Research on Neo-Tropical Non-Domestic Animals (Wildlife) Part 2: The Beginning of Neo-tropical Animal Research Within the Department of Food Production, UWI 1996 to 2001

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Abstract

This paper is the second in a three-part series. It describes the work conducted at UWI, St Augustine, Trinidad and Tobago between 1996 to 2001. This report is described from a UWI, St Augustine scholar's perspective. It is an account of the research work conducted by and the experiences of the author on Neo-tropical non-domestic animal conservation and production during this period. The first paper in this three-part series began by stating the lessons learnt about Neo-tropical animals from the time of the arrival of the Spanish into the New World/Neo-tropics in 1492 to 1995. These lessons were that scientific researchers and policy makers had put Neo-tropical animals on their backburners and that the knowledge, up to 1995, of these animals were contained within the experiences of the zookeepers and animal curators at the modern-day zoos, both within and outside of the Neo-tropics. There was still a lack of the proper understanding of the digestive and reproductive systems of these animals, which was and is the basis for intensive animal production systems or *ex situ* living conservation. Part 1 highlighted three main events that occurred in 1996: (1) the publication of the book by Juhani Ojasti based on 25 years work in Venezuela at the Universidade Central de Caracas, (2) the establishment of the Intensive Production Unit of Agouti (*Dasyprocta leporina*) at UWI's Field Station in Trinidad and Tobago, today this is still in operation after 28 years, and (3) the offering of a graduate elective course "Tropical Zoo and Wildlife Production and Management" at the Faculty of Agriculture, UWI. The early papers arising from the production modelling thinking at UWI are highlighted.

Keywords: Research, production, Neo-tropical non-domestic animals, Ojasti, AL65B/AGLS 6502, agouti (*Dasyprocta leporina*), cocrico (*Ortalis ruficauda*), The Open School of Tropical Animal Science and Production.

Introduction

Part 1 presented the initiatives of Neo-tropical wildlife (Neo-tropical non-domestic animals) research from the late 1800s to 1995. First, a background from 1492 was outlined. It was stated that three events took place in 1996. Because of this it is suggested that this year be used as the beginning of the second period of research with Neo-tropical animals, from the UWI, St Augustine scholars' perspectives.

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This Part 2 presents the work conducted at St Augustine between 1996 to 2001. It must be mentioned that there is still a vast amount of literature (both grey and published) on Neo-tropical animals that has been generated in Central and South America that is yet to be comprehensively reviewed and analysed.

The paper, herein, is complementary to Garcia (2022) in which the evolution and justification for domestic animal science teaching and research at ICTA-UCWI-UWI from 1922 to 2021 (an Anglophone biased institution) were presented. It was highlighted that non-domestic animal research was only featured from the standpoint of zoological classification. The early focus was in the discipline of entomology of Neo-tropical animals (invertebrates), when they became pests of cultivated commercial crops and domestic livestock (all of the latter were not Neo-tropical in origin). This work began within the Department of Entomology then later continued within the evolved Departments of Biology and Zoology and which today is the Department of Life Sciences.

The COMFAUNA (Communidad sobre Manejo de Fauna Silvestre en la Amazonía y Latinoamérica) initiative that began in 1992, in Brazil (Belem), was very important (https://www.facebook.com/somoscomfauna/). This initiative led by Professor Richard Bodmer was both the catalyst and the process that brought together research workers from Latin America and the Caribbean into a community without any prompting and directions from any external organisations or internal or external institutions. This paper is an attempt to document the personal research experience of this author from a historic and experiential perspective. The work at St Augustine with Neo-tropical animal production began in September 1992 with the student projects mentioned in Part 1. This was around the same time as the beginning of the COMFAUNA initiative in Belem, Brazil. However, the workers at St Augustine were only made aware of the COMFAUNA collaboration and initiatives in 2004 after having begun collaboration with the Institute Nationale de la Recherche Agronomique (INRA) Antilles-Guyane, in French Guiana in 2002. This will be described in Part 3.

The events that took place in 1996 were:

(1) The publication of a book by the Food and Agriculture Organization (FAO) with the title "Wildlife utilization in Latin America: Current situation and prospects for sustainable management" (Ojasti 1996), based on 25 years of work at the Universidad Central in Caracas, Venezuela.
(2) The establishment of an intensive agouti (*Dasyprocta leporina/D. aguti*) production unit at the UWI Faculty of Agriculture Field Station in Trinidad.
(3) The first offering of a course with the focus on Neo-tropical animals "AL65B/AGLS 6502: Tropical Zoo and Wildlife Production and Management" within the UWI Faculty of Agriculture.

The second and third of these events were initiated by the author of this paper who joined the academic staff of the UWI Faculty of Agriculture, Department of Livestock Science in December. Up to that time there were no lectures or courses taught within the UWI system on wildlife (non-domestic Neo-tropical animals), as it pertained to the production of terrestrial mammals, reptiles or avian species. However, the teaching of entomology (insects that were pest of commercial crops and livestock) were core disciplines within the programme of the Imperial College of Tropical Agriculture (ICTA) since its foundation at St Augustine in 1922 (Garcia 2022). Zoology and Neo-tropical animals and wildlife were then considered by the academic community firstly within the

domain of natural history then later within the domains of ecology, forestry, conservation and biodiversity as was explained in Part 1. These were within the skills set and academic training of the staff within the Departments of Biology, Zoology and Plant Science within the then Faculty of Natural Sciences. However, within these university-trained persons there was limited focused training in the principles of animal production during their formation. Part 1 described the authors 1995 visits to major zoos and selected wildlife locations in the USA. As a result of the experiences gained from these visits, from 1996 to 2019 the author used every opportunity to visit zoos worldwide. From this was obtained, from the zookeepers and curators within these facilities, a vast amount of knowledge about Neo-tropical animals. This added significantly to the development, evolution and content of the course "Tropical Zoo and Wildlife Production and Management".

There were four conclusions from the Forestry Phase described in Part 1 which became the foundation for the way forward from 1996:

1. Knowledge of the anatomy and physiology of Neo-tropical mammals and animals in general was limited.
2. Forestry personnel in Trinidad and Tobago were responsible for the implementation of the wildlife hunting laws.
3. Forestry's focus on wildlife in Trinidad and Tobago was on hunting.
4. There was the beginning of an appreciation for the need for a better understanding of the animals from the standpoint of animal production.

As a result of the foregoing conclusions and due to the human resource (academic and technical staff) and financial limitations, it was decided that the elective course on wildlife would cover "wildlife management" and "zoos" (with a focus on Neo-tropical animals). The course was therefore conceptualised as being divided into two parts, *in situ "*Wildlife conservation and management" (management of animals within their natural habitat, drawing from the experiences and models from the Wisconsin School of Wildlife Management) and *ex situ "*Wildlife conservation and management" (zoos and intensive animal production). The course is described in more detail later in this Part.

In Part 1 it was mentioned that the great grandfather of the author, who was a successful cocoa and coffee plantation owner, in the late 1800s and early1900s, fed his 16 children with Neo-tropical animals as the main protein sources and the fruits were from the land that he cultivated (Thompson and Clyne 2000). However, with the decline of markets for the cocoa and coffee commodities in the 1920s and 1930s the British Colonial Government and the ICTA did not see it necessary to explore the opportunities with our local animals. Blaut (1997) suggested that "Eurocentrism" may have been the reason why looking inwards within the Caribbean for solutions was not a way for moving agriculture forward. *Solutions must come from Europe!* The author of this current paper has been committed to move the Neo-tropical animal agenda forward in spite of the Eurocentric detractors within the UWI system. It should be noted that the international focus of this agenda in the post 1995 phase has come from the interaction of the author with scientists from Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Suriname and Peru (Spanish, Portuguese, Dutch and French speaking South America). This was good, as herein was found the largest centre of animal biodiversity on earth (Ojasti 1996). The author has been actively communicating with scientists

from this area in Spanish and French, languages which are not widely spoken in the English-speaking Caribbean.

Objectives

The following were the objectives of this paper (Part 2):

1. To document the lessons learnt from the wildlife research undertaken pre-1996, more specifically on the "Neo-tropical non-domestic animals" and to continue the narrative on the research on Neo-tropical non-domestic animals at the Faculty of Agriculture/ Faculty of Science and Agriculture/ Faculty of Food and Agriculture, St Augustine from 1996 to 2001; these were turbulent administrative years within the UWI, St Augustine agriculture system (Garcia, 2022).
2. To briefly review the FAO book "Wildlife utilization in Latin America: current situation and prospects for sustainable management" (Ojasti 1996).
3. To describe the establishment of the Intensive Agouti Production unit at the UWI Field Station on 31 July 1996.
4. To describe the course "AL65B/AGLS 6502: Tropical Zoo and Wildlife Production and Management".
5. To report on the activities undertaken and the evolution of wildlife production research at UWI, St Augustine from 1996 to 2001:
    a. Assessment of the knowledge about Neo-tropical animals for the purpose of developing intensive production models as a means of *ex situ* conservation (Garcia 1999).
    b. The conceptualisation of the Open School of Tropical Animal Science and Production, OSTAS&P (Garcia and Archibald 2001).

Lessons learnt

The work done and experiences up to 1995 suggested the following hypotheses:

1. Neo-tropical animals have evolved and have become successfully adapted to the Neo-tropical environments.
2. There are Neo-tropical animals which can be reared intensively using the principles of domestic animal production.
3. Neo-tropical animals conservation success will be dependent on a synergism between production, utilisation and health.
4. Laws governing wildlife conservation should be formulated based on an understanding of science, animal life cycles and ecological information.

The activities undertaken since 1996 have been to test these hypotheses. This Part is the bridge linking the past Eurocentric initiatives with Neo-tropical animals and the evolution of the thinking and research on Neo-tropical animals from the perspectives of the Neo-tropical countries. It therefore covers only a six-year period 1996 to 2001, after which there was an abundance of literature generated by scientists from within the Neo-tropics.

A review of the book "Wildlife utilization in Latin America: Current situation and prospects for sustainable management" (Ojasti 1996)

Juhani Ojasti was one of the pioneers of Latin American wildlife management. What he did was to bring to the attention of the Anglophone world the initiatives of the original pioneers of Latin American wildlife conservation and management, who were the natural history experts on Neo-tropical animals within Latin America. These pioneers were those persons who organised the early meetings that Ojasti cited. **The earliest pioneer could be considered to be Miguel Alverez**

del Torro of Mexico who was the key speaker at the first Latin American wildlife meeting in Mexico in 1963. The zoo in Chiapas, Mexico was named in his honour, "Zoologico Regional Miguel Alvarez del Torro (ZOOMAT)" in 1980. This is a truly Neo-tropical zoo that only exhibits endemic fauna.

Juhani Ojasti was trained as a biologist in Finland before going to work at the Universidad Central de Venezuela in 1958, where he spent about 50 years. The Introduction to Ojasti (1996) highlighted meetings on Latin American wildlife going back almost 60 years from today's date (2024). His opening statement is quoted below.

> *"Numerous scientific and technical events held in the last 20 years testify to the deep concern over the fate of the indigenous wildlife of Latin America. Despite this, wildlife as a renewable natural resource continues to be overlooked, underestimated, and under attack from short-term economic interest. Seemingly, the warning admonitions of scientists and other citizens worried by the progressive decline of wildlife are taking a long time to translate into effective policy for the rehabilitation and development of the sector. Perhaps this is partly due to the lack of decisive documentation on the importance of wildlife."*

The meetings on Latin American wildlife that he mentioned included (up to 1983):

> *1° Convención Nacional de Caza, Mexico, 1964; Simposio sobre la Biota Amazonica, Belem, 1967; 1° Foro sobre Protección y Fomento de la Fauna Silvestre, Caracas, 1970; Simposio Internacional sobre Fauna Silvestre y Pesca Fluvial y Lacustre Amazonico, Manaus, 1973; Simposio sobre Flora y Fauna Silvestre y su Medio Ambiente en el Continente Americano, Monterrey, 1973; Encuentro Nacional sobre Conservaçao da Fauna e Recursos Faunísticos, Brasilia, 1977; Reunión Regional Centroamericana sobre Vida Silvestre, Matagalpa, 1978; Seminario sobre Caça Amadorista, Brasilia, 1978; Simposio sobre Manejo de Vida Silvestre, Valdivia, 1979, 1° Congreso Nacional sobre Conservación de Fauna Silvestre, San José, 1980; Simposio Conservación y Manejo de la Fauna Silvestre en Latinoamérica, Arequipa, 1983.*

At the above-mentioned meetings that were held in Argentina, Brazil, Chile, Costa Rica, Mexico, Nicaragua and Venezuela, it would be noted the terms Amazonian, fauna silvestre or vida silvestre (wildlife) and Latinoamericano were used. **It should also be noted that COMFAUNA initiative (1992) in Belem, Brazil was 28 years after the 1° Convención Nacional de Caza, Mexico (First National Convention on Hunting, Mexico), 1964.** In Part 3 it will be described why it was suggested that the term "Neo-tropical non-domestic animals" ought to be more specifically used. Ojasti (1996) also went on to say later in the book:

> *"Most of the information now available is descriptive and/or anecdotal, based on the experiences, views or beliefs of hunters and campesinos, or on naturalists' accounts observations of animals in captivity, and so forth. The diffuse information is repeatedly cited but there is no way to check its origin and accuracy."*

He further stated:

> *"The problem of Latin American wildlife requires its own solutions, geared to the specific realities of the countries, the region and the type of user."*

This statement above may be considered one of his major contributions to Latin American

wildlife conservation. The publication has legitimate content as it was the result of work that Ojasti conducted over a period of 25 years. He made efforts to gather information from as many Latin American countries as possible.

Structure and contents of the book

Ojasti (1996) contains chapters on "Patterns of utilisation", "Key groups of species", "Environmental, socio-economic and administrative aspects", "General discussions and conclusions", Recommendations", "References", "Bibliography" and "Appendices". The lists of references and Institutional contacts were exhaustive. This book is a must read for anyone who is interested in "Neo-tropical Wildlife" in its broadest sense.

The book is multidisciplinary and very informative. Recommendations are listed in three areas: broad recommendations, management recommendations and research priorities.

Broad recommendations

Most countries of the region lack the technical capacity to implement the necessary basic administrative research and wildlife protection at the field level. A review of the potential for bolstering the wildlife services by beefing up, training and/or recycling staff and making changes in the support infrastructure is therefore recommended. Enhanced wildlife protection services are considered particularly urgent.

Management recommendations

Each wildlife species and population require a specific form of management in line with its own biology, current status and pattern of utilisation.

Research priorities

The documentation of the basic biology of some of the key species such as *Geochelone* spp., *Dasypus novemcinctus*. *Tapirus terrestris*, *Tayassu pecari* and the *Mazama* species was needed. In view of the lack of trained staff to perform these essential functions, it was recommended that research be shared out among the wildlife services, universities and other research centres.

These recommendations suggested that the biology of the key species needed to be known and that trained staff was limited in ability to perform the essential functions, that strongly included research. This suggesed that university courses involving research would be important. It was therefore a coincidence and an historical accident that the author of this paper offered for the first time, in 1996, at UWI, St Augustine the course "Tropical Zoo and Wildlife Production and Management", the details of which are presented below.

Nine components were synthesized and identified by Ojasti (1996) as a strategy for Neo-tropical wildlife management. These were used in the evolution of the course "Tropical Zoo and Wildlife Production and Management". The components were:

(1) total protection;
(2) protected areas;
(3) sport hunting;
(4) captive breeding;
(5) extensive management of commercial species;
(6) environmental education;
(7) research;
(8) wildlife protection services;
(9) other strategies.

All these were suggested as there was the realisation that Latin America and the Caribbean is a very complex environment made up of at least 33 countries. These consisted of democratic republics, independent states, European and American colonial dependencies and some non-democratic states. These countries have very different legal systems, speak different languages (English, French, Spanish, Portuguese, Dutch and some native and creole languages), have a wide range of geographic formations and climates ranging from sea

level (most Caribbean states) to in excess of 4000 meters above sea level and finally very different cultures. Therefore, the suggestions of Ojasti had components that could be selected for each country to suit the needs of the specific country and location.

In contrast the "Wisconsin school" in the USA were able to develop a simple approach. There was one main language (English), more or less one legal system, one country and one political system. This system is what was referred to as the "North American approach", by Garcia et al. (2005). It contains five components: (1) management of over exploited or hunted species; (2) management of scarce and declining species (endangered or threatened species); (3) management of overabundant and pest species; (4) management of national parks and protected areas; (5) the financing of wildlife management.

There is a notable absence of megafauna (large land mammals) within the Neo-tropics. The largest land mammal is the tapir/ South American tapir (*Tapirus terrestris*), the national animal of Belize, which weighs between 250 - 300 kg. The Neo-tropics, however, contains one of the most diverse collections of animal species in the world as shown in Table 1 (Ojasti 1996).

Table 1: Numbers of species of terrestrial vertebrate in selected Latin American countries, roughly north to south

Country	Mammal	Birds	Reptiles	Amphibians	Total
Mexico	478	994	653	223	2,348
El Salvador	170	460	98	26	754
Nicaragua	152	627	169	56	1,004
Costa Rica	203	825	222	157	1,407
Panama	225	883	214	143	1,465
Colombia	350	1,700	416	270	2,736
Venezuela	320	1,311	280	140	2,051
Suriname	183	640	160	80	1,063
Brazil	653	1,750	396	164	2,963
Peru	372	1,690	266	231	2,559
Bolivia	280	1,188			
Argentina	300	957	175	69	1,501
Uruguay	95	382	58	34	569
Chile	134	434	76	26	670

Source: Ojasti (1996)

However, information on the Caribbean (Spanish, English and French speaking) and Belize and Guyana (English speaking Central and South America) was missing from Table 1.

Table 2 was developed based on Ojasti's information. It is dated (almost 30 years) but the information suggested that the Neo-tropics contained greater than 25% of the world's known mammals, about 33% of the known birds, 19% and 46% of the world's reptiles and amphibians respectively.

The plant and animal species diversity of Trinidad and Tobago is presented in Table 3. Alkins-Koo and Soomai (1993) presented more details on the species reported in Trinidad and Tobago.

Today there is widespread confusion within the minds of

Table 2: The numbers of Neo-tropical animal species

Animal Kingdom Species	Approximate Number of Species
MAMMALIAN	
South America	800
Central America	270
TOTAL	**1070**
>25% of all known mammals	
BIRDS	
South America and other Neo-tropics	**2390**
33% of all birds of the world	
REPTILES	
South American Neo-tropics]	**1,115**
19% of world reptiles	
AMPHIBIANS	
South American Neo-tropics	**1,865**
About 46% of world amphibians	

Source: Estimated from Ojasti (1996)

the different conservation groups and wild animal lovers. It seems that many of the "wildlife conservation aficianados" (those who seem to be the most vocal on animal wildlife issues) have forgotten that all present-day domestic species of animals were once wild or undomesticated. It is also a historical accident that all present day-domestic species of animals (with the exception of the muscovy duck, (*Cairina moschata*), the table turkey, (*Melargis gallopavo*), and the guinea pig, (*Cavia porcellus*) were all non Neo-tropical in origin. Chickens, goats, pigs, sheep, dairy cattle, beef cattle and buffaloes are all not native to the Neo-tropics or the New World as was explained in Part 1.

A review of the book "Manejo de Fauna Silvestre Neotropical" (Ojasti 2000)

Ojasti (2000) was a further elaboration of the efforts of Ojasti (1996) but in a more structured North American format. The geographical tone began with "Neo-tropical" but then transcended to "America tropical". This would imply an identification more with America and the Smithsonian philosophy rather than the Latin American countries' approaches. However, the preface, translated into English, did close with the following:

> *"On the other hand, the orientation of the present work and the selection of particular examples are based on Venezuelan experiences. Even the structure of the book is related to the wildlife management course that has been taught at the Central University of Venezuela for two decades."*

This suggested that since the early 1980s a course on Neo-tropical wildlife management was being offered in Venezuela, the closest neighbour of Trinidad and Tobago, but it was not until 1996 that such a course was offered at UWI in Trinidad and Tobago.

Francisco Dallmeier was a Venezuelan scientist who rose to the heights of the American Smithsonian Institution and was a former student of Ojasti. There are ten sections in the book as follows: general principles, Neo-tropical fauna and its situation, users and utilisation, policies/laws on fauna and instruments, abundance, population dynamics, population management, energetics and feed supply, habitat, and Latin American experiences and approaches.

The establishment of the intensive agouti (*D. leporina/D. aguti*) production unit at the UWI Field Station in 1996

Part 1 of this paper stated that the agouti was one of the most widely distributed Neo-tropical animals and it was the most popular non-domestic animal reared in captivity in Trinidad and Tobago. Therefore, it would be the most logical animal with which to begin the research on intensive animal production of Neo-tropical mammalian animals. Work on an aquatic Neo-tropical animal species, the cascadura's (*Hoplosternum littorale*) reproductive systems and ecology was earlier reported on by Singh (1978) and followed up on by the intensive production modelling by Ramnarine (1992). In Brazil work with other terrestrial aquatic species was also being done but this is outside the scope of this paper. Most notable about this agouti's intensive production unit was that it has been in continuous production since 1996. It has generated a book (Brown-Uddenberg et al. 2004), several M.Sc. and final year research projects, two M.Phil theses, three Ph.D. theses, many refereed publications, and it has been used as a training and teaching unit. All this was done, and it is still not on the DFP's establishment with no dedicated

Table 3: Number of animal species in Trinidad and Tobago

Major groups	Number of species
Vascular plants	2160
Birds	450
Mammals	95
Reptiles	85
Snakes	55
Amphibians	30
Freshwater fishes	45
Marine fishes	354
Butterflies	600
Nematodes	200-300

Source: Cross (2001)

staff or funding. No other unit within the FFA has achieved this level of academic and publication output without dedicated support and funding.

The unit was established on 31 July 1996 because on 1 August 1996 the Faculties of Agriculture and Natural Sciences were to be merged. The space was acquired, cleaned and two agoutis were sourced (sexes unknown, as sexual identification was the first challenge to be addressed), and housed in rabbit cages. Therefore, by 1 August no permission was needed, as possession was 99% of the law. The work thus begun quietly with no need to ask permission for space. The first set of cages were built with a grant of US$2,000 US awarded, to Roxann Brown (an M.Phil. candidate in Livestock Science), by the Inter-American Foundation Development Studies Fellowship, Office of Planning and Programming, the Vice Chancellery, UWI Mona, Jamaica. Then concrete floor pen cages were built by the final year and graduate students working with the agouti (Plates 1 and 2).

The justifications for the establishment of the agouti unit

The main motives behind establishing the unit were:

(1) To have statistically valid groups of animals for animal production studies and to have captive bred populations of the same age, sex, nutritional backgrounds and life histories.

(2) To have daily interactions and observations of the animals in order better understand how to care for them.

(3) To appropriately house the animals so that training in the management of the animals would be possible.

(4) The animals had to be housed by their physiological states as this would be necessary in order to facilitate controlled breeding and reproduction.

(5) To be able to distinguish between males and females as there were no external signs of sexual dimorphism, so housing management was important for sexual differentiation and observing for reproduction and parturition management.

(6) To sustain long term animal production and physiology research; wild caught animals were unsuitable for this.

(7) To conduct animal nutrition studies and to develop the appropriate apparatus specifically for the agouti because of its unique behaviour, this had already been done for all the domestic animal species but were not suited to Neo-tropical rodents.

(8) To be able to study the anatomy and physiology of the animal's digestive and reproductive systems using animals with known life histories.

Approaches taken to the unit design and housing

The unit cages and housing design were based on already existing knowledge of closely related species, these were the domestic rabbit (*Oryctolagus*

Plate 1: The first cages constructed specifically for the Agouti Unit in 1996 that are still being used in 2024

Graduate students building the concrete floor pens

Roxann Brown-Uddenberg

Brown and white agouti on the concrete floor pens

Plate 2: The development of the floor pens of the Agouti Unit post 1996

cuniculus) and the guinea pig (*Cavia porcellus*). The internal design of the cages was also based on information obtained from the keepers at the Emperor Valley Zoo in Trinidad and Tobago and from zoo exhibits in the USA.

First order of business for the unit

The first orders of business for the unit were:

(1) To be able to differentiate the sexes.
(2) To learn to handle the animals in captivity.
(3) To manipulate breeding and conception.
(4) To confirm the length of gestation.
(5) To determine parturition interval.
(6) To observe for *post-partum* estrus.
(7) To conceptualise and test an intensive production model.

Item (7) was reported on by Brown-Uddenberg (2001) and it should be noted that before this report there were only about six refereed publications on the *Dasyprocta sp.*; 22 years later the agouti unit has generated many times that number of refereed publications. The detailed work on the *Dasyprocta* species conducted in Brazil was not known to the UWI team until 2004; it will be described in Part 3.

A description of the course "AL65B/AGLS 6502: Tropical Zoo and Wildlife Production and Management"

This course is a five-credit elective course first developed in 1996 for the M.Sc. in Tropical Animal Science and Production

out of the Department of Livestock Science, UWI. It was also designed for use as an elective for advanced undergraduate agriculture and science students and for students from other faculties who may be interested in Neo-tropical animals and conservation. Exchange students from the University of Wisconsin, Madison, were allowed to take this course and have it credited to their Wildlife major. The student performance evaluation was initially 40% coursework and 60% examination (a three-hour written exam at the end of the week 13 of the semester). Later it evolved into a 50%:50% evaluation system. The course work included an individual or group project on a Neo-tropical species or species grouping with a written individual or group report and a 15-minute individual or group presentation. It also included a three day/two night survival camp somewhere in Trinidad and Tobago. The camp was under the direction and control of retired army staff sergeant Anthony Zue Garcia, an expert on snakes and survival. This field laboratory exercise was also aimed at preparing the students for future wildlife field research. The projects within the course helped to expand the research efforts on Neo-tropical animals and contributed to shared publications. In 2016 a three-credit undergraduate course was offered: and *"ENRM 2004 Wildlife Resource Management"*. This was essentially the wildlife management half of the five-credit course and did not involve the field survival experience.

These courses have led to the development of a compendium of Neo-tropical animals which now contains information on 55 species or species groups of Neo-tropical animals on the website of the Open School of Tropical Animal Science and Production. This compendium did not exist anywhere before and is now a very informative guide for future researchers and decision makers on Neo-tropical animals.

The courses contains the following: the history and role of zoos; endangered species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) accord; local laws for the protection of wildlife and endangered species in the world with particular reference to the Neo-tropics; the management of non-domestic animals in captivity; approaches to the management of zoos and wildlife conservation; what is wildlife management?; strategies and methods used in wildlife management with special reference to the Caribbean and Latin America; future horizons for Neo-tropical wildlife conservation, management, production and utilisation.

The course objectives are:

1. To provide an appreciation of the role and function of zoos.
2. To provide an understanding of the components of management of zoos and animal display facilities.
3. To describe the forms of wildlife management and explain their importance to conservation efforts.
4. To highlight different approaches at Neo-tropical conservation.
5. To highlight the laws and organisations involved in international wildlife conservation.
6. To highlight wildlife utilisation in Latin America and the Caribbean.

Graduates of the course are able to describe:

1. The role, function and management of zoos.
2. The four basic traditional goals of wildlife management and how they are achieved.
3. The CITES accord, and to explain how it is implemented.
4. Some of the major international issues affecting wildlife in the world.
5. The anatomy, physiology, health, nutrition, environmental requirements and possible approaches to the management of some selected Caribbean tropical wildlife species in captivity and in the wild.

6. The areas of conflict between different schools of thought on wildlife management and conservation.

7. Approaches at wildlife utilisation within the Neo-tropics.

The course logical framework has three vertical axes, *"in situ* conservation and management", *"ex situ* conservation and management" with their interactions within the middle axis (Figure 1).

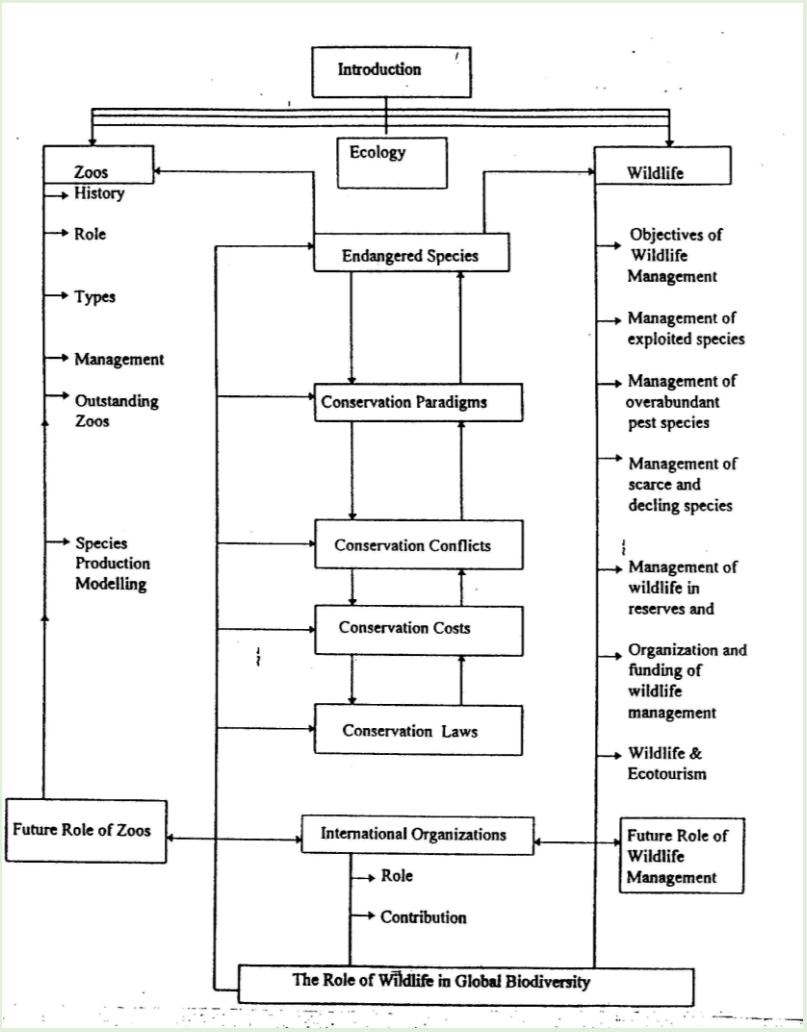

Figure 1: Tropical Zoo and Wildlife Production and Management course logical framework

The evolution of wildlife research at UWI, St. Augustine, Trinidad from 1996 to 2001

The evolution of the research is divided into phases described below.

(1) The assessment of the knowledge about Neo-tropical animals for the purpose of developing intensive production models as a means of ex situ *conservation*

As explained in Part 1, there was a lot of confusion regarding the definition of the term "Wildlife". In addition, it appeared that the sources of information on Neo-tropical animals were very dispersed and that there were many information gaps about the Neo-tropical mammals in particular, when compared to that of the domesticated animal species. It is again being repeated that most of these domesticated animals were imported into the Neo-tro pics. To put some perspective with respect to Neo-tropical animals specifically for *ex situ* conservation and intensive product ion, Garcia (1999) reviewed the world-wide literature on resources devoted to *ex situ* and *in situ* wildlife conservation. It was found that the resources devoted to this were vast, however, there did not exist an approach or system of guidelines for intensive production modelling *ex situ*. Approaches and concepts for developing intensive animal production were therefore proposed at a conference in 1998 with proceedings published in 1999. At the conference Garcia et al. (1999) presented considerations for the development of the wildlife sector and a case for wildlife farming. It was strongly suggested that *ex situ*

conservation should be linked to intensive animal production using the principles and processes that evolved for domestic animals over the last 5,000 years.

(2) The conceptualisation of the Open School of Tropical Animal Science and Production [OSTAS&P]- 1999 to 2001

The initiation of this thinking was reported on by Garcia (1999) in which it was suggested that the intensification of animal production systems was a needed approach for improved *ex situ* wildlife conservation. The details were further published by Garcia and Archibald (2001). This became necessary as it was realised that much information, experiential learning and organised and focused research and publications were known about the introduced domesticated animals within Latin America and the Caribbean. However, little was known about our Neo-tropical native animals, since the conquistadores destroyed the Neo-tropical civilisations 500 years ago. A broad framework was therefore needed for the development of quick and sustainable intensive production systems for each species as we did not have 5,000 years with which to play. The two papers referred to above (Garcia 1999; Garcia and Archibald 2001] should be consulted for details.

(3) Work on the anatomy of the agouti (Dasyprocta leporina) and rearing of the Cocrico (Ortalis ruficauda).

It was suggested that the foundation of any animal production system was based on the understanding of the digestive and reproductive systems (Garcia 1999; Garcia and Archibald 2001). Then Brown et al (1999) and Brown et al (2000) indicated that the agouti was the most popular neo-tropical animal reared in captivity in Trinidad. It was therefore decided to visit the literature on the agouti's digestive and reproductive systems. All that was found was Jones (1834). This article was three pages, about 150 years old and only contained a very brief description of the digestive system of the animal. Nothing was found on the reproductive system of this animal until after 2004 through collaboration with persons in South America. This will be elaborated on in Part 3.

Garcia et al (2000) found that the digestive system of the agouti was similar to both the rabbit (*Oryctolagus cuniculus*) and the guinea pig (*Cavia porcellus*), both have been fully domesticated. The agouti was reported to have a very large caecum and a very long small intestine. This had important implications for the feeding of this animal and for the development of the intensive production model (Brown-Uddenberg 2001).

Work on the rearing of the cocrico in Tobago was also done (Garcia et al. 2001). This was an attempt at modelling what was being done by cocrico keepers in Tobago.

Discussion

The effort to review the research on Neo-tropical non-domestic animals (wildlife), for the 100th anniversary edition of *Tropical Agriculture*, was a very ambitious undertaking. That was why the decision made by this author was to divide the work into three parts. What was even more ambitious was that this research work was conducted within a multilingual context and within multidisciplinary frameworks. The first part covered all known work up to 1999s; it was then decided that Part 2 would be from 1996 to 2001 (5 years), and that Part 3 would cover 2002 to 2024 (22 years). The end of the second period was selected to be 2001 as this was the year that the intensive production model for the agouti was conceptualised, developed and tested (Brown-Uddenberg 2001).

The lessons learnt from the research undertaken pre-1996 were as follows:

1. The term "wildlife" needed proper clarification to get everyone on the same page.

2. The basic anatomy and physiology of the digestive and reproductive systems (the foundation of successful animal production) of the popular wildlife animal species were unknown.
3. The experts on the housing, handling, feeding, reproduction and care of these animals were the zookeepers, who took care of these animals 365 days per year.
4. There was a body of persons in Trinidad and Tobago who reared these animals without any formal animal husbandry knowledge or training, but they were successful in the rearing of these animals through observations and trial and error.
5. There was a need to have these animals reared using the domestic animal husbandry production principles.
6. A university course was needed to address the care and management of animal wildlife or non-domestic Neo-tropical animals.

Item 6 was also strongly recommended by Ojasti (1996), and it was discovered that he had already been doing this for more than 20 years in Venezuela.

In this part of the paper the analysis of Ojasti (1996) suggested the following four important conclusion/ recommendations.

1. *Most countries of the region lack the technical capacity to implement the necessary basic administrative research and wildlife protection at the field level. A review of the potential for bolstering the wildlife services by beefing up, training and/or recycling staff and making changes in the support infrastructure is therefore recommended. Enhanced wildlife protection services are considered particularly urgent*.
2. *Each wildlife species and population require a specific form of management in line with its own biology, current status and pattern of utilisation.*
3. *It is also urgent to document the basic biology of some of the key species such as* Geochelone spp., Dasypus novemcinctus. Tapirus terrestris, Tayassu pecari *and the Mazama species.*
4. *In view of the lack of trained staff to perform these essential functions, it is recommended that research be shared out among the wildlife services, universities and other research centres.*

The agouti unit was established and over a 5-year period the intensive production model was developed, and a thesis (Brown-Uddenberg 2001) was produced. This suggested that, if one applied the principles of domestic animal production to the production of Neo-tropical non-domestic animals, success in predictable production and reproduction could be achieved. To this end the principles of the Open School of Tropical Animal Science and Production was developed as a framework for working with all Neo-tropical non-domestic animals (Garcia and Archibald 2001). The basis for the directions for future work with these animals was now laid.

Conclusions based on the hypotheses proposed

The hypotheses proposed were:

1. Neo-tropical animals have evolved and have become successfully adapted to the Neo-tropical environments.
2. There are Neo-tropical animals which can be reared intensively using the principles of domestic animal production as suggested by Garcia and Archibald (2001) and demonstrated by Brown-Uddenberg (2001).
3. Neo-tropical animals conservation success will be dependent on a synergism between production and utilisation
4. Laws governing wildlife conservation should be formulated based on an understanding of science, animal life cycles and ecological information.

By 2001 Hypothesis 2 could be accepted for the agouti (*D. leporina*), and Hypotheses 1, 3 and 4 were still being tested and will be addressed in Part 3 spanning the period 2002 to 2024.

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References

Alkins-Koo, M., and S. Soomai. 1993. "Trinidad and Tobago Status Report on the Key Animal Species. Appendix D." In *Proceedings of a Workshop, Identification of Key Species for Conservation and Socio-Economic Development, March 1989*. Trinidad and Tobago, edited by Promilia Kapoor-Vijay and Michael B. Usher, Commonwealth Secretariat, London. Pg. 121–156.

Blaut, J.M. 1997. "Eurocentrism, Diffusionism, And the Assessment of Tropical Agriculture." In *Proceedings of TA 2000, 4-9 September 1994. Tropical Agriculture, Special Issue* 227–230.

Brown, R.C., G.W. Garcia, M. Manick, and S. Poujade. 1998. "A Case Study: Wildlife Farming in Trinidad." In *Proceedings of TA2000, 4–9 September 1994. Tropical Agriculture, Special Issue* 171–174.

Brown, R.C., G.W. Garcia, M. Manick, S. Poujade, K. Arishima and T. Makita. 2000. "The Survey of Wildlife Farms in Trinidad." *Japanese Journal of Zoo and Wildlife Medicine* **5 (1):** 123–126. (A translation into Japanese of Brown et al. 1998).

Brown-Uddenberg, R.C.L. 2001. "The Conceptualization of an Intensive Production Model for the Agouti (*Dasyprocta leporina*) A Neotropical Rodent in Trinidad, West Indies." M.Phil Thesis in Livestock Science, The University of the West Indies, Trinidad, Trinidad and Tobago, W.I.

Brown-Uddenberg, R.C., G.W. Garcia, Q.S. Baptiste, A.O. Adogwa, T. Counand, and T. Sampson. 2004. *The Agouti Booklet and Producers' Manual, Wildlife Farmers' and Producers' Booklet #1*, The Open Tropical Forage-Animal Production Laboratory, Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago: GWG Publications. ISBN: 976-95123-0-3.

Cross, R. 2001. "Biodiversity Strategy & Action Plan for Trinidad and Tobago." Environmental Management Authority (EMA), Trinidad and Tobago.

Garcia, G.W. 1999. "Intensification of Animal Production Systems for Improved Wildlife Conservation." In *Agriculture in the Caribbean: Issues and Challenges (UWI Ag. 50) Volume III.* The UWI Faculty of Agriculture and Natural Sciences-CEPAT, August 1999 89-99.

Garcia, G.W. 2022. "An Historical, Biographical, Social and Disciplinary Account of the Contribution to Agriculture Teaching and Research of the Imperial College of Tropical Agriculture (ICTA)- The University College of the West Indies (UCWI)- The University of the West Indies (UWI) (1921 to 2021) to the Caribbean and World Food and Agriculture." In *Conference Proceedings, Celebrating 100 years of Agricultural Research and Innovation: Perspectives on Tropical Food and Agriculture Systems, 10-11 November 2021.* Communications and Publications Unit, Faculty of Food and Agriculture, UWI, St Augustine, Trinidad and Tobago 1–26.

Garcia, G.W., D. Cabb, R. Mohammed, and R. Brown-Uddenberg, R. 1999. "A Note on Considerations for Development of the Wildlife Sector: The Case of Wildlife Farming." *Agriculture in the Caribbean: Issues and Challenges (UWI Ag. 50) Volume III*: 100–105.

Garcia, G.W., Q.S. Baptiste, A.O. Adogwa, M. Kaakuni, and T. Makita. 2000. "The Digestive System of the Agouti (*Dasyprocta leporina*): Gross Anatomy and Histology." *Japanese Journal of Zoo and Wildlife Medicine* **5 (1):** 55–66.

Garcia, G.W., and K.A.E. Archibald. 2001. "The Philosophy of the Open School of Tropical Animal Science and Production." Caribbean Food Crops Society, Thirty Seventh Annual Meeting, Trinidad and Tobago 20–27.

Garcia, G.W., R. Macfarlane, C.H.O. Lallo, T. Jonkman, N. Biptah, and T. Makita. 2001. "The Rufous-vented Chachalaca or Cocrico (*Ortalis ruficauda*) in Tobago, West Indies: A Case Study." *Japanese Journal of Zoo and Wildlife Medicine* **6 (2):** 61–66.

Garcia, G.W., G.G. Young, K.M. Amour, D. James, C.H.O. Lallo, W. Mollineau, A. Roopchand, M. Spencer, M.A. Prosper, N. Ganessingh, R. Rooplal, N. Gayan, A. Steil, A. Xande, A. Bemelmans, S. Gamma Norgueira Filho, D. Guimaraes, H. Gálvez, and P. Mayor Aparicio. 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, Department of Food Production, Faculty of Science and Agriculture, UWI, St Augustine. 24 Sagan Drive, Champs Fleurs, Trinidad and Tobago: GWG Publications, SBN 976-95123-1-1.

Jones, R. 1834. "Some Notes on the Dissection of an Agouti (*Dasyprocta aguti*, Ill)." *Proceedings of Zoological Society of London* **2**: 82–84.

Ojasti, J. 1996. "Wildlife Utilization in Latin America: Current Situation and Prospects for Sustainable Management, FAO Conservation Guide 25." FAO, Rome.

Ojasti, J. 2000. SI/MAB Series # 5, edited by F. Dallmeier. Smithsonian Institution / MAB Biodiversity Program, Washington D.C.

Rannarine, I. 1992. "Development, Growth and Nutrient Requirements of the Cascadu, *Hoplosternum littorale,* (Hancock, 1928, *Osteichthyes, Callichthyidae*)." Ph.D. Thesis, Department of Zoology, Faculty of Natural Sciences, UWI, St Augustine.

Singh, T.B. 1978. "The Biology of the Cascadu, *Hoplosternum littorale*, Hancock, 1928, with Reference to the Reproductive Biology and Population Dynamics." Ph.D. Thesis, Faculty of Natural Sciences, UWI, St Augustine.

Thompson, D.T., and J.P. Clyne 2000. *We are Family*. Private publication, Trinidad and Tobago, Second Printing 2002.