservation of two cracid species, the Pawi or Trinidad piping guan (Pipile pipile) and Cocrico (Ortalis ruficauda) in Trinidad and Tobago*. National report

- presented at the Second International Cracid Symposium, Caracas, Venezuela 28/02/1988 – 06/03/1988. Wildlife Section Forestry Division.
- Johnson, S. (1979) (Editor): *A Dictionary of the English Language*. Times Books, London
- National Herbarium Trinidad and Tobago, *Tree Species List*. 23/02/01. Examined by the first author with the assistance of Johnson, W. 24/08/04.
- Rare Centre for Tropical Conservation (1997): *Memorandum of Understanding*. Rare Centre for Tropical Conservation and The Government of the Republic of Trinidad and Tobago. 01/07/97.
- Strahl, S. D., Beaujon, S., Brooks, D. M., Begazo, A. J., Sedaghatkish, G. and Olmos, F. (1997) (Editors): *THE CRACIDAE Their Biology and Conservation*. Hancock House Publishers Ltd. B.C., Canada, 506 pages
- Simpson, J.A. and Weiner, E.S.C. (1989) (Editors): *The Oxford English Dictionary*, 2nd Edition, Volumes VI and X, Oxford University Press, Oxford, UK.
- Taxonomic Reference List The Family Cracidae: Order Galliformes, Suborder:Craci* <http://www.cracids.org/distribution.html20/08/04>.and <http://www.cracids.org/taxon2.html4/10/2007>

Part 4.3

Species Recovery Proposal for the Pawi



Figure 4.12: The Majestic Pawi or The “Trinidad Tropical Turkey”

4.3.1 Preparation of a Draft Pawi Recovery Plan

The initial stage of constructing a recovery plan will involve consultations from a number of individuals or groups who have some interest in the project. These parties are most likely to come from the following:

- Government agencies with responsibility for threatened species and communities such as the Ministry of the Environment and Water Resources, Environmental Management Authority (EMA), the Ministry of Tourism, the Ministry of Community Development and the Ministry of Food Production
- The Centre for Neo-tropical Animal Wildlife (CNAW)
- The recovery team (UWI, other individuals or organisations with expertise)
- Individuals, groups, and organisations that may be affected by (or have responsibility for) the recovery actions proposed in the plan
- The relevant local councils, regional bodies and government agencies
- Other individuals or groups with a particular interest or expertise in the species or community covered (for example, poultry farmers and the Caribbean Poultry Association)
- Where appropriate, local residents or council representatives of the same.

There would be then the need for 1) public consultations, 2) the development of a draft recovery plan and 3) the finalizing of a five year recovery plan.

1. Public Consultations

Public consultations could be the first phase and the dates, times and venues if these can be advertised for a week before the first date of meetings in all local newspapers. Reminders should be published a day before any scheduled meeting. The location of the meetings should be skewed towards the local communities that surround the proposed area of the Matura National Park. These would include Grande Riviere, Matura and Morne Video. Consultations should also be held in Port of Spain and San Fernando for the convenience of other interested persons.

2. Development of Draft Recovery Plan

After the consultations are completed the draft of the recovery plan should include several key points. It must identify the various interest groups that will be affected by its implementation. It will also need to

identify the persons or organizations that are affected by the plan. The most important groups that should be identified in the plan are the person(s) or organization(s) that have direct ownership or management responsibilities for the area occupied by the species/communities covered by the plan. In addition, where relevant, an outline must be done to describe how these persons and organizations are to be involved in the implementation of the plan.

3. Finalizing a Five Year Recovery Plan

On an average a recovery plan is normally adopted to cover a five-year period. At the end of this period, the plan should be reviewed and revised, thereby ensuring that a plan is always in force and that the plan's effectiveness is regularly assessed.

4.3.2 Components of the Five Year Recovery Plan

4.3.2.1 Part A: Species/Ecological Community Information and General Requirements*Error! Bookmark not defined.*

INTERNATIONAL OBLIGATION

The information from this comes from the EMA Environmentally Sensitive Area (ESA) Matura National Park, 2004.

In furtherance of Schedule I of the Rules, compliance with Government's international obligations under the following Conventions:

- a. the Protocol concerning Specially Protected Areas and Wildlife to the Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean (the SPAW Protocol) which entered into force in Trinidad and Tobago on May 26, 2000;
- b. the United Nations Convention on Biological Diversity (the Biodiversity Convention) which entered into force in Trinidad and Tobago on August 01, 1996; and
- c. the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which entered into force in Trinidad and Tobago on April 18, 1984.

BENEFITS TO OTHER SPECIES/ECOLOGICAL COMMUNITIES

Included in the recovery plan it is recommended that the Trinidad Piping Guan be made into a Flagship Species and this be promoted. An educational initiative should be undertaken. In that way greater sensitivity to the Pawi can be generated. In addition, the Trinidad Piping Guan can then be used as an umbrella species and the area designated for the recovery of the species can also be used for the benefit of other native species in the area such as the Ocelot (*Leopardus pardalis*) and the Red Howler Monkey (*Alouatta seniculus*), which are two other threatened Neo-tropical animal wildlife species in Trinidad, or the ecological community itself.

The recovery plan must, where possible, identify if there are any broader biodiversity benefits to be gained from the plan. The plan should also state how these can most effectively be maximised and achieved (e.g. conservation agreements with landholders, increases in public awareness, etc). The recovery plan should be implemented with as little disruption to the natural environment as possible.

SOCIAL AND ECONOMIC IMPACTS

In designing the recovery plan, attention must be to minimise any significant adverse social and economic impacts, consistently with the principles of ecologically sustainable development. In the EMA Environmental Sensitive Area (ESA) Matura National Park Notice, 2004, a line stated “Sustainable Economic and Human Development” in the objectives of the designation. However, no further detail was given.

In developing the recovery plan some consideration should be given to any potential adverse social and economic impacts that may result from the implementation of the plan. This process however is not reliant on information derived from consultations.

Consequently, it is assumed that the application of a recovery plan will have no adverse social and economic impacts to the Matura area or the surrounding villages.

4.3.2.2 Part B: Distribution and Location

“Recovery plans need to provide detailed information on the distribution and location of the species/community, important populations and areas of habitat critical to the survival of the species. The information can be

presented in various forms (maps, latitude and longitude coordinates, descriptions etc).” (Environment Australia, June 2002)

One of the major constraints in developing a recovery plan for the Trinidad Piping Guan is the lack of knowledge of the current extent of the geographic location of the population(s). The two major factors associated with this is the small numbers in the population(s) as well as the fact that the species are arboreal and detection is difficult. As has been stated in the previous section it is believed that the last remaining populations can be found only in the eastern Northern Range.

Consequently research should be carried out using radio tracking devices (for members of the species that can be captured and be electronically tagged) so that a more definitive range for the species can be established.

Because the population is so small and the exact range unknown but is understood to be confined to the eastern end of the Northern Range, it can be assumed that the entire area maybe required for the survival of the species.

Below is a list of qualitative data that is unknown to a large extent about the Distribution and Location of the Trinidad Piping Guan.

- sites to meet essential life cycle requirements e.g. breeding or nesting
- sites of food sources, water, shelter, fire and flood refuges or those used at other times of environmental stress
- essential travel routes between the above sites
- sites necessary for seed dispersal mechanisms to operate or to maintain populations of species essential to the threatened species or ecological community (e.g. particular pollinators)
- habitat that is required to maintain genetic diversity

The Trinidad Piping Guan has such low population numbers that core population cannot be distinguished. All the Pawi populations presently residing in the Northern Range are critically endangered. Consequently, any recovery plan should be implemented before complete extinction takes place.

4.3.2.3 Part C: Identification of Potential and Known Threats

The first potential threat would be “habitat destruction” due to hurricanes (the last existing habitat of the Pawi is the north-east peninsular of Trinidad). Other threats are deforestation, logging, birds of prey and animal disease. The known threats are poaching and hunting.

4.3.2.4 Part D: Objectives, Criteria and Actions

The objectives must be able to be conducted within a reasonable time frame which was previously identified as five years.

There has not been much data available on the length of a research project of this magnitude. However, a rough estimate of two years for on-site research to be conducted and the information gathered in the process can be applied.

It is important to note that computer simulations are used to test the sensitivity of the species when different parameters are changed. The simulations are only effective if the information collected on the Pawi is accurate. An example may be a population's response to a change in the number of fruiting trees for the Pawi. The resulting change in population indicates how sensitive the species are for this specific parameter if the change is great then it would imply increasing the conditions of this factor would cause a positive impact on the population levels.

EVALUATION OF SUCCESS OR FAILURE

A team of qualified personnel including zoologists, foresters and members of relevant non-governmental organizations (NGOs) as well as other interests can be contracted to evaluate the action plans as determined from the prior research and assessment stage that is discussed above.

The evaluation of success and failure can easily be measured either by increase in juveniles in the population (increased natality) or a fall in mortality levels of the species. If there is no appreciable change in the population the exercise can be seen as a failure and a new research exercise and data analysis must be done.

4.3.2.5 Part E: Management Practices

A multiple use approach should be continued for managing the Matura National Park area. At present tours conducted in the area and research work being conducted are not in conflict but the carrying capacity of activities that can be conducted in the Park without any adverse or deleterious effects to the flora and fauna that inhabit the area should be conducted. This knowledge allows for a quantifiable level of acceptable disturbance to be used in booking future tours and expanding or confining activities in the Park. This will thereby allow greater efficiency and sustainability in the area.

It is advised that experts in a number of disciplines including ecology and economics be consulted during the process of establishing the

carrying capacity of the area. The residents of the area must also be included in these discussions as any increase or decrease in activities in the area will directly or indirectly affect some of their livelihoods. The recovery plan team would also need to incorporate the financial statement for all the projects and personnel who are to contribute to the Recovery Plan and the wider management of the Matura National Park and its facilities.

4.3.2.6 Part F: Ex Situ Captive Bred Management

The information generated from the captive bred colonies as suggested in **Recommendations 4.2.7** of the previous section would assist in providing previously unknown facts about the Pawi. This is also consistent with the recommendations from the “Summary of alternative solutions to the threats to neo-tropical animal wildlife conservation in Small Island States” in the Introduction to this book. Information such as the presence and types of diseases affecting it, in addition to general information on its prolificacy, fecundity, reproductive physiology, gross anatomy and longevity are all vital for its successful rehabilitation and re-establishment in the wild. In areas of the Pawi’s habitat that has been altered a parallel habitat/recreation drive would have to be conducted to maintain the Pawi until they can be released in a suitable habitat. There is an ongoing reforestation drive that is conducted under the directive of the Forestry Department that can aid in creating suitable habitat for re-introducing the captive-bred progeny. The output of Pawi from these centres can also be used to facilitate further *Ex Situ* research or animal release into suitable habitats as mandated by a proper re-introduction protocol. This is illustrated in figure 4.12 below. The frame work for developing *Ex Situ* intensive production models for Neo-tropical animals as suggested in Garcia (1998), Uddenberg et al (2004) and Garcia et al (2005) could be used.

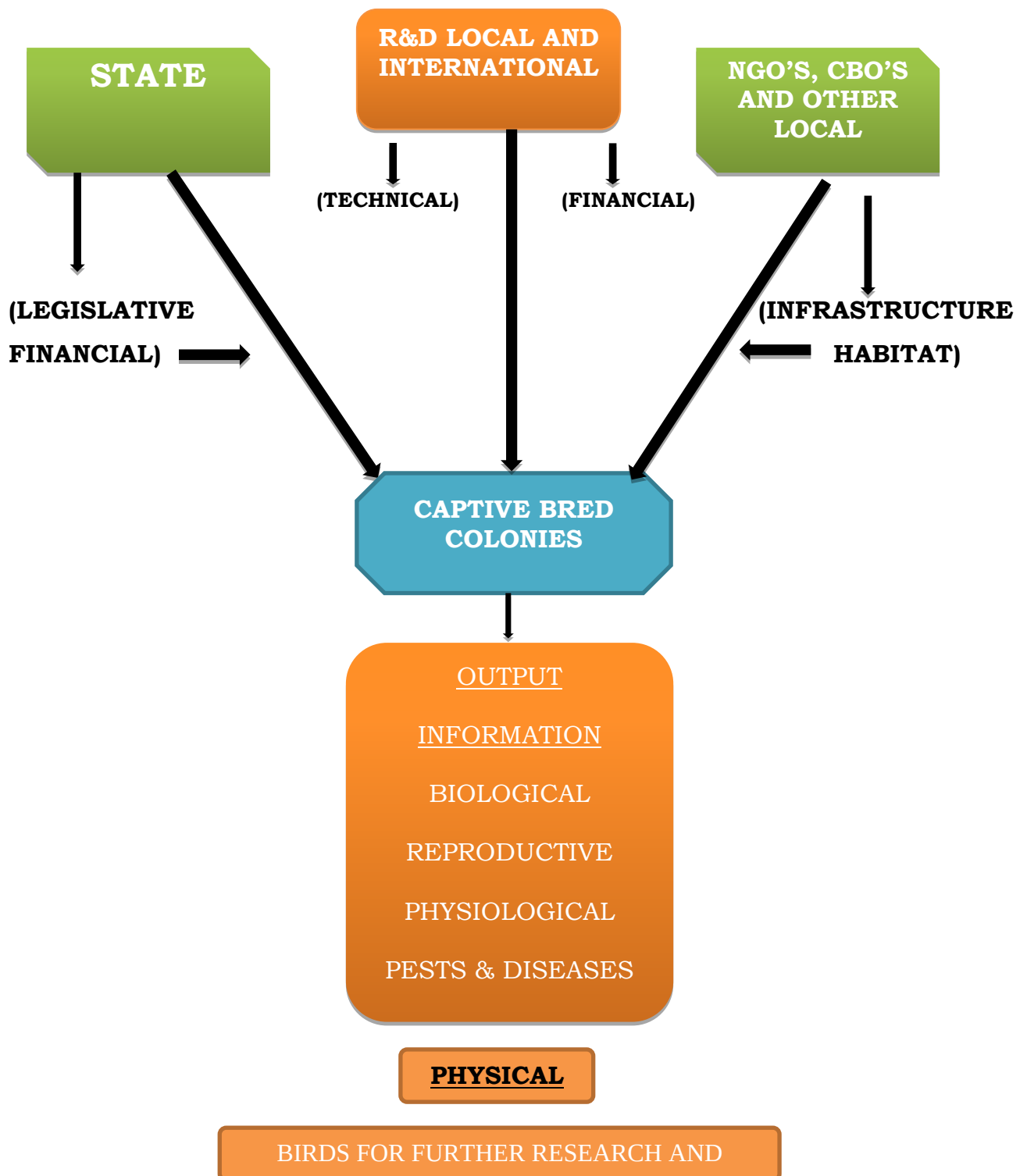


Figure 4.13: The Process flow for the Pawi Captive Breeding Centre [Living Gene banks]

4.3.3 References and Literature Consulted

- Australian Government Department of the Environment and Heritage (2006):
<http://www.deh.gov.au/biodiversity/threatened/publications/recovery/guidelines/parta.html>
- Brown-Uddenberg, R. C.; Garcia, G.W; Baptiste, Q. S.; Adogwa, A. O.; Counand, T. and Sampson, T. (2004): *The Agouti Booklet and Producers' Manual, Wildlife Farmers' and Producers' Booklet #1*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago. ISBN#: 976-95123-0-3
- Garcia, G.W (1998): Intensification of Animal Production Systems for Improved Wildlife Conservation, Proceedings of UWI, Ag.50 Conference, August 1998, Faculty of Agriculture and Natural Sciences, The University of the West Indies, St Augustine, Trinidad and Tobago, W.I., Volume 3: 91-101
- Garcia, G. W., Young,G.G., Amour,K. M., James,D., Lallo, C. H. O., Mollineau, M., Roopchand, A., Spencer, M., Prosper, M. A., Ganessingh, N., Rooplal,R., Gayan, N., Steil, A., Xande, A., Bemelmans, A., Norgueira Filho, S. G., Guimaraes, D., Gálvez, H., and Mayor Aparicio, P. [2005]: *The Collared Peccary/ Pakira/ Javelina/ Catto/ Catete/ Porco de Monte/ Taitetu/ Sajino/ Quenk [Pecari tajacu, Tayassu tajacu] Booklet & Producers' Manual, Wildlife Farmers' and Producers' Booklet #2*, The Open Tropical Forage-Animal Production Laboratory [OTF-APL], Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. GWG Publications, 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago. ISBN 976-95123-1-1
- The Environmental Management Authority of Trinidad and Tobago (2006): <http://www.ema.co.tt/http://www.ema.co.tt/>

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About the Series: Wildlife Farmers' and Producers' Booklets

The first in this series was on the **Agouti** [*Dasyprocta leporina*] that was launched in 2004. The second in the series was on the **Quenk/Wild Hog/Collared Peccary/Javelina** [*Peccary tajacu/Tayassu tajacu*] in 2005. The third in this series is on the National Birds of Trinidad and Tobago. At present we are working on the following animals, Capybara, Red Brocket [*Mazama americana*], Lappe [*Agouti paca*], Green Iguana [*Iguana iguana*] and the Manicou/Opossum [*Didelphis marsupialis insularis*]. The contents of the booklets in this series were designed and structured in order to meet the needs of a wide and varied audience [primary and secondary school children, university undergraduates and researchers and farmers or hobbyists who would be interested in rearing or conserving our **Neo-tropical animals**]. The first two books in the series have been the focus of an essay and short stories competition in some schools in Trinidad and Tobago under the direction and sponsorship of eTeck.

The Agouti Book

This is available from the website of the **“Open School of Tropical Animal Science and Production”**.

Review of the Agouti Book

“....The manual is exhaustive and beautifully illustrated and constitutes the most complete reference on Agouti production produced to date. The manual specifically oriented for the benefit of Agouti farmers and producers, reviews the scientific information related to the species covering all aspects of taxonomy, morphology, health, reproductive patterns, housing, social behavior and reference values on haematological and biochemical parameters. The final section outlines in clear detail the process of setting up an intensive Agouti farm, including key technical coefficients based on more than ten years of experience of the authors on the production of *Dasyprocta* species in Trinidad....”

Dr. Ferran JORI, BEDIM 2005:

<http://www.bib.fsagx.ac.be/bedim/production/bulletin/pdf/v13n2.pdf>

Comment on the Quenk Book

“The educational dimension of this document is not limited to the peccary producer, as the title suggests; it should extend to every local school library. We look forward to the promise, of this excellent endeavor, of similar documents in preparation on other wild animals here, in our domain, which deserve our attention.”

Holman E. WILLIAMS, DVM. FRCVS

Professor Emeritus of Livestock Science, UWI, 2004 September 01

About the First Author:



Prof. Gary Wayne Garcia [B.Sc. General Agriculture, UWI] is the Professor of Livestock Science at the University of the West Indies, St Augustine and is a trained Ruminant Nutritionist. He obtained his Ph.D. from the UWI in 1988 and has been teaching Animal Production there since 1990. He began research in Neo-tropical Animal Wildlife in 1992 at the encouragement of five undergraduate students. He has developed in association with Dr. Keith Archibald the concept and philosophy of the **Open Tropical Forage-Animal Production Laboratory [OTF-APL]** and **The Open School of Tropical Animal Science and Production [OSTASP]**. He has also developed the **M.Sc. in Tropical Animal Science and Production** and this programme has been going since 1995. Recognizing the scarcity of information on Neo-tropical Animals Professor Garcia started the Series on **“Wildlife Farmers’ and Producers’ Booklets”**. He is now in the process of developing the **“Electronic Journal of Neo-tropical Animal Wildlife”**.