CONVENTION SUR LE COMMERCE INTERNATIONAL DES ESPECES
DE FAUNE ET DE FLORE SAUVAGES MENACEES D'EXTINCTION

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PROPOSITION DE TRANSFERT DE L'ANNEXE I A L'ANNEXE II DE LA POPULATION DE *CROCODYLUS MORELETII* DU MEXIQUE

1. Le présent document est soumis par le Mexique. L'annexe est jointe dans la langue dans laquelle elle a été communiquée.

Contexte

2. Le crocodile de Morelet (*Crocodylus moreletii*) a été inscrit à l'Annexe I en 1975 quand les premières annexes ont été rédigées; son inscription était fondée sur l'état de l'espèce tel qu'il était à l'époque. Les Parties n'ont donc pas analysé la proposition initiale sur la base des critères définis ultérieurement et agréés par le biais de la résolution Conf. 9.24 (adoptée par la Conférence des Parties à sa neuvième session et actualisée à ses 12e, 13e et 14e sessions) qui requiert à présent que certaines informations soient communiquées et que des critères spécifiques soient remplis pour qu'une proposition d'amendement des annexes CITES soit examinée. Depuis, le statut de l'espèce dans les annexes n'a pas été examiné.

3. Dès le milieu des années 1990, le Mexique a commencé à souligner la nécessité d'examiner et d'actualiser le statut du crocodile de Morelet (*Crocodylus moreletii*) dans différentes listes (Liste rouge de l'UICN, ESA des Etats-Unis d'Amérique, CITES, etc.) en le classant dans la catégorie appropriée; en effet, les populations sauvages de l'espèce présentent des signes évidents de rétablissement et les spécialistes estiment qu'elle ne remplit plus les critères qui la classeraient comme espèce en danger.

4. En 2000, la Commission nationale pour la connaissance et l'utilisation de la biodiversité (CONABIO, autorité scientifique du Mexique) a commencé à compiler et à générer des informations sur l'état des populations sauvages du crocodile de Morelet afin de confirmer l'opinion des spécialistes pour qui l'espèce n'était plus en danger. La même année, l'UICN a classé l'espèce dans la catégorie *Risque plus faible – dépend de la conservation* (LR/cd) dans sa Liste rouge, sur la base d'une évaluation faite par le Groupe de spécialistes des crocodiles qui a conclu que l'espèce était présente sur plus de 40 sites du golfe du Mexique. Les études et les estimations de population ont toutes signalé des densités moyennes et l'on estime avec confiance qu'il y a plus de 10.000 individus matures dans la nature et qu'il y en a encore dans tous les sites où l'espèce était présente dans le passé.

5. A la 11e session de la Conférence des Parties, le Mexique a soumis une proposition, fondée sur des études locales, visant à transférer de l'Annexe I à l'Annexe II la population de *C. moreletii* du Sian Ka'an (Quintana Roo, Mexique). Le Mexique a retiré sa proposition en tenant compte du fait qu'il serait préférable de mener des recherches plus approfondies dans certaines régions et de soumettre une proposition couvrant toute la population du Mexique, voire l'espèce entière.

6. En 2002, un examen de l'état des populations sauvages de *C. moreletii* a été fait sur la base d'une évaluation rapide réalisée par le Sous-Comité technique consultatif pour la conservation, la gestion et l'utilisation durable de Crocodylia au Mexique (COMACROM) et financée par la CONABIO.

7. En 2003, la CONABIO a demandé au COMACROM, par le biais de l'Institut de sciences naturelles et d'écologie du Chiapas (IHNE), de faire une étude visant à évaluer l'état actuel des populations sauvages de l'espèce au niveau national. Cette étude, intitulée "Détermination de l'état des populations sauvages du crocodile de Morelet au Mexique et évaluation de son statut CITES", a commencé début 2004 et a été coordonnée et financée par la CONABIO.

8. Fin 2004, le rapport avec les résultats finals de l'étude a été remis. La CONABIO a organisé un atelier de spécialistes pour étudier et analyser les données de terrain présentées dans ce rapport et toutes les informations disponibles sur l'espèce. Parmi les participants il y avait des scientifiques de renommée internationale, des biologistes connaissant l'écologie et l'herpétologie, des membres du Groupe UICN-CSE de spécialistes des crocodiles, des représentants du COMACROM, des autorités CITES du Mexique [*Dirección General de Vida Silvestre* (DGVS-SEMARNAT), *Procuraduría Federal de Protección al Ambiente* (PROFEPA) et CONABIO], de l'Institut national d'écologie (INE), ainsi que des éleveurs commerciaux et d'autres parties intéressées par la conservation de l'espèce.

9. Une réévaluation de l'état actuel de *C. moreletii* faite sur la base des critères de l'ESA, de la Méthode d'évaluation des risques d'extinction incluse dans la Norme officielle mexicaine des espèces à risque (NOM-059-SEMARNAT-2001) et de la Liste rouge de l'UICN des espèces menacées, a montré que l'espèce ne remplissait plus les conditions requises pour être classée dans une quelconque catégorie de risque et qu'il fallait que les organisations internationales pertinentes répercute cet état de fait de manière appropriée.

10. Récemment, les autorités CITES du Mexique ont examiné le statut de l'espèce dans les annexes CITES en s'appuyant sur les informations disponibles. Sur la base de la résolution Conf. 9.24 (Rev. CoP14), elles ont conclu que l'espèce ne remplissait plus les critères qui permettaient de la considérer comme menacée d'extinction et que son transfert de l'Annexe I à l'Annexe II était justifié. On peut voir cela comme un exemple supplémentaire du succès remporté par la CITES dans le contrôle du commerce et dans la conservation d'une espèce protégée par la Convention.

Situation de l'espèce

11. *Crocodylus moreletii* est largement réparti dans les collines et la plaine côtière du golfe du Mexique, dans la péninsule du Yucatan, au Guatemala et au Belize (au seul Mexique, 202.169 km^2 sont considérés comme habitats convenant à l'espèce). De nos jours, les populations de ce crocodile présentent des signes évidents de rétablissement. Compte tenu des tendances du développement au Mexique, au Guatemala et au Belize, rien ne permet de prévoir une quelconque destruction, modification ou dégradation potentielle de l'habitat d'une gravité et d'une ampleur comparables celles intervenues entre les 16^{e} et 20^{e} siècles.

12. Une estimation actuelle fondée sur les meilleures informations disponibles (voir annexe), indique une population mondiale potentielle de *Crocodylus moreletii* sauvages (tous âges confondus) d'un peu plus de 100.000 individus et de près de 20.000 adultes dans la nature.

13. L'exploitation commerciale des populations sauvages de *C. moreletii* est actuellement interdite. En plus de cette restriction importante, il existe – au moins au Mexique – un stock abondant et solide de crocodiles de Morelet vivant en captivité (animaux reproduits et élevés en captivité), y compris dans des fermes dûment enregistrées par le Secrétariat CITES; cela présente un intérêt potentiel en cas de repeuplement éventuel de certaines zones ainsi que pour le commerce.

14. Jusqu'à présent, et pour toute l'espèce, rien n'indique que des maladie pourraient menacer à l'avenir la continuité et la viabilité des populations sauvages de *C. moreletii*. De même, à part la prédation naturelle connue pour l'espèce (et présente tout au long de son évolution) rien n'indique qu'une espèce prédatrice, native ou exotique, pourrait être un facteur de stress pour le crocodile de Morelet. Rien n'indique non plus que le tourisme ou des activités scientifiques pourraient avoir des effets négatifs ou constituer une menace pour les populations sauvages de l'espèce.

15. Actuellement, les dispositifs réglementaires légaux et de lutte contre la fraude du Mexique, applicables directement et indirectement à *C. moreletii* se sont avérés adéquats et suffisants, comme en témoigne le rétablissement des populations sauvages conforté par les données du terrain. Ce rétablissement paraît solide, de même que le cadre légal qui l'appuie. Les dispositifs légaux équivalents du Guatemala et du Belize viennent renforcer la protection légale conférée à l'espèce dans toute son aire naturelle.

16. Même si le fonctionnement des infrastructures industrielles situées dans les zones naturelles du Mexique implique certaines interactions avec les crocodiles, on observe rarement des conséquences négatives résultant de situations de conflits. Contrairement à l'attitude manifestée envers les crocodiles au cours du 20e siècle, on arrive à présent à limiter les effets négatifs des conflits hommes/crocodiles car les gens sont de plus en plus disposés à coopérer avec les autorités chargées de l'environnement. La plupart de ces conflits sont résolus en déplaçant les animaux.

Conclusion

17. En conclusion, l'existence de *C. moreletii* ne paraît pas compromise par des facteurs naturels ou anthropogènes supplémentaires. La forte capacité intrinsèque de l'espèce à se rétablir et les contrôles internationaux résultant de la CITES et de l'action menée par le Mexique pour sa conservation ont donné de bons résultats. La suppression de la capture dans la nature à des fins commerciales en tant que facteur agissant sur l'espèce, la désignation d'aires naturelles mieux protégées, et l'encouragement aux fermes ayant un cycle complet de reproduction, ont contribué ensemble au rétablissement de l'espèce, comme en atteste sa présence confirmée dans toute son aire (sites où elle était présente dans le passé et sites où elle a été abondamment chassée) avec une abondance comparable à celle d'autres espèces de crocodiles considérées comme communes.

18. L'action de conservation menée au Guatemala et au Belize a donné des résultats prometteurs pour la conservation à long terme de cette importante espèce de reptile. Le Mexique gardera le cap pour atteindre ce but et, s'il y a lieu, il intensifiera son action afin de veiller à ce que cette espèce ne court plus à nouveau de risque d'extinction.

19. L'inscription de *Crocodylus moreletii* à l'Annexe I n'est plus justifiée aujourd'hui, comme en témoignent les résultats des études de terrain et l'analyse scientifique des données compilées qui indiquent que les populations sauvages ne sont ni petites ni en déclin et que leur répartition géographique n'est pas limitée – ce qui conforte la demande de transfert de l'Annexe I à l'Annexe II.

20. Conformément à l'Article II, paragraphe 2, de la Convention, et aux mesures de précaution prévues par l'annexe 4 de la résolution Conf. 9.24 (Rev. CoP14), le Mexique soumet au Comité pour les animaux, pour examen et appui, une proposition de transfert de l'Annexe I à l'Annexe II de sa population de crocodiles de Morelet (*Crocodylus moreletii*) (proposition jointe en tant qu'annexe au présent document), et entend la soumettre formellement à la Conférence des Parties à sa 15e session.

Recommandation

21. Le Mexique demande que le Comité pour les animaux, après examen et évaluation de la proposition jointe au présent document, lui accorde son appui et fasse des recommandations fondées sur les éléments qu'elle contient, afin que le crocodile de Morelet (*Crocodylus moreletii*) ait le statut approprié aux annexes, conformément aux dispositions de la CITES.

A. Proposal

Transfer the Mexican population of Morelet's crocodile (*Crocodylus moreletii*) from Appendix I to Appendix II in accordance with Article II, paragraph 2, which states that Appendix II shall include: (a) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival; and (b) other species which must be subject to regulation in order that trade in specimens of certain species referred to in sub-paragraph (a) of this paragraph may be brought under effective control; and in accordance to the precautionary measures provided by Annex 4 of Resolution Conf. 9.24 (Rev. CoP14).

Based on the information provided in this proposal and according to the Biological criteria for Appendix I presented in Annex I of Resolution Conf. 9.24 (Rev. CoP14), the species is not considered to be threatened with extinction, because:

a) The wild population is not small, an it is assumed to form a single overall population estimated –at a strict minimum, with a global analysis protocol (Sanchez, in press)– at about 102,432 free-ranging individuals (ca. 19,462 adults);

b) The wild population does not have a restricted area of distribution. For Mexico, its distribution area was estimated at 396,455 Km^2 (see **Map 2**). When the Guatemalan Petén and Belize are added, the total extent of occurrence of *C. moreletii* adds up to more than 450,000 Km^2; and

c) The species does not present a marked decline in the population size in the wild and after 34 years of effective ban of the commercial capture in the wild in Mexico, the population of this species in the country has shown, at the beginning of the XXI Century, indices of relative abundance (ind/km) comparable to those known for other crocodile species globally considered as common.

According to the precautionary measures (Resolution Conf. 9.24, Annex 4), the species can be transferred to Appendix II in compliance with Paragraph 2b because it does not satisfy any of the Criteria in Annex I of the same Resolution and even though it is likely to be in demand for trade, its management is such that implementation of the Convention by Mexico is secured and appropriate enforcement controls are in place (see sections 7.1 and 8 of this proposal for detailed information).

B. Proponent

Mexico

C. Supporting statement

1. Taxonomy

1.1 Class: Reptilia
1.2 Order: Crocodylia
1.3 Family: Crocodylidae
1.4 Genus and species: *Crocodylus moreletii* Bibron & Duméril, 1851
1.5 Scientific synonyms: *Crocodilus americanus moreletii*

1.6 Common names:

Danish - Morelets krokodille
Dutch - Bultkrokodil
English - Belize Crocodile; Morelet's Crocodile
Finnish - Kyhmykrokotiili
French - Crocodile de Morelet
German - Beulenkrokodil

Italian - Coccodrillo di Morelet
Spanish - Caimán de Morelet; Cocodrilo de Morelet; Cocodrilo de pantano
Swedish - Moreletkrokodil

1.7 Code numbers

L-306.002.001.005

2. Overview

Crocodylus moreletii is widely distributed in the low sloped and coastal plain of the Gulf of Mexico, the Yucatan peninsula, Guatemala and Belize (e.g. only in Mexico, 202,169 Km^2 are considered suitable habitat for the species). Today, populations of this crocodile show evident signs of recovery. Considering development trends in Mexico, Guatemala and Belize, there are no elements to foresee any actual or potential destruction, modification or degradation of habitat with severity or magnitude comparable to those occurred since the XVI to the middle XX Centuries.

In Mexico, Guatemala and Belize, commercial exploitation of wild populations of *C. moreletii* is forbidden. Complementary to this important restriction, at least in Mexico, exists an abundant and robust captive stock of Morelet's crocodile (fully reproduced and raised in captivity), with potential value for eventual repopulation of areas as well as for commercial purposes.

Up to now, and for the whole range of the species, there is no indication that disease may deserve consideration as a threat for the continuity and future viability of wild populations of *C. moreletii*. Similarly, apart from natural predation known for the species (and present along all of its evolutionary history) there are no signs that predatory species, native or exotic, may represent a stress factor for Morelet's crocodile. Also, there is no indication that tourism, or scientific activity, may signify negative influences or significant threats for wild populations of the species.

Present-day legal regulatory mechanisms and law enforcement in Mexico, directly and indirectly applicable to *C. moreletii*, have resulted adequate and sufficient as shown by the recovery of its wild populations now supported by initial systematized field data. Recovery seems robust, as well as the legal framework supporting it. Equivalent legal systems in Guatemala and Belize lend further strength to the legal protection of the species in all of its natural range.

Even though the operation of industrial infrastructure located in natural landscapes of Mexico implies some interactions with crocodiles, negative outcomes of conflictive situations are seldom seen. Opposite to the attitude towards crocodiles during most of the XX Century, negative impacts of human conflict with crocodiles can be reduced thanks to an increasing citizen's good disposition for cooperation with environmental authorities. Most eventual human-crocodile conflicts are resolved by relocating animals.

In conclusion, the continuing existence of *C. moreletii* does not appear compromised by additional, natural or anthropogenic factors. High intrinsic capacity for recovery, now evident for the species, coupled with Mexico's efforts for its conservation, has yielded successful results. Removal of commercial capture in the wild as a pressing factor on the species, designation of more protected natural areas, and fostering of full-reproductive cycle farms have converged in the recovery of the species. This is attested by its confirmed presence in its whole geographic range (historic localities, localities where it was heavily hunted) with abundances comparable to those of other crocodile species considered as common.

Efforts for conservation in Guatemala and Belize also show promising results for the long-term conservation of this important reptilian species. Mexico will keep a steady pace towards this goal and will increase efforts, where and when needed, to ensure that extinction danger would not reach this species again.

Today, permanence of *Crocodylus moreletii* in Appendix I is no longer justifiable as results of field surveys and scientific analysis of compiled data support Appendix transfer approach.

3. Species characteristics

Field data on *C. moreletii* are now available in an unprecedented amount for Mexico from vigorous surveying efforts between 2002 and 2004 in representative portions of the whole distributional range of the species in this country. Results of scientific analyses have been produced, based on the above mentioned information pertaining to the wild population and its habitat, on specialized published information, and on field reports from areas outside Mexico. These initial results indicate that the global wild population of *C. moreletii* is not currently endangered or even threatened by extinction. It seems clear that *C. moreletii* is a species with high resilience since once commercial capture in the wild was removed, it was able to revert, in just three decades and mostly by itself, a condition of very low population originated by nearly 100 years of overexploitation.

The effectiveness of official protection granted by Mexico to the species, by means of a robust legal and administrative framework, is demonstrated by the consistent recovery of wild populations. That framework gives certainty about the future of the taxon. Besides Mexico has maintained a policy of creation of more natural protected areas and of active administration of those already in existence, many of which are of direct relevance for the conservation of *C. moreletii*. Also, it has created and reinforced an official system (SUMA) based on Units for Wildlife Management and Use (UMAs) for the control and regulation of captive reproduction of *C. moreletii*. The system requires complete reproductive cycle breeding for conservation and commercial use, and guarantees enhancing Mexico's population reserves for the conservation of this crocodile.

Existence of those captive breeding facilities also keeps an open possibility for sustainable economic development that further discourages capture from the natural environment. Strict Mexican regulations control commercial activity of captive-bred specimens. This enforces licit and transparent commercial operations since breeding facilities need to prove they are able to go beyond the second generation (F2) of reproducing individuals, at least one generation further. This is part of the conditions required for commercial use of captive-bred crocodiles and supports utilization consistent with conservation. On the other hand, existence of these intensive, closed-cycle captive crocodile farms, offers a bonus in the form of organized eco-tours to the facilities, with no impact on wild populations, but with potential for economic development, not only for farm owners, but for human communities in the vicinity based on secondary and subsidiary services to visitors.

There is evidence that information available for Guatemala and Belize would support, in general, conclusions recently derived for this taxon in Mexico.

3.1 Distribution

Crocodylus moreletii is a crocodile whose geographic range comprises the Atlantic drainage basin of Mexico, from central Tamaulipas south to Quintana Roo (usually in altitudes below 900 meters above sea level), practically all of Belize and most of northern and eastern Guatemala. Probably it could be find also in north-western Honduras (Smith and Smith, 1977). Its range in Mexico represents about 85% of the total geographic area it occupies (See **Map 1** Distribution of *C. moreletii*).

Map 1. General distribution of *C. moreletii*.

The distribution area of *C. moreletii* in Mexico was calculated by means of the GARP algorithm, on the basis of information linked to available field records of presence. It resulted in 396,455 Km^2 (see **Map 2**). When the Guatemalan Peten and Belize are added, the total extent of occurrence of *C. moreletii* adds up to more than 450,000 Km^2 (see **Map 1**).

Taking geographical data, field data reported by the COPAN Project, and some published information available for Guatemala and Belize, Prof. Oscar Sánchez, specialist in charge of the analyses, first applied a static model he had previously developed for attempting an initial estimation of the potential global population of *C. moreletii* (Sánchez, in press (a); Sánchez, in press (b)), as explained below.

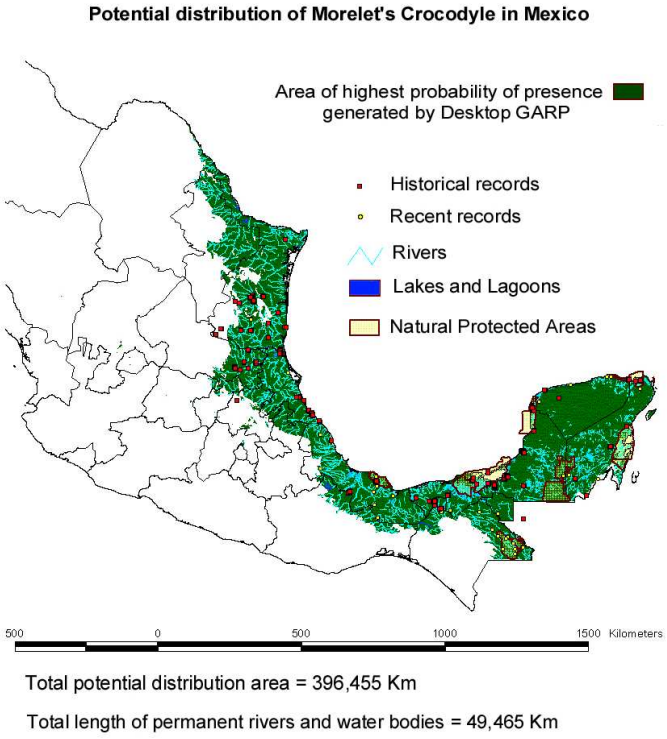
Potential distribution of *C. moreletii* in Mexico

For Mexico and with support of the computational infrastructure present at CONABIO, by means of the Desktop GARP software (Genetic Algorithm for Rule-set Prediction), a map of the area of highest probability of presence of *C. moreletii* was generated. The map was based on several environmental factors known for the recorded localities. The GARP area of highest probability resulted in 396,455 Km^2. Then, for the calculated area, a total length of rivers, and perimeters of freshwater lagoons and other water bodies were calculated with the aid of a Geographical Information System (GIS); this resulted in a first figure for potential habitat length of 106,707 km. Later on and as a first precautionary cut, shore lengths of intermittent water bodies were removed from the initial count, leaving only lengths of those documented as perennial. This resulted in 49,465 km. (see **Map 2**, Potential distribution of *C. moreletii* in Mexico). As a second cautionary cut to avoid undue overestimation, only the simple length of rivers was considered, entirely ignoring an equal length that would have been added if the opposite bank was also considered (despite the fact that it really exists and means additional potential habitat).

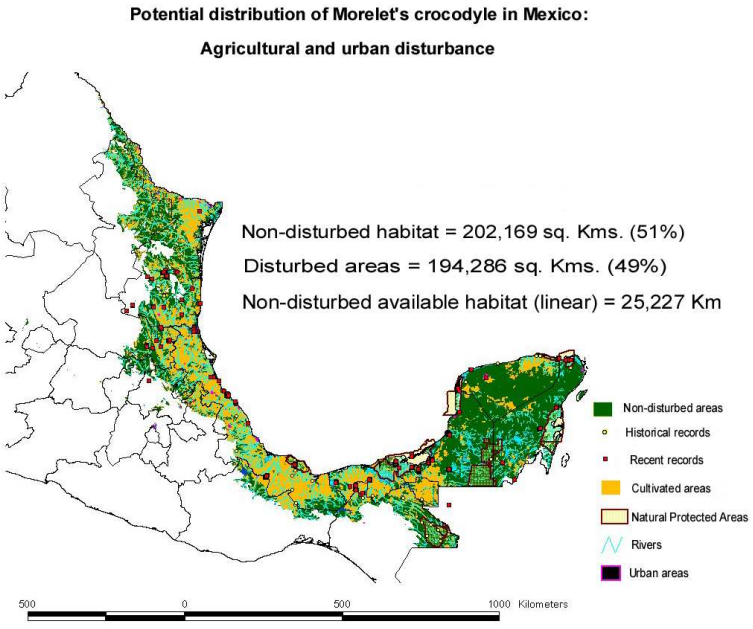
In order to produce an even more precautionary habitat estimation, a third cut was applied: the area actually altered by agricultural and cattle-raising activities was subtracted from the total GARP area. This resulted in an approximately 51% of the area still retaining original vegetation types (i.e. 202,169 Km^2). By analogy, applying the 51% proportion of conserved habitat to the previously obtained lineal measurements for perennial freshwater shorelines, it was inferred that at least 25,227 km would hold habitat suitable for *C. moreletii* in Mexico. This figure was utilized as potential habitat in the country, during subsequent calculations.

Since the COPAN Project has reported evidence of the persistence of crocodile populations even in altered areas, most probably the procedure of successive potential habitat length cuts means a significant underestimation of real habitat length for *C. moreletii* in Mexico, but this option was preferred to keep a

precautionary perspective throughout the analyses. (See **Map 3**, Potential distribution of *C. moreletii* in Mexico related to disturbance by agriculture and urban zones).



Map 2. Area of highest probability of presence of *C. moreletii* in Mexico (GARP). Raw length of rivers and other perennial water bodies present within the area amount almost 50,000 km (only the simple length of rivers was considered, leaving out the approximately equal length of the opposite banks; see below for explanations on further precautionary figure cuts).



Map 3. Yellow areas depict surfaces modified by agricultural and livestock raising activities, within the GARP area calculated for *C. moreletii* in Mexico.

Slightly more than half (51%) has remained with suitable habitat for the species. Analogously, applying an additional cut of 49% to the previously obtained potential habitat length figure (i.e. perennial bodies of water), slightly more than 25,000 km of habitat length were retained; see details in text).

3.2 Habitat

Crocodylus moreletii inhabits areas covered once by tropical forest and savannah, particularly those with slow-course water bodies (rivers or creeks), marshes and lagoons (Platt and Thorbjarnarson 2000; Platt 1996; Casas and Guzmán 1970). Its natural habitat frequently shows floating, submerge and emerging plants. Some fishermen had reported Morelet´s crocodile on salty water swamps, however, it cannot stand salty water for too long (Álvarez del Toro and Sigler 2001) and it's more common to find it on shallow stagnant fresh water (clear or muddy) or with poor movement and where sudden changes of temperature doesn't occur. Together with all the former, other characteristic frequently found on Morelet´s crocodile habitat is the continuous presence of aquatic and terrestrial preys (Ross 1998; Álvarez del Toro and Sigler 2001; Lee 1996 and 2000).

3.3 Biological characteristics

Small individuals consume mostly insects and arachnids, middle size crocodiles eat mollusks, fishes and crustaceans, while adults feed on reptiles, mammals and birds (Pérez-Higareda, *et al*. 1989; Pooley y Gans 1976). *C. moreletii* consume even catfish (Ictaluridae) and turtles, at least those on marshes (*Kinosternon sp*.) (Penny, 1991). Nevertheless, fishes comprise an important resource along the different stages of the crocodile's life, as well as the opportunistic consume of carrion.

The species reach sexual maturity between 6 and 8 years old, with an approximated total length of 1500mm, although according other experiences, it can be reached by younger individuals, as with 4 or 6 years old and 1350-1500mm (Domínguez-Laso, *et al.* 2004). Reproductive activity starts with the construction of the nest at the beginning of the rainy season (April-June) and it ends with birth during September-October. Morelet´s crocodile doesn't excavate it's nest, instead females collect and put together fallen leaves until they form a 1.5m-diameter and 90cm-hight mound. Some other authors mentioned 3m-diameter and 1m-hight mounds and even collective nests (Britton, 2005).

C. moreletii lay between 20 and 45 eggs, an average of 35 per nest (Britton, 2005), with measures around 6.8cm long and 4.1cm wide and hatching after 65-90 days (Álvarez del Toro, 1974). Females are the main keepers of the nest while incubation and they can help newborns left it, while both parents protect juveniles for some period against predators and even some other adult crocodiles (Hunt, 1975). Although longevity on the species is not well documented, unpublished data from captive and semi captive specimens indicates 30 years or more. For example, oldest individuals at *Laguna de las Ilusiones, Tabasco, México*, could be that old at the moment (2005).

3.4 Morphological characteristics

Morelet's crocodile can be distinguished from other Mesoamerican crocodiles by its incomplete and transversal series of sub-caudal scales. Adults present a clearly rounded tip of the rostrum (Smith and Smith 1977) and broadness of the later in its distal constriction is equal or minor than length from that point to the rostrum end (Meerman 1994a). The neck region has four or more post occipital scales and six or more at the back of the neck (Navarro-Serment 2004). Dorsal osteoderms are arranged in 16 or 17 transversal rows and 4 o 6 longitudinal. Scale rows at the limbs are even and flat. As pointed out above, tail has inserted scales at the ventro-lateral or ventral region between the complete transversal rows of scales that surround the tail. Adults had an ochre or yellowish-olive back, usually showing big black spots at the tail and at the back area, which in some adults can be entirely black. Ventral area is light with a creamy yellowish tone (Álvarez del Toro 1974). A thin and soft skin has made this crocodile desirable for commercialization.

Maximum size is reported between 3000 and 3400mm (Levy, 1991). However, most wild adults are less than 2 – 2.5m with an average of 1000 – 1500 mm. Experts form the COMACROM mentioned a maximum size of 3500mm with an average of 2000 – 2500mm and newborn are reported around 220-290 (Smith and Smith, 1977; SEMARNAP, 1999). Some other authors suggest for *C. moreletii* a maximum documented length of 4160mm (Pérez-Higareda, et. al. 1991) and a maximum hypothetic length estimated in 4980mm from a numeric growth model (Merediz, 1999).

3.5 Role of the species in its ecosystem

C. moreletii preys opportunistically on different sizes of animals -according to self size- as mentioned before. It is preyed upon more frequently at juvenile stages, by many birds and medium-sized mammals; adult-size best-known predator is the jaguar. Morelet´s crocodile facilitates many ecological processes, especially in smaller water bodies, where it regulates populations of fish and other species, fertilizes water with faeces, and transports vegetal and animal propagules, as well as micro-organisms, when in transit from one swamp to another.

4. Status and trends

4.1 Habitat trends

In Mexico, during the Spanish conquest in the XVI Century, the Gulf coast was among the first territories colonized. This brought about alteration of numerous areas in the states of Veracruz, Tamaulipas, and part of Tabasco, where massive dismounting of forests occurred for introduction of cattle-raising practices and more agriculture. Now, 480 years have passed since those events, and 51% of the area of extent of occurrence of *C. moreletii* (202,169 Km^2) remains with environmental conditions suitable for the species. Even more, within the 49% of the area subject to historical alteration, many places still bear populations of *C. moreletii*, as shown by data obtained by the COPAN Project (see **Map 3**).

Today, Mexican law has robust restrictions for changes in land use (e.g. the *Ley General del Equilibrio Ecológico y la Protección al Ambiente*; LGEEPA). This allows for the prediction that no significant reductions of the remaining 51% of good-quality habitat in the area of extent of occurrence of *C. moreletii* are expected and much less at magnitudes seen in the XVI to early XX Centuries (when nevertheless, the populations remained as abundant as high-scale commercial exploitation was profitable for unscrupulous persons until the first half of the XX Century).

More recent environmental alteration has probably produced some additional deterioration of populations of *C. moreletii*, but not comparable to those in the past. On the other hand, even in areas where changes to the original environment are not reversible, evidence points to a certain degree of tolerance by *C. moreletii*, especially when the causes are agriculture or low-technology livestock production.

In the last 60 years, industrial development in Mexico has required construction of infrastructure in some portions of the range of *C. moreletii* (e.g. oil wells in southern Veracruz and Tabasco, and thermoelectrical plants in northern Veracruz). Fortunately, starting in 1988 with the enactment of the LGEEPA, every new project has to fulfil strict protocols for the assessment of environmental impacts before it can be approved.

Development of conventional tourism facilities is also subject to that law and, fortunately, there is no evidence indicating that activity may have caused sensible alterations of areas inhabited by *C. moreletii*.

It is true that not all altered areas recover in a spontaneous way, but some do so. Besides, in many cases, conditioning restrictions for the development of infrastructure and economic activity have already had positive effects in Mexico, and responsible companies are actually taking steps –since at least 10 years– to achieve the restoration and compensation goals they have been legally imposed.

Citizens are also effectively improving their commitment towards timely detection and denunciation of illegal attempts of environmental modification. This means that environmental authorities have now a co-adjuvant for the dissuasion of illicit activities contrary to ecological ethics and to the law. Compliance of environmental protection starts with prevention, and Mexico has been actively focusing on this during more than 15 years by now.

In northern Guatemala, the Peten region is the most important stronghold for *C. moreletii*. According to Castañeda-Moya (1998), before 1960 the Peten was sparsely populated (15,000 to 21,000 human inhabitants were estimated for that time). Starting in 1961, an official program fostered colonization and this caused environmental alteration, as well as increase in human conflicts with crocodiles. The same author estimated that slightly above 50% of potential habitat for *C. moreletii* is now altered. Currently, some studies on the status of habitat and populations of *C. moreletii* are in course, and potential threats for habitat persistence are under assessment.

In Belize, virtually all of the country contained suitable habitat for *C. moreletii*. The style of economic development of that country, to date, has not required massive alteration of the natural environment; thus, in general, it can be said that no extensive and drastic alteration of the habitat of *C. moreletii* has occurred in Belize. Recently, the perspective for construction of a large hydro electrical dam, and its possible negative effects on biodiversity are under discussion in the country. Rather paradoxically, although projects of that kind imply undoubted threats for many components of biodiversity, for *C. moreletii* they could even mean a partially favourable factor, in terms of future habitat available in lowland areas.

Today, at least 202,169 Km^2 in Mexico keep offering suitable habitat. As a result of surveys carried out by Mexican experts in Mexico and based on numerical assignation system developed to evaluate five environmental components (relevant to the species concerned), the COPAN Project personnel reported in 24 (57%) of a total of 42 localities evaluated in various areas of the species' distribution in Mexico, habitat resulted apt for the crocodiles, and in 10 of them (24%) it even resulted excellent. Based on these data, a correlation analysis showed that, apparently, there is no strict relation between habitat quality and the number of observed crocodiles. In fact, COPAN found evidence indicative of continued presence of *C. moreletii* even in localities with intermediate or lesser habitat quality. This way, we emphasize that several types of environmental modifications are not automatic synonyms of local extirpation of *C. moreletii*.

Most frequent human activities, as reported by the COPAN field parties for those areas where crocodiles were seen between 2002 and 2004 were, in descending order of importance: fishing, livestock rearing, self-consumption hunting, conventional tourist facilities, agriculture, ecotourism, industry and urban development. Environmental changes such as those related with fishing and livestock rearing would appear as the least disturbing for *C. moreletii*, while others like industry and urban development would seem to be the most negative.

In the light of the facts explained above, it would not be expected that non-drastic present or future destruction, modification, or curtailment of the habitat or range of *C. moreletii* might present an important threat for the survival of the species.

4.2 Population size

Assumed to form a single overall population estimated - at a strict minimum, with a global analysis protocol (Sanchez, in press) - of about 102,432 free-ranging individuals (ca. 19,462 adults) and most probably with a chain-like genetic connection between extremes (Dever *et al.,* 2002), promoting genetic variability.

Evaluation of *Crocodylus moreletii* status in Mexico

Field surveys

Starting in 2000 and extending through 2002-2004, with support from Mexico's National Commission for the Knowledge and Understanding of Biodiversity (CONABIO), Mexico developed the "Swamp Crocodile Project" (COPAN), conducted by Jerónimo Domínguez–Laso and Luis Sigler. This project had two objectives:

a) To gather updated field data on the presence and relative abundance of *Crocodylus moreletii* in a representative portion of the whole geographic range of the species in Mexico; and

b) To gather new information suitable for habitat quality assessment in reference to this crocodile species, from a sample of localities widely distributed along its natural range.

Methods applied during the COPAN Project were those commonly accepted worldwide such as nocturnal surveys for crocodiles along river banks and lake shores, with the aid of lights (Sanchez, 2000), and choosing low or high intensity depending on the field conditions and visual-field width in each particular site (J. Domínguez – Laso and P. Ponce, com. pers.). For habitat assessment, a system based on point assignation to five components of the environment was employed. Point assignation was based on current knowledge of the biology of the species, and on the experience of field personnel; points for each

component were ultimately added up (Domínguez-Laso, *et al.*, 2004; Domínguez-Laso, in press). Sampling effort (**Figure 1**) was intensified in the two last sampling periods (dry "A" and rainy "B" seasons of 2004, respectively).

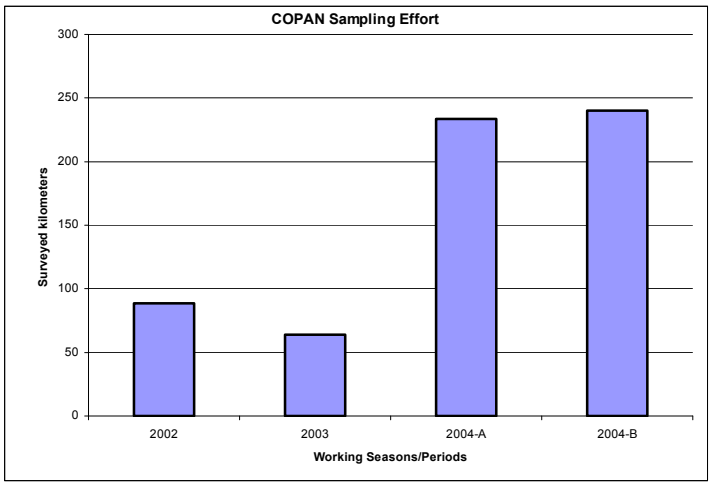


Figure 1. COPAN Project Sampling Effort

Geographic coverage

The COPAN surveys comprised ten Mexican States, for a total of 63 sampled localities within the whole geographic range of the species (see **Map 4**, which depicts recent records of *Crocodylus moreletii*).

Abundance indices of individuals

With the exception of an extreme case, a locality with an unusually high number of individuals per length unit (38 ind/km), indices of relative abundance of individuals (excluding the cited case) average 5.76 ind/km and have a Mode of 3 ind/km. See **Figure 2** (Abundance indices of *C. moreletii* recorded at 63 localities in Mexico).

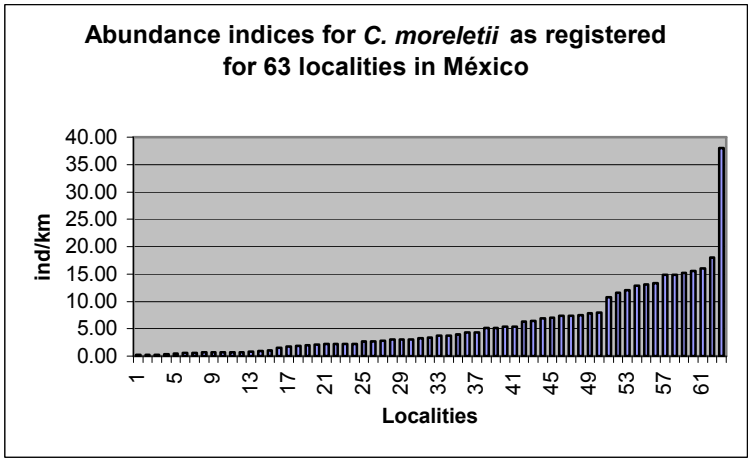


Figure 2. Relative abundance indices for *C. moreletii* as recorded by the COPAN Project

(Data from Domínguez – Laso, *et al.*, 2004).

Estimation of wild population size

Even though the distribution of data does not fit the normal paradigm, an attempt to calculate standard deviation sketched a confidence interval of 0.31 – 10.16 ind/km at the national scale. At least in

principle, this variation might reflect differences in crocodile abundance among the array of sampling sites, each of them with particular circumstances.

Considering average index values known for other common crocodile species (see next paragraphs), an initial, tentative assessment of the potential population of *C. moreletii* in Mexico using an average as high as 5.76 ind/km, could be expected to produce some overestimation (despite the three rigorous cuts previously applied to the estimated length of potential habitat). On the other hand, although the confidence interval was always kept in mind, estimating a potential population for Mexico with its lower limit would certainly underestimate any actual figure.

Thus, since the statistical Mode reflects frequency trends better than the arithmetic average, with the aim of producing a more realistic –yet precautionary– figure, the Mode of the sample of 62 localities was calculated as a guideline; this resulted in a value of 3 ind/km. If an index of abundance of *C. moreletii* for Mexico is computed with data reported by COPAN, the result is 917 individuals / 290 km = 3.16 ind/km. This value is very close to the statistical Mode, and was chosen for further calculations.

It is worth noting that, for many other crocodile species, values of abundance indices obtained with field methods comparable to those used for *C. moreletii* in Mexico, are not far from the figure we found: according to Ross (1998), *C. porosus* and *C. palustris* are among the crocodile species evaluated as in lower priority for conservation on a global scale. For *C. porosus*, with comparable methods, indices between 1 and 3 ind/km have been reported for Malaysia. For *C. palustris*, an index of 2.8 ind/km was informed for the State of Gujarat, India (Vyas and Vyas, 2002). Other species have been reported with indices as follows: 2 ind/km (*C. acutus* in Trujillo, Honduras; Cerrato, 2002); 2 - 2.1 ind/km (*C. novaeguineae* in Irian Jaya, Indonesia; Kurniati and Manolis, 2003); 0.3 – 4.7 ind/km (*A. mississippiensis* in the Everglades, Florida; Mazzotti *et al.* 2003).

Without any intention of making a strict, direct comparison, one cannot ignore the fact that the magnitude of the pondered general index of abundance of *C. moreletii* found in Mexico, based on data from 62 localities, is close to those reported from Belize (2.63), and from Guatemala (an average of 2.078). These not only compare favourably with indices known for lower priority species (Ross, 1998), such as *C. porosus* and *C. novaeguineae*, but also in some cases are slightly higher.

In summary, the pondered, general abundance index found for *C. moreletii* in Mexico, reinforces the precautionary perspective considered necessary for this initial, global population estimate of the species.

Considering all these elements, calculation of the potential number of individuals (of all ages) in the wild population of *C. moreletii* in Mexico yielded: 3.16 ind/km X 25,227 km = 79,718 individuals. Due to the three precautionary potential habitat cuts, and one additional cut made on the index, dragging it below the average, this figure is most probably an underestimation of the real number, but at least gives a departing point for further refinement, without being too optimistic.

Furthermore, an estimate of the potential number of adult *C. moreletii* in the wild in Mexico was produced. This was done analogously projecting the percentage of adults observed in the sample provided by the COPAN Project (for 63 localities, 19% were Class IV size >1500 mm, i. e. reproductive adults) to the gross population estimate. This gave 79,718 ind. X 0.19 = 15,146 estimated free-living adult individuals in Mexico.

These data indicate that the potential population estimated for Mexico, with data from representative portions of all distributional range of the species in the country is considerable. Keeping in mind the author's emphasis (Sánchez, in press (b)) about the indicative nature of the result he obtained, it is very encouraging since it rationally substantiates preceding conjectures (such as: in excess of 10,000 wild ranging adults; IUCN Red List online, 2007). Available evidence does not give elements for supposing current endangerment of the species in Mexico.

Data for Guatemala were treated with a procedure as similar as possible to that used for Mexico. Castañeda Moya (1998) informed that the Peten is the general area of presence of *C. moreletii* in Guatemala, and that there are a total of 13,389 km of river banks there, ca. 50% are altered (this leaves a figure of 6,694.5 km of potentially suitable habitat). On its turn, Lara (1990) mentioned several indices of relative abundance for the Peten; this author's report allows for the calculation of an average of five indices resulting in 2.078 ± 1.40 ind/km.

Thus, lacking enough data for calculating the statistical mode, the average was used. This yielded 2.078 ind/km X 6,694.5 km = 13,911 individuals of all ages, representing potential free-living population in Guatemala.

So, assuming that in Guatemala, similarly to Mexico, about 19% of that number are adults, an estimate of the potential adult population in the wild in Guatemala would be 13,911 X 0.19 = 2,643 individuals. Currently, we have been informed that more detailed studies are on their way, and that priority areas for the conservation of *C. moreletii* in northwestern Peten (where populations seem to be in best condition; Castañeda-Moya, 1998; and pers. comm., 2005) have been suggested.

For Belize, an average index of abundance, provided by Platt (1998), was of 2.63 ind/km. Lacking specific estimates of potential habitat length, some assumptions were made, as follows: a) Belize has an approximate area half of that of the Peten, b) Belize has a density of rivers and freshwater lakes similar to that of the Peten, and c) much as in the Petan and Mexico, ca. 50% of habitat length might remain suitable for *C. moreletii* in Belize. With these provisions and data, a potential habitat length of 3,347.25 km was calculated for the country. With the index value given by Platt (1998), the estimate of potential free-ranging population (all ages) was 2.63 ind/km X 3,347 km = 8,803 individuals.

Applying the generalized restriction of only ca. 19% adults are present in a given population within a sizable area, the estimate of potential adult population of *C. moreletii* in the wild in Belize is 8,803 X 0.19 = 1,673 individuals. In addition to the figures calculated by Sánchez (in press (b)), the Belize Zoo has expressed that the population of this species has recovered from a precarious state in 1981, thanks to the enactment and steady enforcement of the Wildlife Protection Act (Belize Zoo online, 2005).

With component figures for Mexico, Guatemala and Belize, arithmetically, the estimate of the global population of *C. moreletii* (all ages) would be of 79,718 + 13,911 + 8,803 = 102,432 individuals. On its turn, with figures currently available, the estimated potential, global adult population of *C. moreletii* resulted of 15,146 + 2,643 + 1,673 = 19,462 individuals.

In conclusion, rounding figures obtained with the best information at hand, a current, working estimate of the potential global population of free-ranging *Crocodylus moreletii* (all ages), is of slightly more than 100,000 individuals. In the same terms, a current, working estimate of the potential global adult population of *Crocodylus moreletii* in the wild, is of nearly 20,000 individuals.

Following recommendations of the researcher in charge of estimations (Sánchez, in press), the final figures should be considered as a reasonably acceptable departing point for an initial population assessment of *C. moreletii*, but not as a strict, unmovable reference. Thus, these results must be subject to future updating and correction, considering new field and geographic data as they appear. Another pertinent recommendation of the author is that special emphasis should be given to the improvement of monitoring protocols, seeking enhanced systematic and homogeneous application throughout the species' range.

4.3 Population structure

In a combined sample of individuals examined in the field, in Mexico, considered as indicative for the area occupied by the species, 34% were juveniles and 19% adults. Though only indicative, this result is encouraging since the most frequent class was that of juveniles (indicating a good recruitment level), and since adults (i.e. potentially reproductive individuals) were not scarce. From an also combined sample of individuals effectively sexed by the COPAN personnel, a sex proportion of 1.55 to 1 was found, biased towards males. This situation is not uncommon in published reports, as an extreme data was found in Belize, with a 5.3 to 1 proportion, favouring males, not yet explained, but apparently without indication of potential risk (Platt and Thorbjarnarson, 2000). Mexican experts considered it not to be of such magnitude as to be of concern.

4.4 Population trends

The same researcher who produced the population estimates described above (Sánchez in press (a) and (b)) also developed a first Population Viability Analysis (PVA). The Vortex program was used for that purpose (Version 9.42; Lacy *et al.*, 2003). A single, global population was modelled, of only 30,000 initial individuals since this is the limit of Vortex (an astringent scenario, given the fact that the actual

estimate is more than three times larger). Population extinction was restrictively defined as 500 animals remaining but incapable of maintaining a viable population (a much more strict condition as compared to, for example, only 100 individuals remaining or total depletion of individuals). Vortex was fed with current biological and ecological information for *C. moreletii*, including size and sex proportions, reproduction and others. Scenario was set for 500 years lapse, with catastrophe factors related to habitat alteration and decrease of prey availability, implying a progressive diminution of carrying capacity at 0.15% per year (i.e. a global decrease of 75% of the carrying capacity after 500 years).

As can be seen, the model included high stress (hardly probable in the real world, but allowing for worst-scenario predictions). For statistical significance, 500 runs of the population trajectory were performed (500 years of simulation, each).

Results of dynamic modelling described above indicate that probability of extinction, even as strict as was defined and for a global population just 1/3 of the actual estimate (which is the top initial population number that the software accepts to perform the modelling), and after 500 years, would be very low (0.1380 ± 0.0154, standard error). Seen the opposite way, probability of survival of a population of only 30,000 initial individuals, even under such high stress, would be considerably high 0.8620 or 86% (± 0.0154, standard error), which represents an encouraging indication.

Even in a scenario as unfavourable as the one designed for the model (much more restrictive than currently predictable in the real world), statistically, the surviving population at the end of the 500-year lapse would be ca. 1/6 of the initial 30,000 individuals (i.e. (4,626.37 individuals ± 124.77 standard error). Results of the PVA lead to conclude that a species with attributes such as those included in the model (i.e. known attributes of *C. moreletii*) is very resilient or it has high elasticity, which confers both resistance and capacity for vigorous population recovery.

In the model and after 500 years, statistically, genetic diversity remained very high along the 500-year period. Heterozygosity (=presence of different genetic alleles at the same chromosomal site) resulted high at the end of the period (0.9865 ± 0.0003 standard error); in fact, it almost remained at the maximum (1.0). This trend of keeping a high genetic diversity after a long period, together with factors mentioned before, underlie adaptability when facing environmental change and explain the great elasticity that has allowed it for the population comeback we are seeing.

The results obtained with this model for *C. moreletii* (Sánchez, in press (b)), are consistent with the current situation of the species: After 34 years of effective ban of the commercial capture in the wild in Mexico, the population of this species in the country has shown, at the beginning of the XXI Century, indices of relative abundance (ind/km) comparable to those known for other crocodile species globally considered as common.

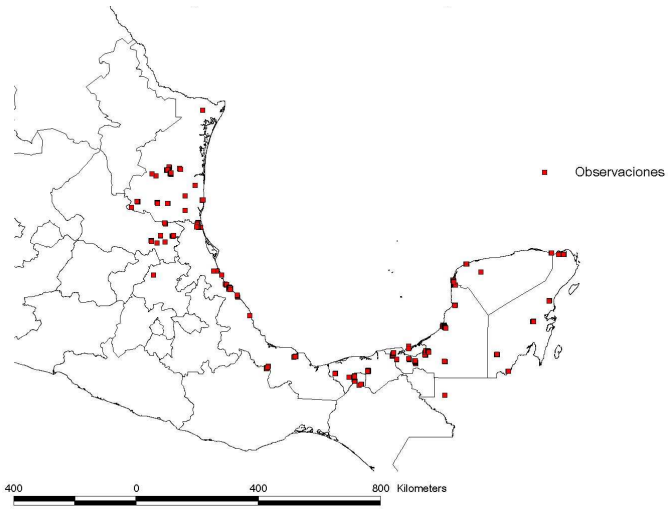
Considering that the current global population estimate for *C. moreletii* is more than threefold of defined as the initial population for the PVA model, if the later could have been run with such a number (ca. 100,000 individuals), the results would have been still more encouraging.

In fact, although one must actually admit that there are stress factors for *C. moreletii* in the wild, these are by far less severe than those imposed in the past by commercial capture. Furthermore, stress factors for *C. moreletii* in the real world are much less drastic than those included in the model, which may allow for a promising future for the species if conditions remain stable, and especially if these improve as it is desirable and possible.

These estimates of population size and probability of extinction should be periodically updated and corrected as needed, so as to maintain a current perspective consistent with any changes that might occur in the future. This calls also for progressive refinement of the models.

4.5 Geographic trends

As demonstrated by survey results of 2002-2004, the species remains present along its whole natural area of distribution and with reasonably high levels of abundance in virtually all of its distributional area in Mexico. This is valid even for those areas of the country historically known as of past overexploitation (such as Tabasco and Veracruz).



Map 4. Known localities for *C. moreletii* as of 2004.

Roughly from 1851 to 2002, *C. moreletii* was known from 105 localities in Mexico. The COPAN Project revisited a sample of 21.9% of these (in some cases after 154 years), and found the species present in all of them. Besides verifying the permanence of the species at these historic sites, 40 new localities were added to the gazetteer for *C. moreletii*, including a first state record for Queretaro. All these bring the total number of localities presently known for the species to 145 (Domínguez–Laso *et al.,* 2004).

5. Threats

The main threat to the species is habitat degradation, especially if it involves prey unavailability and eventual contamination of water bodies. Currently it can be estimated to be moderate in Mexico and Belize, and slightly more pressing in northern Peten, Guatemala.

At the moment, there is no evidence of any pathogen significantly affecting wild populations of *C. moreletii*. There are some findings derived from the isolation of potentially infective bacteria from this crocodile: micro-organisms found include enterobacteria such as *Klebsiella*, *Citrobacter*, *Salmonella*, *Proteus*, and others from the *Staphylococcus* group that, although apparently innocuous in healthy crocodiles, might turn opportunistically infective if a weakening of the immunological system of a crocodile occurs. However, to date, no losses of crocodiles in Mexico are attributable to these micro-organisms (Lucio *et al.,* 2002).

Natural predation on *C. moreletii* occurs mainly, as for many other crocodilian species, since the egg stage. Later on, juveniles remain highly vulnerable to several natural predators until (for *C. moreletii*) they are over 900 mm in total length. Up from that length few carnivores may prey on them and, in the adult phase of life, only large predators such as the jaguar may remain relevant for this crocodile (Álvarez del Toro and Sigler, 2001).

During juvenile stages, individuals of *C. moreletii* may be preyed upon by larger crocodiles; however, this tends to act as an early factor promoting population regulation and adult spacing. Agonistic interactions among adults seem to be reduced by this mechanism, especially in populations with too many adults. Where a steady state of age distribution, cannibalism usually remains at a minimum. According to available data, size class proportions in a combined sample of *C. moreletii* from Mexico do not provide evidence that cannibalism could be of concern.

On the other hand, no evidence exists that any exotic and/or invasive species, deliberately or accidentally introduced or that autonomously expanded its natural distribution range into the natural habitat of *C. moreletii*, could be a foreseeable threat for this crocodile species, either as a predator or as a significant competitor. Predation of nests and juvenile crocodiles thus far documented is related to natural predators. This is valid for all of the range of *C. moreletii* in Mexico, and probably also for Belize and Guatemala, and must be considered as part of naturally occurring ecological processes.

Even when there is some evidence that hybridization between *C. acutus* and *C. moreletii* is occurring, the current available information does not suggest there is a direct, pressing threat to *C. moreletii*. Evidence of hybridization is currently restricted to some areas in Belize and, as authors of a recent article pointed out (Ray *et al.,* 2004), no signs of this phenomenon have been reported outside Belize. On the other hand, these same authors felt that hybridization –if confirmed– would probably pose much less problems for *C. moreletii* than for *C. acutus*, if any. This is why hybridization was not considered a current threat for *C. moreletii*.

Natural phenomena such as hurricanes, in the long run, may tend to favour *C. moreletii*, because flooding allow crocodiles to move among lakes and even among basins, with consequent benefits for genetic variability and viability of the species (Dever *et al*., 2002). However, nests and eggs are potentially more sensitive to the violent effects of hurricanes. Given the ample distribution of the species, and its presence in most of its geographic extension of occurrence, only very local cases of temporal disappearance of ponds or *aguadas* during the dry seasons may be expected to cause temporal alterations, probably in terms of an increase in population density at adjacent permanent water bodies. Otherwise, at the global scale, evidence does not indicate that natural factors can pose a hazard for the continuity of the species in the long term.

Factors related to human activities, and of potential risk for *C. moreletii*, would currently be those related with the construction of oil infrastructure in swamp areas. In a secondary level, construction and operation of thermo electrical centrals may be cited. In a third place, the operation of chemical and transformation industries, if improper disposition of potentially toxic residual materials eventually occurs. On the positive side, as described in detail in the section on legal regulatory mechanisms, establishment and operation of these industries is now subject to strict compliance of the *Ley General del Equilibrio Ecológico y la Protección al Ambiente* (LGEEPA) and every norm linked to it. Supervision of these important aspects is responsibility of the Mexican law enforcement authority, *Procuraduría Federal de Protección al Ambiente* (PROFEPA), which pays close attention and maintains surveillance where it is most needed. Presently, there are instances of exemplary sanctions applied to offenders to environmental law, regardless of their private or official nature, and including imprisonment, pecuniary and/or damage compensation or restoration, as merits deserve according to the law.

In other perspective, land distribution has already concluded, and no government programs fostering colonization of new areas do exist at present. This makes new human settlements a minor threat. Rather than being surprised by human settlement growth, it the evident growth of crocodile populations is a matter of recognition. This is demonstrated by the analyses presented in previous sections of this document, and by the apparently increasing rate of reports of the presence of crocodiles by people living in areas where those animals had not been seen for decades.

Thus, although operation of infrastructure located in natural environments may have a potential for confrontation between humans and crocodiles, the new social attitude towards wild species promotes conflict solutions compatible with conservation.

6. Utilization and trade

6.1 National utilization

Until the middle of the XX Century, commercial utilization of this species was not subject to control in Mexico, Guatemala, or Belize. As a consequence, since 1970 concern about the natural populations had increased considerably. This motivated Mexican authorities to decree a total and permanent official ban to the commercial capture of wild individuals.

Commercial use.- Commercial over-exploitation of *C. moreletii* for more than 100 years (from the middle XIX to middle XX Centuries) was the main cause of its drastic population decline. As a factor of degradation it was far more severe than any reduction of habitat, because the capture of tens of thousands of adult animals a year for skins, reduced the reproductive capacity of wild populations in a significant way.

Currently, all commercial exploitation of *C. moreletii* in Mexico occurs, in a mandatory way, with animals actually born and raised in captivity (full reproductive cycle implied, and beyond the second generation) within administrative units designed as *Unidades de Manejo para la Conservación de la Vida Silvestre*

(UMAs[1]). In addition to the obvious benefits, this means for wild populations a diverting commercial pressure away from them and a tighter governmental control on commercial activity .

As for Guatemala, Castañeda-Moya (1998) stated for that year some illegal capture of *C. moreletii* in the Peten. However, he admitted that amount of such activity had decreased, as compared to the high level seen 25 years before. During certain months, fishermen increase their efforts in the Peten in response to demand for fish in local markets, and some incidental capture of *C. moreletii* in nets has been reported. In any case, this is not a large-scale phenomenon in terms of the low actual number of crocodiles accidentally caught. In general terms, the trend in Guatemala appears as one of progressive decrement of illegal capture.

In Belize, crocodiles are also given official protection, and this enhances positive expectations for *C. moreletii* against commercial capture and occasional poaching, depending on regular surveillance of areas with known occurrence of the species. The relatively small geographical extension of Belize makes effective surveillance a feasible enterprise. In any case, non commercial-scale capture is known to occur in the country.

Recreational use.- Few initiatives offering adventure tourism related to the Morelet's crocodile are known throughout the extent of occurrence of the species. In Mexico it may be occurring in an estimated of less than 0.01% of its range. No figures are known for Guatemala and Belize, but at least there are indications of interest in developing such endeavours. Be it as it may, far from being a source of concern, if responsibly managed in all three countries, these activities might represent an additional impulse for crocodile conservation and for economic development of rural communities.

Scientific use.- In Mexico, biological sample collection from wild species intended for scientific study is regulated by the *Norma Oficial Mexicana* NOM-126-SEMARNAT-2000. Mexican research institutions are required to comply with its terms and, when export of samples of any crocodile species is needed for study, promoters are required to behold the NOM-126 permit as well as an official CITES certificate with authorized tags for cases thus mandated by law and emitted by designated authorities. Foreign researchers wishing to export biological samples of crocodiles for scientific purposes are equally required to hold valid permits as explained above. According to available data, amounts of those export movements are relatively small, as can be seen in sources such as UNEP – WCMC, and in data available from Mexican authorities.

Scientific research on *C. moreletii* in Guatemala can be described as in a stage of consolidation, and most of it occurs within that country. No indication of over-utilization with scientific purposes is known for Guatemala.

On its turn, Belize has been an important centre of operation for several research projects, (mainly ecological and on genetics) focusing on *C. moreletii*. This has involved field and laboratory research. Export of biological samples of crocodiles for scientific study has strict official provisions and protocols, as can be seen in several research articles published in scientific journals about this crocodile species. Besides that, number of research projects has never been so high so as to imply any significant negative impact on wild populations of *C. moreletii* in that country.

It has to be noted that in Mexico, as in Guatemala and Belize, most scientific research on *C. moreletii* has focused on field surveys for the presence of this species, its relative abundance and habitat quality, none of which require removal of individuals. Research protocols followed so far, have been those accepted worldwide and do not involve significant alteration of their habitats and behaviour. On the contrary, impact of research activities related to this species have contributed and supported conservation measures.

All of the above-explained facts point out that, currently, no overexploitation of *C. moreletii* seems to occur either for commercial, recreational or scientific use.

6.2 Legal trade

[1] *http://www.semarnat.gob.mx/gestionambiental/vidasilvestre/Pages/sistemadeunidadesdemanejo.aspx*

From data on the international trade in crocodile skins for 1996-2006, available from UNEP-WCMC Trade Database (2007), referable to whole skins and excepting cuts and secondary materials, it can be seen that the world market of crocodile skins, equable to individuals, shows an increment from 1997 to 2000, and later an important downfall in 2002, to a level close to that of 1998 (ca. 1,100,000 individuals). Reasons for this trend are unclear, but far from revealing an expanding market, this behaviour suggests one with signs of depression. See **Figure 4, 5 and 6** for details.

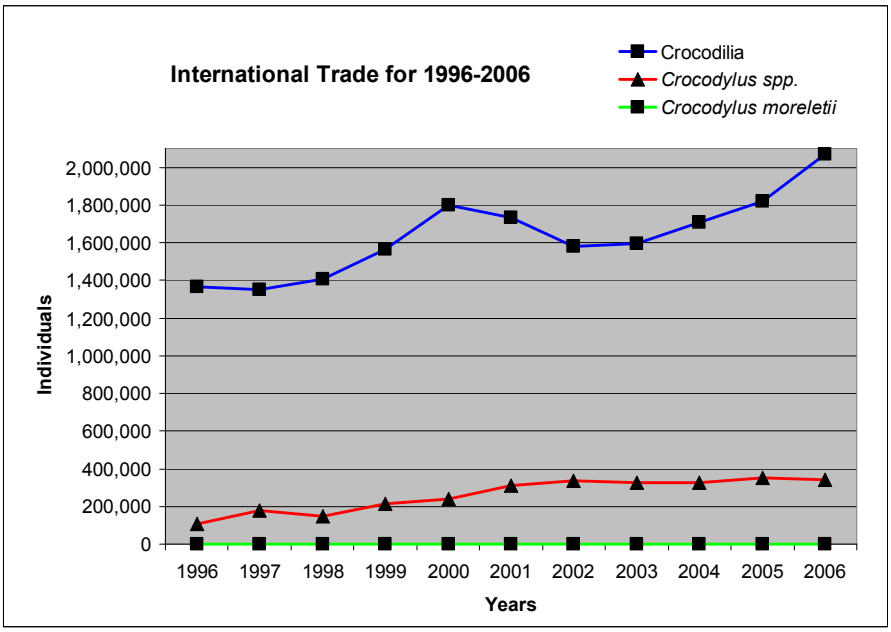


Figure 4. The world market related to crocodiles (source of data UNEP-WCMC, 2007) seems to have been passed through a steady increase in the late XX Century, a depression during 2000-2002 and another augment up to now.

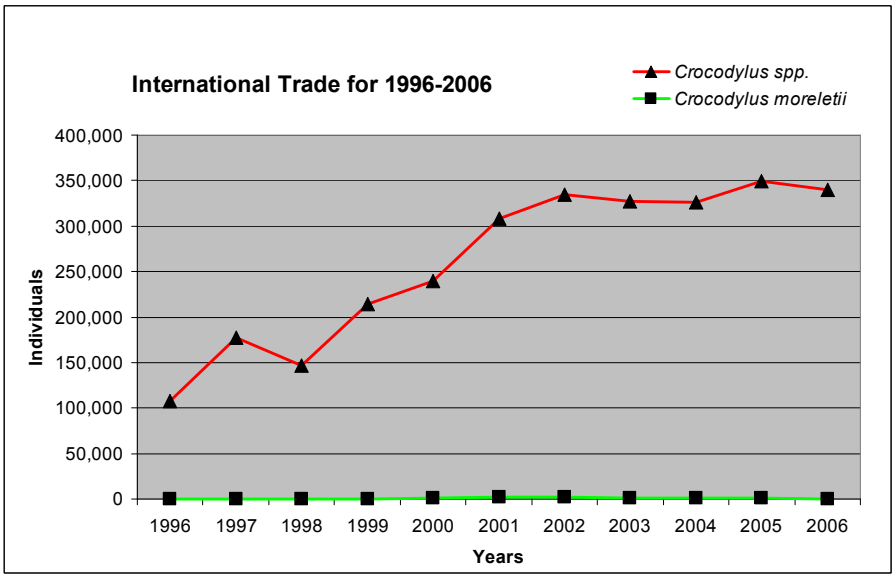


Figure 5. *Crocodylus* has shown a similar increasing pattern through XX and XXI Centuries shifting, though a relative stabilization since 2002 is observed.

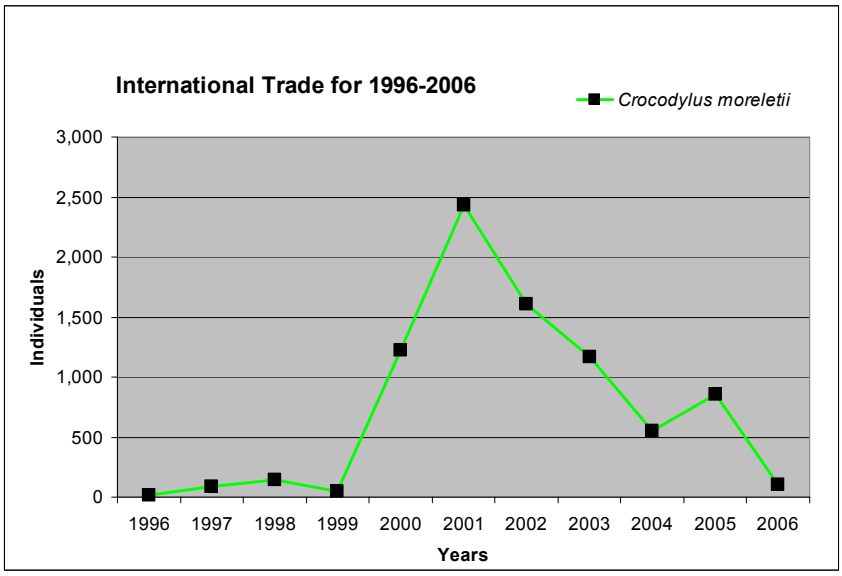


Figure 6. Out of *Crocodilia* and other members of its genera, *C. moreletii* maintains low commercial volumes and, out of an increase in 1999-2001, it shows a recent downward trend.

6.3 Parts and derivatives in trade

According to the UNEP-WCMC Database on CITES species trade (2006), parts and derivatives from *Crocodylus moreletii* more commonly found in trade are skins, skin pieces and leather products, but some other are specimens, eggs, bodies, scales, skin pieces, skulls, and shoes. The major exporting country during 2001-2006 was Mexico (3680 skins, 750 skin pieces, 392 small leather products), as Belize only exported 531 specimens with a scientific purpose to the United States of America. Major importing countries were Japan (3241 skins), Spain (266 small leather products, 159 skins) and France (154 skins).

6.4 Illegal trade

The UNEP-WCMC Trade Database on CITES species shows just a few illegal movements between 2001 and 2006 on parts and derivatives of *C. moreletii*, between Mexico (exporter) and United States (importer) mainly on leather products (7), shoes (4 pairs) and skulls (1).

As for Guatemala, Castañeda-Moya (1998) stated for that year some illegal capture of *C. moreletii* subsisted in the Peten. However, he admitted that the amount of such activity had decreased, as compared to the high level seen 25 years before. In general terms, the trend in Guatemala appears as one of progressive decrease of illegal capture.

Important research, collaboration and capacity building activities and agreements, including technical workshops, have taken place and are underway between Belize, Guatemala and Mexico in order to reinforce surveillance/inspection activities to prevent and minimize illegal wildlife trade that might persist through the borders.

6.5 Actual or potential trade impacts

International trade on *C. moreletii* is very low, which seemingly implies that no severe danger to the continuity of the species can derive from it. During the first half of the XX Century hundreds of thousands of skins a year were marketed; the current level is of about 8250 individuals in a 10-year period (ca. 825 ind/year). This means two orders of magnitude below the level of trade that threatened the species until 1970; plus, only captive-reared individuals are now legally allowed for commercial purposes in Mexico, Guatemala and Belize.

As can be seen if **Figure 7**, *C. moreletii* represents only a small fraction of trade in crocodilians at a global scale, qualifying to the lowest level, really far away from the market leaders: *Caiman crocodilus fuscus*, *Alligator mississippiensis* and *Crocodylus niloticus*.

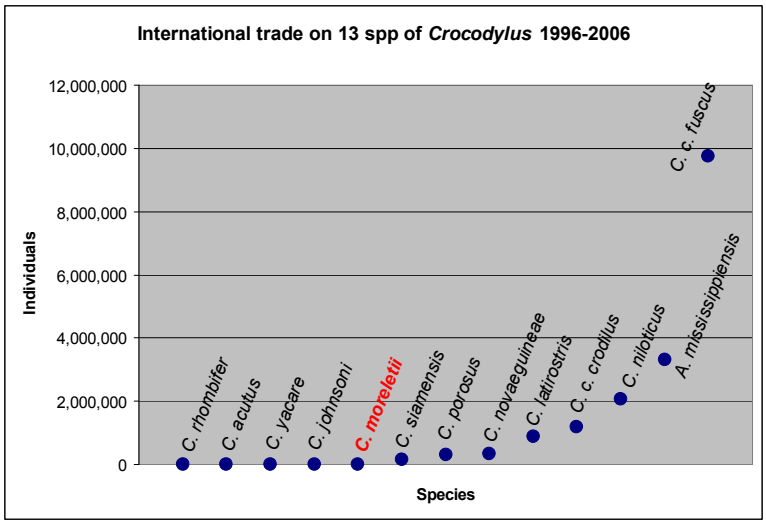


Figure 7. Current trade on *C. moreletii* would not be anticipated to represent a threat for the species, since the highest volumes of the world market correspond to taxa such as *Caiman crocodilus fuscus*, *Alligator mississippiensis* and *Crocodylus niloticus* (UNEP-WCMC, 2007).

Particularly for *C. moreletii*, skin trade originating in Mexico shows a diverging trend respect that of the global international market for crocodilians. This is, although it grew at the end of the XX Century, currently presents an apparent depression, as shown before in **Figure 6**.

From the aforementioned information, it can be concluded that current market trends would not seem to pose a threat, or an obstacle, for the recent recovery of the species in the wild. Besides, the capacity for captive production of *C. moreletii* in Mexico clearly surpasses the total demand known to date.

7. Legal instruments

7.1 National

Since 1970, and stimulated by the concern about the drastic diminution of wild populations of *C. moreletii* in the XX Century, Mexico decreed a total ban, of national coverage, for the commercial capture of all crocodile species. This ban had to be backed by effective presence and scrutiny of authorities in those areas previously known as of catch concentration and also, by surveillance in known centres of skin treatment and product confection and direct trade. Border port surveillance and law enforcement in general had to be reinforced to ensure the effectiveness of banning. A difficulty to fulfil the later was the enormous extension of Mexico where *C. moreletii* exists, which meant a formidable challenge for the conservation of this taxon. Despite this, results on field data gathered by the COPAN Project between 2002 and 2004 and their scientific analysis demonstrate an ample recovery of wild population. .

Coverage of official operations in law enforcement was not the only area considered. Mexico has promoted and developed, mainly since the last 10 years, a policy for continuous creation of new protected natural areas and maintenance of those already existing. Today, the National Protected Areas System (SINAP) includes at least 12 areas that pose additional protection to *C. moreletii* in an estimated 13% of its geographical range.

In spite recovery of the species being a reality, instead of assuming this comeback as a consummated fact, Mexico continues invigorating efforts towards law enforcement and continued improvement of existing legislation and administration. This aims to the widening of current protection of all wildlife species and their habitats, including *C. moreletii*.

This framework has been progressively covering more aspects on environmental matters (Brañes, 2002; INE, 1999; INE, 2000; PROFEPA, 2003; DGVS, 2002). In fact, since 2000, Mexico launched the *Programa de Conservación de Vida Silvestre y Diversificación Productiva en el Sector Rural*. This program defines the conceptual, strategic, legal and administrative framework to which any initiative for the use and conservation of wild species must strictly articulate. A special feature of this Program is that

attempts to grant clarity and certainty in the solution of human needs in rural areas, procuring conservation based on present-day paradigms about the sustainable use of natural resources.

For the special case of crocodiles and since September 1999, Mexico formed a technical advisory body, the *"Subcomité Técnico Consultivo para la Conservación, Manejo y Aprovechamiento Sustentable de los Crocodylia en Mexico* (COMACROM)". This is a multi-way consultant organ for Mexican wildlife authorities, especially focusing on the orientation of conservation programs, and notoriously considering *C. moreletii*. As explained at the beginning of this document, COMACROM includes scientists, technicians, non-governmental organizations, producers, all authorities involved, and other stakeholders. These experts periodically meet and analyze available information on Mexican crocodilians. Opinions emitted by COMACROM provide important guidelines that feed an adaptive management mechanism, supporting actions intended to consolidate the current, visible recovery of wild populations of Morelet's crocodile. COMACROM also participates in meetings of the IUCN-SSC's Crocodile Specialist Group (CSG) and contributes with papers for the Crocodile Specialist Group Newsletter, besides having official representatives at the CSG.

Conservation activities just described delineate current degree of integration of legal and administrative frameworks for conservation in Mexico. In recent years, this system has been reinforced by passing of Official Norms dealing with finer details of wildlife conservation, such as risk status determination of species in the Mexican territory. The *Norma Oficial* NOM-059-SEMARNAT-2001 had its immediate ancestor in the *Norma Oficial* NOM-059-ECOL-1994, which became updated with the addition of a scientifically based and officially approved method for determination of risk status of wild species (MER), explained in detail by Tambutti *et al.* (2001). Currently, NOM-059-SEMARNAT-2001 does not consider *C. moreletii* under threat, since all available evidence was considered as enough to demonstrate recovery of wild populations. However, characteristic precautionary stance of Mexican policy for the conservation of wildlife, invigorated during the last two decades, motivate the NOM to deliberately take measurements to ensure stability of present-day recovery of *C. moreletii* by taking the species under its custody and placing it under "Subject to Special Protection" (Pr) category (i.e. taxa not currently under risk, but of high interest for Mexican people so that they deserve to remain under the protection of the State to ensure their continuity and abundance). This specific measure allows the Mexican federal government an additional option to reinforce, maintain and innovate policies aiming to keep the steady pace of recovery and permanent protection for particular species such as *C. moreletii*.

As explained, Mexico has adequate regulatory mechanisms both in the law and its enforcement, to ensure the permanence of *C. moreletii* as a wild species viable to the future. The sufficiency of these mechanisms has been proven by the evident recovery of the species itself.

In Guatemala and Belize, respective environmental laws are in active process of furthering their coverage and improving effectiveness. This constitutes a most welcome support for the Mexican efforts, since complementarity among national laws in the international scenario is one of the key factors for success in conservation.

7.2 International

As mentioned before, the species was included in CITES Appendix I in 1975 and since, the Convention has proven to be very effective in control international trade of the species and in the prevention of illegal activities that could lead to detrimental activities on wild populations. This can be corroborated by the evident recovery of the species along its distribution range and the few reports of illegal trade in *C. moreletii* parts and derivatives reported by Parties. CITES provisions contained in Resolutions Conf. 11.12 and Conf. 12.10 (Rev. CoP14), related to the Universal tagging system for the identification of crocodilian skins and to the Guidelines for a procedure to register and monitor operations that breed Appendix-I animal species for commercial purposes, respectively, have settled the mechanisms needed to secure controlled international trade in crocodilian species and the conservation and recovery of *C. moreletii*.

8. Species management

8.1 Management measures

In this moment, Mexico does not have ranching operations involving wild populations. At this stage only full-cycle captive breeding establishments to export specimens are authorized and operating. However, the long term plans aim to support the establishment of ranching operations to promote *in situ* conservation; in order for that to happen there are still some issues that need to be taken care of, among them: conduct more in depth studies to have a better understanding of the crocodile populations in different areas, establish monitoring programs before ranching activities can initiate, have clear rules as to how to conduct these activities in a case by case basis, set up specific inspection programs to ensure these activities are conducted as needed.

Currently, there is an agreement between captive breeding operations and the Mexican government where captive breeding operations have the obligation to grant 10% of the offspring they produce to the government in case it is necessary to use them for reintroduction programs. Fortunately, this has not been necessary because of the current status of wild crocodile populations.

8.2 Population monitoring

Next to researchers presence contributing to supervision, monitoring is currently being developed in several areas of Mexico, as well as a sampling protocol with defined routes and systematized methods under a Trinational Strategy for the Conservation of *C. moreletii*, in order to be able to have a monitoring plan in place which generates data about population trends over time.

8.3 Control measures

8.3.1 International

The same concern on the status of Morelet's crocodile by the United States of America in the seventies, impelled *Crocodylus moreletii* inclusion in the Endangered Species Act in June 2, 1970 as an Endangered taxon (E). That measure gave effective support to Mexico's policy for the species protection at that time, since it acted in synergy with the Mexican ban also passed in 1970.

No other international measures, in addition to CITES and the U.S. ESA, are in place to control the movement of specimens of Morelet's crocodile across international borders.

8.3.2 Domestic

Mexico has several programs in place to prevent laundering of illegally taken specimens. As it has been stated before, "Mexico has created and reinforced an official system (SUMA) based on Units for Wildlife Management and Use (UMAs) for control and regulation of captive reproduction of *C. moreletii*. The system requires complete reproductive cycle breeding for conservation and commercial use, and guarantees enhancing Mexico's population reserves for the conservation of this crocodile. Strict Mexican regulations control commercial activity of captive-bred specimens. This enforces licit and transparent commercial operations, since breeding facilities need to prove that they are able to go beyond the second generation (F2) of reproducing individuals, at least one generation further. These are part of the conditions required for commercial use of captive-bred crocodiles and support utilization consistent with conservation".

The SUMA system is based on 6 basic elements, which are specified in the "*Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural*" (INE- SEMARNAT, 1997):

I. The register of the UMA through the Wildlife Division (*Dirección General de Vida Silvestre*; DGVS, SEMARNAT).

In order to submit a register of an intensive UMA (i.e., a captive breeding establishment), it is necessary to present the following information: type of land ownership of the UMA, scientific and common name of the species to be used, a proof of the legal provenance of the specimens in the UMA, and the UMA's objectives. A Management Plan for the UMA should accompany this application.

II. Adequate management of habitat

The use of Morelet's crocodile is only authorized in intensive UMAs, some of which contribute to habitat conservation. This may be through funding to support projects or through participation of their experts in conservation projects, which include conservation and restoration of habitat.

III. Monitoring wild populations of the species being used

Generally, the projects mentioned in the above point include population monitoring of the species concerned.

IV. Controlled use

For intensive UMAs, such as the captive breeding operations for *C. moreletii*, presentation of reports and periodic inventories is required. These should include information and register of births and deaths and their causes with their respective veterinary certifications, number and identification of traded specimens, as well as the management activities that take place in these establishments. This enables the DGVS to have a strict control of the specimens contained in the UMA, which in turn, makes the laundering of wild illegal specimens quite difficult.

V. A management plan approved and registered by DGVS

The management plan represents the conceptual and operative basis of the UMAs and should be presented by the technician responsible of the Unit. The plan should be directly related to the objectives and terms established by the current legislation. It is subject to a periodic verification and should guarantee the conservation of wildlife in it and its habitat, as well as the adequate use of the species.

It should also contain the basic taxonomy and biology of the species being used; physical and biological description of the UMA's area, infrastructure and location; specific objectives of the UMA; schedule of activities; management measures for the species (e.g., feeding, sanitary and reproduction programs); contingency measures, surveillance mechanisms; as well as measures and forms of use including the type of marks/tags for specimen identification, products and sub-products proceeding from the UMA.

VI. Certificate of production and marking/tagging methods

The certification and marking of specimens, products and sub-products is a central element for the functioning of the SUMA, because it establishes the necessary certainty frame to differentiate and combat the illegal trade.

They vary depending on the species and type of products and sub-products involved. However, each of these should be registered and authorized, which provides confidence to the consumer and to the authorities responsible of surveillance about the origin of each product. The UMAs have a serial register number that accompanies all its production.

For Morelet's crocodile there are two registered marking systems. The first one consists in inter-digital staples, while the other is based on the traditional marking of notches in the tail (which only some operations keep using). These marks are registered by the DGVS through the corresponding UMA inventories.

On the other hand, once the production cycle of the specimens is concluded and the use is authorized, the universal tagging system defined by CITES is utilized for leather exports. It consists in a plastic safety seal with the UMA's register code that CITES Secretariat provides, the species code, a consecutive number and the production year. The DGVS authorizes the elaboration of these safety seals.

When requesting a CITES export permit, the petitioners have to indicate the number of the authorized specimens to be used based on the inter-digital staples and the safety seal that will correspond to the leather. This way, the DGVS has a strict control over all the traded specimens.

On the other hand, there are several inspection programs that help prevent laundering of wild specimens and illegal activities concerning *C. moreletii*. The Authority in charge of environmental law enforcement in Mexico (PROFEPA) carries out several activities focused on wildlife protection. These include, among others, surveillance activities in marketing, exhibition and controlled reproduction/propagation sites and inspection activities in ports, airports and frontiers.

As a result of rigorous exercises related to strategic planning, PROFEPA started its "Program for Procuring Environmental Justice" in 2001. Partly, this program is conformed by the Inspection and Surveillance Program for the Enforcement of Environmental Legislation concerning the Use of Natural Resources, which is the main program related to wildlife protection. In addition, special operatives are carried out with the coordination of federal, state and municipal dependencies to verify law enforcement.

8.4 Captive breeding and artificial propagation

Since more than two decades now, Mexico has developed an important strategic complement with a preventive perspective: establishment and operation of full reproductive cycle crocodile farms –with proven beyond-second generation viability– has been actively fostered by the federal government. Currently, ecological legal dispositions of Mexico include the Wildlife Management and Conservation Units System (SUMA) mentioned above. In the case of Morelet's crocodile, these full-cycle farms have interacted with scientific research institutions, educational institutions with an interest on the conservation of the species, and have been supported, and in cases owned and/or managed by private investors wishing to support conservation through sustainable economic activity with the species. This has facilitated technical improvement of entirely captive reproduction with an eye on cost-benefit, which has advantages both for economically viable maintenance of a stock for eventual reintroduction and for legal commercial operations. Mexican law dealing with ecological and commercial aspects has direct applicability to such full-cycle crocodile farms.

Some of these farms have already attained capacity for medium-scale commercial operations, and a high organization level for keeping control of their procedures. This has earned them official certification by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The CITES still keeps *C. moreletii* within Appendix I (its original designation since 1975); according Article VII paragraph 4, specimens of that Appendix species bred in captivity for commercial purposes shall be deemed to be specimens of species included in Appendix II, but only if they are proven to come from entirely captive reproduction in certified farms and in accordance to Resolution Conf. 10.16, regarding regulation and trade of specimens of animal species bred in captivity. That certification implies the formal commitment of those farms for not supplementing their stock or otherwise exerting any trade with wild-caught specimens. Mexican authorities are especially vigilant on the fulfilment of obligations concerning any CITES certified wildlife reproduction facilities.

8.5 Habitat conservation

There are more than 21 natural protected areas in Mexico, offering secure harbour to *C. moreletii* in ca. 51,868 Km^2, as well as a strong legal and administrative protection and law enforcement. There are a couple of protected areas in the Peten, Guatemala for the species, and several in Belize with significant legal and administrative measures in the later and slightly less in the former.

8.6 Safeguards

According to the precautionary measures (Resolution Conf. 9.24, Annex 4), the species can be transferred to Appendix II in compliance with Paragraph 2b as it does not satisfy any of the Criteria in Annex I of the same Resolution and even though it is likely to be in demand for trade, its management is such that implementation of the Convention in Mexico is secured and appropriate enforcement controls are in place (See sections 7.1 and 8 of this proposal for detailed information).

9. Information on similar species

There are some species in trade that resemble *Crocodylus moreletii*, as could be *C. acutus, C. rhombifer, C. niloticus, C. novaeguineae* and *Osteolaemus tetraspis*. However, as pointed out before, Morelet's crocodile can be distinguished from other Mesoamerican crocodiles by its incomplete and transversal series of sub-caudal scales. Furthermore, Morelet´s crocodile presents six nuchal scales of similar size,

while all the similar species above mentioned show only four (*O. tetraspis*) or four bigger scales and 2 small (i.e. *C. acutus, C. novaeguineae, C. rhombifer, C. niloticus*). More detailed information with morphological characteristics, parts and derivatives in trade and identification keys on CITES crocodile species is already available at the CITES Identification Guide for Crocodilians (Environment Canada,1995). According to this guide, it is possible to distinguish between crocodile species similar to *C. moreletii* even without special training; distinctive characteristics could be easily observed in whole skins, which are the main products of Morelet´s crocodile in trade.

10. Consultations

The proposal covers only the Mexican population of *Crocodylus moreletii*.

11. Additional remarks

The Mexican strategy for recovery of wild populations of *C. moreletii* has three essential components:

- Complete prohibition of commercial capture in the wild, its supervision and strong law enforcement;
- Designation and stewardship of an increasing number of protected natural areas (ANPs) and their integration in the National Protected Areas System (SINAP) in such a way their permanence, stability and care can be guaranteed for the future; and
- Encouragement for productive activities that give primary and secondary support to conservation and to the effective sustainable use of the species, especially those implying continuous full-reproductive cycle captive reproduction.

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