Chinese Striped-necked Turtle (*Mauremys sinensis*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2022
Revised, April 2022, May 2023
Web Version, 6/20/2023

Organism Type: Reptile
Overall Risk Assessment Category: Uncertain

Photo: Howard Cheng. Licensed under CC BY-SA 3.0. Available: https://commons.wikimedia.org/w/index.php?curid=880176. (02/22/22).

1 Native Range and Status in the United States

Native Range

From Chen and Lue (2009):

"*Mauremys sinensis* is distributed in Taiwan, southeastern China (including Hainan I.), and northern Vietnam (Ernst and Barbour 1989, Iverson 1992)."

From Li et al. (2021):

"*Mauremys sinensis* occurs in coastal areas of southern China (Fujian, Guangdong, Guanxi, lowland Hainan and Zhejiang) from south of Shanghai to the border with Vietnam, including lowland Hainan and much of Taiwan; in Viet Nam the species ranges at least as far south as Quang Ngai."

From Jablonski et al. (2018):

"The Chinese Stripe-necked Turtle, *Mauremys sinensis* (Gray, 1834), is widely distributed in subtropical and tropical regions of Taiwan, south-eastern China (including Hainan), eastern Laos and northern and central Vietnam (van Dijk et al., 2014)."

Status in the United States

From Jackson (2012):

"On 13 July 1972, the author collected a subadult or small adult female *M. sinensis* (ca. 16 cm CL [carapace length] […]) in a baited hoop trap on the eastern edge of Calf Pond, a 4.8-ha permanent lake in southeastern Gainesville, Alachua County, Florida (29.6281ºN, 82.2856ºW, Datum WGS84). […] This specimen represents the first known voucher for this species of turtle in Florida, only the third species and second genus of the large family Geoemydidae (after two species of *Rhinoclemmys*), and the 140th verified non-indigenous herpetofaunal species in the state (Krysko et al. 2011; Rochford et al. 2011; K. Krysko, pers. comm.)."

From Powell (2019):

"Status: Eradicated in Florida."

Mauremys sinensis is part of Group II of the New Mexico's Director's Species Importation List (NMDGF 2010). *M. sinensis* is listed as a Prohibited Species in Oregon along with other species in the *Mauremys* genus (ODFW 2022). It is listed as a Prohibited level 3 species in Washington along with other species in the *Mauremys* genus (WDFW 2022).

From The Turtle Source (2022):

"It is the hard work of a few innovative American breeders that make limited numbers of them available in the US."

According to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) trade database, approximately 7500 live *M. sinensis* were imported into the United States from 2005 through 2019. Exporting jurisdictions included China, France, Hong Kong, South Korea, Switzerland, and Taiwan (CITES 2023).

Means of Introductions in the United States

From Powell (2019):

"Means of Introduction: Pet escape."

"Subsequent investigation revealed that the *Mauremys* had escaped from the residence […] an estimated 15 months earlier."

Remarks

Information searches for this screening were conducted using the accepted name, *Mauremys sinensis*, and the synonym *Ocadia sinensis* (WoRMS 2022).

From Het Terrarium (2022):

"*Ocadia sinensis* is known for the many species with which these can produce hybrids, both in the wild and in captivity (accidentally and intentionally) there are many variations known. Also hybrids with *Mauremys reevesii* are known."

From Li et al. (2021):

"While *Mauremys sinensis* was considered somewhat secure in parts of its range until recently, it has subsequently been targeted by collectors as other, more valuable, turtle species have disappeared from the wild. At present, it appears that populations have collapsed throughout the range, including in former strongholds, representing at least an 80% reduction in total population of mature adults over the past generation (estimated at 20 years) due to ongoing over-exploitation combined with habitat loss, qualifying the species for Critically Endangered A2cd+A4cd."

"*Mauremys sinensis* is listed on CITES Appendix III (China). It is not protected under species protection legislation in Viet Nam. It is not listed on the China National Key Protected Animals list."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to WoRMS (2022), *Mauremys sinensis* (Gray, 1834) is the accepted name for this species.

From ITIS (2022):

Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Deuterostomia
      Phylum Chordata
        Subphylum Vertebrata

Infraphylum Gnathostomata
Superclass Tetrapoda
Class Reptilia
Order Testudines
Suborder Cryptodira
Superfamily Testudinoidea
Family Geoemydidae
Subfamily Geoemydinae
Genus *Mauremys*
Species *Mauremys sinensis* (Gray, 1834)

Size, Weight, and Age Range

From AnAge (2022):

"The maximum longevity of *Mauremys sinensis* is 22.8 years in captivity and the average adult weight is 1,241 g."

Chen and Lue (2009) reports a range of 30mm to 279mm for carapace length.

Environment

From Chen and Lue (2009):

"*Mauremys sinensis* prefers still and slow-moving waters, such as ponds, reservoirs, lakes, agricultural ditches, and low-elevation rivers (Mao 1971, Ernst and Barbour 1989; Chen and Lue 2008)."

"In the Keelung River [Taiwan], *M. sinensis* prefers deep and slow-current pools and avoids highly modified river sections (Chen and Lue 2008)."

From Jablonski et al. (2018):

"Due to its extensive distribution, *M. sinensis* is tolerant of a range of temperatures. Pan et al. (2003) reported that juveniles like water temperatures around 26°C degrees, […]. These authors also found the upper and lower limits of thermal tolerance in China to be around 41.9°C and 1.8°C respectively (Pan et al., 2003)."

Climate

From Jablonski et al. (2018):

"This species is well adapted to a wide range of climatic conditions, including southern temperate, subtropical and tropical zones, where it inhabits various aquatic habitats, including ponds, lakes, reservoirs, irrigation ditches, and rivers at low elevations (Ernst and Barbour, 1989)."

"Pan et al. (2003) reported that juveniles like […] air temperatures around 29°C degrees, and basking temperatures around 32°C degrees."

"It is interesting that this individual [introduced in Slovakia] survived at least one winter with the average temperature in the coldest month (January 2016) being about 3°C degree during the day and -3°C during the night (data of the The Slovak Hydrometeorological Institute)."

From Jackson (2012):

"[…] with a latitudinal range of approximately 16–32ºN (Iverson 1992)."

Distribution Outside the United States

Native

From Chen and Lue (2009):

"*Mauremys sinensis* is distributed in Taiwan, southeastern China (including Hainan I.), and northern Vietnam (Ernst and Barbour 1989, Iverson 1992)."

From Li et al. (2021):

"*Mauremys sinensis* occurs in coastal areas of southern China (Fujian, Guangdong, Guanxi, lowland Hainan and Zhejiang) from south of Shanghai to the border with Vietnam, including lowland Hainan and much of Taiwan; in Viet Nam the species ranges at least as far south as Quang Ngai."

From Jablonski et al. (2018):

"The Chinese Stripe-necked Turtle, *Mauremys sinensis* (Gray, 1834), is widely distributed in subtropical and tropical regions of Taiwan, south-eastern China (including Hainan), eastern Laos and northern and central Vietnam (van Dijk et al., 2014)

Introduced

Mauremys sinensis is reported as introduced in Micronesia, Poland, and Singapore (GRIIS-Federated States of Micronesia, GRIIS-Poland, and GRIIS-Singapore accessed through GBIF Secretariat 2022). No further information was found on the status of *M. sinensis* in Micronesia or Singapore.

From Di Blasio et al. (2021):

"European *Mauremys sinensis* records in natural habitats comprise two findings for Portugal in July 2019, seven for Spain, from 2014 to 2019 (LIFE09 NAT/ES/000529), one for Poland (Marini 2017), one in Slovakia (Jablonski et al. 2018), and several findings (always a single individual) in urban ponds in Italy: from Brescia (V. Ferri, pers. comm. 2019); in Rome (R. Santoro, pers. comm. 2019); near Trento and in Ferrara (GBIF 2020); and in Palermo Botanical Garden (Panzeri et al. 2014)."

"This record of *Mauremys sinensis* natural reproduction was the first in Italy (Panzeri et al. 2014). The presence of both hatchlings and adults leads to hypothesize [sic] that there may be a naturalized local population, suggesting that without an intensive control of the introduced nuclei, this situation can lead to a widespread naturalization of this species *Mauremys sinensis* in the study area."

From Jablonski et al. (2018):

"During a study of the distribution of introduced species of turtles in Slovakia we recorded a basking adult female of *M. sinensis* on 12 August 2015, at around 14:00 hrs local time (Fig. 1A–C [in source material]). The individual was observed at Chorvatské rameno, an artificial canal (former oxbow lake of the Danube River, Fig. 1D [in source material]), located in a suburban area of south Bratislava (48.100°N, 17.129°E, 134 m a.s.l.). The site is covered by dense vegetation, primarily *Myriophyllum spicatum*, and water temperature during daytime in August 2016 ranged from 23.5 to 25°C, measured by digital thermometer."

"The finding of *M. sinensis* represents the first recorded individual in Slovakia and simultaneously its first confirmed overwintering under the climatic conditions of Central Europe."

"According to Bataller (pers. comm., 2017), in Valencia, eastern Spain over 40,000 exotic turtles have been captured since, and from them only four records were of *M. sinensis*."

From Lee et al. (2016):

"From the survey of natural habitats [in South Korea], we found that 8 species belonging to 3 families including […], *Mauremys sinensis*, […] have inhabited in 12 study sites."

From Sung et al. (2021):

"Non-native turtles were found throughout Hong Kong, including all major islands (Figure 1 [in source material]). The most frequently recorded species was RES [*Trachemys scripta elegans*] (33% of records), followed by *Mauremys sinensis* (17%) and *M. mutica* (15%)."

Means of Introduction Outside the United States

From Sung et al. (2021):

"We believe that most of the non-native turtles were intentionally released as abandoned pets or in religious releases (Yeung 2018). Accidental release/escape of turtles is probably rare in Hong Kong because outdoor turtle farms are rare in Hong Kong."

Short Description

From Het Terrarium (2022):

"The most striking feature of this turtle is the pattern of yellow narrow lines that run from the nose, over the face into the neck. This pattern also remains visible in adult animals. But the

striking pattern of extended (often red) spots on the shell is only visible in young animals. The shell of adults is often an inconspicuous dark brown or grey with possibly a greenish hue. The head is somewhat pointed in shape and the neck is moderately secreted. The legs are very powerful and there is a swimming membrane between the toes too improve movement in the water. The lined pattern that one sees on the neck and head can also be found on the body, tail and on the legs, but the degree and visibility can differ per individual, age and origin. Young animals have a slight edge along the marginals, this disappears as the turtle gets older. The plastron is light / yellow-cream in colour with a dark spot in the core of each shield. The spots on the marginals often have a lighter core."

"As with many aquatic turtles, the males can be recognized by the placement of the cloaca, which is placed further outside the shell than that of the females. The wider base of the tail and the indentation of the plastron."

Biology

From Chen and Lue (2009):

"The turtle is omnivorous and reproduces between Apr. and July (Chen and Lue 1998 1999)."

"The long reproductive life and high adult survivorship of turtles are tempered by high mortality in the egg and juvenile stages, leading to low recruitment (Iverson 1991)."

"River-dwelling turtles, such as *M. sinensis*, directly depend on the quality of both aquatic and surrounding terrestrial habitats at all stages of their life cycle. During this study, *M. sinensis* used aquatic habitats for basking, feeding, mating, and overwintering. Terrestrial habitats are also important as nesting sites and as sources of food resources. In general, males used the aquatic habitats more consistently, whereas females spent more time on land, for example, laying eggs and ingesting terrestrial plants. Thus, adult females are more likely to be threatened by riparian habitat destruction than males."

"As the mean body size of female *M. sinensis* is significantly larger than that of males (Chen and Lue 1998), females require more food for growth. A deficiency in the food supply for females would be detrimental to their long-term survival."

"Females mainly consumed plant food, but their diet composition shifted from specializing in *Murdannia keisak* leaves to more-generalized plant items."

From Du et al. (2010):

"Incubation period of *O. sinensis* eggs was shorter than that of *M. mutica* eggs. In both species, hatching success was high in the temperature range of 26–30°C, and hatchlings were mainly males if incubated at low temperatures and females at high temperatures. The pivotal temperature for sex determination fell into the range of 28–30°C for *O. sinensis* and 26–28°C for *M. mutica*. Incubation temperature profoundly affected post-hatching growth in *M.mutica*, but not in *O. sinensis*. […] temperatures around 26 or 28°C would be optimal incubation

temperatures for *M. mutica* or *O. sinensis* to improve hatching success and post-hatching and to yield offspring with a balanced sex ratio."

From Li et al. (2021):

"Forest, Wetlands (inland), Artificial/Aquatic & Marine"

"*Mauremys sinensis* is a typical inhabitant of standing or very slow-flowing wetlands in lowland areas, ranging possibly up to 300 m altitude, using ponds, creeks, flooded rice fields and ditches."

"*Mauremys sinensis* reaches maturity at about four years in captivity. In Hainan it nests mid-February, 2–20 eggs per clutch (Zhou and Li 2013). Eggs weigh 6.2–10 g, hatchlings weigh 6.6 g and measure 32.3 mm carapace length. Clutches are up to 13 eggs (McCormick pers. comm. 2018)."

From Jablonski et al. (2018):

"In the wild, food preference in *M. sinensis* depends on sex, where females are known to feed primarily on vegetation, while males readily consume carrion or other animals slow enough to be caught (Chen and Lue, 1998)."

Human Uses

From Het Terrarium (2022):

"*Ocadia sinensis* is one of the most common kept Asian turtles in the hobby. This species is bred in great numbers in so-called 'Farms', especially in China and also Taiwan. The main objective is to meet the high demand of the Chinese market for turtle parts for traditional 'medicines' and food, which has so plundered the natural population that it is now greatly reduced. Another part of the farmed turtles ends up in Europe to be sold for low prices in pet stores and at the famous reptile fairs. Especially now the sale of *Trachemys scripta* (ornamental turtle) is banned in Europe, we expect demand to rise even further."

From Li et al. (2021):

"*Mauremys sinensis* is widely collected from the wild for pets, as food, to supply turtle farms, and for merit release, captured often by traps and drift fence arrays in shallow wetland areas. It is extensively farmed in Taiwan and mainland China, as well as 52 registered farms in Vietnam."

From The Turtle Source (2022):

"It is the hard work of a few innovative American breeders that make limited numbers of them available in the US."

From Jablonski et al. (2018):

"Despite the species being listed by the CITES and IUCN (Appendix III – China, Endangered; Buhlmann et al., 2000), it remains a popular pet animal and is still extensively farmed for trade (Shi and Fan, 2002). In China and Taiwan, the recorded number of adult animals for pet trade is nearly 400 thousand; in the Hubei and Guangxi regions, the annual production for trade ranges between 1.5 and 2 million animals (Shi and Fan, 2002). Available data for Taiwan estimated annual production in the largest farms at over 30 thousand hatchlings (Chen et al., 2000). *Mauremys sinensis* is one of the most popular reptiles in the pet trade globally (Kopecký et al., 2013; Masin et al., 2014), […]"

According to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) trade database, approximately 7500 live *M. sinensis* were imported into the United States from 2005 through 2019. Exporting jurisdictions included China, France, Hong Kong, South Korea, Switzerland, and Taiwan (CITES 2023).

From González de la Vega et al. (2021):

"Between 2006 and 2019, […] 45,320 live individuals of the Chinese stripe-necked turtle *Mauremys sinensis* have been imported into Spain, mainly from China, Hong Kong, Taiwan and Japan (Cites Trade Database, 2020)."

Diseases

No records of OIE-reportable diseases (OIE 2022) were found for *Mauremys sinensis.*

WoRMS (2022) lists multiple species of blood flukes or nematodes as endoparasites that affect this species. These include *Platt ocadiae, Diaschistorchis takahashii, Platt yoshidai, Adenogaster selfi*.

Colon et al. (2022) reports infection of *Mauremys sinensis* with *Salmonella enterica*.

Threat to Humans

From Colon et al. (2022):

"*Salmonellae* are estimated to cause 93.8 million cases of gastroenteritis and 155,000 deaths globally each year [Majowicz et al. 2010]."

Colon et al. (2022) reports infection of *Mauremys sinensis* with *Salmonella enterica*.

3 Impacts of Introductions

From Sung et al. (2021):

"We collected 696 records of non-native turtles, involving 25 species and three putative hybrids in Hong Kong […] All three putative hybrid species involved both native (i.e. *Cuora trifasciata*,

M. reevesii and *Sacalia bealei*) and non-native species (i.e. *Cu. amboinensis*, *Cyclemys* sp., and *M. sinensis*) (Figure 2 [in source material]).”

Mauremys sinensis is regulated in New Mexico, Oregon, and Washington (NMDGF 2010; ODFW 2022; WDFW 2022).

4 History of Invasiveness

The History of Invasiveness for this species is classified as Data Deficient. *Mauremys sinensis* has been reported as introduced outside of its native range with a few established populations (South Korea, Hong Kong, and Italy). In Hong Kong, *M. sinensis* has been suspected of hybridizing with the native *M. reevesii*. There were no details found indicating if the hybridization had a negative impact on the *M. reevesii* population. *M. sinensis* is found in the pet and food trade. It has a significant trade history (over 1 million organisms annually) within the native range; trade volume outside of the native range still involves hundreds to thousands of individuals imported annually into the U.S. and other countries.

5 Global Distribution

Figure 1. Known global distribution of *Mauremys sinensis*. Observations are reported from China, Taiwan, Vietnam, Germany, Netherlands, Spain, Portugal, France, Italy, Switzerland, Hong Kong, United States, Réunion, Thailand, Japan, South Korea, and Singapore. Map from GBIF Secretariat (2022). The observations in the United States, Germany, Netherlands, Spain, Portugal, France, Switzerland, Réunion, Japan, Thailand, Singapore, and northern China were not used to select source points for the climate match as they do not represent established populations.

6 Distribution Within the United States

Figure 2. Known observations of *Mauremys sinensis* in the United States. Map from GBIF-US (2023). These observations do not represent established populations and were not used to select source points for the climate match.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Mauremys sinensis* to the contiguous United States had mostly medium local matches. Areas of high match were found in Texas and in Florida and north along the Atlantic Coast to North Carolina. Areas of low match were found in the inland southeast, the northeast, the northern Great Plains, the Pacific Coast from Washington to northern California, and in the Cascade and Sierra Nevada ranges. Everywhere else had a medium climate match. The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.276, High (scores of 0.103 or greater are classified as High.). Alabama, California, Colorado, Delaware, Kentucky, Mississippi, Montana, Nebraska, Tennessee, and West Virginia had Medium individual Climate 6 scores. Arkansas, Connecticut, Massachusetts, Maine, Michigan, Minnesota, North Dakota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Dakota, Vermont, Wisconsin, and Wyoming had Low individual scores. All other States had High individual scores.

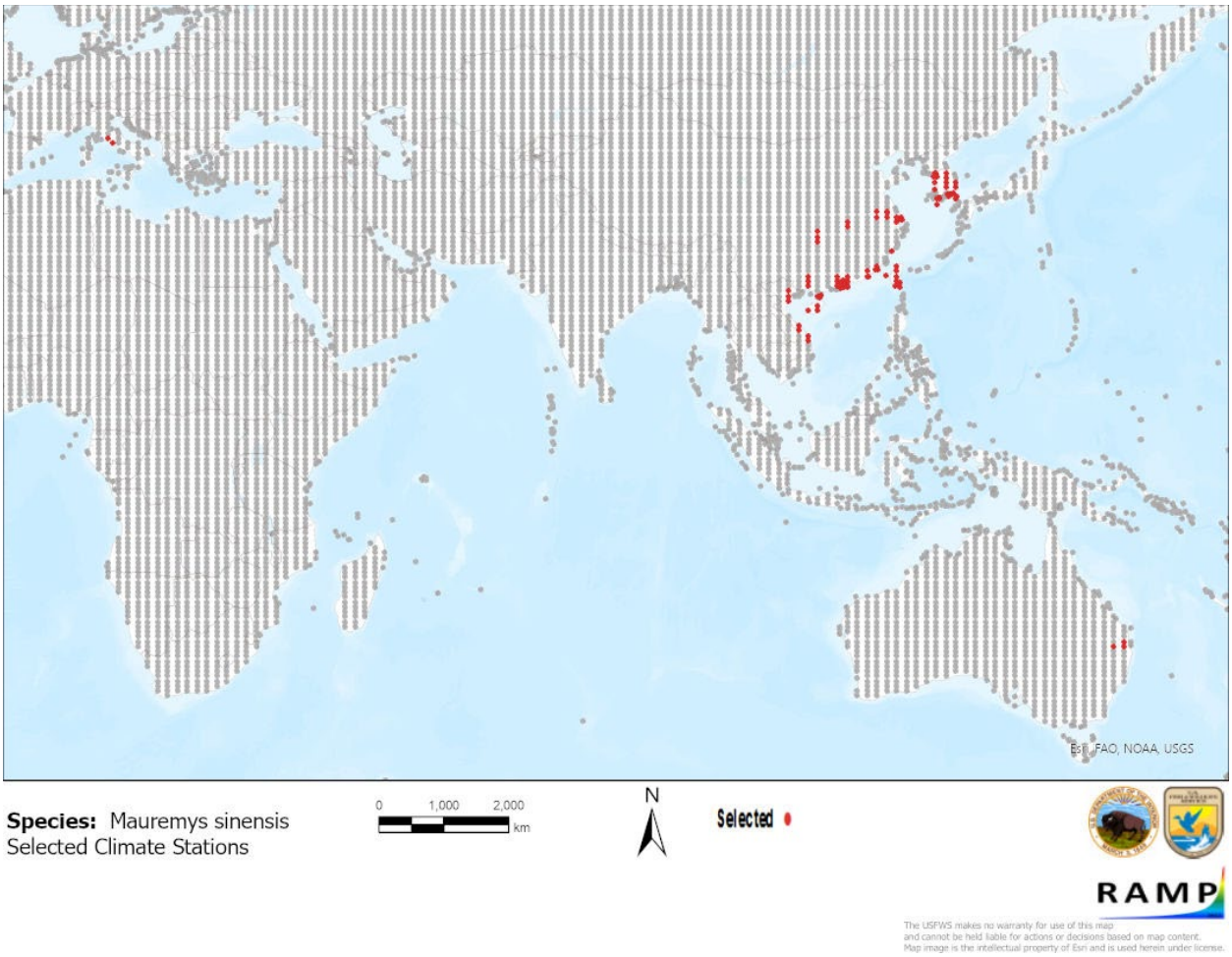

Figure 3. RAMP (Sanders et al. 2021) source map showing weather stations Europe and Asia selected as source locations (red; China, Hong Kong, Italy, South Korea, Taiwan, Vietnam) and non-source locations (gray) for *Mauremys sinensis* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

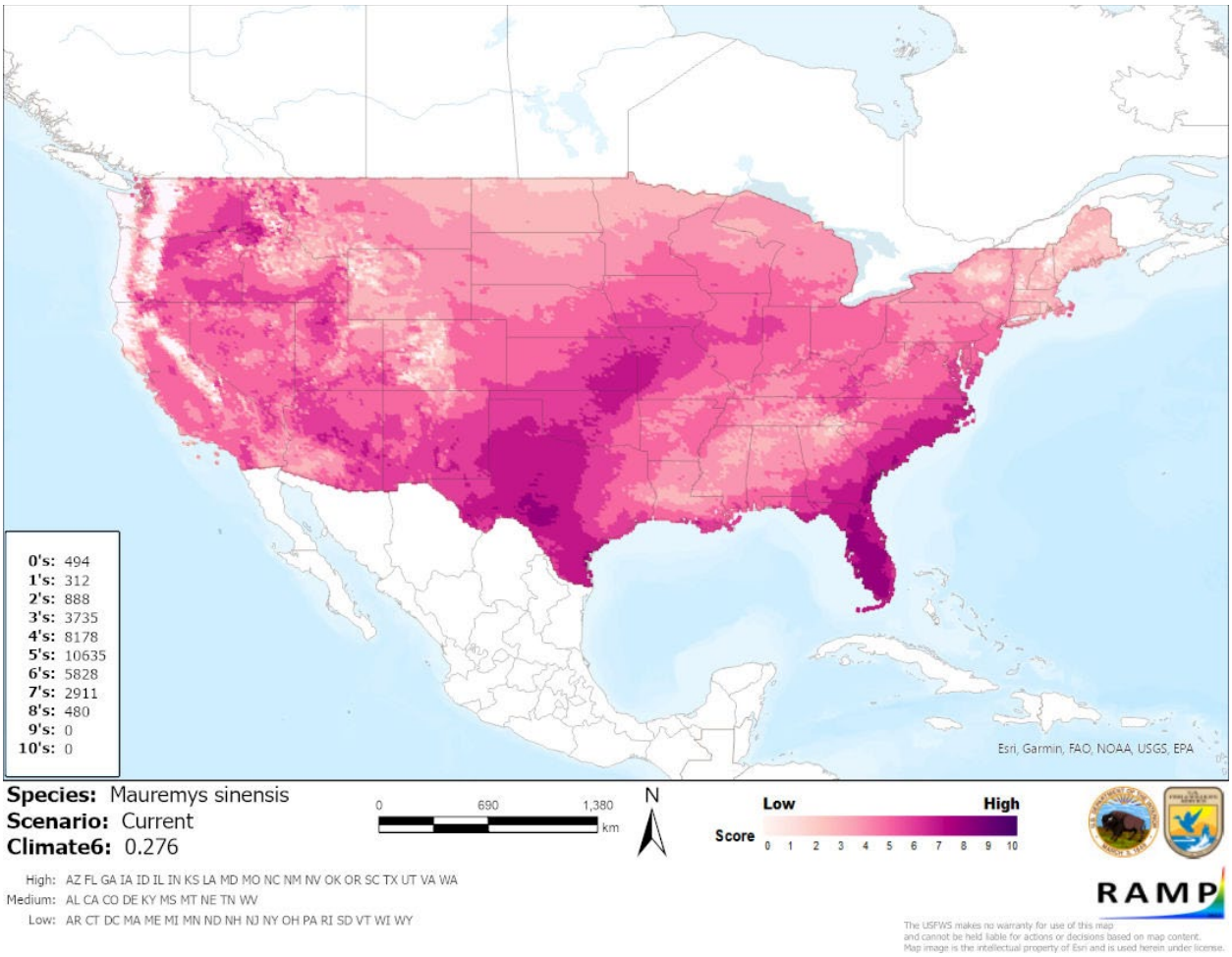

Figure 4. Map of RAMP (Sanders et al. 2021) climate matches for *Mauremys sinensis* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The Certainty of Assessment is Low. There is reasonably complete information regarding this species distribution, biology, and trade history. The information on introductions may not be complete. Minimal information was available regarding impacts of introduction.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Chinese striped-necked turtle (*Mauremys sinensis*) is a freshwater turtle native to China, Taiwan, Laos, and Vietnam. This species is popular in the pet trade both within and outside the native range, and it has a history of being used as a food source and in traditional medicine. *M. sinensis* is regulated in New Mexico, Oregon, and Washington. Introductions outside of its native range have been reported in in Europe and Asia. A few of those introductions have resulted in established populations in Italy, South Korea, and Hong Kong. In Hong Kong, putative hybrids of *M. sinensis* and a native species of *Mauremys* have been observed. There was no information available on the impact this hybridization had on the native species. The History of Invasiveness is classified as Data Deficient. The Overall Climate Match for *Mauremys sinensis* to the contiguous United States is High. Areas of high match were found in the Southeast and Southern Plains. The Certainty of this Assessment is Low, primarily due to the lack of detailed impact information. The Overall Risk Assessment Category for *Mauremys sinensis* is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): Data Deficient**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Low**
- **Remarks, Important additional information: *Mauremys sinensis* can carry *Salmonella* bacteria.**
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

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11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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