CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Thirty-first meeting of the Animals Committee
Geneva (Switzerland), 13-17 July 2020

Species specific matters

Maintenance of the Appendices

Periodic Review of species included in Appendices I and II

PERIODIC REVIEW OF *TERRAPENE COAHUILA*

1. This document has been submitted by Mexico (Scientific Authority of Mexico – CONABIO).*

2. During the 29th meeting of the Animals Committee (Geneva, Switzerland, July 2017), in response to Notification to the Parties No. 2017/069, Mexico volunteered to assess the Coahuila box turtle (*Terrapene coahuila*) as part of the periodic review of species included in the CITES Appendices.

3. *Terrapene coahuila* is a microendemic species of the wetland system located in the desert valley of Cuatro Ciénegas in the State of Coahuila, Mexico. Its population has declined by more than 90% in slightly over 40 years. The current habitat suitable for the species amounts to 5.39 km^2, which represents only 0.6% of the Cuatro Ciénegas Protected Area. Its wild population is estimated to be less than 1,800 individuals, which are highly vulnerable to the desiccation of pools for the purpose of water use (mainly for agriculture and livestock farming).

4. The Coahuila box turtle has been included in CITES Appendix I since the Convention entered into force in 1975. Since 2009, no legal or illegal cross-border movements of individuals or specimens of the species have been officially recorded; therefore, international trade does not represent a threat to its survival.

5. After reviewing the status of the species, Mexico recommends that *Terrapene coahuila* remain in CITES Appendix I, in accordance with the following criteria of Resolution Conf. 9.24 (Rev. CoP17), Annex 1: A (i, iii, v), B (i, ii, iii, iv), C (i, ii).

---

* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

A. Proposal resulting from the periodic review

Maintain *Terrapene coahuila* in CITES Appendix I, in accordance with the following criteria of Resolution Conf. 9.24 (Rev. CoP17), Annex 1: A (i, iii, v), B (i, ii, iii, iv), C (i, ii).

B. Proponent

Mexico*

C. Supporting statement

1. Taxonomy

1.1 Class: Reptilia

1.2 Order: Testudines

1.3 Family: Emydidae

1.4 Genus, species or subspecies, including author and year: *Terrapene coahuila*

1.5 Scientific synonyms: No subspecies or synonyms

1.6 Common names:
English: Coahuila Box Turtle, Aquatic Box Turtle, Aquatic Box Terrapin, Coahuila Box Terrapin, Water Box Turtle
French: Tortue-boîte de Coahuila, tortue-boîte du Mexique
Spanish: Tortuga de Cuatro Ciénegas, Galápago Caja Mexicana, Tortuga Coahuila, Tortuga de Bisagra o Tortuga de Bisagra de Cuatro Ciénegas

1.7 Code numbers: 6708

2. Overview

At the 29th Meeting of the Animals Committee (2017, Geneva), Mexico volunteered to assess *T. coahuila* as part of the Periodic Review in accordance with Res. Conf. 14.8 (Rev. CoP17) during the period between CoP17 and CoP19.

3. Species characteristics

3.1 Distribution

T. coahuila is endemic to the wetland system of the Cuatro Ciénegas Valley, which is located in the Chihuahuan Desert in the State of Coahuila, Mexico. The Cuatro Ciénegas Valley has an area of 843 km^2 (Van Dijk *et al.*, 2007) and is shaped like an hourglass 50 km long and 8-24 km wide (Dodd, 2001); it is part of a protected area classified as a Protected Area for Flora and Fauna with a surface of 849.08 km^2. The estimated area occupied by the species is only 5.39 km^2, in the proximity of the wetlands (see **Figure 1**).

3.2 Habitat

T. coahuila lives in shallow wetland areas with a muddy bottom. It can spend time in the water but also on land; however, it is believed to spend close to 90% of its time (during the day) in muddy areas or

* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

directly submerged in shallow waters, at a distance no greater than 10 m from the pools. The species can travel between wetlands (Cueto-Mares *et al.*, 2017) and the vegetation in which it has been found to be most active includes associations of plants of saline environments such as *Distichlis spicata*, but also areas with denser vegetation composed of *Eleocharis caribaea* and *Scirpus maritimus,* among others.

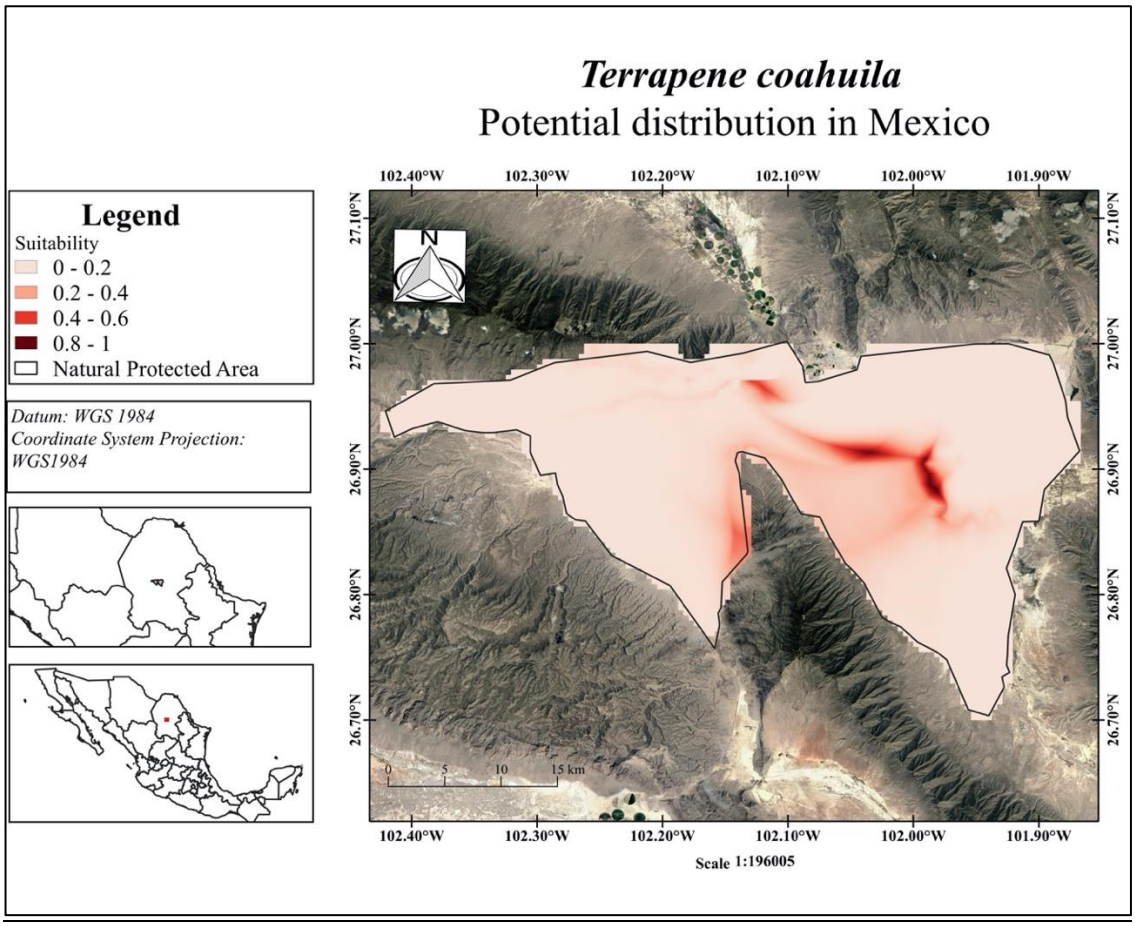

Figure 1. Potential distribution of *Terrapene coahuila* with different degrees of habitat suitability. Dark red areas are sites with favourable climatic and habitat conditions for the species; lighter areas are sites with less environmental suitability. The distribution was estimated using records of presence based on the surveys conducted by Castañeda Gaytán *et al.,* (2011, 2012, 2013, 2014 and 2015), records of the Mexican National Biodiversity Information System (SNIB-CONABIO, 2006), 11 bioclimatic layers (Bio 2, 3, 4, 6, 7, 8, 9, 12, 14 and 15, established by Cuervo-Robayo *et al.,* 2015), and the terrain elevation data for building the model. Layers with an autocorrelation (Pearson's r) greater than 0.75 were eliminated. The model was generated using 75% of the data, and the remaining records of presence were used to validate it. We considered 500 iterations and ran 10 replications of the model, of which we chose the one with the highest area under the curve. The area under the curve of the model selected was 0.94; the variables that contributed the most to the model were elevation (31.2%), isotherm (26.6%) and precipitation in the coldest four months (18.5%)].

3.3 Biological characteristics

Habitat preference: Although the Coahuila box turtle belongs to one of the genera with the greatest preference for terrestrial habitats among the close to 60 species of the Emydidae family (Seidel & Ernst, 2017), this species is predominantly aquatic.

Diet: It is an opportunist omnivorous species; it feeds on small fish and arthropods, although in the wild it mainly consumes plant matter, true flies (Diptera), dragonflies and damselflies (Odonata) and beetles (Brown, 1974). Based on studies conducted by Brown (1968) and Howeth and Brown (2011), the plant matter found in the stomach contents of the species consisted of the following: *Eleocharis rostellata* (64%), mushroom remains (15%) and *Chara* spp. plants (11%). As regards animal matter, Diptera larvae were found in 64% of the stomachs, while crustaceans, spiders and small fish were present at low frequencies. There is no evidence of seasonal or ontogenetic variation in diet composition; in fact, it is thought that the species' diet may be flexible to adapt to food availability.

Dispersal: As regards the species' movements, it has been established through a telemetry analysis that adult individuals can travel distances greater than 800 m in one day as a part of their home range

requirements (Becerra-López, data in prep.). They can even travel across dry terrain, and there does not seem to be a marked difference in the distances travelled by males and females. Historically, the species has shown considerable local dispersal (Howeth et al., 2008). Genetic information suggests that it has managed to travel enough to have a homogeneous genetic structure; however, there are indications of limited dispersal in certain areas in the various systems of the wetland. These limitations may increase due to the desiccation of the Cuatro Ciénegas Valley and could lead to a loss of genetic variability and the extirpation of certain populations (Howeth et al., 2008).

Life history: Its life history is relatively slow, as happens with many species of turtles (Stephens & Weins, 2003). The average estimated life span of the genus is 32 years. Records of longevity for turtles of the genus *Terrapene* range from 138 years (*Terrapene carolina*; Nigrelli, 1954) to 40 years (*T. ornata*; Blair, 1976, Converse *et al.*, 2005).

Reproduction: Individuals reach sexual maturity at a length of ~ 90 mm; minimum size of maturity is recorded to be 93.1 and 90.7 mm for males and females, respectively (Brown 1974), which is estimated to be equivalent to 15 years on average (Howeth & Brown, 2011). Although there are records of seasonal reproduction from September to June, the highest mating activity has been observed in March and April, with some copulation observed in November and December. This suggests almost continuous reproduction, with peaks in certain months of the year. Copulation takes place in shallow waters, so that both the male and the female have the possibility of coming out to breathe (Brown 1968). Oviposition probably occurs from late April-early May to early September. Nests are made on the banks of pools or among rushes. It is estimated that females can lay up to 3 clutches per year, with a clutch size of 2.3 eggs on average, although in larger females clutch size can be larger, reaching up to 4 eggs (Brown 1974; Howeth & Brown, 2011). The incubation period ranges between 65 and 70 days (Legler 1960, Brown 1974). Eggs hatch in different months of the year – usually from September to November – depending on whether it is the first, second or third reproductive event of females, although hatching is generally associated with abundant rainfall events (Brown 1968). Sex of hatchlings is related to temperature: temperatures of 26-27 °C produce males, and temperatures of 28 °C produce females (Bauer & Jesser-Häger 2006).

Captive breeding: In captivity, there are records of individuals mating all year round, except in the months of October, January and February (Brown, 1968). When conditions are favourable, Brown (1974) suggests that mating can occur all year round. Barnhart and Putnam (2019) report that oviposition takes place at the beginning of summer on moist substrate (e.g., gravel, sand) near vegetation and normally in the evening (Cerda & Waught 1992, Bauer & Jesser-Häger 2006). The mean incubation period recorded is 46.3 days in an incubator (Bauer & Jesser-Häger 2006). There are guidelines and examples available to breed the species in captivity (Meijer 2007; Barnhart & Putnam, 2019).

Survival: Field surveys conducted between 2009 and 2015 were only able to record the presence of three hatchlings with a carapace length of less than 40 mm (Castañeda-Gaytán *et al.*, 2013, 2014, 2015). The species is presumed to have low survival at early life stages based on the few observations of hatchlings and the frequent observation of nests with signs of predation.

3.4 Morphological characteristics

Lengths reported for *T. coahuila* in the literature suggest sizes of 159 and 168 mm for females and males, respectively (Iverson, 1982); however, recent studies not published yet reported carapace lengths of 150.9 mm in females and up to 184.8 mm in males (Castañeda, pers. comm.). The colour of adults is typically a dull olive-brown, whereas younger individuals are more greenish but also dull-coloured. The plastron is yellow with some darker markings and has a well-developed hinge in its anterior part that divides the second posterior lobe (Brown, 1971). The anterior lobe is 68% shorter than the posterior lobe. The hinge is opposed to the fifth marginal scute (M5). The ratio of shell depth to carapace length is lower in males than in females (Lemos-Espinal *et al.*, 2015). The phalangeal formula is 23332 in the front and hind limbs, with claws in four digits in all limbs (Williams *et al.*, 1960). Adult individuals generally exhibit pronounced sexual dimorphism: males are larger and heavier; the iris of males is darker and brown, while that of females is lighter coloured, in a range of yellow tones (Brown, 1974); and adult males have a plastral concavity and a thicker tail at the base and a longer tail relative to females.

Figure 2. Specimen of *Terrapene coahuila*. (Photo by Gamaliel Castañeda)

3.5 Role of the species in its ecosystem

The Coahuila box turtle is a prey of various species of small and medium-size mammals (mainly raccoons, possums and skunks). However, it also predates on several species of fish, snails and other invertebrates (Brown, 1968). As long as the water levels allow it, it contributes to maintaining a continuous water flow in channels between pools or smaller wetland systems, which promotes the flow of individuals (i.e., fish and aquatic invertebrates) between wetlands, with an impact on the dispersal of genetic material and the distribution of species, some of which are endemic (Howeth *et al*., 2008).

4. Status and trends

4.1 Habitat trends

The habitat is being degraded due to human use. The use of water – which is closely associated with the distribution of the species – for agricultural purposes, excessive tourism and the diversion of the natural course of several water bodies have contributed to the deterioration of the Valley and to a considerable reduction in the water level of wetlands (SEMARNAT, 1999; Souza *et al*., 2007).

No assessments of changes in land use have quantitatively determined the amount of wetland loss that has occurred in the Cuatro Ciénegas Valley. However, there is qualitative and photographic evidence of the reduction and desiccation of wetlands for the construction of wells to obtain water for agricultural purposes (e.g., the aquifer of the Hundido Valley (Annex 2) located 55 km south west of Cuatro Ciénegas, and also north of the town of Cuatro Ciénegas in the area known as “Cañón de la Calavera” in the same protected area). Other wetlands in the Valley have also experienced changes due to the construction of canals and water pipes for irrigation. To a large extent, the whole aquatic system of the protected area has been altered directly or indirectly (Ibarra-Flores, J. C., pers. comm.).

4.2 Population size

Few research studies have been conducted on *Terrapene coahuila*. Yet, data collected between 1964 and 1967 suggested a population density of 133-156 ind/ha (13,300 – 15,600 ind/km^2) in some sites at the foothills of the Sierra de San Marcos y Pinos; these wetlands are currently dry (Brown, 1974). It is important to note that Brown (1968) reported populations greater than ~ 148.2 ind/ha (14,820 ind/km^2) in a site located at the foothills of the Sierra de San Marcos y Pinos. At present, the density estimated by Castañeda *et al.* (2011, 2012, 2013, 2014 and 2015), essentially in the (wetland) site of Los Gatos, was only 3.1 ind/ha (310 ind/km^2). This site is located in the central part of the second segment in the east of the protected area polygon and is a permanent wetland with areas with little annual variation in water levels and seasonally flooded areas that are normally a good habitat for the species.

4.3 Population structure

The Universidad Juárez del Estado de Durango (UJED, Juárez University of Durango State) has provided data on the population structure of the species (Castañeda Gaytán *et al.*, 2011, 2012, 2013, 2014 and 2015). The following sex ratios were reported: 1:0.5 in 2011; 1:0.7 in 2012; 1:0.44 in 2013, with 2% of individuals of undetermined sex; 1:0.63 in 2014, with 10% of individuals of undetermined sex; and 1:0.85 in 2015; the overall sex ratio estimated for the population was 1:0.6, which shows a slightly male-biased population structure. It was also highlighted that, in all the years surveyed, the proportion of immature individuals was lower than 20%. According to the sizes reported by Brown (1968), the population structure consists of a majority of adult individuals, but it is unknown whether this reflects the fact that immature individuals are present but not easy to find in the surveys or rather a particular case of low recruitment rate for the species (Howeth *et al.,* 2008; Castañeda-Gaytán, 2013).

4.4 Population trends

The density estimated by Castañeda et al. from 2012 to 2015 in the wetland of Los Gatos was only 3.1 ind/ha (that is, 310 ind/km^2), in contrast with the density estimated by Brown (1968) in a site at the foothills of the Sierra de San Marcos y Pinos, where densities of 148.2 ind/ha (1,482 ind/km^2) were reported in 1968. This suggests a population decline of 98% over the last 50 years with an annual loss of 3.224 ind/ha (322.4 ind/km^2). The approximate distance between survey sites ranged between 12 and 16 km, and in 2011 those sites were found to be totally dry (Howeth & Brown, 2011). An extrapolation of the density reported by Castañeda *et al.* (in press) to the area suitable for the species estimated this year (539.76 ha, see Section 3.1) yields an estimated population size of 1,740 individuals of Coahuila box turtle in its entire range. If this trend continues, the species may become extinct in the next few decades. It should be noted that there is no record of captive breeding populations in Mexico.

4.5 Geographic trends

The above-mentioned disturbances (see Section 4.1) have led to a ~ 40% decline in the range of *T. coahuila* (Van Dijk *et al.*, 2007) over a 40-year period (1960-2002). Recently, the potential area of distribution of the species was estimated to be 7.2 km^2, which represents only 0.85% of the total area of the valley (Salas *et al.*, 2011). There is no approximate figure of the proportion of the valley that used to be flooded before the creation of the canals, so it is difficult to quantify the area of wetlands and habitat for the species that has been lost.

5. Threats

Loss of wetlands resulting from intensive use of the aquifer: there is considerable overexploitation of water resources within and outside the Cuatro Ciénegas Valley, where there has been an increase of irrigation canals, diversion of water flows and extraction of groundwater (Souza *et al.*, 2006); the purpose of all these activities is the irrigation of agricultural crops (95%) and human consumption to a lesser extent (Dijk *et al.*, 2007). In 2018, the wetland was reported to have an annual water deficit of 7.59 million cubic metres, which may in fact be 14 million if the irregularities reported by the NGO Pronatura Noreste (2018) are considered. This excessive use affects the species, since there is a direct relationship between its distribution and water bodies; the reduction in the size of water bodies and related vegetation leads to a decrease in the habitat of the species, and desiccation automatically means a loss of the habitat available for the species. This loss of wetlands and habitat has increased over the last 50 years with the growth of industrial agriculture (Contreras, 1984; Souza *et al.*, 2006).

Tourism: for many years now, tourism in various areas and wetlands where the species is known to occur is very intense. Some sources report over 18,000-20,000 visitors a year, which generates deforestation, pollution, crowds and overall disturbance (García-Gutiérrez & López López, 2017). Since 2002, the Mexican National Commission for Protected Areas (CONANP, Comisión Nacional de Áreas Naturales Protegidas) has organized several actions to subsidize projects related to tourism. However, due to the increase in demand, the integrity of the use and conservation of the area has not been consolidated yet.

Illegal harvest of specimens: this is mainly for use as pets and for sale on the illegal market. This happens due to the large presence of tourists in areas that are part of the range of the species and the fact that the animals are easy to capture.

Intrinsic factors of the species: long life span, high mortality at juvenile stages and climate change (i.e., long periods of drought and reduction of wetlands due to lack of recharge, susceptibility to temperature increases, which determines the sex of the hatchlings [Bull *et al*., 1982]).

6. Utilization and trade

6.1 National utilization

Currently, there are no known uses of the species on a national level, possibly because it is not attractive for the pet trade due to its inconspicuous appearance. However, it is not uncommon for the species to be captured by tourists and residents of the area to be used as a pet.

The cultural and economic significance of *T. coahuila* has grown because it is considered a flagship species of the Cuatro Ciénegas Valley. It has been well studied thanks to the support from governmental and other sources, which has led to activities aimed at raising public awareness of the plight of the species and also at conserving the species and its habitat.

Efforts are currently underway to breed the species in captivity; according to Meijer (2007), it is bred for educational and collection purposes but not for commercial purposes. The Association of Zoos & Aquariums (AZA) is also making efforts to breed the species for conservation purposes (AZA 2012; Barnhart & Putnam 2019).

6.2 Legal trade

Use: The only legal way to use and trade in specimens of this species in Mexico is through Wildlife Management and Conservation Units (UMAs, Spanish acronym, see Section 7.1.). There are currently only two intensive UMAs (breeding operations) that breed the species, both outside its range: the herpetology laboratory of the National Autonomous University of Mexico (UNAM) and a private breeder (both in the State of Mexico) and there have not been any applications to use the species so far.

Exports: The UNEP-WCMC/CITES database contains records of cross-border movements between 1981 and 2008, most with source codes “C” (bred in captivity) and “F” (born in captivity), and some with purpose code “B” (breeding in captivity), according to CITES definitions. As regards exports from Mexico (MX), the only record is the legal export of 300 samples of scutes (shells) reported as wild (“W”) to the United States for scientific purposes (“S”) in 2005. In addition, 164 wild (“W”) specimens were re-exported in 2007 from the United States (US) to Mexico (MX) for scientific purposes.

Most of these movements were exports of live specimens from other countries, mainly the United Kingdom (GB) and a territory under its administration (Jersey, JE), which reported the following exports from 1991 to 2007: a) 117 live specimens from GB to US and Bulgaria (BG), and b) 36 live specimens from JE to Germany (DE), GB and US. Jersey has been the main exporter of live specimens since 2001, with source codes “C” and “F” and purpose code “B” (breeding in captivity). As regards purpose code “T” (trade), the export of two live specimens was recorded from China (CN) to France (FR) in 2008 with source code “C” and also that of 25 live specimens (source code “C”) from GB to US in 1993.

According to the information provided by the Scientific Authority (SA) of the United Kingdom, the SA authorized the import of five specimens from the Jersey Zoo: one frozen body (source code F, purpose code S); three live individuals (two females and one male) born in 1981 at the Dallas Zoo, whose wild parents had been acquired in 1970 by a private collector and imported for the purpose of conservation breeding (B) under the European breeding program managed by EAZA, the European Association of Zoos and Aquaria, and a live male born in 1996 at the Jersey Zoo whose parents were two individuals born at the Dallas Zoo in 1981.

International

According to Meijer and Zwartepoorte (2010) and Pritchard (1995), several groups or individuals outside Mexico (e.g., in the United States, the Netherlands, Germany and the United Kingdom) currently own or used to own specimens of *T. coahuila*. It is not known whether the entire founder stock was obtained legally, although according to the records of UNEP-WCMC/CITES (see Section 6.2), the parental stock was harvested in pre-Convention times. Moreover, the information provided by the Scientific Authority of the UK and the studbook provided (Meijer 2007) show that most individuals in Europe originate from the same pre-Convention parental stock that later bred in captivity.

6.3 Parts and derivatives in trade

Both the legal and illegal specimens that have been observed in trade are generally live individuals and to a lesser extent scientific samples of scutes of the carapace.

6.4 Illegal trade

National:

– Due to the dull appearance of the Coahuila box turtle, the targeted search of these animals is relatively low and their use is mainly as pets. According to researchers and hobbyists, the species is occasionally harvested because of its singular traits, that is, being the only species in the genus with aquatic habits and having a very restricted distribution.

– The Mexican agency in charge of environmental law enforcement (PROFEPA) reports that it has not recorded any illegal movements of the species in the country for at least 18 years.

– Tourism is a major activity in the range of the species, and there may be illegal collection by visitors (tourists) or wildlife harvesters in a discrete and occasional way.

– There are informal accounts of people who report having illegally collected some individuals in Cuatro Ciénegas (Castañeda-Gaytán, pers. comm.); yet, it is not always possible to determine which species was harvested, as interviewees sometimes describe species with aquatic habits (similar to the Coahuila box turtle), while on other occasions the descriptions could match the Texas tortoise (*Gopherus berlandieri*).

International:

– According to PROFEPA, the Mexican law enforcement agency, there are no official records of exports of *T. coahuila* from Mexico during the period from 2000 to 2018.

– The UNEP-WCMC/CITES database includes records of two illegal transactions (“I”) in 1984, both from Mexico to the United States.

– On 22 August 2018, a Spanish newspaper (EcoDiario) reported the seizure of over 1,100 turtles of 62 different species that were being transported by an organization devoted to illegal wildlife trade; one of the individuals was presumed to belong to the species *T. coahuila* (EcoDiario, 2018).

6.5 Actual or potential trade impacts

Although harvest of specimens from the wild is low, its scope and impact are unknown. Even if it were feasible for the species to be traded for use as a pet, its current status regarding distribution, abundance and threats to its habitat do not make it appropriate to propose any trade in wild individuals, at least in the medium term. Moreover, due to its biological life history characteristics, the harvest of adult wild individuals would have a negative effect on the reproductive potential of the species. It is therefore recommended to continue to allow trade only in captive-bred (i.e., source code C) individuals.

7. Legal instruments

7.1 National

The main legal instruments to regulate the use and conservation of wild species in Mexico as well as their habitats and ecosystems are the General Ecological Balance and Environmental Protection Act (Ley General de Equilibrio Ecológico y Protección al Ambiente, LGEEPA; DOF, 1988) and the General Wildlife Act (Ley General de Vida Silvestre, LGVS; DOF 2000) and their respective regulations (DOF-LGEEPA, 2014; DOF-LGVS, 2014). In addition, there is the Official Mexican Standard NOM-059-SEMARNAT-2010 (DOF-SEMARNAT, 2010) and its latest update ("Modificación del anexo Normativo III" DOF-SEMARNAT-2019), which lays down the criteria and mechanisms necessary to determine the category of risk of a species and contains the list of species considered to be at risk on a national level.

The General Wildlife Act establishes the criteria regarding the types of use and harvest that are permitted. Given that the species is classified as Endangered in the list of species at risk, it can only be taken from the wild for conservation of research purposes. Therefore, it cannot be harvested for commercial purposes. In Mexico, it is only possible to harvest wild species through a UMA with a management plan listing specific actions for the species of interest that has been approved by the authorities.

7.2 International

a) The Cuatro Ciénegas Valley is part of the global network of Biosphere Reserves and is part of UNESCO's Man and the Biosphere Programme.

b) The Valley is also listed as a Wetland of International Importance in the Ramsar Convention and is the most important wetland of the Chihuahuan Desert because of its high number of endemic species.

c) *T. coahuila* is listed in CITES Appendix I since 1975.

The instruments mentioned above have helped conserve the wildlife and the habitat of the Cuatro Ciénegas Valley through financial support for research.

8. Species management

8.1 Management measures

a) There are currently no government or academic programmes aimed at the reproduction, restocking or recovery of the species. However, there are approaches aimed at consolidating the cooperation between various sectors in order to develop a strategy along those lines. The Universidad Juárez del Estado de Durango, CONANP, the University of Southern California and local entrepreneurs have proposed a formal approach in this regard.

b) Some efforts that have contributed to the conservation of the species and its habitat are the result of the acquisition of land and water rights in the Valley, as has been done in the past by the NGO Pronatura A.C. However, there is also uncertainty in this regard due to the recent sale of land for purposes other than conservation and preservation, which is susceptible to being used despite being part of a protected area.

c) The results of the various monitoring surveys conducted (Castañeda *et al*., 2011 a 2015) and the information reported by the residents of the Cuatro Ciénegas Valley themselves (involved in field training activities) have led to the conclusion that there is a need to promote a programme for the reproduction and restocking the species. These measures have been proposed recently (in 2018) and are currently being developed.

8.2 Population monitoring

From 2009 to 2018, CONANP designated resources to determine the current status of the species and its vulnerability. In this context, there have been monitoring surveys and estimations of the current distribution and population status of the Coahuila box turtle, and telemetry equipment has been used to determine the movements of the species.

The IUCN and its Species Survival Commission (SSC) assessed the conservation status of *T. coahuila*. It is now classified as Endangered (EN) on the IUCN Red List. However, given its declining population trend and habitat loss, it could be reclassified into a category of greater risk.

8.3 Control measures

8.3.1 International

International trade of the species is regulated by CITES Appendix I.

8.3.2 National

According to Mexican legislation, *T. coahuila* is listed in the Mexican Official Standard NOM-059-SEMARNAT-2010 as a species that is Endangered and endemic to Mexico. This classification entered into force in January 2020 (DOF 2019).

Regarding section 7.1., the General Wildlife Act establishes that wildlife specimens can only be used for commercial purposes if conservation activities are being carried out under the UMA scheme. As regards scientific research, this legislation lays down the criteria that must be met to apply for the harvest of specimens or samples, which must be approved by the authorities. All cross-border movements must be accompanied by documentation proving the legal origin of the specimens, the records of institutions, CITES permits and/or certificates and must be subject to a review by the environmental law enforcement agency (PROFEPA) at the ports, airports and borders designated for the export of specimens. In some cases, an animal health certificate issued by the Department of Agriculture and Rural Development (Secretaría de Agricultura y Desarrollo Rural, SADER) is also required.

8.4 Captive breeding and artificial propagation

National level:

a) There are no national programs that promote the reproduction of the species.

b) In 2018, the School of Biological Sciences of UJED proposed to develop the first programme to assist gravid females in order to obtain offspring in captivity. The aim of the programme is to create a working group that will be trained with the necessary knowledge and skills to manage specimens in captivity and to build four enclosures that will temporarily house females that are about to lay their eggs. The programme is proposed for conservation and recovery purposes, not for commercial purposes.

c) According to the Species Survival Plan (Barnhart & Putnam, 2019), there is only one specimen in captivity in the Africam Safari Zoo (Puebla, Mexico).

International level:

Reproduction of the species in captivity has been observed in places outside its natural range such as the United States and the United Kingdom (Murphy & Mitchell 1984; Cerda & Waugh 1992; Meijer & Zwartepoorte, 2010).

a) Europe: in 2007 a studbook was published for the species (Meijer, 2007) as part of the records of the European Studbook Foundation. Although the studbook keeper estimated the existence of fewer than 100 individuals in Europe, only some sites with specimens were listed, mainly in private collections: two sites in The Netherlands, one in Germany, three in the United Kingdom (including the Durrell Wildlife Conservation Trust – Jersey Zoo), and one in Austria. The turtles of Jersey Zoo – where most of the specimens in Europe originate from – descended from offspring born at the Dallas Zoo whose parents were donated in 1970 and had been captured in Cuatro Ciénegas.

b) United States of America: the Scientific Authority of the United States provided information included in a studbook for the species (AZA, 2012). Historically, up to 527 specimens in 41 institutions have been reported, and several individuals were reported as wild (W); the studbooks contains entries from 1965 to 1991. For 2012, AZA reported the existence of 63 live specimens in 15 institutions (19:35 and 9 of undetermined sex). For 2015, the Chelonian Advisory Group reported 66 individuals (18:30 and 18 of undetermined sex in 12 institutions); the studbook keeper (Trent Barnhart, Santa Barbara Zoological Gardens) reported that AZA housed 71 live individuals (15:33 and 24 of undetermined sex) in 15 zoos (13 in the United States and two in Europe). In 2019, the authors of AZA's survival plan for the species (Barnhart & Putnam, 2019) reported the existence of 71 individuals (25:35 and 11 of undetermined sex) in 13 institutions.

The most recent assessment of the species highlighted the following: the existence of gaps in certain age groups and the need to increase the population in 5 years and to reduce the sex ratio bias (more males aged 5 years or less, more females aged 6 or more). It was also reported that the captive population in AZA institutions is descended from 12 founders, only 6 of which were not related to each

other. Because of these data and the number of individuals (over 50), the species is included in a Yellow AZA Species Survival Plan; this means that the captive population cannot retain 90% gene diversity for 100 years or 10 generations. According to Barnhart's computer sheet (AZA, date unknown), it is necessary to increase the number of captive individuals (parentals) and lineages to ensure the genetic and demographic health of the species.

8.5 Habitat conservation

The Cuatro Ciénegas Valley is located in protected area classified as a Protected Area for Flora and Fauna (DOF 1994) with a surface of 84,347 ha (84.35 km^2). The Coahuila box turtle is the flagship species of the protected area.

NGOs and universities have also contributed to the conservation of certain areas in the Valley:

– Desuvalle A.C. and The Nature Conservancy (TNC) acquired and manage a surface of 200 ha (0.2 km^2) within the protected area that is part of the natural range of the species and in which ecotourism and environmental activities take place; they also promote the sustainable use of other species.

– Pronatura Noreste and TNC purchased 2,800 ha (2.8 km^2) including a considerable area of wetlands and habitats that are critical for the species. Conservation and environmental education activities take place in a section of the protected area known as Pozas Azules.

– The National Autonomous University of Mexico (UNAM) coordinates research in some wetlands in which the species occurs.

8.6 Safeguards

N.A.

9. Information on similar species

Four species of the genus *Terrapene* occur in the Americas: *T. nelsoni, T. ornata, T. carolina* and *T. coahuila*. Some phenotypes of individuals of *T. nelsoni* can resemble *T. coahuila* in the colour pattern of the head and limbs. However, the greatest difference lies in the pattern of markings on the carapace of *T. nelsoni*, which is brown with scattered yellow or white spots, while *T. coahuila* has colours ranging from brown to olive green, typically with no pattern; in some cases there are black vermiculations. However, *T. nelsoni* is not normally found in markets because of its low abundance, its rarity and its restricted range.

The species that are most frequently present in markets are *T. ornata* and *T. carolina*. *T. ornata* has very characteristic colour patterns in its carapace, limbs and eyes: its carapace is coloured brown in different shades (from pale to dark) and there are lines of a different width and length throughout the carapace and even the plastron. Its front limbs range in colour from yellowish brown to bright orange, so it is unlikely to be confused with *T. coahuila*.

T. carolina has a range of colour patterns from yellow to dark brown, with spots that can be yellow, orange or reddish both on the carapace and the front limbs and head, and also has a prominent keel. Some phenotypes of the subspecies *T. carolina triunguis* can resemble the colour pattern of the carapace of *T. coahuila;* yet, the colour of the limbs as well as the multiple orange or reddish spots on the head can be used to differentiate both species.

Some species of the genus *Cuora* can also bear some resemblance and are relatively common in trade, for example *Cuora amboinensis*. Yet, certain traits can be used to distinguish them, such as the colour of the plastron and the general colour of the skin, as well as the characteristic plastron with three yellow stripes on the sides of the head.

Apart from the species of the genera *Terrapene* and *Cuora*, in some cases, unexperienced persons may find similarities with some species of the family Kinosternidae, such as *Kinosternon hirtipes* or *Kinosternon integrum*. Yet, the differences between *Kinosternon* and *T. coahuila* are slightly more marked regarding the morphology of the plastron, since *Kinosternon* has a much narrower plastron compared to the carapace and has barbels on the neck and throat; the carapace is also longer in *Kinosternon* and can exceed 170 mm

(Legler & Vogt, 2013), whereas in *Terrapene* the average length of the plastron ranges from 100 to 108 mm (Howeth & Brown, 2011).

10. Consultations

The following institutions were consulted: the Scientific Authority of the United Kingdom (Vincent Fleming, Nichola Burnett), the Scientific Authority of the United States of America (Rose Marie Gnam, Thomas E.J. Leuteritz), the AZA Studbook Keeper and Program Leader, Santa Barbara Zoological Gardens, Mr. Trent Barnhart, the European Studbook Foundation (Laurens Woldring), and Dallas Zoo (Alison Rackley).

11. Additional remarks

N.A.

12. References

AZA regional Studbook. Coahuilan Box (*Terrapene coahuila*). 2012. Beth Moorhead, Houston Zoo, Inc. (AZA Studbook Keeper).

Barnhart, T. (Unknow publication date). Coahuilan Box Turtle – *Terrapene coahuila*. Informative Data Sheet. AZA (Association of Zoos & Aquariums.

Barnhart, T. & Putnam, A. Population Analysis & Breeding and Transfer Plan. Coahuilan Box Turtle (*Terrapene coahuila*). AZA Species Survival Plan – Yellow Program. 2019. Population Management Center, Lincoln Park Zoo, Santa Barbara Zoo, Association of Zoos and Aquariums.

Bauer, M. & Jasser-Hager, I. 2006. The Mexican aquatic box turtle *Terrapene coahuila* Schmidth and Owen, 1944. Husbandry and breeding to the F_2 generation. Radiata 15:4-49.

Blair, W. 1976. Some aspects of the biology of the ornate box turtle, *Terrapene ornata*. The Southwestern Naturalist, 21/1: 89-103.

Brown, W. S. 1968. Natural history of *Terrapene coahuila* a relict aquatic box turtle in northern Mexico. Master's Thesis, Arizona State University, Tempe.

Brown, W. S. 1971. Morphometrics of *Terrapene coahuila* (Chelonia, Emydidae), with comments on its evolutionary status. The Southwestern Naturalist. 16 (2): 171-184.

Brown, W. S. 1974. Ecology of the aquatic box turtle *Terrapene coahuila* (Chelonia, Emydidae), with comments on its evolutionary status. Bulletin of the Florida State Museum. 19 (1): 1-67

Bull, J., Vogt, R., McCoy, J.1982. Sex Determining Temperatures In Turtles: A geographic comparison. Evolution. 36: 326-332.

Castañeda-Gaytán, G., Salas-Westphal, A., Becerra-López, J. 2011. Monitoreo de la tortuga de Cuatro Ciénegas (*Terrapene coahuila*) en el área de Protección de Flora y Fauna de Cuatro Ciénegas en el estado de Coahuila. Informe técnico final. CONANP-PROMOBI, 2011 p.p. 53.

Castañeda Gaytán, G., Salas-Westphal, A., Becerra-López, E., Valenzuela-Ceballos, S., Cueto-Mares A., Cano-Villegas, O. 2012. Monitoreo de la Tortuga de Bisagra. Informe Técnico Final CONANP-FCB-UJED.

Castañeda-Gaytán, G., S. I. Valenzuela-Ceballos., Cueto-Mares, A., Becerra-López, E., Salas-Westphal, A., & Cano-Villegas, O. 2013. Monitoreo de la tortuga de Cuatro Ciénegas (*Terrapene coahuila*) en el área de Protección de Flora y Fauna de Cuatro Ciénegas. Informe técnico final. CONANP-PROMOBI, 2012. P.p. 46.

Castañeda-Gaytán, G., A. Cueto-Mares, Rubio-Rincon, A., Muñoz-Rodríguez, M., Guevara, F., Valenzuela-Ceballos, S., Salas-Westphal, A., Gadsden-Esparza, H. 2014. Monitoreo de la tortuga de Cuatro Ciénegas (*Terrapene coahuila*) en el área de Protección de Flora y Fauna de Cuatro Ciénegas. Informe técnico final. CONANP-PROMOBI, 2014. P.p. 45.

Castañeda-Gaytán, G., Becerra-López. E., Cueto-Mares, A., Rubio-Rincon, A., Valenzuela-Ceballos, S., Gadsden-Esparza H., Salas-Westphal, A. 2015. Monitoreo de la tortuga de Cuatro Ciénegas (*Terrapene coahuila*) en el área de Protección de Flora y Fauna de Cuatro Ciénegas. Informe técnico final. CONANP-PROMOBI, 2015. P.p. 43. 2015.

Cerda, A. & Waugh, D. 1992. Status and management of the Mexican box terrapin *Terrapene coahuila* at the Jersey Wildlife Preservation Trust. Dodo 28: 126-142.

Chelonian Advisory Group, Regional Collection Plan. 2015. Chelonian TAG Steering Committee. Association of Zoos & Aquariums (AZA).

Contreras-Balderas S. 1984. Environmental impacts in Cuatrocienegas, Coahuila, Mexico: A commentary. Journal of the Arizona-Nevada Academy of Science 19:85-88.

Converse, S., J. Iverson, J. Savidge. 2005. Demographics of an ornate box turtle population experiencing minimal human-induced disturbances. Ecological Applications, 15/6: 2171-2179.

Cuervo-Robayo, A. O. Téllez-Valdés, M. A. Gómez-Albores, C. S Venegas-Barrera, J. Manjarrez, E. Martínez-Meyer. 2015. An update of high-resolution monthly climate surfaces for Mexico. International Journal Climatology 34: 2427–2437.

Cueto-Mares A., G. Castañeda-Gaytán, E. Becerra & A. Rubio Rincón. 2017. Ecología espacial y direccionalidad de hembras de *Terrapene coauhila* en el Valle de Cuatro Ciénegas. Revista Mexicana de Biodiversidad 88:860-866.

Diario Oficial de la Federación. Ley General de Equilibrio Ecológico y Protección al Ambiente. 1988. Camara de Diputados del H. Congreso de la Unión. Ultima reforma. 05/06/2018.

Diario Oficial de la Federación (DOF). Ley General de Vida Silvestre. LGVS. 2000. Cámara de Diputados del H. Congreso de la Unión. Ultima reforma DOF. 19/01/018.

Diario Oficial de la Federación (DOF). 07/11/1994. DECRETO por el que se declara como área natural protegida, con el carácter de área de protección de flora y fauna, la región conocida como Cuatrociénegas, con una superficie de 84,347-47-00 hectáreas, municipio del mismo nombre, Coah.

Diario Oficial de la Federación (DOF). Secretaría del Medio Ambiente y Recursos Naturales. 2010. NOM-059-SEMARNAT-2010 Protección ambiental-Especies nativas de México de flora y fauna silvestres-categorías de riesgo y especificaciones para su inclusión, exclusión o cambio. Lista de especies en riesgo. Diario Oficial de la Federación, 30 de diciembre de 2010.

Diario Oficial de la Federación (DOF). 31/10/2014. Reglamento de la Ley General del Equilibrio Ecológico y la Protección al Ambiente en Materia de Evaluación del Impacto Ambiental.

Diario Oficial de la Federación (DOF). 09/05/2014. Reglamento de la Ley General de Vida Silvestre.

Diario Oficial de la Federación (DOF). 14/11/2019. MODIFICACIÓN del Anexo Normativo III, Lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, publicada el 30 de diciembre de 2010.

Dodd, C. K. 2001. North American Box Turtles: a natural history. University Oklahoma Press. 203 pp.

EcoDiario. 2018. La Guardia Civil desarticula la mayor organización internacional de tráfico ilegal de tortugas amenazadas https://ecodiario.eleconomista.es/medio-ambiente/noticias/9342904/08/18/La-guardia-civil-desarticula-una-gran-organizacion-internacional-dedicada-al-trafico-ilegal-de-tortugas-amenazadas.html http://www.diariodemarratxi.com/incautados-1-100-ejemplares-de-tortugas-protegidas-en-un-criadero-ilegal-de-llucmajor/

García-Gutíerrez, I. López-López, Y. 2017. Cuatrociénegas: conflictos asociados al turismo en un área natural protegida. Cuadernos de turismo, No. 40:295-314.

Howeth, J.G., McGaugh, S.E., & Hendrickson, D. 2008. Contrasting demographic and genetic estimates of dispersal in the endangered Coahuilan box turtle: a contemporary approach to conservation. Molecular ecology. 17(19):4209-21. https://www.ncbi.nlm.nih.gov/pubmed/19378401

Howeth, J. & Brown, W.S. 2011. *Terrapene coahuila* Schmidt and Owens 1944 – Coahuilan Box Turtle. In: Rhodin, A.G.J., Pritchard, P.C.H., Van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., Iverson, J.B., and Mittermeier, R.A. (Eds.). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs No. 5, pp. 049.1–049.13, doi:10.3854/crm.5.049.coahuila.v1.2011, http://www.iucn-tftsg.org/cbftt" \h

Howeth, J.G.; McGaugh, S.E. & Hendrickson, D.A. 2008. Contrasting demographic and genetic estimates of dispersal in the endangered Coahuilan box turtle: a contemporary approach to conservation. Molecular Ecology 17: 4209–4221.

Iverson, J. B. 1982. Biomass in turtle populations: a neglected subject. Oecologia 55:69-76.

Legler, J. M. 1960. Natural history of the ornate box turtle, *Terrapene ornata ornata* Agassiz. University of Kansas. Publication of the Museum of Natural History. 11:527-669.

Legler J. & Voght R. 2013 The Turtles of Mexico, Land and Freshwater Forms. University of California Press. 402pp.

Lemos-Espinal J., Smith H., Dixon J., Cruz A. 2015. Anfibios y reptiles del estado de Coahuila. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Meijer, H. 2007. Annual Report, Studbook breeding program, Coahuilan Box Turtle (*Terrapene coahuila*). European Studbook Foundation.

Meijer, H. & H. Zwartepoorte. 2010. Studbook breeding programme, *Terrapene coahuila* (Coahuila Box Turtle). Annual report 2010. European Studbook Fundation.

Murphy, J. B., & L. A. Mitchell. 1984. Breeding the aquatic box turtle at Dallas Zoo. International Zoo Yearbook, 23(1):35-137.

Nigrelli, R. 1954. Some longevity records for vertebrates. Transactions. The New York Academy of Science

Pritchard, P. 1995. Conservation of reptiles and amphibians. In Conservation of endangered species in captivity. An interdisciplinary approach. Eds. Gibbons Jr. E. F., Durrant B. S. and J. Demarest. State University of New York Press. Albany. 147-168.

Pronatura Noreste A. C. 2018. Seguridad hídrica del valle de Cuatro Ciénegas. Agosto 2018. Pp. 29.

Salas-Wesphal, A. I., Castañeda-Gaytan, G., García de la Peña, M. C., Becerra-López, J. E., García-Barrera, C., Ramírez, G., Huerta-García A., & S. L. Ramos. 2011. Ecología de la tortuga de Cuatrocienegas (*Terrapene coahuila*) en el área de protección de flora y fauna de Cuatrocienegas: Protocolo de monitoreo para su conservación. Universidad Juárez Del Estado de Durango- CONANP. 145 pp.

Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT). 1999. Programa del manejo del Área de Protección de Flora y Fauna Cuatro Ciénegas México. Instituto Nacional de Ecología, Tlacopac, Mexico.

Seidel M. & Ernst C. 2017. A Systematic Review of the Turtle Family Emydidae. Vertebrate Zoology. 67: 1–122

Schmidt K. P. & Owens, D. W. 1944. Amphibians and reptiles of northern Coahuila, Mexico. Field Museum of Natural History Zoological Series 29:97-115.

SNIB-CONABIO, 2006. Sistema Nacional de Información sobre la Biodiversidad de México. http://www.snib.mx/ (fecha de consulta: Agosto 2014)

Souza V. Falcón L.I. Elser J.J. Eguiarte L.E. Protecting a window into the ancient Earth: towards a Precambrian park at Cuatro Cienegas, Mexico. 2007. The Citizen's Page, Evolutionary Ecology Research. http://www.evolutionary-ecology.com/citizen/citizen.html

Souza, V., Espinosa-Asuar L., Escalante A., Eguiarte L., Farmer J., Forney L., Lloret L., Rodríguez-Martínez J., Soberón X., Dirzo R. & Elser J. 2006. An endangered oasis of aquatic microbial biodiversity in the Chihuahuan Desert. Proceedings of the National Academy of Sciences of the United States of America 103: 6565-6570.

Stephens, P.R. & Wiens, J.J. 2003. Ecological diversification and phylogeny of emydid turtles. Biological Journal of the Linnean Society 79: 557-610

Van Dijk, P.P., Flores-Villela, O. & Howeth, J. 2007. *Terrapene coahuila* (errata version published in 2016). The IUCN Red List of Threatened Species 2007: e.T21642A97428806. http://dx.doi.org/10.2305/IUCN.UK.2007.RLTS.T21642A9304337.en. Downloaded on 11 September 2018.

Williams, K. L., Smith, H. M. y Chrapliwy, P. S. 1960. Turtles and lizards from northern Mexico. Transactions of the Illinois Academy of Science 53:36-45.

ACKNOWLEDGMENTS

Thanks are due to the author of the review of this species, Dr. Gamaliel Castañeda Gaytán, and his team at the School of Biological Sciences of the Universidad Juárez del Estado de Durango for the comprehensive information provided, which included scientific information not yet published.