



BIOTRADE – DESIGNER’S TOOLKIT

MORELET’S CROCODILE

CROCODYLUS MORELETTI

3



Sustainable Materials for the Fashion Industry
Biodiversity/Ecosystems/Community Impact Review



Note

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The views expressed in this publication are those of the author and do not necessarily reflect the views of the United Nations.

Acknowledgements

This publication was prepared for the United Nations Conference on Trade and Development (UNCTAD) BioTrade Initiative by Burak Cakmak.

UNCTAD would also like to acknowledge the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), the Dirección General de Vida Silvestre – Secretaría de Medio Ambiente y Recursos Naturales (DGVS-SEMARNAT), the Procuraduría Federal de Protección al Ambiente (PROFEPA), the Mexican Customs Authorities, the Comisión Nacional de Áreas Naturales Protegidas, and the Mexican producers and researchers for their valuable information provided for this publication. Particular recognition is given to María de la Paz López, Manuel Muñiz, Marco Novelo, Jesús Cota, Hesiquio Benítez, Alejandra García Naranjo and Gabriela López.

This publication was developed within the Swiss State Secretariat for Economic Affairs (SECO)–UNCTAD partnership, under the BioTrade Facilitation Programme – Phase II.

This publication, BioTrade Designer's Toolkit: Morelet's Crocodile *Crocodylus moreletii*. Sustainable Materials for the Fashion Industry: Biodiversity / Ecosystems / Community Impact Review is a product of the BioTrade Initiative, part of the Division on International Trade in Goods and Services, and Commodities (DITC), UNCTAD. It is part of a larger effort by UNCTAD to analyze trade-related issues of particular importance for developing countries. This study benefited from inputs by Lorena Jaramillo, Adrienne Stork, Eduardo Escobedo and Yvonne Paredes. The desktop formatting was done by Rafe Dent.

Guillermo Valles
Director
Division on International Trade
in Goods and Services, and Commodities

UNCTAD/DITC/TED/2012/4
UNITED NATIONS PUBLICATION
Copyright © United Nations, 2014
All rights reserved

Contents

Note	ii
Acknowledgements	ii
I. INTRODUCTION	1
A. Material name and specifications	1
1. Taxonomy	1
2. Common names	1
3. Name (etymology)	1
4. General characteristics of the skin	1
B. Facts	2
1. Distribution	2
2. Habitat	3
3. Reproductive biology	3
II. MARKET OVERVIEW	5
A. Sourcing insights	6
1. Legal trade	6
2. Parts and derivatives in trade	6
3. Actual or potential trade impacts	6
B. Harvest overview	7
1. Exporters	7
2. Tanneries	7
C. National utilization	7
1. Commercial applications	7
2. By-products	7
D. Trade policies	9
1. National legislation	9
2. International regulations	9
3. Law enforcement	9
III. BIODIVERSITY-BASED MATERIAL AND ENVIRONMENTAL IMPACT REVIEW	11
A. Conservation overview	11
1. Conservation status	11
2. Principal threats	11
3. Illegal trade	11
4. CoPan Project	12
5. Morelet's Crocodile Monitoring Programme	12
B. Sustainable use	12
1. Management units for conservation of wildlife	12
2. Captive breeding	13
3. Sustainable use programmes	14
4. Slaughter methods	14
C. Ecosystem and habitat impact	14
1. Role of the species in its ecosystem	14
2. Habitat conservation benefits	14
D. Access benefit sharing/community benefits	15
References	16
Notes	18

I. INTRODUCTION

The conservation and sustainable use of biodiversity is creating new opportunities for developing countries' trade and investment, as well as for their small and medium-sized enterprises dealing with biodiversity products. Trade in species such as Morelet's crocodile can be a tool for enhancing development as well as to ensure market demands are met through sustainably managed harvesting methods that promote conservation of the species in its native ecosystem.

At present, commercial harvest of wild specimens of the Morelet's crocodile for international trade is not allowed by domestic legislation in the three States covering the range of the species (Mexico, Guatemala and Belize). In addition, Mexico has an abundant captive population of the species ("closed-cycle" captive-breeding operations).

The species' inherent ability to recover, coupled with conservation efforts, the ban on wild harvests of the species, the designation of new protected areas, and the promotion of closed-cycle operations, have all contributed to the recovery of the Morelet's crocodile. This is proved by its presence throughout its native range in the region.

Moreover, the status of the species in Mexico is and will continue to be followed by the recently established Morelet's Crocodile Monitoring Programme, which is intended to cover the whole range of distribution in the future.

A. Material name and specifications

1. Taxonomy

Class: Reptilia.

Order: Crocodylia.

Family: Crocodylidae.

Genus and species: *Crocodylus moreletii* (Bibron and Duméril, 1851).

Scientific synonyms: *Crocodylus americanus moreletii*.

2. Common names

English: Belize crocodile, Morelet's crocodile, Central American crocodile.

French: crocodile de Morelet.

German: beulenkrokodil.

Portuguese: Crocodilo-de-Morelet, Crocodilo-Mexicano.

Spanish: cocodrilo de Morelet, cocodrilo de pantano, lagarto negro.

3. Name (etymology)

Crocodylus is derived from the Greek *krokodeilos* which means literally "pebble worm" (*kroko* = pebble; *deilos* = worm, or man) referring to the appearance of a crocodile. *Moreletii* means "of Morelet", after the French naturalist P.M.A. Morelet (1809–1892) who discovered this species in Mexico in 1850.

4. General characteristics of the skin

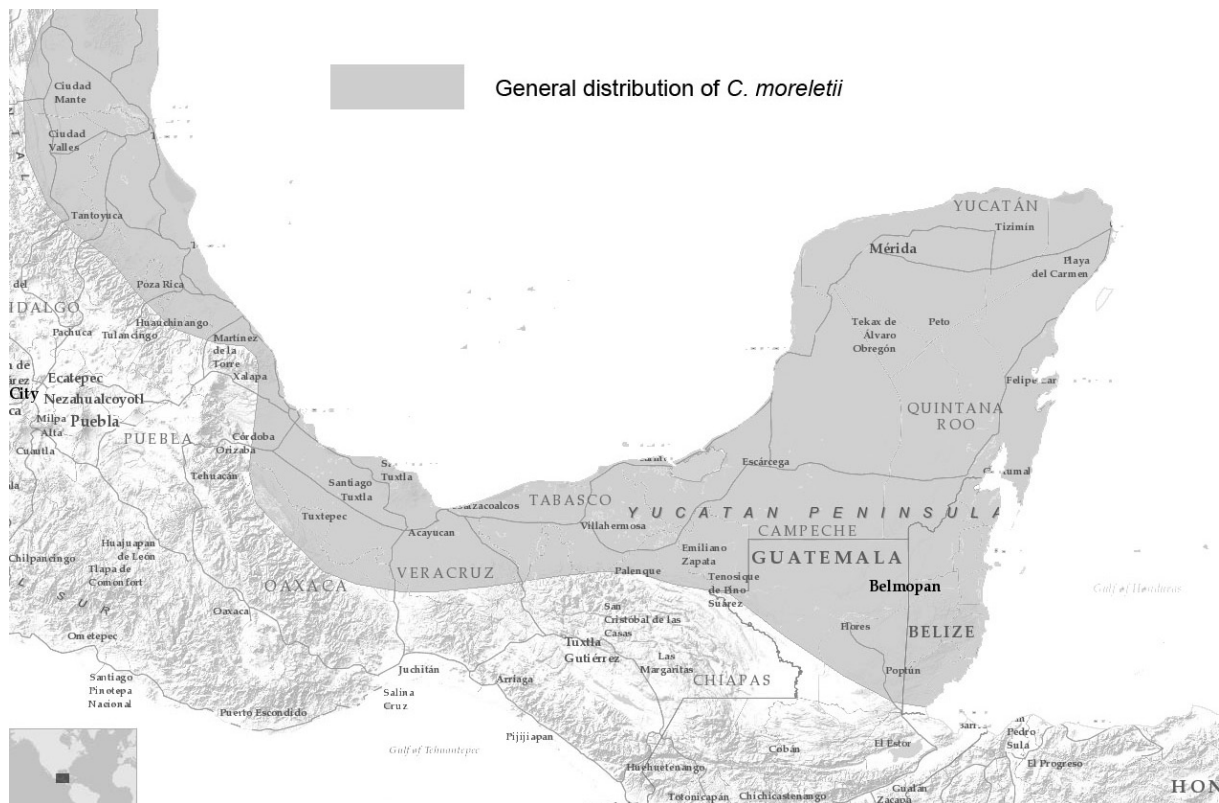
Morelet's crocodile (*Crocodylus moreletii*) is a reptile which can reach 3.5 metres in length, but with an average of 2–2.5 metres (Levy, 1991; Perez-Higareda et al., 1991; Smith and Smith, 1977; Subcomité Técnico Consultivo para la Conservación, Manejo y Aprovechamiento Sustentable de los Crocodylia en México (Technical Advisory Subcommittee for the Conservation, Management and Sustainable Use of Crocodylians in Mexico) (COMACROM), personal communication). It can produce skins of more than 40 centimetres. Individuals can reach a considerable length in a relatively short period (growing from 40 centimetres to a maximum of 2 metres during the first 4 years). The colour of adults is olive-yellow on the dorsal area, with large black markings on the tail and back. The ventral area is pale with a creamy-yellowish tone (Alvarez del Toro, 1974).

Morelet's crocodile is considered to belong to the classic skin group because it is a medium-sized species with a broad snout (Platt et al., 2010; Meerman, 1994; Smith and Smith, 1977), a wide body and very small osteoderms (the bony deposits forming skin scales and plates). The belly has small scales with specific patterns of between 27 and 32 rows per section. Morelet's crocodile hides have a unique "fingerprint" for each individual, as the patterns in the ventro-lateral and ventral region have imbricate rows of scales.

There are two ways of skinning. International trade requires that most skins be obtained by belly cuts. For national and special orders individuals may be skinned with a horn back cut. In the case of Morelet's crocodile, the dorsal section presents very small osteoderms so it can be used for special designs.

Due to the low average content of calcium oxide (forming osteoderms) almost the whole skin can be used and shaved very thinly to obtain thicknesses of less than 3 millimetres. This allows for transformation and manufacture into very high quality goods or very

Figure 1. General distribution of *Crocodylus moreletii*



Source: Cedeño-Vázquez, J.R., Platt, S.G. & Thorbjarnarson, J. (IUCN Crocodile Specialist Group) 2012. *Crocodylus moreletii*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. www.iucnredlist.org. Downloaded on 18 March 2014.

delicate articles that can be worn in direct contact with the human skin (for example, gloves). The proportion between belly scale width and total skin makes it optimal also for bigger products, such as one-piece handbags, shoes, and similar products. The thin, soft, resistant and flexible skin has made *Crocodylus moreletii* desirable for commercialization (BOSTID, 1983).

B. Facts

1. Distribution

The distribution range of Morelet's crocodile includes the low slopes and coastal plains of the Gulf of Mexico and the Yucatan Peninsula (usually at elevations below 900 metres), northern and eastern Guatemala, and Belize. Mexico represents close to 85 per cent of the global range of *Crocodylus moreletii* (figure 1; Platt et al., 2010; Ross, 1987). The potential distribution of the species, calculated by means of Desktop GARP software (CONABIO, 2005) on the basis of the species' records, produced a map of highest probability

area of occurrence. The result yielded a potential area of 450,000 square kilometres over Belize, Guatemala and Mexico, of which 396,455 square kilometres were within Mexico (figure 2). According to the final results, at least 51 per cent of the area of distribution is covered by original vegetation (202,169 square kilometres), and approximately 25,277 kilometres of this area can provide optimum habitat for the species in Mexico.

2. Habitat

The Morelet's crocodile lives in areas once covered by tropical forest or savannah, particularly those with slow-flowing water bodies, swamps and lagoons. Its natural habitat often has floating submerged or emerged plants and continuous availability of aquatic and terrestrial prey (Ross, 1998; Álvarez del Toro and Sigler, 2001; Lee, 1996, 2000).

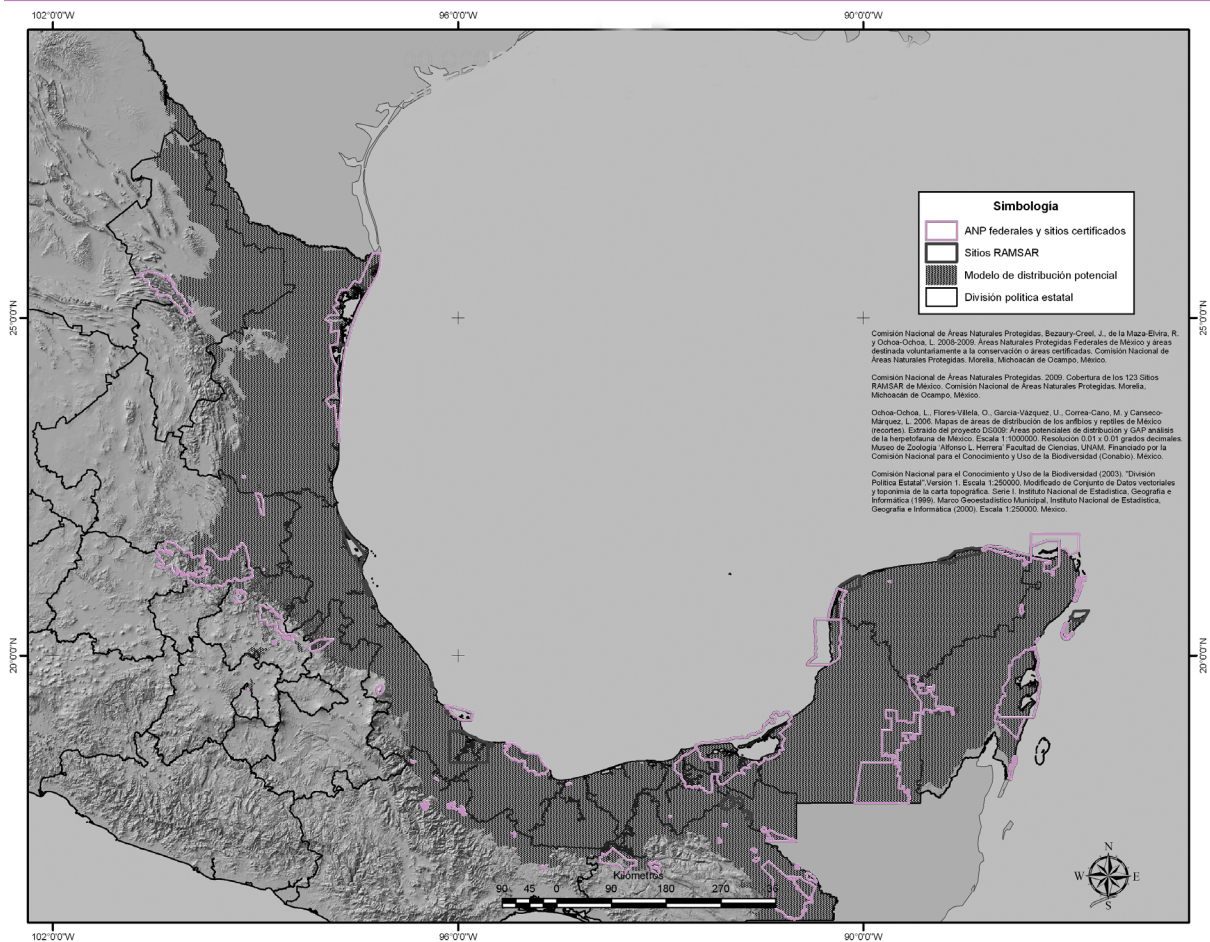
3. Reproductive biology

The species reaches sexual maturity between 6 and

8 years of age, having an approximate length of 1.5 metres, although sexual maturity may be reached by younger individuals of between 4 and 6 years (Dominguez, 2006). Platt et al. (2010) indicates that sexual maturity in captivity can be reached at a younger age (4–5 years) than in the wild (7–8 years). Although longevity of the species is not well documented, unpublished data on captive and semi-captive specimens indicate 30 years or more.

Reproductive activity starts with the construction of the nest by females collecting fallen leaves to form a mound (Britton, 2005) and the laying of eggs at the end of the dry season (May/April to June/July); it ends with the hatching of eggs in August–October, when the wet season is at its peak (Platt et al., 2008; Perez-Higareda, 1980; Alvarez del Toro, 1974). The crocodiles lay between 20 and 45 eggs, with an average of 35 per nest (Alvarez del Toro, 1974; Britton, 2005).

Figure 2. Potential distribution of *Crocodylus moreletii* in Mexico



Source: CITES, 2010b

Note: Total distribution area = 306 455 Km.

Total length of permanent rivers and water bodies = 49 465 Km

II. MARKET OVERVIEW

Mexico has been the main exporter of skins of Morelet’s crocodile, since the Belizean Wildlife Protection Act prohibits the hunting of the species, so crocodiles are officially protected from commercial harvest and poaching in Belize, as determined by regular surveillance of the areas in which the species occurs. The species is not subject to commercial activities in Guatemala either.

With the transfer of Morelet’s crocodile from Appendix I to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for Mexico and Belize populations, most of the

captive-breeding operations registered are potential exporters, as no need for registration at the CITES secretariat is required.

In Mexico, the only establishments authorized for to harvest and export are closed-cycle captive-breeding operations, which must have proven viability in production of offspring beyond the second generation and be part of the official system of Management Units for Conservation of Wildlife (Unidades de Manejo para la Conservación de la Vida Silvestre (UMAs), CITES, 2010b). Wild specimens are, therefore, not part of international trade.

Farms working for commercial purposes have various levels of development and production capacity. Some

Figure 3. Crocodile skin trade, 2000-2010. The world market for crocodiles seems to have passed a stable trend since 2000, showing an increase up to 2006 and a decrease until 2010 (UNEP–WCMC)

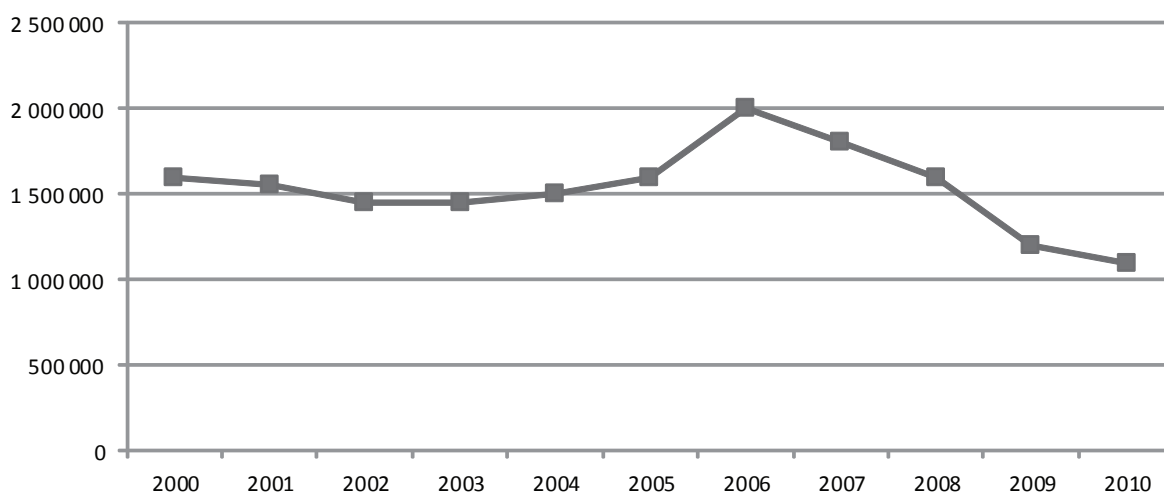
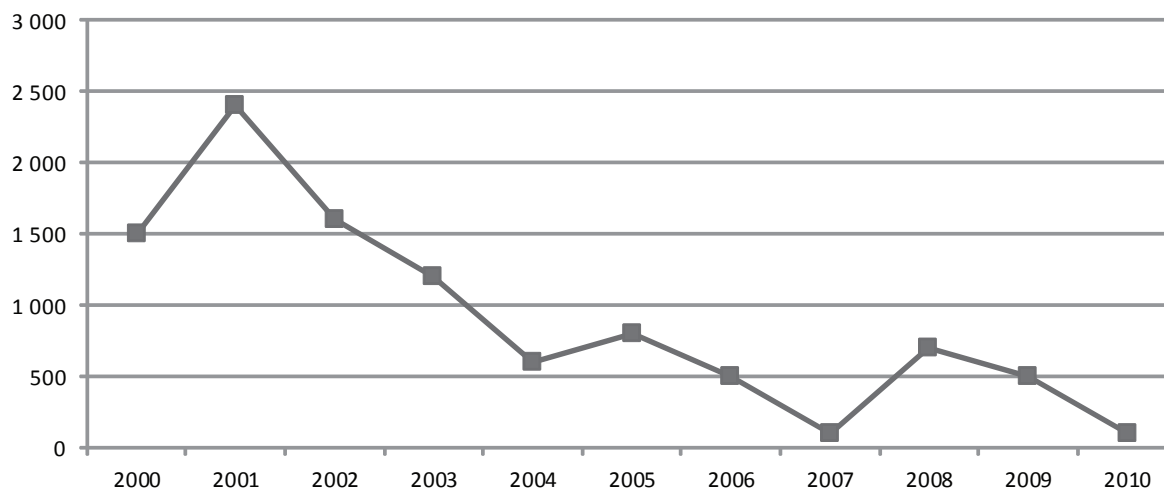


Figure 4. *Crocodylus moreletii* skin trade 2000-2010. Out of Crocodylia and other members of its genera, *Crocodylus moreletii* maintains low commercial volumes and, out of an increase in 2000-2001, it shows a recent downward trend (UNEP–WCMC).



closed-cycle breeding farms have received support from the Mexican Government and are in contact with educational and scientific institutions interested in the conservation of the species. Others belong to or are managed by private investors that wish to support conservation by undertaking sustainable economic activities with the species. This has facilitated cost-benefit oriented technical improvements, which have advantages both for maintaining economic viability of the captive-breeding operations for legal trade and for maintaining a reserve of individuals for possible reintroductions or founder stocks in wild habitats.

A. Sourcing insights

1. Legal trade

Data on international trade in crocodile skins is available from the United Nations Environment Programme–World Conservation Monitoring Centre (UNEP–WCMC) Trade Database for 2000–2010, including whole skins and excluding cuts and secondary materials (figure 3). This data shows an increase in the global market up to 2006, followed by a considerable decrease in 2010. Reasons for this trend are unclear but reveal a market that is decreasing rather than expanding.

A similar phenomenon can be seen in the international trade of the Morelet's crocodile (figure 4). However, these data were recorded before the transfer to Appendix II of CITES (2010b) and removal from the Endangered Species Act (ESA) in the United States of America (2012), which were the main limitations to

Morelet's crocodile skin market at a global scale.

From the total number of skins that are potentially produced in Mexico annually, it is estimated that 2,500 crocodiles could be exported for international trade every year. Specifically for Morelet's crocodile, changes in CITES and ESA status are expected to allow the expansion and promotion of international trade of sustainably-produced skins over the next few years. Informal data indicate that 2012 exports will reach almost 1,000 skins from closed cycle captive breed farms (Marco Novelo, personal communication¹).

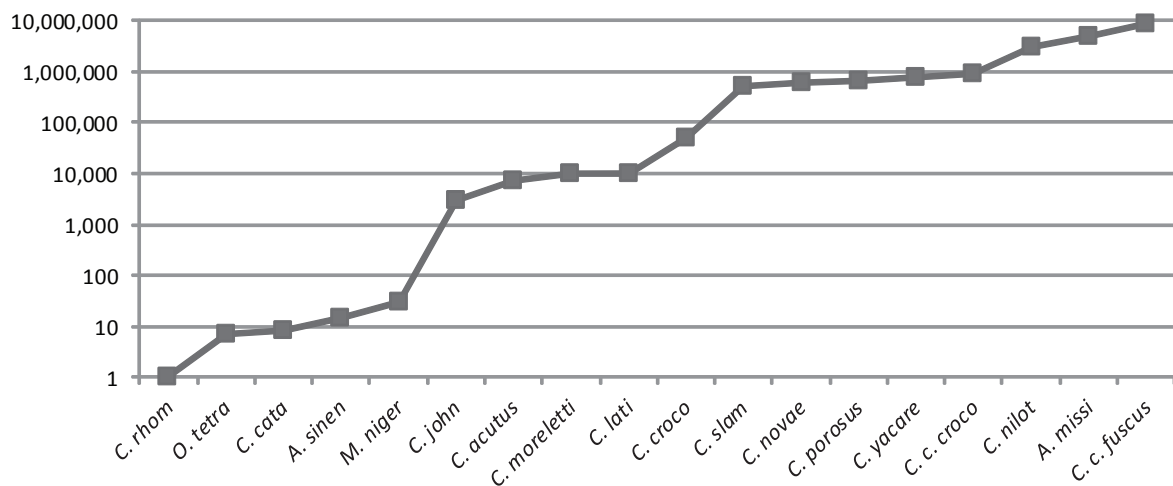
2. Parts and derivatives in trade

Between 2000 and 2010, according to the UNEP–WCMC Trade Database, parts and derivatives of the Morelet's crocodile most commonly found in trade were skins, skin pieces and leather products, although other products include specimens, eggs, bodies, scales, skulls and shoes. The largest exporter between 2000 and 2010 was Mexico (8,983 skins, 750 skin pieces and 1,410 leather products). The major importing countries of skins were Japan (4,480), Spain (163), France (154) and the Republic of Korea (60). Other importers were Italy, Colombia, and the Russian Federation.

3. Actual or potential trade impacts

Around 8,600 Morelet's individual crocodiles were traded in the past 10 years (860 per year) (CITES, 2010b). The Morelet's crocodile represents only a small fraction of the global trade in crocodylians (figure 5), far behind the market leaders: *Caiman crocodilus fuscus*, *Alligator mississippiensis* and *C. niloticus*.

Figure 5. Crocodile skin trade by species, 2000–2010. Among the crocodylian species internationally traded, *Crocodylus moreletii* occupies a place well behind the market leaders such as *Caiman crocodilus fuscus*, *Alligator mississippiensis* and *Crocodylus niloticus* (UNEP–WCMC).



Morelet's crocodile skin trade originating in Mexico shows a trend that apparently reflects the global international market for crocodylians. It fluctuates with global demand for skins. Current trends in international trade do not seem to represent a threat or an obstacle to the recent recovery of the species in the wild, considering that only captive-bred individuals can be exported and that this provision would remain in effect with the zero quota for wild specimens included in the CITES 2010 listing. Moreover, present annual production in Mexican farms does not exceed 40,000 individuals of the Morelet's crocodile. The risk of laundering wild specimens through farms is very low, because the quality of skins produced in captivity is much higher and international trade demand focuses on such skins (José Carlos Rodarte; Manuel Muñoz, COMACROM, personal communication²).

B. Harvest overview

Crocodiles are skinned after receiving orders from clients to ensure skin freshness as much as possible. Fresh skins generally cannot be stored in the farms more than three to four months. Currently, producers are harvesting skins that are on average 35–40 cm in size. The farmers process all skins by the same method, involving the skinning, salting, scraping and curing of each skin. Later on, skins are rolled and carefully stored in plastic bags under refrigeration until they are sold and sent to tanners.

1. Exporters

Following the transfer of *Crocodylus moreletii* from Appendix I to Appendix II in CITES for Mexico and Belize, most of the captive-breeding operations can become potential exporters, as no need for registration at the CITES secretariat is required. In Mexico, there are commercial farms at different levels of development and production capacity, including some in early stages such as UMA Cococanek (Tamaulipas). Currently, there are eight captive-breeding operations with commercial purposes registered at the Wildlife General Office in Mexico (DGVS) as UMAs.

2. Tanneries

Mexico has an important tannery industry. Most of the tanner industries are located in León (Guanajuato), where over 250,000 skins are tanned per year. Out of these, 90% of the skins are parts or whole skins from imported *Caiman crocodilus*.

Due to the large amount of imported caiman skins,

only low numbers of skins of Morelet's crocodile enter the market. There is a great opportunity to highlight the quality of the Morelet's crocodile skin. Currently, tanners are paying a similar price for the two skin types and only a small number of skins are used for cowboy clothing.

Currently, only a few main tanners (for example, Hermès Cuir Précieux and Pantera s.r.l. Hides and Skins) are working with Mexican farmers, although there are other potential clients. Many of the tanneries demand top quality skins with a certain size (that is, 40 cm or bigger).

C. National utilization

Until the mid-twentieth century, commercial harvest of the Morelet's crocodile was not subject to specific regulation in Mexico, Guatemala or Belize. This was the main cause of the drastic decrease of its populations. As a consequence of this, concern about the populations increased significantly in 1970, which led Mexican authorities to ban the commercial harvest of wild individuals.

Currently, all commercial exploitation of the Morelet's crocodile in Mexico must compulsorily involve animals born and raised in captivity in UMAs. Since 2000, the national harvest authorized in Mexico amounts to fewer than 2,000 skins a year. However, total potential production in farms is about 17,800 individuals and approximately 10,100 skins per year. In Belize, crocodiles are also officially protected from commercial harvest and poaching, enforcement depending on regular surveillance of areas in which the species occur. Reportedly, the species is not subject to commercial activities in Guatemala given that the Protected Areas Act prohibits the export of and trade in wild specimens of endangered species.

1. Commercial applications

Farmers in Mexico have examples of tanned skins and finished products. For instance, the UMA Cocodrilos Mexicanos farm created its own brand "Cocole" selling finished products, especially handbags. Another company possessing its own label is called "Caimanes y Cocodrilos de Chiapas" with its own artisanal tannery and manufacture.

Examples of commercial products (local and foreign) are shown in figures 6–10.

2. By-products

Many by-products are obtained from Morelet's

Figure 6. Bags



Figure 7. Wallets

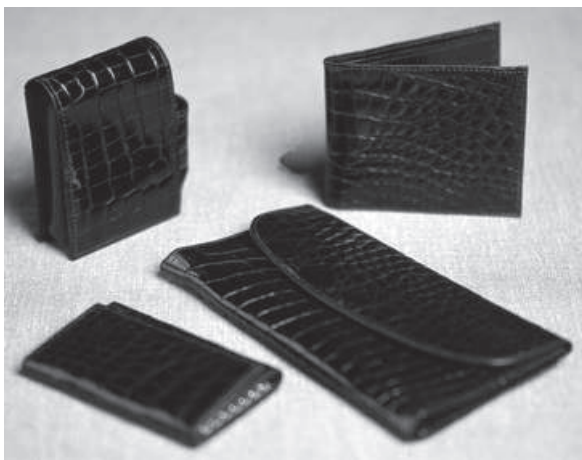


Figure 8. Left: boots; right: meat product



Figure 9. Left: finished skin (*Cocodrilos Maya*; photo: Manuel Muñiz); right: finished skins (*Cocodrilos Mexicanos S.A. de C.V.*; photo: Manuel Muñiz)

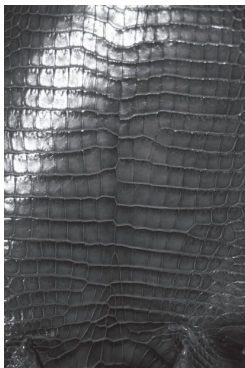


Figure 10. Left: storage (*Cocodrilos Mexicanos S.A. de C.V.*); right: working with the skins (*Cocodrilos de Palizada*)



crocodiles beside the skin, which is the main product within the value chain of the species. Among the more important ones are the meat, body parts such as the head, hands and feet, as well as oil or fat (from intestines and liver) and organ parts. All of these are locally consumed and some meat and skins are also exported (Japan is the main importer of meat).

Although production is limited, there is demand for meat at a national level. Most of it is sold in local or city restaurants and markets, as many beneficial attributes are ascribed to the meat, oil, faeces and entrails (including lowering cholesterol, use as an expectorant and treatment for dermal diseases, rheumatism, cough, asthma and emphysema, as aphrodisiacs, cosmetics, perfumes and against alcoholism).

D. Trade policies

1. National legislation

In Mexico, Morelet's crocodile conservation is governed with an extensive number of laws addressing the conservation process including:

- General Law of Ecological Equilibrium and Environmental Protection (Ley General del Equilibrio Ecológico y la Protección al Ambiente);
- General Law of Wildlife and its Regulations (Ley General de Vida Silvestre y su Reglamento);
- Mexican Official Rule NOM-059-SEMARNAT-2010 on Environmental Protection – Native Species of Wild Flora and Fauna of Mexico – Risk Categories and Specifications for their Inclusion, Exclusion or Change – List of Species at Risk.

2. International regulations

The species is listed in CITES Appendix II with a zero quota for wild specimens for commercial purposes since 2010 for Mexico and Belize populations (Guatemala population remains in Appendix I). This measure allows international trade for individuals, parts and derivatives from captive-bred specimens accompanied by CITES permits issued by a management authority. This provision will remain in effect until the zero quota is removed through a new amendment

proposal adopted by the Conference of the Parties. By that time, sustainable levels of wild specimens harvested will be determined by results of the Monitoring Programme.

One of the marking systems applied in Mexico for crocodile species (in addition to interdigital tags and scale cutting that are used by UMAs) is the Universal Tagging System for the Identification of Crocodilian Skins established by CITES (CITES, 2010a). This system is used for every specimen destined for international trade and consists of a non-reusable plastic security tag. Any application for a CITES export permit must include the number of the authorized specimen based on the skin's plastic security tag.

Customs codes applicable to crocodile skins are 4103.20.01 "caiman, crocodile or lizard" (un-tanned), 4106.40.99 "the rest" (tanned) and 4113.30.01 "reptile" (prepared skins after tanning and scrolled skins). It is worth mentioning that these customs codes include all reptile skins, so it is not possible to distinguish volumes of Morelet's crocodile exported in particular. Further information on customs regimes applicable to crocodile skins is available in table 1.

3. Law enforcement

As part of the Programme to Deliver Environmental Justice, the Federal Agency for Environmental Protection (PROFEPA) implements the Environmental Inspection Programme through activities involving the control, verification, inspection and surveillance of entry and exit of goods and people located at ports, airports and borders, as well as throughout Mexico's territory. The Agency also implements the Wildlife Inspection Programme, monitoring all stages of the use of wild species ensuring their protection.

Specific actions include the verification of cross-border movements in compliance with CITES and other international agreements in coordination with customs authorities; inspection and special operations in areas of wildlife harvest, stockpiling, distribution and sale, in coordination with public law enforcement and judicial authorities; and surveillance of areas of wildlife distribution and harvest.

Table 1. Customs regimes applicable for import and export of crocodile skins

Customs code	Description	Unit	Customs duty IMP	Customs duty EXP
4103.20.01	Caiman, crocodile or lizard.	Head	Free	Free
Free trade agreements	NAFTA (North America): Free FTA EU-MX (European Union): Free JAPAN: Free Third parties: Free (no customs duty)			
Customs regimes	On import: CITES permit or certificate required (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes, <u>when they are listed in CITES Appendices</u>) or SEMARNAT authorization and PROFEPA inspection (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes). Documents are issued according to Article 9 and inspection is carried out according to Article 8 of the Agreement; Zoosanitary Certificate from SAGARPA and inspection at the country's entry point (certificate is given according to Article 7 of the Agreement, previous verification of fulfilment of HRZ). On export: CITES permit or certificate required (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes, <u>when they are listed in CITES Appendices</u>) or SEMARNAT authorization and PROFEPA inspection (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes). Documents are issued according to Article 9 and inspection is carried out according to Article 8 of the Agreement).			

Customs code	Description	Unit	Customs duty IMP	Customs duty EXP
4106.40.99	The rest	M ²	Free	Free
4113.30.01	Reptile			
Free trade agreements	NAFTA (North America): Free FTA EU-MX (European Union): Free JAPAN: Free Third parties: Free (no customs duty)			
Customs regimes	On import: CITES permit or certificate required (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes, <u>when they are listed in CITES Appendices</u>) or SEMARNAT authorization and PROFEPA inspection (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes). Documents are issued according to Article 9 and inspection is carried out according to Article 8 of the Agreement; chapter 4 (Trade information) from NOM-020-SCFI-1997 (importer can choose any of the alternatives established in Article 6 to prove fulfilment of NOM). On export: CITES permit or certificate required (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes, <u>when they are listed in CITES Appendices</u>) or SEMARNAT authorization and PROFEPA inspection (parts and derivatives of wildlife species addressed to definitive, temporal or fiscal deposit customs regimes). Documents are issued according to Article 9 and inspection is carried out according to Article 8 of the Agreement).			

Note: Although export of manufactured products of reptile skins could be regulated by SEMARNAT, the agreement establishing controls and not-customs regulations of SEMARNAT is not clear and does not indicate precisely if such controls are applicable to products of crocodile skins.

III. BIODIVERSITY-BASED MATERIAL AND ENVIRONMENTAL IMPACT REVIEW

In 1970, Mexico established a total ban on the commercial harvest of crocodiles. The ban was backed by surveillance and law enforcement in areas where harvests were concentrated, in tanneries, centres of manufacture and direct trade, and on the borders. This was also accompanied by the creation of captive-bred operations to divert pressure from wild populations, additional conservation efforts and designation of new protected areas, which have all contributed to the recovery of the Morelet's crocodile in Mexico (CITES, 2010b).

Since 1988, wild plants and animals are protected by the General Act on Ecological Balance and Environmental Protection, which establishes a framework for the conservation and restoration of ecological balance and environmental protection through sustainable use. In July 2000, the General Wildlife Act (Ley General de Vida Silvestre – LGVS) entered into force. Its objective is the conservation of wildlife and its habitat through their protection and authorization of optimum levels of sustainable use. Such use aims to maintain wildlife and habitat diversity and integrity, promote their restoration, and increase the welfare of the country's citizens. In the case of the Morelet's crocodile, the LGVS only allows the harvest of individuals obtained through controlled captive breeding.

In September 1999, COMACROM was created. It is an advisory body for Mexican authorities that focus on providing guidance to programmes for the conservation and sustainable use of crocodiles. It includes scientists, technicians, non-governmental organizations, producers, authorities and other stakeholders. COMACROM participates in meetings of the IUCN Crocodile Specialist Group (IUCN-CSG) and contributes to its publications, besides having representatives in the IUCN-CSG itself.

In the last decade, Mexico has also promoted and developed a policy for the creation and maintenance of protected areas to protect the habitat of the Morelet's crocodile in the framework of the National Protected Area System. During the CoP15 of CITES in 2010, it was stated that about 77 federal and certified protected

areas in Mexico provide shelter and legal protection to the Morelet's crocodile in its potential range. It was also pointed out that of this number, 11 have records of the species. There are also 41 RAMSAR sites in the potential range of the Morelet's crocodile, 13 of which have records of the species (figure 2) (CITES, 2010b, page 11).

A. Conservation overview

1. Conservation status

IUCN-CSG Action Plan

Availability of survey data: moderate;
Need for wild population recovery: moderate;
Potential for sustainable management: high.

2012 IUCN Red List

Crocodylus moreletii is classified under Least Concern category in the *IUCN Red List of Threatened Species* published in 2012, which includes widespread and abundant species (Cerdeño-Vázquez et al., 2012).

The Mexican Endangered Species List (NOM-059-SEMARNAT-2010)

Morelet's crocodile is currently included in the category Subject to Special Protection, which includes taxa that are not at risk but are of interest for the country and deserve government protection to ensure their continuity and abundance.

2. Principal threats

The main threat to the species is habitat degradation, especially if it involves a reduction in prey availability and possible pollution of water bodies.

Current trends in international trade do not seem to represent a threat or an obstacle to the recent recovery of the species in the wild, considering that only captive-bred individuals can be exported. The risk of wild specimen laundering through farms is very low.

3. Illegal trade

The UNEP-WCMC Trade Database shows few illegal movements of parts and derivatives of the Morelet's crocodile between 1975 and 2010 for Mexico, Guatemala and Belize, with the United States as the only importer. Between 1982 and 2010, Mexico mainly exported leather products (320) and shoes (420 pairs). There are records of eight illegal trade operations from Guatemala between 1989 and 1997, mainly involving pairs of shoes (27), and two cases in Belize, which involved the export of 31 eggs in 1995 and 1 kilogram of meat in 2009. Regarding Guatemala, Castañeda-

Moya (1998) stated that illegal capture of the species continued in the Petén in that year. However, he admitted that the volume of such activity had decreased compared to the situation 25 years before.

4. CoPan Project

From 2000 to 2004, with support from CONABIO, Mexico developed the CoPan project, which had two main objectives:

- To gather updated field data on the presence and relative abundance of *Crocodylus moreletii*;
- To gather new information suitable for habitat quality assessment in reference to this crocodile species.

The main results and conclusions of the study were:

- The species is present throughout its original range (historic sites);
- Forty new sites were reported for the species (giving a total of 145);
- It is estimated that there exists a population of approximately 80,000 individuals in Mexico, of which 15,000 are adults of reproductive age;
- It is estimated that nearly 40 per cent of individuals are juveniles (class II), which suggests a positive population trend;
- It is estimated that the area of potential distribution of the species in Mexico is 396,455 km²;
- It was found that just over half the sites in which crocodiles exist are stable, and the remaining sites are in excellent condition.

During a workshop of experts and authorities organized by CONABIO in late 2004, the CoPan Project report was revised to compare new information with current status of the Morelet's crocodiles in the IUCN Red List, the NOM-059 and the ESA (Sanchez et al., 2011, page 36). These results served as the basis for CITES Appendices transfer in 2010 (CoP15 Com. I Rec. 7) and removal of the species from the ESA in 2012 due to recovery (DOI Federal Register, 2012, 77(100)).

5. Morelet's Crocodile Monitoring Programme

In Mexico, a country-wide Monitoring Programme for the populations and habitat of the Morelet's crocodile is being implemented, and the possibility of the involvement of Belize and Guatemala in the near future is being considered. The aim of the programme is to build on the experiences and results of the CoPan Project, together with suggestions made within the CITES framework and recommendations by the IUCN-CSG, to obtain more complete information about the

status and trends of populations of the species and its habitat (CITES, 2010b, page 9).

Stage 1 of the Monitoring Programme (2009–2011) included a preliminary design reviewed and assessed at the Trinational Mexico–Belize–Guatemala Workshop on the Monitoring Programme for Morelet's Crocodile, where experts and authorities agreed on the most appropriate methods, seasons, routes/localities and variables to be measured for crocodiles and their habitat. Based on this workshop's results, a procedures manual was developed and published with support of experts (Sanchez et al., 2011) from the three countries as a tool to secure the gathering of comparable field data on the species through standard methodologies, common understanding, clear objectives and structured coordination and reporting schemes.

As part of the ongoing stage 2 initiated in 2011, four coordination regions were established in Mexico in order to implement the Programme. Agreements were signed between CONABIO and implicated institutions/organizations, which are now responsible for carrying out the fieldwork, following the procedures manual and reporting into a central web-based database maintained by CONABIO. Information stored in the database is being analysed periodically to produce estimates of wild population sizes and trends in the short, medium and long term (Sanchez et al., 2011; Sanchez et al., 2012). Information obtained through the monitoring programme will provide basic and robust elements for decision-making processes on the conservation, management and sustainable use of the species (see figure 12).

Monitoring results of the 2011 season from 82 sites provided a national population estimate of more than 78,600 individuals in the wild, which is similar to the figure obtained during the CoPan project in 2002–2004. Moreover, habitat in monitoring sites was considered appropriate (from good to very good) and populations seem to be healthy in terms of both structure (size classes; numbers of reproductive adults and production of hatchlings) and physically. Results and analysis of subsequent seasons will be published periodically on CONABIO's website.

B. Sustainable use

1. Management units for conservation of wildlife

As stated previously, currently all commercial exploitation of Morelet's crocodile in Mexico for international trade must compulsorily involve animals born and

raised in captivity in UMAs (closed-cycle operations, and with proven viability of second generation). No wild specimens can be legally harvested for international trade.

At present, no ranching operations involving wild specimens exist in Mexico. However, the Monitoring Programme will provide information to identify potential localities where this could be done following the management units system (Platt et al., 2010).

According to Article 84 of LGVS, if any wild specimen of any species is to be harvested in a UMA, the extraction rate must be proved to be smaller than natural rate of recovery of populations targeted. Article 85 of the LGVS establishes that harvest of species (since it is included in the NOM-059-SEMARNAT-2010) will be authorized only when priority is given to restoration, repopulation and reintroduction activities.

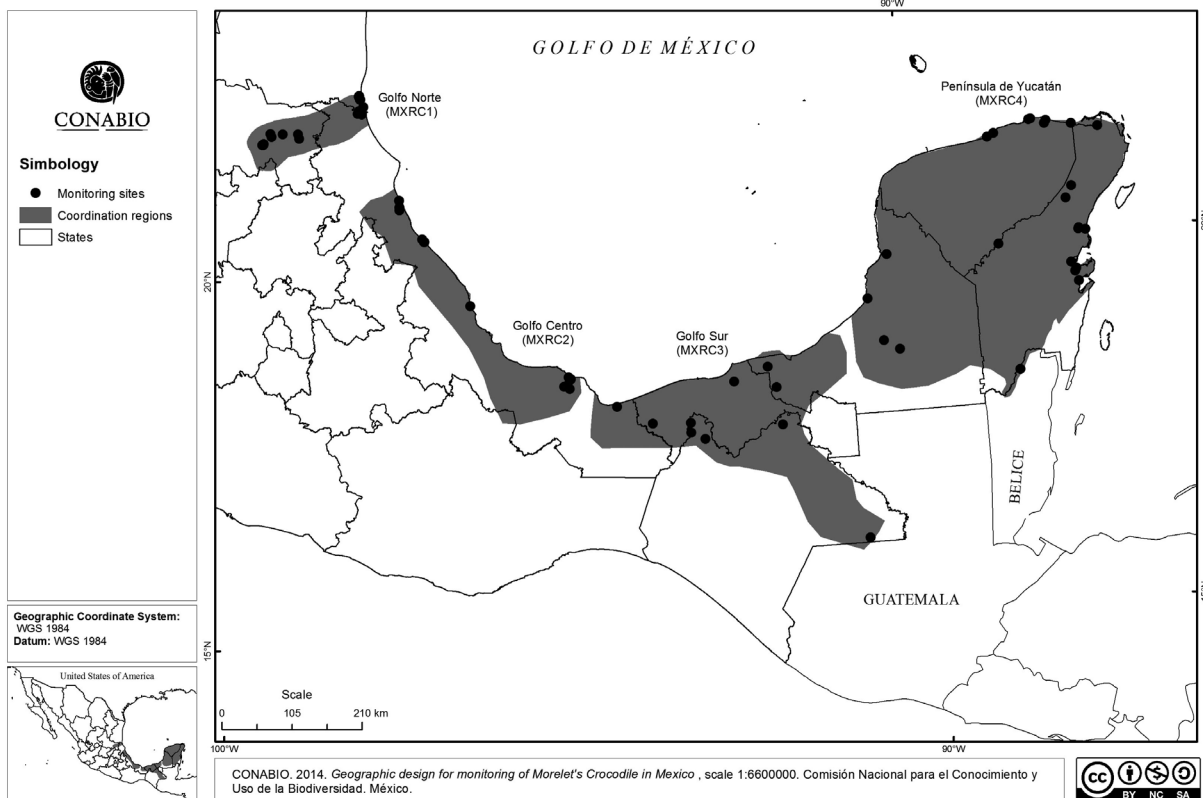
SEMARNAT randomly inspects UMAs, and if any inconsistencies are detected in the management plan, population studies, sampling activities, inventories or periodic reports, notifications are sent and punitive measures may be applied.

Additionally, CONABIO and DGVS-SEMARNAT are joining efforts to develop a “Type Management Plan for Morelet’s Crocodile”. Such a publication will serve as a standard template for stakeholders interested in crocodile captive-breeding production.

2. Captive breeding

Casas-Andreu et al. (2011) report that the beginning of the nesting season in captivity coincides with the first rain of the season and the highest annual temperature. The maximum number of eggs per nest (50) is reported to be higher than that observed in the wild (42). These authors also report that the viability of eggs laid in captivity was 73.15 per cent and annual hatching success was near to that reported in the wild (40.7 per cent in captivity versus 50 per cent in the wild). The authors also suggest that successful captive breeding frequently depends on environmental factors, the reproductive quality of males (sometimes changing males between enclosures can have positive results), the physical condition of the females, the stocking rates, sex ratios, and that territoriality may be influencing the reproductive traits.

Figure 11. Geographic design for monitoring of Morelet’s Crocodile in Mexico



Source: CONABIO, 2014

Captive-breeding techniques in Mexican farms allow commercial-size individuals to be obtained in 2-4 years, although to obtain bigger sizes and satisfy international demand, 4 years are required (UMA CAICROCHIS, UMA COCOMEX, UMA Cocodrilos Maya, personal communication, no date).

Up to 50 or more eggs can be obtained in Mexican UMAs per female between April and July, and these are maintained in an incubator for 75 days (at 29°C to 33°C, depending on production needs) until September, when eggs hatch. Survival of hatchlings is more than 85 per cent and they are kept in a maternity area for two weeks until they are stronger and placed in a controlled environment. Until two years of age the animals are supervised carefully and every six months they are changed to new enclosures with lower densities, according to the sizes of the individuals. Mortality rate is approximately 10 per cent during the first year and 5 per cent in subsequent years, reducing as age increases. Optimum conditions allow for growing rates of 3 cm–4 cm per month, attaining up to 120 cm in a year and a half.

When animals reach 1 metre–1.2 metre in length, they are assessed and selected according to their quality and suitability for different products. Every animal selected for high or premium quality skin is allocated

to an individual enclosure with 2 m² minimum surface until they reach a commercial width of 35 cm–40 cm in the “belly” cut. Individual enclosures are built to avoid any damage or stress to the animal and its skin, including smooth and polished floors and water coverage, and individual attention (concerning health, feeding and cleaning).

Mexican UMAs are currently transforming their technologies to support individual enclosures. Estimations point to a volume of 2,500 high quality skins for 2015, and between 8,000 and 10,000 skins per year from 2022 onward. Projected production for the next few years is shown in table 2 and figure 11 (UMA CAICROCHIS, UMA COCOMEX, UMA Cocodrilos Maya, UMA El Colibrí, personal communication).

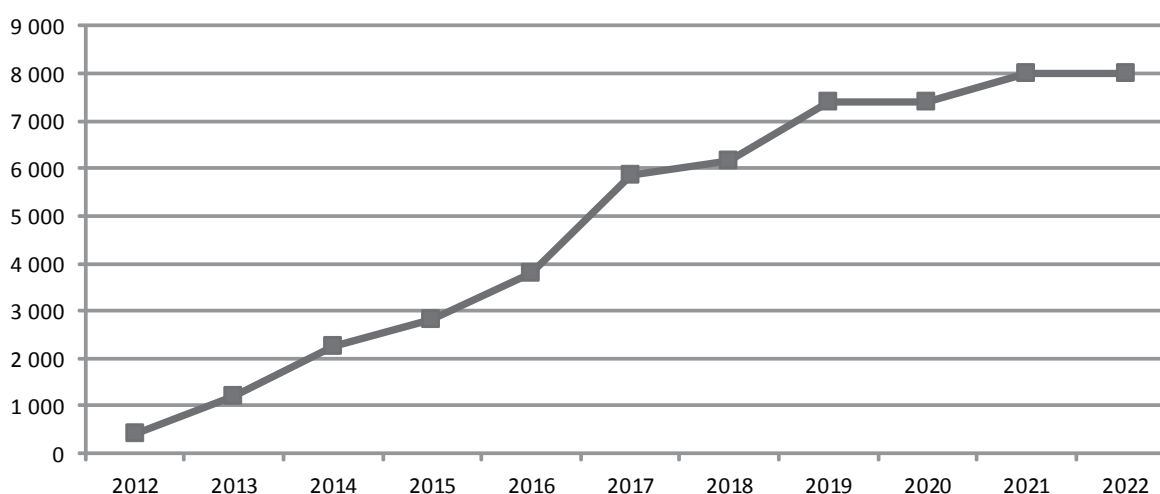
3. Sustainable use programmes

It is worth noting that if harvesting of wild specimens is considered for *Crocodylus moreletii* in the future, several studies on the natural history of crocodiles point out the extreme resistance of wild populations to removal of youngest specimens (that is, eggs or newborns) or oldest/biggest specimens (that is, male adults). Many harvesting programmes around the world concerning different species show that annual

Table 2. Estimated production of high-quality skins per year in the UMAs of Campeche, Sinaloa, Veracruz, Chiapas, Tamaulipas and Yucatán

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
400	1 200	2 250	2 800	3 800	5 850	6 150	7 400	7 400	8 000	8 000	53 250

Figure 12. Estimated production of high-quality skins per year in the UMAs of Campeche, Sinaloa, Veracruz, Chiapas, Tamaulipas and Yucatán



removal of 50–80 per cent of laid eggs or 5–10 per cent of the adult population does not have restraining effects on population growth (David, 1994; Webb et al., 1992; Woodward et al., 1992).

Recruitment in the wild (entry of young specimens into the adult population) depends on the density, structure and size of adult populations, and is not very sensitive to the quantity of eggs laid or the survival of newborns (Ross, 1999). In this regard, two interlinking factors are of paramount importance for the survival of crocodile populations: maintaining the reproductive female populations, and the protection of their habitat (Ross, 1997). Management plans based on hunting or removal of big specimens for human safety can reduce restraining effects of recruitment, so populations with controlled harvest of big male adults show a faster population growth of the species (Ross, 1999). However, in this respect, decisions in Mexico will be based on results derived from the Monitoring Programme.

4. Slaughter methods

All farms follow international procedures recommended by the IUCN-CSG. A small incision is made in the nuchal zone of the specimen manually (between skull and vertebrae) with an awl in order to disconnect brain functions. This procedure allows the killing of the animal in a humane fashion and the complete use of all body parts.

Before slaughter, the specimen is separated and washed, and following slaughter it is refrigerated and suspended for 24 hours, when it is again washed out to obtain the different parts, separated on consecutive tables (skin, meat, internal organs).

C. Ecosystem and habitat impact

1. Role of the species in its ecosystem

The Morelet's crocodile facilitates a number of ecological processes, especially in smaller water bodies, where it regulates populations of fish and other species, fertilizes water with its faeces, and transports plant propagates and micro organisms by moving from one swamp to another (Aguilar, 2005). It is preyed upon by birds and medium-sized mammals in juvenile stages and by the jaguar as an adult.

In the wild, small individuals feed mainly on insects and spiders, medium-sized ones eat molluscs, fish and crustaceans, and adults prey on reptiles, mammals and birds (Perez-Higareda et al., 1989; Pooley and Gans, 1976). Fish are an important source of food

in the different life stages of the species, as well as carrion, consumed opportunistically.

2. Habitat conservation benefits

Due to closed cycle production, little habitat conservation is obtained directly from such farms, although they have their own personal ethic and contribution to conservation, education and research programmes. This is achieved through training, implementation of conservation programmes, courses and support to academic research programmes, among others. With the legal production of skin, illegal trade has been reduced and the farmers are in close contact with authorities to report any possible illegal trade.

Additionally, wildlife management through the UMA scheme has to fulfil requirements of proper habitat management in order to achieve conservation objectives, which includes the monitoring of vegetation cover, restoration activities, fire prevention and soil conservation, among others. These activities have to be described in detail as part of the management plan of the unit, together with strategies to attend possible contingencies and surveillance mechanisms.

D. Access benefit sharing/community benefits

The LGVS in its Article 18 points out that legitimate land owners where wildlife is distributed have the right to sustainably use the wildlife and obtain benefits, as well as the obligation of conserving the habitat and to be responsible for any negative effects that such use might have on wildlife and its habitat. In order to use those resources, land has to be registered as a UMA and fulfil the requirements thereof (registration at the Wildlife General Office, management plan approved and registered, monitoring of wild populations, periodic reports and inventories, certificate of production and marking/tagging methods).

Morelet's crocodile has a high socio-economic value as it can represent an important income source for local communities, producers and traders. Some closed-cycle breeding farms have received support from the Mexican Government and are in contact with educational and scientific institutions interested in the conservation of the species. They also give technical assistance, capacity-building workshops and courses, and parental stock sale. Some other operations, such as Cocodrilos de Palizada and Cococanek, are community based; currently they have low production capacity but are alternated with activities such as eco-

tourism, research and educational tourism, which lead to other economic and social benefits.

Such activities can be carried out in UMAs in Mexico, developing their own value chains that offer services to specific stakeholders to spread knowledge about the species:

- Guided visits to the captive-breeding operation;
- Restaurant services;
- Gifts and souvenirs shops;
- Complementary recreational activities such as fishing or sports;
- Hotel services;
- Conferences and exhibitions.

Some efforts have been made to incorporate the UMAs into local and national touristic networks. In addition, there are UMAs managed by private investors

that wish to support conservation by undertaking sustainable economic activities with the species. This has facilitated cost-benefit oriented technical improvements, which have advantages both for maintaining economic viability of the captive-breeding operation and for maintaining a reserve of individuals for possible re-introductions or founder stocks.

It can be expected that the Monitoring Programme will be able to provide information on potential sites for ranching activities, which can involve rural communities for the collection of eggs in the wild, in coordination with current producers who will grow the individuals in captivity. The development of this collaboration should promote conservation of the species and habitat in its natural range by providing additional benefits for communities through the sustainable use this resource.

References

- Aguilar, M. X. (2005). *Crocodylus moreletii*. Algunas especies de anfibios y reptiles contenidos en el Proyecto de Norma Oficial Mexicana PROY-NOM-059-ECOL-2000. Facultad de Ciencias, Centro de Investigación en Recursos Bióticos, Universidad Autónoma del Estado de México. Bases de datos SNIBCONABIO. Proyecto W035. México. D.F.
- Alvarez del Toro, M. (1974). Los Crocodylia de México (estudio comparativo). Instituto Mexicano de Recursos Naturales Renovables, A. C. México.
- Alvarez del Toro, M., and L. Sigler (2001). Los Crocodylia de Mexico, 2ª Edición. PROFEPA, Mexico, D.F.
- Barrios-Quiroz, G. and G. Casas-Andreu. (2010). Crecimiento con diferentes dietas en crías de *Crocodylus moreletii* Dumeril Bibron & Dumeril 1851 (Crocodylia: Crocodylidae) en cautiverio, Tabasco, México. *Revista Latinoamericana de Conservación*. 1(2): 104 -111.
- Bondavalli, C. and R. E. Ulanowicz. (1999). Unexpected Effects of Predators Upon Their Prey: The Case of the American alligator. *Ecosystems*. 2: 49-63.
- BOSTID (1983). Crocodiles as a Resource for the Tropics. Report of an Ad Hoc Panel of the Advisory Committee on Technology Innovation. Board on Science and Technology for International Development. Office of International Affairs. National Research Council. National Academy Press, Washington D. C. 52 pp. <http://sleekfreak.ath.cx:81/3wdev/CD3WD/AGRIC/B20CRE/INDEX.HTM>.
- Britton, A. (2005). *Crocodylus moreletii* (Bibron and Dumeril, 1851) http://www.flmnh.ufl.edu/CNHC/csp_cmor.htm.
- Casas-Andreu, G. and M. Guzman-Arroyo. (1972). Estado actual de las investigaciones sobre cocodrilos mexicanos. Inst. Nal. de Inv. Biol. Pesqueras, México, D. F., 50 pp.
- Casas-Andreu, G., G. Barrios-Quiroz and R. Macip-Rios. (2011). Reproducción en cautiverio de *Crocodylus moreletii* en Tabasco, México. *Revista Mexicana de Biodiversidad*. 82: 261-273.
- Cerdeño-Vázquez, J.R., pLatt, S.G. & Thorbjarnarson, J. (IUCN Crocodile Specialist Group) (2012). *Crocodylus moreletii*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2 –www.iucnredlist.org-. Downloaded on 07 June 2013.
- Cedeño-Vazquez, J. R. and S. D. Perez-Rivera. (2010). El Cocodrilo de Pantano (*Crocodylus moreletii*) en Laguna Esmeralda, Quintana Roo, México. *Revista Latinoamericana de Conservación* 1(2): 91-98.
- Cedeño, J. R., A. Villegas and L. Sigler. (2011). Guía Gráfica para identificación morfológica de *Crocodylus moreletii* y posibles híbridos con *C. acutus*. Pp.: 207-221. In: Programa de Monitoreo del Cocodrilo de Pantano (*Crocodylus moreletii*) México-Belice-Guatemala. Sanchez Herrera, O., G. Lopez Segurajauregui, A. Garcia Naranjo Ortiz de la Huerta y H. Benitez Diaz (eds.). Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México. 270 pp.
- CITES (2010a).Resolution Conf. 11.12 Rev. CoP15 . <http://www.cites.org/eng/res/11/11-12R15.php> (accessed 29 November 2013).
- CITES (2010b). 15th meeting of the Conference of Parties, Prop. 8. Doha (Qatar): 9 pp. <http://www.cites.org/eng/cop/15/prop/E-15-Prop-08.pdf> (accessed 28 November 2013).
- CONABIO n/d. Web-based Database. <http://www.biodiversidad.gob.mx/planeta/cites/index.html> (accessed 29 November 2013).
- CONABIO (2005). Proposal for the Reclasification of Morelet's crocodile (*Crocodylus Moreletii*) in the Endangered Specied Acti (ESA) of the United States of America. CONABIO and SEMARNAT. Mexico D.F., 38 pp.
- CONABIO (2013). Programa de Monitoreo del Cocodrilo de Pantano (*Crocodylus moreletii*) México-Belice-Guatemala. Mapa del diseño de muestreo para el monitoreo (regiones de coordinación y sitios de monitoreo en la plataforma Google Earth).
- David, D. (1994). Harvesting wild crocodilians: guidelines for developing a sustainable use program. Pp. 274-309. In: Crocodiles, Proceedings of the 12th Working Meeting of the Crocodile Specialist Group, vol. 1. IUCN-The World Conservation Union, Gland, Switzerland.
- Dominguez Laso, J. (2006). Determinación del estado de las poblaciones silvestres del cocodrilo de pantano (*Crocodylus moreletii*) en México y evaluación de su estatus en la CITES. Instituto de Historia Natural y Ecología. Informe final SNIB-CONABIO proyecto No. CS009. México.
- Escobedo-Galvan, A. H., V. Palacios-Chavez, and A. Vovides-Tejera (2008). *Crocodylus moreletii* (Morelet's crocodile). Salinity tolerance. *Herpetological Review* 39: 346-347.
- Environment Canada (1995). CITES Identification Guide – Crocodilians. Authority of the Minister of Environment. ISBN 0-662-61957-9. Canada.
- Gonzalez-Avila, F. (2010). Condición de salud en la población del cocodrilo de pantano (*Crocodylus moreletii*) del Río hondo, Quintana Roo, México. Tesis de Licenciatura en Biología. Instituto Tecnológico de Chetumal.
- Hunt, H. R. (1973). Breeding Morelet's crocodile *Crocodylus moreletii* at Atlanta Zoo. *International Zoo Yearbook* 13: 103-105.

- Hunt, H. R. (1975). Maternal behaviour in the Morelet's crocodile, *Crocodylus moreletii*. *Copeia* 1975(4): 763-764.
- Hunt, H. R. (1980). Propagation of Morelet's crocodile. SSAR Contribution to Herpetology SSAR: USA 1: 161-165.
- King F. W. and P. Brazaitis (1971). Species Identification of commercial crocodilian skins. *Zoologica NY Zool. Soc. New York, United States*. 56(2): 15-70.
- Kushlan, J. A. (1974). Observations on the role of the American alligator (*Alligator mississippiensis*) in the southern Florida wetlands. *Copeia* 1974: 993-996.
- Lacy, R. C., M. Borbat, and J. P. Pollack. (2003). Vortex. A Stochastic Simulation of the Extinction Process. Version 9.42. Brookfield, IL: Chicago Zoological Society.
- Lee, J. C. (1996). The amphibians and reptiles of the Yucatán Peninsula. Comstock Publishing Associates. Ithaca, New York.
- Lee, J. C. (2000). A field guide to the amphibians and reptiles of the Maya World. Cornell University Press, Ithaca, New York.
- Levy, C. (1991). Endangered Species. Crocodiles and Alligators. Chartwell Books, New Jersey, 128 pp.
- Meerman, J. (1994). The status of crocodiles in the eastern Corozal District. Pp.: 107-112. In: Estudio Integral. Recursos Naturales de la Frontera México-Belice. CIQRO, Chetumal, México.
- Naiman, R. J. y K. H. Rogers. (1997). Large Animals and System-Level Characteristics in River Corridors. *BioScience*. 47: 521-529.
- Navarro-Serment, C. J. (2004). The return of Morelet's crocodile. *Crocodylus moreletii*. *Reptilia*. 2004: 54-60.
- NOM-059-SEMARNAT-2010 (2010). NORMA Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario Oficial de la Federación, 30 de diciembre de 2010.
- Perez-Higareda, G. (1980). Notes on nesting of *Crocodylus moreletii* in southern Veracruz, Mexico. *Bulletin of Maryland Herpetological Society* 16(2): 52-53.
- Perez-Higareda, G., A. Rangel-Rangel, H. A. Smith and D. Chizar. (1989). Comments on food and feeding habits of Morelet's crocodile. *Copeia* 1989: 1039-1041.
- Perez-Higareda, G., A. Rangel-Rangel and H. A. Smith (1991). Maximum sizes of Morelet's and American crocodiles. *Bulletin of the Maryland Herpetological Society* 27:34-37.
- Platt, S. G. (1996). Ecology and Status of Morelet's Crocodile in Belize. PhD dissertation. Clemson, SC. Clemson University.
- Platt, S. G. and T. R. Rainwater (2005). A review of morphological characters useful for distinguishing Morelet's crocodile (*Crocodylus moreletii*) and American crocodile (*Crocodylus acutus*) with an emphasis on populations in the coastal zone of Belize. *Bulletin of Chicago Herpetological Society*. 40(2): 25-29.
- Platt, S. G., T. R. Rainwater, J. B. Thorbjarnarson and S. T. McMurry (2008). Reproductive dynamics of a tropical freshwater crocodilian: Morelet's crocodile in northern Belize. *J. Zool.* 275: 177-189.
- Platt, S. G., L. Sigler and T. R. Rainwater (2010). Morelet's Crocodile *Crocodylus moreletii*. Pp. 79-83. In: Crocodiles. Status Survey and Conservation Action Plan. Third Edition, ed. by S.C. Manolis and C. Stevenson. Crocodile Specialist Group: Darwin.
- Platt, S. G. and J. B. Thorbjarnarson (2000). Population status and conservation of Morelet's crocodile, *Crocodylus moreletii*, in northern Belize. *Biological Conservation*. 96(1): 21-29.
- Pooley, A. C. and C. Gans (1976). The Nile crocodile. *Scientific American*. 234: 114-124.
- Ross, J. P. (1987). *Crocodylus moreletii*. Duméril and Bribon Morelet's crocodile. *Society for the Study of Amphibians and Reptiles*. 407.1-407.3.
- Ross, J. P. (1997). Biological basis and application of sustainable use for the conservation of crocodilians. Pp. 182-186. In: Memorias de la 4ª reunion regional del Grupo de Especialistas en Cocodrilidos de América Latina y el Caribe. Centro Regional de Innovación Agroindustrial, S. C. Villahermosa, Tabasco, México.
- Ross, J. P. (1998). Crocodiles. Status Survey and Conservation Action Plan (online). 2nd. Ed. IUCN/SSC Crocodile Specialist Group. IUCN, Gland, Switzerland and Cambridge, United Kingdom. Viii+ 167 pp. <http://www.flmnh.ufl.edu/natsci/herpetology/act-plan/plan1998a.htm>.
- Ross, J. P. (1999). Bases biológicas para el uso sostenible de los cocodrilidos. Pp. 275-279. In: Manejo y conservación de fauna silvestre en América Latina. T. Fang, O. Montenegro y R. Bodmer (eds.). Museo de Historia Natural Noel Kempf Mercado, University of Florida, Instituto de Ecología y Wildlife Conservation Society.
- Ross, J. P. (2000). *Crocodylus moreletii*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 15 November 2011.
- Sanchez, O. (2011). Introducción. Pp. 19-32. In: Programa de Monitoreo del Cocodrilo de Pantano (*Crocodylus moreletii*) México-Belice-Guatemala. Sanchez, O., G. Lopez Segurajauregui, A. Garcia Naranjo Ortiz de la Huerta y H. Benitez Diaz (eds.). Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México. 270 pp.

- Sanchez, O. and J. G. Alvarez-Romero (2006). Conservation Status of the Morelet's Crocodile (*Crocodylus moreletii*) in Mexico: a proposal for its reclassification in the U.S. Endangered Species Act (ESA). In: Crocodiles. Proceedings of the 18th Working Meeting of the Crocodile Specialist Group, IUCN – The World Conservation Union, Gland, Switzerland and Cambridge UK. <http://www.conabio.gob.mx/institucion/proyectos/resultados/InfCS009.pdf>.
- Sanchez, O., G. Lopez Segurajauregui, A. García Naranjo Ortiz de la Huerta y H. Benitez Diaz (2011). Programa de Monitoreo del Cocodrilo de Pantano (*Crocodylus moreletii*) México-Belice-Guatemala. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México. 270 pp. http://www.conabio.gob.mx/institucion/cooperacion_internacional/doctos/manualf_monitoreo_cocodrilo.pdf.
- Sánchez, O., G. López Segurajáuregui, A. García Naranjo Ortiz de la Huerta y H. Benítez Díaz (2012). Informe del Programa de Monitoreo del Cocodrilo de Pantano en México Temporada 2011. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México 72.pp. http://www.biodiversidad.gob.mx/planeta/cites/Pdf/InformeTemp2011_MX_Final.pdf.
- SEMARNAP (1999). Proyecto para la Conservación y Aprovechamiento Sustentable de los Crocodylia en México (COMACROM). INE/SEMARNAP. 107pp.
- Serna-Lagunes R., J. Zuñiga-Vega, P. Diaz-Rivera, F. Clemente-Sanchez, A. Perez Vazquez and J. Reta-Mendiola (2010). Variabilidad morfológica y crecimiento corporal de cuatro poblaciones de *Crocodylus moreletii* en cautiverio. *Revista Mexicana de Biodiversidad*. 81:713-719.
- Sigler, L. and J. Dominguez-Laso (2008). Historical and current distribution of the Morelet's crocodile *Crocodylus moreletii* (Duméril and Duméril 1851) in Mexico. *Crocodile Specialist Group Newsletter* 27(1): 11-13.
- Smith H. M. and R. B. Smith (1977). Synopsis of the Herpetofauna of Mexico. Vol. 5. Guide to Mexican Amphibiaenians and Crocodylians. Bibliographic Addendum II. John Johnson. North Bennigton, Vt. 187 pp.
- UNEP-WCMC CITES Trade Database (2013). *Crocodylus Moreletii*. Available at: <http://www.unep-wcmc-apps.org>.
- Webb, G., C. Manolis, B. Otley and A. Heyward (1992). Crocodile management and research in the Northern Territory: 1990-1992. Pp. 233-275. In: Crocodiles. Proceedings of the 11th Working Meeting of the Crocodile Specialist Group, Vol. 2. IUCN-The World Conservation Union, Gland, Switzerland.
- Woodward, A., C. Moore and M. Delaney (1992). Experimental alligator harvest. Final report study number 7567, Florida Game and Freshwater Fish Commission, Gainesville, United States. 118 pp.

Notes

- 1 Marco Novelo, UMA Cocodrilos Maya Farm.
- 2 José Carlos Rodarte, UMA COCOMEX Farm, no date ; Manuel Muñoz, UMA CAICROCHIS Farm, no date; COMACROM, no date.